Advisory Committee on Fishery Management ICES CM 2001/ACFM:19

REPORT OF THE

ARCTIC FISHERIES WORKING GROUP

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Palægade 2–4 DK–1261 Copenhagen K Denmark

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Asgeir Aglen	Norway
Adnan M. Ajiad	Norway
Michaela Aschan	Norway
Boris Berenboim	Russia
Erik Berg	Norway
Bjarte Bogstad	Norway
Vladimir Borisov	Russia
Ray Bowering	Canada
Tatiana Bulgakova	Russia
Jose Miguel Casas	Spain
Santiago Cerviño	Spain
Konstantin V. Drevetnyak	Russia
Anatoly Filin	Russia
Åge Fotland	Norway
Kristin Guldbrandsen Frøysa	Norway
Alf Harbitz	Norway
Åge Høines	Norway
Yuri Kovalev	Russia
Yu. M. Lepesevich	Russia
Harald Loeng (part-time)	Norway
Tara Marshall	Norway
Sigbjørn Mehl (Chair)	Norway
Hilario Murua	Spain
Kjell H. Nedreaas	Norway
Odd Nakken	Norway
John D. Neilson	Canada
Geir Ottersen (part-time)	Norway
Rüdiger Schöne	Germany
Mikhail Shevelev	Russia
Ekaterina Volkovinskaya (translater)	Russia
Natalia Yaragina	Russia
Morten Åsnes	Norway

1.2 Introduction

At its October 2000 meeting ACFM decided the following:

"The **Arctic Fisheries Working Group** [AFWG] (Chair: S. Mehl, Norway) will meet in Bergen, Norway from 24 April–3 May 2001 to:

a) assess the status of and provide catch options for the year 2002 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 (B_{pa}) and reducing the fishing mortality to less than F = 0.42;

c) when historic data on maturity and weights become available revisit the appropriateness of the biological reference points for NEA cod;

d) assess the status of the shrimp stock in the Barents Sea, taking predation by cod into account;

e) identify major deficiencies in the assessments;

f) review the layout of a Quality Handbook and prepare a workplan for writing such a document. A draft of the Quality Handbook shall be reviewed by the Working Group in 2002.

AFWG will report by 10 May 2001 for the attention of ACFM."

1.3 General Comments

The working group continues to be well attended and comprised of a broad range of environmental science, biological science and stock assessment expertise. The host (Bergen, IMR) provided excellent facilities and assistance which allowed the meeting to proceed effectively and efficiently.

Work with an alternative assessment model for NEA cod (Fleksibest) continued and advancements made in accordance with recommendations from the ICES Workshop on Fleksibest conducted in January, 2001. Considerable effort was afforded to the revision of historic data on maturity and weights at age for NEA cod which allowed for a comprehensive review of the current biological reference points which culminated in a revised PA framework for NEA cod. As well, more work on incorporating the effects of environmental conditions was included.

1.4 Environmental considerations

1.4.1 Background

A close connection between environmental fluctuations and variation in population parameters of fish in the Barents Sea was suggested already by Helland-Hansen and Nansen (1909) and has been corroborated during recent years. Particularly year-to-year variability in sea temperature has been documented to influence Northeast Arctic cod through recruitment (Sætersdal and Loeng 1987; Ottersen and Sundby 1995; Tretyak *et al.* 1995), growth (Loeng *et al.* 1995; Michalsen *et al*. 1998; Ottersen and Loeng 2000), and distribution (Shevelev *et al.* 1987; Ottersen *et al.* 1998). However, also herring (Ottersen and Loeng 2000; Toresen and Østvedt 2000), haddock (Loeng *et al*. 1995; Ottersen and Loeng 2000, Lepesevich and Bochkov WD 19), and capelin (Gjøsæter and Loeng 1987; Gjøsæter 1999) are effected by climatic fluctuations. All these relations between temperature variability and fish population parameters show the importance of taking environmental conditions into consideration in Barents Sea fish stock management. Especially, it seems important to focus on temperature impact on recruitment processes since this is the basis for year-class strength (Borisov and Elizarov WD 12, Sætersdal and Loeng, 1987). Also the interaction between capelin, herring and gadoid species is important (Hamre, 1994). Strong indications of global warming also in the oceans as described by Barnett et al. (2001) and Levitus *et al*. (2001) gives further reason to take environmental factors into account.

1.4.2 Sea temperature

Figure 1.1 shows temperature anomalies in the Fugløya-Bear Island section during the period 1977 to January 2001. Temperatures in the Barents Sea have been relatively high during most of the 1990s, and with a continuous warm period from 1989-1995. During 1996-1997, the temperature was just below the long-term average, while there have been some sudden changes during the last couple of years. In January 2000 the temperature increased rapidly to 1.1°C above the average, and thereafter dropped gradually to just above the average during autumn 2000. In January-February 2001 the temperature anomalies reached 0.9°C above the average (Anon. 2001; Loeng 2001; Loeng *et al.* WD 33).

1.4.3 Prediction of sea temperature

Six months forecasts of Kola-section temperature based on linear regression models, statistically derived from data for the period 1921-1997 (Ottersen *et al.* 2000), show that the predictive value for a specific month based on values from six months earlier varies considerably throughout the year. The tendency found was that of persistence across the spring and summer months being higher than for other seasons, allowing for reasonably reliable forecasts from spring until autumn.

A six-month forecast for August 2001 based on observations for February 2001 gives an objective temperature forecast for August 2001 of 5.2 ºC. This will be above the 1921-1999 mean of 4.67 ºC by one standard deviation of the mean. However, the last years there has been a tendency to a late onset of winter cooling leading to high positive temperature anomalies in January through March while temperature has approached the mean values during spring and summer. Such a high positive anomaly is present also in February 2001 (4.4 ºC as compared to the 1921-1999 mean of 3.44). If a development similar to that of the last three years continues one would expect the positive temperature anomaly in August to be less than that arrived at above. Summer sea temperatures in the southern Barents Sea are expected to lie in the range from average to moderately warm.

Long-term prediction are very uncertain. In Anon (2001) there is prognosis up to 2008 based on periodicity in climate variation. However, periodic variations count only for 25-30% of the total climate variability in the Barents Sea

(Ottersen *et al.* 2000). The results from these predictions indicate decreasing temperature until 2002, and then increased temperature in 2003. Lepesevich and Bochkov (WD 19) have the same results in their prediction without describing the method which is used.

1.4.4 Ice

Variability in ice coverage is closely linked to the temperature of the inflowing Atlantic water. The ice has a relatively short response time to temperature change (about one year), but usually the sea ice distribution in the eastern Barents Sea responds a bit later than in the western part. There was less ice than average in 2000. The somewhat lower index than in 1999 was due to slightly less coverage in most of the Barents Sea during winter.

1.4.5 Atlantic inflow to the Barents Sea

The current observed in the section Fugløya-Bjørnøya is predominantly barotropic, and reveals large fluctuations in both current speed and lateral structure (Ingvaldsen *et al.,* 1999, 2001). Fluxes with strong variability at time scales ranging from one to several months have been found. The strongest fluctuations, especially in the inflow, occur in late winter and early spring, with both maximum and minimum in this period. High outflows occurred in April both in 1998 and 1999. In 2000 there were two periods with strong outflow, in January and in June. During the period August 2000 and March 2001 there was a modest inflow without any outflow episodes.

1.4.6 Zooplankton

The Barents Sea ecosystem is highly dependent on inflow of plankton from the Norwegian Sea, particularly *Calanus finmarchicus* (Anon., 2001). Not just the net inflow, but also the timing is important. Outflow events, as described above, may have great impact on the import of zooplankton from the Norwegian Sea to the Barents Sea (Loeng and Ingvaldsen 2001). Since zooplankton is the main food item for fish larvae, the variation in volume transport of Atlantic water will indirectly influence their food conditions and thus growth and survival.

Both Russian and Norwegian scientists undertook standard investigations on zooplankton in the Barents and Norwegian seas in 2000. An unusually westerly distribution of the major proportion of euphausiids was observed in the Barents Sea by Russian investigations, while Norwegian scientists found a slight increase in the biomass of smaller zooplankton in the whole Barents Sea.

1.4.7 Capelin

The biomass of capelin in 2001 is predicted (Gjøsæter, WD 6) based on surveys in 2000 and assumptions (mostly *status quo*) about capelin mortality, maturation and growth. A slight decrease from 4.3 million tonnes in 2000 to 4.1 million in 2001 is predicted. Cod growth and cod cannibalism is strongly dependent on capelin abundance.

1.4.8 Conclusions

The year 2000 was warm in the Barents Sea; increased transport of heat from southwest was the main oceanographic feature. In contrast to the previous year, higher amount of heat entered the southern and eastern Barents Sea. Slow decrease in temperature to a level slightly exceeding the long-term mean was observed in the southwest, while temperatures considerably above normal were observed in the north-western and eastern areas. The year 2001 is expected to be moderately warm with less ice than average.

The main problem in climate fish relations is to establish algorithms that can be used directly in fish stock assessment. If quantitative relations are established, it may give more reliable results in fish stock assessment work.

1.5 Alternative assessment model for NEA cod (Fleksibest)

The work with an alternative assessment model for NEA cod (Fleksibest) has made considerable progress since the last assessment meeting. At the present WG working documents on different model runs and results (Frøysa, Bogstad and Åsnes, WD 16) and on prognosis (Åsnes, Bogstad and Frøysa, WD 18) were presented. New model runs including data for year 2000 were performed and are presented in section 3. In last year's WG report (ICES CM 2001/ACFM:02) it was stated that the aim was to use Fleksibest as the main assessment model for Northeast Arctic cod at the next meeting of the AFWG. ICES, however, requires that any analytical software used by ICES assessment working groups has to undergo a defined testing process in order to ensure quality and efficiency (ICES CM 1999/ACFM:25, working document ACFM May 2000, Certification of software used for assessment purposes). At the ICES Annual Science

Conference in September 2000 it was decided to arrange a workshop in Bergen, Norway from 16-19 January 2001 to define a workplan for testing the model and results of runs, enable participants through hand-on exploration of Fleksibest to contribute to the test and further development of the method and discuss the interpretation of results from Fleksibest (ICES 2001). The results of the workshop are presented in ICES CM 2001/ACFM:09. The Workshop concluded that it is still premature to use Fleksibest as the main assessment model for Northeast Arctic cod. The main reasons were that the model was not tested well enough with respect to model formulations, parameter sensitivity, parameter correlations, that there were too many free parameters. In addition, it was recommended that Fleksibest needed to develop tools (e.g. plot of all types of residuals) to assist interpretation of its results. Although more analytical tools are included, the number of free parameters have been significantly reduced and more test runs have been performed, the issue of parameter correlations and overparameterization remains to be resolved.

1.6 Biological reference points for NEA cod

The Russian Government in a letter dated 07 August 2000 requested that ICES re-estimate the MBAL of 500 thousand tons criteria taking into account cod stock condition for the last 3-4 decades and other factors influencing year-class strength. ICES responded by noting that data available at the 2000 WG meeting were too incomplete to provide an adequate basis for revision of reference points and the B_{pa} of 500,000 t was maintained as the basis for advice (ICES 2000). ICES further responded that time series for weight at age and maturity at age derived from relevant Russian and Norwegian sources were being analysed. The Russian authorities were informed that these analyses would be finalised for the 2001 assessment and the series would be used as the basis for a review of the PA framework for NEA cod.

Three working documents describing these analyses were presented at the present WG meeting (Ajiad and Jakobsen WD 1, Gusev *et al.* WD 2, Yaragina WD 3). The results of the evaluation are presented in detail in Section 10.

1.7 Reliability of Catch Statistics

At the previous WG meeting it was recognized that there is growing evidence of both substantial discarding and unreporting of catches throughout the Barents Sea for most groundfish stocks in recent years (ICES CM 2001/ACFM:02, Nakken WD8, 2000 WG, Schöne WD4, 1999 WG).

The WG is aware that discarding has been going on throughout the whole period since 1946. Work is going on at IMR to correct the catch at age of younger age groups of NEA cod for discards. The result will be presented to the next WG meeting, including the effects of the corrected catch at age on the estimated stock numbers in the whole time series.

During the present meeting results from telephone interviews carried out in December 2000 – January 2001 with Norwegian fishermen and fish buyers were presented (Nakken WD 10). The results indicated that 3-4 % of the Norwegian catch of cod by weight was discarded at sea during 1999likely corresponding to about 8-12 % by number. This suggests that the catches of young cod (3 and 4 year olds) are substantially underrepresented in the catch-at-age matrix based on landings.

Inaccuracies in catch statistics continue to represent one of the most serious errors in stock assessments and generally results in underestimating fishing mortality and overestimating stock size. Therefore, additional precaution is advised when considering total allowable catches (TACs).

1.8 Discrepancies in Norwegian-Russian cod age readings

In 1992 PINRO, Murmansk and IMR, Bergen began a routine exchange program of cod otholith in order to validate age readings and ensure consistency in age interpretations (Nedreaas and Yaragina, WD 4). In addition, once a year the age readers come together and evaluate discrepancies which are seldom more than 1 year although most often PINRO reads one year more than IMR. One of the main consequences of age reading differences are different mean-weights-at-age. Nevertheless, in recent years, there seems to be a decreasing trend in the discrepancies which should improve precision in age composition.

Another potential problem with ageing errors is discussed in Nakken and Pennington (WD 17). Errors in age readings tend to mix fish among adjacent age groups. The effect might be larger for catch data than survey data since more readers from different institutes are reading otoliths from the catch data. The converged VPA estimates may be biased, and in particular the estimates for low stock numbers may be significantly biased upwards. In WD 17 it is therefore suggested to use only converged estimates for abundant cohorts in the tuning procedure.

The cod otolith exchange program will continue and problems related to discrepancies in age readings should continue to be addressed.

1.9 ICES Quality Handbook

The Chairman first presented ICES' basic idea of the Handbook:

1) Establish standards for assessments and document these standards

2) Establish checking procedures on the data that are submitted.

3) Establish responsibilities for data and analysis

A draft of the ICES Quality Handbook with Annexes (Lassen and Sparholt 2001a,b) was presented. The ICES Secretariat is responsible for keeping the Handbook up to date once it has been developed and agreed. A main task of the ICES Secretariat is to function as documentation centre. Data files, documentation of methods and calculations are accessible through the Secretariat. The ICES Quality Handbook consists of a general part and about 130 Annexes, one for each fish or shellfish stock assessed by ICES. The Annexes will be a complete and detailed documentation of the assessments. They will include a general part (stock definition, fishery and ecosystem aspects), a data part (commercial catch, biological data, surveys, commercial CPUE and other relevant data), and parts regarding estimation of historical stock development (method chosen etc.), projections, biological reference points and other issues. The level of details should be sufficient for any assessment scientist to repeat the assessment. It is the responsibility of the WGs to prepare and update the stock specific Annexes, when needed. The Secretariat will record modifications in the Annexes, keeping versions of old documentation available and supplying users with the most recently approved version. The national laboratories are responsible for the quality control of the data sets they submit to ICES.

It was decided that a subgroup consisting of the chairman and the Norwegian stock co-ordinators should prepare a draft of a Quality Handbook for the AFWG stocks and distribute it to the WG members to be reviewed at the next WG meeting.

1.10 Scientific Presentations

WD 1 (presented by A. Ajiad) Based on the spawning rings in the otoliths from approximately 200000 individuals sampled at the Lofoten spawning grounds, the fractions mature at age of Northeast Arctic cod were estimated for a period between 1932 and 1999 by applying a modified method originally proposed by Gulland. Mean weight of the spawning stock based on Lofoten data as well as a combine weight from Lofoten and Finnmark was presented. An attempt was made to estimate and compare the spawning stock biomass based on the new series with the spawning stock from the Working group. A continuous trend in age at 50% maturity is indicated: age at 50% maturity decreases from 10.5 years in 1932 to 6.5 in 1999.

WD 2 (presented by N.A. Yaragina) presents historical time series on Northeast Arctic cod weight at age for 1946-1981 collected onboard research vessels estimated juvenile bottom fish as well as onboard fishing trawlers in quarters IV and I. There are considerable year-to-year variations in weight at age values. An upward trend in mean weight at age for the 50 years of investigations is observed. The highest variations of these values as well as their considerable increase are observed from late 70's to early 80's especially in fish of older ages (age 8 and older).

WD 3 (presented by N.A. Yaragina) presents historical time series on Northeast Arctic cod maturity ogives for 1959-1983 (by PINRO data). Data were based on visual examination of cod gonads in the prespawning period. An increasing trend in maturation rate is observed. Mean age at 50% maturity declined from 9.14 years for cohorts of the 1950's to 6.92 years for those of the 1990's. The maturity ogives were generally similar to those derived after Gulland (1964) by otolith spawning marks (WD 1). Some discrepancies noted were the most pronounced in the 1950-70's, when proportion of mature fish in younger age groups were generally higher from the Russian data than from the Norwegian ones. For 1989-1998, discrepancies in the percentage of mature fish calculated by different methods were insignificant.

WD 4 (presented by K. Nedreaas) presents a short status of the comparative cod age readings between PINRO, Russia, and IMR, Norway, since 1992. The results show an improvement over this time period, i.e., the percentage age readings showing a different result (usually 1 year) has decreased from about 30% in 1992 to less than 20% today. During an annual exchange of age readers the discrepancies are discussed and an agreement is at present achieved for all otoliths except ca. 3%. The results were also used in WD 17.

WD 6 (presented by B. Bogstad) – The biomass of capelin in 2001 is predicted based on surveys in 2000 and assumptions (mostly *status quo*) about mortality, maturation and growth. A slight decrease from 4.3 million tonnes in 2000 to 4.1 million in 2001 is predicted. This prediction may be utilised when predicting cod growth and cod cannibalism.

WD 8 (presented by Yu. Kovalev) – the sensitivity of F_{low}, F_{med}, F_{high}, F_{loss}, $F_{0,1}$ for NEA cod to changes in population parameters such as weight, maturity rate and natural mortality due to cannibalism was investigated. Reference points based on SPR equilibrium curve were considerably more sensitive. The sensitivity within this group increased for the points located to the right of the SPR curve. In general, a decrease in cod abundance leads to an increase in growth and maturation rate and a decrease in cannibalism. All of the changes in the population parameters led to increased estimates of the studied reference points. In 1984-1999, the variability of the biological reference points estimated on the basis of data averaged by three successive years was considerable.

WD 9 (presented by Yu.Kovalev) – presents reconstructed time series for SSB of NEA cod for 1953-1984 based on reconstructed stock weight-at-age data, reconstructed maturity ogives and modeled natural mortality coefficients. It was shown that the SSB values estimated using reconstructed maturity ogives were considerably lower. The mean SSB was 343 000 tonnes compared to 438 000 tonnes according to the current assessment by AFWG. The use of the reconstructed weight-at-age and natural mortality data, in addition to the reconstructed maturity ogives, will further reduce the mean SSB to 327 000 tonnes.

WD 10 (presented by O. Nakken) – A survey (telephone interviews) was carried out amongst fishermen and fish buyers to investigate the amounts of discards and unreported landings of Northeast arctic cod. According to the answers, discards may constitute 8-12% in numbers of the total Norwegian catch, while only 2-7% of the answers indicated unreported landings.

WD 11 (presented by O. Nakken) – The stock-recruitment plot in previous reports from the Working Group is based on time series of recruitment (age 3) and SSB which are not comparable over the entire period 1946-2000. The effect of cannibalism was, therefore, removed from the recruitment series and the biomass of 8 years old and older was taken as a proxy for SSB, and mean values for 10 year periods were computed for each series. The result indicates that mean recruitment at age 3 are almost directly proportional to the mean biomass of 8+ at levels of 8+ biomass below 550,000 t. At higher “SSB” the recruitment appears to level off.

WD 12 (presented by V.M. Borisov) – analyses the use of MBAL as a reference point for NEA cod. A lack of formal relationship between SSB and progeny appearing of it indicates the presence of other factors affecting the strength of year classes. It was shown that variation of water temperature in the Barents Sea, related to the intensity of warm Atlantic waters inflow providing favourable conditions for survival of eggs, larvae and young cod could be a more reliable predictor. A search for algorithms of such relationship seems to be quite helpful for estimation of recruitment to the fishable stock.

WD 13 (presented by T. Marshall) – fecundity data available for seven years in the time period 1986 to 2000 were used to develop a general fecundity model for Northeast Arctic cod. Potential fecundity was predicted from a combination of weight and length. This multivariate model provides a method for incorporating interannual variation in growth into fecundity estimates using information about the length and weight at length (condition). A refined version of the model will in future be used to estimate reproductive potential.

WD14 (presented by T. Marshall) – historical data on liver condition and capelin stock biomass were summarized so that they could be compared to the reconstructed values of weight and proportion mature being estimated at this working group. Temporal trends in liver condition correspond closely to that observed in capelin stock biomass. Both show a peak in the late-1950’s/early-1960’s followed by a sharp decrease in the mid- to late-1960’s. Throughout the 1970’s liver condition and capelin stock biomass values were high and stable.

WD 15 – (presented by B. Bogstad) – A model for size preferences in cod cannibalism is presented. This is based on estimates of cod consumption by cod by predator length and prey length, as well as data on the size distribution in the cod stock. It is found that the preferred predator length/prey length ratio is about 3.1. This model need to be combined with a model for how cannibalism is affected by capelin abundance in order to give predictions of cod cannibalism. The model is developed for use in length-structured models such as Fleksibest, but can also be used in age-structured models with age as a proxy for length.

WD 16 (presented by K. G. Frøysa) describes cod assessments made by Fleksibest prior to the AFWG meeting, for the period 1. quarter 1985- 1. quarter 2000. The performance of Fleksibest as an assessment model for cod was investigated. The main issue was to investigate whether the signals from the different data sources (catch data and survey data) are reflected in the model results in a consistent way. This was done by giving the two data sources approximately equal weight, as well as giving all weight to one of the data sources. The extreme weighting runs gave the expected results. It is concluded that the two data sources should be given approximately equal weight in order to utilize all the available information.

WD 17 (presented by O. Nakken and M. Pennington) – Is it the stock number generated by the converged VPA that is proportional to “true” stock numbers, or is it the abundance indices from surveys? The document provides evidence that stock numbers from the converged VPA are biased, especially so, for low abundant cohorts and that the survey indices are more likely to be proportional to stock numbers. It is, therefore, suggested that:

- proportionality should be assumed for all ages, (e.g. catchability independent of year class strength)
- and that only cohorts of high abundance should be used in the tuning procedure.

WD 18 (presented by M. N. Åsnes) – Fleksibest was used for predicting the development of North East Arctic Cod.. The age and length structure makes it possible to model the effects on the population of changes in growth, recruitment, fishing mortality etc. in a consistent way. Several scenarios were investigated, where one or more of recruitment, growth, and fishing pressure were changed. The starting values for the prognosis were determined by an assessment giving equal weight to catch and survey data. When using Fleksibest for prediction the effect of changes in external parameters (e.g. capelin abundance and temperature) on the population dynamics can be easily included, when it is known.

WD33 (presented by G. Ottersen) summarizes the hydrographic conditions in the Barents and Norwegian Seas and presents forecasts. In the Norwegian Sea a warm autumn and first part of winter 2000/2001 gives reason to expect above average temperatures in 2001 in the eastern part and deeper layers along the Norwegian Coast. The most recent measurements show a clear positive temperature anomaly in the central Barents Sea. Moderate positive anomalies are expected to prevail throughout summer/autumn 2001.

1.11 Time of Next Meeting

The Working Group proposes the dates of April 17-26 2002 for it’s next meeting.

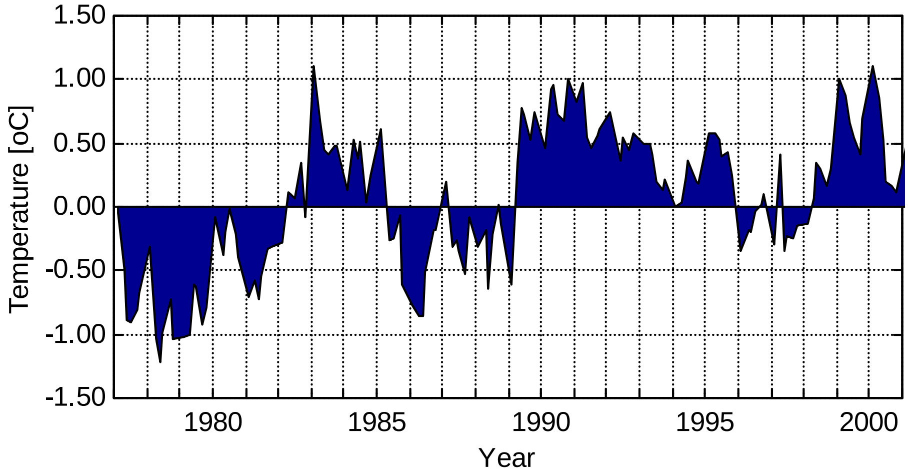

Figure 1. Temperature anomalies in the section Fugløya – Bear Island (Anon., 2001).

2 NORWEGIAN COASTAL COD IN SUB-AREAS I AND II

2.1 Status of the Fisheries

2.1.1 Historical development of the fisheries

Cod in the Barents Sea, the Norwegian Sea and in the coastal areas living under variable environmental conditions form groups with some peculiarities in geographical distribution, migration pattern, growth, maturation rates, genetics features etc. The degree of intermingle of different groups is still uncertain. However, taking into account some biological characteristics of cod in the coastal zone and the specifics of the coastal fishery, the working group considered it acceptable to assess the coastal cod stock (in the frame of ICES) separately from NEA cod. Scientific investigation should continue in order to elucidate the stock structure in these areas further.

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 2000 (Tables 2.1, 2.10, Figure 2.2)

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 1999 reported to the Working Group is 40,732 t and the provisional figure for 2000 is 36,715 t (Tables 2.1, 2.10, Figure 2.2).

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

2.1.3 Expected landings in 2001

No estimate of expected landings for 2001 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 ten last years (1991-2000) such that catch NCC=11,387 + 0.1466* Norwegian catch NEAC (R^2 = 0.86), the expected landings of NCC in 2001 are 34,183 t. This is about 3000 t less than the catch in 2000. 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 2000 using RV Jan Mayen. In 2000 the survey covered the same areas as the coastal surveys in 1995-1999.

The trawl-acoustic coastal survey in 2000 estimated a total survey biomass of NCC of about 80,000 t (75 million fish) for the coastal area from Varanger to Stadt at 62° N (Tables 2.2, 2.3, 2.8). The spawning biomass accounted for 29,000 t (8 million fish) of this total (Tables 2.4, 2.5). Thus, spawners make up about 36% of the total biomass. Seventy five percent of the total coastal biomass was distributed from the Russian border to 67° N and 25% south of 67° N (Norwegian statistical areas 06 and 07). The bulk of the biomass was comprised of ages 3-6 (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° N) nearly all otoliths collected were of the NCC type, which is similar to the results of the 1995-1998 surveys (ICES 1996/ACFM:4; ICES 1997/ACFM:4; ICES 1998/ACFM:2; ICES 1999/ACFM:3; ICES 2000/ACFM:3; ICES 2001/ACFM:2).

The numbers of NCC per year-class from all the coastal surveys is given in Table 2.8. The total numbers increased in 2000 compared with the 1999 survey. However, this increased biomass consisted mostly of zero group cod caught in the northern part at the outer areas and might belong to the North East Arctic cod stock. For the age groups 2 and older the biomass and numbers are at the same level in 2000 as in 1999.

The Norwegian 2001 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 4245 cod otoliths were sampled during the 2000 survey. These were separated into NCC type (3215) and NEAC (1030). As in previous years, NCC were found throughout the survey area. The 2000 survey data shows the same pattern as the 1995-1999 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 2000 was at the same level as in 1999 for ages younger than 7 years. Weight at age for cod older than 7 years has increased. However, these weights are uncertain due to limited number of age samples. 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 1995-1999.

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 late autumn when the stage at the maturity scale can be 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 below 6 years old on average for the surveyed area in 2000 (Table 2.7). There are some variations between the different areas. The 2000 data show that the average M_{50} has increased more the half a year compared with that found in the 1999 survey (ICES 2001/ACFM:2). The average M_{50} for the NEAC in 2000 is close to 7 years old.

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 2000 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 and time of the year of capture as given by the Norwegian Directorate for Fisheries. Cod samplings from commercial catches done by the Institute of Marine Research, Bergen was used 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-age (0-10+) for the period 1984-2000 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. Weight-at-age in the stock from 1984-1994 was set as an average of weight-at-age from the coastal survey 1995-1996. This was done because no survey data from this period are available. Since the 2000 survey showed a rather big increase in the weight-at-age for cod older than 7 years and the numbers used to calculate this weights are few, weight-at-age in the stock for these ages were recalculated as an average of 1997-1999.

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 1995-2000 are obtained from the Norwegian coastal survey. In the period from 1984-1994 no maturity-at-age data are available. In last years assessment maturity ogives for these years were calculated from the commercial catches. This is clearly an overestimation and maturity-at-age for these years was therefore recalculated using an average of the data from the coastal survey 1995-1999. The maturity ogives increased from the 1999 survey to the 2000 survey by approximately half a year. Such an increase in only one year is rather unlikely. Therefore, maturity ogive in 2000 was set as an average of 1995-1999. The maturity ogive in 2000 was set as an average of 1995-1999 because the rather big change obtained in the survey is unlikely to be correct. 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 (1995-2000) have been used in the tuning (Table 2.8).

2.3.6 Prediction data (Table 2.21)

The input data to the short term prediction with management option table (2001-2003) are given in Table 2.21. For 2001-2003 the weight in stock and weight in catch were set to an average of 1998-2000. The maturity-at-age was set to the average of 1995-1999 because of the rather big change from 1999 to 2000. The recruitment in 2001 and 2002 was set as an average of the recruitment in 1998-2000. This might be an overestimation since the SSB has steadily decreased in this period and is presently at a much lower level. The exploitation pattern is calculated using the average fishing mortality (age 3-7) from 1997 to 1999 scaled to the fishing mortality (age 3-7) in 1999. The exploitation pattern was not scaled to the 2000 level because the fishing mortality of the oldest ages estimated by the XSA are suspected to be to low (as seen for the NEAC some years ago).

2.4 Methods Used in the Assessment

2.4.1 VPA and tuning (Table 2.9)

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 8 and older. (2) The survivors estimate was shrunk towards the mean F of the final 2 years or the 4 oldest ages. (3) The standard error of the mean to which the survivor estimates are shrunk was set to 1.0 (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

2.5.1 Fishing mortality and VPA (Tables 2.14-2.20, Figure 2.2)

The average age 4-7 fishing mortality in 2000 were estimated to be 0.49 (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. The total biomass of the stock in the period from 1984-2000 has been between 121,000 t and 310,000 t (Tables 2.18, 2.20). At the end of 2000 the biomass was estimated to be the lowest observed and only about half the biomass estimated five years ago in 1996. The spawning stock biomass has been between 65,000 t and 185,000 t (Tables 2.19, 2.20, Figure 2.2). As for the total stock biomass, the lowest observed SSB was estimated in 2000. The SSB has declined steadily from 1994 to present. The SSB in 2000 was only about half of the average in the period 1984-1999 and was reduced by 10% from 1999 to 2000.

A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1984 is given in Table 2.20 and Figure 2.2.

2.5.2 Recruitment (Tables 2.8, 2.16, 2.20)

Both the survey estimates of abundance in 2000 (age 1-4, Table 2.8) and the XSA-estimate (age 2 and 3, Tables 2.16, 2.20) indicate lower than average year classes from 1996-1999.

2.6 Reference Points and Safe Biological Limits

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 well below the previous observed lowest level. In addition, the recruitment (age 2) has steadily decreased since the early nineties, and was in 1998-2000 (1996-1998 year classes), at the lowest observed level in the time series. Results from the 2000 Norwegian coastal survey also indicate a year class strength below average for 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.

2.7 Catch Options for 2001 and Management Scenarios (Tables 2.22-2.23, Figure 2.2)

The total stock biomass and the SSB is further reduced during 2000. The management option table (2.22) shows that the expected catch of 34,183 t in 2001 will give an unchanged fishing mortality (F_{2001}=0.48). The total stock biomass and the SSB will however be further reduced with about 20 % (99,000 t and 50,000 t). The *status quo* catch in 2002 (F_{2000}) is 30,000 t, and leads to a further decrease of the total stock biomass (92,000 t) and the SSB (43,000 t). To rebuild the SSB to the 1999 level, fishing mortality has to be reduced to near zero (Table 2.23). A catch of 12,000 t (F=0,17) brings the SSB up to the level of SSB in 2001 (Table 2.23, Figure 2.2).

2.8 Comments to the Assessment

2.8.1 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. If the estimated fishing mortalities in 2000 are correct the exploitation pattern has changed. Using this exploitation pattern in the short-term prediction leads to higher fishing mortalities for age 4-5 and lower fishing mortalities for ages 7-9. This will only have minor effect on the SSB in 2003 (increased by 4 %) using $F_{\text{status quo}}$ in 2002.

2.8.2 A comparison of the assessment results and the survey results (Figures 2.1)

Both the assessment and the surveys from 1995-2000 show a declining stock. For ages 2-8 the survey indexes and the XSA estimates are well correlated except for the 6 year old cod in 1997 and 7 year old cod in 1998 (Figure 2.1). It therefore seems like the survey and the XSA assessment reflect the changes in the stock number quite well. There is a general trend towards decreasing catchability with increasing age, except for cod older than 8 years.

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
2000	37	19**)
Average (1984-2000)	53	30

*) 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	70	3562	2644	2755	1402	1124	822	134	45	7	3	12568
04 West Finnmark/Tromsø	11418	4817	4760	2753	2370	2648	2058	494	183	17	40	31558
05 Lofoten/Vesterålen	2848	24	969	1700	1338	1416	501	139	123	0	0	9058
00 Vestfjord	3284	0	821	1361	1508	1012	1016	335	34	34	0	9405
06 Nordland	0	1184	2085	2457	1611	1519	855	263	82	27	54	10137
07 Møre	0	0	249	586	745	265	199	0	21	0	0	2065
Total	17620	9587	11528	11612	8974	7984	5451	1365	488	85	97	74791

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	172	940	2037	1937	2418	1965	358	162	28	22	10039
04 West Finnmark/Troms	115	353	1551	2410	3812	6445	5556	1943	1255	109	440	23989
05 Lofoten/Vesterålen	26	3	438	1649	2049	3292	1615	635	1383	0	0	11090
00 Vestfjord	83	0	300	1147	3123	3194	3954	1747	404	404	0	14356
06 Nordland	0	160	874	1741	2070	4188	2859	1253	1017	385	770	15317
07 Møre	0	0	218	840	1473	945	1118	0	138	0	0	4732
Total	224	688	4321	9824	14464	20482	17067	5936	4359	926	1232	79523

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	0	0	56	191	436	92	41	7	3	826
04 West Finnmark/Troms	0	0	0	0	71	291	1111	361	143	15	40	2032
05 Lofoten/Vesterålen	0	0	0	0	254	354	195	40	49	0	0	892
00 Vestfjord	0	0	0	0	754	891	975	335	34	34	0	3023
06 Nordland	0	0	0	0	48	471	402	187	49	27	54	1238
07 Møre	0	0	0	0	82	85	109	0	16	0	0	292
Total	0	0	0	0	1265	2283	3228	1015	332	83	97	8303

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	0	0	77	411	1041	247	146	28	22	1972
04 West Finnmark/Troms	0	0	0	0	114	709	3000	1418	979	99	440	6759
05 Lofoten/Vesterålen	0	0	0	0	389	823	630	184	553	0	0	2579
00 Vestfjord	0	0	0	0	1562	2811	3796	1747	404	404	0	10724
06 Nordland	0	0	0	0	62	1298	1344	890	610	385	770	5359
07 Møre	0	0	0	0	162	302	615	0	106	0	0	1185
Total	0	0	0	0	2366	6354	10426	4486	2798	916	1232	28578

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	7	48	355	739	1381	2151	2392	2680	3573	3761	8720
04 West Finnmark/Troms	10	73	326	875	1608	2434	2700	3934	6863	6551	11009
05 Lofoten/Vesterålen	9	117	452	970	1531	2325	3225	4583	11259		
00 Vestfjord	25		366	842	2071	3157	3894	5216	11720	11720	
06-07 Nordland/Møre	60	136	419	709	1285	2757	3345	4764	12393	14071	14071
Weighted average	13	72	365	809	1554	2539	3049	4352	9173	10778	12643

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	0	0	4	17	53	69	90	100	100
04 West Finnmark/Troms	0	0	0	0	3	11	54	73	78	91	100
05 Lofoten/Vesterålen	0	0	0	0	19	25	39	29	40	75	100
00 Vestfjord	0	0	0	0	50	88	96	100	100	100	100
06-07 Nordland/Møre	0	0	0	0	3	31	47	71	60	100	100
Weighted average	0	0	0	0	11	32	55	73	77	90	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
2000	17620	9587	11528	11612	8974	7984	5451	1365	488	85	97	74791

Table 2.9

```
Lowestoft VPA Version 3.1

   27/04/2001  10:30

 Extended Survivors Analysis

 Coastal cod (run: XSANCC14/X14)

 CPUE data from file fleet

 Catch data for  17 years. 1984 to 2000. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT04: Norw. Coast. ,   1995, 2000,   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 >=    8


 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 =   1.000

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

      Prior weighting not applied


 Tuning had not converged after  100 iterations


 Total absolute residual between iterations
 99 and 100 =     .00016

 Final year F values
 Age         ,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 99,  .0079,  .0781,  .3651,  .4962,  .6053,  .4861,  .3514,  .3093
 Iteration **,  .0080,  .0782,  .3651,  .4963,  .6054,  .4861,  .3514,  .3092



 Regression weights
       ,  .954,  .976,  .990,  .997, 1.000, 1.000



 Fishing mortalities
    Age,  1995,  1996,  1997,  1998,  1999,  2000

      2,  .028,  .036,  .052,  .028,  .016,  .008
      3,  .051,  .106,  .140,  .150,  .087,  .078
      4,  .140,  .195,  .199,  .294,  .180,  .365
      5,  .258,  .489,  .274,  .422,  .466,  .496
      6,  .350,  .390,  .492,  .489,  .583,  .605
      7,  .515,  .484,  .678,  .659,  .785,  .486
      8,  .454,  .742,  .930,  .799,  .806,  .351
      9,  .352,  .567,  .964,  .803, 1.003,  .309
```

Table 2.9 (continued)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1995	3.28E+04	1.99E+04	1.98E+04	2.52E+04	2.08E+04	8.98E+03	4.41E+03	2.07E+03
1996	3.69E+04	2.61E+04	1.55E+04	1.41E+04	1.59E+04	1.20E+04	4.39E+03	2.29E+03
1997	2.87E+04	2.91E+04	1.93E+04	1.04E+04	7.08E+03	8.83E+03	6.04E+03	1.71E+03
1998	2.21E+04	2.23E+04	2.07E+04	1.29E+04	6.49E+03	3.54E+03	3.67E+03	1.95E+03
1999	1.77E+04	1.76E+04	1.57E+04	1.27E+04	6.94E+03	3.26E+03	1.50E+03	1.35E+03
2000	2.18E+04	1.43E+04	1.32E+04	1.08E+04	6.50E+03	3.17E+03	1.22E+03	5.48E+02

Estimated population abundance at 1st Jan 2001

	0.00E+00	1.77E+04	1.08E+04	7.52E+03	5.36E+03	2.90E+03	1.60E+03	7.01E+02

Taper weighted geometric mean of the VPA populations:

	3.21E+04	2.75E+04	2.30E+04	1.74E+04	1.12E+04	6.62E+03	3.14E+03	1.42E+03

Standard error of the weighted Log(VPA populations) :

	.3752	.3898	.3760	.3842	.4185	.4654	.5533	.6479

Log catchability residuals.

Fleet : FLT04: Norw. Coast.

Age	1995	1996	1997	1998	1999	2000
2	.11	-.18	.18	.04	.02	-.17
3	-.17	.12	.27	-.11	-.13	.02
4	.00	.06	.18	-.09	-.17	.03
5	-.25	.25	.37	-.24	-.21	.08
6	-.40	-.44	.90	-.24	-.26	.41
7	-.08	-.39	.28	.26	-.17	.09
8	.10	-.10	.43	-.75	-.11	.44
9	.37	-.73	-2.35	-.74	-.62	-.55

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	-.0073	.0356	.1805	.0607	-.3858	-.9092	-.9092
S.E(Log q)	.1711	.1220	.2732	.5380	.2633	.4420	1.2209

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	1.20	-.767	-1.65	.78	6	.17	-.36

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	.72	1.428	2.75	.87	6	.11	-.01
4	.97	.104	.31	.69	6	.13	.04
5	1.86	-1.258	-8.48	.36	6	.48	.18
6	2.38	-1.331	-12.79	.19	6	1.19	.06
7	1.19	-.774	-1.16	.81	6	.33	-.39
8	1.09	-.242	.27	.65	6	.54	-.91
9	1.05	-.057	1.40	.25	6	1.03	-1.68

Table 2.9 (continued)

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1998

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Norw. Coast. ,	14899.,	.300,	.000,	.00,	1,	.593,	.009
P shrinkage mean ,	27524.,	.39,,,,				.354,	.005
F shrinkage mean ,	6350.,	1.00,,,,				.054,	.022

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17682.,	.23,	.29,	3,	1.269,	.008

Age 3 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
FLT04: Norw. Coast. ,	11042.,	.212,	.002,	.01,	2,	.953,	.077
F shrinkage mean ,	6965.,	1.00,,,,				.047,	.119

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
10807.,	.21,	.07,	3,	.340,	.078

Age 4 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. ,	7354.,	.174,	.055,	.32,	3,	.956,	.372
F shrinkage mean ,	12312.,	1.00,,,,				.044,	.238

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7523.,	.17,	.08,	4,	.445,	.365

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Norw. Coast. ,	5328.,	.152,	.080,	.53,	4,	.956,	.499
F shrinkage mean ,	6110.,	1.00,,,,				.044,	.447

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5360.,	.15,	.07,	5,	.458,	.496

Table 2.9 (continued)

```
Age  6   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. ,      2872.,   .153,       .117,    .77,   5,    .929,     .611

   F shrinkage mean  ,      3370.,   1.00,,,,                              .071,     .541

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      2905.,       .16,      .10,    6,    .647,   .605


 Age  7   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. ,      1651.,   .155,       .067,    .43,   6,    .941,     .473

   F shrinkage mean  ,       931.,   1.00,,,,                              .059,     .729

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1596.,       .16,      .08,    7,    .523,   .486


Age  8   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. ,       770.,   .174,       .124,    .71,   6,    .920,     .324

   F shrinkage mean  ,       236.,   1.00,,,,                              .080,     .811

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       701.,       .18,      .17,    7,    .975,   .351


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

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N,  Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT04: Norw. Coast. ,       366.,   .207,       .138,    .67,   6,    .842,     .283

   F shrinkage mean  ,       190.,   1.00,,,,                              .158,     .489

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       330.,       .24,      .16,    7,    .669,   .309
```

Table 2.10

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	829,	396,	4095,	170,	110,	41,	7,
3,	3478,	7848,	4095,	940,	1921,	1159,	349,
4,	6954,	7367,	12662,	8236,	3343,	1434,	1233,
5,	7278,	8699,	8906,	12430,	6451,	2299,	1330,
6,	6004,	7085,	5750,	4427,	6626,	5197,	1129,
7,	4964,	3066,	3868,	2649,	4687,	2720,	3456,
8,	2161,	705,	1270,	1127,	1461,	949,	773,
9,	819,	433,	342,	313,	497,	236,	141,
+gp,	624,	264,	407,	149,	333,	86,	73,
TOTALNUM,	33111,	35863,	41395,	30441,	25429,	14121,	8491,
TONSLAND,	74824,	75451,	68905,	60972,	59294,	40285,	28127,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	125,	40,	4,	332,	810,	1193,	1326,	554,	252,	156,
3,	607,	665,	369,	573,	896,	2376,	3438,	2819,	1322,	971,
4,	1452,	3160,	1706,	1693,	2345,	2480,	3150,	4786,	2346,	3664,
5,	3114,	4422,	2343,	4302,	5188,	4930,	2258,	4023,	4263,	3807,
6,	1873,	2992,	2684,	2467,	5546,	4647,	2490,	2272,	2773,	2671,
7,	1297,	1945,	3072,	3337,	3270,	4160,	3935,	1546,	1602,	1104,
8,	873,	898,	1871,	1514,	1455,	2082,	3312,	1826,	751,	326,
9,	132,	837,	627,	777,	557,	898,	959,	975,	774,	132,
+gp,	94,	279,	690,	798,	433,	543,	684,	343,	320,	152,
TOTALNUM,	9567,	15238,	13366,	15793,	20500,	23309,	21552,	19144,	14403,	12983,
TONSLAND,	24822,	41690,	52557,	54562,	57207,	61776,	63319,	51572,	40732,	36715,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	99,	100,	100,

Table 2.11

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	.2480,	.2140,	.2270,	.3310,	.2460,	.3000,	.3450,
3,	.6190,	.7120,	.5250,	.6730,	.6340,	.6610,	1.1740,
4,	1.1490,	1.4150,	1.0800,	1.1200,	1.1700,	1.8360,	1.5150,
5,	1.7340,	2.0360,	1.7060,	1.6930,	1.7270,	2.1700,	1.6780,
6,	2.3250,	2.7370,	2.2560,	2.3590,	2.3280,	2.4480,	2.7080,
7,	3.4860,	4.0120,	3.3530,	3.7430,	3.2560,	4.3910,	3.8980,
8,	4.8450,	6.1160,	4.8380,	5.3260,	4.7000,	4.8990,	6.5150,
9,	5.6080,	6.4600,	5.8380,	6.1290,	5.4500,	6.6610,	7.2990,
+gp,	8.8400,	10.7550,	7.0530,	11.6230,	8.2020,	11.6080,	13.9240,
SOPCOFAC,	1.0002,	1.0000,	1.0001,	1.0001,	1.0001,	1.0000,	1.0002,

Table 2 Catch weights at age (kg)

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	.1640,	.1680,	.2410,	.2540,	.3020,	.2740,	.2770,	.3760,	.4670,	.5150,
3,	.9220,	.5560,	.6450,	.8050,	.7100,	.9210,	.9700,	.9780,	1.1550,	1.3050,
4,	1.6080,	1.3590,	1.7100,	1.4760,	1.3350,	1.4640,	1.5540,	1.5180,	1.6330,	2.2720,
5,	2.1080,	2.2670,	2.5910,	2.0970,	1.8420,	1.9790,	1.9700,	2.2810,	2.1710,	2.5550,
6,	2.5070,	2.9570,	3.5880,	3.2870,	2.4670,	2.5160,	2.8970,	3.1250,	3.2490,	3.2830,
7,	3.4690,	3.9030,	4.3660,	4.0950,	4.1910,	3.4610,	3.7160,	3.9000,	4.0950,	4.5040,
8,	4.9760,	5.3170,	5.8990,	5.5920,	5.7780,	4.8660,	4.8290,	5.5200,	5.0130,	5.4000,
9,	5.7340,	4.5580,	6.4940,	7.2170,	6.3760,	5.3910,	6.3490,	6.3330,	6.0180,	6.3790,
+gp,	11.0590,	7.0320,	7.5090,	8.3310,	9.9030,	8.8540,	9.2670,	9.3370,	6.2550,	6.4200,
SOPCOFAC,	1.0003,	1.0001,	1.0000,	1.0000,	1.0001,	1.0001,	1.0003,	.9919,	1.0002,	.9999,

Table 2.12

Table 3 Stock weights at age (kg)

AGE	1984,	1985,	1986,	1987,	1988,	1989,	1990,
2,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,
3,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,
4,	1.4790,	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,	2.1370,
6,	2.8140,	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,	4.7220,
8,	6.6850,	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,	6.9800,
+gp,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,

Table 3 Stock weights at age (kg)

AGE	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
2,	.3210,	.3210,	.3210,	.3210,	.3900,	.2520,	.2400,	.3720,	.3230,	.3650,
3,	.7580,	.7580,	.7580,	.7580,	.7910,	.7240,	.6830,	.8830,	.8410,	.8090,
4,	1.4790,	1.4790,	1.4790,	1.4790,	1.5250,	1.4330,	1.3640,	1.4560,	1.6750,	1.5540,
5,	2.1370,	2.1370,	2.1370,	2.1370,	2.2220,	2.0530,	1.8930,	2.1070,	2.1920,	2.5390,
6,	2.8140,	2.8140,	2.8140,	2.8140,	2.8810,	2.7480,	2.8160,	2.9500,	2.8570,	3.0490,
7,	4.7220,	4.7220,	4.7220,	4.7220,	4.6650,	4.7220,	4.4260,	4.3190,	4.5400,	4.3520,
8,	6.6850,	6.6850,	6.6850,	6.6850,	6.9790,	6.6850,	6.4060,	5.6250,	6.5790,	6.2030,
9,	6.9800,	6.9800,	6.9800,	6.9800,	6.7590,	6.9320,	7.8050,	8.3230,	9.4540,	8.5270,
+gp,	9.7230,	9.7230,	9.7230,	9.7230,	9.8970,	9.7230,	10.8270,	12.4680,	12.9020,	12.0660,

Table 2.13

Table 5 Proportion mature at age

AGE	1984,	1985,	1986,	1987,	1988,	1989,	1990,
2,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,
3,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,
5,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,
8,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
9,	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,

Table 5 Proportion mature at age

AGE	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
2,	.0100,	.0100,	.0100,	.0100,	.0000,	.0000,	.0000,	.0200,	.0100,	.0100,
3,	.0600,	.0600,	.0600,	.0600,	.0100,	.0300,	.0600,	.1500,	.0300,	.0600,
4,	.2400,	.2400,	.2400,	.2400,	.2000,	.2400,	.2900,	.2500,	.2100,	.2400,
5,	.4900,	.4900,	.4900,	.4900,	.4700,	.5600,	.4500,	.5300,	.4400,	.4900,
6,	.7200,	.7200,	.7200,	.7200,	.6700,	.8000,	.7600,	.7400,	.6500,	.7200,
7,	.8800,	.8800,	.8800,	.8800,	.8500,	.9200,	.9700,	.8700,	.7700,	.8800,
8,	.9500,	.9500,	.9500,	.9500,	.8600,	.9900,	1.0000,	.8900,	1.0000,	.9500,
9,	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 2.14

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	.0105,	.0059,	.1358,	.0051,	.0030,	.0011,	.0002,
3,	.0744,	.1298,	.0775,	.0416,	.0736,	.0395,	.0110,
4,	.2169,	.2229,	.3190,	.2207,	.2042,	.0722,	.0537,
5,	.3337,	.4622,	.4601,	.5989,	.2696,	.2111,	.0887,
6,	.6283,	.6366,	.6431,	.4380,	.7634,	.3631,	.1519,
7,	.3095,	.7883,	.9003,	.7087,	1.2404,	.8542,	.4394,
8,	1.0724,	.6332,	.9338,	.7333,	1.1866,	.9356,	.6319,
9,	.8447,	.6357,	.7415,	.6252,	.8742,	.5961,	.3300,
+gp,	.8447,	.6357,	.7415,	.6252,	.8742,	.5961,	.3300,
FBAR 4- 7,	.6221,	.5275,	.5806,	.4916,	.6194,	.3751,	.1834,

Table 8 Fishing mortality (F) at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	FBAR 98-**
AGE											
2,	.0024,	.0009,	.0001,	.0150,	.0276,	.0364,	.0523,	.0280,	.0158,	.0080,	.0173,
3,	.0201,	.0154,	.0102,	.0258,	.0511,	.1058,	.1397,	.1503,	.0865,	.0782,	.1050,
4,	.0579,	.1380,	.0500,	.0591,	.1403,	.1950,	.1994,	.2944,	.1801,	.3651,	.2799,
5,	.1867,	.2506,	.1439,	.1718,	.2584,	.4888,	.2738,	.4219,	.4659,	.4963,	.4614,
6,	.1737,	.2755,	.2372,	.2220,	.3499,	.3895,	.4925,	.4895,	.5832,	.6054,	.5593,
7,	.2616,	.2753,	.5072,	.5217,	.5149,	.4841,	.6784,	.6589,	.7849,	.4861,	.6433,
8,	.1866,	.2916,	.4657,	.5070,	.4538,	.7417,	.9303,	.7990,	.8060,	.3514,	.6521,
9,	.2031,	.2747,	.3406,	.3579,	.3520,	.5672,	.9639,	.8031,	1.0032,	.3092,	.7052,
+gp,	.2031,	.2747,	.3406,	.3579,	.3520,	.5672,	.9639,	.8031,	1.0032,	.3092,	
FBAR 4- 7	.1700,	.2349,	.2346,	.2437,	.3159,	.3894,	.4110,	.4662,	.5035,	.4882,	

Table 2.15

Terminal Fs derived using XSA (With F shrinkage)

Table 9 Relative F at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	.0168,	.0112,	.2339,	.0104,	.0048,	.0028,	.0010,
3,	.1196,	.2461,	.1336,	.0847,	.1189,	.1052,	.0600,
4,	.3487,	.4226,	.5495,	.4491,	.3296,	.1925,	.2929,
5,	.5364,	.8761,	.7924,	1.2182,	.4352,	.5626,	.4834,
6,	1.0100,	1.2069,	1.1076,	.8910,	1.2325,	.9679,	.8283,
7,	2.1050,	1.4944,	1.5506,	1.4417,	2.0026,	2.2770,	2.3954,
8,	1.7238,	1.2004,	1.6084,	1.4918,	1.9157,	2.4940,	3.4451,
9,	1.3578,	1.2052,	1.2771,	1.2719,	1.4114,	1.5890,	1.7989,
+gp,	1.3578,	1.2052,	1.2771,	1.2719,	1.4114,	1.5890,	1.7989,
REFMEAN,	.6221,	.5275,	.5806,	.4916,	.6194,	.3751,	.1834,

Table 9 Relative F at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	MEAN 98-**
AGE											
2,	.0139,	.0038,	.0006,	.0615,	.0875,	.0934,	.1274,	.0601,	.0315,	.0163,	.0360,
3,	.1181,	.0657,	.0434,	.1061,	.1617,	.2718,	.3400,	.3224,	.1718,	.1601,	.2181,
4,	.3406,	.5877,	.2131,	.2424,	.4441,	.5009,	.4851,	.6315,	.3577,	.7478,	.5790,
5,	1.0982,	1.0671,	.6135,	.7053,	.8182,	1.2554,	.6661,	.9051,	.9253,	1.0165,	.9489,
6,	1.0220,	1.1732,	1.0111,	.9111,	1.1077,	1.0004,	1.1982,	1.0500,	1.1582,	1.2400,	1.1494,
7,	1.5392,	1.1720,	2.1623,	2.1412,	1.6301,	1.2433,	1.6506,	1.4134,	1.5588,	.9957,	1.3226,
8,	1.0978,	1.2413,	1.9853,	2.0809,	1.4366,	1.9049,	2.2635,	1.7139,	1.6008,	.7198,	1.3448,
9,	1.1947,	1.1697,	1.4520,	1.4690,	1.1145,	1.4566,	2.3452,	1.7227,	1.9924,	.6334,	1.4495,
+gp,	1.1947,	1.1697,	1.4520,	1.4690,	1.1145,	1.4566,	2.3452,	1.7227,	1.9924,	.6334,	
REFMEAN,	.1700,	.2349,	.2346,	.2437,	.3159,	.3894,	.4110,	.4662,	.5035,	.4882,	

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,	1990,
AGE							
2,	87941,	74518,	35638,	36712,	40546,	43078,	41234,
3,	53607,	71250,	60652,	25473,	29904,	33096,	35232,
4,	39415,	40742,	51233,	45952,	20005,	22745,	26048,
5,	28351,	25978,	26691,	30489,	30170,	13354,	17324,
6,	14224,	16627,	13398,	13794,	13715,	18864,	8853,
7,	7515,	6213,	7202,	5766,	7288,	5234,	10742,
8,	3631,	1661,	2312,	2397,	2324,	1726,	1824,
9,	1587,	1017,	722,	744,	942,	581,	554,
+gp,	1191,	613,	847,	350,	621,	209,	285,
TOTAL	237460,	238618,	198696,	161678,	145516,	138887,	142097,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	GMST 84-98
AGE												
2,	58718,	49210,	30321,	24650,	32832,	36901,	28735,	22147,	17713,	21773,	0,	39885,
3,	33753,	47961,	40253,	24821,	19882,	26148,	29133,	22327,	17631,	14274,	17682,	34415,
4,	28530,	27086,	38665,	32623,	19803,	15467,	19258,	20741,	15729,	13239,	10807,	28088,
5,	20211,	22044,	19317,	30113,	25177,	14092,	10419,	12917,	12651,	10755,	7523,	20619,
6,	12981,	13730,	14047,	13695,	20762,	15919,	7076,	6487,	6935,	6500,	5360,	13015,
7,	6227,	8933,	8534,	9072,	8980,	11980,	8829,	3541,	3256,	3169,	2905,	7425,
8,	5668,	3924,	5554,	4207,	4408,	4394,	6044,	3668,	1500,	1216,	1596,	3279,
9,	794,	3851,	2400,	2854,	2075,	2293,	1713,	1952,	1351,	548,	701,	1347,
+gp,	562,	1276,	2622,	2909,	1601,	1371,	1201,	677,	548,	627,	707,	
TOTAL,	167443,	178014,	161713,	144944,	135520,	128564,	112409,	94456,	77314,	72102,	47281,	

Table 2.17

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	879,	745,	356,	367,	405,	431,	412,
3,	3216,	4275,	3639,	1528,	1794,	1986,	2114,
4,	9460,	9778,	12296,	11029,	4801,	5459,	6252,
5,	13892,	12729,	13079,	14940,	14783,	6543,	8489,
6,	10241,	11971,	9646,	9932,	9875,	13582,	6374,
7,	6613,	5467,	6338,	5074,	6414,	4606,	9453,
8,	3449,	1578,	2197,	2277,	2208,	1640,	1733,
9,	1587,	1017,	722,	744,	942,	581,	554,
+gp,	1191,	613,	847,	350,	621,	209,	285,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	587,	492,	303,	247,	0,	0,	0,	443,	177,	218,
3,	2025,	2878,	2415,	1489,	199,	784,	1748,	3349,	529,	856,
4,	6847,	6501,	9280,	7829,	3961,	3712,	5585,	5185,	3303,	3177,
5,	9903,	10802,	9465,	14755,	11833,	7891,	4689,	6846,	5566,	5270,
6,	9346,	9885,	10114,	9860,	13910,	12735,	5378,	4801,	4508,	4680,
7,	5479,	7861,	7510,	7984,	7633,	11022,	8564,	3080,	2507,	2789,
8,	5385,	3728,	5276,	3997,	3791,	4350,	6044,	3264,	1500,	1155,
9,	794,	3851,	2400,	2854,	2075,	2293,	1713,	1952,	1351,	548,
+gp,	562,	1276,	2622,	2909,	1601,	1371,	1201,	677,	548,	627,

Table 2.18

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	28234,	23921,	11441,	11785,	13016,	13828,	13238,
3,	40641,	54009,	45977,	19310,	22669,	25087,	26710,
4,	58304,	60260,	75778,	67968,	29589,	33640,	38532,
5,	60597,	55516,	57042,	65159,	64478,	28537,	37028,
6,	40033,	46789,	37703,	38820,	38597,	53084,	24916,
7,	35490,	29338,	34010,	27230,	34417,	24713,	50733,
8,	24275,	11103,	15460,	16023,	15538,	11538,	12194,
9,	11080,	7100,	5039,	5194,	6579,	4054,	3871,
+gp,	11578,	5957,	8238,	3403,	6043,	2034,	2772,
TOTALBIO,	310230,	293994,	290689,	254892,	230926,	196515,	209995,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	18854,	15798,	9732,	7913,	12806,	9300,	6898,	8172,	5722,	7946,
3,	25593,	36358,	30511,	18814,	15728,	18932,	19903,	19555,	14830,	11547,
4,	42208,	40064,	57184,	48249,	30203,	22166,	26275,	29954,	26351,	20571,
5,	43203,	47113,	41278,	64352,	55950,	28932,	19729,	26996,	27735,	27304,
6,	36538,	38639,	39527,	38538,	59821,	43749,	19932,	18983,	19818,	19817,
7,	29411,	42185,	40294,	42839,	41898,	56574,	39086,	15168,	14783,	13791,
8,	37901,	26237,	37125,	28124,	30769,	29373,	38730,	20464,	9870,	7542,
9,	5542,	26880,	16754,	19921,	14023,	15894,	13376,	16114,	12772,	4676,
+gp,	5470,	12403,	25496,	28284,	15843,	13332,	13006,	8367,	7078,	7568,
TOTALBIO,	244720,	285677,	297900,	297035,	277042,	238252,	196935,	163773,	138960,	120762,

Table 2.19

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE							
2,	282,	239,	114,	118,	130,	138,	132,
3,	2438,	3241,	2759,	1159,	1360,	1505,	1603,
4,	13993,	14462,	18187,	16312,	7101,	8074,	9248,
5,	29693,	27203,	27951,	31928,	31594,	13983,	18144,
6,	28823,	33688,	27146,	27950,	27790,	38220,	17940,
7,	31231,	25818,	29929,	23962,	30287,	21748,	44645,
8,	23061,	10548,	14687,	15221,	14761,	10962,	11584,
9,	11080,	7100,	5039,	5194,	6579,	4054,	3871,
+gp,	11578,	5957,	8238,	3403,	6043,	2034,	2772,
TOTSPBIO,	152180,	128256,	134050,	125248,	125645,	100718,	109939,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	189,	158,	97,	79,	0,	0,	0,	163,	57,	79,
3,	1536,	2181,	1831,	1129,	157,	568,	1194,	2933,	445,	693,
4,	10130,	9615,	13724,	11580,	6041,	5320,	7620,	7489,	5534,	4937,
5,	21170,	23086,	20226,	31532,	26297,	16202,	8878,	14308,	12204,	13379,
6,	26308,	27820,	28459,	27747,	40080,	34999,	15148,	14047,	12882,	14268,
7,	25881,	37123,	35458,	37699,	35613,	52048,	37914,	13196,	11383,	12136,
8,	36006,	24925,	35269,	26718,	26461,	29080,	38730,	18213,	9870,	7165,
9,	5542,	26880,	16754,	19921,	14023,	15894,	13376,	16114,	12772,	4676,
+gp,	5470,	12403,	25496,	28284,	15843,	13332,	13006,	8367,	7078,	7568,
TOTSPBIO,	132231,	164191,	177315,	184690,	164516,	167442,	135866,	94830,	72224,	64902,

Table 2.20

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 4- 7,
1984,	87941,	310230,	152180,	74824,	.4917,	1.0002,	.6221,
1985,	74518,	293994,	128256,	75451,	.5883,	1.0000,	.5275,
1986,	35638,	290689,	134050,	68905,	.5140,	1.0001,	.5806,
1987,	36712,	254892,	125248,	60972,	.4868,	1.0001,	.4916,
1988,	40546,	230926,	125645,	59294,	.4719,	1.0001,	.6194,
1989,	43078,	196515,	100718,	40285,	.4000,	1.0000,	.3751,
1990,	41234,	209995,	109939,	28127,	.2558,	1.0002,	.1834,
1991,	58718,	244720,	132231,	24822,	.1877,	1.0003,	.1700,
1992,	49210,	285677,	164191,	41690,	.2539,	1.0001,	.2349,
1993,	30321,	297900,	177315,	52557,	.2964,	1.0000,	.2346,
1994,	24650,	297035,	184690,	54562,	.2954,	1.0000,	.2437,
1995,	32832,	277042,	164516,	57207,	.3477,	1.0001,	.3159,
1996,	36901,	238252,	167442,	61776,	.3689,	1.0001,	.3894,
1997,	28735,	196935,	135866,	63319,	.4660,	1.0003,	.4110,
1998,	22147,	163773,	94830,	51572,	.5438,	.9919,	.4662,
1999,	17713,	138960,	72224,	40732,	.5640,	1.0002,	.5035,
2000,	21773,	120762,	64902,	36715,	.5657,	.9999,	.4882,
Arith. Mean ,	40157,	238135,	131426,	52518,	.4175		.4034,
Units ,	(housands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 2.21

Prediction with management option table: Input data

Year: 2001								
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	20544	0.2000	0.0100	0.0000	0.0000	365	0.0350	453
3	17682	0.2000	0.0600	0.0000	0.0000	809	0.1373	1146
4	10807	0.2000	0.2400	0.0000	0.0000	1554	0.2457	1808
5	7523	0.2000	0.4900	0.0000	0.0000	2539	0.4236	2336
6	5360	0.2000	0.7200	0.0000	0.0000	3049	0.5708	3219
7	2905	0.2000	0.8800	0.0000	0.0000	4352	0.7739	4166
8	1596	0.2000	0.9500	0.0000	0.0000	6203	0.9245	5311
9	701	0.2000	1.0000	0.0000	0.0000	8527	1.0102	6243
10+	707	0.2000	1.0000	0.0000	0.0000	12066	1.0102	7337
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 2002								
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	20544	0.2000	0.0100	0.0000	0.0000	365	0.0350	453
3		0.2000	0.0600	0.0000	0.0000	809	0.1373	1146
4		0.2000	0.2400	0.0000	0.0000	1554	0.2457	1808
5		0.2000	0.4900	0.0000	0.0000	2539	0.4236	2336
6		0.2000	0.7200	0.0000	0.0000	3049	0.5708	3219
7		0.2000	0.8800	0.0000	0.0000	4352	0.7739	4166
8		0.2000	0.9500	0.0000	0.0000	6203	0.9245	5311
9		0.2000	1.0000	0.0000	0.0000	8527	1.0102	6243
10+		0.2000	1.0000	0.0000	0.0000	12066	1.0102	7337
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 2003								
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	20544	0.2000	0.0100	0.0000	0.0000	365	0.0350	453
3		0.2000	0.0600	0.0000	0.0000	809	0.1373	1146
4		0.2000	0.2400	0.0000	0.0000	1554	0.2457	1808
5		0.2000	0.4900	0.0000	0.0000	2539	0.4236	2336
6		0.2000	0.7200	0.0000	0.0000	3049	0.5708	3219
7		0.2000	0.8800	0.0000	0.0000	4352	0.7739	4166
8		0.2000	0.9500	0.0000	0.0000	6203	0.9245	5311
9		0.2000	1.0000	0.0000	0.0000	8527	1.0102	6243
10+		0.2000	1.0000	0.0000	0.0000	12066	1.0102	7337
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : MANNCC07
Date and time: 27APR01:11:03

Table 2.22 Prediction with management option table

Year: 2001					Year: 2002					Year: 2003	
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
0.9602	0.4835	111092	61129	34183	0,0000	0.0000	98537	49533	0	130643	73967
.	.	.	.	.	0,0500	0.0252	.	49533	1934	128059	71853
.	.	.	.	.	0,1000	0.0504	.	49533	3812	125557	69815
.	.	.	.	.	0,1500	0.0755	.	49533	5633	123134	67848
.	.	.	.	.	0,2000	0.1007	.	49533	7402	120787	65950
.	.	.	.	.	0,2500	0.1259	.	49533	9119	118513	64119
.	.	.	.	.	0,3000	0.1511	.	49533	10787	116310	62351
.	.	.	.	.	0,3500	0.1762	.	49533	12408	114175	60645
.	.	.	.	.	0,4000	0.2014	.	49533	13982	112105	58998
.	.	.	.	.	0,4500	0.2266	.	49533	15511	110098	57407
.	.	.	.	.	0,5000	0.2517	.	49533	16998	108151	55870
.	.	.	.	.	0,5500	0.2769	.	49533	18444	106263	54386
.	.	.	.	.	0,6000	0.3021	.	49533	19850	104431	52953
.	.	.	.	.	0,6500	0.3273	.	49533	21217	102653	51567
.	.	.	.	.	0,7000	0.3525	.	49533	22547	100927	50228
.	.	.	.	.	0,7500	0.3776	.	49533	23841	99251	48934
.	.	.	.	.	0,8000	0.4028	.	49533	25100	97624	47683
.	.	.	.	.	0,8500	0.4280	.	49533	26326	96044	46473
.	.	.	.	.	0,9000	0.4532	.	49533	27520	94508	45302
.	.	.	.	.	0,9500	0.4783	.	49533	28683	93016	44170
.	.	.	.	.	1,0000	0.5035	.	49533	29815	91566	43075
.	.	.	.	.	1,0500	0.5287	.	49533	30918	90157	42015
.	.	.	.	.	1,1000	0.5539	.	49533	31992	88786	40990
.	.	.	.	.	1,1500	0.5790	.	49533	33040	87453	39997
.	.	.	.	.	1,2000	0.6042	.	49533	34061	86156	39036
.	.	.	.	.	1,2500	0.6294	.	49533	35057	84894	38105
.	.	.	.	.	1,3000	0.6546	.	49533	36027	83666	37204
.	.	.	.	.	1,3500	0.6797	.	49533	36974	82471	36331
.	.	.	.	.	1,4000	0.7049	.	49533	37898	81307	35485
.	.	.	.	.	1,4500	0.7301	.	49533	38800	80174	34665
.	.	.	.	.	1,5000	0.7553	.	49533	39680	79070	33871
.	.	.	.	.	1,5500	0.7804	.	49533	40538	77994	33100
.	.	.	.	.	1,6000	0.8056	.	49533	41377	76946	32354
.	.	.	.	.	1,6500	0.8308	.	49533	42196	75925	31630
.	.	.	.	.	1,7000	0.8560	.	49533	42996	74929	30927
.	.	.	.	.	1,7500	0.8811	.	49533	43777	73959	30246
.	.	.	.	.	1,8000	0.9063	.	49533	44541	73012	29585
.	.	.	.	.	1,8500	0.9315	.	49533	45287	72088	28943
.	.	.	.	.	1,9000	0.9567	.	49533	46016	71187	28321
.	.	.	.	.	1,9500	0.9818	.	49533	46729	70308	27716
.	.	.	.	.	2,0000	1.0070	.	49533	47426	69450	27130
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANNCC07
Date and time : 27APR01:11:03
Computation of ref. F: Simple mean, age 4 - 7
Basis for 2001 : TAC constraints

Table 2.23 Catch options for 2002 with corresponding total stock biomasses and spawning stock biomasses in 2003.

F	Basis	Catch 2002 (t)	Total stock biomass 2003 (t)	SSB 2003 (t)
0,01	SSB 2003 = SSB 1999	1,000	129,000	72,000
0,10	SSB 2003 = SSB 2000	7,400	121,000	65,000
0,17	SSB 2003 = SSB 2001	12,000	114,000	61,000
0,35	SSB 2003 = SSB 2002	23,000	101,000	50,000
0.49	$F_{status\ quo}$	30,000	92,000	43,000

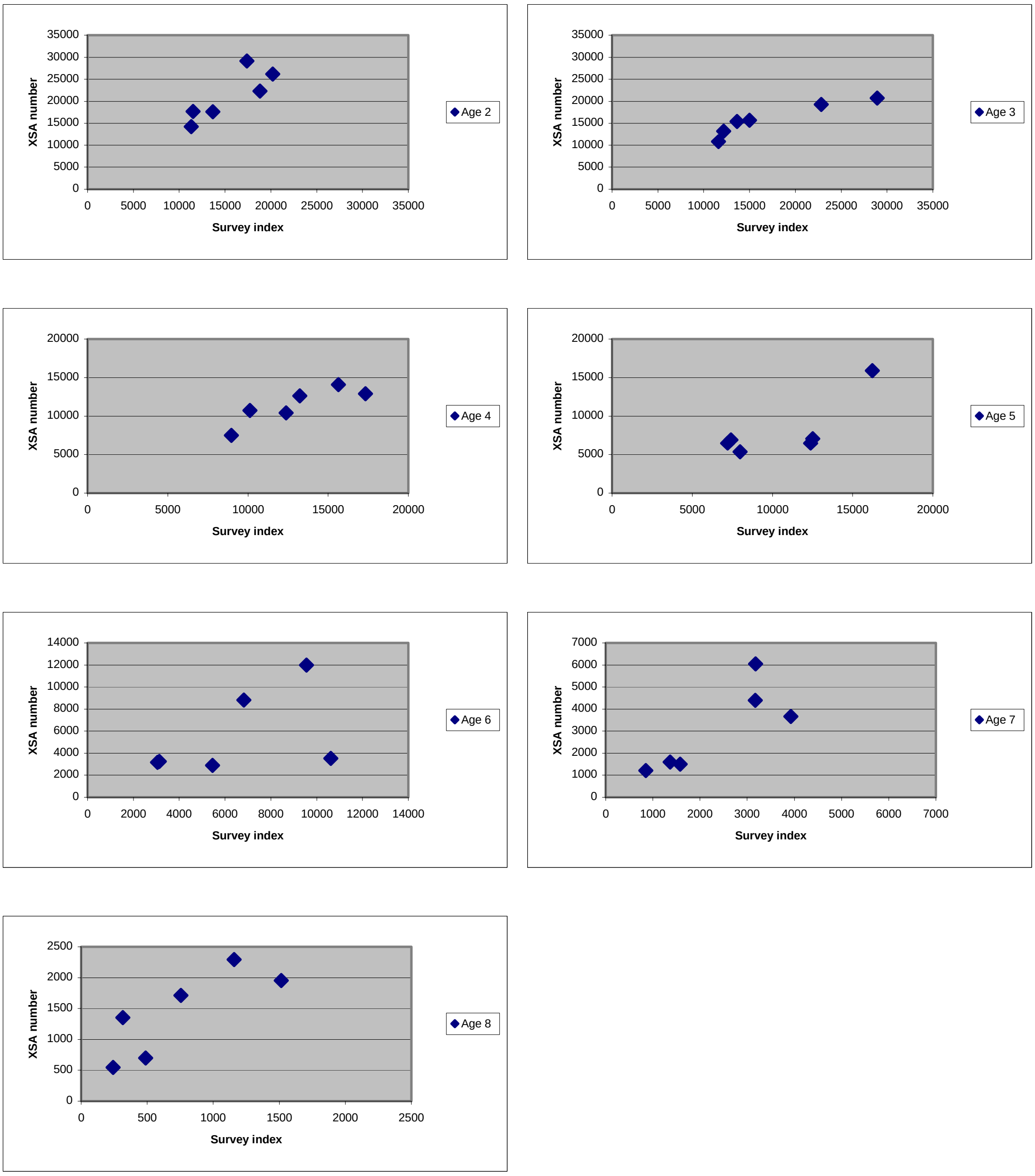

Figure 2.1 Norwegian Coastal cod – Coastal acoustic survey vs XSA. Age (n) in survey = age (n+1) in from XSA the year after because the surveys are conducted late autumn.

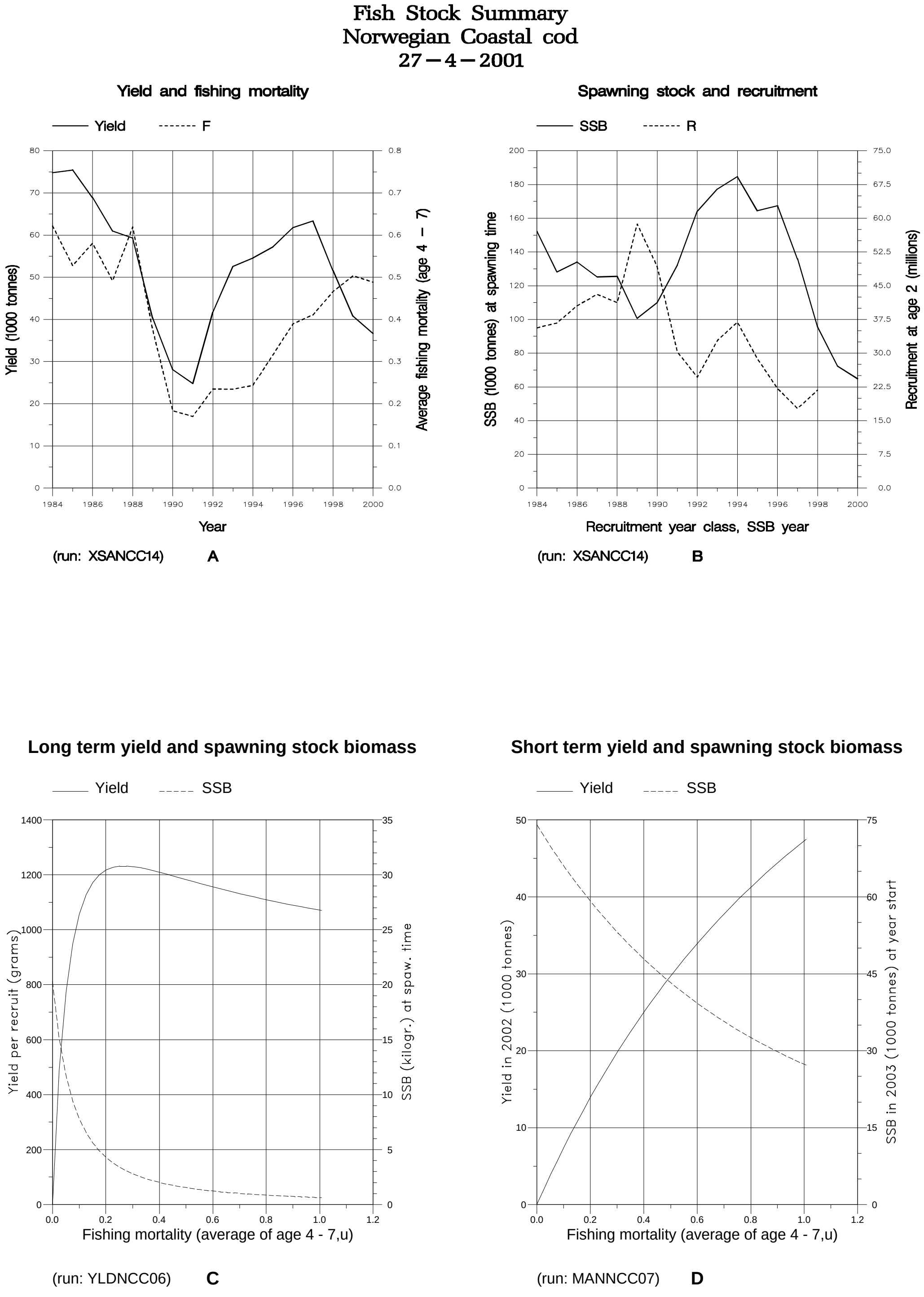

Figure 2.2 Norwegian Coastal cod: Historical yield and fishing mortality (A). Spawning stock biomass and recruitment (B). Long term yield pr recruit and spawning stock biomass pr recruit (C). Short term yield and spawning stock biomass (D).

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 414,000 t in 2000. 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 2001 (Tables 3.1-3.3, Figure 3.1A)

Final reported landings for 1999 amount to 484,910 t (Table 3.1), excluding 23,397 t of Norwegian coastal cod. The provisional figures for 2000 are 414,144 t, excluding 19,106 t of Norwegian coastal cod. This is 24,144 t higher than the catch assumed by the Working Group last year (390,000 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 1999 to 2000, catches decreased in all areas (Table 3.1).

3.1.3 Expected landings in 2001

The mixed Norwegian-Russian fisheries commission agreed on a TAC for North-east Arctic cod and Norwegian coastal cod combined of 435,000 t for 2001. Of this, 40,000 t is assumed to be Norwegian coastal cod. Since similar quotas for 2000 gave a catch of 19,000 t of coastal cod and 414,000 t of North East Arctic cod, it is expected that the catch of North East Arctic cod in 2001 will be 415,000 t.

The Working Group has no information on the size of expected unreported landings in 2001 but believes this could continue to be a problem.

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.

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: 1998 and 2000 are below average and 1999 is weak. Regarding the fishable stock, the abundance of age groups 5 and 6 had increased in 2001 compared to 2000, while the abundance of older fish has declined further.

Joint Barents Sea winter survey (bottom trawl and acoustics)

The preliminary swept area estimates and acoustic estimates from the Joint winter survey on demersal fish in the Barents Sea in winter 2001 are given in Tables A2 and A3. Both the swept area estimates and the acoustic estimates show decreased abundance of ages 1, 2 and 3 and some increase for ages 4-7. The estimates of older fish show a considerable decrease.

Before 2000 this survey was made without participation from Russian vessels, while in the two latest surveys Russian vessels have covered important parts of the Russian zone. 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). There was a high proportion of first time spawners in the survey, and 6 year olds represents more than 50% of the 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, 1998 and 2000 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. The results for the Svalbard area (Division IIb) have been used earlier in the XSA tuning but have been left out in the two latest assessments.

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 to the results of the joint survey in winter 2001. The time series was revised at the last WG meeting (Gusev and Yaragina WD 35 at AFWG 2000).

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 been low in the three latest years. 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 (see Section 1.8).

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 2000 Russian survey and the winter 2001 joint Norwegian –Russian survey were in general agreement with each other.

The joint winter survey in 2001 shows some increase in weights for most ages (Table A7). The Russian autumn survey shows a small decrease or the same level of the weight of fish at all ages (Table A13).

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 1985-2001, 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).

As in previous assessments, Russian ogives were used for 1984, Norwegian ogives were used for 1982-1983. New data were available for the historical period prior to 1982 (See Chapter 10).

3.3 Data used in the assessment

3.3.1 Catch at age (Table 3.7 and 3.8)

For 2000, 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 by Spanish trawl (Divisions IIa and 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.

3.3.2 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 2000, 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.

Stock weights

Stock weights at age a (W_a) at the start of year y for 1983-2001 (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)

3.3.3 Natural mortality

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

3.3.4 Maturity at age (Tables 3.5 and 3.11)

As noted in Section 3.2.5, arithmetic averages of the Russian and Norwegian maturity at age values were used for 1985-2001.

3.3.5 Tuning data (Table 3.12)

As in the 2000 assessment the following surveys and commercial CPUE data series was used in the tuning:

Name	Place	Season	Age	Years
Russian bottom trawl	Total area	Autumn	1-8	1982-2000
Norwegian trawl fleet	Total area	All year	9-14	1985-2000
Russian trawl fleet	Total area	All year	9-14	1985-2000
Norwegian bottom trawl	Barents Sea	Winter	1-8	1981-2001
Norwegian acoustic	Barents Sea + Lofoten	Winter	1-11	1985-2001

As in last years' 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.

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 2001 could be included in the assessment. Some of the survey indices have been multiplied by a factor 10. 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 10 and older (last year used age 11 and older)
3. F of the 2 oldest age groups used in F shrinkage
4. Standard error of the mean to which estimates are shrunk set to 1.0
5. Tapered time weighting power 3 over 10 years

3.3.6 Recruitment indices (Table 3.6)

At the last AFWG meeting it was decided that survey estimates of ages 1 and 2 should not be used in the XSA-tuning, since the noise in those values, together with the noise in cannibalism, is carried over to the XSA-estimates of older ages. Those survey data, not used in the XSA, is therefore used to estimate the year-class strength at age 3 by making regressions with VPA estimates of recruitment at age 3 (the RCT-program in the ICES software). The input is shown in Table 3.6a, and the output is shown in Table 3.6b (shrunk towards the VPA-mean) and 3.6c (not shrunk towards the mean). Since all survey indices indicated the year-classes 1998, 1999 and 2000 to be below average, the results without shrinkage towards mean were considered to be best. The 0-group index was removed from the input because it got a very low weight in the regression.

3.3.7 Predation and cannibalism

The method used for calculation of the consumption is described by Bogstad and Mehl (1997). The estimates 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 2000 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 3.4.2). It was assumed that the mature part of the cod stock is found outside the Barents Sea for three months during the first half of the year. There were very few samples of the stomach contents of cod in the spawning areas. Thus, consumption by cod in the spawning period was omitted from the calculations. It is believed that the cod generally eats very little during spawning, although some predation by cod on herring has been observed close to the spawning areas. The geographical distribution of the cod stock by season is based on Norwegian survey data.

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

	Age						
Year	0	1	2	3	4	5	6
1984	0	412	21	0	0	0	0
1985	1498	371	66	0	0	0	0
1986	53	408	385	97	0	0	0
1987	674	180	277	14	0	0	0
1988	29	407	22	2	0	0	0
1989	910	143	0	0	0	0	0
1990	0	61	28	0	0	0	0
1991	122	151	214	2	0	0	0
1992	4248	1016	153	4	0	0	0
1993	3782	20033	506	52	1	0	0
1994	8271	6870	641	131	53	8	0
1995	8255	15249	758	251	86	3	0
1996	9783	21514	1499	142	56	20	1
1997	2948	15790	1916	176	17	1	0
1998	75	4825	600	245	35	3	1
1999	556	1865	371	74	4	0	0
2000	1728	2304	171	32	23	6	0

The consumption by cod of various prey species is shown in Table A16. The consumption of capelin in 2000 was similar to 1999. The estimated consumption of cod by cod in 2000 indicates that the decreasing trend over the two previous years has levelled off.

3.3.8 Prediction data (Table 3.23, Figure 3.4)

The input data to the short-term prediction with management option table (2001-2003) are given in Table 3.23. For 2001 stock weights and maturity were taken from surveys as described in Sections 3.3.2 and 3.3.4. It is assumed that the weights remain stable in the near future.

Stock weights and maturity in 2002 and later years were set equal to the 1999-2001 average, while catch weights and exploitation pattern in 2001 and later years were set equal to the 1998-2000 average.

The stock number at age in 2001 was taken from the final VPA (Table 3.18) for ages 4 and older. The recruitment at age 3 in year 2001 and later was estimated from surveys (section 3.3.6). The natural mortality due to cannibalism, $M_2(a,y)$ was predicted by the following model:

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

Where $M_2(a,y)$ is the mortality of fish in year y of age a; $l(a,y)$ 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). Work has been started to improve this model (Bogstad, WD 15).

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

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

The following parameter values were obtained: α=0.0518, β= 0.0000112, δ=0.20148, γ=3.278, κ=0.5653. These values were used to predict the natural mortality at age 2 and 3 due to cannibalism in 2001. The biomass of cod by age was taken from the prediction, while the length at age in 2002 was set equal to the value for 2001. The model given above predicted the natural mortality due to cannibalism in 2001 and later years.

Figure 3.2 shows the development in natural mortality of ages 1, 2 and 3 due as predicted by the model above and the abundance of capelin in the period 1984-2001. The predicted abundance of capelin in 2001 was taken from Working Document 6.

3.4 Methods used in the assessment

3.4.1 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 Quality Control Diagrams and in retrospective analysis. In the years 1997-1999 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, and at the previous assessment meeting (August 2000) the following changes were made:

The oldest true age group was reduced from 14 to 12.

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)

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.

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.

The only change in the present assessment compared to last year (described above) was that catchability was set independent of age for age 10 and older. The reason was that the diagnostics from using last years setting (age 11 and older) did not give any support for a significant difference in catchability for those age groups. This change lead to slightly faster convergence, while the results only differed in the forth digit of the estimated fishing mortalities. Comments in the ACFM-minutes regarding high catchabilities for ages 6-8 in the Russian survey in 1994 was considered and a separate run excluding those ages for that year was run. This improved the correlation coefficient for those age groups in this fleet, but did not change the tuning results.

3.4.2 Including cannibalism in the VPA (Tables 3.13-3.16)

As a starting point the number of cod consumed by cod were estimated from the stock estimates in the last assessment. Then the number consumed was added to the catches used for tuning. The resulting stock then lead to a new estimate of consumption. This procedure was repeated until the revision of consumed numbers differed less than 1% for the latest year.

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.

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 1984-2000 are given in the text tables below.

Year	M2 age 1	M2 age 2	M2 age 3	M2 age 4	M2 age 5	M2 age 6
1984	0.2435	0.0351	0.0006	0.0000	0.0000	0.0000
1985	0.3582	0.0555	0.0004	0.0000	0.0000	0.0000
1986	0.5067	0.7905	0.1101	0.0000	0.0000	0.0000
1987	0.5206	0.7947	0.0575	0.0000	0.0000	0.0000
1988	0.7998	0.1086	0.0086	0.0000	0.0000	0.0000
1989	0.2148	0.0011	0.0000	0.0000	0.0000	0.0000
1990	0.0481	0.0587	0.0000	0.0000	0.0000	0.0000
1991	0.1022	0.2353	0.0050	0.0000	0.0000	0.0000
1992	0.4624	0.1425	0.0067	0.0000	0.0000	0.0000
1993	2.5574	0.4429	0.0660	0.0029	0.0025	0.0000
1994	1.7127	0.6255	0.1950	0.0948	0.0258	0.0047
1995	1.8623	0.9474	0.5422	0.1998	0.0082	0.0001
1996	1.9609	1.0591	0.4564	0.2321	0.0802	0.0060
1997	2.4448	1.0916	0.3196	0.0986	0.0104	0.0019
1998	1.5776	0.6714	0.3806	0.1108	0.0292	0.0177
1999	1.0458	0.4484	0.1577	0.0118	0.0000	0.0000
2000	0.9897	0.2312	0.0609	0.0700	0.0262	0.0005

Year	F age 1	F age 2	F age 3	F age 4	F age 5	F age 6
1984	0.0000	0.0017	0.0192	0.1236	0.3075	0.6275
1985	0.0001	0.0015	0.0528	0.1700	0.3767	0.6051
1986	0.0001	0.0018	0.0329	0.2121	0.4926	0.7067
1987	0.0000	0.0011	0.0553	0.2284	0.5094	0.9334
1988	0.0000	0.0009	0.0543	0.1269	0.3702	0.5966
1989	0.0000	0.0009	0.0327	0.1284	0.2658	0.4014
1990	0.0000	0.0004	0.0086	0.0622	0.1342	0.2308
1991	0.0000	0.0007	0.0133	0.0625	0.1875	0.3210
1992	0.0004	0.0011	0.0337	0.1265	0.2206	0.4430
1993	0.0000	0.0006	0.0129	0.0934	0.3442	0.4599
1994	0.0000	0.0003	0.0097	0.1061	0.3136	0.6410
1995	0.0000	0.0003	0.0105	0.0994	0.3279	0.5762
1996	0.0000	0.0006	0.0245	0.1201	0.3262	0.5379
1997	0.0000	0.0007	0.0233	0.2137	0.5577	0.7054
1998	0.0000	0.0018	0.0495	0.2842	0.5388	0.7713
1999	0.0000	0.0004	0.0159	0.2049	0.5881	0.8287
2000	0.0000	0.0003	0.0092	0.1004	0.4135	0.6907

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. For comparison with the historic time series an additional VPA with the same terminal Fs and fixed natural mortality (0.2) is presented (Table 3.22).

3.5 Results of the assessment

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

The average age 5-10 fishing mortalities ($F_{5\text{-}10}$) for the years 1981-1989 were in the range 0.66 to 0.98 (Table 3.21). The lowest value occurred during 1989 and the highest in 1988. In 1990, fishing mortality dropped to 0.32 mainly as a result of management measures brought into effect to control the amount of fishing effort. $F_{5\text{-}10}$ then increased, reaching 1.04 in 1997 before dropping to 0.92 in 1998. The estimated for $F_{5\text{-}10}$ in 2000 is higher than predicted last year (0.91 vs. 0.64), and the spawning stock biomass in 2000 is estimated to be 222,000 t, compared to 249,000 t in last year's ACFM assessment.

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.

For the historic time series (prior to 1982) improved data on maturity and weights at age were applied (see Chapter 10). This lead to considerable changes to the historic estimates of stock biomass, particularly the spawning stock. The new weights were considered as the best available estimates of weight at age in stock. Therefore, sum of product corrections (based on discrepancies between landings and weights at age in catch) should not be applied to the stock biomass.

3.5.2 Recruitment (Table 3.6A-C)

From the RCT –calculations the estimated number (millions) of recruits at age 3 is 474 for the 1998 year-class, 140 for the 1999 year-class and 315 for the 2000 year-class.

3.6 Reference points

The revisions of the historic time series make it necessary to re-examine the reference points.

3.6.1 Biomass reference points (Figure 3.3)

Revised historic data have lead to proposed new values of $\mathbf{B}_{lim}$ of 140,000 t and $\mathbf{B}_{pa}$ of 375,000 t (See Chapter 10.) The stock-recruitment plot with cannibalism included is given in Fig. 3.3 and a plot without cannibalism included in Fig. 10.13.

3.6.2 Fishing mortality reference points

At the 1998 WG meeting, the following values were estimated for the fishing mortality references points $\mathbf{F}_{0.1}$ = 0.13, $\mathbf{F}_{max}$ = 0.24, $\mathbf{F}_{low}$ =0.27, $\mathbf{F}_{med}$ =0.46 and $\mathbf{F}_{high}$ = 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 $\mathbf{F}_{lim}$=$\mathbf{F}_{med}$ for Northeast Arctic cod, haddock and saithe. A precautionary fishing mortality ($\mathbf{F}_{pa}$) is then defined as $\mathbf{F}_{pa}$=Flime$^{-1.645\sigma}$ (σ = 0.2-0.3). The 1998 WG, however, found that setting $\mathbf{F}_{lim}$=$\mathbf{F}_{med}$ did not correspond very well with the exploitation history for cod. The median value for $\mathbf{F}_{loss}$ was estimated at 0.70, and the 5th percentile of this value was adopted as a precautionary reference fishing mortality ($\mathbf{F}_{pa}$=0.42) by the WG in 1998. Since 1998 ACFM has used $\mathbf{F}_{lim}$=$\mathbf{F}_{loss}$=0.70 and $\mathbf{F}_{pa}$ =0.42. This value of $\mathbf{F}_{pa}$ corresponds both to the upper 5 percentile of $\mathbf{F}_{loss}$ and to σ = 0.3 in the equation above.

With the revisions of the time series, the F reference points relating to the stock-recruitment –plot needs to be reconsidered. The combination of different sources of new historic data and evaluating biomass reference points (Chapter 10) did not leave much time for evaluating the F reference points. Some calculations from the PA-Soft programme (with the same settings as used by the 1998 working group) are presented in Table 3.27. The calculations revealed that the results are rather sensitive to the number of years used for averaging exploitation pattern, maturity, natural mortality and weights at age. This sensitivity was also illustrated in a Working Document (WD 8). Averaging over the last 5 years gave values of $\mathbf{F}_{loss}$ fairly close to those obtained at the 1998 WG. On this basis, the former $\mathbf{F}_{pa}$ of 0.42 is considered to be sufficiently precautionary, and is used until the subject is further explored.

Values of $\mathbf{F}_{0.1}$ and $\mathbf{F}_{max}$ estimated at the present meeting are shown in Tables 3.26 and 3.27. Averaging input data over the 3 recent years gives $\mathbf{F}_{0.1}$ = 0.11 and the one for $\mathbf{F}_{max}$ = 0.22 (Table 3.26), while averaging input over the 5 recent years gives $\mathbf{F}_{0.1}$ = 0.12 and $\mathbf{F}_{max}$ = 0.24 (Table 3.27).

3.7 Catch options (Table 3.24)

The management option table (Table 3.24) assumes a TAC constraint of 415,000 t in 2001 (see section 3.1.3). The corresponding $F_{5\text{-}10}$ in 2001 is 0.66. Fishing at $\mathbf{F}_{pa}$ (0.42) in 2002 gives a catch of 332,000 t and a spawning stock in 2003 of 502,000 t, which is above the new proposed $\mathbf{B}_{pa}$ (375,000t) and close to the old $\mathbf{B}_{pa}$. Fishing at $F_{status\ quo}$ in 2002 will cause the spawning stock to remain below the new proposed $\mathbf{B}_{pa}$, but above $\mathbf{B}_{lim}$.

In Figure 3.1D the catch level in 2002 and spawning stock biomass level in 2003 are plotted against the fishing mortality in 2002.

3.8 Medium-term forecasts and management scenarios

3.8.1 Input data (Table 3.23)

The input data were the same as used for the short-term predictions, using the same data for the years after 2002 as for 2002 (Table 3.23).

3.8.2 Methods

It was decided to limit the risk analysis for North-east Arctic cod to a single-species analysis, where only uncertainty in the initial stock estimate and the recruitment is taken into account. The simulation period was 2001-2006.

The uncertainty of the stock estimate in 2001 and later years was modelled 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. 2000 simulations were performed for each harvest control rule.

3.8.3 Results

The text table below shows some of the results of the short-term prediction and the risk analysis.

F	Basis	Landings 2002	SSB 2003	P (SSB< $\mathbf{B}_{pa}$) in 2006
0.24	$\mathbf{F}_{max}$	200	585	<5%
0.42	$\mathbf{F}_{pa}$	332	502	<5%
0.44	5 % probability of SSB < $\mathbf{B}_{pa}$ in 2006	347	495	5%
0.51	Agreed TAC 2002*	395	466	16%
0.55	Agreed TAC 2002**	415	453	26%
0.58	Agreed TAC 2002***	435	442	36%
0.66	F_{2001}	483	411	58%
0.91	F_{2000}	611	338	94%

*assuming 40 000 t of the total quota taken as Norwegian coastal cod
**assuming 20 000 t of the total quota taken as Norwegian coastal cod
***assuming 0t of the total quota taken as Norwegian coastal cod

3.8.4 Management considerations

The spawning stock in 2001 is well below the new proposed $\mathbf{B}_{pa}$, but above $\mathbf{B}_{lim}$. The fishing mortality has been above $\mathbf{F}_{lim}$ throughout the 7 latest years. The F in 2001 induced by the agreed TAC should result in a large reduction in F from

2000 to 2001, but the resulting SSB in 2002 will still be below $\mathbf{B}_{pa}$. 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.

It is 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. The experience that the realized fishing mortality has tended to be well above the level which is assumed when TACs are decided is a strong reason for caution when setting quotas.

The assumed catch in 2001 of 415,000 tonnes, corresponds to a fishing mortality of 0.66. This is well above $\mathbf{F}_{pa}$. The (provisional) agreed TAC for 2002 also corresponds to F higher than $\mathbf{F}_{pa}$, while the resulting SSB in 2003 will be above the new proposed $\mathbf{B}_{pa}$.

3.9 Comments to the assessment (Figures 3.4-3.9).

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 3.4-3.6) there are indications that the assessments have improved

in the recent years. It should however be noticed that this year's assessment show a considerable upward revision of the F in 2000, compared to the one predicted last year. It should be noted that the high F(5-10) for 2000 is mainly caused by high Fs for ages 7 to 10, which are of low abundance and could thus be subject to poor sampling. For ages 5 and 6, which contributed most to the catch, the Fs are significantly reduced from 1999 to 2000.

Last year the Working Group was seriously concerned about possible discarding and under-reporting (Section 1.7, in the ACFM CM 2001/ACFM:02). The Working Group expresses serious concerns that mis-reporting and discarding of similar magnitude still continues (section 1.7). 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 quotas. It also calls for an evaluation of the current management and catch control systems.

The temperature prognosis given in Section 1.4 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) indicates that strong year classes of cod and haddock occur in warm years (WD 12). Models for predicting recruitment which integrate abundance indices for pre-recruit fish with ecological and environmental data should be developed (Bogstad, WD 11, August 2000).

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.

3.10 Alternative assessment methods (Fleksibest)

3.10.1 Background

There have been large problems with the assessment of Northeast Arctic cod in the recent years. One of the reasons 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.

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 the 1999 report. In the 2000 report an assessment (not including prediction) with Fleksibest was presented. This year a complete assessment including a medium-term prediction is presented for comparison with the XSA assessment.

3.10.2 Model description

A complete description of the mathematical formulations used in Fleksibest is given in Frøysa *et al*. (2001). 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 is an extension of 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:

A population model, which describes the numbers at age and length in the stock, and the associated mortalities, over time.

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.

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.

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.

In Fleksibest, both the population and the catches (for each fleet) are modelled, and compared to observations. This will allow for taking the uncertainty in both data sources into account.

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

3.10.3 Stock assessment using Fleksibest

3.10.3.1 Time period

A quarterly time step is used. The model is run for the period 1.quarter 1985- 1.quarter 2001. 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 1985 with terminal Fs set to give the same stock abundance in the start of 1985 as obtained by Fleksibest.

3.10.3.2 Model stock, length and age structure

The cod stock is divided into an immature (ages 3-10, lengths 20-105 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 survey and catch data files.

3.10.3.3 Data used

Survey data

The same surveys as in last year’s assessment were used, but some age and length groups with few or very noisy observations have been deleted from some surveys. The table below shows the age, length and year range for the surveys used.

Survey	Quarter	Year range	Age range	Length range	Stock covered
Norwegian winter bottom trawl	1	1985-1993	3-9	20-90 cm	Immature
Norwegian winter bottom trawl	1	1994-2001	3-9	20-90 cm	Immature
Norwegian winter acoustic	1	1985-1993	3-9	20-90 cm	Immature
Norwegian winter acoustic	1	1994-2001	3-9	20-90 cm	Immature
Lofoten acoustic	1	1985-1989	5-12+	55-110 cm	Mature
Lofoten acoustic	1	1990-2001	5-12+	55-110 cm	Mature
Russian bottom trawl	4	1985-1993 and 1995-2000	3-8	20-105 cm	Immature and mature
Norwegian summer bottom trawl	3	1995-2000	3-8	20-105 cm	Immature and mature

The Norwegian winter survey in the Barents Sea (bottom trawl and acoustic indices) was split into two time periods because of the change of gear and increase in area coverage in 1994 (Jakobsen *et al*., 1997). The Lofoten acoustic survey was split into two periods because of the change of echosounder in 1990 (Korsbrekke, 1997). The 1994 data from the Russian bottom trawl survey (Lepesevich and Shevelev, 1997) gave extremely high residuals and were removed. The XSA also indicates a bad fit for this survey in 1994. The Norwegian summer trawl survey in the Barents Sea is described by Aglen (1999).

Catch data

In last year's report, all the six main fleets for which we have data on catches by age and length were used separately in the assessment. This meant that a large number of parameters had to be estimated. Based on the advice from the Fleksibest workshop in 2001 (ICES, 2001/ACFM:09), it was decided to combine all the fleets into one. However, this gave a selection pattern with full recruitment to the fishery at an earlier age than generally seen in the XSA. It was thus decided to treat the gillnet fishery separately from the other fleets, as this fleet is fishing on much larger fish than the other fleets. Thus, we use catch in numbers at age and length by quarter from the following two fleets:

- Combined fleet: All fleets except gillnet (Danish seine, handline, longline, Norwegian trawl, Russian trawl)

- Gillnet

Data for 1985-2000 are used, for length groups 20-135 cm and ages 3-12+.

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 the combined fleet 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. The F values are set so that the catches taken by this fleet are approximately equal to the estimates of unreported landings used by the Working Group for those years.

Consumption data

Data on the consumption (kg/time step) of cod by cod for the period 1985-2000 calculated in the same way as in Bogstad and Mehl (1997). The data are given by predator age group and prey length group.

3.10.3.4 Model assumptions

Some trial runs with Fleksibest for the period 1. quarter 1985- 1. quarter 2000 were carried out prior to the Working Group meeting (Frøysa et al., WD 16). The model assumptions used here and the choice of weighting of the data sources are based on these trial runs, with a few modifications.

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

A linear relationship between survey indices $I(y,a,l)$ and population numbers $N(y,a,l)$ has been used in all the runs presented here.

The relation between the stock number and survey index is given as:

$$I(y,a,l) = q(y)s(l)N(y,a,l)$$

For the length selectivity there are two possible formulations:

Linear model: $s(l) = al + b$

Logistic model: $s(l) = \dfrac{1}{1+\exp(-4\alpha(l-l_{50}))}$

In the linear model a) a is the slope and b is the intercept. If $q(y)$ is equal for all years, $q(y)$ should be set to one, because $q(y)(al+b) = a'l + b'$ in this case.

In b) α is the slope at l_{50}.

The linear formulation given by a) is used for all surveys except for the Lofoten survey, which has a logistic length selection curve. The slope is close to zero in all the linear selection curves used in the assessments presented here.

Linear mean growth in length, variable by year, was assumed. The ratio between the growth rate of mature and immature fish was assumed to be the same for all years.

The maturation parameters were set to values giving approximately the same values for maturity at age as in the input to the XSA. A large discrepancy is observed for 1987, when the condition factor was very low. This could possibly be accounted for by also including the condition factor in the maturation function.

The cannibalism parameters were not estimated, but were adjusted to give approximately the same level as indicated by the XSA. Also, consumption data were downweighted in the estimations. This was done for several reasons:

1. 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.

2. The parameters used in the cannibalism model in Fleksibest are strongly correlated and the fit to the data is not very good. This could be improved as outlined in Bogstad (WD 15).

3. The consumption should be given by predator length group, not by predator age group.

4. Observations are made of stomach content, while the model uses calculated consumption as 'observations'. This may not be the correct way of utilizing the stomach content data in Fleksibest.

The values of the contribution to the objective function from catches were upweighted with a factor of 20 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'). This 'equal weighting run' is the final assessment from Fleksibest and is called the key run (Run 4).

3.10.4 Results from the assessment

The three runs presented are described in the text table below:

Run label	Catch data weighting factor	Survey data weighting factor	Surveys included
4	20	1	All
5	60	0.001	All
6	0.01	1	BT & Lof

BT is the Norwegian Barents Sea Winter Trawl survey and Lof is the Lofoten survey. For run 4, about 55% of the total contribution to the objective function comes from the catch data (Table 3.28).

Run 5 is an assessment where the information from the catches is dominant, run 6 is an assessment where the survey data (only the Norwegian Barents Sea Winter Trawl survey and the Lofoten survey) dominate.

Likelihood components, input data and parameter estimates for the key run (Run 4) are given in Table 3.28. The model values of natural mortality, maturity, stock weight, catch weights and catch in numbers by age group derived from these parameters are given in Table 3.29. This table also presents the fishing mortalities, stock numbers, stock biomass and spawning stock biomass. Results (total stock biomass, SSB, F, catches, recruitment, total stock number) of the key run are shown in Fig. 3.10a-f. The total annual catch in weight as estimated by the model is somewhat higher than the reported catches in the years 1987 and 1994-1997, but are in general in good agreement with the reported catches in tons. In general, the trends given by XSA and Fleksibest are very similar for the recruitment, the stock numbers and stock biomass. Fleksibest shows the same overall trends for $F_{5\text{-}10}$ as XSA, but the curve given by Fleksibest is smoother. One reason for this may be that Fleksibest is less vulnerable to noise in the catch data of the oldest ages due to the fixed selectivity pattern by length. Fleksibest gives high spawning biomass in the years 1992-1995, with significantly higher SSB than XSA gives in the years 1993-1995. Else the SSB trends are very similar.

The modelled and observed length at age in the stock is shown in Fig.3.11a-c. The modelled lengths seems to be somewhat lower than those observed in the Norwegian surveys.

Residual plots describing the fit between modelled and observed survey indices and between modelled and observed catch in number. The plots show the sum over age and length groups year by year and are given in Figure 3.12a-f.

3.10.4.1 Alternative runs with different weighting of data sources

The effect of a very strong upweighting of the catch data (run 5) and of the survey data (run 6) is illustrated in Figures 3.13a-f. It is seen that both runs give rather strange results in some way. A strong upweighting of the catch data gives very high estimates of the year classes 1994 and 1995 at age 3. Catches at young ages have been high for these year classes. These high estimates lead to a large increase in stock biomass after 1998 and a very large increase in SSB in the last year. Those trends are not seen in the other assessments. The catch-based assessment (run 5) has similar overall trends in $F_{5\text{-}10}$ as run 4, but shows significantly lower values after 1996. The surveys do not indicate the year classes 1994 and 1995 to be much stronger than average. But the 1983 year class is estimated as extremely strong in run 6, showing that the survey-based assessment has problems in estimating year classes with index values far outside the usual range. A strong upweighting of the survey data gives modelled catches which deviate much from the observed catches in many years. The underestimates are not believed to be reasonable, as overreporting of catches is not considered to be likely for this stock. After 1989, recruitment in run 6 is always lower than recruitment in the other runs, but run 6 shows the same overall trends in the recruitment as the other assessments.

3.10.4.2 Retrospective analysis

Results (total stock biomass, SSB, F, catches, recruitment, total stock number) of a retrospective analysis with the same settings as in the key run are shown in Figure 3.13a-f.

The runs stops in first quarter, and are labelled after the year that contains the last time step. The shortest run stops in first quarter in 1995, and is thus labelled 1995.

The Norwegian summer trawl survey has been removed in the retrospective analysis because of the short time series for this survey; this has a minor effect on the assessment. The retrospective pattern seems to be fairly consistent back to 1998. In 1994-1998 the results show that the fishing mortality is overestimated, some years the deviations between two succeeding years are large. The recruitment in the assessment year is underestimated in the period 1991-1997. The patterns are the opposite of what XSA shows for the most recent years. The total stock biomass and SSB are underestimated before 1998; this is in accordance with the overestimation of F_{5-10} in the period.

The reason for the deviations in the mid 1990's is probably that the time series for several of the surveys becomes very short or not present when the time period is shortened. Special problems associated with this are seen when 1995 or 1996 are the last years. When 1995 is the last whole year (label 1996), the Norwegian Barents Sea surveys are used, but the time series for the second part contain only two years, and the estimated catchabilities are rather shaky. When 1994 is the last whole year (label 1995), the model does not use any survey information for the immature stock in 1994. The Norwegian Barents Sea surveys are not used for 1994, since this year is the first year in the second part of the times series for those surveys. The index from the Russian survey in 1994 is deleted because of very high residuals. It should be investigated whether not splitting the Barents Sea time series would improve the retrospective pattern.

3.10.5 Use of Fleksibest for predictions

Fleksibest is well suited for prognosis, because the length-dependence of population dynamics processes makes it easy to get consistency between the values of weight, maturity and mortality at age. In the prognosis runs with Fleksibest, the same values as in the key run were used for most parameters. For the parameters that are variable by year, the values for the last year were used for all years in the prognosis, except for growth, recruitment and fishing mortality. The values of those parameters are given in the text table below:

	Recruitment age 3 (10^7)	Growth (cm/year)	F			F_{5-10}		
			Fixed quota	mid	high	Fixed quota	mid	high
2001	37	11.7	0.576	0.576	0.576	0.478	0.478	0.478
2002	18	11.0	0.415	0.475	0.720	0.353	0.404	0.610
2003	37	10.0	0.345	0.475	0.720	0.301	0.414	0.623
2004	37	9.0	0.330	0.475	0.720	0.288	0.412	0.617
2005	37	8.0	0.340	0.475	0.720	0.289	0.401	0.599

The recruitment at age 3 in 2002 and 2003 is set relatively close to the values obtained from the RCT3 analysis. The recruitment in 2004 and later is assumed to be equal to the recruitment in 2003. The growth in 2001 is set equal to the 2000 value, and then a declining trend is assumed. The reason for this is that a decline in the capelin stock in the near future is likely. The historic pattern of the herring recruitment indicates that a strong herring year class in the near future is likely, and there are indications that the 1999 year class of herring may be strong (ICES C.M. 2001/ACFM:17). This may hamper the capelin recruitment severely in 2001 and 2002 (Gjøsæter and Bogstad, 1998).

The values of recruitment, catch weight, stock weight, maturity, natural mortality and fishing mortality at age for the 'fixed quota' run are given in Table 3.30. This is comparable to the usual prediction input table (Table 3.23). The management option table for the Fleksibest prediction is given in Table 3.31.

The 'quota' run is a run where the fishing mortality is set so that the catch in biomass is set very close to 395 000 tons all years of the prognosis. This is the level agreed upon by the management authorities for the period 2001-2003. In the 'med' run the catch is 395 000 tons in 2001, and then F_{5-10} is close to 0.40 (i.e. approximately at $\mathbf{F}_{pa}$) for the rest of the period. Run 'high' is as run 'med', but with F_{5-10} close to 0.61 from 2002 and onwards. The other parameters are equal for all the scenarios. The results of medium-term projections with these different fishing mortalities are shown in Figure 3.15a-f.

3.10.5.1 Comments to the prognosis

From Figs. 3.15a-f it is seen that the three alternatives give very similar results for stock numbers, but large differences for the spawning stock biomass and significant differences in the stock biomass. This shows that if catches are kept at approximately 400 000 tons over the whole period, SSB will increase very rapidly until 2005, even if the growth is medium or below medium and the recruitment is assumed to be poor in the whole period. The poor recruitment is seen in the stock biomass, where a decrease is seen after 2005 even with the low fishing mortality (0.3) in 'fixed quota'. The two other scenarios show a decreasing stock biomass after 2001 ('high') and 2002 ('med') and a decreasing SSB after 2003 ('high') and 2004 ('med'). It should be noted, however, that if the SSB is increased to the level indicated by 'fixed quota', it is likely that the recruitment estimates for the years after 2004 are too pessimistic. One should also note that the catch in biomass in 2005 is equal for 'high' and 'fixed quota', even if F_{5-10} is twice as high in 'high' (0.60) than in 'fixed quota' (0.29). This indicates that much can be gained if F_{5-10} is kept as low as possible over the next years.

3.10.6 Future work

Fleksibest is now a complete framework for assessment of Northeast Arctic cod. Further work will focus on investigating the effect of changing the model assumptions. Also, it should be attempted to also conduct the estimate of recruitment within the Fleksibest framework. More suggestions for further development of Fleksibest can be found in the report of the Fleksibest workshop (ICES 2001/ACFM:09).

In last years' report, main issues for future work with Fleksibest were listed. Some, but not all, of those have been addressed during the last year:

Conflicting signals from different data sources have been identified, and the effects of changing the weighting of the data sources has been studied. Also, the discrepancy between modelled and observed catches has been much reduced when equal or high weight is given to the catch data. The validity of the assumptions of parameters being constant over time (e.g. survey and fleet selection/catchability) has been studied, and tools for comparing observed and modelled length distributions have been developed. No work has been done on parameter correlations and the choice of objective function.

It should be investigated further how the effect of species interactions and environmental influence can be included in the predictions.

3.11 Comparison of results from XSA and Fleksibest.

3.11.1 Comparison of the assessments

The abundance at age in 2001 in the Fleksibest assessment is lower for ages 3-5 and higher for ages 6-9 compared to the XSA assessment. The reference F in 2000 estimated by Fleksibest is lower (0.73 vs. 0.91). For earlier years, the comparisons between Fleksibest and the 2001 XSA assessment would give approximately the same results as the comparisons with the 2000 XSA given in Section 3.10.4.

3.11.2 Comparison of the predictions

The standard and Fleksibest predictions differ in a fundamental way because all input values to the standard prediction (Table 3.23) are independent and can be determined separately. This may lead to internal inconsistencies in the prediction input. The population parameters at age in the Fleksibest prediction (Table 3.30) is determined by the values of growth, recruitment and fishing mortality chosen, as mentioned in Section 3.10.5. With this method, the values of weight, maturity and mortality at age will be consistent with each other.

The catch in 2001 is assumed to be 415 000 tonnes in the standard prediction, while in Fleksibest, a catch of 395 000 tonnes is used for this year. This difference occurs because in the Fleksibest predictions it was assumed that the catch of coastal cod in 2001 will be 40 000 tonnes vs. 20 000 tonnes in the standard prediction. The recruitment at age 3 in 2002 and 2003 is somewhat higher in the Fleksibest prediction than in the standard prediction.

The reference F in 2001 is much higher in the standard prediction than in the Fleksibest prediction. This is due to both lower abundance of older fish and lower weight at age in the catch in the standard prediction. The weight at age in stock from Fleksibest is higher than in the standard prediction for ages 3 and 4 and lower for age 6 and older. Thus, the catch weight/stock weight ratio for age 5 and older fish is different when using the two prediction methods. The difference in natural mortality, maturity ogive and exploitation pattern at age are minor.

The stock development in the short-term prediction is more optimistic in the Fleksibest prediction than in the traditional one, with higher spawning stock biomass and total stock biomass for comparable F levels. This is mainly due to higher abundance of age 6+ in the initial year in the Fleksibest run and higher weight at age in the catch.

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	159 021	216 898	108 991		484 910
2000 [1]	136 470	204 364	73 310		414 144

[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	133,3	25,7	101,9	115,0	107,2	1,8
2000 [1]	111,0	25,5	105,7	98,7	72,0	1,3

[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	13 700	2 137	4 093	3 019	223 390	8 994	11 315	210 379	1 985	5 898	484 910
2000 [1]	13 350	2 621	5 787	3 136	192 717	8 694	9 085	166 202	7 437	5 115	414 144

[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
2000	0,29	0,64	1,21	1,78	2,54	3,58	4,50	5,72	7,57	7,92	12,78	14,91	15,40	20,15

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			
2000	0,18	0,48	0,85	1,44	2,16	3,12	4,44	5,79	7,49	9,66	10,36			

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		
2000 [2]	0,26	0,73	1,36	2,04	2,87	3,67	4,88	5,78	7,05	8,45	8,67	9,33	6,88	

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

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			
2000 [1]	0,23	0,61	1,24	1,75	2,47	3,12	4,65	6,06	7,66	10,94	11,40	7,20		

[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	-	-	6	19	51	84	96	100
2001	-	-	4	28	62	89	96	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
2001	-	1	7	39	53	64	100	100

Table 3.6a. Recruitment indicies for NEA cod. Input for the RCT- analysis.

```
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
9,16,2             (No. of surveys, No. of years, VPA Column No.),,
1985,   205,   6,    2,   4,    -11,     -11,     -11,  -11,   -11,  -11
1986,   173,   1,    1,   3,    -11,     -11,     -11,  -11,   -11,  -11
1987,   243,   1,    1,   1,    -11,     -11,     -11,  -11,   -11,  -11
1988,   412,   1,    1,   4,    -11,     -11,     -11,  -11,   -11,  -11
1989,   721,   1,    3,   8,    -11,     -11,     -11,  -11,   -11,  -11
1990,   893,   4,    4,  44,    -11,     -11,     -11,  -11,   -11,  -11
1991,   812,   4,    8,  15,    -11,     -11,     -11    -11, 296.5, 349.8
1992,   658,  32,    3,  13,    -11,     -11,   535.8, 577.2, 274.6, 166.2
1993,   429,   3,    4,   6, 1035.9,   858.3,   541.5, 292.9, 170.0,  92.9
1994,   712,  12,    8,  10, 5253.1,  2619.2,   707.6, 339.8, 238.0, 188.3
1995,   869,  30,   13,  26, 5768.5,  2396.0,  1045.1, 430.5, 396.0, 427.7
1996,   564,  10,    7,  27, 4815.5,  1623.5,   643.7, 632.9, 211.8, 150.0
1997,   590,  16,    6,  18, 2418.5,  3401.3,   340.1, 304.3, 235.2, 245.1
1998,   -11,   2,    4,  12,  484.6,   358.3,   248.3, 221.4, 191.1, 138.2
1999,   -11,   1,    1, -11,  128.8,   154.1,    76.6,  63.9,   -11,   -11
2000,   -11,   6,  -11, -11,  657.9,   629.9,     -11,   -11,   -11,   -11
R-0      Russian Bottom trawl survey, area I+IIb,   age 0
R-1      Russian Bottom trawl survey, area I+IIb,   age 1
R-2      Russian Bottom trawl survey, area I+IIb,   age 2
N-BST1     Norwegian Barents Sea, Bottom trawl survey, age 1
N-BSA1     Norwegian Barents Sea Acoustic survey age 1
N-BST2     Norwegian Barents Sea, Bottom trawl survey, age 2
N-BSA2     Norwegian Barents Sea Acoustic survey age 2
N-BST3     Norwegian Barents Sea, Bottom trawl survey, age 3
N-BSA3     Norwegian Barents Sea Acoustic survey age 3
```

Table 3.6b. Recruitment predictions based on survey indicies, shrunk towards the vpa mean.

```
Analysis by RCT3 ver3.1 of data from file :
age3.rct
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
Data for    9 surveys over   16 years :  1985 - 2000

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

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

Forecast/Hindcast variance correction used.

Yearclass =   1993

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

R-0       2.00   3.22   2.04   .109      8   1.39    6.00    2.519     .021
R-1       1.55   4.19    .56   .619      8   1.61    6.68     .714     .263
R-2        .80   4.40    .46   .704      8   1.95    5.96     .573     .408
N-BST1
N-BSA1
N-BST2
N-BSA2
N-BST3
N-BSA3
                                       VPA Mean =    6.10     .659     .308

Yearclass =   1994

         I-----------Regression----------I  I-----------Prediction---------I
Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

R-0       1.97   3.28   1.86   .111      9   2.56    8.32    2.433     .003
R-1       1.55   4.12    .57   .574      9   2.20    7.52     .800     .032
R-2        .79   4.43    .43   .705      9   2.40    6.34     .517     .076
N-BST1
N-BSA1
N-BST2
N-BSA2
N-BST3    1.10    .36    .09   .960      3   5.48    6.41     .188     .510
N-BSA3     .51   3.78    .13   .931      3   5.24    6.45     .251     .324
                                       VPA Mean =    6.10     .612     .054

Yearclass =   1995

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

R-0       1.55   3.74   1.45   .158     10   3.43    9.06    2.054     .006
R-1       1.36   4.28    .54   .573     10   2.64    7.86     .796     .042
R-2        .81   4.41    .41   .698     10   3.30    7.10     .536     .093
N-BST1
N-BSA1
N-BST2    2.91 -12.20    .52   .353      3   6.95    8.04    2.547     .004
N-BSA2    1.38  -1.85    .58   .307      3   6.07    6.53    1.178     .019
N-BST3    1.20   -.12    .13   .878      4   5.98    7.06     .291     .315
N-BSA3     .54   3.65    .12   .890      4   6.06    6.93     .245     .444
                                       VPA Mean =    6.17     .590     .077
```

Table 3.6b (Continued

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
R-0	1.09	4.31	1.09	.242	11	2.40	6.93	1.301	.007
R-1	1.13	4.51	.52	.588	11	2.08	6.87	.626	.029
R-2	.76	4.50	.38	.729	11	3.33	7.04	.470	.051
N-BST1	.39	3.35	.12	.948	3	8.48	6.63	.249	.181
N-BSA1	.62	1.80	.19	.883	3	7.39	6.42	.377	.079
N-BST2	1.20	-1.38	.28	.621	4	6.47	6.41	.453	.054
N-BSA2	1.90	-4.87	.58	.282	4	6.45	7.36	1.191	.008
N-BST3	.97	1.10	.13	.852	5	5.36	6.30	.200	.280
N-BSA3	.48	3.95	.11	.901	5	5.02	6.35	.156	.280
					VPA Mean =		6.24	.581	.033

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
R-0	1.04	4.34	1.00	.245	12	2.83	7.29	1.216	.008
R-1	1.10	4.51	.50	.563	12	1.95	6.65	.593	.033
R-2	.74	4.49	.41	.663	12	2.94	6.67	.481	.050
N-BST1	.43	2.91	.22	.744	4	7.79	6.27	.356	.092
N-BSA1	.64	1.64	.15	.867	4	8.13	6.87	.282	.147
N-BST2	1.23	-1.60	.24	.618	5	5.83	5.60	.520	.043
N-BSA2	3.19	-12.95	1.18	.063	5	5.72	5.31	1.868	.003
N-BST3	.95	1.20	.11	.864	6	5.46	6.41	.154	.292
N-BSA3	.48	3.93	.09	.907	6	5.51	6.58	.125	.292
					VPA Mean =		6.27	.541	.040

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
R-0	.98	4.37	.94	.242	13	1.10	5.44	1.114	.011
R-1	1.08	4.52	.47	.553	13	1.61	6.25	.548	.045
R-2	.72	4.50	.39	.651	13	2.56	6.36	.447	.068
N-BST1	.43	2.98	.18	.732	5	6.19	5.61	.411	.081
N-BSA1	.70	1.12	.30	.500	5	5.88	5.23	.767	.023
N-BST2	1.07	-.41	.36	.357	6	5.52	5.49	.668	.031
N-BSA2	2.67	-9.66	.95	.073	6	5.40	4.79	1.600	.005
N-BST3	.96	1.17	.10	.864	7	5.26	6.21	.143	.341
N-BSA3	.51	3.75	.12	.816	7	4.94	6.27	.166	.341
					VPA Mean =		6.30	.501	.054

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------				I	I-----------Prediction---------			I
R-0	.95	4.41	.91	.241	13	.69	5.07	1.137	.064
R-1	1.06	4.54	.47	.543	13	.69	5.27	.610	.221
R-2									
N-BST1	.43	2.97	.19	.729	5	4.87	5.05	.607	.224
N-BSA1	.70	1.09	.31	.495	5	5.04	4.64	1.062	.073
N-BST2	1.06	-.37	.36	.359	6	4.35	4.26	1.197	.057
N-BSA2	2.71	-9.89	.97	.071	6	4.17	1.43	3.302	.008
N-BST3									
N-BSA3									
					VPA Mean =		6.32	.483	.353

Table 3.6b (Continued

Yearclass = 2000

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
R-0	.91	4.47	.88	.239	13	1.95	6.24	1.033	.064
R-1									
R-2									
N-BST1	.43	2.95	.19	.725	5	6.49	5.74	.389	.448
N-BSA1	.71	1.05	.31	.489	5	6.45	5.61	.636	.168
N-BST2									
N-BSA2									
N-BST3									
N-BSA3									
					VPA Mean =		6.34	.461	.320

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	489	6.19	.37	.17	.22	429	6.06
1994	628	6.44	.14	.11	.56	712	6.57
1995	1069	6.98	.16	.13	.67	869	6.77
1996	635	6.45	.11	.07	.47	565	6.34
1997	665	6.50	.11	.09	.75	590	6.38
1998	462	6.14	.12	.10	.67		
1999	231	5.44	.29	.31	1.16		
2000	380	5.94	.26	.18	.46		

Table 3.6c. Recruitment predictions based on survey indicies, not shrunk towards the vpa mean.

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

age3.rct

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

Data for    9 surveys over   16 years :  1985 - 2000

Regression type = C
Tapered time weighting applied
power =    0 over  20 years
Survey weighting not applied
Final estimates not shrunk towards mean
Estimates with S.E.'S greater than that of mean
+                                                   included
Minimum S.E. for any survey taken as    .00
Minimum of   3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass =   1993
```

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----	Regression	----	----I		I----	Prediction	----	----I
R-0	2.08	3.10	2.09	.105	8	1.39	5.98	2.557	.030
R-1	1.58	4.15	.57	.616	8	1.61	6.69	.715	.379
R-2	.81	4.37	.47	.701	8	1.95	5.96	.573	.591
N-BST1									
N-BSA1									
N-BST2									
N-BSA2									
N-BST3									
N-BSA3									
					VPA Mean =		6.07	.663	.000

```
Yearclass =   1994
```

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----	Regression	----	----I		I----	Prediction	----	----I
R-0	2.08	3.11	1.93	.105	9	2.56	8.44	2.501	.003
R-1	1.58	4.08	.57	.575	9	2.20	7.55	.796	.032
R-2	.81	4.39	.43	.700	9	2.40	6.33	.522	.074
N-BST1									
N-BSA1									
N-BST2									
N-BSA2									
N-BST3	1.10	.36	.09	.960	3	5.48	6.41	.188	.571
N-BSA3	.51	3.78	.13	.931	3	5.24	6.45	.251	.320
					VPA Mean =		6.07	.620	.000

Table 3.6c (Continued)

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-0	1.66	3.57	1.52	.151	10	3.43	9.26	2.117	.006
R-1	1.39	4.23	.55	.580	10	2.64	7.91	.788	.046
R-2	.84	4.35	.43	.694	10	3.30	7.12	.546	.096
N-BST1									
N-BSA1									
N-BST2	2.91	-12.22	.52	.352	3	6.95	8.04	2.544	.004
N-BSA2	1.38	-1.84	.58	.308	3	6.07	6.53	1.175	.021
N-BST3	1.20	-.12	.13	.878	4	5.98	7.06	.289	.343
N-BSA3	.54	3.65	.12	.890	4	6.06	6.93	.243	.483
					VPA Mean =		6.12	.605	.000

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-0	1.18	4.15	1.16	.234	11	2.40	6.99	1.361	.005
R-1	1.18	4.44	.52	.598	11	2.08	6.89	.627	.025
R-2	.79	4.42	.39	.725	11	3.33	7.07	.486	.041
N-BST1	.39	3.35	.12	.948	3	8.48	6.63	.248	.157
N-BSA1	.62	1.81	.19	.883	3	7.39	6.42	.375	.069
N-BST2	1.20	-1.39	.28	.620	4	6.47	6.41	.452	.047
N-BSA2	1.89	-4.86	.58	.281	4	6.45	7.36	1.185	.007
N-BST3	.97	1.10	.13	.852	5	5.36	6.30	.198	.246
N-BSA3	.48	3.95	.11	.901	5	5.02	6.35	.155	.404
					VPA Mean =		6.18	.607	.000

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-0	1.15	4.15	1.09	.239	12	2.83	7.42	1.294	.004
R-1	1.15	4.44	.51	.584	12	1.95	6.68	.595	.020
R-2	.77	4.41	.42	.675	12	2.94	6.69	.491	.030
N-BST1	.43	2.91	.22	.745	4	7.79	6.27	.354	.057
N-BSA1	.64	1.65	.15	.867	4	8.13	6.87	.280	.091
N-BST2	1.24	-1.62	.24	.614	5	5.83	5.60	.519	.026
N-BSA2	3.15	-12.68	1.16	.065	5	5.72	5.32	1.830	.002
N-BST3	.96	1.19	.11	.864	6	5.46	6.41	.153	.306
N-BSA3	.48	3.93	.09	.907	6	5.51	6.58	.124	.464
					VPA Mean =		6.19	.580	.000

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-0	1.10	4.17	1.03	.243	13	1.10	5.38	1.185	.007
R-1	1.14	4.44	.49	.586	13	1.61	6.27	.553	.031
R-2	.76	4.41	.41	.673	13	2.56	6.37	.459	.044
N-BST1	.42	2.99	.18	.735	5	6.19	5.62	.404	.057
N-BSA1	.69	1.16	.30	.506	5	5.88	5.24	.752	.017
N-BST2	1.08	-.47	.36	.355	6	5.52	5.48	.666	.021
N-BSA2	2.62	-9.34	.93	.076	6	5.40	4.82	1.552	.004
N-BST3	.96	1.14	.10	.864	7	5.26	6.21	.141	.468
N-BSA3	.51	3.75	.12	.818	7	4.94	6.27	.163	.352
					VPA Mean =		6.21	.558	.000

Table 3.6c (Continued)

Yearclass = 1999

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
R-0	1.10	4.17	1.03	.243	13	.69	4.93	1.216	.082
R-1	1.14	4.44	.49	.586	13	.69	5.23	.591	.348
R-2									
N-BST1	.42	2.99	.18	.735	5	4.87	5.06	.585	.354
N-BSA1	.69	1.16	.30	.506	5	5.04	4.66	1.019	.117
N-BST2	1.08	-.47	.36	.355	6	4.35	4.22	1.186	.086
N-BSA2	2.62	-9.34	.93	.076	6	4.17	1.59	3.103	.013
N-BST3									
N-BSA3									
					VPA Mean =		6.21	.558	.000

Yearclass = 2000

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
R-0	1.10	4.17	1.03	.243	13	1.95	6.31	1.161	.068
R-1									
R-2									
N-BST1	.42	2.99	.18	.735	5	6.49	5.75	.367	.675
N-BSA1	.69	1.16	.30	.506	5	6.45	5.63	.595	.257
N-BST2									
N-BSA2									
N-BST3									
N-BSA3									
					VPA Mean =		6.21	.558	.000

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	509	6.23	.44	.25	.32	429	6.06
1994	639	6.46	.14	.11	.66	712	6.57
1995	1148	7.05	.17	.12	.48	869	6.77
1996	628	6.44	.10	.07	.55	565	6.34
1997	678	6.52	.08	.08	.89	590	6.38
1998	474	6.16	.10	.09	.79		
1999	140	4.94	.35	.21	.38		
2000	315	5.76	.30	.11	.14		

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
2000	32	207	4761	32584	93076	47337	12727	6704	4794	1644	316	72	11	1	14

Table 3.8

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

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

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	4008,	710,	140,	991,	1281,
4,	10387,	13192,	3872,	6808,	10954,
5,	18906,	43890,	31054,	35214,	29045,
6,	16596,	52017,	55983,	100497,	45233,
7,	13843,	45501,	77375,	83283,	62579,
8,	15370,	13075,	21482,	29727,	30037,
9,	59845,	19718,	15237,	13207,	19481,
10,	22618,	47678,	9815,	5606,	9172,
11,	10093,	31392,	30041,	8617,	6019,
12,	9573,	9348,	7945,	13154,	4133,
+gp,	8137,	18055,	12595,	7719,	9862,
0 TOTALNUM,	189376,	294576,	265539,	304823,	227796,
TONSLAND,	706000,	882017,	774295,	800122,	731982,
SOPCOF %,	103,	91,	89,	99,	109,

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

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	24687,	24099,	47413,	11473,	3902,	10614,	17321,	31219,	32308,	37882,
4,	77924,	120704,	107659,	155171,	37652,	24172,	33931,	133576,	77942,	97865,
5,	64013,	113203,	112040,	146395,	201834,	129803,	27182,	71051,	148285,	64222,
6,	46867,	73827,	55500,	100751,	161336,	250472,	70702,	40737,	53480,	67425,
7,	37535,	49389,	22742,	40635,	84031,	86784,	87033,	38380,	18498,	23117,
8,	33673,	20562,	16863,	10713,	30451,	51091,	39213,	35786,	17735,	8429,
9,	23510,	24367,	10559,	11791,	13713,	14987,	17747,	13338,	23118,	7240,
10,	10589,	15651,	10553,	8557,	9481,	7465,	6219,	10475,	9483,	11675,
11,	4221,	8327,	5637,	6751,	4140,	3952,	3232,	3289,	3748,	4504,
12,	1288,	3565,	1752,	2370,	2406,	1655,	1220,	1070,	997,	1843,
+gp,	4935,	2158,	797,	1287,	1350,	1906,	819,	433,	513,	682,
0 TOTALNUM,	329242,	455852,	391515,	495894,	550296,	582901,	304619,	379354,	386107,	324884,
TONSLAND,	827180,	876795,	695546,	826021,	1147841,	1343068,	792557,	769313,	744607,	622042,
SOPCOF %,	115,	93,	105,	93,	106,	105,	100,	112,	93,	104,

1

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

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

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	45478,	42416,	13196,	5298,	15725,	55937,	34467,	3709,	2307,	7164,
4,	132655,	170566,	106984,	45912,	25999,	55644,	160048,	174585,	24545,	10792,
5,	123458,	167241,	205549,	97950,	78299,	34676,	69235,	267961,	238511,	25813,
6,	51167,	89460,	95498,	58575,	68511,	42539,	22061,	107051,	181239,	137829,
7,	38740,	28297,	35518,	19642,	25444,	37169,	26295,	26701,	79363,	96420,
8,	17376,	21996,	16221,	9162,	8438,	18500,	25139,	16399,	26989,	31920,
9,	5791,	7956,	11894,	6196,	3569,	5077,	11323,	11597,	13463,	8933,
10,	6778,	2728,	3884,	3553,	1467,	1495,	2329,	3657,	5092,	3249,
11,	5560,	2603,	1021,	783,	1161,	380,	687,	657,	1913,	1232,
12,	1682,	1647,	1025,	172,	131,	403,	316,	122,	414,	260,
+gp,	1298,	775,	784,	782,	337,	156,	279,	240,	190,	180,
0 TOTALNUM,	429983,	535685,	491574,	248025,	229081,	251976,	352179,	612679,	574026,	323792,
TONSLAND,	783221,	909266,	776337,	437695,	444930,	483711,	572605,	1074084,	1197226,	933246,
SOPCOF %,	110,	124,	102,	103,	129,	123,	109,	108,	105,	112,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	7754,	35536,	294262,	91855,	45282,	85337,	39594,	78822,	8600,	3911,
4,	13739,	45431,	131493,	437377,	59798,	114341,	168609,	45400,	77484,	17086,
5,	11831,	26832,	61000,	203772,	226646,	79993,	136335,	88495,	43677,	81986,
6,	9527,	12089,	20569,	47006,	118567,	118236,	52925,	56823,	31943,	40061,
7,	59290,	7918,	7248,	12630,	29522,	47872,	61821,	25407,	16815,	17664,
8,	52003,	34885,	8328,	4370,	9353,	13962,	23338,	31821,	8274,	7442,
9,	12093,	22315,	19130,	2523,	2617,	4051,	5659,	9408,	10974,	3508,
10,	2434,	4572,	4499,	5607,	1555,	936,	1521,	1227,	1785,	3196,
11,	762,	1215,	677,	2127,	1928,	558,	610,	913,	427,	678,
12,	418,	353,	195,	322,	575,	442,	271,	446,	103,	79,
+gp,	216,	476,	195,	296,	283,	218,	268,	847,	142,	58,
0 TOTALNUM,	170067,	191622,	547596,	807885,	496126,	465946,	490951,	339609,	200224,	175669,
TONSLAND,	689048,	565254,	792685,	1102433,	829377,	867463,	905301,	698715,	440538,	380434,
SOPCOF %,	124,	118,	130,	137,	115,	127,	107,	109,	121,	127,

Table 3.8 (Continued)

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	3407,	8948,	3108,	6942,	24634,	28968,	13648,	9828,	5085,	1911,
4,	9466,	20933,	19594,	14240,	45769,	70993,	137106,	22774,	17313,	7551,
5,	20803,	19345,	20473,	18807,	27806,	78672,	98210,	135347,	32165,	12999,
6,	63433,	28084,	17656,	20086,	19418,	25215,	61407,	54379,	81756,	17827,
7,	21788,	42496,	17004,	15145,	11369,	11711,	13707,	21015,	27854,	30007,
8,	9933,	8395,	18329,	8287,	3747,	4063,	3866,	3304,	5501,	6810,
9,	4267,	2878,	2545,	5988,	1557,	976,	910,	1236,	827,	828,
10,	1311,	708,	646,	783,	768,	726,	455,	519,	290,	179,
11,	882,	271,	229,	232,	137,	557,	187,	106,	41,	59,
12,	109,	260,	74,	153,	36,	136,	227,	69,	13,	15,
+gp,	41,	37,	83,	69,	71,	76,	100,	62,	28,	13,
0 TOTALNUM,	135440,	132355,	99741,	90732,	135312,	222093,	329823,	248639,	170873,	78199,
TONSLAND,	399038,	363730,	289992,	277651,	307920,	430113,	523071,	434939,	332481,	212000,
SOPCOF %,	118,	125,	90,	95,	102,	102,	102,	100,	99,	101,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	4963,	21835,	10094,	6531,	4879,	7655,	12827,	31887,	7501,	4761,
4,	10933,	36015,	46182,	59444,	42587,	28782,	36491,	88874,	77714,	32584,
5,	16467,	27494,	63578,	102548,	115329,	80711,	69633,	48972,	92816,	93076,
6,	20342,	23392,	33623,	59766,	98485,	100509,	83017,	40493,	31139,	47337,
7,	19479,	18351,	14866,	32504,	32036,	54590,	65768,	34513,	15778,	12727,
8,	25193,	13541,	9449,	10019,	7334,	10545,	28392,	26354,	15851,	6704,
9,	3888,	18321,	6571,	6163,	3014,	2023,	4651,	6583,	8828,	4794,
10,	428,	2529,	12593,	3671,	1725,	930,	1151,	965,	1837,	1644,
11,	48,	264,	1749,	7528,	1174,	462,	373,	197,	195,	316,
12,	12,	82,	377,	995,	1920,	230,	213,	69,	40,	72,
+gp,	4,	13,	86,	144,	264,	894,	383,	117,	72,	26,
0 TOTALNUM,	101757,	161837,	199168,	289313,	308747,	287331,	302899,	279024,	251771,	204041,
TONSLAND,	319158,	513234,	581611,	771086,	739999,	732228,	762403,	592624,	484910,	414144,
SOPCOF %,	95,	103,	101,	101,	100,	101,	100,	101,	100,	100,

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Table 3.9

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 2 Catch weights at age (kg)

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.3500,	.3200,	.3400,	.3700,	.3900,
4,	.5900,	.5600,	.5300,	.6700,	.6400,
5,	1.1100,	.9500,	1.2600,	1.1100,	1.2900,
6,	1.6900,	1.5000,	1.9300,	1.6600,	1.7000,
7,	2.3700,	2.1400,	2.4600,	2.5000,	2.3600,
8,	3.1700,	2.9200,	3.3600,	3.2300,	3.4800,
9,	3.9800,	3.6500,	4.2200,	4.0700,	4.5200,
10,	5.0500,	4.5600,	5.3100,	5.2700,	5.6200,
11,	5.9200,	5.8400,	5.9200,	5.9900,	6.4000,
12,	7.2000,	7.4200,	7.0900,	7.0800,	7.9600,
+gp,	8.1460,	8.8480,	8.4300,	8.2180,	8.8910,
0 SOPCOFAC,	1.0300,	.9143,	.8915,	.9920,	1.0880,

Table 2 Catch weights at age (kg)

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	.4000,	.4400,	.4000,	.4400,	.3200,	.3300,	.3300,	.3400,	.3500,	.3400,
4,	.8300,	.8000,	.7600,	.7700,	.5700,	.5800,	.5900,	.5200,	.7200,	.5100,
5,	1.3900,	1.3300,	1.2800,	1.2600,	1.1300,	1.0700,	1.0200,	.9500,	1.4700,	1.0900,
6,	1.8800,	1.9200,	1.9300,	1.9700,	1.7300,	1.8300,	1.8200,	1.9200,	2.6800,	2.1300,
7,	2.5400,	2.6400,	2.8100,	3.0300,	2.7500,	2.8900,	2.8900,	2.9400,	3.5900,	3.3800,
8,	3.4600,	3.7100,	3.7200,	4.3300,	3.9400,	4.2500,	4.2800,	4.2100,	4.3200,	4.8700,
9,	4.8800,	5.0600,	5.0600,	5.4000,	4.9000,	5.5500,	5.4900,	5.6100,	5.4500,	6.1200,
10,	5.2000,	6.0500,	6.3400,	6.7500,	7.0400,	7.2800,	7.5100,	7.3500,	6.4400,	8.4900,
11,	7.1400,	7.4200,	7.4000,	7.7900,	7.2000,	8.0000,	8.2400,	8.6700,	7.1700,	7.7900,
12,	8.2200,	8.4300,	8.6700,	10.6700,	8.7800,	8.3500,	9.2500,	9.5800,	8.6300,	8.3000,
+gp,	9.3890,	10.1850,	10.2380,	9.6800,	10.0770,	9.9440,	10.6050,	11.6310,	11.6210,	11.4220,
0 SOPCOFAC,	1.1483,	.9348,	1.0485,	.9294,	1.0634,	1.0455,	1.0004,	1.1232,	.9305,	1.0416,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 2 Catch weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	.3100,	.3200,	.3200,	.3300,	.3800,	.4400,	.2900,	.3300,	.4400,	.3700,
4,	.5500,	.5500,	.6100,	.5500,	.6800,	.7400,	.8100,	.7000,	.7900,	.9100,
5,	1.0500,	.9300,	.9600,	.9500,	1.0300,	1.1800,	1.3500,	1.4800,	1.2300,	1.3400,
6,	2.2000,	1.7000,	1.7300,	1.8600,	1.4900,	1.7800,	2.0400,	2.1200,	2.0300,	2.0000,
7,	3.2300,	3.0300,	3.0400,	3.2500,	2.4100,	2.4600,	2.8100,	3.1400,	2.9000,	3.0000,
8,	5.1100,	5.0300,	4.9600,	4.9700,	3.5200,	3.8200,	3.4800,	4.2100,	3.8100,	4.1500,
9,	6.1500,	6.5500,	6.4400,	6.4100,	5.7300,	5.3600,	4.8900,	5.2700,	5.0200,	5.5900,
10,	8.1500,	7.7000,	7.9100,	8.0700,	7.5400,	7.2700,	7.1100,	6.6500,	6.4300,	7.6000,
11,	8.6800,	9.2700,	9.6200,	9.3400,	8.4700,	8.6300,	9.0300,	9.0100,	8.3300,	8.9700,
12,	9.6000,	10.5600,	11.3100,	10.1600,	11.1700,	10.6600,	10.5900,	9.6600,	10.7100,	10.9900,
+gp,	11.9520,	12.7170,	12.7370,	12.8860,	13.7220,	14.1480,	13.8290,	14.8480,	14.2110,	14.0740,
0 SOPCOFAC,	1.0970,	1.2356,	1.0226,	1.0277,	1.2903,	1.2327,	1.0911,	1.0785,	1.0520,	1.1170,

Table 2 Catch weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	.4500,	.3800,	.3800,	.3200,	.4100,	.3500,	.4900,	.4900,	.3500,	.2700,
4,	.8800,	.7700,	.9100,	.6600,	.6400,	.7300,	.9000,	.8100,	.7000,	.5600,
5,	1.3800,	1.4300,	1.5400,	1.1700,	1.1100,	1.1900,	1.4300,	1.4500,	1.2400,	1.0200,
6,	2.1600,	2.1200,	2.2600,	2.2200,	1.9000,	2.0100,	2.0500,	2.1500,	2.1400,	1.7200,
7,	3.0700,	3.2300,	3.2900,	3.2100,	2.9500,	2.7600,	3.3000,	3.0400,	3.1500,	3.0200,
8,	4.2200,	4.3800,	4.6100,	4.3900,	4.3700,	4.2200,	4.5600,	4.4600,	4.2900,	4.2000,
9,	5.8100,	5.8300,	6.5700,	5.5200,	5.7400,	5.8800,	6.4600,	6.5400,	6.5800,	5.8400,
10,	7.1300,	7.6200,	8.3700,	7.8600,	8.7700,	9.3000,	8.6300,	7.9800,	8.6100,	7.2600,
11,	8.6200,	9.5200,	10.5400,	9.8200,	9.9200,	10.2800,	9.9300,	10.1500,	9.2200,	8.8400,
12,	10.8300,	12.0900,	11.6200,	11.4100,	11.8100,	11.8600,	10.9000,	10.8500,	10.8900,	9.2800,
+gp,	12.9450,	13.6730,	13.9040,	13.2420,	13.1070,	13.5440,	13.6680,	13.1770,	14.3440,	14.4480,
0 SOPCOFAC,	1.2405,	1.1822,	1.3003,	1.3660,	1.1520,	1.2688,	1.0683,	1.0890,	1.2139,	1.2723,

Table 3.9 (Continued)

Table 2 Catch weights at age (kg)

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.4900,	.3700,	.8400,	1.4200,	.9400,	.6400,	.4900,	.5400,	.7400,	.8100,
4,	.9800,	.6600,	1.3700,	1.9300,	1.3700,	1.2700,	.8800,	.8500,	.9600,	1.2200,
5,	1.4400,	1.3500,	2.0900,	2.4900,	2.0200,	1.8800,	1.5500,	1.3200,	1.3100,	1.6400,
6,	2.0900,	1.9900,	2.8600,	3.1400,	3.2200,	2.7900,	2.3300,	2.2400,	1.9200,	2.2200,
7,	2.9800,	2.9300,	3.9900,	3.9100,	4.6300,	4.4900,	3.4400,	3.5200,	2.9300,	3.2400,
8,	4.8500,	4.2400,	5.5800,	4.9100,	6.0400,	5.8400,	5.9200,	5.3500,	4.6400,	4.6800,
9,	6.5700,	6.4600,	7.7700,	6.0200,	7.6600,	6.8300,	8.6000,	8.0600,	7.5200,	7.3000,
10,	9.1600,	8.5100,	9.2900,	7.4000,	9.8100,	7.6900,	9.6000,	9.5100,	9.1200,	9.8400,
11,	10.8200,	12.2400,	11.5500,	8.1300,	11.8000,	9.8100,	12.1700,	11.3600,	11.0800,	13.2500,
12,	10.7700,	10.7800,	16.2000,	8.5700,	14.1600,	10.7100,	13.7200,	14.0900,	11.4700,	16.8800,
+gp,	13.9320,	14.0410,	17.0340,	8.6090,	14.0080,	12.0510,	13.3800,	16.7060,	16.4840,	11.6170,
0 SOPCOFAC,	1.1809,	1.2521,	.8953,	.9483,	1.0182,	1.0160,	1.0224,	1.0001,	.9879,	1.0108,

Table 2 Catch weights at age (kg)

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	1.0500,	1.1600,	.8100,	.8200,	.7700,	.7900,	.6700,	.6800,	.6300,	.5700,
4,	1.4500,	1.5700,	1.5200,	1.3000,	1.2000,	1.1100,	1.0400,	1.0500,	1.0100,	1.0200,
5,	2.1500,	2.2100,	2.1600,	2.0600,	1.7800,	1.6100,	1.5300,	1.6200,	1.5400,	1.6000,
6,	2.8900,	3.1000,	2.7900,	2.8900,	2.5900,	2.4600,	2.2200,	2.3000,	2.3400,	2.3400,
7,	3.7500,	4.2700,	4.0700,	3.2100,	3.8100,	3.8200,	3.4200,	3.3000,	3.2100,	3.3400,
8,	4.7100,	5.1900,	5.5300,	5.2000,	4.9900,	5.7200,	5.2000,	4.8600,	4.2900,	4.4900,
9,	6.0800,	6.1400,	6.4700,	6.8000,	6.2300,	6.7400,	7.1900,	6.8700,	6.0000,	5.7400,
10,	8.8200,	7.7700,	7.1900,	7.5700,	8.0500,	8.0400,	7.7300,	9.3000,	6.7300,	7.5500,
11,	11.8000,	10.1200,	7.9800,	8.0100,	8.7400,	9.2800,	8.6100,	10.3000,	10.0800,	8.0900,
12,	16.5800,	11.5400,	10.1100,	9.4800,	9.2200,	10.4000,	11.0700,	15.0500,	13.8800,	12.5300,
+gp,	16.6900,	14.3320,	14.1830,	11.9780,	12.3190,	10.9660,	11.1170,	14.5240,	14.0360,	17.3060,
0 SOPCOFAC,	.9521,	1.0270,	1.0127,	1.0090,	1.0030,	1.0147,	1.0004,	1.0072,	.9967,	1.0050,

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Table 3.10

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 3 Stock weights at age (kg)

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.3500,	.3200,	.3400,	.3700,	.3900,
4,	.5900,	.5600,	.5300,	.6700,	.6400,
5,	1.1100,	.9500,	1.2600,	1.1100,	1.2900,
6,	1.6900,	1.5000,	1.9300,	1.6600,	1.7000,
7,	2.3700,	2.1400,	2.4600,	2.5000,	2.3600,
8,	3.1700,	2.9200,	3.3600,	3.2300,	3.4800,
9,	3.9800,	3.6500,	4.2200,	4.0700,	4.5200,
10,	5.0500,	4.5600,	5.3100,	5.2700,	5.6200,
11,	5.9200,	5.8400,	5.9200,	5.9900,	6.4000,
12,	7.2000,	7.4200,	7.0900,	7.0800,	7.9600,
+gp,	8.1460,	8.8480,	8.4300,	8.2180,	8.8910,

Table 3 Stock weights at age (kg)

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	.4000,	.4400,	.4000,	.4400,	.3200,	.3300,	.3300,	.3400,	.3500,	.3400,
4,	.8300,	.8000,	.7600,	.7700,	.5700,	.5800,	.5900,	.5200,	.7200,	.5100,
5,	1.3900,	1.3300,	1.2800,	1.2600,	1.1300,	1.0700,	1.0200,	.9500,	1.4700,	1.0900,
6,	1.8800,	1.9200,	1.9300,	1.9700,	1.7300,	1.8300,	1.8200,	1.9200,	2.6800,	2.1300,
7,	2.5400,	2.6400,	2.8100,	3.0300,	2.7500,	2.8900,	2.8900,	2.9400,	3.5900,	3.3800,
8,	3.4600,	3.7100,	3.7200,	4.3300,	3.9400,	4.2500,	4.2800,	4.2100,	4.3200,	4.8700,
9,	4.8800,	5.0600,	5.0600,	5.4000,	4.9000,	5.5500,	5.4900,	5.6100,	5.4500,	6.1200,
10,	5.2000,	6.0500,	6.3400,	6.7500,	7.0400,	7.2800,	7.5100,	7.3500,	6.4400,	8.4900,
11,	7.1400,	7.4200,	7.4000,	7.7900,	7.2000,	8.0000,	8.2400,	8.6700,	7.1700,	7.7900,
12,	8.2200,	8.4300,	8.6700,	10.6700,	8.7800,	8.3500,	9.2500,	9.5800,	8.6300,	8.3000,
+gp,	9.3890,	10.1850,	10.2380,	9.6800,	10.0770,	9.9440,	10.6050,	11.6310,	11.6210,	11.4220,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 3 Stock weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	.3100,	.3200,	.3200,	.3300,	.3800,	.4400,	.2900,	.3300,	.4400,	.3700,
4,	.5500,	.5500,	.6100,	.5500,	.6800,	.7400,	.8100,	.7000,	.7900,	.9100,
5,	1.0500,	.9300,	.9600,	.9500,	1.0300,	1.1800,	1.3500,	1.4800,	1.2300,	1.3400,
6,	2.2000,	1.7000,	1.7300,	1.8600,	1.4900,	1.7800,	2.0400,	2.1200,	2.0300,	2.0000,
7,	3.2300,	3.0300,	3.0400,	3.2500,	2.4100,	2.4600,	2.8100,	3.1400,	2.9000,	3.0000,
8,	5.1100,	5.0300,	4.9600,	4.9700,	3.5200,	3.8200,	3.4800,	4.2100,	3.8100,	4.1500,
9,	6.1500,	6.5500,	6.4400,	6.4100,	5.7300,	5.3600,	4.8900,	5.2700,	5.0200,	5.5900,
10,	8.1500,	7.7000,	7.9100,	8.0700,	7.5400,	7.2700,	7.1100,	6.6500,	6.4300,	7.6000,
11,	8.6800,	9.2700,	9.6200,	9.3400,	8.4700,	8.6300,	9.0300,	9.0100,	8.3300,	8.9700,
12,	9.6000,	10.5600,	11.3100,	10.1600,	11.1700,	10.6600,	10.5900,	9.6600,	10.7100,	10.9900,
+gp,	11.9520,	12.7170,	12.7370,	12.8860,	13.7220,	14.1480,	13.8290,	14.8480,	14.2110,	14.0740,

Table 3 Stock weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	.4500,	.3800,	.3800,	.3200,	.4100,	.3500,	.4900,	.4900,	.3500,	.2700,
4,	.8800,	.7700,	.9100,	.6600,	.6400,	.7300,	.9000,	.8100,	.7000,	.5600,
5,	1.3800,	1.4300,	1.5400,	1.1700,	1.1100,	1.1900,	1.4300,	1.4500,	1.2400,	1.0200,
6,	2.1600,	2.1200,	2.2600,	2.2200,	1.9000,	2.0100,	2.0500,	2.1500,	2.1400,	1.7200,
7,	3.0700,	3.2300,	3.2900,	3.2100,	2.9500,	2.7600,	3.3000,	3.0400,	3.1500,	3.0200,
8,	4.2200,	4.3800,	4.6100,	4.3900,	4.3700,	4.2200,	4.5600,	4.4600,	4.2900,	4.2000,
9,	5.8100,	5.8300,	6.5700,	5.5200,	5.7400,	5.8800,	6.4600,	6.5400,	6.5800,	5.8400,
10,	7.1300,	7.6200,	8.3700,	7.8600,	8.7700,	9.3000,	8.6300,	7.9800,	8.6100,	7.2600,
11,	8.6200,	9.5200,	10.5400,	9.8200,	9.9200,	10.2800,	9.9300,	10.1500,	9.2200,	8.8400,
12,	10.8300,	12.0900,	11.6200,	11.4100,	11.8100,	11.8600,	10.9000,	10.8500,	10.8900,	9.2800,
+gp,	12.9450,	13.6730,	13.9040,	13.2420,	13.1070,	13.5440,	13.6680,	13.1770,	14.3440,	14.4480,

Table 3 Stock weights at age (kg)

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.4900,	.3700,	.3700,	.4200,	.4100,	.3100,	.1900,	.2100,	.3000,	.4000,
4,	.9800,	.6600,	.9200,	1.1600,	.8800,	.8800,	.5100,	.4000,	.5200,	.7100,
5,	1.4400,	1.3500,	1.6000,	1.8100,	1.6000,	1.4700,	1.2800,	.7900,	.8700,	1.1800,
6,	2.0900,	1.9900,	2.4400,	2.7900,	2.8100,	2.4700,	1.9400,	1.9000,	1.4800,	1.7200,
7,	2.9800,	2.9300,	3.8200,	3.7800,	4.0600,	3.9200,	3.2800,	2.9800,	2.6900,	2.4600,
8,	4.8500,	4.2400,	4.7600,	4.5700,	5.8300,	5.8100,	5.1700,	4.3900,	4.6300,	3.5700,
9,	6.5700,	6.4600,	6.1700,	6.1700,	7.6900,	6.5800,	6.5200,	7.8100,	7.0500,	4.7100,
10,	9.1600,	8.5100,	7.7000,	7.7000,	10.1200,	6.8300,	9.3000,	12.1100,	9.9800,	7.8000,
11,	10.8200,	12.2400,	9.2500,	9.2500,	14.2900,	11.0000,	13.1500,	13.1100,	9.2500,	8.9600,
12,	10.7700,	10.7800,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.9320,	14.0410,	12.9880,	13.0330,	13.4130,	13.5870,	13.8260,	13.0180,	14.4790,	13.4230,

Table 3.10 (Continued)

Table 3 Stock weights at age (kg)

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	.5200,	.4400,	.3400,	.2300,	.2000,	.2000,	.2000,	.2200,	.2030,	.1940,
4,	1.1400,	.9300,	1.1700,	.7500,	.4900,	.4900,	.5200,	.5300,	.5200,	.4650,
5,	1.7400,	1.8100,	1.8200,	1.4200,	1.1400,	.9700,	1.0800,	1.1600,	1.1700,	1.2050,
6,	2.4300,	2.7200,	2.8200,	2.4100,	2.1200,	2.0500,	1.8800,	1.9400,	2.0300,	1.9800,
7,	3.2100,	3.9000,	4.0300,	3.8300,	3.4700,	3.5300,	3.3700,	2.9500,	3.0300,	3.1230,
8,	4.5400,	5.1800,	5.5000,	5.4200,	4.9400,	5.5000,	5.2600,	4.5700,	4.4600,	4.1630,
9,	6.8800,	6.7700,	6.7700,	6.6300,	7.1600,	7.7700,	8.9300,	7.4200,	6.4800,	5.4740,
10,	10.7200,	9.6000,	8.5700,	7.6300,	9.1200,	10.1600,	12.1500,	10.3700,	10.2700,	8.3420,
11,	9.4500,	12.4300,	9.2500,	8.1100,	10.1000,	10.6700,	10.9000,	11.7400,	10.8800,	9.8120,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	14.1000,	13.6620,	12.8870,	12.7540,	12.7270,	12.6340,	13.3770,	13.8960,	13.6970,	13.9000,

1

Table 3.11

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 5 Proportion mature at age

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0100,	.0100,	.0100,	.0100,	.0100,
6,	.0300,	.0300,	.0300,	.0300,	.0300,
7,	.0600,	.0600,	.0700,	.0900,	.0900,
8,	.1100,	.1300,	.1300,	.1700,	.2300,
9,	.1800,	.1600,	.2500,	.2900,	.3500,
10,	.4400,	.4200,	.4700,	.5400,	.5200,
11,	.6500,	.7500,	.7300,	.7900,	.7900,
12,	.8600,	.9100,	.9100,	.8800,	.9500,
+gp,	.9600,	.9500,	.9700,	.9700,	.9700,

Table 5 Proportion mature at age

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0100,
5,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0300,
6,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0400,	.0600,
7,	.1000,	.0800,	.0700,	.0800,	.0700,	.0600,	.0600,	.0600,	.1200,	.1000,
8,	.2400,	.2200,	.1900,	.1600,	.1300,	.1200,	.0900,	.1000,	.3400,	.1900,
9,	.4000,	.4100,	.4000,	.3700,	.2600,	.1400,	.1200,	.1000,	.4900,	.4500,
10,	.5800,	.6300,	.6400,	.6800,	.5300,	.4100,	.2200,	.3000,	.6700,	.6900,
11,	.7200,	.8200,	.8400,	.8700,	.8300,	.6700,	.6000,	.5000,	.8400,	.7700,
12,	.8500,	.9200,	.9400,	.9300,	.9200,	.9100,	.8200,	.8200,	.8700,	.8500,
+gp,	.9600,	.9700,	.9700,	.9600,	.9700,	.9600,	.9700,	.9700,	1.0000,	.9900,

1

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 5 Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0100,
5,	.0100,	.0100,	.0100,	.0000,	.0000,	.0100,	.0000,	.0300,	.0000,	.0000,
6,	.0600,	.0500,	.0300,	.0300,	.0100,	.0200,	.0300,	.0500,	.0200,	.0100,
7,	.1200,	.1500,	.0700,	.1300,	.0600,	.0600,	.0700,	.0900,	.0400,	.0700,
8,	.3100,	.3400,	.2800,	.3700,	.2000,	.2200,	.1400,	.1900,	.1200,	.2300,
9,	.6500,	.6100,	.4200,	.6600,	.5500,	.3500,	.3800,	.3900,	.3400,	.5800,
10,	.9100,	.8100,	.8100,	.8900,	.7300,	.7400,	.6400,	.5800,	.5500,	.8100,
11,	.9800,	.9200,	.9800,	.9500,	.9900,	.9400,	.8900,	.8200,	.7400,	.8900,
12,	.9800,	.9700,	.9800,	.9900,	.9800,	.9400,	.9000,	1.0000,	.9500,	.9100,
+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,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0200,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0100,	.0200,	.0000,	.0000,	.0100,	.0000,	.0200,	.0000,	.0000,	.0000,
6,	.0500,	.0100,	.0200,	.0100,	.0200,	.0500,	.0800,	.0200,	.0300,	.0200,
7,	.1100,	.1000,	.1600,	.0300,	.0900,	.1200,	.2600,	.1300,	.1300,	.1300,
8,	.3000,	.3400,	.5300,	.2100,	.2100,	.2900,	.5400,	.4400,	.3900,	.3500,
9,	.5900,	.6400,	.8100,	.5000,	.5600,	.4500,	.7600,	.7100,	.7700,	.6500,
10,	.7900,	.8100,	.9200,	.9600,	.7800,	.8400,	.8700,	.7700,	.8900,	.8200,
11,	.8600,	.9400,	.9500,	1.0000,	.7900,	.8300,	.9300,	.8100,	.8300,	1.0000,
12,	.8800,	1.0000,	.9800,	.9600,	.9500,	1.0000,	.9400,	.8900,	.7800,	.9000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.8000,	.9000,	.9000,

Table 3.11 (Continued)

Table 5 Proportion mature at age

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0500,	.0800,	.0500,	.0100,	.0500,	.0100,	.0200,	.0000,	.0100,
5,	.0200,	.1000,	.1000,	.1800,	.0900,	.0800,	.0700,	.0500,	.0500,	.0500,
6,	.0700,	.3400,	.3000,	.3100,	.3600,	.1900,	.1800,	.3300,	.1800,	.2100,
7,	.2000,	.6500,	.7300,	.5600,	.5500,	.5300,	.2200,	.5300,	.4100,	.5800,
8,	.5400,	.8200,	.8800,	.9000,	.8500,	.7100,	.4600,	.6200,	.6900,	.7700,
9,	.8000,	.9200,	.9700,	.9900,	.9600,	.6200,	.5000,	1.0000,	.8500,	.8600,
10,	.9700,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.7500,	1.0000,	1.0000,	.9800,
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,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,
5,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,	.0200,	.0400,	.0100,	.0600,
6,	.2800,	.4300,	.3000,	.3300,	.3300,	.2600,	.1400,	.1900,	.1000,	.2200,
7,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,	.5600,	.4400,	.4500,	.6400,
8,	.8300,	.9300,	.9100,	.8100,	.7400,	.8300,	.8200,	.8200,	.7900,	.8300,
9,	.9700,	.9700,	.9700,	.9700,	.9500,	.9800,	.9500,	.9300,	.8800,	.9700,
10,	1.0000,	1.0000,	.9900,	.9900,	.9800,	1.0000,	.9500,	.9800,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	.9500,	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,

1

Table 3.12

North-East Arctic cod (Sub-areas I and II) (run name: XSAASA19)
105
FLT02: Norwegian trawl catch and effort age 9 - 14 (Catch: Thous (Catch: Unknown) (Effort: Unknown)
1985 2000
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
1.24	1154	221	22	6	6
1.10	1510	213	25	2	9
0.73	890	154	74	9	1

FLT03: Russian trawl catch and effort ages 9 - 14 (Catch: Thousa (Catch: Unknown) (Effort: Unknown)
1985 2000
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
4.25	742	185	25	1	0

Table 3.12 (Continued)

```
FLT04: NorBarTrSur rev99 (Catch: Unknown) (Effort: Unknown)
1980 2000
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
   1     1828      834      382       89       11        4
FLT05: NorBarLofAcSur rev99 (Catch: Unknown) (Effort: Unknown)
1984 2000
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
   1    1716     812     554     190      23       8       5       3       1
```

Table 3.12 (Continued)

FLT07: RusSurCatch/hr rev00 (ages 1-8) (Catch: Unknown) ((Catch: Unknown)
(Effort: Unknown)
1982 2000
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
1	276	219	169	58	8	3

Table 3.13

Lowestoft VPA Version 3.1

1/05/2001 9:41

Extended Survivors Analysis

Arctic Cod (run: XSAASA19/X19)

CPUE data from file fleet

Catch data for 55 years. 1946 to 2000. Ages 3 to 13.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT02: Norwegian tra,	1991,	2000,	9,	12,	.000,	1.000
FLT03: Russian trawl,	1991,	2000,	9,	12,	.000,	1.000
FLT04: NorBarTrSur r,	1991,	2000,	3,	8,	.990,	1.000
FLT05: NorBarLofAcSu,	1991,	2000,	3,	11,	.990,	1.000
FLT07: RusSurCatch/h,	1991,	2000,	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 >= 10

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 converged after 27 iterations

1

Regression weights

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

Fishing mortalities

Age,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000
3,	.018,	.040,	.079,	.205,	.553,	.481,	.343,	.430,	.174,	.070
4,	.062,	.127,	.096,	.201,	.299,	.352,	.312,	.395,	.217,	.170
5,	.188,	.221,	.347,	.339,	.336,	.406,	.568,	.568,	.588,	.440
6,	.321,	.443,	.460,	.646,	.576,	.544,	.707,	.789,	.829,	.691
7,	.425,	.540,	.567,	1.169,	.891,	.750,	.847,	.736,	.818,	1.033
8,	.345,	.598,	.598,	.988,	.946,	.862,	1.236,	1.055,	.941,	1.071
9,	.379,	.455,	.664,	1.054,	.967,	.757,	1.337,	1.177,	1.454,	.861
10,	.244,	.455,	.661,	1.031,	1.018,	.952,	1.544,	1.241,	1.447,	1.371
11,	.145,	.233,	.668,	1.153,	1.220,	.863,	1.514,	1.468,	.935,	1.148
12,	.195,	.392,	.611,	1.080,	1.125,	.846,	1.477,	1.614,	1.762,	1.196

1

XSA population numbers (Thousands)

	AGE									
YEAR ,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,
1991 ,	4.17E+05,	2.00E+05,	1.06E+05,	8.19E+04,	6.21E+04,	9.55E+04,	1.36E+04,	2.19E+03,	3.94E+02,	7.50E+01,
1992 ,	7.29E+05,	3.35E+05,	1.54E+05,	7.22E+04,	4.86E+04,	3.32E+04,	5.54E+04,	7.64E+03,	1.40E+03,	2.79E+02,
1993 ,	9.03E+05,	5.73E+05,	2.42E+05,	1.01E+05,	3.80E+04,	2.32E+04,	1.50E+04,	2.88E+04,	3.97E+03,	9.11E+02,
1994 ,	8.22E+05,	6.83E+05,	4.26E+05,	1.40E+05,	5.21E+04,	1.76E+04,	1.05E+04,	6.31E+03,	1.22E+04,	1.66E+03,
1995 ,	6.67E+05,	5.48E+05,	4.58E+05,	2.49E+05,	6.00E+04,	1.32E+04,	5.37E+03,	2.99E+03,	1.84E+03,	3.14E+03,
1996 ,	4.34E+05,	3.14E+05,	3.33E+05,	2.68E+05,	1.14E+05,	2.02E+04,	4.21E+03,	1.67E+03,	8.83E+02,	4.45E+02,
1997 ,	7.20E+05,	2.20E+05,	1.81E+05,	1.81E+05,	1.27E+05,	4.42E+04,	6.97E+03,	1.62E+03,	5.29E+02,	3.05E+02,
1998 ,	8.76E+05,	4.18E+05,	1.32E+05,	8.39E+04,	7.32E+04,	4.47E+04,	1.05E+04,	1.50E+03,	2.83E+02,	9.52E+01,
1999 ,	5.67E+05,	4.66E+05,	2.31E+05,	6.11E+04,	3.12E+04,	2.87E+04,	1.27E+04,	2.65E+03,	3.55E+02,	5.34E+01,
2000 ,	5.94E+05,	3.90E+05,	3.07E+05,	1.05E+05,	2.18E+04,	1.13E+04,	9.18E+03,	2.44E+03,	5.12E+02,	1.14E+02,

Estimated population abundance at 1st Jan 2001

,	0.00E+00,	4.53E+05,	2.69E+05,	1.62E+05,	4.30E+04,	6.36E+03,	3.16E+03,	3.18E+03,	5.06E+02,	1.33E+02,

Taper weighted geometric mean of the VPA populations:

,	6.56E+05,	3.97E+05,	2.51E+05,	1.26E+05,	5.57E+04,	2.38E+04,	8.65E+03,	2.58E+03,	7.75E+02,	2.65E+02,

Standard error of the weighted Log(VPA populations) :

,	.2458,	.3530,	.4433,	.5628,	.6721,	.5641,	.4990,	.7319,	1.1409,	1.4241,

Table 3.13 (Continued)

Log catchability residuals.

Fleet : FLT02: Norwegian tra

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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	-2.25	-.72	.14	-.14	.12	-.06	-.32	-.05	.25	.23
10	-3.40	-.77	.50	-.04	-.99	.57	-.23	.37	-.04	.11
11	-3.52	-.84	1.01	.07	-1.12	.43	.34	-.18	-.36	.85
12	99.99	-.13	.38	.10	.16	.07	.07	-.34	-.68	.26

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	-1.7604	-1.8692	-1.8692	-1.8692
S.E(Log q)	.2749	.5325	.7033	.3700

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	1.00	-.015	1.73	.77	10	.31	-1.76
10	1.06	-.172	1.49	.63	10	.63	-1.87
11	1.01	-.034	1.76	.72	10	.79	-1.81
12	.86	1.693	2.44	.97	9	.27	-1.93

1

Fleet : FLT03: Russian trawl

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	.46	.20	.90	.81	.58	.15	-.11	-.76	-.34	-.01
10	-.18	.47	.13	.59	.52	.36	-.16	-.63	-.40	.14
11	.00	-.35	-1.15	-1.29	.22	-.61	-.12	.17	99.99	-.38
12	.30	-.48	-1.36	-.76	-2.29	-1.15	-.81	.35	99.99	-2.08

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	-3.4717	-3.4825	-3.4825	-3.4825
S.E(Log q)	.5322	.4516	.6319	1.5640

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	1.25	-.399	2.06	.37	10	.73	-3.47
10	.80	.911	4.35	.83	10	.37	-3.48
11	1.46	-1.839	2.43	.83	9	.62	-3.80
12	1.46	-.850	3.97	.51	9	1.50	-4.57

1

Fleet : FLT04: NorBarTrSur r

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3	-.40	-.32	.04	.05	-.01	-.04	.08	-.09	-.02	.09
4	-.55	-.03	-.08	.21	.05	.17	.04	-.22	-.01	-.05
5	-.14	-.32	.22	-.03	.14	-.02	.16	-.03	-.04	-.17
6	-.31	-.28	-.19	.35	-.03	.03	.11	-.04	-.10	-.05
7	-.25	.02	-.20	.09	-.14	-.25	.15	.07	.07	.04
8	-.86	.24	.28	.25	-.20	.11	-.20	-.21	.12	.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									

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
Mean Log q,	-6.1387,	-6.4082,	-6.7681,
S.E(Log q),	.1428,	.1460,	.1995,

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,	.70,	1.769,	7.96,	.89,	10,	.10,	-5.60,
4,	.71,	1.494,	7.78,	.86,	10,	.16,	-5.70,
5,	.77,	1.567,	7.39,	.92,	10,	.15,	-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,	.90,	1.005,	6.70,	.96,	10,	.13,	-6.14,
7,	1.04,	-.338,	6.24,	.95,	10,	.17,	-6.41,
8,	1.19,	-1.067,	6.13,	.88,	10,	.24,	-6.77,

1

Fleet : FLT05: NorBarLofAcSu

Age ,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000
3 ,	-.46,	.06,	.62,	-.08,	-.34,	-.29,	.32,	-.42,	.26,	.18
4 ,	-.50,	.34,	.30,	.20,	-.22,	-.06,	.14,	-.39,	.28,	-.04
5 ,	-.08,	.12,	.54,	.10,	-.11,	-.35,	.21,	-.32,	.29,	-.02
6 ,	.28,	.41,	-.03,	.09,	-.13,	-.12,	.04,	-.20,	.27,	-.01
7 ,	.45,	.80,	.34,	-.41,	-.43,	-.05,	.13,	.29,	.22,	-.30
8 ,	1.19,	1.41,	.68,	.56,	-.65,	-.37,	.02,	.46,	.20,	-.59
9 ,	.43,	1.42,	.50,	1.02,	-.45,	-.19,	.35,	.01,	.19,	-.87
10 ,	.31,	.39,	.56,	.52,	.19,	99.99,	-.18,	-.40,	.33,	-.35
11 ,	-.16,	-.09,	.66,	1.12,	1.38,	1.14,	99.99,	1.49,	.73,	-.11
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,	9,	10,	11
Mean Log q,	-5.4213,	-5.3316,	-5.3984,	-5.5938,	-4.7821,	-4.7821,
S.E(Log q),	.1761,	.3221,	.5380,	.5954,	.3906,	1.1509,

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,	.99,	.010,	5.82,	.34,	10,	.38,	-5.76,
4,	.79,	.605,	7.26,	.66,	10,	.28,	-5.75,
5,	.83,	.537,	6.82,	.71,	10,	.31,	-5.70,

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
6,	1.18,	-1.161,	4.28,	.91,	10,	.20,	-5.42,
7,	.91,	.453,	5.85,	.85,	10,	.32,	-5.33,
8,	.61,	1.883,	7.23,	.84,	10,	.27,	-5.40,
9,	.66,	1.008,	6.78,	.67,	10,	.39,	-5.59,
10,	.73,	2.030,	5.63,	.94,	9,	.22,	-4.78,
11,	.94,	.221,	4.08,	.81,	9,	.68,	-3.92,

1

Fleet : FLT07: RusSurCatch/h

Age ,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000
3 ,	-.12,	-.01,	.07,	-.21,	-.20,	-.07,	-.50,	.32,	.27,	.15
4 ,	-.38,	-.47,	.06,	-.22,	-.27,	-.20,	.01,	.27,	.28,	-.05
5 ,	-.57,	-1.20,	1.07,	.52,	-.09,	-.51,	-.58,	.28,	.37,	-.04
6 ,	.17,	.10,	.67,	1.66,	-.23,	-.53,	-.83,	.02,	.19,	.15
7 ,	.91,	.10,	.93,	2.16,	.10,	-.23,	-.93,	-.61,	.04,	.19
8 ,	.21,	.38,	1.07,	1.98,	.44,	.19,	-.83,	-.67,	-.21,	-.13
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									
11 ,	No data for this fleet at this age									
12 ,	No data for this fleet at this age									

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
Mean Log q,	-6.8024,	-6.9352,	-6.8958,
S.E(Log q),	.6775,	.8437,	.8171,

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,	.59,	.685,	9.95,	.40,	10,	.33,	-7.60,
4,	.62,	1.202,	9.28,	.70,	10,	.26,	-7.04,
5,	1.22,	-.390,	5.62,	.43,	10,	.57,	-6.83,

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
6,	2.04,	-.969,	1.65,	.17,	10,	1.39,	-6.80,
7,	2.36,	-1.069,	1.51,	.13,	10,	1.96,	-6.94,
8,	4.41,	-1.307,	-3.96,	.03,	10,	3.38,	-6.90,

1

Terminal year survivor and F summaries :

Age 3 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
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	495042.,	.300,	.000,	.00,	1,	.324,	.064
FLT05: NorBarLofAcSu,	544949.,	.415,	.000,	.00,	1,	.170,	.059
FLT07: RusSurCatch/h,	524977.,	.361,	.000,	.00,	1,	.224,	.061
P shrinkage mean ,	397368.,	.35,,,,				.251,	.080
F shrinkage mean ,	67186.,	1.00,,,,				.031,	.399

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
453257.,	.17,	.19,	5,	1.116,	.070

1

Age 4 Catchability dependent on age and year class strength

Year class = 1996

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	259691.,	.213,	.015,	.07,	2,	.337,	.176
FLT05: NorBarLofAcSu,	284530.,	.247,	.136,	.55,	2,	.256,	.162
FLT07: RusSurCatch/h,	287678.,	.232,	.153,	.66,	2,	.288,	.160
P shrinkage mean ,	250634.,	.44,,,,				.099,	.182
F shrinkage mean ,	134187.,	1.00,,,,				.020,	.317

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
269330.,	.13,	.06,	8,	.469,	.170

Age 5 Catchability dependent on age and year class strength

Year class = 1995

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	147388.,	.179,	.049,	.27,	3,	.394,	.475
FLT05: NorBarLofAcSu,	168021.,	.212,	.170,	.80,	3,	.289,	.427
FLT07: RusSurCatch/h,	203535.,	.235,	.090,	.38,	3,	.219,	.365
P shrinkage mean ,	126418.,	.56,,,,				.075,	.536
F shrinkage mean ,	139033.,	1.00,,,,				.024,	.497

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
162164.,	.12,	.07,	11,	.561,	.440

Table 3.13 (Continued)

```
1
 Age  6   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: Norwegian tra,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT03: Russian trawl,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT04: NorBarTrSur r,     40567.,   .170,      .047,    .28,   4,  .432,     .721
 FLT05: NorBarLofAcSu,     43698.,   .190,      .131,    .69,   4,  .371,     .684
 FLT07: RusSurCatch/h,     48737.,   .239,      .173,    .72,   4,  .161,     .631

   F shrinkage mean  ,     42661.,   1.00,,,,                       .036,     .696

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     43032.,       .11,      .06,   13,    .507,   .691


 Age  7   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: Norwegian tra,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT03: Russian trawl,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT04: NorBarTrSur r,      6345.,   .176,      .029,    .16,   5,  .472,    1.035
 FLT05: NorBarLofAcSu,      5803.,   .203,      .132,    .65,   5,  .360,    1.093
 FLT07: RusSurCatch/h,      7117.,   .297,      .059,    .20,   5,  .107,     .962

   F shrinkage mean  ,      9119.,   1.00,,,,                       .062,     .817

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      6361.,       .13,      .05,   16,    .401,  1.033


1
 Age  8   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: Norwegian tra,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT03: Russian trawl,         1.,   .000,      .000,    .00,   0,  .000,     .000
 FLT04: NorBarTrSur r,      3412.,   .183,      .022,    .12,   6,  .548,    1.022
 FLT05: NorBarLofAcSu,      2791.,   .216,      .150,    .69,   6,  .283,    1.155
 FLT07: RusSurCatch/h,      2759.,   .388,      .065,    .17,   6,  .090,    1.163

   F shrinkage mean  ,      3423.,   1.00,,,,                       .078,    1.020

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      3163.,       .15,      .05,   19,    .343,  1.071

 Age  9   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: Norwegian tra,      3982.,   .300,      .000,    .00,   1,  .333,     .737
 FLT03: Russian trawl,      3157.,   .573,      .000,    .00,   1,  .091,     .865
 FLT04: NorBarTrSur r,      3494.,   .177,      .018,    .10,   6,  .252,     .807
 FLT05: NorBarLofAcSu,      2512.,   .263,      .202,    .77,   7,  .208,    1.003
 FLT07: RusSurCatch/h,      2184.,   .355,      .096,    .27,   6,  .045,    1.094

   F shrinkage mean  ,      2004.,   1.00,,,,                       .071,    1.152

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      3178.,       .15,      .07,   22,    .470,   .861

1
 Age 10   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
 FLT02: Norwegian tra,       601.,   .339,      .070,    .21,   2,  .241,    1.245
 FLT03: Russian trawl,       545.,   .424,      .168,    .40,   2,  .212,    1.316
 FLT04: NorBarTrSur r,       478.,   .185,      .074,    .40,   6,  .070,    1.414
 FLT05: NorBarLofAcSu,       394.,   .345,      .085,    .24,   8,  .297,    1.563
 FLT07: RusSurCatch/h,       311.,   .385,      .137,    .36,   6,  .012,    1.755

   F shrinkage mean  ,       592.,   1.00,,,,                       .169,    1.256

 Weighted prediction :
```

Table 3.13 (Continued)

Survivors, at end of year	Int, s.e	Ext, s.e	N	Var, Ratio	F
506.	.23	.05	25	.216	1.371

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1989

Fleet	Estimated, Survivors	Int, s.e	Ext, s.e	Var, Ratio	N	Scaled, Weights	Estimated F
FLT02: Norwegian tra	205.	.432	.316	.73	3	.261	.872
FLT03: Russian trawl	88.	.463	.066	.14	3	.266	1.448
FLT04: NorBarTrSur r	111.	.198	.033	.17	6	.031	1.275
FLT05: NorBarLofAcSu	155.	.425	.072	.17	9	.185	1.046
FLT07: RusSurCatch/h	92.	.450	.192	.43	6	.005	1.412
F shrinkage mean	121.	1.00				.253	1.215

Weighted prediction :

Survivors, at end of year	Int, s.e	Ext, s.e	N	Var, Ratio	F
133.	.31	.08	28	.251	1.148

1

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1988

Fleet	Estimated, Survivors	Int, s.e	Ext, s.e	Var, Ratio	N	Scaled, Weights	Estimated F
FLT02: Norwegian tra	34.	.337	.121	.36	4	.585	1.069
FLT03: Russian trawl	9.	.705	.537	.76	3	.069	2.105
FLT04: NorBarTrSur r	30.	.234	.061	.26	6	.014	1.143
FLT05: NorBarLofAcSu	27.	.408	.176	.43	9	.077	1.238
FLT07: RusSurCatch/h	39.	.616	.239	.39	6	.002	.987
F shrinkage mean	25.	1.00				.254	1.275

Weighted prediction :

Survivors, at end of year	Int, s.e	Ext, s.e	N	Var, Ratio	F
28.	.33	.08	29	.259	1.196

1

Table 3.14 Fishing mortality when cannibalism added to catch for the period 1984-2000.

Run title : Arctic Cod (run: XSAASA19/X19)

At 1/05/2001 9:45

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.0060,	.0018,	.0003,	.0023,	.0020,
4,	.0199,	.0247,	.0123,	.0208,	.0319,
5,	.0529,	.1094,	.0746,	.1477,	.1160,
6,	.0967,	.2014,	.1987,	.3655,	.2873,
7,	.1773,	.4156,	.5199,	.5098,	.4088,
8,	.1923,	.2533,	.3525,	.3856,	.3466,
9,	.3117,	.4037,	.5280,	.3818,	.4725,
10,	.2784,	.4400,	.3601,	.3748,	.5015,
11,	.3419,	.7856,	.5540,	.6252,	.9071,
12,	.3120,	.6182,	.4604,	.5039,	.7111,
+gp,	.3120,	.6182,	.4604,	.5039,	.7111,
0 FBAR 5-10,	.1849,	.3039,	.3390,	.3609,	.3555,
FBAR 4- 8,	.1078,	.2009,	.2316,	.2859,	.2381,

Table 8 Fishing mortality (F) at age

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	.0253,	.0224,	.0332,	.0198,	.0158,	.0268,	.0238,	.0713,	.0530,	.0538,
4,	.1605,	.1659,	.1317,	.1448,	.0834,	.1282,	.1120,	.2578,	.2552,	.2249,
5,	.2627,	.3694,	.2289,	.2664,	.2845,	.4562,	.2082,	.3612,	.5088,	.3462,
6,	.2776,	.5503,	.3114,	.3321,	.5290,	.6907,	.4854,	.5510,	.5108,	.4594,
7,	.4114,	.5308,	.3231,	.3956,	.5128,	.6127,	.5488,	.5348,	.5236,	.4338,
8,	.4034,	.4164,	.3454,	.2478,	.5873,	.6883,	.6284,	.4576,	.5094,	.4828,
9,	.5042,	.5783,	.3915,	.4343,	.5791,	.6547,	.5450,	.4516,	.6123,	.4023,
10,	.5125,	.7617,	.5347,	.6430,	.7640,	.7372,	.6322,	.7389,	.6845,	.7360,
11,	.4558,	1.0302,	.6978,	.8038,	.7616,	.8767,	.8590,	.8431,	.6500,	.8441,
12,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,	.7981,
+gp,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,	.7981,
0 FBAR 5-10,	.3953,	.5345,	.3558,	.3865,	.5428,	.6400,	.5080,	.5159,	.5582,	.4768,
FBAR 4- 8,	.3031,	.4066,	.2681,	.2773,	.3994,	.5152,	.3966,	.4325,	.4616,	.3894,

1

Run title : Arctic Cod (run: XSAASA19/X19)

At 1/05/2001 9:45

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	.0558,	.0659,	.0311,	.0173,	.0224,	.0394,	.0296,	.0249,	.0228,	.0406,
4,	.2698,	.3048,	.2356,	.1440,	.1102,	.1029,	.1515,	.2052,	.2284,	.1415,
5,	.4921,	.6481,	.7433,	.3526,	.3897,	.2105,	.1800,	.4072,	.4783,	.3998,
6,	.5151,	.8272,	1.0105,	.4843,	.4481,	.3801,	.2010,	.4660,	.5366,	.5672,
7,	.5263,	.6071,	.9783,	.5778,	.4013,	.4693,	.4294,	.3990,	.7711,	.6189,
8,	.6904,	.6547,	.8789,	.7401,	.5283,	.5770,	.6827,	.5251,	.9300,	.8460,
9,	.7357,	.8124,	.9431,	1.0699,	.7372,	.7165,	.8762,	.8025,	1.1794,	.9684,
10,	.8353,	.9819,	1.3756,	.8488,	.8071,	.8159,	.8839,	.8051,	1.0793,	1.0904,
11,	1.0014,	.9477,	1.4406,	1.3026,	.7625,	.4988,	1.2307,	.6721,	1.5623,	.8536,
12,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,	.9829,
+gp,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,	.9829,
0 FBAR 5-10,	.6325,	.7552,	.9883,	.6789,	.5519,	.5282,	.5422,	.5675,	.8291,	.7485,
FBAR 4- 8,	.4988,	.6084,	.7693,	.4598,	.3755,	.3480,	.3289,	.4005,	.5889,	.5147,

Table 8 Fishing mortality (F) at age

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	.0212,	.0390,	.1948,	.2130,	.0829,	.1648,	.1329,	.1451,	.0485,	.0315,
4,	.1021,	.1662,	.1982,	.4950,	.2092,	.3101,	.5662,	.2220,	.2077,	.1285,
5,	.2275,	.2964,	.3518,	.5358,	.5198,	.4782,	.7537,	.6697,	.3455,	.3542,
6,	.2505,	.3840,	.3901,	.5055,	.7007,	.5698,	.6842,	.8502,	.5455,	.6204,
7,	.5126,	.3411,	.4198,	.4429,	.7025,	.6945,	.6741,	.8578,	.6624,	.6734,
8,	.8312,	.6563,	.7385,	.4847,	.7011,	.8879,	.9089,	.9287,	.7769,	.7089,
9,	.9561,	1.1371,	.9711,	.5181,	.6092,	.7711,	1.2306,	1.3076,	1.0356,	.9372,
10,	.7847,	1.3451,	.7370,	.8854,	.7154,	.4565,	.7613,	1.0265,	.9809,	1.0392,
11,	.8344,	1.2967,	.7203,	.9922,	.9114,	.6125,	.6172,	1.8114,	1.4331,	1.4842,
12,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,	1.2775,
+gp,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,	1.2775,
0 FBAR 5-10,	.5938,	.6933,	.6014,	.5621,	.6581,	.6430,	.8355,	.9401,	.7245,	.7222,
FBAR 4- 8,	.3848,	.3688,	.4197,	.4928,	.5667,	.5881,	.7174,	.7057,	.5076,	.4971,

Table 3.14 (Continued

Table 8 Fishing mortality (F) at age

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.0250,	.0666,	.0206,	.0198,	.0532,	.1430,	.1128,	.0629,	.0327,	.0086,
4,	.0994,	.2106,	.2036,	.1236,	.1700,	.2121,	.2284,	.1269,	.1284,	.0622,
5,	.2282,	.3021,	.3285,	.3075,	.3767,	.4926,	.5094,	.3702,	.2658,	.1342,
6,	.5137,	.5492,	.4996,	.6275,	.6051,	.7067,	.9334,	.5966,	.4014,	.2308,
7,	.8465,	.7973,	.7791,	1.1361,	.9250,	.9480,	1.1459,	1.0359,	.7143,	.2503,
8,	1.0789,	.9850,	1.0285,	1.2112,	1.0189,	1.0914,	1.0140,	.9987,	.8701,	.3731,
9,	1.2819,	1.1616,	.9708,	1.2623,	.7786,	.8282,	.7793,	1.1582,	.7428,	.2944,
10,	1.2338,	.7501,	.9209,	.9580,	.5057,	1.1122,	1.3244,	1.7253,	.9834,	.3443,
11,	.9567,	.9534,	.5822,	1.0877,	.4205,	.8747,	1.0277,	1.5388,	.5892,	.5376,
12,	1.1082,	.8607,	.7590,	1.0346,	.4666,	1.0047,	1.1904,	1.6542,	.7943,	.4441,
+gp,	1.1082,	.8607,	.7590,	1.0346,	.4666,	1.0047,	1.1904,	1.6542,	.7943,	.4441,
0 FBAR 5-10,	.8638,	.7575,	.7546,	.9171,	.7017,	.8632,	.9511,	.9808,	.6630,	.2712,
FBAR 4- 8,	.5533,	.5688,	.5679,	.6812,	.6191,	.6901,	.7663,	.6257,	.4760,	.2101,

Table 8 Fishing mortality (F) at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	FBAR 98-**
AGE											
3,	.0183,	.0404,	.0789,	.2047,	.5527,	.4809,	.3429,	.4301,	.1736,	.0701,	.2246,
4,	.0625,	.1265,	.0963,	.2009,	.2992,	.3522,	.3123,	.3950,	.2167,	.1704,	.2607,
5,	.1875,	.2206,	.3467,	.3394,	.3361,	.4064,	.5681,	.5680,	.5881,	.4397,	.5319,
6,	.3210,	.4430,	.4599,	.6457,	.5763,	.5439,	.7073,	.7890,	.8287,	.6912,	.7696,
7,	.4254,	.5396,	.5668,	1.1693,	.8908,	.7500,	.8467,	.7357,	.8182,	1.0333,	.8624,
8,	.3447,	.5982,	.5975,	.9883,	.9461,	.8623,	1.2362,	1.0554,	.9409,	1.0709,	1.0224,
9,	.3788,	.4551,	.6642,	1.0536,	.9669,	.7569,	1.3365,	1.1767,	1.4540,	.8607,	1.1638,
10,	.2435,	.4555,	.6613,	1.0311,	1.0178,	.9525,	1.5436,	1.2415,	1.4468,	1.3710,	1.3531,
11,	.1446,	.2328,	.6682,	1.1532,	1.2198,	.8630,	1.5139,	1.4679,	.9348,	1.1480,	1.1836,
12,	.1946,	.3924,	.6112,	1.0805,	1.1253,	.8464,	1.4765,	1.6136,	1.7620,	1.1958,	1.5238,
+gp,	.1946,	.3924,	.6112,	1.0805,	1.1253,	.8464,	1.4765,	1.6136,	1.7620,	1.1958,	
0 FBAR 5-10,	.3168,	.4520,	.5494,	.8712,	.7890,	.7120,	1.0397,	.9277,	1.0128,	.9111,	
FBAR 4- 8,	.2682,	.3856,	.4134,	.6687,	.6097,	.5829,	.7341,	.7086,	.6785,	.6811,	

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Table 3.15

Run title : Arctic Cod (run: XSAASA19/X19)

At 1/05/2001 9:45

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,	1950,
AGE					
3,	734497,	428855,	446554,	472677,	710902,
4,	582966,	597729,	350475,	365481,	386098,
5,	405783,	467894,	477442,	283441,	293070,
6,	198974,	315120,	343366,	362798,	200199,
7,	94185,	147889,	210932,	230469,	206100,
8,	97114,	64587,	79910,	102685,	113334,
9,	246943,	65603,	41048,	45987,	57173,
10,	102870,	148030,	35870,	19821,	25701,
11,	38521,	63758,	78056,	20487,	11155,
12,	39479,	22406,	23796,	36724,	8976,
+gp,	33328,	42765,	37374,	21336,	21134,
0 TOTAL,	2574662,	2364636,	2124822,	1961905,	2033843,

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

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	1092988,	1204159,	1605848,	647779,	275409,	443916,	812552,	501571,	691500,	799052,
4,	580878,	872525,	964076,	1271856,	519975,	221955,	353844,	649589,	382403,	536919,
5,	306199,	405074,	605146,	691905,	900903,	391651,	159849,	259001,	410974,	242561,
6,	213665,	192773,	229216,	394073,	434020,	554970,	203206,	106278,	147762,	202303,
7,	122980,	132527,	91028,	137448,	231477,	209363,	227735,	102397,	50153,	72587,
8,	112117,	66725,	63815,	53950,	75765,	113483,	92886,	107703,	49108,	24324,
9,	65612,	61325,	36024,	36989,	34477,	34478,	46683,	40568,	55799,	24159,
10,	29182,	32445,	28160,	19940,	19615,	15819,	14667,	22162,	21145,	24766,
11,	12743,	14311,	12402,	13507,	8583,	7481,	6197,	6381,	8667,	8732,
12,	3687,	6614,	4182,	5054,	4950,	3281,	2549,	2149,	2249,	3705,
+gp,	13989,	3938,	1880,	2707,	2738,	3722,	1687,	857,	1142,	1351,
0 TOTAL,	2554041,	2992417,	3641779,	3275208,	2507911,	2000118,	1921855,	1798656,	1820903,	1940458,

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Run title : Arctic Cod (run: XSAASA19/X19)

At 1/05/2001 9:45

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	926695,	734810,	476587,	342140,	785390,	1598553,	1308149,	166364,	112970,	198940,
4,	619931,	717564,	563232,	378256,	275327,	628794,	1258171,	1039834,	132851,	90405,
5,	351040,	387525,	433157,	364332,	268147,	201894,	464464,	885286,	693373,	86560,
6,	140481,	175698,	165953,	168651,	209661,	148693,	133920,	317625,	482350,	351872,
7,	104623,	68719,	62903,	49461,	85079,	109665,	83248,	89683,	163185,	230923,
8,	38512,	50605,	30658,	19362,	22722,	46634,	56154,	44365,	49266,	61794,
9,	12288,	15808,	21529,	10423,	7562,	10968,	21441,	23228,	21485,	15915,
10,	13229,	4821,	5744,	6864,	2927,	2962,	4386,	7309,	8524,	5408,
11,	9713,	4698,	1478,	1188,	2405,	1069,	1073,	1484,	2675,	2372,
12,	3073,	2921,	1491,	287,	264,	919,	532,	256,	620,	459,
+gp,	2332,	1351,	1113,	1278,	670,	351,	461,	498,	278,	312,
0 TOTAL,	2221918,	2164519,	1763844,	1342243,	1660155,	2750501,	3331998,	2575933,	1667579,	1044961,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	409015,	1026675,	1837462,	529207,	628980,	620797,	351568,	644845,	200700,	139416,
4,	156396,	327857,	808416,	1238128,	350164,	473992,	431049,	252013,	456633,	156538,
5,	64252,	115615,	227319,	542896,	617938,	232583,	284612,	200350,	165251,	303749,
6,	47513,	41900,	70379,	130918,	260105,	300847,	118042,	109660,	83959,	95776,
7,	163376,	30280,	23366,	39010,	64654,	105672,	139328,	48756,	38366,	39836,
8,	101819,	80113,	17627,	12572,	20510,	26221,	43200,	58134,	16929,	16197,
9,	21710,	36308,	34026,	6896,	6339,	8330,	8835,	14252,	18804,	6374,
10,	4947,	6833,	9535,	10548,	3363,	2822,	3154,	2113,	3156,	5465,
11,	1488,	1848,	1457,	3736,	3563,	1346,	1464,	1206,	620,	969,
12,	827,	529,	414,	581,	1134,	1173,	597,	646,	161,	121,
+gp,	421,	697,	408,	525,	550,	572,	583,	1198,	218,	87,
0 TOTAL,	971765,	1668655,	3030409,	2515016,	1957300,	1774355,	1382434,	1333174,	984797,	764528,

Table 3.15 (Continued)

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	152563,	153479,	168706,	403195,	528898,	1045583,	288731,	206597,	174576,	245871,
4,	110605,	121825,	117561,	135313,	323625,	410569,	741955,	211187,	158840,	138330,
5,	112702,	81991,	80801,	78522,	97900,	223548,	271909,	483402,	152299,	114382,
6,	174505,	73449,	49624,	47629,	47271,	54994,	111840,	133756,	273309,	95588,
7,	42166,	85476,	34724,	24653,	20821,	21132,	22210,	36004,	60306,	149791,
8,	16632,	14808,	31530,	13044,	6481,	6760,	6705,	5781,	10462,	24171,
9,	6527,	4630,	4528,	9230,	3181,	1915,	1858,	1991,	1744,	3588,
10,	2044,	1483,	1186,	1404,	2138,	1195,	685,	698,	512,	679,
11,	1583,	487,	573,	387,	441,	1056,	322,	149,	102,	157,
12,	180,	498,	154,	262,	107,	237,	361,	94,	26,	46,
+gp,	66,	70,	170,	116,	208,	130,	156,	82,	56,	40,
0 TOTAL,	619573,	538195,	489558,	713754,	1031070,	1767120,	1446730,	1079742,	832231,	772641,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	GMST 46-98	AMST 46-98
AGE													
3,	416601,	729023,	903131,	821662,	666842,	434168,	719927,	875728,	566749,	593816,	0,	500249,	619675,
4,	199573,	334914,	573223,	683347,	548167,	314144,	219758,	418325,	466353,	390076,	453257,	377993,	467049,
5,	106422,	153504,	241617,	426219,	457651,	332759,	180855,	131661,	230727,	307444,	269330,	260558,	319234,
6,	81886,	72231,	100801,	139866,	248529,	267741,	181449,	83895,	61083,	104915,	162164,	152660,	186624,
7,	62130,	48636,	37972,	52105,	60041,	114348,	127251,	73235,	31205,	21835,	43032,	76774,	95857,
8,	95487,	33242,	23215,	17638,	13249,	20170,	44225,	44675,	28731,	11272,	6361,	34430,	46400,
9,	13628,	55383,	14964,	10457,	5375,	4211,	6972,	10518,	12731,	9180,	3163,	14756,	25964,
10,	2189,	7639,	28766,	6306,	2985,	1673,	1618,	1500,	2655,	2435,	3178,	5903,	13944,
11,	394,	1405,	3966,	12157,	1841,	883,	529,	283,	355,	512,	506,	2304,	7237,
12,	75,	279,	911,	1665,	3142,	445,	305,	95,	53,	114,	133,	866,	3692,
+gp,	25,	44,	205,	236,	423,	1704,	535,	157,	93,	40,	38,		
0 TOTAL,	978408,	1436300,	1928771,	2171658,	2008246,	1492246,	1483423,	1640071,	1400736,	1441640,	941162,		

1

Table 3.16 Natural mortality, including cannibalism for the period 1984-2000

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 4 Natural Mortality (M) at age

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
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,

1

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Table 4 Natural Mortality (M) at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
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,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
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,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.2000,	.2000,	.2000,	.2006,	.2004,	.3101,	.2575,	.2086,	.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,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	.2050,	.2067,	.2660,	.3950,	.7422,	.6564,	.5196,	.5806,	.3577,	.2609,
4,	.2000,	.2000,	.2029,	.2948,	.3998,	.4321,	.2986,	.3108,	.2118,	.2700,
5,	.2000,	.2000,	.2025,	.2258,	.2082,	.2802,	.2104,	.2292,	.2000,	.2262,
6,	.2000,	.2000,	.2000,	.2047,	.2001,	.2060,	.2019,	.2177,	.2000,	.2005,
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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Table 3.17 Fishing mortality when cannibalism treated as natural mortality.

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	.0061,	.0018,	.0003,	.0023,	.0020,
4,	.0200,	.0249,	.0124,	.0209,	.0321,
5,	.0532,	.1101,	.0751,	.1484,	.1167,
6,	.0973,	.2024,	.1997,	.3662,	.2882,
7,	.1781,	.4160,	.5201,	.5101,	.4096,
8,	.1932,	.2545,	.3536,	.3869,	.3480,
9,	.3125,	.4047,	.5286,	.3832,	.4741,
10,	.2798,	.4405,	.3617,	.3766,	.5031,
11,	.3432,	.7827,	.5536,	.6259,	.9031,
12,	.3120,	.6182,	.4604,	.5039,	.7111,
+gp,	.3120,	.6182,	.4604,	.5039,	.7111,
0 FBAR 5-10,	.1857,	.3047,	.3398,	.3619,	.3566,
FBAR 4- 8,	.1084,	.2016,	.2322,	.2865,	.2389,

Table 8 Fishing mortality (F) at age

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	.0254,	.0225,	.0334,	.0199,	.0159,	.0270,	.0240,	.0718,	.0535,	.0543,
4,	.1612,	.1667,	.1325,	.1457,	.0840,	.1291,	.1128,	.2589,	.2564,	.2266,
5,	.2637,	.3700,	.2299,	.2676,	.2859,	.4568,	.2094,	.3626,	.5093,	.3477,
6,	.2787,	.5501,	.3125,	.3333,	.5297,	.6900,	.4862,	.5517,	.5121,	.4607,
7,	.4122,	.5311,	.3243,	.3969,	.5139,	.6129,	.5494,	.5357,	.5251,	.4363,
8,	.4046,	.4175,	.3469,	.2494,	.5880,	.6880,	.6287,	.4593,	.5111,	.4855,
9,	.5057,	.5790,	.3932,	.4364,	.5805,	.6551,	.5463,	.4535,	.6141,	.4053,
10,	.5149,	.7613,	.5364,	.6441,	.7645,	.7380,	.6333,	.7388,	.6860,	.7381,
11,	.4585,	1.0260,	.6980,	.8035,	.7621,	.8756,	.8584,	.8415,	.6511,	.8449,
12,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,	.7981,
+gp,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,	.7981,
0 FBAR 5-10,	.3966,	.5348,	.3572,	.3879,	.5437,	.6401,	.5089,	.5169,	.5596,	.4789,
FBAR 4- 8,	.3041,	.4071,	.2692,	.2786,	.4003,	.5154,	.3973,	.4337,	.4628,	.3914,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	.0562,	.0663,	.0313,	.0174,	.0226,	.0398,	.0298,	.0251,	.0230,	.0409,
4,	.2717,	.3063,	.2366,	.1449,	.1110,	.1037,	.1525,	.2064,	.2292,	.1422,
5,	.4944,	.6498,	.7420,	.3537,	.3909,	.2119,	.1814,	.4087,	.4792,	.4004,
6,	.5168,	.8279,	1.0069,	.4854,	.4494,	.3818,	.2026,	.4683,	.5382,	.5680,
7,	.5279,	.6094,	.9764,	.5787,	.4033,	.4713,	.4320,	.4019,	.7725,	.6211,
8,	.6931,	.6564,	.8798,	.7409,	.5303,	.5797,	.6844,	.5291,	.9302,	.8479,
9,	.7389,	.8167,	.9416,	1.0674,	.7389,	.7183,	.8781,	.8041,	1.1783,	.9682,
10,	.8379,	.9855,	1.3731,	.8476,	.8074,	.8182,	.8850,	.8105,	1.0769,	1.0900,
11,	1.0011,	.9522,	1.4366,	1.2968,	.7617,	.5024,	1.2253,	.6772,	1.5554,	.8533,
12,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,	.9829,
+gp,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,	.9829,
0 FBAR 5-10,	.6348,	.7576,	.9866,	.6789,	.5533,	.5302,	.5439,	.5704,	.8292,	.7493,
FBAR 4- 8,	.5008,	.6100,	.7683,	.4607,	.3770,	.3497,	.3306,	.4029,	.5899,	.5159,

Table 8 Fishing mortality (F) at age

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	.0214,	.0394,	.1959,	.2141,	.0837,	.1660,	.1338,	.1460,	.0489,	.0318,
4,	.1028,	.1673,	.1996,	.4959,	.2106,	.3121,	.5671,	.2234,	.2090,	.1296,
5,	.2285,	.2976,	.3536,	.5375,	.5211,	.4800,	.7544,	.6703,	.3475,	.3562,
6,	.2517,	.3849,	.3917,	.5078,	.7021,	.5715,	.6857,	.8497,	.5478,	.6225,
7,	.5144,	.3427,	.4210,	.4451,	.7050,	.6973,	.6763,	.8581,	.6643,	.6766,
8,	.8330,	.6583,	.7375,	.4863,	.7032,	.8908,	.9121,	.9296,	.7789,	.7123,
9,	.9584,	1.1338,	.9698,	.5192,	.6109,	.7746,	1.2298,	1.3057,	1.0352,	.9390,
10,	.7876,	1.3393,	.7386,	.8842,	.7149,	.4600,	.7689,	1.0301,	.9848,	1.0380,
11,	.8388,	1.2904,	.7222,	.9905,	.9079,	.6132,	.6231,	1.8042,	1.4314,	1.4798,
12,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,	1.2775,
+gp,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,	1.2775,
0 FBAR 5-10,	.5956,	.6928,	.6020,	.5633,	.6595,	.6457,	.8379,	.9406,	.7264,	.7241,
FBAR 4- 8,	.3861,	.3702,	.4207,	.4945,	.5684,	.5904,	.7191,	.7062,	.5095,	.4994,

Table 3.17 (Continued)

Table 8 Fishing mortality (F) at age

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	.0252,	.0672,	.0208,	.0194,	.0532,	.0330,	.0555,	.0546,	.0330,	.0087,
4,	.1003,	.2121,	.2050,	.1248,	.1715,	.2132,	.2292,	.1276,	.1292,	.0628,
5,	.2300,	.3045,	.3308,	.3096,	.3792,	.4952,	.5101,	.3709,	.2669,	.1352,
6,	.5163,	.5518,	.5033,	.6302,	.6078,	.7094,	.9332,	.5968,	.4021,	.2322,
7,	.8475,	.7996,	.7821,	1.1350,	.9266,	.9486,	1.1426,	1.0322,	.7128,	.2516,
8,	1.0789,	.9846,	1.0295,	1.2084,	1.0192,	1.0915,	1.0141,	.9942,	.8660,	.3743,
9,	1.2765,	1.1589,	.9701,	1.2573,	.7818,	.8326,	.7851,	1.1537,	.7395,	.2951,
10,	1.2299,	.7508,	.9204,	.9565,	.5089,	1.1136,	1.3249,	1.7101,	.9769,	.3444,
11,	.9557,	.9516,	.5854,	1.0812,	.4238,	.8775,	1.0337,	1.5299,	.5881,	.5352,
12,	1.1082,	.8607,	.7590,	1.0346,	.4666,	1.0047,	1.1904,	1.6542,	.7943,	.4441,
+gp,	1.1082,	.8607,	.7590,	1.0346,	.4666,	1.0047,	1.1904,	1.6542,	.7943,	.4441,
0 FBAR 5-10,	.8632,	.7583,	.7560,	.9162,	.7039,	.8652,	.9517,	.9763,	.6607,	.2721,
FBAR 4- 8,	.5546,	.5705,	.5701,	.6816,	.6208,	.6916,	.7658,	.6244,	.4754,	.2112,

Table 8 Fishing mortality (F) at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	FBAR 98-**
AGE											
3,	.0134,	.0341,	.0130,	.0098,	.0105,	.0246,	.0234,	.0495,	.0159,	.0092,	.0249,
4,	.0631,	.1276,	.0943,	.1069,	.0999,	.1208,	.2151,	.2852,	.2055,	.1004,	.1971,
5,	.1889,	.2227,	.3463,	.3156,	.3300,	.3278,	.5597,	.5411,	.5888,	.4135,	.5145,
6,	.3227,	.4452,	.4638,	.6433,	.5790,	.5409,	.7063,	.7725,	.8305,	.6907,	.7646,
7,	.4272,	.5416,	.5699,	1.1677,	.8922,	.7540,	.8498,	.7371,	.8205,	1.0333,	.8636,
8,	.3466,	.6001,	.6008,	.9889,	.9478,	.8661,	1.2362,	1.0591,	.9402,	1.0709,	1.0234,
9,	.3806,	.4577,	.6672,	1.0536,	.9689,	.7633,	1.3348,	1.1787,	1.4531,	.8607,	1.1642,
10,	.2445,	.4580,	.6650,	1.0318,	1.0188,	.9579,	1.5435,	1.2393,	1.4434,	1.3710,	1.3512,
11,	.1451,	.2341,	.6713,	1.1529,	1.2157,	.8684,	1.5150,	1.4711,	.9373,	1.1480,	1.1854,
12,	.1946,	.3924,	.6112,	1.0805,	1.1253,	.8464,	1.4765,	1.6136,	1.7620,	1.1958,	1.5238,
+gp,	.1946,	.3924,	.6112,	1.0805,	1.1253,	.8464,	1.4765,	1.6136,	1.7620,	1.1958,	
0 FBAR 5-10,	.3184,	.4542,	.5521,	.8668,	.7895,	.7017,	1.0384,	.9213,	1.0127,	.9067,	
FBAR 4- 8,	.2697,	.3874,	.4150,	.6445,	.5698,	.5219,	.7134,	.6790,	.6771,	.6618,	

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Table 3.18

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

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,	1950,
AGE					
3,	728139,	425311,	442592,	468348,	704908,
4,	577860,	592530,	347574,	362238,	382556,
5,	402060,	463732,	473210,	281072,	290427,
6,	197212,	312115,	340097,	359415,	198391,
7,	93323,	146496,	208708,	228044,	204032,
8,	96213,	63939,	79121,	101579,	112107,
9,	244722,	64933,	40588,	45487,	56484,
10,	101777,	146581,	35470,	19586,	25387,
11,	38117,	62991,	77255,	20227,	11003,
12,	39205,	22142,	23578,	36361,	8856,
+gp,	33324,	42765,	37377,	21337,	21133,
0 TOTAL,	2551952,	2343535,	2105569,	1943694,	2015284,

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

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	1083753,	1193111,	1590377,	641584,	272778,	439602,	804781,	496824,	683690,	789653,
4,	575973,	865011,	955076,	1259285,	514924,	219807,	350332,	643259,	378598,	530599,
5,	303320,	401364,	599477,	684912,	891184,	387619,	158175,	256234,	406511,	239862,
6,	211595,	190765,	226975,	389987,	429102,	548181,	200984,	105033,	145989,	199996,
7,	121764,	131099,	90099,	135956,	228785,	206850,	225110,	101196,	49529,	71623,
8,	110900,	66016,	63110,	53333,	74845,	112048,	91748,	106395,	48488,	23986,
9,	64808,	60583,	35603,	36525,	34028,	34036,	46105,	40060,	55027,	23813,
10,	28785,	32000,	27799,	19673,	19329,	15591,	14474,	21860,	20840,	24380,
11,	12568,	14083,	12237,	13311,	8459,	7368,	6103,	6291,	8550,	8592,
12,	3651,	6506,	4133,	4985,	4880,	3232,	2513,	2118,	2220,	3650,
+gp,	13989,	3938,	1880,	2707,	2738,	3722,	1687,	857,	1142,	1351,
0 TOTAL,	2531108,	2964476,	3606766,	3242259,	2481052,	1978057,	1902013,	1780129,	1800584,	1917505,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

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

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	916842,	728338,	472064,	338678,	776941,	1582560,	1295416,	164955,	112039,	197105,
4,	612324,	709603,	558039,	374580,	272501,	621906,	1245195,	1029477,	131705,	89647,
5,	346346,	382037,	427678,	360621,	265306,	199663,	458995,	875269,	685697,	85743,
6,	138702,	172949,	163321,	166726,	207288,	146941,	132256,	313440,	476187,	347649,
7,	103298,	67732,	61876,	48854,	84015,	108284,	82121,	88421,	160667,	227600,
8,	37908,	49883,	30149,	19083,	22424,	45954,	55340,	43651,	48433,	60756,
9,	12084,	15518,	21185,	10240,	7448,	10803,	21072,	22854,	21054,	15642,
10,	13000,	4726,	5614,	6764,	2883,	2913,	4313,	7170,	8373,	5306,
11,	9541,	4605,	1444,	1164,	2373,	1053,	1052,	1457,	2610,	2335,
12,	3022,	2871,	1455,	281,	261,	907,	522,	253,	606,	451,
+gp,	2332,	1351,	1113,	1278,	670,	351,	461,	498,	278,	312,
0 TOTAL,	2195401,	2139612,	1743938,	1328269,	1642109,	2721334,	3296742,	2547445,	1647648,	1032545,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	404774,	1015319,	1818949,	523916,	621616,	613942,	348054,	638490,	198489,	137735,
4,	154909,	324399,	799193,	1224278,	346265,	468089,	425778,	249276,	451722,	154747,
5,	63671,	114439,	224670,	535936,	610486,	229669,	280485,	197708,	163230,	300088,
6,	47037,	41482,	69576,	129164,	256342,	296843,	116349,	108003,	82807,	94414,
7,	161288,	29940,	23112,	38504,	63643,	104000,	137232,	47987,	37806,	39202,
8,	100131,	78947,	17401,	12421,	20199,	25746,	42398,	57130,	16658,	15929,
9,	21306,	35642,	33463,	6815,	6253,	8186,	8650,	13943,	18463,	6259,
10,	4863,	6690,	9391,	10388,	3320,	2779,	3089,	2070,	3093,	5368,
11,	1461,	1811,	1435,	3673,	3513,	1330,	1436,	1172,	605,	946,
12,	815,	517,	408,	571,	1117,	1160,	590,	631,	158,	118,
+gp,	421,	697,	408,	525,	550,	572,	583,	1198,	218,	87,
0 TOTAL,	960676,	1649883,	2998007,	2486189,	1933303,	1752317,	1364643,	1317607,	973249,	754892,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	150863,	151833,	166679,	398235,	523847,	1036839,	286234,	204635,	172717,	242677,
4,	109236,	120440,	116237,	133659,	319584,	406490,	735703,	209302,	157276,	136818,
5,	111295,	80899,	79765,	77527,	96594,	220427,	268903,	478961,	150833,	113161,
6,	172067,	72400,	48847,	46914,	46572,	54124,	109983,	132188,	270627,	94564,
7,	41481,	84062,	34137,	24176,	20453,	20764,	21800,	35415,	59586,	148208,
8,	16316,	14551,	30937,	12785,	6362,	6630,	6584,	5693,	10329,	23917,
9,	6397,	4542,	4451,	9047,	3127,	1880,	1822,	1955,	1725,	3557,
10,	2004,	1461,	1167,	1381,	2107,	1171,	669,	680,	505,	674,
11,	1557,	480,	565,	381,	435,	1037,	315,	146,	101,	156,
12,	176,	490,	152,	257,	106,	233,	353,	92,	26,	46,
+gp,	66,	70,	170,	116,	208,	130,	156,	82,	56,	40,
0 TOTAL,	611458,	531229,	483107,	704478,	1019394,	1749724,	1432521,	1069150,	823780,	763818,

Table 3.18 (Continued

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	GMST 46-98	AMST 46-98
AGE													
3,	411824,	720592,	892522,	811816,	658310,	428641,	711851,	868506,	564271,	590531,	0,	495134,	613402,
4,	196961,	331021,	566387,	675255,	541581,	310110,	216934,	413607,	462518,	388349,	450754,	374011,	462186,
5,	105203,	151392,	238553,	420787,	451871,	328580,	178396,	129787,	227894,	304713,	268139,	257582,	315657,
6,	80932,	71305,	99205,	137798,	244869,	263790,	178885,	82588,	60073,	103551,	160721,	150736,	184358,
7,	61381,	47984,	37404,	51082,	59014,	112349,	124999,	72137,	30683,	21435,	42473,	75714,	94616,
8,	94350,	32783,	22857,	17321,	13010,	19797,	43278,	43752,	28260,	11059,	6245,	33918,	45766,
9,	13468,	54620,	14729,	10262,	5275,	4129,	6817,	10293,	12421,	9037,	3103,	14523,	25618,
10,	2168,	7536,	28294,	6188,	2930,	1639,	1576,	1469,	2593,	2378,	3129,	5807,	13760,
11,	391,	1390,	3903,	11913,	1805,	866,	515,	276,	348,	501,	494,	2265,	7140,
12,	75,	277,	900,	1633,	3080,	438,	297,	93,	52,	112,	130,	852,	3650,
+gp,	25,	44,	205,	236,	423,	1704,	535,	157,	93,	40,	38,		
0 TOTAL,	966778,	1418944,	1904959,	2144291,	1982169,	1472043,	1464083,	1622664,	1389206,	1431706,	935225,		

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Table 3.19

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	254849,	136099,	150481,	173289,	274914,
4,	340937,	331817,	184214,	242699,	244836,
5,	446286,	440545,	596245,	311990,	374651,
6,	333289,	468173,	656387,	596629,	337265,
7,	221176,	313502,	513421,	570111,	481515,
8,	304996,	186702,	265846,	328099,	390132,
9,	973994,	237005,	171279,	185131,	255308,
10,	513974,	668411,	188345,	103218,	142673,
11,	225651,	367868,	457348,	121160,	70420,
12,	282275,	164292,	167165,	257435,	70497,
+gp,	271456,	378386,	315087,	175349,	187892,
0 TOTALBIO,	4168882,	3692801,	3665819,	3065111,	2830103,

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

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	433501,	524969,	636151,	282297,	87289,	145069,	265578,	168920,	239291,	268482,
4,	478058,	692009,	725857,	969649,	293507,	127488,	206696,	334495,	272591,	270606,
5,	421615,	533814,	767331,	862989,	1007038,	414753,	161338,	243423,	597571,	261449,
6,	397799,	366270,	438062,	768275,	742347,	1003170,	365792,	201664,	391251,	425991,
7,	309280,	346101,	253178,	411947,	629160,	597796,	650567,	297518,	177809,	242086,
8,	383714,	244919,	234769,	230934,	294890,	476204,	392683,	447924,	209470,	116810,
9,	316264,	306548,	180151,	197233,	166739,	188902,	253117,	224738,	299899,	145737,
10,	149682,	193600,	176245,	132792,	136079,	113501,	108698,	160673,	134210,	206985,
11,	89737,	104495,	90555,	103693,	60902,	58944,	50286,	54540,	61300,	66934,
12,	30013,	54844,	35831,	53190,	42844,	26988,	23247,	20287,	19159,	30297,
+gp,	131347,	40110,	19247,	26204,	27591,	37015,	17892,	9967,	13275,	15429,
0 TOTALBIO,	3141009,	3407679,	3557376,	4039204,	3488383,	3189831,	2495895,	2164149,	2415826,	2050805,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

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

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	284221,	233068,	151061,	111764,	295238,	696327,	375671,	54435,	49297,	72929,
4,	336778,	390282,	340404,	206019,	185301,	460210,	1008608,	720634,	104047,	81578,
5,	363663,	355294,	410571,	342590,	273265,	235602,	619644,	1295399,	843407,	114895,
6,	305145,	294013,	282545,	310111,	308859,	261555,	269803,	664492,	966659,	695298,
7,	333654,	205229,	188104,	158775,	202475,	266378,	230760,	277642,	465934,	682799,
8,	193710,	250910,	149537,	94841,	78931,	175545,	192584,	183771,	184531,	252138,
9,	74320,	101645,	136428,	65640,	42675,	57905,	103040,	120443,	105690,	87437,
10,	105953,	36390,	44408,	54588,	21740,	21174,	30662,	47678,	53839,	40323,
11,	82819,	42684,	13894,	10875,	20098,	9087,	9500,	13129,	21742,	20948,
12,	29013,	30314,	16454,	2856,	2911,	9669,	5524,	2444,	6492,	4958,
+gp,	27875,	17178,	14173,	16470,	9201,	4967,	6369,	7389,	3953,	4396,
0 TOTALBIO,	2137149,	1957006,	1747579,	1374529,	1440693,	2198418,	2852164,	3387455,	2805591,	2057698,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	182148,	385821,	691201,	167653,	254863,	214880,	170546,	312860,	69471,	37188,
4,	136320,	249787,	727266,	808024,	221610,	341705,	383200,	201913,	316205,	86658,
5,	87866,	163647,	345992,	627045,	677639,	273307,	401093,	286676,	202406,	306089,
6,	101599,	87943,	157241,	286743,	487049,	596655,	238515,	232207,	177207,	162392,
7,	495154,	96707,	76038,	123596,	187748,	287041,	452865,	145879,	119088,	118389,
8,	422555,	345787,	80219,	54527,	88269,	108649,	193334,	254800,	71461,	66900,
9,	123791,	207793,	219854,	37616,	35894,	48132,	55876,	91184,	121484,	36552,
10,	34676,	50977,	78601,	81651,	29113,	25849,	26656,	16521,	26635,	38975,
11,	12590,	17245,	15127,	36074,	34848,	13669,	14264,	11898,	5579,	8362,
12,	8822,	6248,	4742,	6512,	13192,	13760,	6427,	6843,	1720,	1099,
+gp,	5449,	9529,	5674,	6947,	7206,	7750,	7970,	15783,	3124,	1256,
0 TOTALBIO,	1610969,	1621485,	2401955,	2236387,	2037430,	1931396,	1950747,	1576565,	1114380,	863860,

Table 3.19 (Continued)

Table 3.19 (Continued)

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	73923,	56178,	61671,	167259,	214777,	321420,	54384,	42973,	51815,	97071,
4,	107052,	79490,	106938,	155044,	281234,	357711,	375209,	83721,	81784,	97141,
5,	160265,	109213,	127624,	140324,	154550,	324027,	344196,	378380,	131225,	133530,
6,	359619,	144077,	119188,	130889,	130867,	133685,	213367,	251157,	400528,	162651,
7,	123613,	246303,	130405,	91385,	83038,	81395,	71503,	105538,	160286,	364593,
8,	79133,	61697,	147261,	58428,	37091,	38519,	34038,	24994,	47822,	85383,
9,	42028,	29339,	27462,	55822,	24043,	12369,	11881,	15271,	12159,	16754,
10,	18354,	12436,	8986,	10636,	21321,	8000,	6225,	8240,	5040,	5258,
11,	16843,	5870,	5224,	3521,	6210,	11407,	4141,	1910,	932,	1395,
12,	1899,	5283,	1645,	2794,	1147,	2527,	3830,	995,	280,	497,
+gp,	924,	979,	2209,	1513,	2796,	1768,	2150,	1073,	806,	533,
0 TOTALBIO,	983653,	750867,	738612,	817614,	957075,	1292829,	1120925,	914251,	892676,	964804,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	214149,	317061,	303457,	186718,	131662,	85728,	142370,	191071,	114547,	114563,
4,	224535,	307850,	662673,	506442,	265375,	151954,	112806,	219212,	240510,	180582,
5,	183054,	274020,	434166,	597517,	515133,	318723,	192667,	150553,	266636,	367180,
6,	196666,	193949,	279758,	332092,	519123,	540769,	336304,	160221,	121947,	205031,
7,	197033,	187139,	150738,	195643,	204778,	396592,	421245,	212803,	92970,	66942,
8,	428348,	169814,	125714,	93878,	64272,	108883,	227643,	199945,	126038,	46038,
9,	92658,	369776,	99713,	68039,	37771,	32081,	60875,	76372,	80489,	49466,
10,	23241,	72349,	242479,	47214,	26717,	16653,	19145,	15234,	26628,	19838,
11,	3696,	17277,	36103,	96618,	18235,	9239,	5612,	3236,	3790,	4918,
12,	810,	3005,	9770,	17718,	33413,	4755,	3228,	1005,	562,	1212,
+gp,	351,	600,	2647,	3014,	5389,	21522,	7156,	2183,	1278,	561,
0 TOTALBIO,	1564540,	1912840,	2347218,	2144893,	1821868,	1686900,	1529053,	1231836,	1075394,	1056331,

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Table 3.20

Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,	1948,	1949,	1950,
AGE					
3,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,
5,	4463,	4405,	5962,	3120,	3747,
6,	9999,	14045,	19692,	17899,	10118,
7,	13271,	18810,	35939,	51310,	43336,
8,	33550,	24271,	34560,	55777,	89730,
9,	175319,	37921,	42820,	53688,	89358,
10,	226148,	280733,	88522,	55738,	74190,
11,	146673,	275901,	333864,	95716,	55632,
12,	242756,	149506,	152120,	226543,	66972,
+gp,	260598,	359467,	305634,	170088,	182256,
0 TOTSPBIO,	1112776,	1165059,	1019114,	729879,	615339,

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

YEAR,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	2706,
5,	4216,	5338,	7673,	8630,	10070,	4148,	1613,	2434,	5976,	7843,
6,	11934,	10988,	13142,	23048,	22270,	30095,	10974,	6050,	15650,	25559,
7,	30928,	27688,	17722,	32956,	44041,	35868,	39034,	17851,	21337,	24209,
8,	92091,	53882,	44606,	36949,	38336,	57144,	35341,	44792,	71220,	22194,
9,	126506,	125685,	72060,	72976,	43352,	26446,	30374,	22474,	146950,	65582,
10,	86815,	121968,	112796,	90299,	72122,	46535,	23914,	48202,	89921,	142819,
11,	64611,	85686,	76066,	90213,	50549,	39492,	30172,	27270,	51492,	51539,
12,	25511,	50457,	33681,	49467,	39416,	24559,	19063,	16635,	16668,	25753,
+gp,	126093,	38907,	18670,	25156,	26763,	35534,	17356,	9668,	13275,	15274,
0 TOTSPBIO,	568705,	520599,	396417,	429694,	346919,	299823,	207840,	195377,	432489,	383479,

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Run title : Arctic Cod (run: SVPASA10/V10)

At 3/05/2001 14:07

Traditional vpa using file input for terminal F

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

YEAR,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	3404,	0,	0,	0,	0,	0,	0,	816,
5,	3637,	3553,	4106,	0,	0,	2356,	0,	38862,	0,	0,
6,	18309,	14701,	8476,	9303,	3089,	5231,	8094,	33225,	19333,	6953,
7,	40038,	30784,	13167,	20641,	12149,	15983,	16153,	24988,	18637,	47796,
8,	60050,	85309,	41870,	35091,	15786,	38620,	26962,	34917,	22144,	57992,
9,	48308,	62004,	57300,	43323,	23471,	20267,	39155,	46973,	35935,	50714,
10,	96417,	29476,	35970,	48583,	15870,	15669,	19624,	27653,	29611,	32662,
11,	81163,	39269,	13616,	10332,	19897,	8542,	8455,	10766,	16089,	18644,
12,	28433,	29404,	16125,	2828,	2853,	9089,	4972,	2444,	6167,	4512,
+gp,	27875,	17178,	14173,	16470,	9201,	4967,	6369,	7389,	3953,	4396,
0 TOTSPBIO,	404228,	311678,	208207,	186570,	102315,	120722,	129784,	227215,	151870,	224482,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
3,	0,	3858,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	4996,	0,	0,	0,	0,	0,	0,	0,	0,
5,	879,	3273,	0,	0,	6776,	0,	8022,	0,	0,	0,
6,	5080,	879,	3145,	2867,	9741,	29833,	19081,	4644,	5316,	3248,
7,	54467,	9671,	12166,	3708,	16897,	34445,	117745,	18964,	15481,	15391,
8,	126766,	117567,	42516,	11451,	18536,	31508,	104400,	112112,	27870,	23415,
9,	73036,	132988,	178082,	18808,	20100,	21659,	42466,	64741,	93543,	23759,
10,	27394,	41292,	72313,	78385,	22708,	21713,	23191,	12721,	23705,	31960,
11,	10827,	16210,	14370,	36074,	27530,	11345,	13266,	9637,	4630,	8362,
12,	7763,	6248,	4647,	6251,	12532,	13760,	6041,	6090,	1342,	989,
+gp,	5449,	9529,	5674,	6947,	7206,	6975,	7173,	12626,	2812,	1130,
0 TOTSPBIO,	311662,	346511,	332913,	164491,	142028,	171238,	341385,	241536,	174699,	108253,

Table 3.20 (Continued)

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
3,	0,	0,	617,	0,	0,	0,	0,	0,	0,	0,
4,	0,	3975,	8555,	7752,	2812,	17886,	3752,	1674,	0,	971,
5,	3205,	10921,	12762,	25258,	13909,	25922,	24094,	18919,	6561,	6676,
6,	25173,	48986,	35756,	40576,	47112,	25400,	38406,	82882,	72095,	34157,
7,	24723,	160097,	95196,	51175,	45671,	43139,	15731,	55935,	65717,	211464,
8,	42732,	50592,	129590,	52585,	31527,	27348,	15658,	15496,	32997,	65745,
9,	33622,	26992,	26639,	55264,	23081,	7669,	5941,	15271,	10335,	14409,
10,	17804,	12436,	8986,	10636,	19189,	7200,	4669,	8240,	5040,	5152,
11,	16843,	5870,	5224,	3521,	6210,	11407,	4141,	1910,	932,	1395,
12,	1899,	5283,	1645,	2794,	1147,	2527,	3830,	995,	280,	497,
+gp,	924,	979,	2209,	1513,	2796,	1768,	2150,	1073,	806,	533,
0 TOTSPBIO,	166925,	326131,	327177,	251075,	193456,	170266,	118371,	202396,	194764,	340999,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
3,	0,	3171,	0,	0,	0,	0,	0,	0,	0,	0,
4,	8981,	3078,	19880,	5064,	0,	0,	0,	2192,	0,	0,
5,	10983,	32882,	39075,	65727,	36059,	6374,	3853,	6022,	2666,	22031,
6,	55066,	83398,	83927,	109590,	171311,	140600,	47083,	30442,	12195,	45107,
7,	128072,	140354,	91950,	117386,	126963,	249853,	235897,	93633,	41836,	42843,
8,	355528,	157927,	114399,	76041,	47561,	90373,	186668,	163955,	99570,	38212,
9,	89878,	358683,	96722,	65998,	35882,	31439,	57831,	71026,	70830,	47982,
10,	23241,	72349,	240055,	46742,	26183,	16653,	18188,	14929,	26628,	19838,
11,	3696,	17277,	36103,	95652,	18235,	9239,	5332,	3236,	3790,	4918,
12,	810,	3005,	9770,	17718,	33413,	4755,	3228,	1005,	562,	1212,
+gp,	351,	600,	2647,	3014,	5389,	21522,	7156,	2183,	1278,	561,
0 TOTSPBIO,	676607,	872726,	734528,	602933,	500996,	570810,	565236,	388625,	259355,	222703,

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Table 3.21 Summary, including cannibalism for the period 1984-2000

Run title : Arctic Cod (run: SVPASA10/V10) ,

At 3/05/2001 14:07

Table 16 Summary (without SOP correction)

Traditional vpa using file input for terminal F

,	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 5-10,	FBAR 4- 8,
1946,	728139,	4168882,	1112776,	706000,	.6344,	.1857,	.1084,
1947,	425311,	3692801,	1165059,	882017,	.7571,	.3047,	.2016,
1948,	442592,	3665819,	1019114,	774295,	.7598,	.3398,	.2322,
1949,	468348,	3065111,	729879,	800122,	1.0962,	.3619,	.2865,
1950,	704908,	2830103,	615339,	731982,	1.1896,	.3566,	.2389,
1951,	1083753,	3141009,	568705,	827180,	1.4545,	.3966,	.3041,
1952,	1193111,	3407679,	520599,	876795,	1.6842,	.5348,	.4071,
1953,	1590377,	3557376,	396417,	695546,	1.7546,	.3572,	.2692,
1954,	641584,	4039204,	429694,	826021,	1.9223,	.3879,	.2786,
1955,	272778,	3488383,	346919,	1147841,	3.3087,	.5437,	.4003,
1956,	439602,	3189831,	299823,	1343068,	4.4795,	.6401,	.5154,
1957,	804781,	2495895,	207840,	792557,	3.8133,	.5089,	.3973,
1958,	496824,	2164149,	195377,	769313,	3.9376,	.5169,	.4337,
1959,	683690,	2415826,	432489,	744607,	1.7217,	.5596,	.4628,
1960,	789653,	2050805,	383479,	622042,	1.6221,	.4789,	.3914,
1961,	916842,	2137149,	404228,	783221,	1.9376,	.6348,	.5008,
1962,	728338,	1957006,	311678,	909266,	2.9173,	.7576,	.6100,
1963,	472064,	1747579,	208207,	776337,	3.7287,	.9866,	.7683,
1964,	338678,	1374529,	186570,	437695,	2.3460,	.6789,	.4607,
1965,	776941,	1440693,	102315,	444930,	4.3486,	.5533,	.3770,
1966,	1582560,	2198418,	120722,	483711,	4.0068,	.5302,	.3497,
1967,	1295416,	2852164,	129784,	572605,	4.4120,	.5439,	.3306,
1968,	164955,	3387455,	227215,	1074084,	4.7272,	.5704,	.4029,
1969,	112039,	2805591,	151870,	1197226,	7.8832,	.8292,	.5899,
1970,	197105,	2057698,	224482,	933246,	4.1573,	.7493,	.5159,
1971,	404774,	1610969,	311662,	689048,	2.2109,	.5956,	.3861,
1972,	1015319,	1621485,	346511,	565254,	1.6313,	.6928,	.3702,
1973,	1818949,	2401955,	332913,	792685,	2.3811,	.6020,	.4207,
1974,	523916,	2236387,	164491,	1102433,	6.7021,	.5633,	.4945,
1975,	621616,	2037430,	142028,	829377,	5.8395,	.6595,	.5684,
1976,	613942,	1931396,	171238,	867463,	5.0658,	.6457,	.5904,
1977,	348054,	1950747,	341385,	905301,	2.6518,	.8379,	.7191,
1978,	638490,	1576565,	241536,	698715,	2.8928,	.9406,	.7062,
1979,	198489,	1114380,	174699,	440538,	2.5217,	.7264,	.5095,
1980,	137735,	863860,	108253,	380434,	3.5143,	.7241,	.4994,
1981,	150863,	983653,	166925,	399038,	2.3905,	.8632,	.5546,
1982,	151833,	750867,	326131,	363730,	1.1153,	.7583,	.5705,
1983,	166679,	738612,	327177,	289992,	.8863,	.7560,	.5701,
1984,	398235,	817614,	251075,	277651,	1.1059,	.9162,	.6816,
1985,	523847,	957075,	193456,	307920,	1.5917,	.7039,	.6208,
1986,	1036839,	1292829,	170266,	430113,	2.5261,	.8652,	.6916,
1987,	286234,	1120925,	118371,	523071,	4.4189,	.9517,	.7658,
1988,	204635,	914251,	202396,	434939,	2.1490,	.9763,	.6244,
1989,	172717,	892676,	194764,	332481,	1.7071,	.6607,	.4754,
1990,	242677,	964804,	340999,	212000,	.6217,	.2721,	.2112,
1991,	411824,	1564540,	676607,	319158,	.4717,	.3184,	.2697,
1992,	720592,	1912840,	872726,	513234,	.5881,	.4542,	.3874,
1993,	892522,	2347218,	734528,	581611,	.7918,	.5521,	.4150,
1994,	811816,	2144893,	602933,	771086,	1.2789,	.8668,	.6445,
1995,	658310,	1821868,	500996,	739999,	1.4771,	.7895,	.5698,
1996,	428641,	1686900,	570810,	732228,	1.2828,	.7017,	.5219,
1997,	711851,	1529053,	565236,	762403,	1.3488,	1.0384,	.7134,
1998,	868506,	1231836,	388625,	592624,	1.5249,	.9213,	.6790,
1999,	564271,	1075394,	259355,	484910,	1.8697,	1.0127,	.6771,
2000,	590531,	1056331,	222703,	414144,	1.8596,	.9067,	.6618,
Arith. Mean ,	612093,	2045100,	372934,	671005,	2.4912,	.6469,	.4801,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

1

Table 3.22 Summary, no cannibalism included

Run title : Arctic Cod (run: SVPASA09/V09) ,

At 4/05/2001 11:36

Table 16 Summary (without SOP correction)

Traditional vpa using file input for terminal F

,	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 5-10,	FBAR 4- 8,
1946,	728139,	4168882,	1112776,	706000,	.6344,	.1857,	.1084,
1947,	425311,	3692801,	1165059,	882017,	.7571,	.3047,	.2016,
1948,	442592,	3665819,	1019114,	774295,	.7598,	.3398,	.2322,
1949,	468348,	3065111,	729879,	800122,	1.0962,	.3619,	.2865,
1950,	704908,	2830103,	615339,	731982,	1.1896,	.3566,	.2389,
1951,	1083753,	3141009,	568705,	827180,	1.4545,	.3966,	.3041,
1952,	1193111,	3407679,	520599,	876795,	1.6842,	.5348,	.4071,
1953,	1590377,	3557376,	396417,	695546,	1.7546,	.3572,	.2692,
1954,	641584,	4039204,	429694,	826021,	1.9223,	.3879,	.2786,
1955,	272778,	3488383,	346919,	1147841,	3.3087,	.5437,	.4003,
1956,	439602,	3189831,	299823,	1343068,	4.4795,	.6401,	.5154,
1957,	804781,	2495895,	207840,	792557,	3.8133,	.5089,	.3973,
1958,	496824,	2164149,	195377,	769313,	3.9376,	.5169,	.4337,
1959,	683690,	2415826,	432489,	744607,	1.7217,	.5596,	.4628,
1960,	789653,	2050805,	383479,	622042,	1.6221,	.4789,	.3914,
1961,	916842,	2137149,	404228,	783221,	1.9376,	.6348,	.5008,
1962,	728338,	1957006,	311678,	909266,	2.9173,	.7576,	.6100,
1963,	472064,	1747579,	208207,	776337,	3.7287,	.9866,	.7683,
1964,	338678,	1374529,	186570,	437695,	2.3460,	.6789,	.4607,
1965,	776941,	1440693,	102315,	444930,	4.3486,	.5533,	.3770,
1966,	1582560,	2198418,	120722,	483711,	4.0068,	.5302,	.3497,
1967,	1295416,	2852164,	129784,	572605,	4.4120,	.5439,	.3306,
1968,	164955,	3387455,	227215,	1074084,	4.7272,	.5704,	.4029,
1969,	112039,	2805591,	151870,	1197226,	7.8832,	.8292,	.5899,
1970,	197105,	2057698,	224482,	933246,	4.1573,	.7493,	.5159,
1971,	404774,	1610969,	311662,	689048,	2.2109,	.5956,	.3861,
1972,	1015319,	1621485,	346511,	565254,	1.6313,	.6928,	.3702,
1973,	1818949,	2401955,	332913,	792685,	2.3811,	.6020,	.4207,
1974,	523916,	2236387,	164491,	1102433,	6.7021,	.5633,	.4945,
1975,	621616,	2037430,	142028,	829377,	5.8395,	.6595,	.5684,
1976,	613942,	1931396,	171238,	867463,	5.0658,	.6457,	.5904,
1977,	348054,	1950747,	341385,	905301,	2.6518,	.8379,	.7191,
1978,	638490,	1576565,	241536,	698715,	2.8928,	.9406,	.7062,
1979,	198489,	1114380,	174699,	440538,	2.5217,	.7264,	.5095,
1980,	137735,	863860,	108253,	380434,	3.5143,	.7241,	.4994,
1981,	150863,	983653,	166925,	399038,	2.3905,	.8632,	.5546,
1982,	151833,	750867,	326131,	363730,	1.1153,	.7583,	.5705,
1983,	166679,	738612,	327177,	289992,	.8863,	.7560,	.5701,
1984,	397998,	817515,	251075,	277651,	1.1059,	.9162,	.6816,
1985,	523644,	956992,	193456,	307920,	1.5917,	.7039,	.6208,
1986,	930532,	1259874,	170266,	430113,	2.5261,	.8652,	.6916,
1987,	270685,	1117971,	118371,	523071,	4.4189,	.9517,	.7658,
1988,	202931,	913894,	202396,	434939,	2.1490,	.9763,	.6244,
1989,	172717,	892676,	194764,	332481,	1.7071,	.6607,	.4754,
1990,	242677,	964804,	340999,	212000,	.6217,	.2721,	.2112,
1991,	408173,	1562641,	676607,	319158,	.4717,	.3184,	.2697,
1992,	700259,	1902667,	872624,	513234,	.5882,	.4542,	.3875,
1993,	758325,	2284678,	733903,	581611,	.7925,	.5524,	.4157,
1994,	522092,	2016452,	600647,	771086,	1.2838,	.8677,	.6467,
1995,	306285,	1687355,	500615,	739999,	1.4782,	.7899,	.5739,
1996,	246769,	1595625,	569741,	732228,	1.2852,	.7040,	.5281,
1997,	473254,	1466694,	565115,	762403,	1.3491,	1.0398,	.7181,
1998,	588784,	1145034,	387922,	592624,	1.5277,	.9234,	.6845,
1999,	467185,	1050850,	259355,	484910,	1.8697,	1.0128,	.6778,
2000,	573516,	1042831,	222703,	414144,	1.8619,	.9067,	.6618,
Arith. Mean ,	580489,	2033236,	372833,	671005,	2.4915,	.6471,	.4805,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

1

Table 3.23

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

Prediction with management option table: Input data

Year: 2001								
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	474000.00	0.2700	0.0000	0.0000	0.0000	0.288	0.0238	0.630
4	450754.00	0.2100	0.0050	0.0000	0.0000	0.508	0.1887	1.032
5	268139.00	0.2000	0.0550	0.0000	0.0000	1.209	0.4926	1.590
6	160721.00	0.2000	0.3360	0.0000	0.0000	2.259	0.7321	2.330
7	42473.000	0.2000	0.5760	0.0000	0.0000	3.281	0.8269	3.280
8	6245.000	0.2000	0.7670	0.0000	0.0000	4.969	0.9799	4.550
9	3103.000	0.2000	0.9820	0.0000	0.0000	6.157	1.1148	6.200
10	3129.000	0.2000	1.0000	0.0000	0.0000	9.096	1.2938	7.860
11	494.000	0.2000	0.9710	0.0000	0.0000	11.245	1.1351	9.490
12	130.000	0.2000	1.0000	0.0000	0.0000	10.850	1.4591	13.820
13+	38.000	0.2000	1.0000	0.0000	0.0000	12.500	1.4591	14.000
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	140000.00	0.2700	0.0000	0.0000	0.0000	0.228	0.0238	0.630
4	.	0.2100	0.0020	0.0000	0.0000	0.498	0.1887	1.032
5	.	0.2000	0.0420	0.0000	0.0000	1.195	0.4926	1.590
6	.	0.2000	0.2220	0.0000	0.0000	2.090	0.7321	2.330
7	.	0.2000	0.5590	0.0000	0.0000	3.145	0.8269	3.280
8	.	0.2000	0.7990	0.0000	0.0000	4.531	0.9799	4.550
9	.	0.2000	0.9440	0.0000	0.0000	6.037	1.1148	6.200
10	.	0.2000	1.0000	0.0000	0.0000	9.236	1.2938	7.860
11	.	0.2000	1.0000	0.0000	0.0000	10.646	1.1351	9.490
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.4591	13.820
13+	.	0.2000	1.0000	0.0000	0.0000	12.500	1.4591	14.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2003								
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	315000.00	0.2700	0.0000	0.0000	0.0000	0.228	0.0238	0.630
4	.	0.2100	0.0020	0.0000	0.0000	0.498	0.1887	1.032
5	.	0.2000	0.0420	0.0000	0.0000	1.195	0.4926	1.590
6	.	0.2000	0.2220	0.0000	0.0000	2.090	0.7321	2.330
7	.	0.2000	0.5590	0.0000	0.0000	3.145	0.8269	3.280
8	.	0.2000	0.7990	0.0000	0.0000	4.531	0.9799	4.550
9	.	0.2000	0.9440	0.0000	0.0000	6.037	1.1148	6.200
10	.	0.2000	1.0000	0.0000	0.0000	9.236	1.2938	7.860
11	.	0.2000	1.0000	0.0000	0.0000	10.646	1.1351	9.490
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.4591	13.820
13+	.	0.2000	1.0000	0.0000	0.0000	12.500	1.4591	14.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANASA06
Date and time: 04MAY01:11:27

Table 3.24

10:54 Friday, May 4, 2001

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

Prediction with management option table

Year: 2001					Year: 2002					Year: 2003	
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
0.7269	0.6590	1278136	299537	415000	0.0000	0.0000	1278615	330334	0	1830695	714505
.	.	.	.	.	0.0250	0.0227	.	330334	20695	1805892	700944
.	.	.	.	.	0.0500	0.0453	.	330334	41048	1781517	687656
.	.	.	.	.	0.0750	0.0680	.	330334	61064	1757563	674637
.	.	.	.	.	0.1000	0.0907	.	330334	80751	1734022	661879
.	.	.	.	.	0.1250	0.1133	.	330334	100114	1710885	649377
.	.	.	.	.	0.1500	0.1360	.	330334	119160	1688145	637126
.	.	.	.	.	0.1750	0.1587	.	330334	137895	1665795	625121
.	.	.	.	.	0.2000	0.1813	.	330334	156323	1643826	613357
.	.	.	.	.	0.2250	0.2040	.	330334	174452	1622232	601828
.	.	.	.	.	0.2500	0.2267	.	330334	192286	1601006	590529
.	.	.	.	.	0.2750	0.2493	.	330334	209831	1580140	579456
.	.	.	.	.	0.3000	0.2720	.	330334	227092	1559629	568604
.	.	.	.	.	0.3250	0.2947	.	330334	244075	1539464	557969
.	.	.	.	.	0.3500	0.3173	.	330334	260785	1519640	547545
.	.	.	.	.	0.3750	0.3400	.	330334	277226	1500151	537329
.	.	.	.	.	0.4000	0.3627	.	330334	293404	1480989	527315
.	.	.	.	.	0.4250	0.3853	.	330334	309323	1462150	517501
.	.	.	.	.	0.4500	0.4080	.	330334	324989	1443626	507881
.	.	.	.	.	0.4750	0.4307	.	330334	340406	1425412	498451
.	.	.	.	.	0.5000	0.4533	.	330334	355578	1407502	489209
.	.	.	.	.	0.5250	0.4760	.	330334	370509	1389891	480149
.	.	.	.	.	0.5500	0.4987	.	330334	385205	1372572	471268
.	.	.	.	.	0.5750	0.5213	.	330334	399670	1355541	462563
.	.	.	.	.	0.6000	0.5440	.	330334	413907	1338792	454029
.	.	.	.	.	0.6250	0.5667	.	330334	427922	1322320	445663
.	.	.	.	.	0.6500	0.5893	.	330334	441717	1306120	437461
.	.	.	.	.	0.6750	0.6120	.	330334	455297	1290187	429421
.	.	.	.	.	0.7000	0.6347	.	330334	468665	1274515	421539
.	.	.	.	.	0.7250	0.6573	.	330334	481827	1259100	413812
.	.	.	.	.	0.7500	0.6800	.	330334	494784	1243938	406235
.	.	.	.	.	0.7750	0.7027	.	330334	507541	1229023	398808
.	.	.	.	.	0.8000	0.7253	.	330334	520102	1214352	391525
.	.	.	.	.	0.8250	0.7480	.	330334	532470	1199919	384385
.	.	.	.	.	0.8500	0.7707	.	330334	544648	1185720	377384
.	.	.	.	.	0.8750	0.7933	.	330334	556640	1171751	370520
.	.	.	.	.	0.9000	0.8160	.	330334	568450	1158008	363789
.	.	.	.	.	0.9250	0.8387	.	330334	580079	1144487	357189
.	.	.	.	.	0.9500	0.8613	.	330334	591532	1131184	350718
.	.	.	.	.	0.9750	0.8840	.	330334	602812	1118094	344372
.	.	.	.	.	1.0000	0.9067	.	330334	613922	1105214	338149
.	.	.	.	.	1.0250	0.9294	.	330334	624864	1092540	332047
.	.	.	.	.	1.0500	0.9520	.	330334	635642	1080068	326063
.	.	.	.	.	1.0750	0.9747	.	330334	646259	1067795	320195
.	.	.	.	.	1.1000	0.9974	.	330334	656717	1055717	314441
.	.	.	.	.	1.1250	1.0200	.	330334	667019	1043831	308797
.	.	.	.	.	1.1500	1.0427	.	330334	677169	1032132	303262
.	.	.	.	.	1.1750	1.0654	.	330334	687167	1020619	297834
.	.	.	.	.	1.2000	1.0880	.	330334	697018	1009286	292510
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANASA06
Date and time : 04MAY01:11:27
Computation of ref. F: Simple mean, age 5 - 10
Basis for 2001 : TAC constraints

Table 3.25

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	0.2700	0.0000	0.0000	0.0000	0.228	0.0238	0.630
4	.	0.2100	0.0020	0.0000	0.0000	0.498	0.1887	1.032
5	.	0.2000	0.0420	0.0000	0.0000	1.195	0.4926	1.590
6	.	0.2000	0.2220	0.0000	0.0000	2.090	0.7321	2.330
7	.	0.2000	0.5590	0.0000	0.0000	3.145	0.8269	3.280
8	.	0.2000	0.7990	0.0000	0.0000	4.531	0.9799	4.550
9	.	0.2000	0.9440	0.0000	0.0000	6.037	1.1148	6.200
10	.	0.2000	1.0000	0.0000	0.0000	9.236	1.2938	7.860
11	.	0.2000	1.0000	0.0000	0.0000	10.646	1.1351	9.490
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.4591	13.820
13+	.	0.2000	1.0000	0.0000	0.0000	12.500	1.4591	12.500
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDASA05
Date and time: 04MAY01:10:55

Table 3.26

North-East Arctic cod (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	5.177	21285.313	2.161	18167.194	2.161	18167.194
0.0500	0.0453	0.122	765.142	4.568	15070.718	1.596	12076.139	1.596	12076.139
0.1000	0.0907	0.199	1081.875	4.188	11556.113	1.257	8675.590	1.257	8675.590
0.1500	0.1360	0.253	1214.854	3.922	9320.424	1.029	6545.394	1.029	6545.394
0.2000	0.1813	0.293	1264.138	3.722	7787.232	0.864	5109.951	0.864	5109.951
0.2500	0.2267	0.325	1273.390	3.563	6678.989	0.740	4092.444	0.740	4092.444
0.3000	0.2720	0.352	1263.344	3.433	5845.907	0.642	3343.733	0.642	3343.733
0.3500	0.3173	0.374	1244.354	3.324	5200.265	0.564	2776.679	0.564	2776.679
0.4000	0.3627	0.393	1221.727	3.231	4687.436	0.500	2337.174	0.500	2337.174
0.4500	0.4080	0.409	1198.197	3.150	4271.731	0.447	1989.991	0.447	1989.991
0.5000	0.4533	0.424	1175.148	3.079	3928.916	0.402	1711.317	0.402	1711.317
0.5500	0.4987	0.437	1153.242	3.015	3642.013	0.363	1484.543	0.363	1484.543
0.6000	0.5440	0.449	1132.753	2.958	3398.803	0.330	1297.791	0.330	1297.791
0.6500	0.5893	0.460	1113.749	2.906	3190.296	0.301	1142.371	0.301	1142.371
0.7000	0.6347	0.469	1096.195	2.859	3009.747	0.276	1011.812	0.276	1011.812
0.7500	0.6800	0.478	1080.001	2.816	2852.008	0.254	901.213	0.254	901.213
0.8000	0.7253	0.486	1065.060	2.777	2713.091	0.235	806.808	0.235	806.808
0.8500	0.7707	0.494	1051.258	2.740	2589.865	0.217	725.669	0.217	725.669
0.9000	0.8160	0.501	1038.485	2.706	2479.842	0.202	655.491	0.202	655.491
0.9500	0.8613	0.508	1026.640	2.674	2381.023	0.188	594.441	0.188	594.441
1.0000	0.9067	0.514	1015.632	2.645	2291.784	0.175	541.048	0.175	541.048
1.0500	0.9520	0.520	1005.375	2.617	2210.798	0.164	494.121	0.164	494.121
1.1000	0.9974	0.526	995.798	2.590	2136.967	0.154	452.689	0.154	452.689
1.1500	1.0427	0.531	986.835	2.566	2069.377	0.144	415.952	0.144	415.952
1.2000	1.0880	0.536	978.426	2.542	2007.261	0.136	383.249	0.136	383.249
1.2500	1.1334	0.540	970.522	2.520	1949.973	0.128	354.029	0.128	354.029
1.3000	1.1787	0.545	963.076	2.499	1896.963	0.121	327.832	0.121	327.832
1.3500	1.2240	0.549	956.048	2.479	1847.762	0.115	304.267	0.115	304.267
1.4000	1.2694	0.553	949.402	2.460	1801.964	0.108	283.006	0.108	283.006
1.4500	1.3147	0.557	943.106	2.442	1759.221	0.103	263.768	0.103	263.768
1.5000	1.3600	0.561	937.131	2.424	1719.231	0.098	246.314	0.098	246.314
1.5500	1.4054	0.564	931.452	2.408	1681.728	0.093	230.437	0.093	230.437
1.6000	1.4507	0.568	926.045	2.392	1646.482	0.089	215.960	0.089	215.960
1.6500	1.4960	0.571	920.889	2.376	1613.289	0.084	202.728	0.084	202.728
1.7000	1.5414	0.574	915.967	2.362	1581.968	0.081	190.609	0.081	190.609
1.7500	1.5867	0.577	911.261	2.347	1552.360	0.077	179.485	0.077	179.485
1.8000	1.6320	0.580	906.755	2.334	1524.324	0.074	169.255	0.074	169.255
1.8500	1.6774	0.583	902.437	2.321	1497.733	0.071	159.829	0.071	159.829
1.9000	1.7227	0.586	898.293	2.308	1472.474	0.068	151.128	0.068	151.128
1.9500	1.7680	0.589	894.312	2.296	1448.445	0.065	143.082	0.065	143.082
2.0000	1.8134	0.591	890.483	2.284	1425.555	0.062	135.629	0.062	135.629
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDASA05
Date and time : 04MAY01:10:55
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.1300
F-max factor : 0.2430
F-0.1 reference F : 0.1179
F-max reference F : 0.2203
Recruitment : Single recruit

Table 3.27. Northeast Arctic cod. Preliminary estimates of biological reference points calculated from the whole revised time series, for different periods of averaging exploitation pattern, natural mortality, maturity ogive and mean weights at age.

Period	1984-2000	1991-2000	1996-2000
Reference point	Deterministic		
MedianRecruits	564271	564271	564271
$\mathbf{B}_{loss}$	102315	102315	102315
SSB90%R90%Surv	244429	244429	244429
SPR%ofVirgin	2,68	2,75	2,33
VirginSPR	16,97	15,25	13,90
SPRloss	0,58	0,58	0,58

Reference point	Deterministic		
FBar	1,00	1,00	1,00
$\mathbf{F}_{max}$	0,26	0,27	0,24
$\mathbf{F}_{0.1}$	0,14	0,14	0,12
$\mathbf{F}_{low}$	0,46	0,44	0,40
$\mathbf{F}_{med}$	0,83	0,80	0,71
$\mathbf{F}_{high}$	1,50	1,41	1,19
F35%SPR	0,15	0,15	0,14
$\mathbf{F}_{loss}$	0,87	0,83	0,74

Table 3.28 Likelihood components, input data, and parameter estimates for key run

Component Name	Weight	Unweighted Likelihood	Weighted Likelihood	Proportion total
totalcatchD.cod	20	387376	7747510	0.450
gillnetD.cod	20	90535	1810702	0.105
bartrawlwin8593.cod	1	1480857	1480857	0.086
bartrawlwin9401.cod	1	751252	751252	0.044
lofoten8589.cod	1	93785	93785	0.005
lofoten9001.cod	1	536742	536742	0.031
baracwin8593.cod	1	1276983	1276983	0.074
baracwin9401.cod	1	1217007	1217007	0.071
rustrawl8500.cod	1	1420319	1420319	0.083
bartrawlaut.9500.cod	1	773468	773468	0.045
stomach.cod	100	1052	105200	0.006
bounds	1	0	0	0.000
Total		8029376	17213825	

Parameter values at end of optimization for key run

```
;Growth parameter for each year
;initial values calculated from Norwegian winter survey (bottom trawl)
;length increase over the year for ages 3, 4, 5, 6 at 1 January in the
;year. The value is a arithmetic mean of the ages.
growth.1985      8.772785    1 ;[8.1664581 ]
growth.1986      7.3011625   1 ;[5.6786611 ]
growth.1987      6.9925771   1 ;[6.9925771 ]
growth.1988      7.395623    1 ;[10.108109 ]
growth.1989      13.157709   1 ;[12.156564 ]
growth.1990      11.851106   1 ;[9.57474   ]
growth.1991      9.8304236   1 ;[9.8304236 ]
growth.1992      8.0951599   1 ;[8.0951599 ]
growth.1993      6.6637723   1 ;[6.6637723 ]
growth.1994      10.258038   1 ;[10.258038 ]
growth.1995      7.5524129   1 ;[7.5524129 ]
growth.1996      10.793708   1 ;[10.375038 ]
growth.1997      9.6489257   1 ;[9.6489257 ]
growth.1998      9.7259628   1 ;[9.7259628 ]
growth.1999      10.566623   1 ;[10.566623 ]
growth.2000      11.7        1 ;[11.7      ]
;growth.2001 (first quarter) is set to growth.2000

;Growth distribution parameters
growth.k0        -0.04145155  1 ;[-0.063092162] Growth distribution param. k0
growth.k1        0.65962154  1 ;[0.65962154] Growth distribution param. k1
growth.exponent  0           0
growth.ratio     0.79568698  1 ;[0.79568698] Ratio of Mature/immature growth

;Cannibalism parameters
cann_beta        0.00103295  0 ;             Cannibalism parameter beta
cann_gamma       0.0001      0 ;             Cannibalism parameter gamma
cann_delta       0.309428    0 ;             Cannibalism parameter delta
cann_alpha       7e-06       0 ;             Cannibalism parameter alpha

;Quarterly natural residual mortality of immature fish (in 3 length intervals)
imm.mort1        0.05        0 ;             Quart. imm mortality interval 1
imm.mort2        0.05        0 ;             Quart. imm mortality interval 2
imm.mort3        0.05        0 ;             Quart. imm mortality interval 3
```

Table 3.28 (Continued)

```
;Number of immature fish in startyear  1985 of age x (10^7)
;VPA values (AFWG 2000)
imm.n_age3       55.659607   1 ;[56.626228 ]
imm.n_age4       37.161523   1 ;[38.956912 ]
imm.n_age5       10.737558   1 ;[10.641774 ]
imm.n_age6       3.4023324   1 ;[3.6429266 ]
imm.n_age7       1.0010851   1 ;[1.3508831 ]
imm.n_age8       0.18648114  1 ;[0.24326745]
imm.n_age9       0.13353243  1 ;[0.069524396]
imm.n_age10      0           0

;Mean length (cm) of immature fish in startyear  1985 at age x
;From the Norwegian winter bottom trawl survey.
imm.l_age3       40.6        0
imm.l_age4       48.7        0
imm.l_age5       61.3        0
imm.l_age6       71.1        0
imm.l_age7       81.2        0
imm.l_age8       85.7        0
imm.l_age9       90          0
imm.l_age10      90          0

;Standard deviation of mean length
;of immature fish in startyear 1985 at age x
;From the Norwegian winter bottom trawl survey.
imm.d_age3       5.1         0
imm.d_age4       4.1         0
imm.d_age5       4.9         0
imm.d_age6       5.3         0
imm.d_age7       5.4         0
imm.d_age8       8.7         0
imm.d_age9       8.7         0
imm.d_age10      8.7         0

;Maturation parameters
maturation.slope 0.03        0 ;             Maturation, slope
maturation.l50   76          0 ;             Maturation, L50

;Number of minimum-age (age 3) fish at start of year x (10^7)
;VPA values (AFWG 2000)
n_minage.1986    125.85911   1 ;[129.3236  ]
n_minage.1987    38.583379   1 ;[40.321241 ]
n_minage.1988    28.72962    1 ;[29.49478  ]
n_minage.1989    19.899317   1 ;[20.448384 ]
n_minage.1990    30.083868   1 ;[30.980202 ]
n_minage.1991    50.120959   1 ;[51.715749 ]
n_minage.1992    81.562045   1 ;[84.351642 ]
n_minage.1993    106.25834   1 ;[110.48673 ]
n_minage.1994    90.146794   1 ;[95.008248 ]
n_minage.1995    57.160246   1 ;[60.593596 ]
n_minage.1996    36.108708   1 ;[38.46124  ]
n_minage.1997    61.089829   1 ;[63.81114  ]
n_minage.1998    72.770724   1 ;[76.342746 ]
n_minage.1999    42.795675   1 ;[45.001571 ]
n_minage.2000    54.471263   1 ;[56.808457 ]
n_minage.2001    37.484386   1 ;[38.371294 ]

;Mean length of minimum-age (age 3) fish at start of year x
;From Norwegian winter bottom trawl survey.
l_minage.1986    34.108383   1 ;[34.417397 ]
l_minage.1987    32.101739   1 ;[31.531425 ]
l_minage.1988    32.123567   1 ;[31.485994 ]
l_minage.1989    32.60733    1 ;[34.480472 ]
l_minage.1990    34.020975   1 ;[35.930986 ]
l_minage.1991    39.721189   1 ;[39.785977 ]
l_minage.1992    39.773265   1 ;[39.838138 ]
l_minage.1993    36.564392   1 ;[36.724547 ]
l_minage.1994    30.881901   1 ;[31.110958 ]
l_minage.1995    30.062027   1 ;[30.450114 ]
l_minage.1996    29.776577   1 ;[30.348102 ]
l_minage.1997    30.97088    1 ;[30.893868 ]
l_minage.1998    31.032796   1 ;[31.015472 ]
l_minage.1999    28.955815   1 ;[29.008611 ]
l_minage.2000    28.765208   1 ;[28.77072  ]
l_minage.2001    33.243159   1 ;[33.279335 ]
```

Table 3.28 (Continued)

```
;Standard deviation of mean length of minimum-age (age 3) fish
;at start of year x
;From Norwegian winter bottom trawl survey.
d_minage.1986    4.4         0
d_minage.1987    3.5         0
d_minage.1988    3.1         0
d_minage.1989    2.9         0
d_minage.1990    4.3         0
d_minage.1991    5.8         0
d_minage.1992    4.8         0
d_minage.1993    4.4         0
d_minage.1994    5           0
d_minage.1995    5.9         0
d_minage.1996    5           0
d_minage.1997    3.9         0
d_minage.1998    4.4         0
d_minage.1999    4.2         0
d_minage.2000    4.1         0
d_minage.2001    4.1         0

;Quarterly natural residual mortality of mature fish (in 3 length intervals)
mat.mort1        0.05        0 ;            Quart. mat mortality interval 1
mat.mort2        0.05        0 ;            Quart. mat mortality interval 2
mat.mort3        0.05        0 ;            Quart. mat mortality interval 3

;Number of mature fish in startyear  1985 of age x (10^7)
;From VPA (AFWG 2000), except mat.n_age4
mat.n_age4       0           0
mat.n_age5       0.868       0
mat.n_age6       1.68        0
mat.n_age7       1.13        0
mat.n_age8       0.54        0
mat.n_age9       0.3         0
mat.n_age10      0.19        0
mat.n_age11      0.04        0
mat.n_age12      0.03        0

;Mean length (cm) of mature fish in startyear 1985  at age x
;From Lofoten survey 1985
mat.l_age4       51          0
mat.l_age5       59.6        0
mat.l_age6       71.1        0
mat.l_age7       79          0
mat.l_age8       88.2        0
mat.l_age9       97.3        0
mat.l_age10      105.2       0
mat.l_age11      114         0
mat.l_age12      114         0

;Standard Deviation of mean length of mature fish in startyear at age x
;Estimated values, not from survey
mat.d_age4       14.9        0
mat.d_age5       1.1         0
mat.d_age6       6.7450297   0
mat.d_age7       3.184107    0
mat.d_age8       5.1070776   0
mat.d_age9       3.0645865   0
mat.d_age10      5.4373194   0
mat.d_age11      10.621258   0
mat.d_age12      3.2658864   0
```

Table 3.28 (Continued)

```
;Overfishing
;This fleet is included to be consistent with the catches added
;by AFWG. The values for 1990-1994 are set to reproduce the unreported
;catches added by AFWG for those years.
gil.slope        0.038709325  1 ;[0.040306618] Slope of selection curve
gil.l50          80           1 ;[76.085203 ] L50 of selection curve
gil.f1985        0.56792894  1 ;[0.32689604]
gil.f1986        0.30323259  1 ;[0.20179912]
gil.f1987        0.25894881  1 ;[0.18965152]
gil.f1988        0.37847588  1 ;[0.23679598]
gil.f1989        0.66277927  1 ;[0.29446561]
gil.f1990        0.14850437  1 ;[0.075101849]
gil.f1991        0.12821     1 ;[0.088016857]
gil.f1992        0.096732168  1 ;[0.070438391]
gil.f1993        0.12874745  1 ;[0.088446037]
gil.f1994        0.17743332  1 ;[0.11683898]
gil.f1995        0.31058993  1 ;[0.17780391]
gil.f1996        0.33226444  1 ;[0.20392442]
gil.f1997        0.37094507  1 ;[0.25953434]
gil.f1998        0.45380871  1 ;[0.3190855 ]
gil.f1999        0.46327879  1 ;[0.31031909]
gil.f2000        0.48042858  1 ;[0.25597286]
; Imposed overfishing
;ovr.slope        0.04        0 ;             Slope of selection curve
;ovr.l50          52          0 ;             L50 of selection curve
ovr.f1985        0           0
ovr.f1986        0           0
ovr.f1987        0           0
ovr.f1988        0           0
ovr.f1989        0           0
ovr.f1990        0.026       0
ovr.f1991        0.037       0
ovr.f1992        0.085       0
ovr.f1993        0.031       0
ovr.f1994        0.018       0
ovr.f1995        0           0
ovr.f1996        0           0
ovr.f1997        0           0
ovr.f1998        0           0
ovr.f1999        0           0
ovr.f2000        0           0
;total fleet, a sum of 6 fleets (5 norwegian and 1 russian)
tot.slope        0.049952079  1 ;[0.050440795] Slope of selection curve
tot.l50          52.809682   1 ;[52.809682 ] L50 of selection curve
;initial values: F 5-10  AFWG 2000
tot.f1985        0.32023725  1 ;[0.30670172]
tot.f1986        0.4952408   1 ;[0.49317317]
tot.f1987        0.86405831  1 ;[0.8908066 ]
tot.f1988        0.76142808  1 ;[0.74381401]
tot.f1989        0.51626071  1 ;[0.45997345]
tot.f1990        0.17311723  1 ;[0.16122354]
tot.f1991        0.17205251  1 ;[0.16711257]
tot.f1992        0.1940335   1 ;[0.18816635]
tot.f1993        0.2743188   1 ;[0.26498392]
tot.f1994        0.4139167   1 ;[0.39303469]
tot.f1995        0.46698256  1 ;[0.44882811]
tot.f1996        0.56550451  1 ;[0.54258424]
tot.f1997        0.81910046  1 ;[0.80351379]
tot.f1998        0.93937363  1 ;[0.91437533]
tot.f1999        0.84544149  1 ;[0.80955783]
tot.f2000        0.5621822   1 ;[0.5222607 ]
;tot.f2001 is equal to tot.f2000
```

Table 3.28 (Continued)

```
;survey names
;1 lofac   - Lofoten acoustic (1985-2000)
;2 ba1tr   - Barents Sea trawl (1983-1993)
;3 ba1ac   - Barents Sea acoustic (1983-1993)
;4 svatr   - Svalbard bottom trawl survey (1987-1999) not in use at present
;5 ba2ac   - Barents Sea acoustic (1994-2000)
;6 ba2tr   - Barents Sea trawl (1994-2000)
;7 rustr   - Russian autumn bottom trawl survey - 1982-1999
;8 nortr   - Norwegian summer (autumn) survey - bottom trawl (1995-1999)

;Survey catchability parameter names
;04 cbt    - Catchability
;01 b0     - Exponent (for power fit) or constant (for linear fit)
;02 slope  - Slope
;03 l50    - L50
;   b      - b in y = ax+b

; NOTE! For straight lines, cbt must be fixed to 1
; to avoid overparameterization

;Lofoten acoustic (1985-1989) Divide due to change in
; echo sounder and prprocessing tools
lof1ac.cbt       0.6774637   1 ;[0.54901554] Catchability
lof1ac.b0        1           0 ;             b0
lof1ac.slope     0.008120707  1 ;[0.021429913] Slope
lof1ac.l50       43.142634   1 ;[48.259462 ] L50

;Lofoten acoustic (1990-2001)
lof2ac.cbt       1.01        1 ;[1.01      ] Catchability
lof2ac.b0        1           0 ;             b0
lof2ac.slope     0.021869068  1 ;[0.01957959] Slope
lof2ac.l50       64.523775   1 ;[66.634996 ] L50

;Barents Sea trawl (1985-1993)
ba1tr.cbt        1           0 ;             Catchability
ba1tr.b0         1           0 ;             b0
ba1tr.slope      -0.0001903785  1 ;[0.00032225923] Slope
ba1tr.b          0.40624286  1 ;[0.37117586] b

;Barents Sea trawl (1994-2001)
ba2tr.cbt        1           0 ;             Catchability
ba2tr.b0         1           0 ;             b0
ba2tr.slope      0.0013932076  1 ;[0.00069026434] Slope
ba2tr.b          0.42758195  1 ;[0.43802066] b

;Barents Sea acoustic (1985-1993)
ba1ac.cbt        1           0 ;             Catchability
ba1ac.b0         1           0 ;             b0
ba1ac.slope      0.0013583172  1 ;[0.00059687618] Slope
ba1ac.b          0.24685255  1 ;[0.27594548] b

;Barents Sea acoustic (1994-2001)
ba2ac.cbt        1           0 ;             Catchability
ba2ac.b0         1           0 ;             b0
ba2ac.slope      0.0016228811  1 ;[0.00053980578] Slope
ba2ac.b          0.39932749  1 ;[0.42788989] b

;Russian autumn bottom trawl survey - 1985-2000
rustr.cbt        1           0 ;             Catchability
rustr.b0         1           0 ;             b0
rustr.slope      0.00075734734  1 ;[0.00070811298] Slope
rustr.b          0.083616135  1 ;[0.076054957] b

;Norwegian summer (autumn) survey - bottom trawl (1995-2000)
nortr.cbt        1           0 ;             Catchability
nortr.b0         1           0 ;             b0
nortr.slope      -0.00099994068  1 ;[-0.0003353451] Slope
nortr.b          0.69632724  1 ;[0.64202033] b
```

Table 3.29 Results from the key run

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Total fishing mortality at age

Year	1985	1986
Age		
3	0.0665	0.0322
4	0.1632	0.2527
5	0.3521	0.4263
6	0.4941	0.6016
7	0.6568	0.7009
8	0.7821	0.7853
9	0.8624	0.8241
10	0.9176	0.8470
11	0.9226	0.8608
12+	0.9290	0.8624
F 5-10	0.6775	0.6975

Total fishing mortality at age

Year	1987	1988	1989	1990	1991	1992	1993
Age							
3	0.0363	0.0292	0.0314	0.0193	0.0409	0.0475	0.0294
4	0.1807	0.1118	0.0955	0.0845	0.0835	0.1447	0.1351
5	0.6469	0.3229	0.2162	0.1371	0.1746	0.2099	0.2518
6	0.8840	0.7101	0.3914	0.1857	0.2129	0.2917	0.3095
7	1.0572	0.8867	0.6507	0.2295	0.2440	0.3187	0.3772
8	1.1386	1.0539	0.8279	0.2876	0.2747	0.3406	0.4035
9	1.1954	1.1425	1.0603	0.3237	0.3148	0.3606	0.4257
10	1.2140	1.1986	1.1686	0.3563	0.3352	0.3813	0.4449
11	1.2249	1.2129	1.2287	0.3670	0.3492	0.3898	0.4628
12+	1.2309	1.2225	1.2438	0.3724	0.3534	0.3947	0.4695
F 5-10	1.0227	0.8858	0.7192	0.2533	0.2594	0.3171	0.3688

Total fishing mortality at age

Year	1994	1995	1996	1997	1998	1999	2000	1998-2000
Age								
3	0.0250	0.0238	0.0281	0.0380	0.0459	0.0288	0.0195	0.0314
4	0.1508	0.1238	0.1259	0.2061	0.2177	0.1982	0.1212	0.1790
5	0.3511	0.3521	0.3313	0.4688	0.5404	0.4823	0.3550	0.4592
6	0.4790	0.5283	0.5759	0.7615	0.8197	0.7501	0.5515	0.7071
7	0.5363	0.6331	0.7157	0.9804	1.0640	0.9349	0.6925	0.8971
8	0.6078	0.6925	0.8073	1.1059	1.2528	1.1106	0.8099	1.0578
9	0.6368	0.7794	0.8603	1.1834	1.3681	1.2621	0.9433	1.1912
10	0.6597	0.8123	0.9305	1.2235	1.4289	1.3413	1.0513	1.2738
11	0.6793	0.8376	0.9552	1.2674	1.4589	1.3771	1.0981	1.3114
12+	0.6955	0.8560	0.9775	1.2854	1.4907	1.3986	1.1192	1.3362
F 5-10	0.5451	0.6330	0.7035	0.9539	1.0790	0.9802	0.7339	

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Residual natural mortality (M1)

Year	1985	1986
Age		
3	0.2000	0.2000
4	0.2000	0.2000
5	0.2000	0.2000
6	0.2000	0.2000
7	0.2000	0.2000
8	0.2000	0.2000
9	0.2000	0.2000
10	0.2000	0.2000
11	0.2000	0.2000
12+	0.2000	0.2000

Residual natural mortality (M1)

Year	1987	1988	1989	1990	1991	1992	1993
Age							
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	0.1999	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	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
12+	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000

Residual natural mortality (M1)

Year	1994	1995	1996	1997	1998	1999	2000	1998-2000
Age								
3	0.2000	0.1999	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	0.2000
5	0.2000	0.2000	0.2000	0.1999	0.1999	0.1999	0.2000	0.1999
6	0.2000	0.2000	0.2000	0.2000	0.1999	0.1999	0.2000	0.1999
7	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
8	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
9	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
10	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
11	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
12+	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000

Predation mortality (M2)

Year	1985	1986
Age		
3	0.0319	0.1374
4	0.0067	0.0140

Predation mortality (M2)

Year	1987	1988	1989	1990	1991	1992	1993
Age							
3	0.1660	0.0817	0.0471	0.0612	0.0518	0.0806	0.1779
4	0.0417	0.0248	0.0139	0.0059	0.0172	0.0207	0.0474

Predation mortality (M2)

Year	1994	1995	1996	1997	1998	1999	2000	1998-2000
Age								
3	0.3742	0.4379	0.2738	0.1634	0.0761	0.0617	0.0786	0.0721
4	0.0932	0.1199	0.0944	0.0519	0.0230	0.0123	0.0126	0.0160

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Stock numbers (thousands) at age by Jan. 1

Year / Age	1985	1986	1987
3	556596	1258584	385834
4	371615	412977	869730
5	116056	252227	253483
6	50823	66767	133911
7	21311	25387	29948
8	7265	9046	10312
9	4335	2720	3377
10	1900	1498	979
11	400	621	523
12+	300	227	294
Total	1130601	2030055	1688391

Stock numbers (thousands) at age by Jan. 1

Year / Age	1988	1989	1990	1991	1992	1993	1994
3	287296	198993	300838	501205	815620	1062583	900869
4	258052	210514	150632	227257	374038	587498	707070
5	553460	179283	150061	110676	164793	255011	391226
6	107044	317810	115933	106250	75762	107924	159375
7	45222	42873	174976	78674	70233	46295	64519
8	8518	15248	18292	113842	50453	41800	25985
9	2704	2431	5451	11231	70796	29374	22851
10	837	706	689	3229	6718	40419	15926
11	238	207	180	395	1885	3736	20963
12+	196	105	74	144	311	1216	2548
Total	1263567	968170	917127	1152903	1630608	2175856	2311333

Stock numbers (thousands) at age by Jan. 1

Year / Age	1995	1996	1997	1998	1999	2000	2001
3	568719	360577	610889	727626	427797	544535	374843
4	494756	293304	218278	408920	527273	319948	404176
5	441888	308451	187475	134296	255571	339964	223015
6	219402	245641	174900	93066	62655	127093	192930
7	80354	105288	112472	66447	33345	24123	59817
8	30854	34880	42102	34525	18755	10705	9873
9	11582	12629	12732	11404	8073	5053	3895
10	9967	4376	4379	3199	2380	1872	1612
11	6665	3593	1406	1047	624	507	533
12+	9741	5750	2903	981	380	206	194
Total	1873929	1374489	1367537	1481512	1336852	1374006	1270887

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Spawning stock biomass (tons) at Jan. 1

Year	1985
Age	
4	0
5	15242
6	52597
7	47491
8	31919
9	23752
10	19198
11	5165
12+	3854
SSB total	199217

Spawning stock biomass (tons) at Jan. 1

Year	1986	1987	1988	1989	1990	1991	1992	1993
Age								
4	0	0	0	0	0	0	0	0
5	49946	40858	11375	1753	11468	28455	35294	70476
6	81335	90157	55920	43335	33746	75406	89351	87178
7	78808	80375	69035	53864	156693	118904	155603	118135
8	46013	52515	35090	43973	55595	326530	178856	162078
9	18053	25497	17229	13984	27823	62517	368254	156055
10	12351	9526	7327	5622	5630	24452	52762	281656
11	6939	6599	2608	2166	1960	4232	18683	36842
12+	3102	5506	3085	1537	1172	2147	4460	15750
SSB total	296546	311033	201669	166234	294087	642642	903262	928168

Spawning stock biomass (tons) at Jan. 1

Year	1994	1995	1996	1997	1998	1999	2000	2001
Age								
4	0	0	0	0	0	0	0	0
5	58109	52642	16240	12638	9285	13821	24709	17718
6	139987	173497	130388	72268	35509	23510	51679	103291
7	114175	182870	199830	190854	89509	38414	31233	89171
8	104133	109986	132423	158763	122859	53602	28801	28676
9	122700	70690	65485	73789	67689	44600	24847	17340
10	106464	74324	33848	31526	25646	18975	14337	10517
11	179445	60629	33696	14110	10126	6476	5221	4884
12+	31627	111821	73481	40901	15514	5827	2989	2467
SSB total	856640	836457	685391	594849	376136	205224	183816	274063

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Total stock biomass (tons) at Jan. 1

Year	1985
Age	
3	320307
4	362171
5	225845
6	157478
7	93632
8	42101
9	32031
10	19198
11	5165
12+	3854
Total	1261781

Total stock biomass (tons) at Jan. 1

Year	1986	1987	1988	1989	1990	1991	1992	1993
Age								
3	487650	124260	87128	69920	122896	347385	519512	504068
4	436699	420493	130153	120302	136732	234327	455658	581528
5	409925	335342	499424	163411	197828	207502	283898	448140
6	192152	275587	200483	456347	212454	262200	219143	256175
7	105380	111507	125188	115003	448761	250430	259608	174832
8	50163	56517	39409	58753	75990	473159	233114	196841
9	18669	25775	17513	14507	30454	68002	410497	169729
10	12682	9585	7338	5640	5669	24852	53716	289554
11	6939	6599	2608	2166	1960	4232	18683	36842
12+	3102	5506	3085	1537	1172	2147	4460	15750
Total	1723361	1371172	1112329	1007585	1233916	1874236	2458289	2673458

Total stock biomass (tons) at Jan. 1

Year	1994	1995	1996	1997	1998	1999	2000	2001
Age								
3	263454	161051	96146	173003	212147	99407	123792	133912
4	518740	326621	165703	140820	252614	325362	181534	252197
5	573103	623512	350598	217992	157315	290807	410916	268303
6	381286	533016	518645	338657	170827	114999	247441	393557
7	201254	290838	350040	356838	191043	88878	69142	176096
8	122571	139293	162226	195161	155881	74668	42023	39084
9	131453	74269	71556	78590	71884	48028	27909	19703
10	110277	76038	34436	32283	26080	19253	14599	10831
11	179445	60629	33696	14110	10126	6476	5221	4884
12+	31627	111821	73481	40901	15514	5827	2989	2467
Total	2513210	2397088	1856527	1588353	1263428	1073704	1125564	1301034

Table 3.29 (Continued)

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stocks cod.imm cod.mat
areas 0

Weight (kg) in catch (Observed)

Year / Age	1985	1986	1987	1988	1989	1990	1991
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	0.96	0.64	0.50	0.55	0.76	0.83	1.09
4	1.37	1.27	0.88	0.86	0.96	1.23	1.48
5	2.00	1.87	1.55	1.31	1.31	1.66	2.17
6	3.20	2.79	2.31	2.23	1.92	2.22	2.89
7	4.63	4.49	3.48	3.52	2.92	3.24	3.72
8	6.04	5.83	5.92	5.32	4.61	4.65	4.70
9	7.66	6.82	8.52	8.00	7.50	7.26	6.05
10	9.80	7.66	9.57	9.14	9.13	9.80	8.81
11	11.79	9.81	12.24	11.30	11.17	13.30	11.94
12+	14.09	11.16	13.64	15.41	14.94	14.25	16.61

Weight (kg) in catch (Observed)

Year / Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	1998-2000
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	1.17	0.82	0.85	0.82	0.85	0.73	0.70	0.65	0.60	0.65
4	1.57	1.52	1.30	1.26	1.13	1.06	1.06	1.03	1.05	1.05
5	2.22	2.15	1.98	1.79	1.63	1.54	1.60	1.49	1.61	1.57
6	3.11	2.80	2.85	2.57	2.45	2.21	2.28	2.26	2.33	2.29
7	4.26	4.14	3.28	3.79	3.82	3.41	3.28	3.18	3.33	3.26
8	5.18	5.53	5.28	4.96	5.81	5.30	4.86	4.31	4.47	4.54
9	6.11	6.48	6.88	6.15	6.87	7.31	6.90	6.00	5.70	6.20
10	7.79	7.20	7.64	7.99	8.13	7.86	9.45	6.82	7.57	7.94
11	10.82	8.07	8.10	9.15	9.74	10.20	11.31	11.44	9.18	10.64
12+	12.65	11.67	10.18	9.75	11.19	11.42	15.21	14.41	13.61	14.41

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stocks cod.imm cod.mat
areas 0

Weight (kg) in catch (Model)

Year / Age	1985	1986	1987	1988	1989	1990	1991
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	1.01	0.61	0.48	0.53	0.71	0.90	1.18
4	1.35	1.42	0.91	0.91	1.05	1.49	1.54
5	2.34	1.89	1.71	1.35	1.42	1.92	2.35
6	3.58	3.10	2.30	2.29	1.92	2.44	2.97
7	4.88	4.40	3.82	3.15	3.16	3.19	3.71
8	6.40	5.78	5.45	5.01	4.28	4.79	4.72
9	8.09	7.13	7.38	6.86	6.34	6.13	6.57
10	10.84	8.72	9.25	9.08	8.27	8.60	8.06
11	12.89	10.50	11.51	11.00	10.51	10.86	10.36
12+	13.28	11.64	15.63	12.89	13.70	13.20	12.41

Weight (kg) in catch (Model)

Year / Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	1998-2000
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	1.02	0.80	0.68	0.66	0.67	0.62	0.69	0.55	0.57	0.60
4	1.70	1.50	1.23	1.13	1.12	1.19	1.12	1.09	1.09	1.10
5	2.15	2.25	1.88	1.77	1.62	1.68	1.64	1.56	1.69	1.63
6	3.24	2.81	2.70	2.69	2.44	2.34	2.23	2.22	2.34	2.26
7	4.03	4.15	3.35	3.84	3.63	3.52	3.18	3.05	3.25	3.16
8	4.95	5.05	4.88	4.69	4.98	4.99	4.76	4.37	4.32	4.48
9	6.11	6.05	5.89	6.49	5.98	6.52	6.51	6.33	5.92	6.25
10	8.25	7.33	7.02	7.63	8.11	7.70	8.32	8.48	8.15	8.32
11	10.03	9.76	8.54	8.97	9.54	10.16	9.80	10.75	10.33	10.29
12+	13.16	12.25	11.80	10.98	12.56	12.24	15.21	15.03	12.51	14.25

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0

Weight (kg) in stock at Jan. 1

Year / Age	1985	1986	1987	1988	1989	1990	1991	1992
3	0.58	0.39	0.32	0.30	0.35	0.41	0.69	0.64
4	0.97	1.06	0.48	0.50	0.57	0.91	1.03	1.22
5	1.95	1.63	1.32	0.90	0.91	1.32	1.87	1.72
6	3.10	2.88	2.06	1.87	1.44	1.83	2.47	2.89
7	4.39	4.15	3.72	2.77	2.68	2.56	3.18	3.70
8	5.80	5.55	5.48	4.63	3.85	4.15	4.16	4.62
9	7.39	6.86	7.63	6.48	5.97	5.59	6.05	5.80
10	10.10	8.47	9.79	8.77	7.99	8.23	7.70	8.00
11	12.91	11.17	12.62	10.96	10.47	10.89	10.71	9.91
12+	12.85	13.66	18.73	15.74	14.64	15.84	14.91	14.34

Weight (kg) in stock at Jan. 1

Year / Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	1998-2000
3	0.47	0.29	0.28	0.27	0.28	0.29	0.23	0.23	0.36	0.25
4	0.99	0.73	0.66	0.56	0.65	0.62	0.62	0.57	0.62	0.60
5	1.76	1.46	1.41	1.14	1.16	1.17	1.14	1.21	1.20	1.17
6	2.37	2.39	2.43	2.11	1.94	1.84	1.84	1.95	2.04	1.87
7	3.78	3.12	3.62	3.32	3.17	2.88	2.67	2.87	2.94	2.80
8	4.71	4.72	4.51	4.65	4.64	4.52	3.98	3.93	3.96	4.14
9	5.78	5.75	6.41	5.67	6.17	6.30	5.95	5.52	5.06	5.93
10	7.16	6.92	7.63	7.87	7.37	8.15	8.09	7.80	6.72	8.01
11	9.86	8.56	9.10	9.38	10.04	9.67	10.38	10.30	9.16	10.12
12+	12.95	12.41	11.48	12.78	14.09	15.81	15.33	14.51	12.72	15.22

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stocks cod.imm cod.mat
areas 0

Proportion mature at age

Year / Age	1985	1986	1987	1988	1989	1990	1991	1992
3	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
5	0.067	0.122	0.122	0.023	0.011	0.058	0.137	0.124
6	0.334	0.423	0.327	0.279	0.095	0.159	0.288	0.408
7	0.507	0.748	0.721	0.551	0.468	0.349	0.475	0.599
8	0.758	0.917	0.929	0.890	0.748	0.732	0.690	0.767
9	0.742	0.967	0.989	0.984	0.964	0.914	0.919	0.897
10	1.000	0.974	0.994	0.998	0.997	0.993	0.984	0.982
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12+	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Proportion mature at age

Year / Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	1998-2000
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	0.157	0.101	0.084	0.046	0.058	0.059	0.048	0.060	0.066	0.0557
6	0.340	0.367	0.326	0.251	0.213	0.208	0.204	0.209	0.262	0.2070
7	0.676	0.567	0.629	0.571	0.535	0.469	0.432	0.452	0.506	0.4510
8	0.823	0.850	0.790	0.816	0.813	0.788	0.718	0.685	0.734	0.7303
9	0.919	0.933	0.952	0.915	0.939	0.942	0.929	0.890	0.880	0.9203
10	0.973	0.965	0.977	0.983	0.977	0.983	0.986	0.982	0.971	0.9837
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

Table 3.29 (Continued)

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stocks cod.imm cod.mat
areas 0
fleets totalcatchD.cod gillnetD.cod

Model catch in numbers (thousands) at age

Year	1985	1986	1987	1988	1989	1990	1991	1992
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	28453	29584	9807	6324	4659	3723	13366	21183
4	45277	74218	112474	21772	15106	8429	12492	29633
5	28518	71290	98968	124805	28109	13548	12539	18670
6	16966	25045	65240	45454	84577	14092	14658	11840
7	9066	10829	16500	22498	17389	26359	12518	12120
8	3543	4232	5987	4798	7454	3512	20634	9442
9	2272	1322	2028	1611	1416	1189	2366	14238
10	1040	744	594	515	438	166	728	1451
11	220	312	319	147	132	45	93	418
12+	166	114	180	122	68	19	34	70
Total	135519	217690	312098	228045	159346	71082	89428	119066

Model catch in numbers (thousands) at age

Year	1993	1994	1995	1996	1997	1998	1999	2000
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	20406	12698	7631	6294	16134	24626	9303	7927
4	53171	67858	40803	25325	31627	63619	76298	28960
5	41793	83732	99653	67744	56615	45896	80256	81706
6	21405	44860	70382	86303	76784	43291	27519	43763
7	11097	20066	30176	44150	58981	36764	17074	9950
8	10732	9085	12522	16148	24031	21233	10782	4994
9	7970	8357	5200	6152	7614	7412	5045	2645
10	11474	6024	4631	2267	2677	2134	1545	1059
11	1104	8155	3175	1899	880	707	412	296
12+	365	1014	4723	3092	1833	671	253	122
Total	179517	261850	278896	259372	277177	246352	228487	181420

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stocks cod.imm cod.mat
areas 0
fleets totalcatchD.cod gillnetD.cod

Observed catch in numbers (thousands) at age

Year	1985	1986	1987	1988	1989	1990	1991	1992
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	19827	24601	10451	9320	4905	1318	3498	14281
4	41156	59095	117702	19556	15829	5815	8518	22808
5	24947	71522	84258	117466	28910	9871	12313	18690
6	16756	23485	57247	48956	66518	13789	15180	17119
7	10562	10443	13079	19909	24998	23675	14196	12909
8	3509	3796	3576	3153	5194	5160	18101	9545
9	1437	890	872	1163	795	607	2706	12829
10	713	696	450	384	275	127	270	1766
11	132	517	184	105	41	49	36	179
12+	97	206	308	128	40	20	14	45
Total	119136	195251	288127	220140	147505	60431	74832	110171

Observed catch in numbers (thousands) at age

Year	1993	1994	1995	1996	1997	1998	1999	2000
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	7684	5557	4744	7029	10454	28163	8086	4287
4	37104	49637	35103	25578	32825	78276	72596	27490
5	54335	79313	95626	70977	63737	42661	81445	76969
6	28253	50250	79442	87255	75833	35607	27626	40948
7	11530	28783	28300	46093	60404	29470	13875	11426
8	7452	7686	6796	8735	22662	23807	14380	6214
9	5190	4522	2499	1797	3198	6147	7971	4447
10	9814	2497	1441	817	817	886	1815	1429
11	1290	5407	770	352	286	161	191	179
12+	290	834	1832	831	413	136	91	41
Total	162942	234486	256553	249464	270629	245314	228076	173430

Table 3.29 (Continued)

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runid skrei Wed May  2 12:54:41 2001
stocks cod.imm cod.mat
areas 0
fleets  totalcatchD.cod gillnetD.cod
```

Model catch in biomass (tons) at age

Year Age	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	28698	18178	4686	3341	3292	3334	15712	21543
4	61161	105653	102749	19738	15790	12589	19248	50403
5	66691	134597	169168	168256	39774	26040	29522	40234
6	60764	77666	150350	104284	162530	34365	43465	38371
7	44270	47637	63031	70861	54908	84080	46480	48882
8	22672	24461	32612	24041	31901	16820	97358	46743
9	18376	9422	14964	11054	8972	7290	15557	87051
10	11271	6483	5500	4676	3620	1431	5870	11963
11	2833	3280	3676	1621	1388	485	964	4196
12+	2198	1331	2809	1574	927	248	426	921
Total	318933	428708	549544	409445	323102	186682	274601	350308
Total+	348737	479164	613483	453385	361911	234872	345590	509793

(++ Also includes: overfish thirdcountries)

Model catch in biomass (tons) at age

Year Age	1993	1994	1995	1996	1997	1998	1999	2000
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	16277	8617	5004	4192	9993	16872	5162	4521
4	79516	83159	46214	28481	37492	71132	83426	31653
5	94164	157217	176117	109830	94845	75459	125572	137863
6	60165	121060	189288	210967	179995	96473	61224	102230
7	46034	67241	115925	160157	207857	116814	52049	32310
8	54172	44364	58700	80379	119828	101025	47082	21577
9	48260	49257	33738	36776	49663	48221	31917	15648
10	84153	42274	35357	18383	20612	17764	13098	8629
11	10773	69661	28484	18112	8945	6926	4424	3057
12+	4468	11965	51866	38829	22440	10206	3804	1520
Total	497981	654814	740693	706105	751669	560891	427757	359007
Total+	606168	807531	864039	803735	832460	616555	472625	406083

(++ Also includes: overfish thirdcountries)

Table 3.29 (Continued)

runid skrei Wed May 2 12:54:41 2001
stocks cod.imm cod.mat
areas 0
fleets totalcatchD.cod gillnetD.cod

Observed catch in biomass (tons) at age

Year	1985	1986	1987	1988	1989	1990	1991	1992
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	19126	15739	5248	5132	3707	1099	3826	16749
4	56292	75093	104014	16881	15212	7159	12624	35861
5	49948	133755	130298	154400	37888	16352	26754	41536
6	53648	65634	132331	109286	127798	30610	43802	53174
7	48885	46842	45483	70098	72902	76661	52765	54981
8	21186	22116	21179	16788	23943	23996	85114	49432
9	11015	6070	7433	9300	5963	4406	16364	78443
10	6988	5334	4306	3508	2510	1245	2379	13749
11	1556	5072	2253	1187	458	652	430	1937
12+	1367	2298	4201	1972	598	285	233	569
Total	270010	377952	456746	388552	290977	162464	244290	346430
Total+	304376	425428	509500	430714	330181	211119	317795	508889

(++ Also includes: overfish thirdcountries)

Observed catch in biomass (tons) at age

Year	1993	1994	1995	1996	1997	1998	1999	2000
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	6294	4712	3876	5989	7672	19737	5250	2552
4	56265	64514	44148	29018	34939	82774	74624	28961
5	116878	156739	171213	115706	97997	68427	121213	123629
6	79022	143091	203914	213388	167787	81037	62376	95597
7	47752	94529	107134	176041	206093	96594	44065	38014
8	41237	40587	33702	50747	120026	115725	61913	27767
9	33606	31118	15362	12354	23384	42419	47816	25356
10	70613	19078	11519	6640	6424	8370	12376	10811
11	10413	43820	7048	3430	2918	1822	2186	1643
12+	3384	8491	17868	9299	4717	2068	1311	558
Total	465465	606679	615784	622612	671956	518972	433130	354887
Total+	581165	767445	739638	730365	763190	582834	482979	410087

(++ Also includes: overfish thirdcountries)

Table 3.30 Fleksibest equivalent to standard prediction input table (3.23)

Calculated from predictions of growth, recruitment, and fishing mortality.
From fixed quota run.

Year: 2001								
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	374843	0.2675	0.0000	0.0000	0.0000	0.3600	0.0298	0.7400
4	404176	0.2215	0.0000	0.0000	0.0000	0.6200	0.0999	1.1600
5	223015	0.2000	0.0660	0.0000	0.0000	1.2000	0.2593	1.7500
6	192930	0.2000	0.2620	0.0000	0.0000	2.0400	0.4085	2.5900
7	59817	0.2000	0.5060	0.0000	0.0000	2.9400	0.4863	3.5600
8	9873	0.2000	0.7340	0.0000	0.0000	3.9600	0.5350	4.7100
9	3895	0.2000	0.8800	0.0000	0.0000	5.0600	0.5714	5.9700
10	1612	0.2000	0.9710	0.0000	0.0000	6.7200	0.6057	7.7900
11	533	0.2000	1.0000	0.0000	0.0000	9.1600	0.6272	10.0700
12+	194	0.2000	1.0000	0.0000	0.0000	12.7200	0.6351	11.5000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

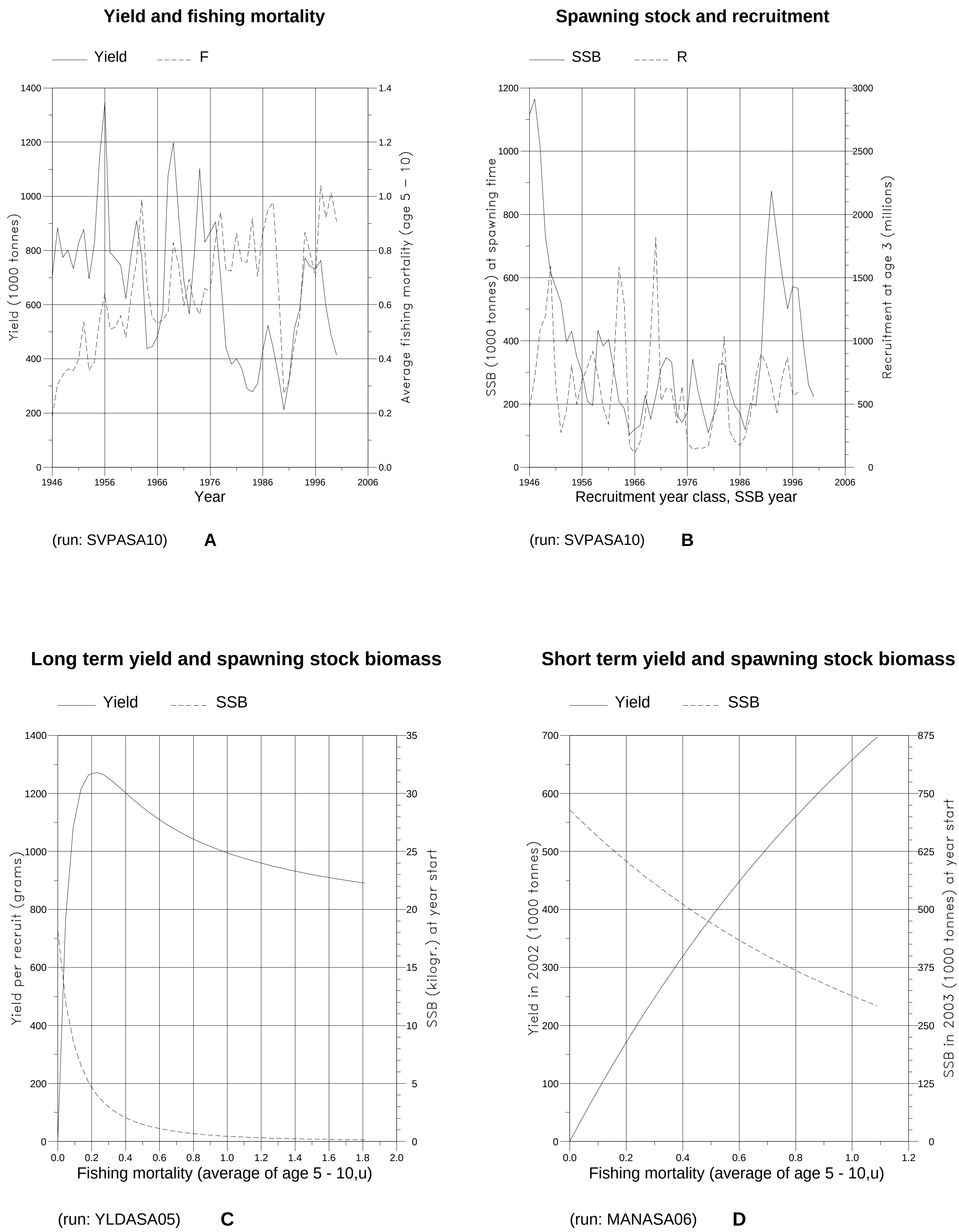
Year: 2002								
Age	Stock size	Natural Mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit pattern	Weight in catch
3	179999	0.3146	0.0000	0.0000	0.0000	0.3600	0.0202	0.7200
4	278462	0.2198	0.0000	0.0000	0.0000	0.8300	0.1126	1.3500
5	285761	0.2000	0.0820	0.0000	0.0000	1.2800	0.1983	1.8300
6	139241	0.2000	0.2860	0.0000	0.0000	2.1100	0.2981	2.6700
7	104828	0.2000	0.5870	0.0000	0.0000	3.2700	0.3625	3.9500
8	30107	0.2000	0.8010	0.0000	0.0000	4.4300	0.3986	5.2600
9	4733	0.2000	0.9200	0.0000	0.0000	5.6100	0.4219	6.6100
10	1805	0.2000	0.9700	0.0000	0.0000	6.8900	0.4376	7.9800
11	715	0.2000	1.0000	0.0000	0.0000	8.8900	0.4506	9.8300
12+	317	0.2000	1.0000	0.0000	0.0000	12.7200	0.4575	11.4700
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2003								
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	374843	0.3619	0.0000	0.0000	0.0000	0.3600	0.0154	0.6700
4	128788	0.2420	0.0000	0.0000	0.0000	0.7900	0.0835	1.2800
5	195691	0.2000	0.1270	0.0000	0.0000	1.5300	0.1967	2.0400
6	189089	0.2000	0.3090	0.0000	0.0000	2.1500	0.2487	2.7100
7	84442	0.2000	0.6000	0.0000	0.0000	3.2800	0.3005	3.9500
8	59718	0.2000	0.8440	0.0000	0.0000	4.7500	0.3367	5.6100
9	16544	0.2000	0.9480	0.0000	0.0000	6.1400	0.3571	7.1600
10	2548	0.2000	0.9820	0.0000	0.0000	7.5400	0.3682	8.6200
11	947	0.2000	1.0000	0.0000	0.0000	9.1000	0.3750	9.9700
12+	537	0.2000	1.0000	0.0000	0.0000	12.6700	0.3801	11.3700
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Table 3.31 Management options table from Fleksibest

Year: 2001					Year: 2002					Year: 2003				
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight
0.5762	0.4777	1301034	274063	395013	0.0000	0.0000	1481571	469335	0	0.0000	0.0000	2092368	996659	0
.	.	.	.	.	0.0250	0.0213	.	469335	27891	0.0250	0.0220	2060739	975563	43484
.	.	.	.	.	0.0500	0.0427	.	469335	55210	0.0500	0.0441	2029730	954932	84469
.	.	.	.	.	0.0750	0.0640	.	469335	81968	0.0750	0.0661	1999329	934754	123078
.	.	.	.	.	0.1000	0.0853	.	469335	108177	0.1000	0.0881	1969523	915021	159428
.	.	.	.	.	0.1250	0.1066	.	469335	133849	0.1250	0.1100	1940299	895722	193630
.	.	.	.	.	0.1500	0.1279	.	469335	158996	0.1500	0.1319	1911646	876847	225791
.	.	.	.	.	0.1750	0.1491	.	469335	183631	0.1750	0.1538	1883551	858386	256011
.	.	.	.	.	0.2000	0.1704	.	469335	207762	0.2000	0.1756	1856003	840330	284388
.	.	.	.	.	0.2250	0.1917	.	469335	231400	0.2250	0.1974	1828989	822671	311011
.	.	.	.	.	0.2500	0.2129	.	469335	254558	0.2500	0.2192	1802499	805398	335970
.	.	.	.	.	0.2750	0.2341	.	469335	277246	0.2750	0.2410	1776522	788504	359347
.	.	.	.	.	0.3000	0.2554	.	469335	299472	0.3000	0.2627	1751047	771980	381221
.	.	.	.	.	0.3250	0.2766	.	469335	321246	0.3250	0.2844	1726063	755817	401670
.	.	.	.	.	0.3500	0.2978	.	469335	342581	0.3500	0.3060	1701561	740008	420763
.	.	.	.	.	0.3750	0.3190	.	469335	363484	0.3750	0.3277	1677530	724544	438569
.	.	.	.	.	0.4000	0.3402	.	469335	383964	0.4000	0.3493	1653960	709417	455156
.	.	.	.	.	0.4250	0.3613	.	469335	404031	0.4250	0.3708	1630842	694621	470583
.	.	.	.	.	0.4500	0.3825	.	469335	423693	0.4500	0.3924	1608166	680148	484911
.	.	.	.	.	0.4750	0.4036	.	469335	442960	0.4750	0.4139	1585924	665990	498196
.	.	.	.	.	0.5000	0.4247	.	469335	461839	0.5000	0.4353	1564105	652140	510492
.	.	.	.	.	0.5250	0.4459	.	469335	480340	0.5250	0.4567	1542702	638591	521850
.	.	.	.	.	0.5500	0.4670	.	469335	498468	0.5500	0.4782	1521705	625337	532316
.	.	.	.	.	0.5750	0.4880	.	469335	516235	0.5750	0.4995	1501107	612372	541940
.	.	.	.	.	0.6000	0.5092	.	469335	533645	0.6000	0.5209	1480899	599688	550766
.	.	.	.	.	0.6250	0.5302	.	469335	550709	0.6250	0.5422	1461073	587279	558834
.	.	.	.	.	0.6500	0.5513	.	469335	567430	0.6500	0.5635	1441621	575140	566186
.	.	.	.	.	0.6750	0.5724	.	469335	583822	0.6750	0.5847	1422535	563263	572859
.	.	.	.	.	0.7000	0.5934	.	469335	599884	0.7000	0.6059	1403808	551644	578888
.	.	.	.	.	0.7250	0.6144	.	469335	615629	0.7250	0.6270	1385432	540276	584311
.	.	.	.	.	0.7500	0.6354	.	469335	631061	0.7500	0.6482	1367401	529154	589157
.	.	.	.	.	0.7750	0.6565	.	469335	646188	0.7750	0.6693	1349706	518273	593460
.	.	.	.	.	0.8000	0.6774	.	469335	661013	0.8000	0.6903	1332342	507626	597250
.	.	.	.	.	0.8250	0.6985	.	469335	675548	0.8250	0.7114	1315302	497209	600552
.	.	.	.	.	0.8500	0.7194	.	469335	689797	0.8500	0.7324	1298578	487017	603395
.	.	.	.	.	0.8750	0.7404	.	469335	703764	0.8750	0.7533	1282164	477045	605807
.	.	.	.	.	0.9000	0.7613	.	469335	717456	0.9000	0.7743	1266054	467288	607806
.	.	.	.	.	0.9250	0.7823	.	469335	730879	0.9250	0.7952	1250243	457740	609422
.	.	.	.	.	0.9500	0.8032	.	469335	744039	0.9500	0.8160	1234722	448398	610674
.	.	.	.	.	0.9750	0.8241	.	469335	756942	0.9750	0.8369	1219488	439257	611582
.	.	.	.	.	1.0000	0.8450	.	469335	769591	1.0000	0.8577	1204533	430312	612168
.	.	.	.	.	1.0250	0.8660	.	469335	781996	1.0250	0.8784	1189853	421559	612451
.	.	.	.	.	1.0500	0.8868	.	469335	794157	1.0500	0.8992	1175442	412993	612448
.	.	.	.	.	1.0750	0.9077	.	469335	806083	1.0750	0.9198	1161293	404611	612175
.	.	.	.	.	1.1000	0.9285	.	469335	817774	1.1000	0.9405	1147403	396409	611650
.	.	.	.	.	1.1250	0.9494	.	469335	829242	1.1250	0.9611	1133765	388382	610888
.	.	.	.	.	1.1500	0.9703	.	469335	840485	1.1500	0.9817	1120375	380527	609906
.	.	.	.	.	1.1750	0.9910	.	469335	851510	1.1750	1.0022	1107227	372839	608714
.	.	.	.	.	1.2000	1.0119	.	469335	862324	1.2000	1.0227	1094317	365316	607328

Figure 3.1


Yield and fishing mortality
Yield
F
Yield (1000 tonnes)
Average fishing mortality (age 5 – 10)
Year
(run: SVPASA10)
A
Spawning stock and recruitment
SSB
R
SSB (1000 tonnes) at spawning time
Recruitment at age 3 (millions)
Recruitment year class, SSB year
(run: SVPASA10)
B
Long term yield and spawning stock biomass
Yield
SSB
Yield per recruit (grams)
SSB (kilogr.) at year start
Fishing mortality (average of age 5 - 10,u)
(run: YLDASA05)
C
Short term yield and spawning stock biomass
Yield
SSB
Yield in 2002 (1000 tonnes)
SSB in 2003 (1000 tonnes) at year start
Fishing mortality (average of age 5 - 10,u)
(run: MANASA06)
D

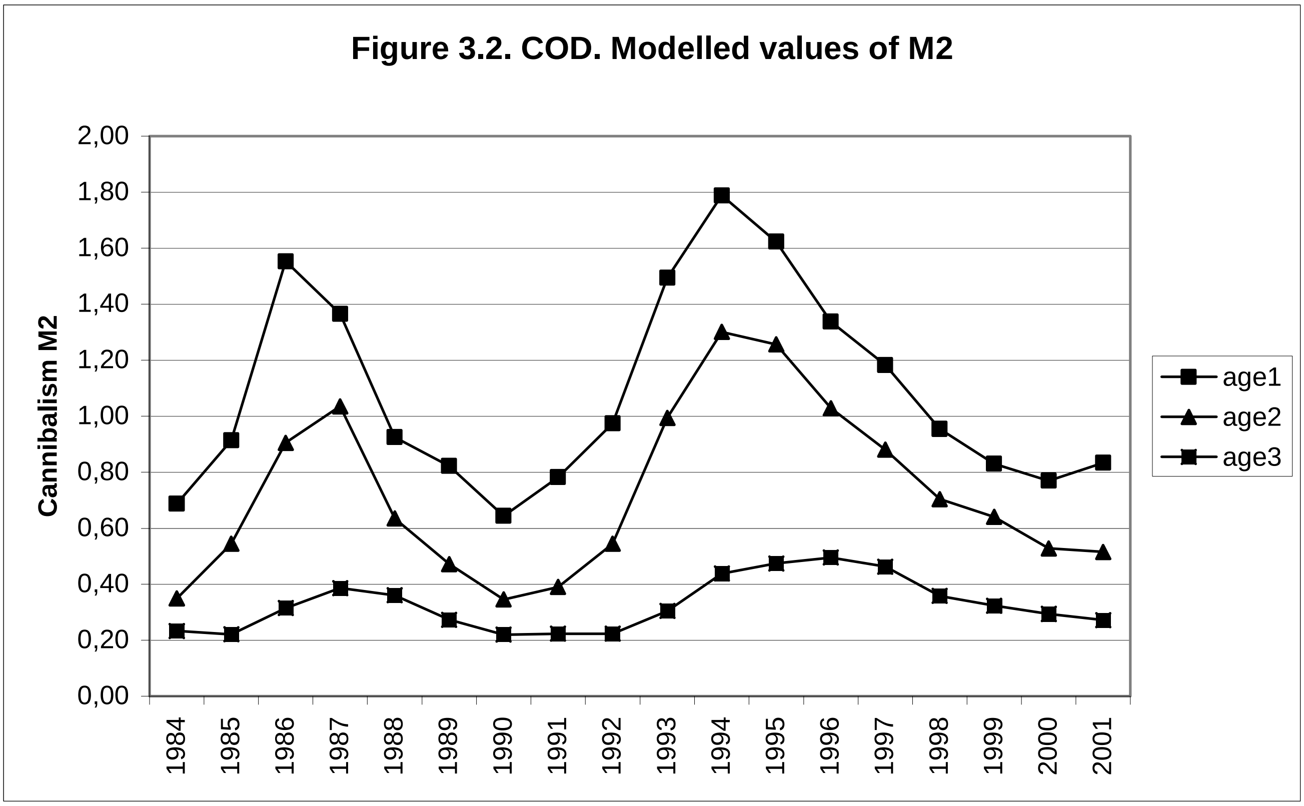
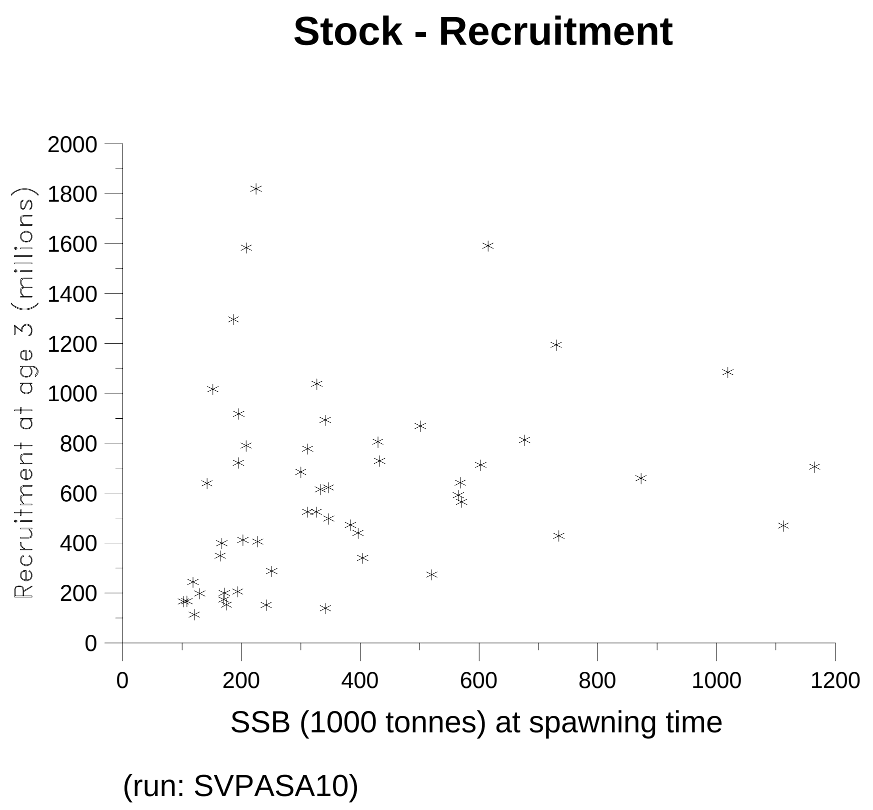


Figure 3.3 Stock-Recruitment, cannibalism taken into account for the period 1984-2000



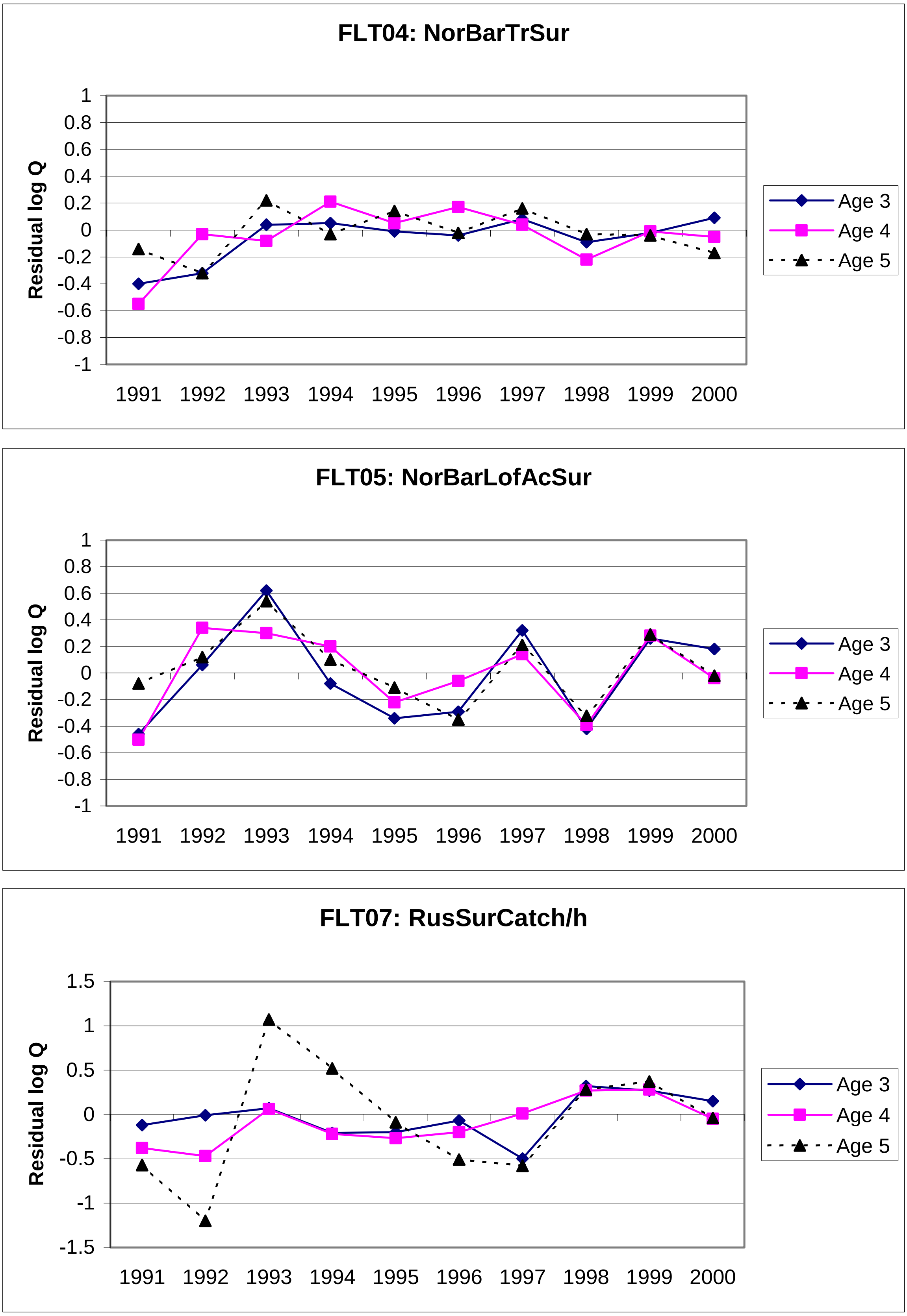


Figure 3.4 Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2001 assessment.

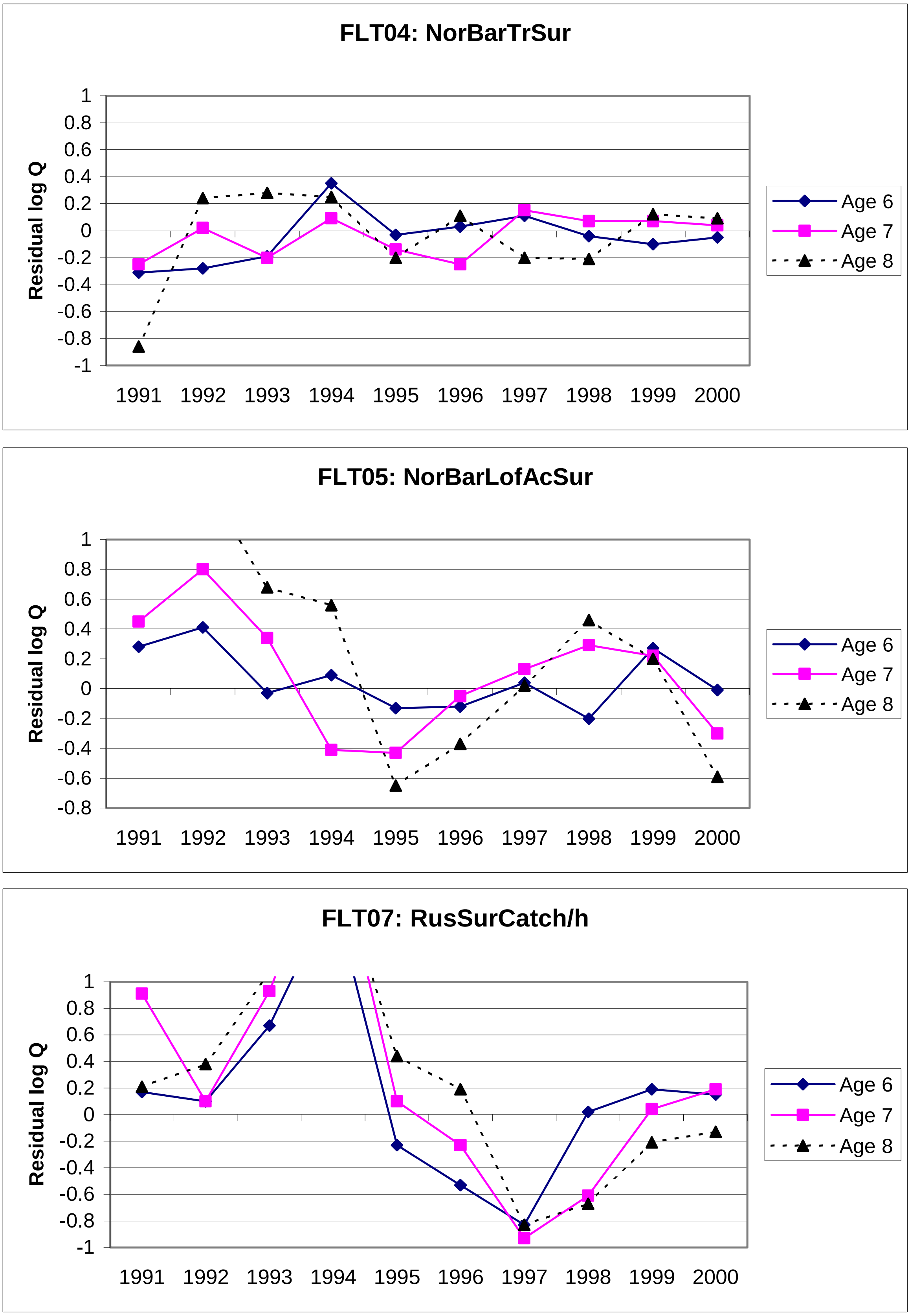


Figure 3.5 Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2001 assessment.

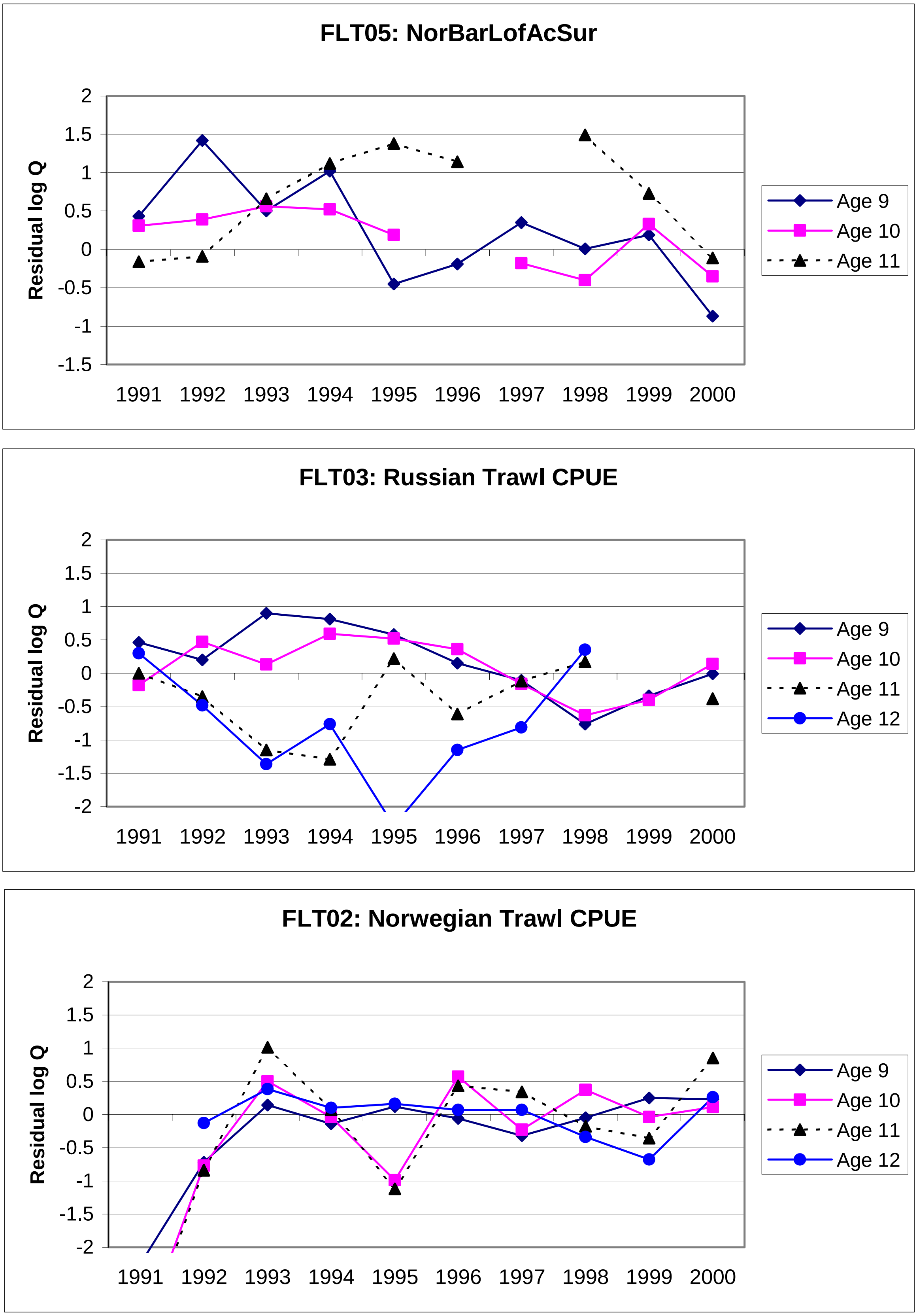


Figure 3.6 Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2001 assessment.

Figure 3.7. NEA Cod, retrospective F

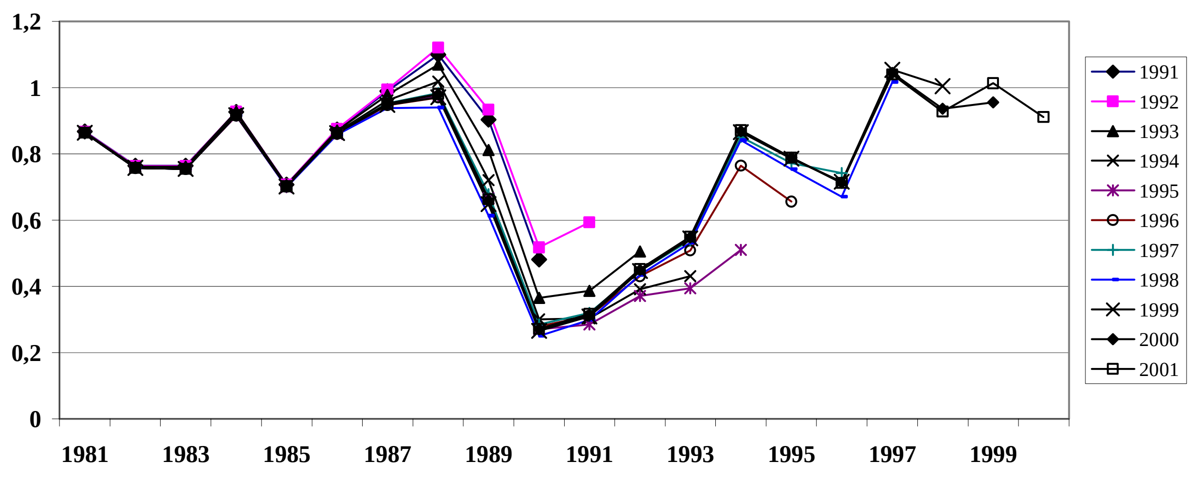


Figure 3.8. NEA Cod, retrospective SSB

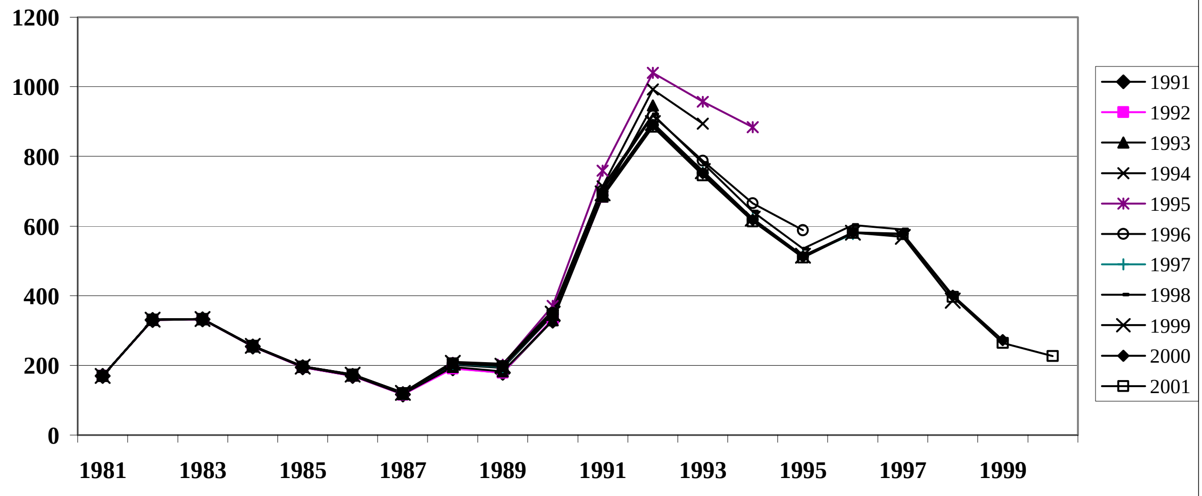
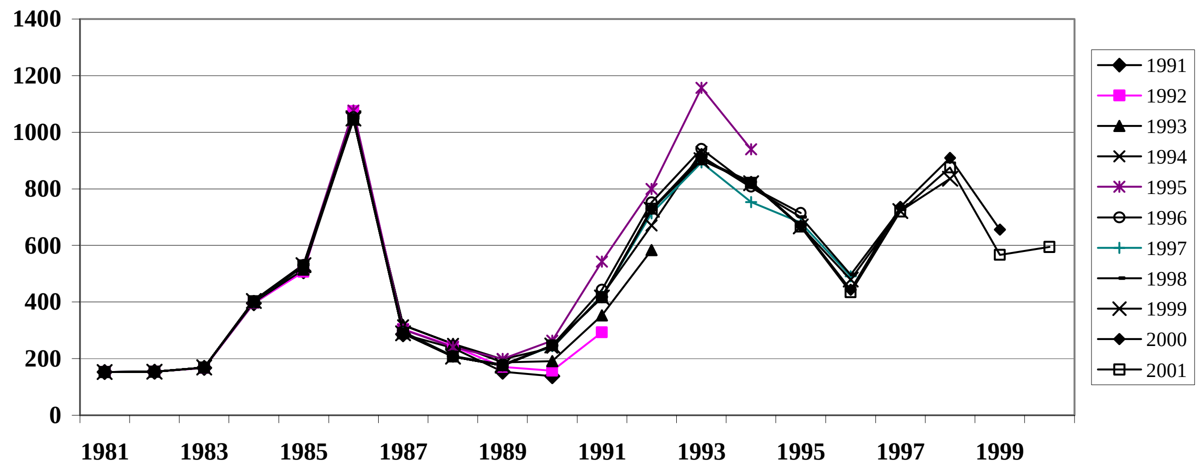


Figure 3.9. NEA Cod, retrospective recruitement age 3



Introduction to the Figures from Fleksibest

The following figures are taken from 4 different sets of Fleksibest runs. The series shown are

Assessment with Fleksibest, Key run (Figures 3.10a-f)
Assessments with different weighting of data (Figures 3.13a-f)
Retrospective analysis (Figures 3.14a-f)
Prognosis with Fleksibest (Figures 3.15a-f)

Each series of figures includes 6 different plots, numbered a-f. The plots are:

Stock biomass
Spawning stock biomass
F_{5-10}
Catch in biomass
Recruitment
Stock numbers

In addition some diagnostic plots for the key run are included. Figure 3.11a-c shows observed and modeled length at age 4,6, and 8. Figure 3.12a-f shows for each fleet and survey, the observed and modeld numbers and indices by year, and the likelihood contribution by year.

Assessment with Fleksibest

Key run

Stock biomass

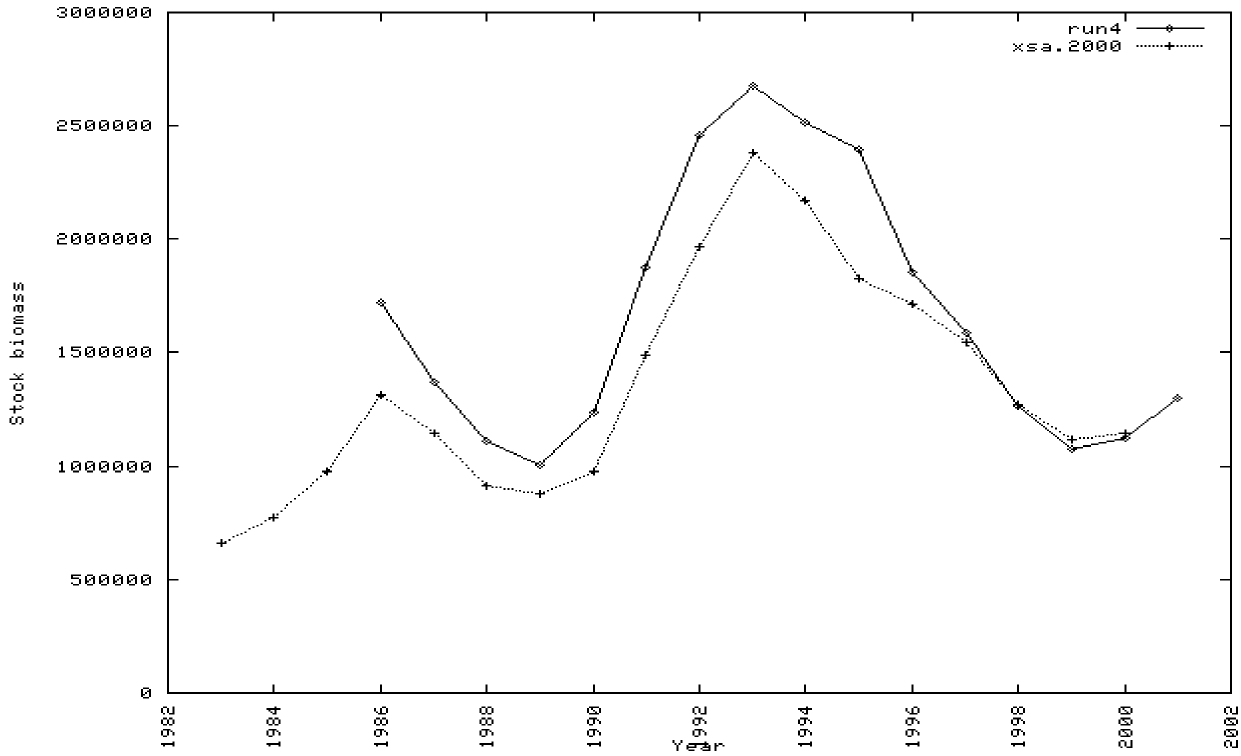


Figure 3.10a (stock biomass in key run, and XSA from 2000**)**

Spawning stock biomass

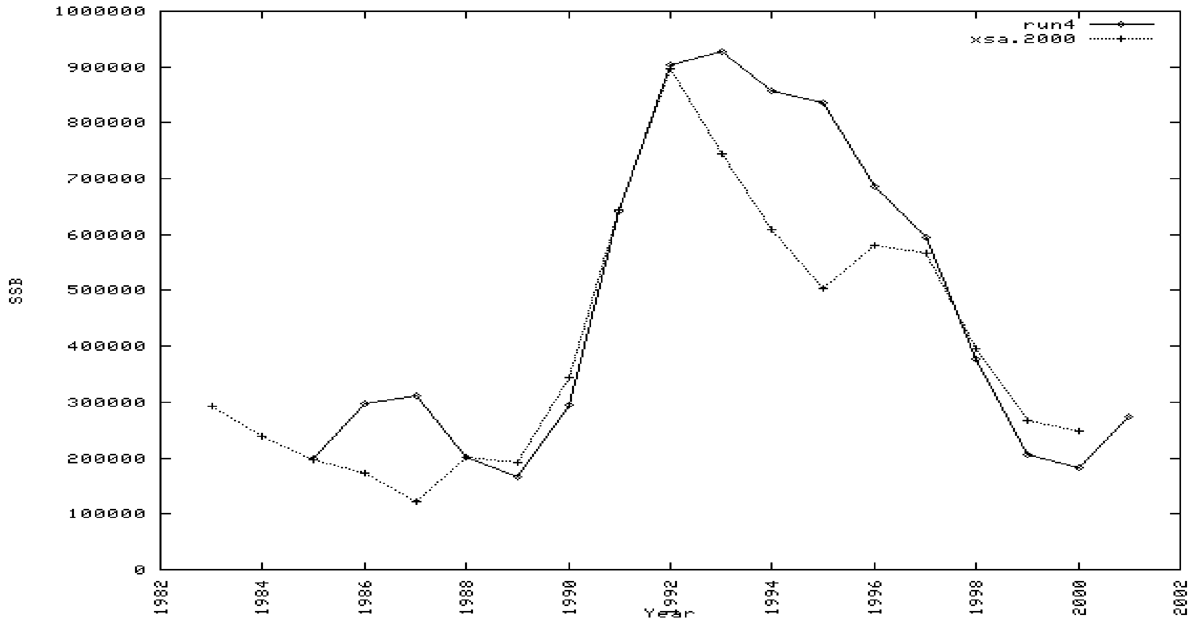


Figure 3.10b (SSB in key run, and XSA from 2000)

$F_{5\text{-}10}$

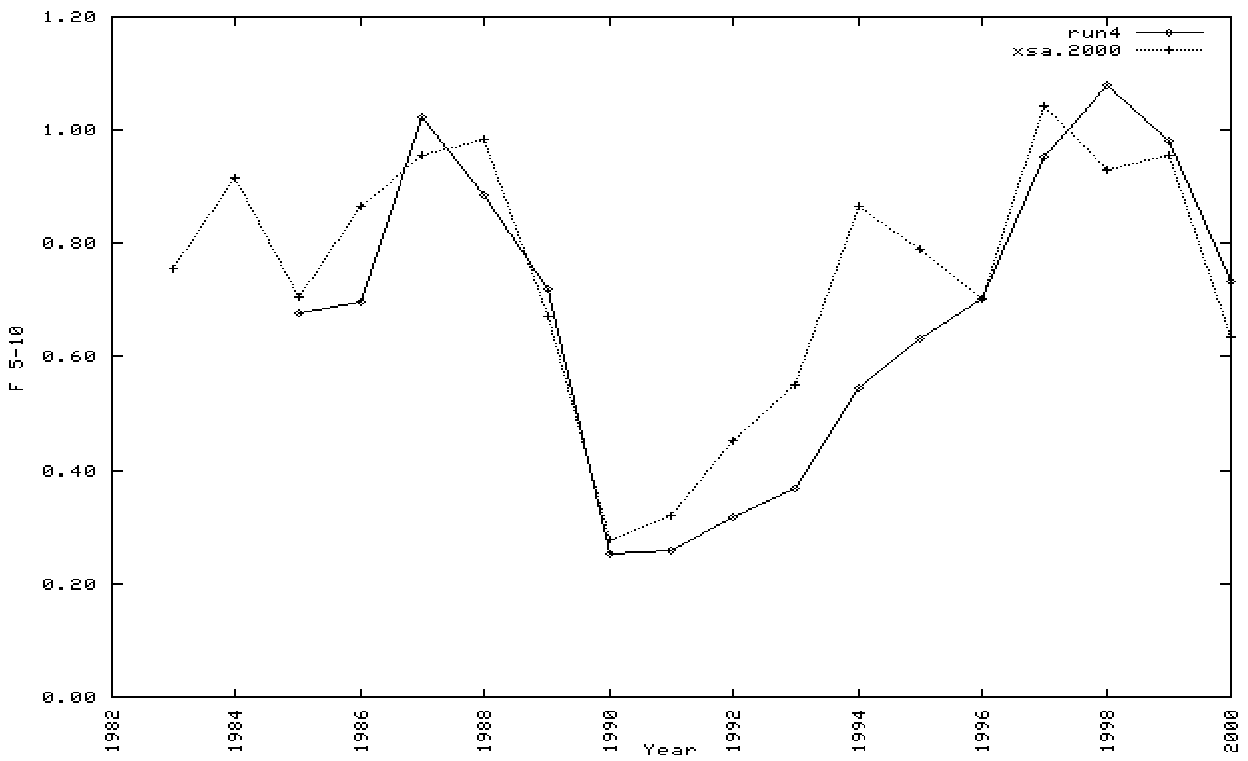


Figure 3.10c ($F_{5\text{-}10}$ in key run, and XSA from 2000)

Catch in biomass

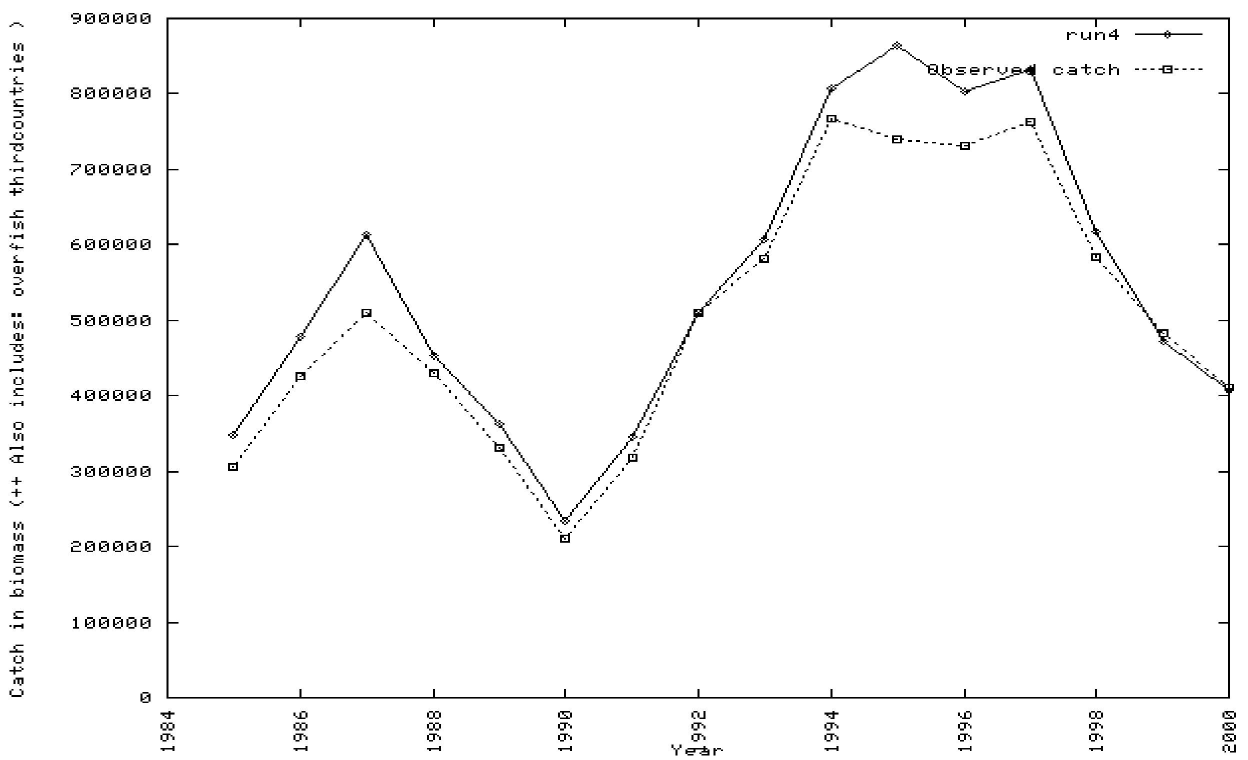


Figure 3.10d (Catch in biomass in key run, and observed catches)

Recruitment at age 3

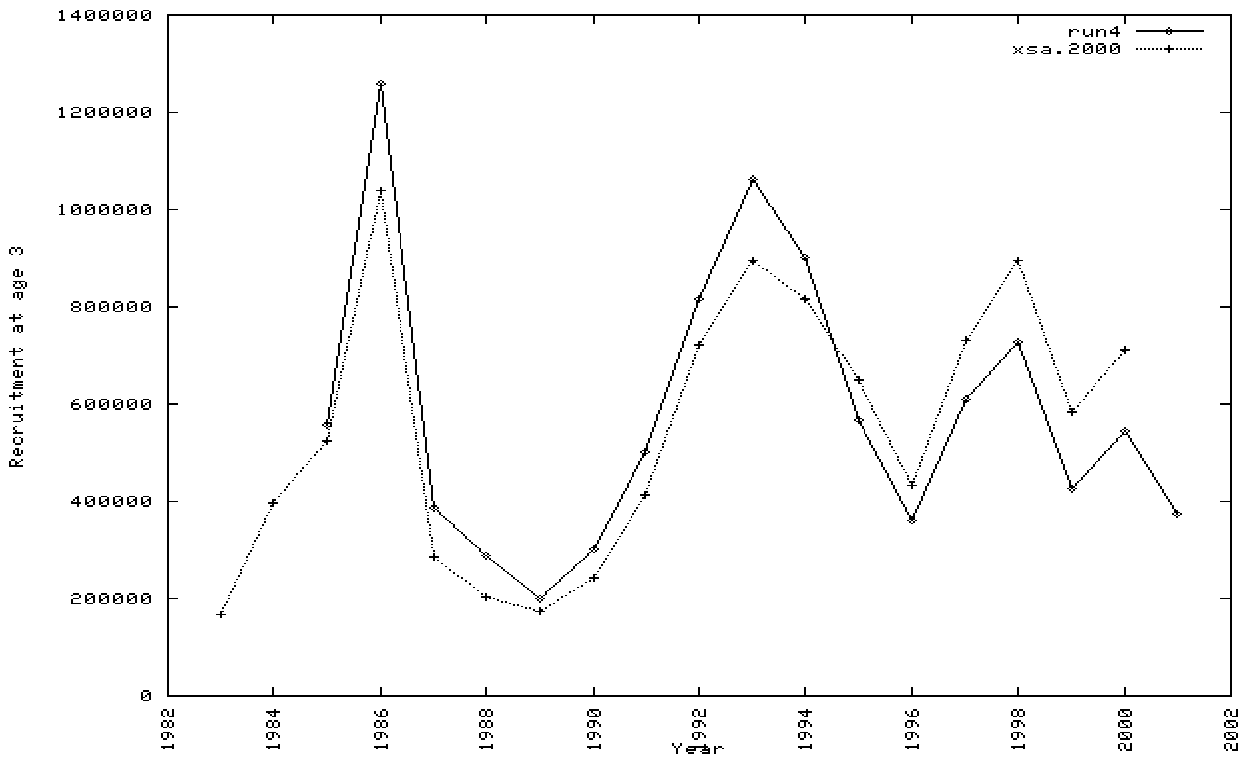


Figure 3.10e (Recruitment (number of 3 year old) in key run, and XSA from 2000)

Stock numbers

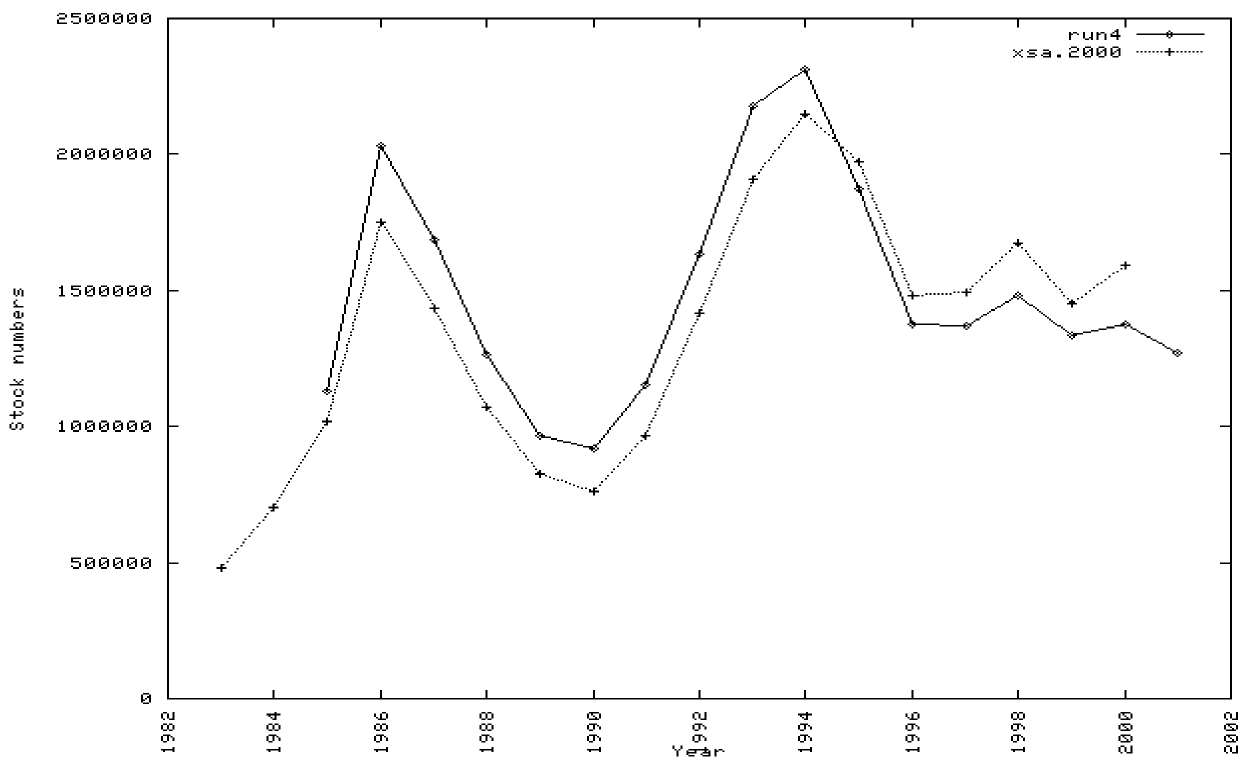


Figure 3.10f (Stock numbers in key run, and XSA from 2000)

Mean length by year for ages 4,6, and 8

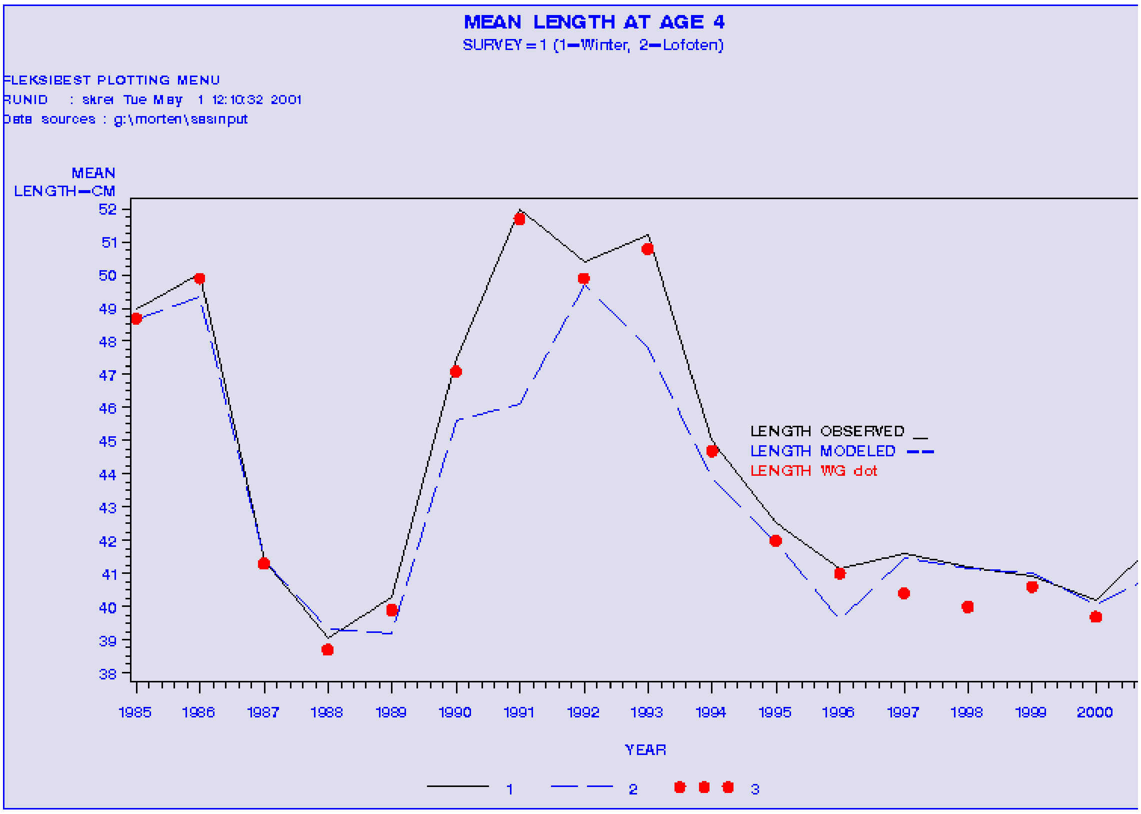


Figure 3.11a (Mean length by year for immature age 4 fish in key run)

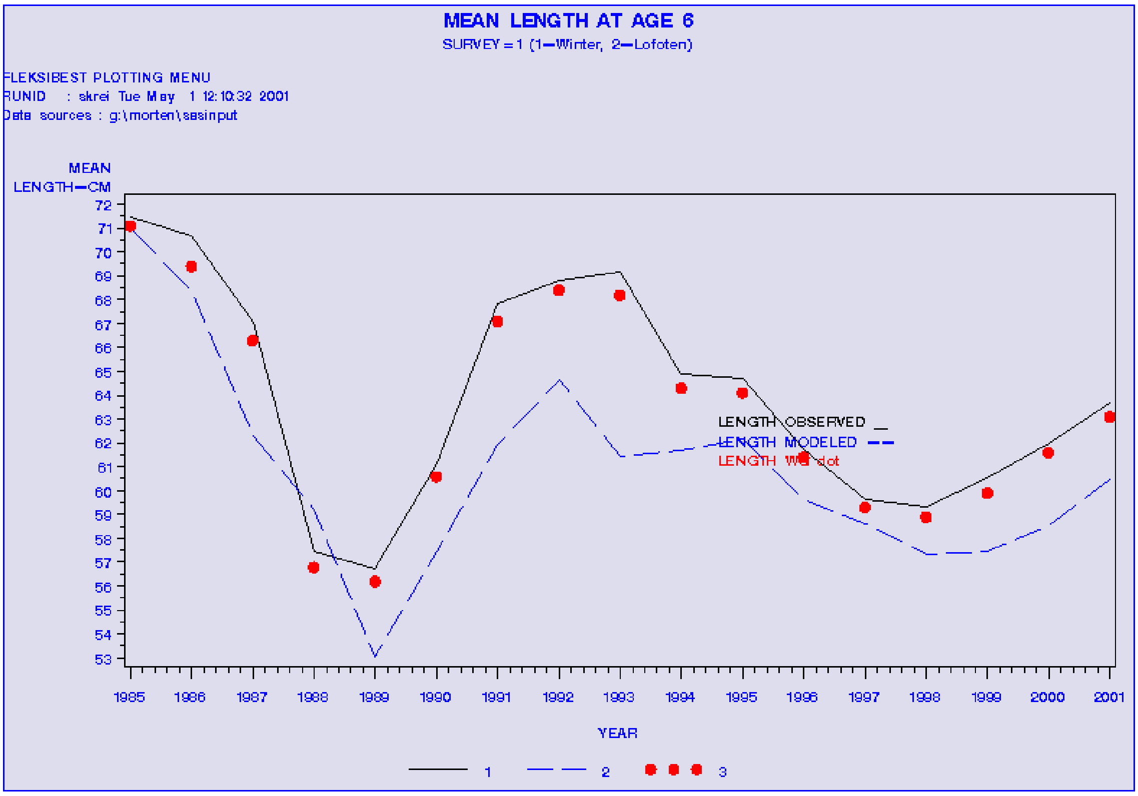


Figure 3.11b (Mean length by year for immature age 6 fish in key run)

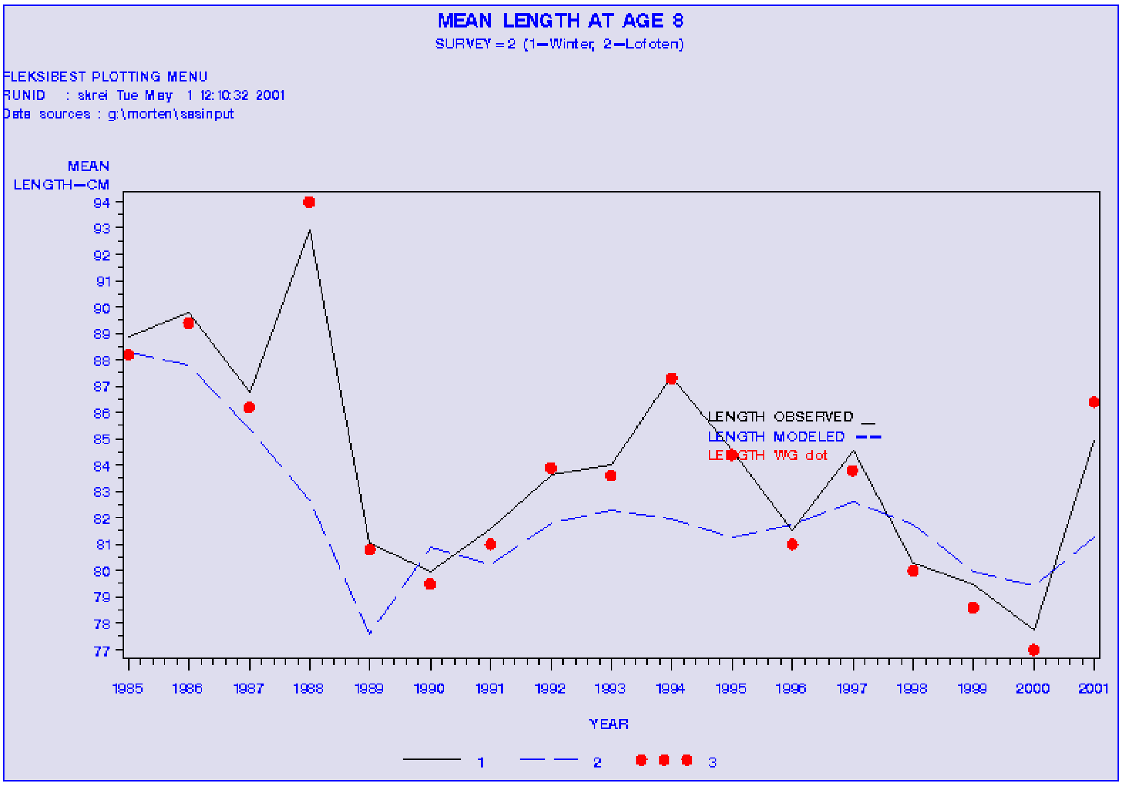


Figure 3.11c (Mean length by year for mature age 8 fish in key run)

Observed and Modeled indices, Winter survey and Lofoten survey

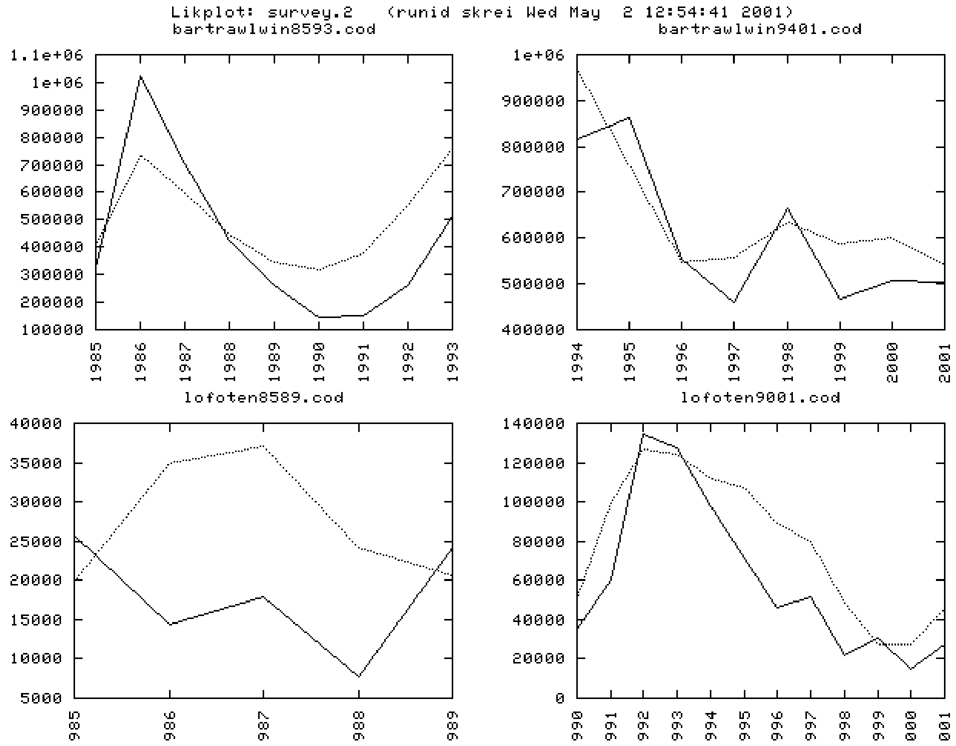


Figure 3.12a (Observed and modeled survey indices, solid line is observed)

Likelihood contribution, Winter survey and Lofoten survey

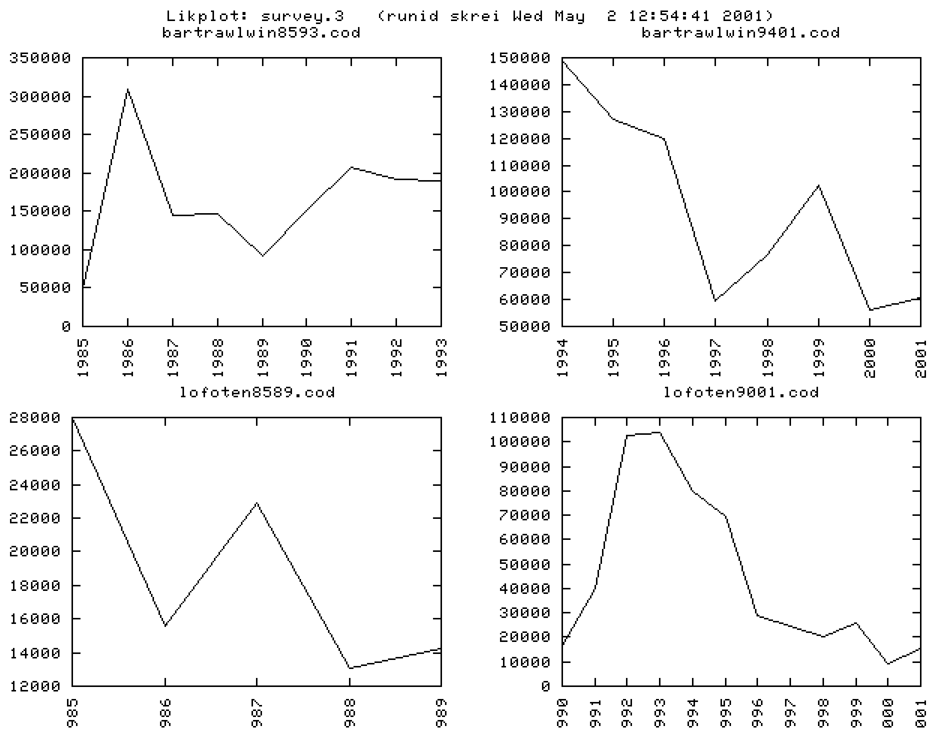


Figure 3.12b (Unweighted likelihood contribution from surveys)

Observed and Modeled indices, acoustic survey, Russian survey, autumn survey

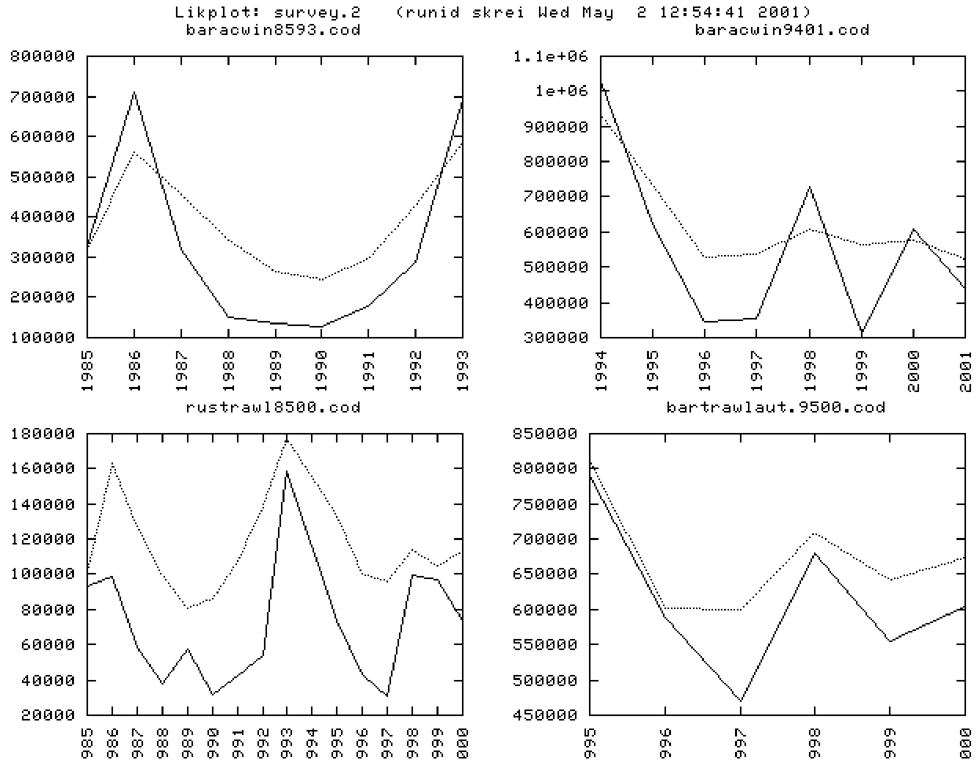


Figure 3.12c (Observed and modeled survey indices, solid line is observed)

Likelihood contribution, acoustic survey, Russian survey, autumn survey

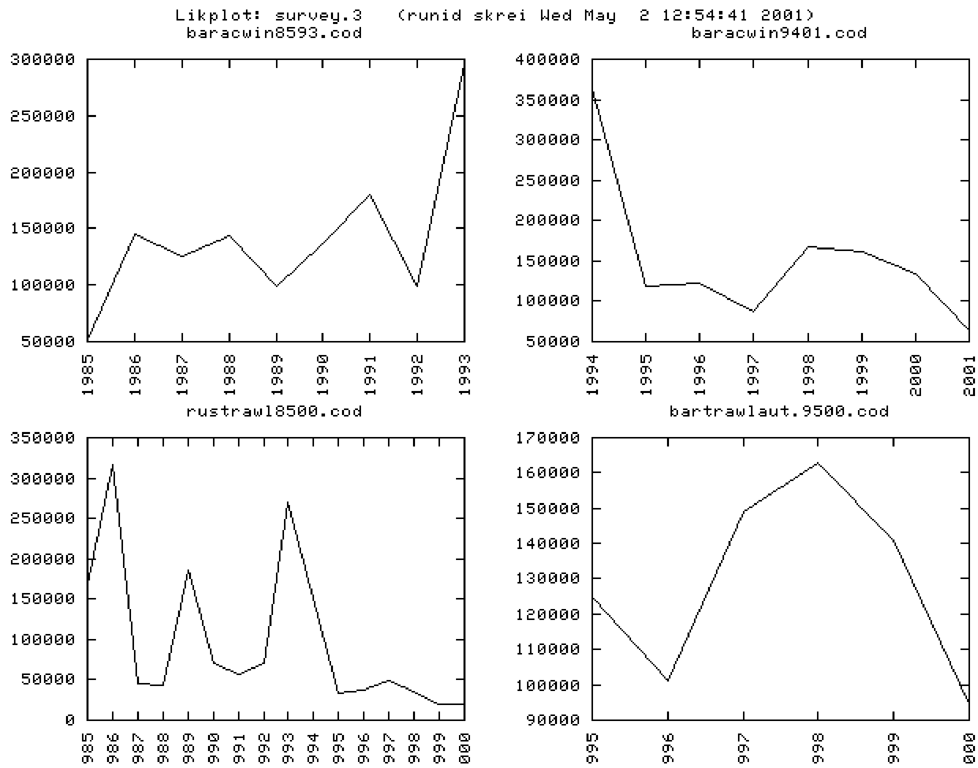


Figure 3.12d (Unweighted likelihood contribution from surveys)

Observed and Modeled Catches, totalfleet and gillnet

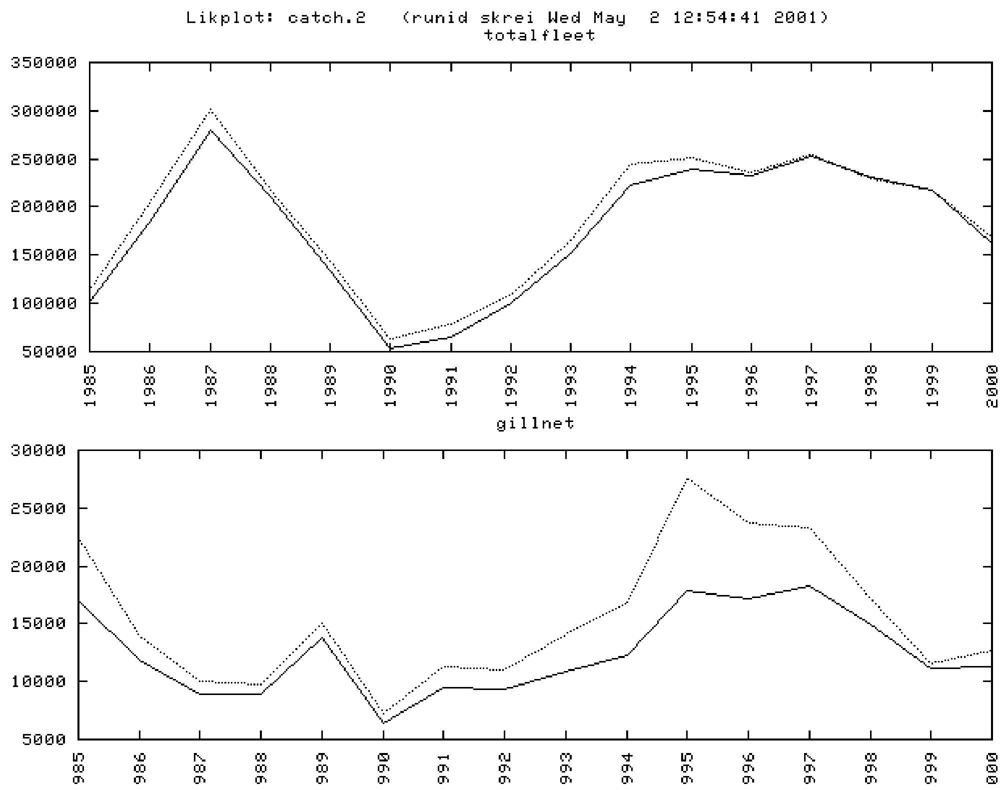


Figure 3.12e (Observed and modeled catches, solid line is observed)

Likelihood contibution from totalfleet and gillnet

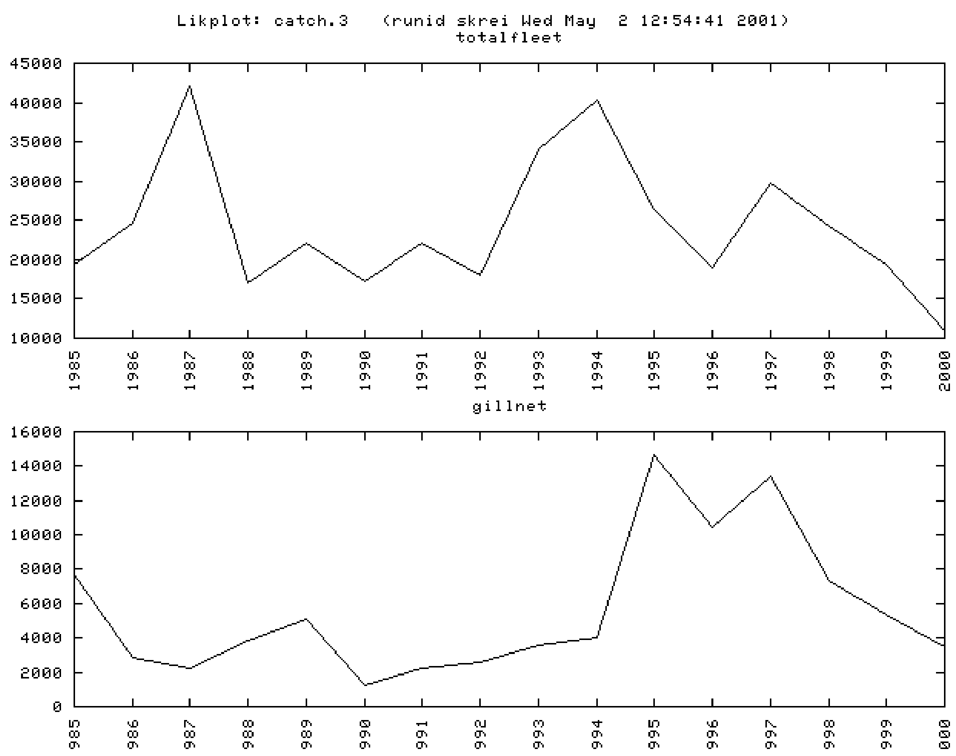


Figure 3.12f (Unweighted likelihood contribution from catches)

Assessments with different weightings of data

Stock biomass

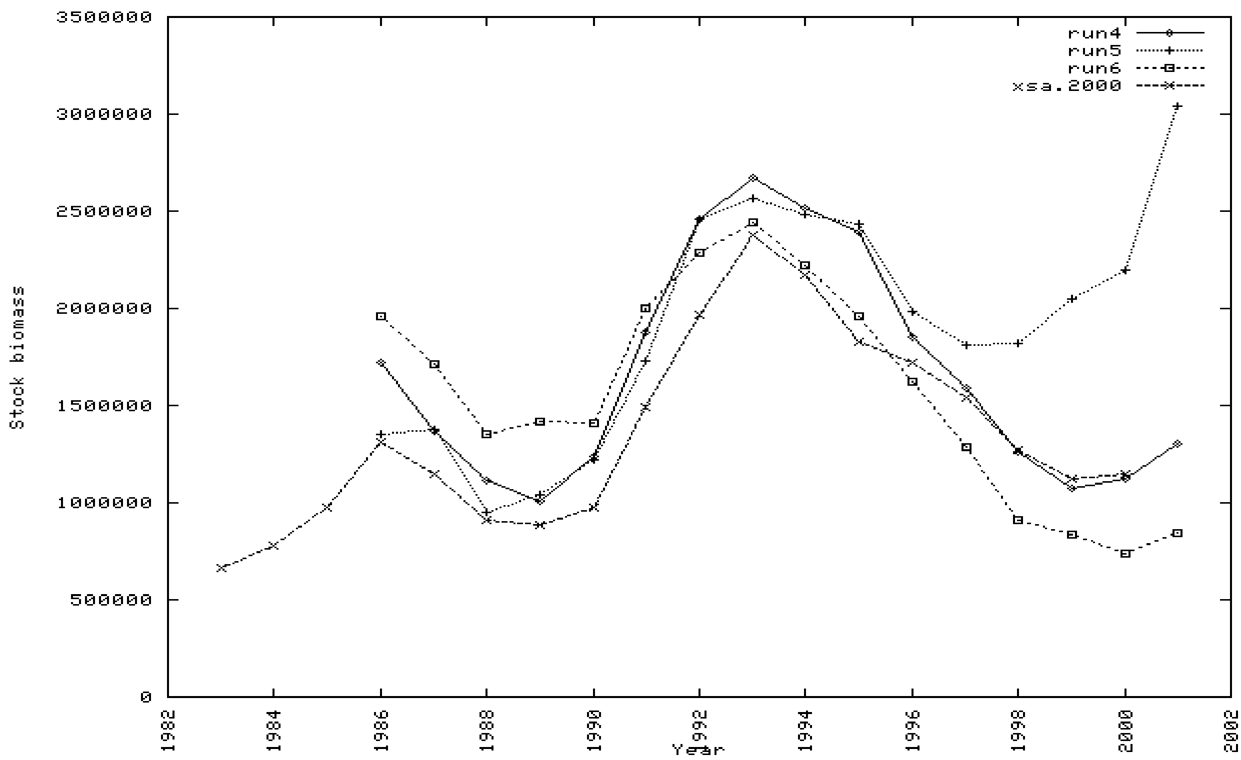


Figure 3.13a (Stock biomass in key run, catch run, survey run, and XSA from 2000)

Spawning stock biomass

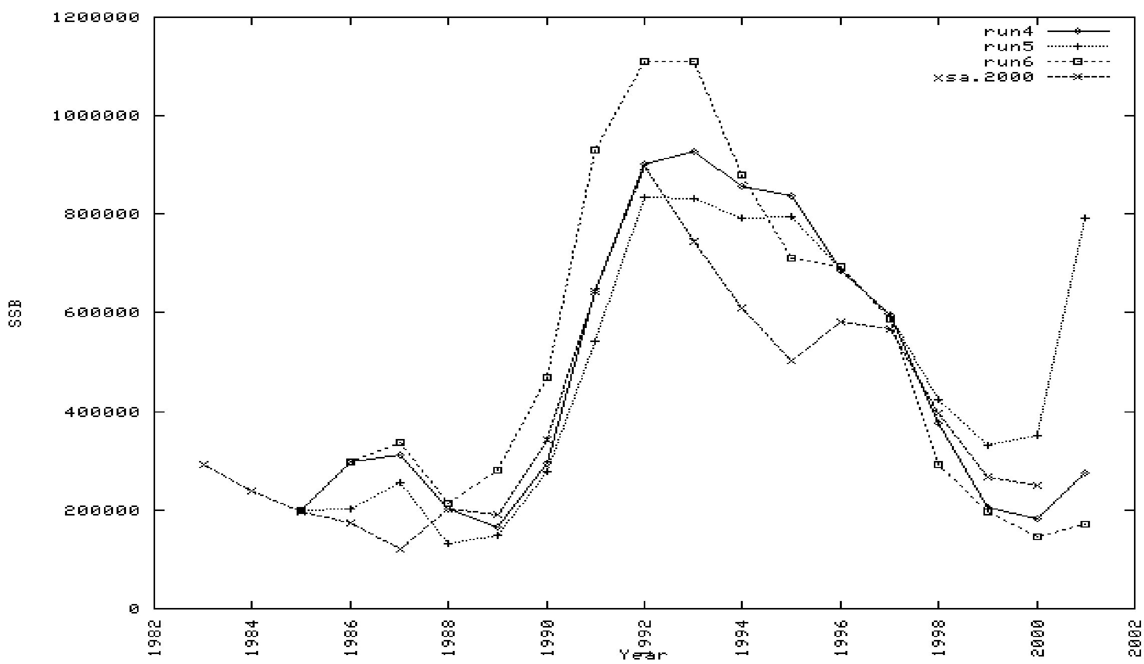


Figure 3.13b (SSB in key run, catch run, survey run, and XSA from 2000)

$F_{5\text{-}10}$

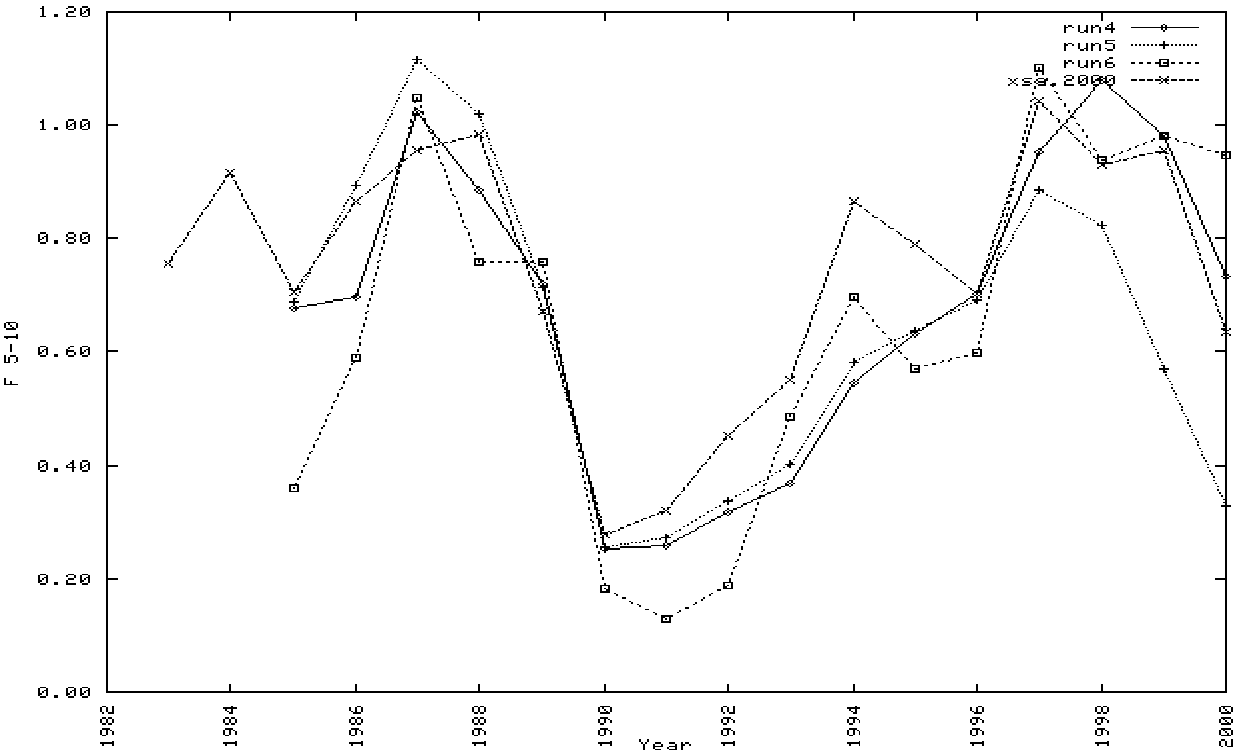


Figure 3.13c ($F_{5\text{-}10}$ in key run, catch run, survey run, and XSA from 2000)

Catch in biomass

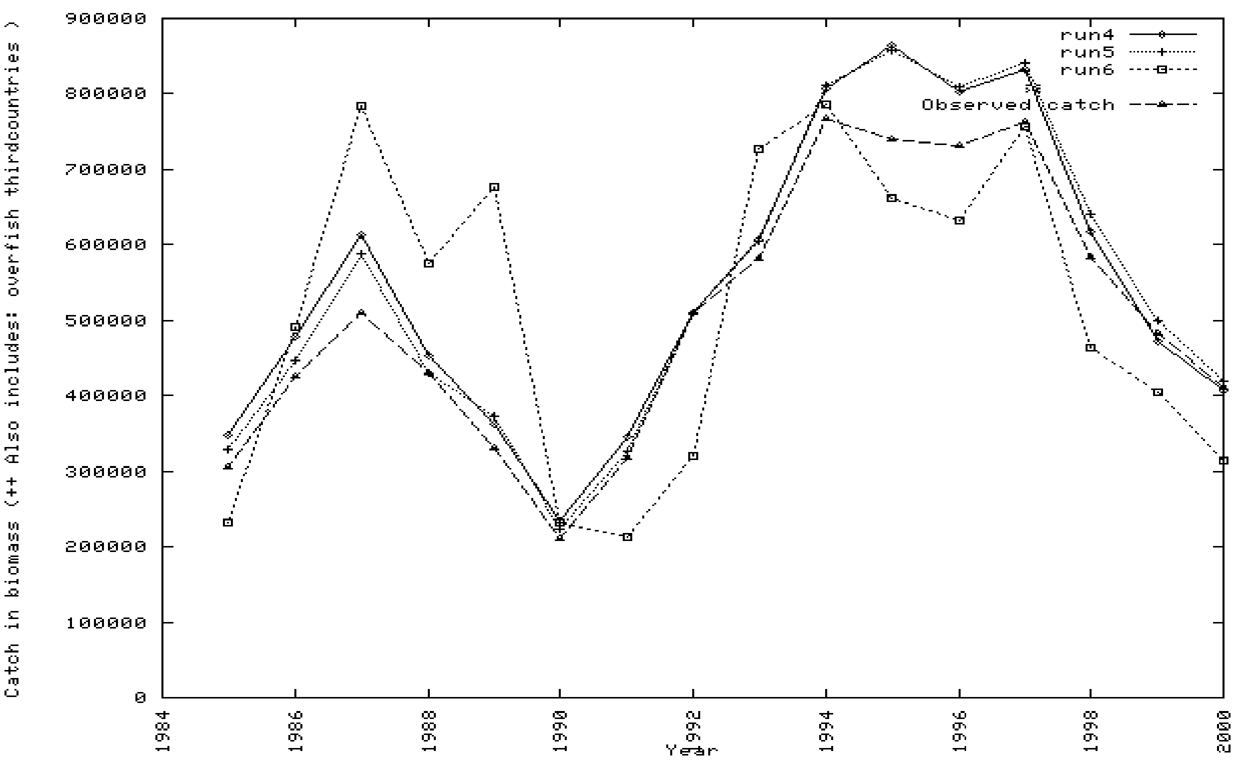


Figure 3.13d (Catch in biomass in key run, catch run, survey run, and observed catches)

Recruitment at age 3

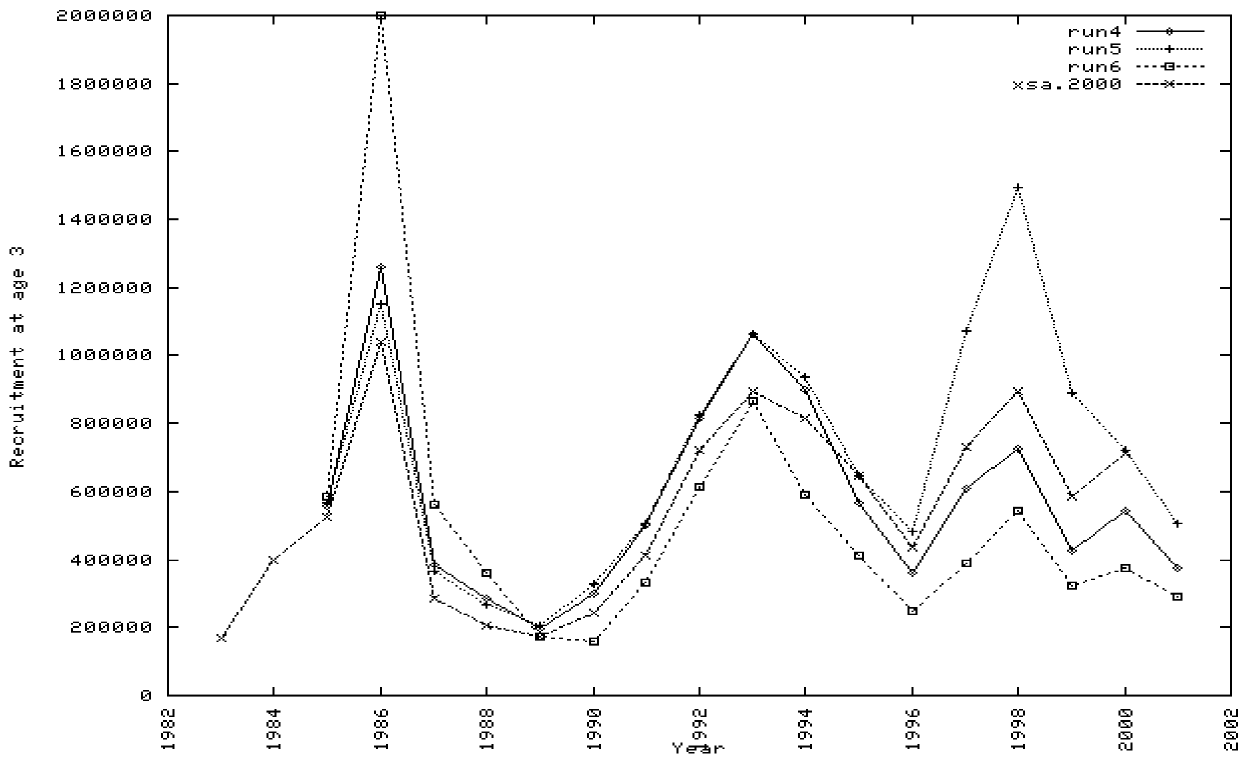


Figure 3.13e (Recruitment at age 3 in key run, catch run, survey run, and XSA from 2000)

Stock numbers

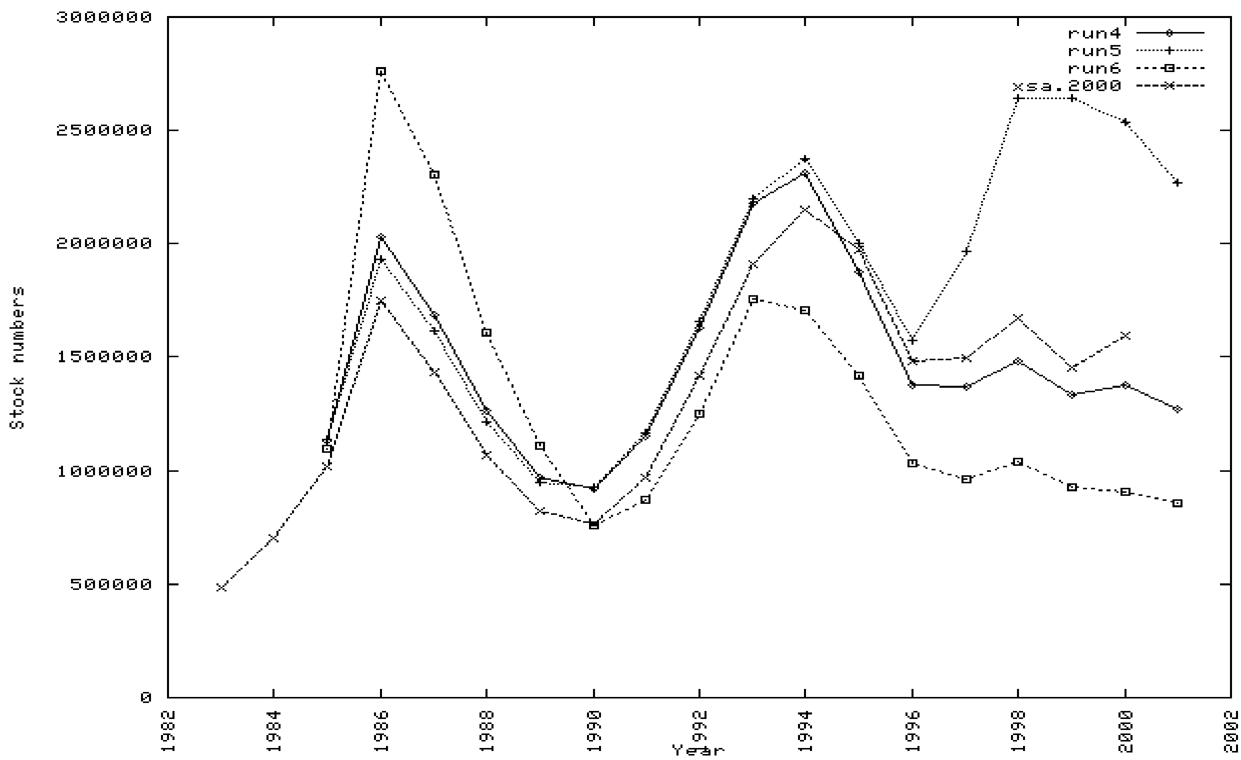


Figure 3.13f (Stock numbers in key run, catch run, survey run, and XSA from 2000)

Retrospective analysis

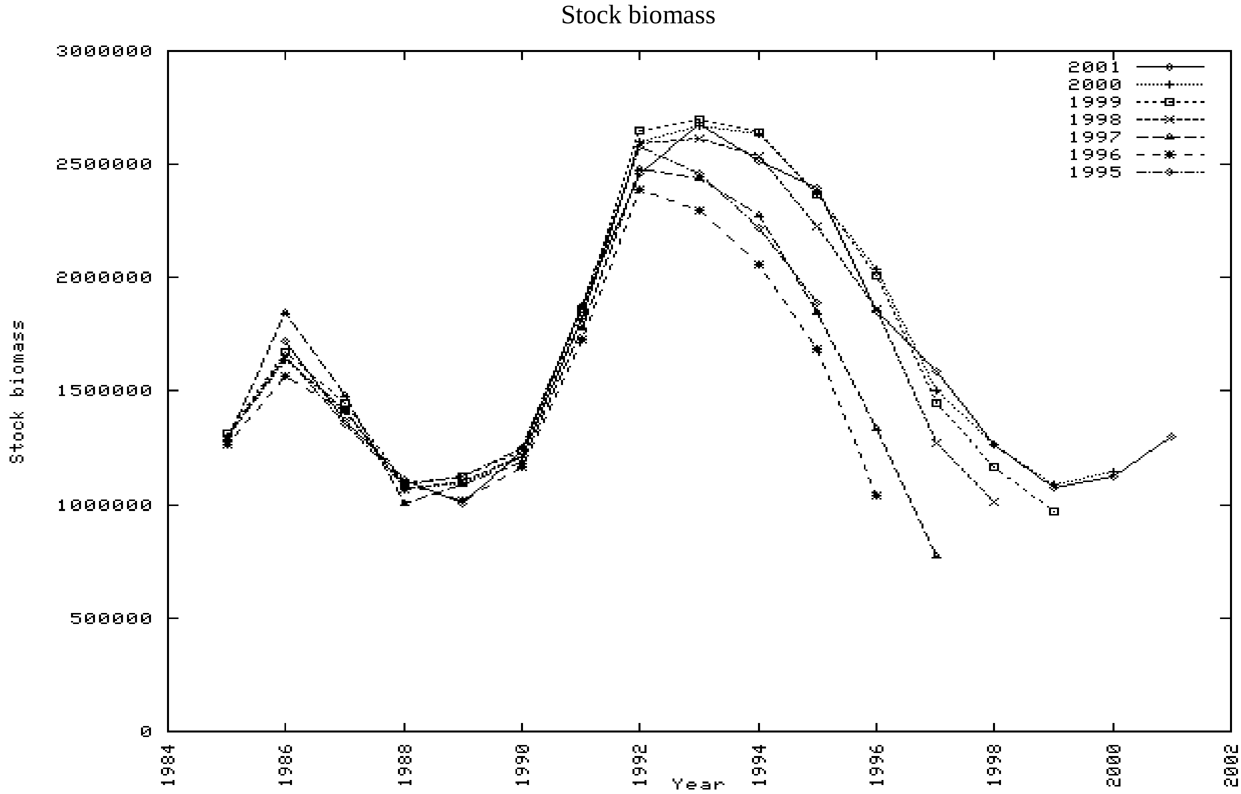


Figure 3.14a (Retrospective pattern for Stock biomass in key run)

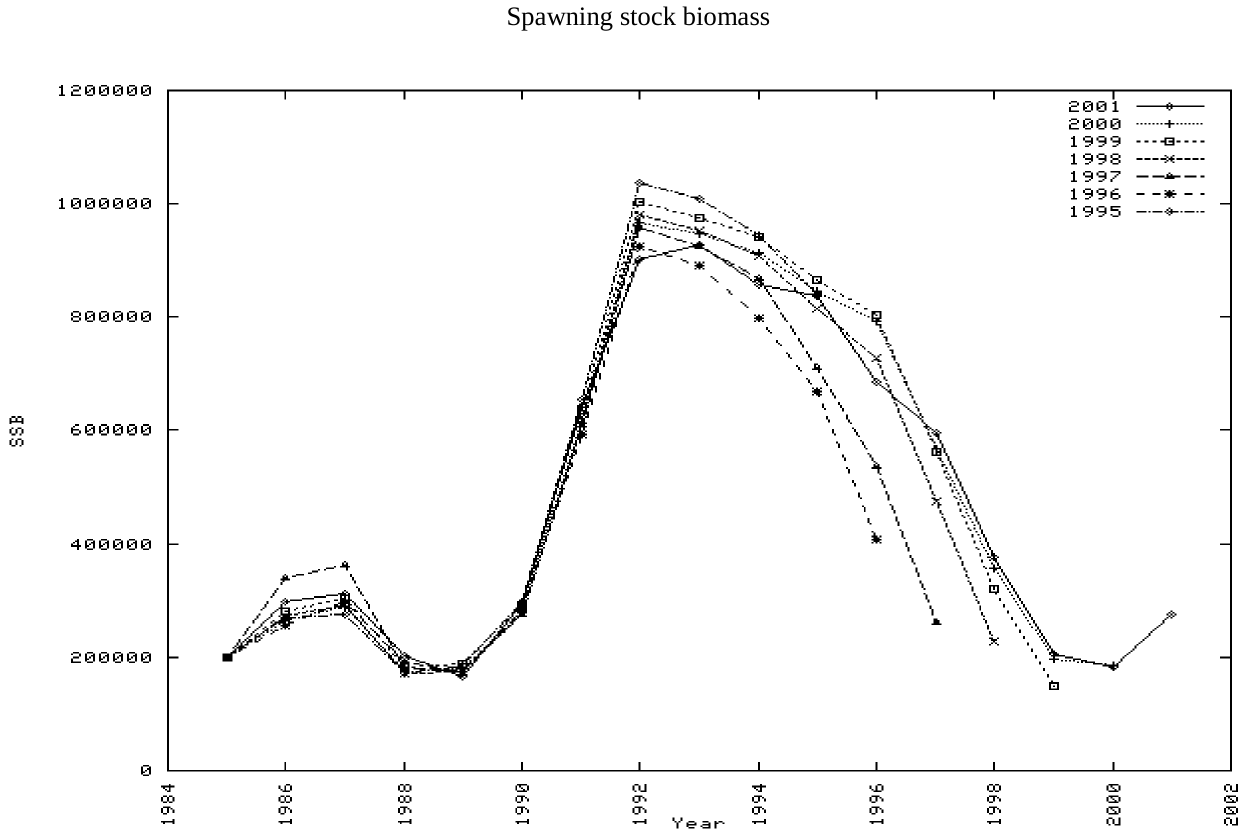


Figure 3.14b (retrospective pattern for SSB in key run)

$F_{5\text{-}10}$

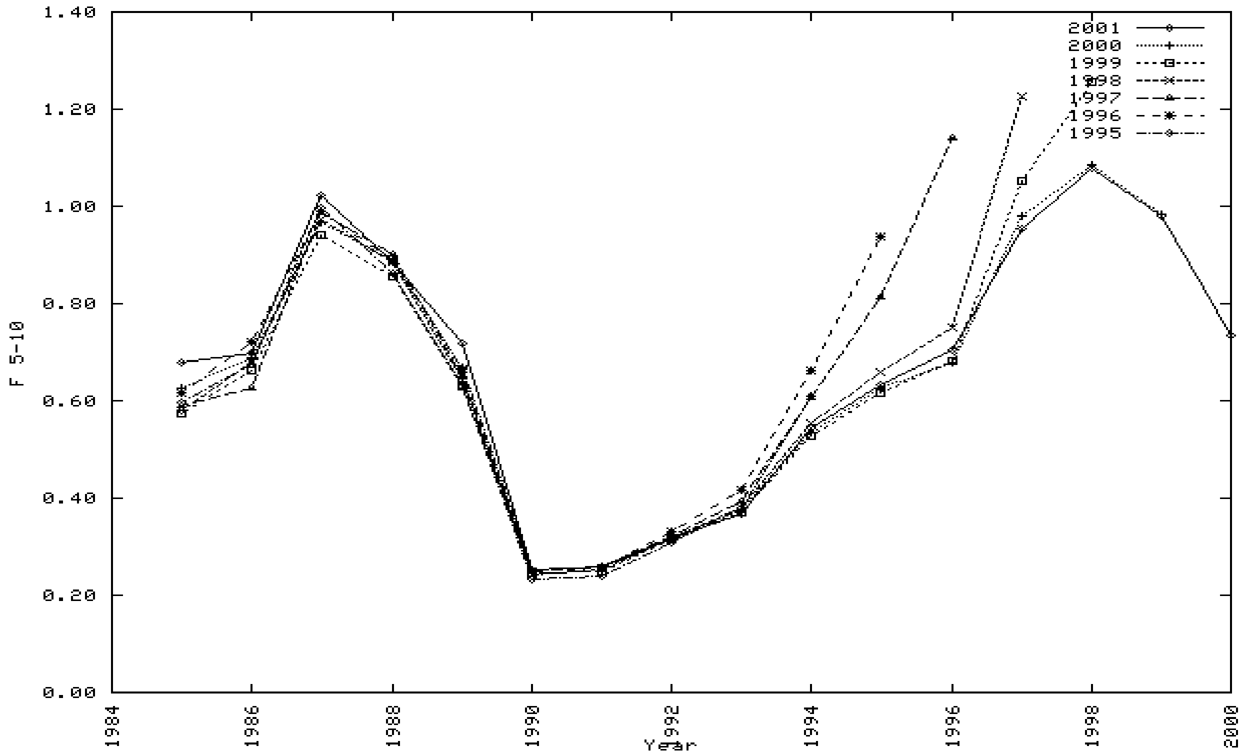


Figure 3.14c (Retrospective pattern for $F_{5\text{-}10}$ in key run)

Catch in biomass

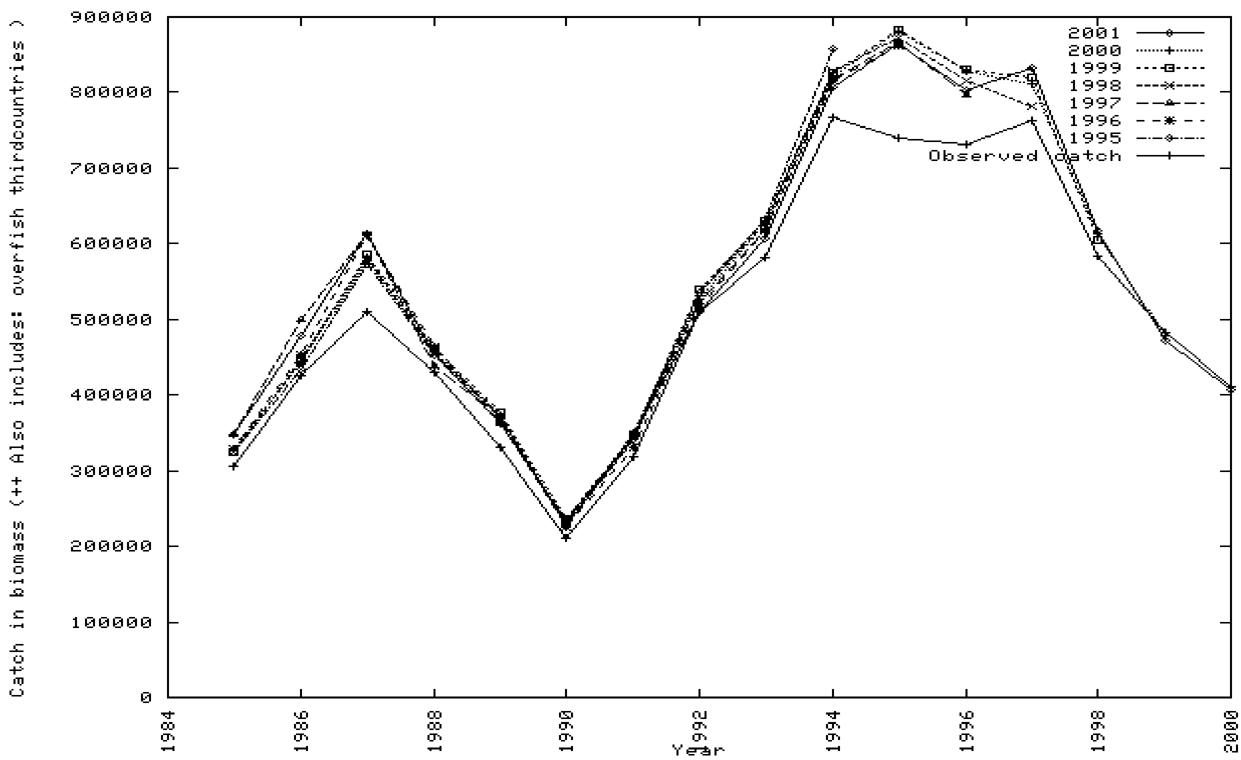


Figure 3.14d (Retrospective pattern for Catch in biomass in key run, and observed catches)

Recruitment at age 3

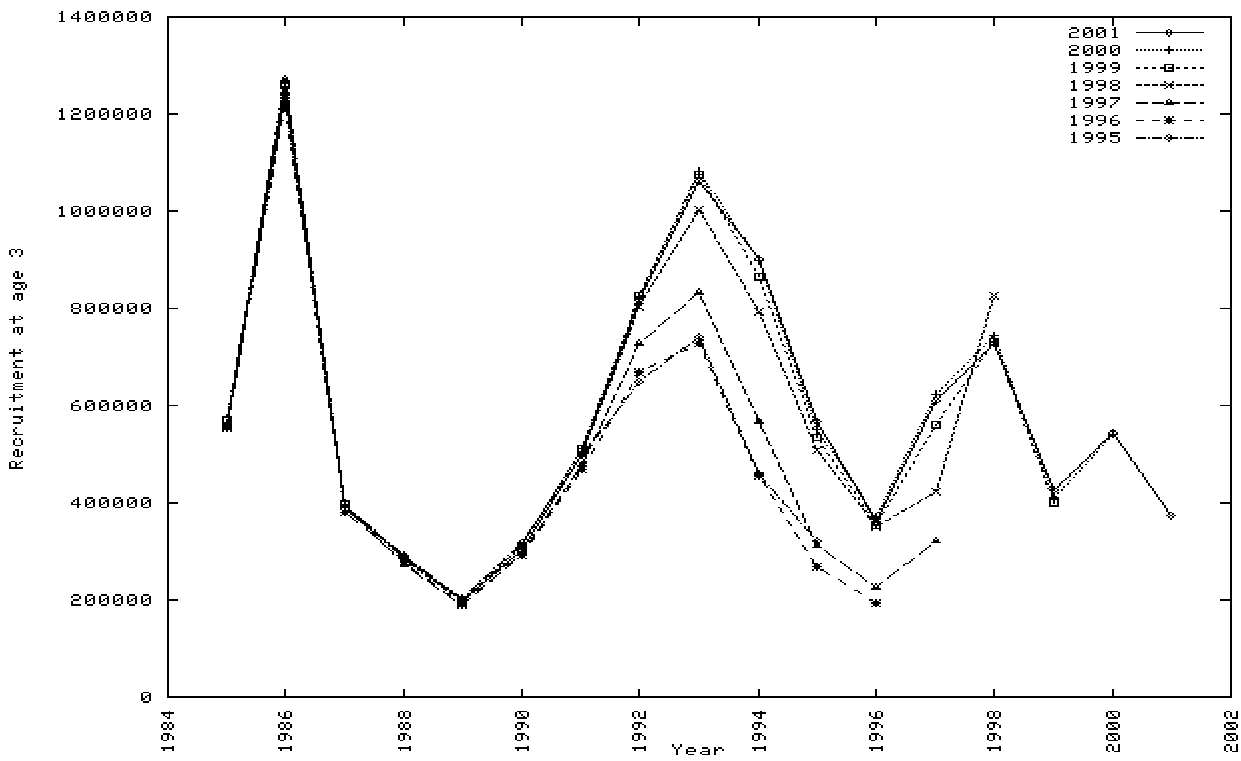


Figure 3.14e (Retrospective pattern for recruitment in key run)

Stock numbers

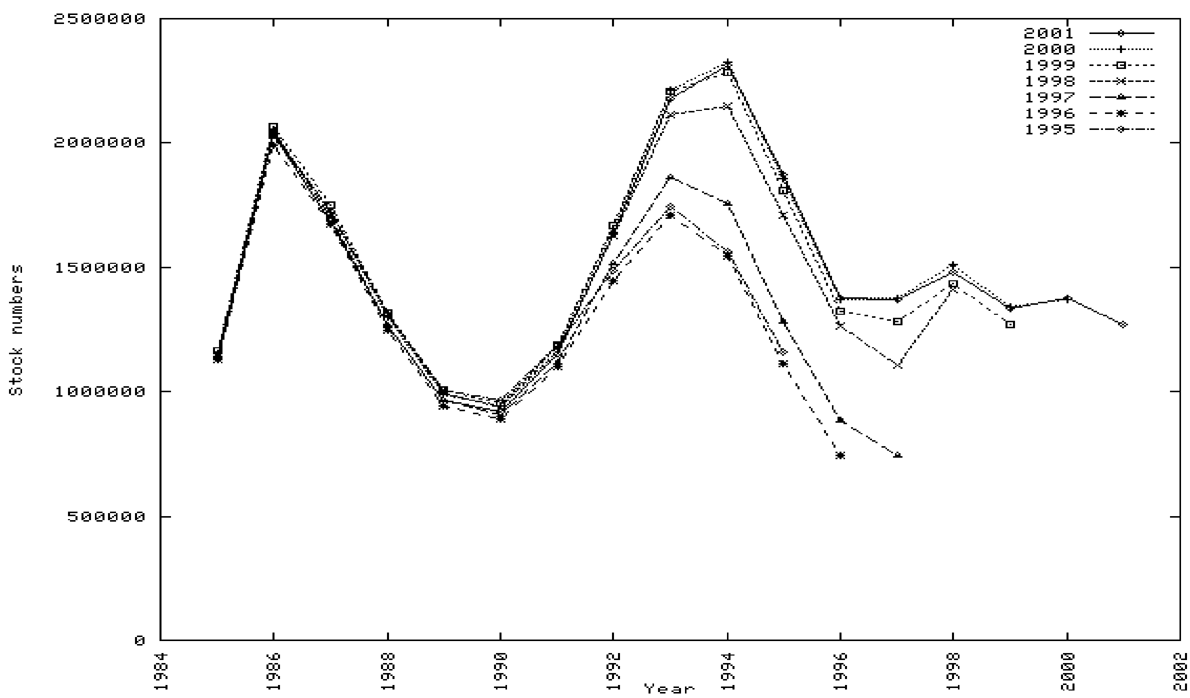


Figure 3.14f (Retrospective pattern for stock numbers in key run)

Prognosis with Fleksibest

Stock biomass

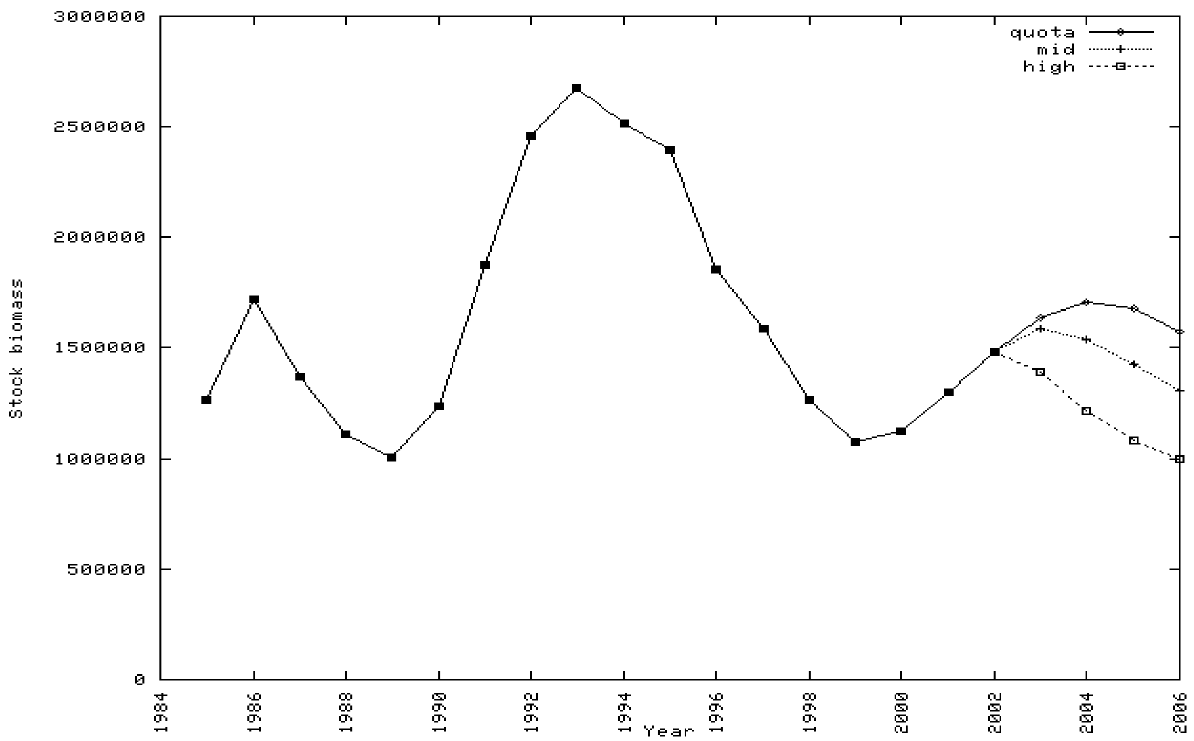


Figure 3.15a (Prediction of stock biomass in ‘quota’, ‘mid’, and ‘high’ fishing scenarios)

Spawning stock biomass

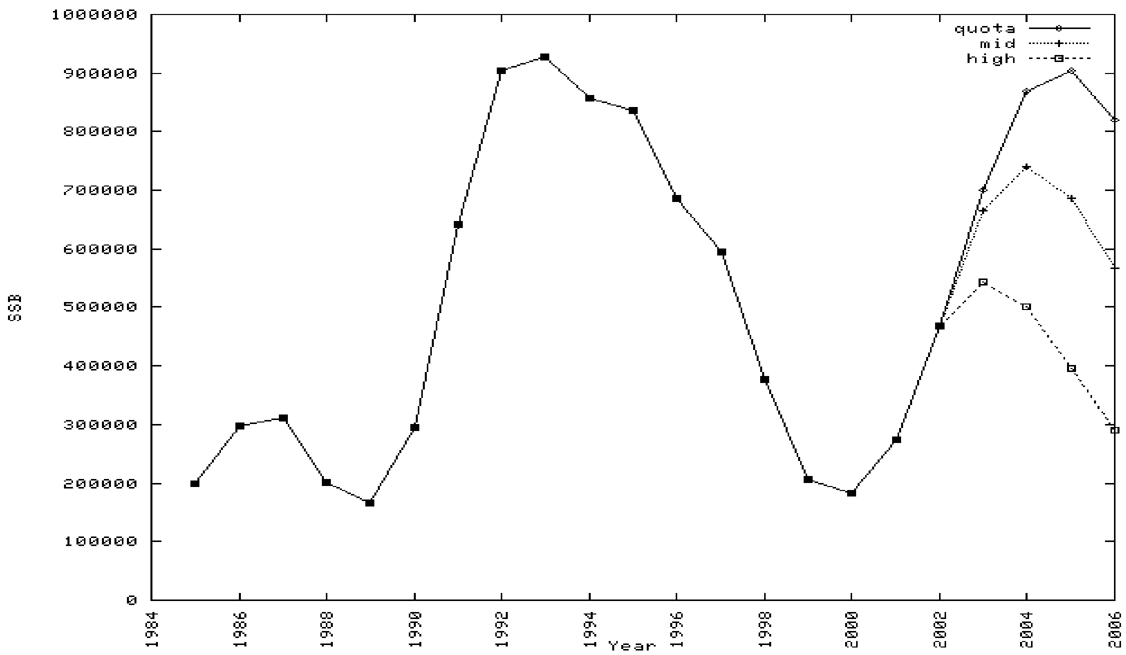


Figure 3.15b (Prediction of SSB in ’quota’, ’mid’, and ’high’ fishing scenarios)

$F_{5\text{-}10}$

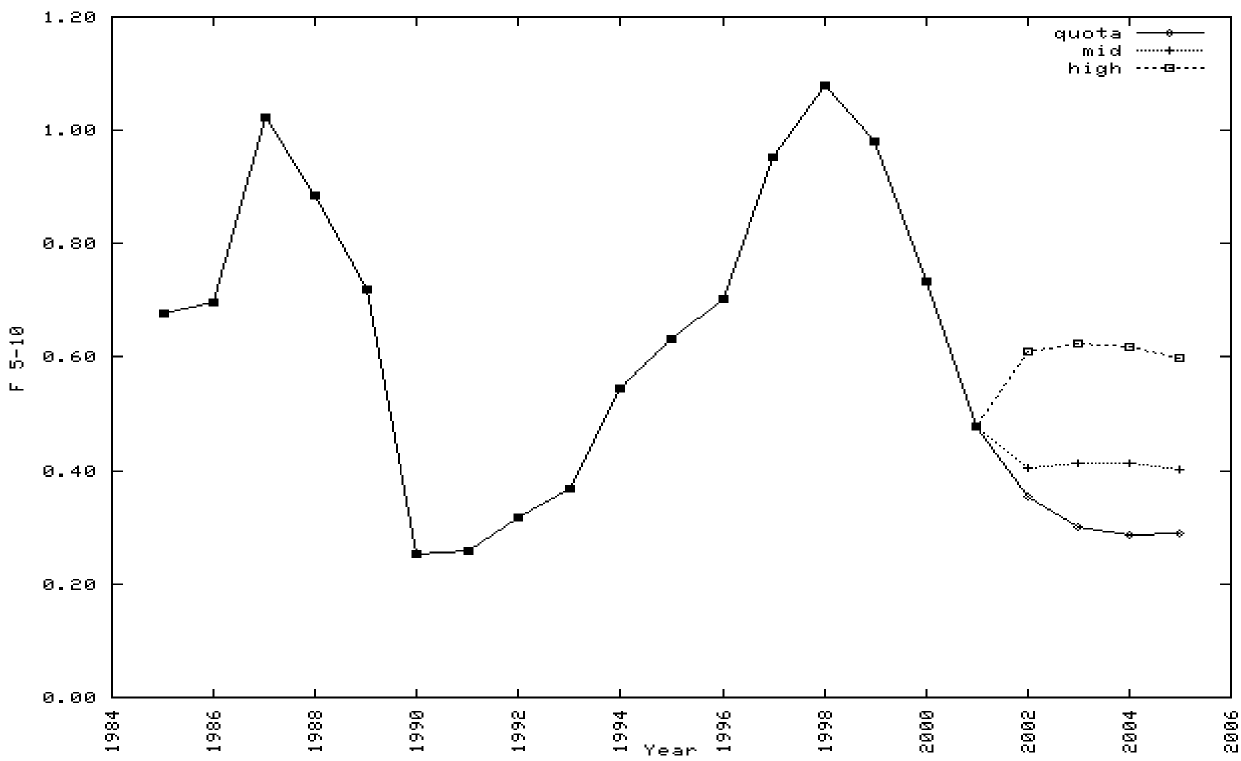


Figure 3.15c ($F_{5\text{-}10}$ in ‘quota’, ‘mid’, and ‘high’ fishing scenarios)

Catch in biomass

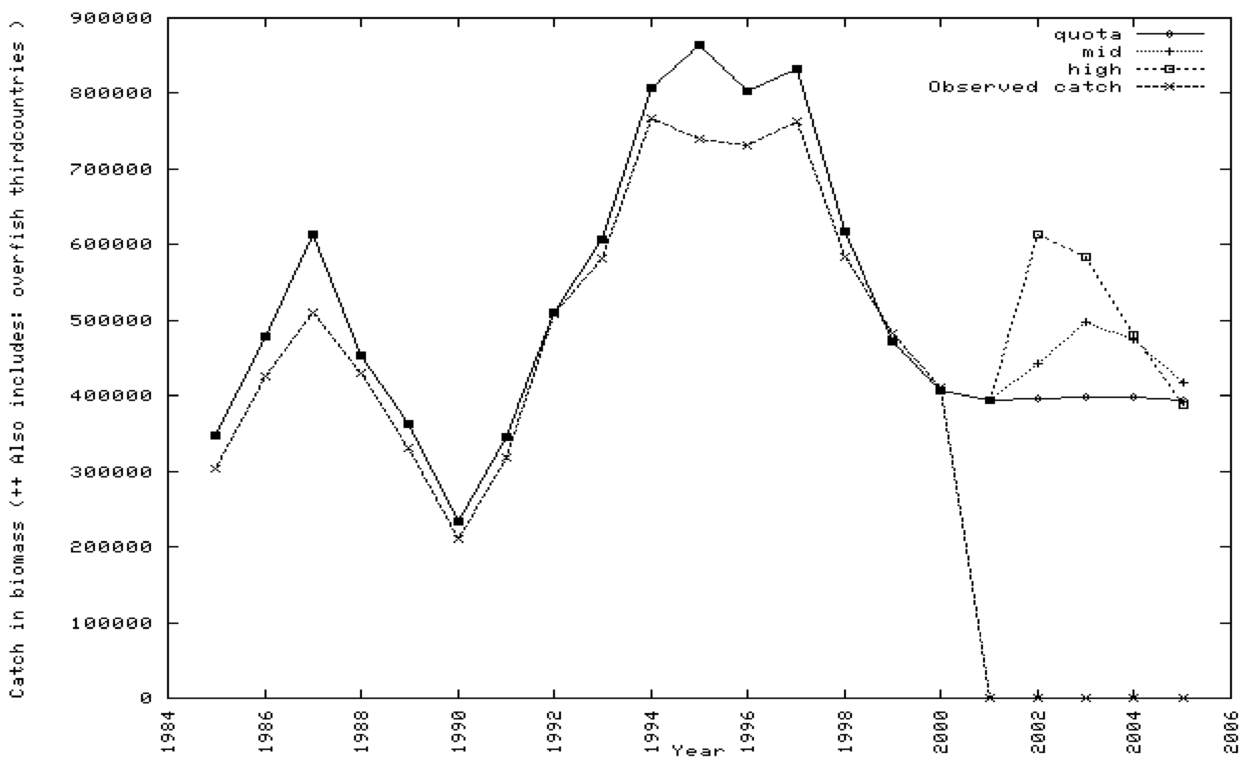


Figure 3.15d (Prediction of Catch in biomass in ‘quota’, ‘mid’, and ‘high’ fishing scenarios, and observed catches)

Recruitment at age 3

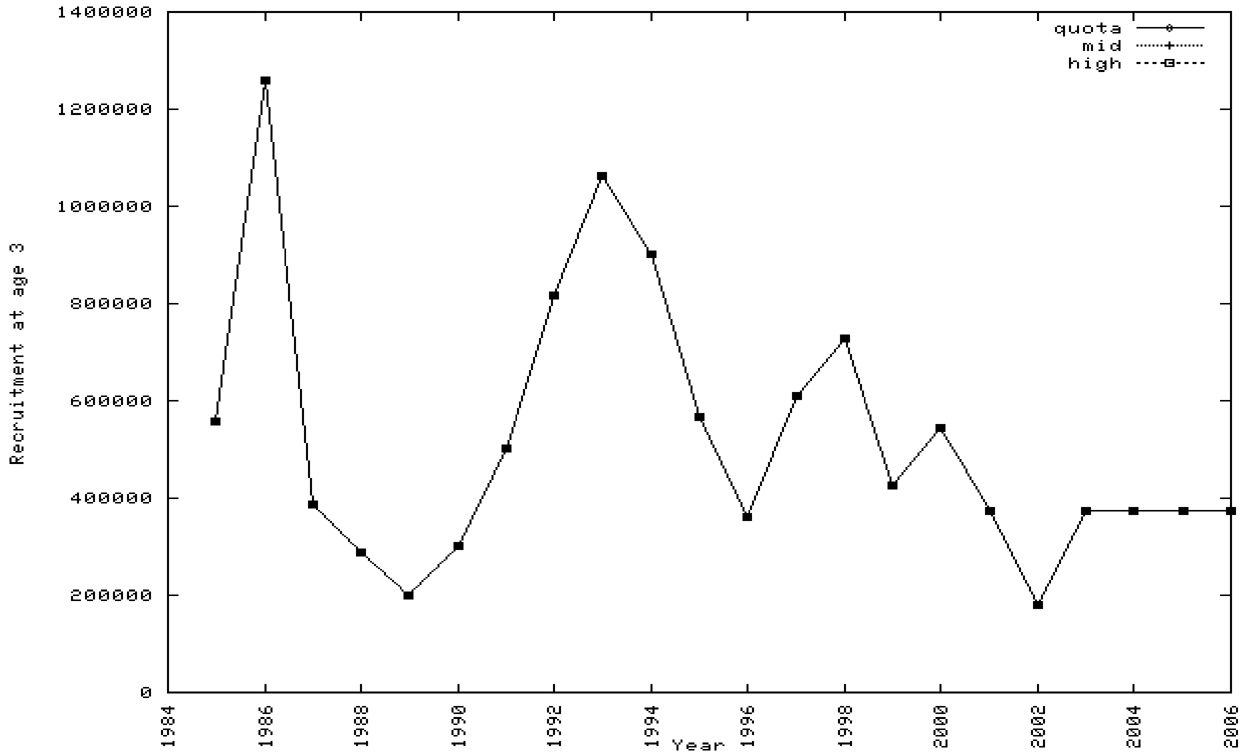


Figure 3.15e (Recruitment numbers for all prognosis scenarios)

Stock numbers

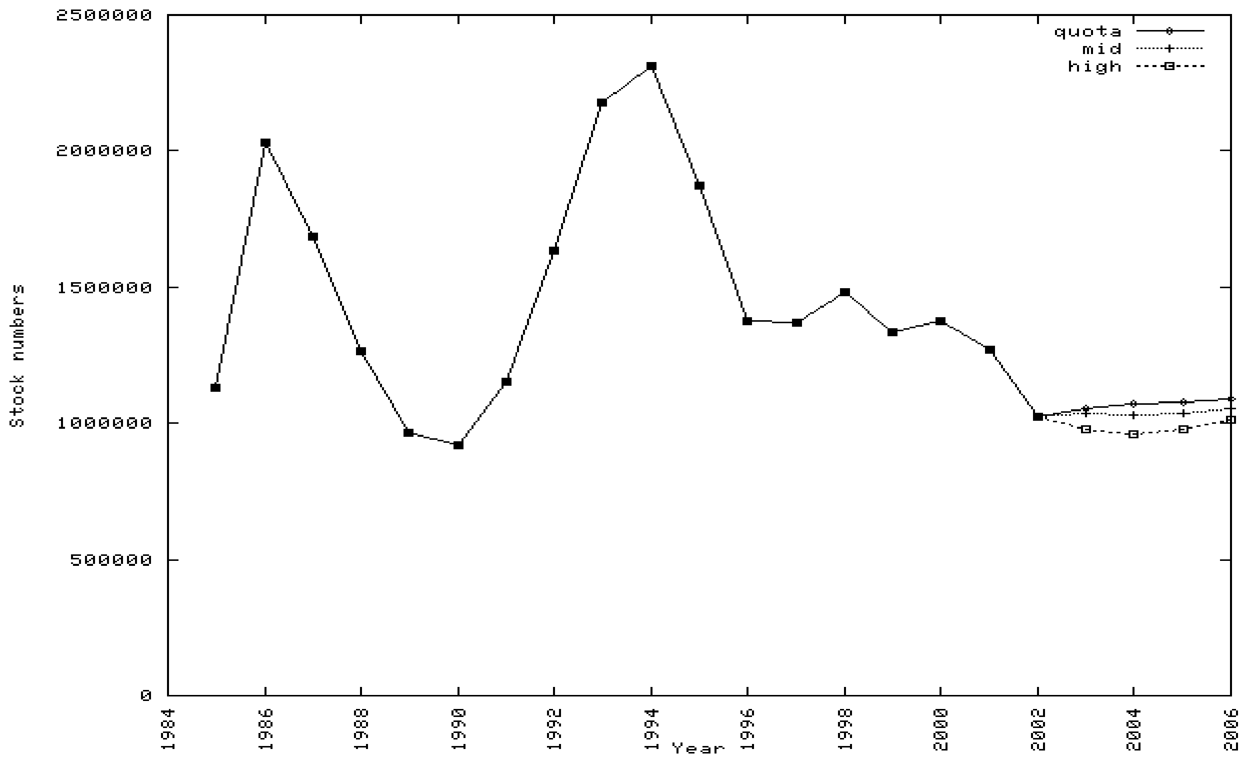


Figure 3.15f (Prediction of Stock numbers in 'quota', 'mid', and 'high' fishing scenarios)

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			0.29			0.34		0.39	
2000[1]			0.34			0.37		0.53	

[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	358,3	304,3	150,0	96,4	45,1	10,3	6,4	4,1	0,8	0,3	976,1
2000	154,1	221,4	245,1	158,8	142,0	45,3	9,5	4,6	2,9	1,0	984,7
2001	629,9	63,9	138,2	171,6	77,3	39,7	11,8	1,4	0,5	0,2	1134,5

[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.

Year	Age 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	128,8	248,3	235,2	132,1	108,3	26,9	4,3	2,0	1,2	0,4	887,5
2001	657,9	76,6	191,1	182,8	83,4	38,2	8,9	1,1	0,4	0,2	1240,6

[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
2001	3,91	15,73	7,17	0,84	0,30	0,31	0,23	0,06	28,55

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
2000	30,3	121,3	130,9	52,5	43,5	9,6	0,9	1,4	0,3	390,7

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
2000	30.3	121.3	130.9	52.5	43.5	9.6	0.9	1.4	0.3	390.7

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
2001	12.0	22.5	33.1	41.6	52.2	63.1	71.2	79.2

[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
2001	14	104	338	664	1257	2186	3145	4463

[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
2001	59.2	66.8	73.1	86.4	88.9	101.8	98.1	128.2

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
2001	1.89	2.71	3.48	6.02	6.88	10.69	10.19	28.58

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
2000 [1]	54	10	86	168	142	123	43	6	3	1	636

[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
2000	3.1	11.7	27.6	21.9	16.9	5.8	0.8	0.3	0.1	0.1	88.3

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

Table A12 North-East Arctic COD. Length at age (cm) from Russian surveys inNovember–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
2000	10.7	20.8	30.1	34.7	49.8	61.1	71.6	82.0	88.3	85.7

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
2000	8	74	232	378	1,102	2,128	3,341	5,053	6,560	8,497	12,353

Table A14 Abundance indices of 0-group fish in the Barents Sea and adjacent waters in 1965–2000.

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
2000	870	417	76	387	195	28	81

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 1965–2000

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
2000	0.30	0.17	0.46	1.49	1.21	1.78	0.64	0.46	0.84

[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	502	27	112	431	713	77	15	21	50	359	0	2307
1985	1150	169	58	154	1602	181	3	31	47	222	0	3616
1986	658	1212	107	141	828	132	140	81	109	310	0	3718
1987	675	1075	67	189	227	32	203	25	4	319	0	2816
1988	409	1226	314	128	336	8	91	9	3	221	0	2744
1989	719	794	239	131	575	3	32	8	10	230	0	2742
1990	1556	135	82	192	1578	7	6	19	15	240	0	3830
1991	1081	65	75	186	2870	8	12	26	20	309	7	4658
1992	1006	101	155	369	2428	328	96	54	105	187	19	4847
1993	776	249	696	311	3007	162	275	282	71	99	2	5929
1994	661	554	695	509	1072	145	575	223	48	78	0	4561
1995	843	968	509	357	619	114	250	388	115	191	1	4355
1996	649	622	1141	335	533	46	103	530	68	95	0	4123
1997	499	382	515	313	906	5	113	340	41	36	1	3152
1998	493	380	504	347	766	94	153	175	35	11	0	2958
1999	479	153	303	269	1832	145	231	75	28	20	1	3536
2000	583	164	343	401	1643	70	158	90	83	11	0	3545

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
2000**	109.0	275.8	346.0	129.1	94.0	29.1	3.0	2.3	1.7	990.0
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 period, 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.

4.1.2 Landings prior to 2001 (Tables 4.1–4.3, Figure 4.1A)

Final reported landings in 1999 are 82,346 t (Table 4.1), e.g. the figure used in last year's assessment. The provisional landings for 2000 are 67,953 t which is nearly 6,000 t higher than the 62,000 t landings expected by the Working Group last year. The agreed TAC was 62,000 t. Catches decreased in Sub-area I, Divisions IIa and 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. Landings from 1994 –1998 were revised according to official statistics from ICES. Landings from earlier period back to 1960 were revised as total landings is a sum of catches in Sub-area I, Division IIa and Division IIb.

4.1.3 Expected landings in 2001

The 62,000 t TAC agreed in 2000 was exceeded by almost 10%. ACFM recommended 66,000 t as the quota for 2001. The agreed TAC for 2001 was 85,000 t. The Norwegian quota of 40,300 t is expected to be taken. Russia has transferred 6,000 t of their quota to Norway and expects to take all the remaining 34,300 t. On this basis the landings in 2001 are estimated to be equal to the TAC.

4.2 Status of Research

4.2.1 Fishing effort and CPUE

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

4.2.2 Survey results (Tables B1-B6)

The overall picture seen in the surveys is summarized as follows: the year-class 1997 seems to be poor, and the 1998, 1999 and 2000 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 2001 Barents Sea bottom trawl and acoustic survey in January-March (Table B1 and B3). There was full area coverage in 1998, 1999 and in 2000. 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, 2 and 3) and 1999 year classes (at age 1 and 2) appear relatively strong in both surveys. The 2000 year-class appears at the same level as 1998 at age 1.

Russian bottom trawl and acoustic survey

Russia provided indices from the 2000 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 2000 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 2000. Having 6 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 age at the WG.

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 specially for age 1, 6 and 7 and consequent very low contribution to terminal year's survivor estimation in any age observed in the survey (<10%). These results suggest that the working group should not include this series in the assessment at present.

4.2.3 Weight at age (Table B6)

Length and weight at age from the surveys are given in Tables B5 and B6, respectively. The figures have been revised in the process of revising the abundance indices. The 2000 weights at age show a decreasing trend from the previous year for age groups above 5years old.

4.3 Data Used in the Assessment

4.3.1 Catch at age (Table 4.7)

Age compositions of the landings for 2000 were available from Norway and Russia in Sub-area I, from Norway, Russia and Germany in Division IIa, and from Norway and Russia 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 0.9% from the nominal catch of 2000.

4.3.2 Weight at age (Tables 4.8–4.9)

The mean weights at age in the catch (Table 4.8) were calculated as weighted averages of the weights in the catch of Norway and Russia. The weights at age in the catch in 2000 continues to show an increase for age groups < 10 and an decrease for higher age groups, but are still below the level of the early 1990s.

Stock weights (Table 4.9) used from 1985 to 1999 were 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 were used when survey data were 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. From 1989 to 2000 the Norwegian weights are from the Lofoten and the Barents Sea (combined).

In 2000 the stock weights calculated as in recent years, show a very high decrease from the weights of 1999 due to the restricted sampling coverage of Russian survey. For this reason, the WG has implemented the weight table for the combined Norwegian Lofoten and Barents Sea weights estimated by Korsbrekke (WG 2000 WD 21) for the period 1989 to 2000. The effect of implementing this information is a smoothen of the weights in stock for ages 6 and upwards.

4.3.3 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.

4.3.4 Maturity at age (Table 4.4 and 4.11)

A maturity ogive was available from Russia for the period 1981-2001 (Table 4.4). The ogive showed a change towards later maturation from last year but an earlier maturation than the period 1994 to 1998. The maturity at age series for the whole period 1950-2001 is shown in Table 4.11.

4.3.5 Data for tuning (Table 4.12)

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

Name	Place	Season	Age	Year	prior weight
Russian bottom trawl	Total area	Autumn	1–7	1983–2000	1
Norwegian bottom trawl	Barents Sea	Winter	1–8	1982–2000	1
Norwegian acoustic	Barents Sea	Winter	1–7	1980–2000	1
Norwegian trawl fleet	Total area	All year	8–13	1985–2000	1

4.3.6 Recruitment indices (Table 4.5)

Four time series of recruitment indices were updated with data from 2000. These are from the Russian bottom trawl survey in autumn (age 0), the International 0-group survey (age 0), and the Norwegian bottom trawl and acoustic survey in winter (age 1 for both indices).

4.3.7 Prediction data (Table 4.19)

The data used for 2001–2003 in the short-term prediction were also used for these years in the medium-term prediction (2001-2005), with the 2003 data extended forward to 2004 and 2005.

The stock numbers at age are taken from the final XSA and the recruitment of the 2000 year class from the RCT3 analysis (Table 4.6). The recruitment at age 3 of the 2001 and subsequent classes is set as the long-term geometric mean of 94 million.

The fishing pattern in 2000 continues to shift towards younger fish, with a very high fishing mortality in age 4, as happened from 1997 to 1999. The mean fishing pattern from 1997 to 1999, scaled to a 2000 $F_{bar\ 00}$, is used in the predictions to account for this shift.

The Russian maturity ogive for 2000 show later maturation than in the preceding years and 2001 maturation show an earlier maturation (the same as in 1999) (Table 4.4). The mean values for the 2000 and 2001 maturity ogives were used for prediction.

The most recent surveys show evidence of improved growth for age groups up to 9 year old except for age 4. Stock weight for older ages are not well estimated from the survey. 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, show increasing trends for all the ages >2. In view of the development of the capelin (Gjøsæter, WD 06) stock and the expected predation rates of NeA cod, the 2000 values were used in the prediction.

4.4 Methods Used in the Assessment

4.4.1 VPA and tuning

The Extended Survivors Analysis (XSA) was used to tune the VPA to the available index series (Table 4.12). The catchability dependent on stock size for ages <7 was used instead of 6 because the diagnostics show the age 6 as the last age group in which the slope differs from 1. In addition, the assessment was made to truncate the older ages (e.g., 1-11+). An age span of ages 1 to 11+ was used because the catchability analysis for the old ages are under-determined. Survivor estimates shrunk towards the mean F of the final 5 years of the 3 oldest ages and S.E.D. of the mean to which the estimates are shrunk was set to 1 due to high variability in the fishing mortality of recent years.

The estimated consumption of NeA haddock by NeA 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 (1984–2000) (Table A16). The consumption of NeA haddock by NeA cod is given below:

	Consumption of NeA haddock by NeA cod (millions individuals)					
			Age			
Year	1	2	3	4	5	6
1984	968,33	14,50	0,07	0,00	0,00	0,00
1985	1 193,46	5,11	0,00	0,00	0,00	0,00
1986	561,22	241,00	166,45	0,00	0,00	0,00
1987	761,34	0,00	0,00	0,00	0,00	0,00
1988	16,78	0,50	9,05	0,00	0,22	0,00
1989	234,04	0,00	0,00	0,00	0,00	0,00
1990	141,10	36,20	3,50	0,00	0,00	0,00
1991	455,28	14,26	0,00	0,00	0,00	0,00
1992	2 090,26	149,89	1,07	0,00	0,00	0,00
1993	1 361,54	165,58	36,95	3,41	2,89	0,00
1994	1 394,43	79,75	24,70	7,67	0,92	0,01
1995	2 901,55	164,09	12,00	30,01	30,06	0,34
1996	1 571,98	161,14	39,97	5,43	2,63	3,43
1997	897,12	35,55	25,83	1,73	0,78	0,53
1998	1 526,08	34,05	2,65	4,02	0,69	0,00
1999	937,83	23,38	0,31	0,00	0,00	0,00
2000	2 678,01	68,62	2,88	0,56	0,37	0,05

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 five most recent years. The underestimation observed last year of 0,55 with relation to the current assessment (0,61) show 10% increase in F_{bar} for 1999.

4.4.2 Recruitment (Tables 4.6, 4.15)

The XSA estimate of the strength of the 1997year class at age 3 was accepted. The strength of the 1998 year class at age 3 was calculated from the XSA estimate at age 2 in the terminal year. Total mortality at age 2 was estimated using the same values of M and F used for predictions to project the 1999 year class to age 3 in 2002. The only year class estimated by the RCT3 program was thus the 2000 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.

4.5 Results of the Assessment

4.5.1 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 2000 decreased slightly, to 0.46. In addition to this, the shift in the exploitation pattern towards younger fish (age 4-5) observed last year, is still apparent. Current fishing mortality is well above $\mathbf{F}_{pa}$ (0.35).

The spawning stock biomass in 2000 decreased by 40% and is now estimated at 70,000 t. which is below $\mathbf{B}_{pa}$ (80,000 t). Total biomass (age 3 and older) decreased from 214,000 t in 1999 to164,000 t in 2000.

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

The estimates of the 1997–1999 year classes at age 3, derived from the XSA (Table 4.19), are 59, 290 and 227 millions, respectively. The RCT3 estimate of the 2000 year class is 168 million at age 3 (Table 4.6). The long-term geometric mean is 94 million individuals.

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

The yield per recruit analysis using the fishing pattern and stock parameters for 2001 from the management option input table gave an estimate of $\mathbf{F}_{0.1}$ = 0.26 while $\mathbf{F}_{max}$ was not defined. The *status quo* exploitation level is F_{00} = 0.46.

4.5.4 Catch options for 2001 (Table 4.21)

The expected catch of 85,000 t in 2001 gives F = 0.67 and the spawning stock biomass will decline from 79,149 t in 2001 to 64,037 t in 2002. A *status quo* F (0.46) in 2002 corresponds to a catch of 80,996 t, which would imply an increase of the spawning stock to 105,358 t in 2003. Although the 1990 year class is not longer predominant, the reduction of the stock is not so marked as expected due to the year classes incoming to the fishery.

4.6 Biological reference points.

4.6.1 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 $\mathbf{B}_{lim}$. $\mathbf{B}_{pa}$ is proposed at 80,000 t, which gives a 95% probability of maintaining SSB above $\mathbf{B}_{lim}$ taking into account, the uncertainty in the assessments and stock dynamics. The Working Group agrees with the approach and the values proposed by ACFM.

4.6.2 Fishing mortality reference points

A $\mathbf{F}_{pa}$ of 0.35, corresponding to $\mathbf{F}_{med}$, 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 $\mathbf{F}_{loss}$ and used the median value of 0.49 as $\mathbf{F}_{lim}$. The value of $\mathbf{F}_{pa}$ is considered to have a high probability of keeping F below $\mathbf{F}_{lim}$. The Working Group also agrees with the approach and the value proposed by ACFM for $\mathbf{F}_{lim}$.

4.7 Medium-term forecasts and management scenarios

4.7.1 Input data (Table 4.19)

The input data were the same as used for the short-term prediction. The recruitment at age 3 of the 2001 and later year classes was set equal to the long-term geometric mean of 94 million.

4.7.2 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 2001-2004.

The uncertainty of the stock estimate in 2001 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 98-00. For year classes 2001 and 2002 the s.e. 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 98 and 99, in recognition of the uncertainty in predation-induced M.

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

In Figure 4.1D the catch level in 2002 and spawning stock biomass level in 2003 are plotted against the fishing mortality, in 2002. In Table 4.22, the results of the medium-term prediction are given, for 0.25, 0.5, 0.76 ($\mathbf{F}_{pa}$) and 1.0 * $\mathbf{F}_{sq}$. Detailed output of the prediction for $\mathbf{F}_{pa}$ is also given (Table 4.23). In the medium term, the spawning stock will increase well above 100,000 t when fishing at $\mathbf{F}_{sq}$ with catches in the range of 81,000-112,000 t. On the other hand, fishing at $\mathbf{F}_{pa}$ the spawning stock will increase well above $\mathbf{B}_{pa}$ with catches progressively increasing from 64,000 t in 2002 to 105,000 in 2005.

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

F	Basis	Landings 2002	SSB 2003	P (SSB< $\mathbf{B}_{pa}$) in 2003
0.11	0.25* $\mathbf{F}_{00}$	23	134	< 5%
0.23	0.5* $\mathbf{F}_{00}$	43	123	< 5%
0.35	$\mathbf{F}_{pa}$	64	113	< 5%
0.46	$\mathbf{F}_{00}$	81	105	< 5%

Weights in '000 t

4.8 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 below $\mathbf{B}_{pa}$ in 2001. The anticipated decrease in stock size has occurred as the influence of the 1990 year class is reduced. In addition the decrease in growth and maturity, together with high levels of predation by cod have contributed to decline either the SSB or total biomass. However, above average year classes are expected to enter in the fishable stock in 2002 and in the near future.

The results of the forecast will depend on the realisation of the predicted high weights, earlier maturity and natural mortality, particularly for the incoming 1999 and 2000 year classes. This will very much depend on the development of the capelin and cod stocks in the near future. Therefore the medium term prediction should be treated 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 assessment methods (fleksibest) being developed for NeA cod should in the future also be suitable for NeA haddock, but will not be attempted before they are accepted for the cod assessment (section 3.10).

The fishing mortality corresponding to the TAC = 85,000 t in 2001 has been revised upwards from around 0.5 (as calculated by ACFM in 00) to 0.67 in the current assessment. The reason for this change 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)

Work is currently underway to revise historical weights at age and maturity rates for the NeA arctic haddock stock. These data will be presented at the next WG meeting. The results will be reviewed in the context of whether or not a revision to the biomass reference points is warranted.

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	125,026	27,781	1,844	154,651
1961	165,156	25,641	2,427	193,224
1962	160,561	25,125	1,723	187,408
1963	124,332	20,956	936	146,224
1964	79,262	18,784	1,112	99,158
1965	98,921	18,719	943	118,583
1966	125,009	35,143	1,626	161,778
1967	107,996	27,962	440	136,397
1968	140,970	40,031	725	181,726
1969	89,948	40,306	566	130,820
1970	60,631	27,120	507	88,257
1971	56,989	21,453	463	78,905
1972	221,880	42,111	2,162	266,153
1973	285,644	23,506	13,077	322,226
1974	159,051	47,037	15,069	221,157
1975	121,692	44,337	9,729	175,758
1976	94,054	37,562	5,648	137,264
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	109,425	38,181	3,048	150,654
1988	43,990	47,087	668	91,745
1989	31,116	23,390	353	54,859
1990	15,093	10,344	303	25,741
1991	18,772	14,417	416	33,605
1992	30,746	22,177	964	53,887
1993	47,573	27,010	3,037	77,620
1994	75,059	46,329	7,315	128,703
1995	70,390	54,169	14,118	138,677
1996	112,781	57,189	3,294	173,264
1997	78,335	67,917	2,504	148,756
1998	45,471	47,774	701	93,946
1999	36,096	42,036	4,214	82,346
2000 [1]	25,626	39,101	3,226	67,953

[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	73,7	34,3	20,5	7,5	0,4
1968	98,1	42,9	31,4	8,6	0,7
1969	41,4	47,8	33,2	7,1	1,3
1970	37,4	23,2	20,6	6,5	0,5
1971	27,5	29,2	15,1	6,7	0,4
1972	193,9	27,9	34,5	7,6	2,2
1973	242,9	42,8	14,0	9,5	13,1
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	18,8	17,7	21,6	18,5	0,5
1982	11,6	11,5	23,9	13,5	-
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	21,4	9,7	11,6	11,7	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	61,3	13,8	31,3	15,1	7,3
1995	57,0	12,1	32,6	20,5	13,9
1996	96,3	14,2	34,0	22,0	3,2
1997	56,9	20,6	42,1	25,1	2,5
1998	26,4	20,0	25,3	23,5	0,7
1999	28,5	8,5	16,8	23,7	4,9
2000 [1]	20,2	5,4	16,1	23,0	3,2

[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	154 651
1961	285	220	-	6 304	60 862	-	39 650	85 345	558	193 224
1962	83	409	-	2 895	54 567	-	37 486	91 910	58	187 408
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	-	88 257
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	322 226
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	137 264
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	77 620
1994	2 761	678	770	2 412	64 688	22	4 673	51 822	877	128 703
1995	2 833	598	1 351	2 675	72 864	14	3 108	54 516	718	138 677
1996	3 743	537	1 524	942	89 500	669	2 275	73 857	217	173 264
1997	3 327	495	1 877	972	97 789	424	2 340	41 228	304	148 756
1998	1 566	241	854	385	68 747	257	1 241	20 559	96	93 946
1999	1 003	64	252	437	48 632	652	694	30 520	92	82 346
2000 [1]	527	119	432	592	41 978	76	733	22 738	758	67 953

[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	32	59	72	94	94	96	100	100
2001*	0	1	49	70	82	96	88	100	88	100

* Preliminary data, revised in april/may 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 40 (No. of survey No. of years PA Column No.)

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	258	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	59	-11	21	212.9	246
1998	-11	11	59	1244.9	856
1999	-11	12	25	847.1	1024
2000	-11	15	64	1217	976

R-T-1 Russian Bottom Trawl Survey 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 :

 Rct1-01.inp

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

 Data for    4 surveys over   40 years :  1961 - 2000

 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 =   1998

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 R-T-1     1.17   2.05    .91   .598     36   2.48    4.95    1.048     .275
 INT0GP     .07   1.47   1.96   .227     32  59.00    5.33    2.242     .060
 N-BST1     .97  -1.50    .88   .589     18   7.13    5.41    1.021     .290
 N-BSA1    1.21  -2.70   1.68   .282     18   6.75    5.46    1.935     .081

                                         VPA Mean =    4.58    1.012     .295


 Yearclass =   1999

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 R-T-1     1.18   2.00    .94   .564     36   2.56    5.03    1.102     .248
 INT0GP     .06   1.56   1.91   .222     32  25.00    3.14    2.256     .059
 N-BST1    1.02  -1.83    .89   .566     18   6.74    5.05    1.037     .280
 N-BSA1    1.21  -2.79   1.54   .304     18   6.93    5.60    1.807     .092

                                         VPA Mean =    4.61     .970     .321


 Yearclass =   2000

         I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 R-T-1     1.21   1.91    .98   .530     36   2.77    5.27    1.181     .217
 INT0GP     .06   1.66   1.86   .222     32  64.00    5.54    2.200     .063
 N-BST1    1.06  -2.11    .90   .549     18   7.10    5.44    1.075     .262
 N-BSA1    1.21  -2.83   1.39   .336     18   6.88    5.47    1.654     .111

                                         VPA Mean =    4.62     .935     .347


 Year     Weighted      Log      Int      Ext      Var      VPA      Log
 Class     Average      WAP      Std      Std     Ratio              VPA
          Prediction            Error    Error

 1998        154       5.04      .55      .18      .10
 1999        126       4.84      .55      .26      .22
 2000        168       5.13      .55      .19      .12
```

Table 4.7

Run title : Arctic Haddock (run: XSAAGE35/X35)

At 1/05/2001 19:28

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

	YEAR	1950
	AGE	
	1	0
	2	4446
	3	3189
	4	37949
	5	35344
	6	18849
	7	28868
	8	9199
	9	1979
	10	1093
	+gp	2977
0	TOTALNU	143893
	TONSLAN	132125
	SOPCOF %	45

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

	YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
	AGE										
	1	4069	0	392	1726	0	97	828	153	169	2319
	2	222	13674	8031	493	989	3012	243	2312	2425	3613
	3	65643	6012	64528	6563	1154	16437	2074	1727	20318	39910
	4	9178	151996	13013	154696	10689	5922	24704	5914	7826	70912
	5	18014	13634	70781	5885	176678	14713	7942	31438	7243	13647
	6	13551	9850	5431	27590	4993	127879	12535	5820	14040	7101
	7	6808	4693	2867	3233	28273	3182	46619	12748	3154	6236
	8	6850	3237	1080	1302	1445	8003	1087	17565	2237	1579
	9	3322	2434	424	712	271	450	1971	822	5918	2340
	10	1182	606	315	319	100	200	356	1072	285	2005
	+gp	1348	880	1005	543	100	185	176	601	500	606
0	TOTALNU	130187	207016	167867	203062	224692	180080	98535	80172	64115	150268
	TONSLAN	120077	127660	123920	156788	202286	213924	123583	112672	88211	154651
	SOPCOF %	65	51	57	60	47	55	57	61	80	84

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

	YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	AGE										
	1	362	0	3	149	0	0	0	0	0	480
	2	5531	4524	2143	834	3498	2577	53	33	1061	281
	3	15429	39503	28466	22363	5936	26345	15907	657	1524	23444
	4	56855	30868	72736	49290	46356	22631	41346	67632	1968	2454
	5	63351	48903	18969	30672	40201	63176	13496	41267	44634	1906
	6	8706	33836	13579	5815	12631	29048	25719	7748	19002	22417
	7	3578	3201	9257	3527	1679	5752	8872	15599	3620	8100
	8	4407	1341	1239	2716	974	582	1616	5292	4937	2012
	9	788	1773	559	833	897	438	218	655	1628	2016
	10	527	242	409	104	123	189	175	182	316	740
	+gp	1434	756	375	633	802	242	271	286	109	293
0	TOTALNU	160968	164947	147735	116936	113097	150980	107673	139351	78799	64143
	TONSLAN	193224	187408	146224	99158	118578	161778	136397	181726	130820	88257
	SOPCOF %	80	75	74	62	70	66	79	79	80	75

Table 4.7 (Continued)

	Table 1	Catch numbers at age		Numbers*10**-3							
	YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
	AGE										
	1	15	133	0	281	1321	3475	184	46	0	0
	2	3535	9399	5956	3713	4355	7499	18456	2033	48	0
	3	1978	230942	70679	9685	10037	13994	55967	47311	17540	627
	4	24358	22315	260520	41706	14088	13454	22043	18812	35290	22878
	5	1257	42981	24180	88120	33871	6810	7368	4076	10645	21794
	6	918	3206	6919	5829	49711	20796	2586	1389	1429	2971
	7	9279	1611	422	4138	2135	40057	7781	1626	812	250
	8	3056	6758	426	382	1236	1247	11043	2596	546	504
	9	826	2638	1692	618	92	1350	311	6215	1466	230
	10	1043	900	529	2043	131	193	388	162	2310	842
	+gp	534	1652	584	1870	934	1604	379	400	323	1460
0	TOTALNU	46799	322535	371907	158385	117911	110479	126506	84666	70409	51556
	TONSLAN	78905	266153	322226	221157	175758	137264	110158	95422	103623	87889
	SOPCOF '	101	86	83	87	81	63	77	95	113	104

	Table 1	Catch numbers at age		Numbers*10**-3							
	YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
	AGE										
	1	1	2	0	0	1	96	8	0	0	6
	2	68	29	162	247	2288	690	154	46	179	293
	3	486	883	704	447	29548	25596	3928	794	1045	516
	4	2561	900	1930	825	1153	61470	88294	9031	3932	1171
	5	22124	3372	884	820	546	1013	52609	50869	12246	1866
	6	10685	12203	1374	301	715	376	586	19465	22922	4126
	7	1034	2625	3282	750	316	346	207	382	3407	6734
	8	162	344	906	2206	634	144	123	65	246	849
	9	162	75	52	489	1312	295	74	35	11	388
	10	72	80	37	69	416	484	119	44	36	50
	+gp	963	649	172	284	113	157	285	310	66	30
0	TOTALNU	38318	21162	9503	6438	37042	90667	146387	81041	44090	16029
	TONSLAN	77153	46955	21607	17318	41270	96585	150654	91745	54859	25741
	SOPCOF '	99	95	92	94	97	90	98	99	96	96

	Table 1	Catch numbers at age		Numbers*10**-3							
	YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE										
	1	21	1258	117	11	33	69	75	11	136	94
	2	329	2668	455	369	196	393	253	2036	451	686
	3	3968	12342	13398	3048	1282	1622	2193	2411	20329	1060
	4	1967	12652	25902	43740	12915	5512	6043	13615	7722	33663
	5	1886	2411	13154	32614	71007	34791	11506	8214	16295	5515
	6	2876	1740	2784	8330	20209	70893	32302	7303	5765	4458
	7	4442	2070	973	1627	3361	10315	47298	12003	3574	1806
	8	4422	2619	1297	660	367	1885	4579	17811	7095	1267
	9	398	2737	2131	1142	295	417	530	1117	2764	1534
	10	21	241	2011	1756	447	281	183	227	255	2157
	+gp	17	18	384	1889	963	1230	536	227	139	382
0	TOTALNU	20347	40756	62606	95186	111075	127408	105498	64975	64525	52622
	TONSLAN	33605	53887	77621	128703	136064	169752	147160	95949	82346	67953
	SOPCOF '	96	100	100	111	103	103	104	107	105	101
	1										

Table 4.8

Table 2 Catch weights at age (kg)

YEAR	1950
AGE	
1	.0000
2	.0000
3	.6600
4	1.0300
5	1.7900
6	2.3800
7	2.8600
8	3.3300
9	3.7000
10	4.4100
+gp	5.4000
0 SOPCOF/	.4545

Table 2 Catch weights at age (kg)

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
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
+gp	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000
0 SOPCOF/	.6514	.5127	.5742	.6021	.4731	.5529	.5679	.6146	.8007	.8379

Table 2 Catch weights at age (kg)

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
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
+gp	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000
0 SOPCOF/	.8026	.7459	.7442	.6183	.6978	.6601	.7919	.7921	.8028	.7547

Table 4.8 (Continued)

Table 2 Catch weights at age (kg)

YEAR		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
	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
	+gp	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000
0	SOPCOF/	1.0105	.8593	.8281	.8657	.8127	.6296	.7708	.9507	1.1278	1.0352

Table 2 Catch weights at age (kg)

YEAR		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
	AGE										
	1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.2500
	2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.6400
	3	.6600	.6600	1.5200	1.5700	.9200	.8600	.6400	.5800	.8000	.8900
	4	1.0300	1.0300	1.8600	1.9900	1.6600	1.2500	.8600	.8400	.8900	1.2200
	5	1.7900	1.7900	2.1000	2.4200	2.3900	1.8800	1.3300	1.0500	1.1700	1.4000
	6	2.3800	2.3800	2.3800	2.6800	2.7100	2.4100	2.4500	1.4300	1.3700	1.6000
	7	2.8600	2.8600	2.8600	2.9300	2.8900	2.6600	2.9800	1.9700	1.7100	1.7700
	8	3.3300	3.3300	3.3300	3.3700	3.2200	3.0400	2.9800	2.5200	2.0100	2.1600
	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
	+gp	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000	5.4000
0	SOPCOF/	.9942	.9510	.9205	.9405	.9689	.9019	.9836	.9950	.9634	.9583

Table 2 Catch weights at age (kg)

YEAR		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE										
	1	.0000	.0400	.0900	.2500	.1900	.1000	.1000	.1200	.1000	.1000
	2	.0000	.2800	.3000	.4400	.3100	.2400	.3900	.5300	.2300	.2900
	3	.7700	.8400	.5900	.5400	.6300	.6400	.6600	.7100	.7300	.6400
	4	1.3100	1.3600	1.0600	.8800	.6600	.7900	.9900	.9000	1.0600	1.1000
	5	1.6100	1.7000	1.5200	1.3300	1.0600	1.0400	1.0900	1.2700	1.2700	1.3900
	6	1.8600	1.9600	1.8400	1.7400	1.6800	1.3400	1.2200	1.3800	1.5500	1.5900
	7	2.1100	2.2900	2.1800	2.0600	2.1100	1.8100	1.4800	1.5400	1.6600	1.8100
	8	2.3400	2.3900	2.3000	2.2000	2.3400	2.2900	1.9900	1.7900	1.7900	1.9300
	9	2.9300	2.3200	2.5200	2.5000	2.6700	2.3100	2.2600	2.3700	2.0600	2.1100
	10	2.3400	2.8800	2.6400	2.5800	2.9100	3.1800	2.2600	2.5100	2.6000	2.2300
	+gp	5.4000	3.1400	3.1100	2.8900	3.0200	2.6200	2.9800	2.6800	2.8500	2.6100
0	SOPCOF/	.9589	.9983	1.0002	1.1112	1.0342	1.0304	1.0377	1.0691	1.0536	1.0078

Table 4.9

Table 3 Stock weights at age (kg)

YEAR	1950
AGE	
1	.0000
2	.0000
3	.6600
4	1.0300
5	1.7900
6	2.3800
7	2.8600
8	3.3300
9	3.7000
10	4.4100
+gp	6.8750

Table 3 Stock weights at age (kg)

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
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
+gp	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750

Table 3 Stock weights at age (kg)

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
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
+gp	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750

Table 4.9 (Continued)

Table 3 Stock weights at age (kg)

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
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
+gp	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750

Table 3 Stock weights at age (kg)

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
1	.0000	.0000	.0520	.0360	.0360	.0420	.0380	.0230	.0390	.0430
2	.0000	.0000	.1330	.1960	.1330	.1030	.0880	.1170	.1160	.1270
3	.6600	.6600	.4800	.2890	.4350	.2960	.2090	.2140	.2740	.2960
4	1.0300	1.0300	1.0430	.9640	.7730	.7760	.4190	.3860	.4390	.7180
5	1.7900	1.7900	1.6410	1.8100	1.8740	1.5300	.9190	.6200	.6840	.9470
6	2.3800	2.3800	2.0810	2.5060	2.4560	2.2620	2.2400	1.1240	1.0090	1.2890
7	2.8600	2.8600	2.5920	2.2400	2.6880	2.2630	2.8600	1.5690	1.4160	1.5690
8	3.3300	3.3300	3.3300	3.3300	3.3300	3.3300	3.1000	3.3300	3.3300	1.9170
9	3.7000	3.7000	3.7000	3.7000	3.7000	3.7000	3.7000	3.7000	3.7000	2.4930
10	4.4100	4.4100	4.4100	4.4100	4.4100	4.4100	4.4100	4.4100	4.4100	4.4100
+gp	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.8750	6.3050	6.8750

Table 3 Stock weights at age (kg)

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
1	.0520	.0450	.0330	.0280	.0290	.0290	.0320	.0230	.0270	.0320
2	.1410	.1350	.1010	.0910	.0890	.0940	.0960	.1140	.0900	.1060
3	.3840	.3460	.3000	.2440	.2180	.2180	.2100	.2390	.3050	.2360
4	.7690	.8300	.8100	.5430	.3640	.4330	.4390	.4890	.6250	.7040
5	1.3190	1.4750	1.4910	1.0640	.8060	.6790	.7820	.8960	1.0540	1.0450
6	1.4420	2.0020	2.0450	1.5920	1.4510	1.1120	1.1060	1.2230	1.5810	1.3260
7	1.7940	2.1230	2.4120	2.0920	2.0080	1.8190	1.5050	1.5020	1.7950	1.4970
8	2.0270	2.2300	2.7780	2.4050	2.2520	2.1900	2.1160	1.8130	1.7870	1.7840
9	2.5160	2.4290	3.1060	2.7520	2.6520	2.8150	3.0140	2.6180	2.3500	1.9870
10	3.0920	3.3030	3.1550	2.7260	2.7120	2.6020	3.3330	2.4680	2.3100	2.3550
+gp	6.8750	5.0650	6.4610	4.0400	3.8140	4.0710	4.1550	3.6680	3.7900	4.1500

Table 4.10

Table 4 Natural Mortality (M) at age

YEAR	1950
AGE	
1	.2000
2	.2000
3	.2000
4	.2000
5	.2000
6	.2000
7	.2000
8	.2000
9	.2000
10	.2000
+gp	.2000

Table 4 Natural Mortality (M) at age

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
AGE										
1	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
2	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
3	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
4	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
5	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
6	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
7	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
8	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
9	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
10	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Table 4 Natural Mortality (M) at age

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
AGE										
1	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
2	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
3	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
4	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
5	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
6	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
7	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
8	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
9	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
10	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Table 4.10 (Continued)

Table 4 Natural Mortality (M) at age

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
1	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
2	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
3	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
4	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
5	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
6	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
7	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
8	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
9	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
10	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Table 4 Natural Mortality (M) at age

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
1	.2000	.2000	.2000	.6645	.6883	1.4223	2.0528	1.3791	.6419	.4037
2	.2000	.2000	.2000	.2479	.2059	1.0575	.2000	.2248	.2000	.4121
3	.2000	.2000	.2000	.2100	.2000	.5552	.2000	.4400	.2000	.2981
4	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
5	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2021	.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
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Table 4 Natural Mortality (M) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
1	.4324	.8742	1.0061	.7248	.9985	1.3394	1.0103	1.3143	.6604	.9774
2	.2353	.3467	.4755	.5998	.6522	.6873	.5561	.3522	.3969	.3131
3	.2000	.2035	.2557	.2778	.3453	.6680	.4499	.2551	.2022	.2414
4	.2000	.2000	.2150	.2162	.3539	.3129	.2502	.2803	.2000	.2063
5	.2000	.2000	.2603	.2061	.3056	.2243	.2309	.2375	.2000	.2189
6	.2000	.2000	.2000	.2014	.2208	.2215	.2102	.2000	.2000	.2048
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
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Table 4.11

Table 5 Proportion mature at age

YEAR	1950
AGE	
1	.0000
2	.0000
3	.0000
4	.0500
5	.2300
6	.5300
7	.8800
8	.9800
9	1.0000
10	1.0000
+gp	1.0000

Table 5 Proportion mature at age

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
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
+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	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
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
+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	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
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
+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

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0100	.0900	.1700	.0700	.0200	.0000	.0000	.0000	.0000	.0000
4	.1200	.5500	.7000	.1400	.0800	.2200	.0100	.0300	.0400	.0200
5	.6400	.7300	1.0000	.3500	.8000	.5300	.2100	.3300	.3000	.3000
6	.7300	.9300	1.0000	.4700	.9300	.8600	.5300	.5100	.6300	.5400
7	.9600	.9600	1.0000	.7400	.9600	.8600	1.0000	1.0000	.8200	.7700
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.8700
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.8000
10	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

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0200	.0150	.0000	.0000	.0000	.0000	.0000	.0100	.0000
4	.0700	.1300	.2190	.0170	.0200	.0000	.0300	.0500	.1700	.1000
5	.3000	.5000	.4900	.1300	.1200	.1000	.1000	.2800	.5000	.3200
6	.5000	.6200	.7600	.4100	.4200	.3600	.2900	.5000	.7100	.5900
7	.8000	.7700	.7900	.9000	.8100	.7800	.6000	.6600	.8100	.7200
8	.9200	.8000	.8800	.8800	.8800	.8600	.8200	.8100	.9100	.9400
9	1.0000	.9400	.8800	1.0000	1.0000	.9000	1.0000	.9100	.9200	.9400
10	1.0000	1.0000	.8700	1.0000	.8700	.9300	.8300	1.0000	1.0000	.9600
+gp	1.0000	1.0000	1.0000	.9700	1.0000	.9000	1.0000	1.0000	1.0000	1.0000

Table 4.12

North-East Arctic haddock (Sub-areas I and II) (run name: XSAAGE35)
104
FLT01: Russian bottom trawl, total area, Nov-Dec, age 1-7, calendar (Catch: Unknown) (Effort: Unknown)
1983 2000
1 1 0.90 1.00
1 7

1	592.0	95.0	5.0	4.0	0.1	0.0	0.0
1	586.0	584.0	15.0	2.0	1.0	0.1	0.0
1	144.0	1343.0	900.0	4.0	1.0	1.0	0.0
1	14.0	107.0	363.0	164.0	1.0	0.1	0.1
1	9.0	17.0	83.0	225.0	57.0	0.1	0.1
1	3.0	7.0	17.0	40.0	76.0	8.0	0.1
1	18.0	24.0	4.0	14.0	41.0	81.0	11.0
1	143.0	106.0	73.0	42.0	73.0	74.0	57.0
1	429.0	176.0	62.0	9.0	3.0	6.0	18.0
1	282.0	1286.0	346.0	50.0	4.0	6.0	9.0
1	48.0	357.0	1985.0	356.0	48.0	8.0	4.0
1	49.0	58.0	442.0	1014.0	116.0	15.0	1.0
1	72.0	42.0	31.0	123.0	370.0	40.0	5.0
1	23.0	57.0	28.0	49.0	362.0	334.0	29.0
1	46.0	19.0	32.0	32.0	10.0	27.0	10.0
1	29.0	115.0	38.0	46.0	8.0	5.0	15.0
1	289.0	61.0	196.0	39.0	37.0	8.0	3.0
1	207.0	262.0	60.0	109.0	26.0	11.0	2.0

FLT02: Norway acoustic surv, Barents sea, Jan-Mar, age 1-7, shift, rev94 (Catch: Number) (Effort: Unknown)
1980 2000
1 1 0.99 1.00
1 7

1	140	50	210	600	180	10	3
1	20	30	40	40	100	60	3
1	50	20	30	10	10	40	20
1	1730	60	20	10	3	3	3
1	8390	2740	60	3	3	3	10
1	3120	4880	1620	3	3	3	3
1	260	710	1900	470	3	3	3
1	50	80	200	380	60	3	3
1	60	80	100	170	190	20	3
1	440	40	30	40	70	110	10
1	2650	490	70	20	20	20	40
1	6850	1100	190	20	3	3	10
1	6900	5650	990	100	3	3	10
1	2280	2400	5060	770	80	3	3
1	2850	360	1130	3910	400	20	3
1	2290	440	310	760	1500	80	10
1	320	660	220	150	480	470	30
1	1560	290	410	150	60	130	180
1	460	570	130	140	40	10	20
1	5090	320	650	190	100	20	10
1	3160	2100	230	220	10	10	0

Table 4.12 (Continued)

FLT03: Norwegian trawl, catch and effort, ages 8 -13 (Catch: Thousands) (Effort: Unknown)
1985 2000
1 1 0.00 1.00
8 10

0.49	166.0	365.0	26.0
0.48	57.0	142.0	236.0
0.47	28.0	41.0	41.0
0.95	16.0	1.0	8.0
0.85	127.0	1.0	9.0
0.48	149.0	3.0	0.1
0.56	703.0	58.0	7.0
0.49	394.0	599.0	96.0
0.49	200.0	279.0	282.0
0.77	209.4	213.6	496.9
0.81	53.0	72.0	120.0
0.61	1197.0	257.0	118.0
0.86	2278.0	240.0	14.0
1.02	6514.0	206.0	68.0
0.96	1080.9	1401.2	180.7
0.80	241.2	448.4	514.0

FLT04: Norway bottom trawl survey, Jan-Mar, age 1-7, shifted, revised94 (Catch: Thousands) (Effort: Unknown)
1982 2000
1 1 0.99 1.00
1 8

1	48	31	24	9	19	25	7	0
1	5146	189	15	8	2	1	4	1
1	15938	4759	147	5	5	1	1	4
1	3703	3846	1108	6	2	1	1	1
1	799	1544	2902	529	0	0	0	0
1	153	253	689	1164	138	1	0	0
1	95	141	216	340	327	34	1	0
1	546	45	34	50	92	118	18	0
1	3003	334	51	42	27	17	42	0
1	13755	1505	244	21	6	7	16	23
1	5990	5077	1056	105	6	4	3	4
1	2280	3395	4366	497	34	2	1	2
1	1793	536	1711	3395	345	28	0	1
1	2636	525	481	1486	2528	116	9	0
1	679	861	280	194	467	622	35	1
1	1379	227	332	132	34	80	81	7
1	576	598	122	102	28	10	17	11
1	4522	272	354	84	40	8	3	7
1	4604	2970	294	254	17	9	1	1

Table 4.13

Lowestoft VPA Version 3.1

1/05/2001 19:27

Extended Survivors Analysis

Arctic Haddock (run: XSAAGE35/X35)

CPUE data from file fleet

Catch data for 51 years. 1950 to 2000. Ages 1 to 11.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
FLT01: Ru	1983	2000	1	7	.900	1.000
FLT02: No	1980	2000	1	7	.990	1.000
FLT03: No	1985	2000	8	10	.000	1.000
FLT04: No	1982	2000	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 < 7

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 7

Catchability independent of age for ages >= 9

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 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 70 iterations

Total absolute residual between iterations
69 and 70 = .00712

Final year F values

Age	1	2	3	4	5	6	7	8	9	10
Iteration 69	.0002	.0020	.0205	.5892	.3654	.4444	.4422	.6730	.3119	.3490
Iteration 70	.0002	.0020	.0205	.5889	.3648	.4438	.4390	.6729	.3127	.3505

1

Regression weights

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

Table 4.13 (Continued)

Fishing mortalities

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	.000	.002	.001	.000	.000	.000	.000	.000	.000	.000
2	.001	.003	.001	.004	.002	.003	.004	.014	.006	.002
3	.055	.068	.024	.013	.020	.028	.028	.062	.198	.020
4	.141	.250	.201	.106	.078	.128	.186	.292	.298	.589
5	.235	.257	.464	.425	.268	.344	.468	.439	.728	.365
6	.284	.354	.533	.638	.521	.509	.643	.636	.657	.444
7	.318	.341	.342	.697	.579	.564	.792	.530	.757	.439
8	.219	.314	.373	.413	.326	.772	.529	.810	.702	.673
9	.208	.204	.457	.666	.327	.763	.510	.233	.270	.313
10	.233	.188	.227	.876	.603	.598	.952	.428	.076	.350

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8	9	10
1991	1.41E+0(	2.63E+05	8.16E+04	1.65E+04	9.97E+03	1.28E+04	1.80E+04	2.49E+04	2.34E+03	1.12E+02
1992	1.06E+0(	9.12E+05	2.08E+05	6.32E+04	1.18E+04	6.45E+03	7.91E+03	1.07E+04	1.64E+04	1.56E+03
1993	3.87E+0!	4.43E+05	6.43E+05	1.58E+05	4.03E+04	7.45E+03	3.71E+03	4.60E+03	6.42E+03	1.09E+04
1994	3.21E+0!	1.41E+05	2.75E+05	4.86E+05	1.04E+05	1.95E+04	3.58E+03	2.16E+03	2.59E+03	3.32E+03
1995	5.39E+0!	1.55E+05	7.73E+04	2.06E+05	3.52E+05	5.56E+04	8.45E+03	1.46E+03	1.17E+03	1.09E+03
1996	3.04E+0!	1.99E+05	8.08E+04	5.37E+04	1.34E+05	1.98E+05	2.64E+04	3.87E+03	8.63E+02	6.90E+02
1997	4.96E+0!	7.96E+04	9.96E+04	4.03E+04	3.45E+04	7.57E+04	9.56E+04	1.23E+04	1.47E+03	3.29E+02
1998	3.29E+0!	1.80E+05	4.55E+04	6.18E+04	2.60E+04	1.72E+04	3.23E+04	3.54E+04	5.94E+03	7.21E+02
1999	7.70E+0!	8.83E+04	1.25E+05	3.31E+04	3.48E+04	1.32E+04	7.44E+03	1.56E+04	1.29E+04	3.86E+03
2000	8.38E+0!	3.98E+05	5.90E+04	8.39E+04	2.01E+04	1.38E+04	5.62E+03	2.86E+03	6.31E+03	8.06E+03

Estimated population abundance at 1st Jan 2001

0.00E+C	3.15E+05	2.90E+05	4.54E+04	3.79E+04	1.12E+04	7.21E+03	2.99E+03	1.19E+03	3.77E+03

Taper weighted geometric mean of the VPA populations:

4.57E+C	1.62E+05	9.29E+04	6.41E+04	3.83E+04	2.03E+04	9.40E+03	4.43E+03	2.19E+03	9.82E+02

Standard error of the weighted Log(VPA populations) :

.6581	.9807	1.0124	1.1115	1.2055	1.2536	1.3097	1.3791	1.3973	1.5275

1

Log catchability residuals.

Fleet : FLT01: Russian botto

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	99.99	99.99	1.02	.19	.25	.09	.39	-.25	-.32	.30
2	99.99	99.99	2.61	.62	.62	.19	-.33	-.18	.54	.39
3	99.99	99.99	.92	1.05	.73	-.42	.01	-.30	-.66	1.28
4	99.99	99.99	.07	.00	-.21	-.08	-.19	-.53	-.51	1.05
5	99.99	99.99	-1.72	-.09	.48	-.43	-.09	-.57	.01	1.23
6	99.99	99.99	99.99	-1.21	.60	-.51	-1.61	-.35	.04	.79
7	99.99	99.99	99.99	99.99	99.99	-1.35	-.78	-2.25	1.06	.85
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Table 4.13 (Continued)

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-.28	.00	.00	.03	-.09	-.02	-.27	.03	.21	.11
2	-.10	.32	.12	-.08	-.39	-.37	-.42	.04	.28	-.14
3	-.16	.20	.37	.11	-.54	-.43	-.69	.10	.37	.15
4	-.48	-.22	.57	.30	-.62	-.08	-.17	-.16	.25	.48
5	-.50	-.43	.38	.02	-.37	.58	-.65	-.55	.47	.52
6	-.24	.50	.69	.25	-.15	.11	-.67	-.42	.20	.25
7	.53	.68	.63	-.39	.25	.86	-1.28	-.03	.04	-.39
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	7
Mean Log	-6.9460
S.E(Log q)	.8622

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.61	3.726	9.90	.90	18	.22	-7.93
2	.79	1.744	8.12	.87	18	.39	-7.09
3	.74	1.565	7.90	.79	18	.55	-6.68
4	.88	.877	7.00	.85	18	.48	-6.47
5	.75	1.708	7.58	.82	18	.60	-6.57
6	.73	1.997	7.59	.84	17	.57	-6.71

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
7	.88	.663	7.22	.75	15	.78	-6.95
1							

Fleet : FLT02: Norway acoust

Age	1980
1	99.99
2	99.99
3	99.99
4	99.99
5	99.99
6	99.99
7	99.99
8	No data for this fleet at this age
9	No data for this fleet at this age
10	No data for this fleet at this age

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	.99	.95	-.25	-.06	.24	-.02	-.47	-.35	-.29	.18
2	.32	.59	.82	.32	.09	.21	-.54	.31	-.48	.12
3	.94	.46	.76	.93	.19	-.13	-.42	-.09	-.34	.11
4	.31	.50	.40	.08	-.73	-.21	-.76	-.13	-.24	-.15
5	.04	.27	.69	.61	1.17	.27	-.55	-.47	-.06	-.05
6	1.19	.37	-.27	.80	.98	1.53	.40	.08	.07	-.49
7	.39	.88	-1.73	.79	.70	1.16	1.73	.24	.07	-.42

Table 4.13 (Continued)

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-.47	.09	.48	.63	.15	-.31	.00	-.18	.08	-.10
2	-.15	-.06	.10	-.11	-.01	.08	.27	-.18	.12	-.01
3	-.42	-.03	.15	-.19	.11	.06	.17	-.09	.25	.06
4	-.33	-.41	.14	.14	-.12	.04	.33	-.05	.74	.14
5	-.61	-.76	.27	.28	-.13	.11	.22	.23	.68	-.45
6	-1.20	-.45	-.46	.17	.16	.28	.32	-.25	.58	-.18
7	-.97	-.12	-.57	-.18	.05	-.01	.73	-.65	.35	99.99
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	7
Mean Log	-6.0146
S.E(Log q)	.6390

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	.63	2.365	7.81	.81	20	.34	-4.80
2	.77	3.325	6.79	.95	20	.23	-5.19
3	.80	2.827	6.52	.95	20	.24	-5.25
4	.73	2.690	6.94	.91	20	.37	-5.44
5	.64	3.053	7.62	.88	20	.48	-5.95
6	.80	1.502	7.01	.84	20	.57	-6.26

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
7	1.18	-1.021	5.45	.79	19	.75	-6.01
1							

Fleet : FLT03: Norwegian tra

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
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	.46	.45	.27	-.44	.23	-.44
9	99.99	99.99	99.99	99.99	1.05	1.44	1.08	-2.76	-2.17	-1.50
10	99.99	99.99	99.99	99.99	-.44	1.27	.79	-.81	.02	-3.21

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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	-.95	-.51	-.32	.05	-1.02	1.60	.64	.58	-.37	-.01
9	-.62	-.10	.19	.47	-.02	2.03	.98	-.87	.35	.12
10	.32	.42	-.44	1.15	.68	1.40	-.19	.22	-.58	.03

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	8	9	10
Mean Log	-1.8336	-2.3000	-2.3000
S.E(Log q)	.7263	1.1953	1.0646

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	.98	.147	1.99	.79	16	.74	-1.83
9	.81	.882	3.31	.69	16	.98	-2.30
10	.84	.867	2.96	.76	16	.91	-2.23
1							

Fleet : FLT04: Norway bottom

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	99.99	.58	.32	.30	.24	.54	.04	-.31	-.36	.12
2	99.99	.72	1.53	.64	-.19	.70	.18	.57	-.58	-.32
3	99.99	.13	.36	1.53	-.18	.17	.48	.43	-.39	-.28
4	99.99	.37	.18	.40	-.28	-.18	.01	.32	-.14	.33
5	99.99	.69	.45	.95	.94	99.99	-.04	-.15	.10	.14
6	99.99	.02	-.60	.48	.61	99.99	.07	.41	-.04	-.47
7	99.99	.52	-.76	-.83	.29	99.99	99.99	-.17	1.34	.31
8	99.99	99.99	-.55	.21	.17	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									

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	-.09	-.08	.36	.19	.12	.00	-.23	-.21	-.10	.05
2	-.03	-.23	.27	.06	-.01	.16	-.07	-.28	-.16	.15
3	-.32	-.04	-.01	.09	.38	.16	-.09	-.25	-.33	.16
4	-.35	-.43	-.24	-.02	.32	.18	.18	-.34	.09	.18
5	-.15	-.31	-.28	.16	.16	.07	-.14	.00	.09	-.11
6	-.26	.11	-.37	.45	.26	.08	-.21	-.09	.04	-.06
7	.19	-.64	-.98	99.99	.63	.83	.61	-.13	-.17	-1.30
8	.45	-.36	-.15	-.04	99.99	-.27	.27	-.05	.21	-.07
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	7	8
Mean Log	-6.6969	-7.0223
S.E(Log q)	.7697	.2573

Table 4.13 (Continued)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.68	3.020	7.27	.90	19	.23	-4.58
2	.79	2.151	6.50	.91	19	.32	-5.02
3	.82	1.882	6.28	.91	19	.32	-5.14
4	.73	3.533	6.89	.95	19	.28	-5.36
5	.63	5.828	7.66	.96	18	.25	-5.91
6	.65	4.578	7.62	.95	18	.29	-6.35

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
7	.76	1.603	7.36	.84	16	.54	-6.70
8	.90	1.218	7.21	.96	12	.23	-7.02
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1999

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	350951.	.300	.000	.00	1	.347	.000
FLT02: No	284331.	.360	.000	.00	1	.241	.000
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	330748.	.300	.000	.00	1	.347	.000
P shrinka	162395.	.98					.000
F shrinka	250721.	1.00					.000

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
315347.	.18	.08	5	.440	.000

1

Age 2 Catchability dependent on age and year class strength

Year class = 1998

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	317635.	.242	.167	.69	2	.299	.002
FLT02: No	297864.	.231	.048	.21	2	.328	.002
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	292789.	.228	.121	.53	2	.338	.002
P shrinka	92897.	1.01					.006
F shrinka	102013.	1.00					.006

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
290368.	.13	.09	8	.697	.002

Table 4.13 (Continued)

Age 3 Catchability dependent on age and year class strength

Year class = 1997

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	51383.	.222	.078	.35	3	.252	.018
FLT02: No	46426.	.183	.084	.46	3	.373	.020
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	41993.	.188	.114	.60	3	.352	.022
P shrinka	64108.	1.11					.015
F shrinka	13444.	1.00					.068

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
45404.	.11	.07	11	.593	.020

1

Age 4 Catchability dependent on age and year class strength

Year class = 1996

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	38841.	.205	.176	.86	4	.227	.578
FLT02: No	39728.	.165	.098	.59	4	.352	.568
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	33381.	.160	.126	.79	4	.387	.647
P shrinka	38349.	1.21					.583
F shrinka	139105.	1.00					.197

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
37886.	.10	.08	14	.838	.589

Age 5 Catchability dependent on age and year class strength

Year class = 1995

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	11544.	.198	.144	.73	5	.213	.356
FLT02: No	11947.	.159	.197	1.24	5	.329	.346
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	10555.	.144	.054	.38	5	.431	.384
P shrinka	20257.	1.25					.218
F shrinka	8624.	1.00					.453

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
11245.	.09	.07	17	.761	.365

Table 4.13 (Continued)

Age 6 Catchability dependent on age and year class strength

Year class = 1994

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	6766.	.204	.143	.70	6	.199	.467
FLT02: No	8091.	.164	.105	.64	6	.283	.404
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	7003.	.143	.068	.48	6	.478	.454
P shrinka	9395.	1.31					.356
F shrinka	4912.	1.00					.598

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
7212.	.10	.05	20	.560	.444

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

Year class = 1993

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	2491.	.205	.104	.51	7	.217	.504
FLT02: No	3821.	.157	.111	.71	6	.278	.356
FLT03: No	1.	.000	.000	.00	0	.000	.000
FLT04: No	2913.	.138	.151	1.09	7	.470	.445
F shrinka	1784.	1.00					.650

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
2986.	.10	.08	21	.833	.439

1

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

Year class = 1992

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	998.	.205	.097	.47	7	.127	.765
FLT02: No	1344.	.168	.092	.55	7	.192	.617
FLT03: No	1181.	.756	.000	.00	1	.048	.678
FLT04: No	1187.	.171	.058	.34	8	.579	.676
F shrinka	1297.	1.00					.633

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
1194.	.13	.04	24	.324	.673

Table 4.13 (Continued)

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

Year class = 1991

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	3425.	.207	.146	.70	7	.135	.340
FLT02: No	3491.	.169	.112	.66	7	.205	.335
FLT03: No	3216.	.686	.247	.36	2	.067	.359
FLT04: No	4236.	.158	.064	.40	8	.532	.283
F shrinka	2631.	1.00					.424

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
3772.	.12	.05	25	.449	.313

1
Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1990

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Ru	3988.	.221	.202	.92	7	.108	.398
FLT02: No	5042.	.173	.135	.78	7	.175	.327
FLT03: No	6188.	.621	.167	.27	3	.128	.274
FLT04: No	4638.	.170	.053	.31	8	.493	.351
F shrinka	3180.	1.00					.479

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
4634.	.16	.06	26	.391	.350

Table 4.14

Run title : Arctic Haddock (run: SVPAGE15/V15)

At 1/05/2001 19:42

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR	1950
AGE	
3	.0547
4	.5936
5	.8245
6	.8125
7	1.1570
8	1.0055
9	.6504
10	.9460
+gp	.9460
0 FBAR 4- 7	.8469

Table 8 Fishing mortality (F) at age

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
AGE										
3	.1400	.1163	.0720	.0619	.0254	.1141	.0454	.0287	.0719	.2012
4	.2196	.5485	.3926	.2460	.1356	.1753	.2502	.1760	.1750	.3802
5	.6341	.5849	.5373	.3091	.4901	.2792	.3751	.5789	.3383	.5192
6	.9135	.8887	.4899	.4146	.4691	.8125	.4072	.5215	.5583	.6531
7	.8053	.9961	.7145	.6139	1.0131	.6249	.8167	.9643	.6025	.5207
8	1.0036	1.2502	.6589	.8609	.6211	.9345	.4513	.8693	.4321	.7026
9	1.4256	1.3695	.5162	1.3582	.4300	.3985	.6298	.7430	.8446	1.1478
10	1.0901	1.2251	.6331	.9584	.6948	.6588	.6371	.8688	.6304	.7976
+gp	1.0901	1.2251	.6331	.9584	.6948	.6588	.6371	.8688	.6304	.7976
0 FBAR 4- 7	.6431	.7546	.5336	.3959	.5270	.4730	.4623	.5602	.4185	.5183

Table 8 Fishing mortality (F) at age

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
AGE										
3	.1697	.1995	.1219	.0811	.0671	.1303	.0615	.0421	.1016	.1708
4	.4876	.5958	.6784	.3193	.2401	.3875	.3091	.3971	.1707	.2354
5	.6974	1.0616	.9366	.6929	.4682	.5962	.4224	.5791	.4980	.2483
6	.7516	1.0617	1.0265	.8709	.6985	.7436	.5206	.4594	.5818	.5040
7	.8335	.7002	1.0012	.8437	.6762	.8235	.5329	.7022	.4050	.5298
8	.8825	.9040	.6536	.9605	.5955	.5278	.5805	.7160	.5023	.4139
9	.9636	1.1812	1.3586	1.3821	1.0492	.5925	.3839	.4946	.5017	.3945
10	.9015	.9374	1.0158	1.0779	.7832	.6549	.5027	.6448	.4734	.4494
+gp	.9015	.9374	1.0158	1.0779	.7832	.6549	.5027	.6448	.4734	.4494
0 FBAR 4- 7	.6925	.8548	.9107	.6817	.5207	.6377	.4462	.5344	.4139	.3794

Table 4.14 (Continued)

Table 8 Fishing mortality (F) at age

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
3	.0234	.2858	.3384	.2251	.2571	.3211	.7661	.3612	.1520	.0367
4	.2691	.3920	.6041	.3427	.5903	.6481	1.2644	.6418	.5032	.3023
5	.1818	1.0698	.9918	.4213	.5181	.6435	.9345	.8615	.9644	.6770
6	.1815	.9504	.4781	.6966	.4476	.7081	.5440	.4444	.8796	.8091
7	.4033	.5515	.2981	.5923	.6000	.8039	.6374	.8047	.5093	.3621
8	.3896	.5809	.2728	.4827	.3510	.8767	.5401	.4532	.7087	.6971
9	.2979	.6928	.2771	.8008	.2025	.8137	.5614	.6758	.5028	.7556
10	.3650	.6150	.2829	.6316	.3855	.8423	.5845	.6509	.5782	.6115
+gp	.3650	.6150	.2829	.6316	.3855	.8423	.5845	.6509	.5782	.6115
0 FBAR 4- 7	.2589	.7409	.5930	.5132	.5390	.7009	.8451	.6881	.7141	.5376

Table 8 Fishing mortality (F) at age

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
3	.0903	.1263	.1839	.0603	.1353	.0681	.0526	.0242	.0682	.0267
4	.2056	.2398	.4423	.3401	.2186	.4560	.4414	.1643	.1834	.1015
5	.5365	.4550	.3920	.3413	.3962	.3035	.9152	.4951	.3492	.1242
6	.8626	.6491	.3388	.2234	.5650	.5244	.2885	1.1222	.4359	.1893
7	.7552	.5329	.3590	.3132	.3858	.5953	.6215	.3094	.5917	.2191
8	.4232	.6151	.3533	.4371	.4761	.3043	.4372	.4030	.3357	.2835
9	.5058	.3541	.1720	.3277	.5072	.4259	.2529	.2123	.1088	1.4084
10	.5673	.5059	.2961	.3614	.5137	.3544	.3040	.2345	.3517	.9916
+gp	.5673	.5059	.2961	.3614	.5137	.3544	.3040	.2345	.3517	.9916
0 FBAR 4- 7	.5900	.4692	.3830	.3045	.3914	.4698	.5666	.5227	.3900	.1585

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	FBAR 98-**
AGE											
3	.0557	.0684	.0242	.0129	.0200	.0281	.0280	.0624	.1993	.0205	.0941
4	.1418	.2513	.2018	.1065	.0781	.1285	.1871	.2928	.2985	.5889	.3934
5	.2352	.2582	.4640	.4252	.2682	.3451	.4690	.4389	.7253	.3648	.5097
6	.2853	.3542	.5338	.6372	.5200	.5100	.6413	.6361	.6551	.4438	.5783
7	.3194	.3424	.3429	.6974	.5798	.5619	.7901	.5295	.7559	.4390	.5748
8	.2187	.3161	.3745	.4133	.3279	.7690	.5261	.8062	.6984	.6729	.7258
9	.2082	.2044	.4599	.6659	.3282	.7651	.5096	.2323	.2705	.3127	.2718
10	.2333	.1878	.2275	.8764	.6031	.5978	.9523	.4279	.0759	.3505	.2848
+gp	.2333	.1878	.2275	.8764	.6031	.5978	.9523	.4279	.0759	.3505	
0 FBAR 4- 7	.2454	.3015	.3856	.4666	.3615	.3864	.5219	.4743	.6087	.4591	

Table 4.15

Table 10	Stock number at age (start of year)	Numbers*10**-3
YEAR	1950	
AGE		
3	66026	
4	92622	
5	68513	
6	36893	
7	45596	
8	15745	
9	4518	
10	1941	
+gp	5287	
0 TOTAL	337141	

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

YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
AGE										
3	553019	60283	1023249	120542	50765	167878	51537	67410	322648	240840
4	51179	393614	43935	779545	92769	40521	122627	40323	53631	245830
5	41886	33641	186200	24292	499066	66319	27842	78175	27687	36860
6	24596	18190	15346	89074	14600	250291	41068	15665	35875	16162
7	13404	8078	6123	7697	48176	7478	90933	22377	7613	16806
8	11738	4905	2442	2454	3411	14321	3277	32898	6985	3412
9	4716	3523	1150	1035	849	1501	4605	1709	11292	3712
10	1930	928	733	562	218	452	825	2009	665	3973
+gp	2201	1348	2339	957	218	418	408	1126	1168	1201
0 TOTAL	704669	524510	1281518	1026158	710071	549179	343123	261691	467564	568796

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

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
AGE										
3	108736	240221	273037	316145	100873	237489	293829	17580	17381	164310
4	161251	75127	161110	197881	238663	77232	170693	226212	13800	12856
5	137614	81075	33898	66932	117722	153693	42920	102594	124514	9526
6	17956	56095	22960	10878	27406	60348	69323	23033	47073	61955
7	6886	6934	15885	6735	3728	11159	23488	33723	11912	21540
8	8175	2450	2818	4779	2372	1552	4010	11286	13681	6505
9	1384	2769	812	1200	1497	1070	750	1837	4516	6778
10	964	432	696	171	247	429	485	418	917	2239
+gp	2624	1350	638	1040	1609	550	750	657	316	886
0 TOTAL	445591	466454	511854	605761	494117	543523	606248	417341	234112	286594

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

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
3	94310	1020157	270142	52818	48635	55919	113935	171171	136906	19199
4	113408	75428	627605	157685	34528	30791	33209	43357	97661	96285
5	8318	70945	41728	280838	91641	15666	13185	7679	18683	48344
6	6084	5678	19928	12672	150883	44693	6740	4240	2656	5831
7	30642	4155	1797	10115	5170	78959	18024	3203	2226	903
8	10382	16762	1960	1092	4580	2323	28935	7801	1173	1095
9	3521	5757	7677	1221	552	2640	791	13803	4060	473
10	3740	2140	2358	4764	449	369	958	370	5749	2010
+gp	1915	3928	2603	4360	3201	3066	936	913	804	3486
0 TOTAL	272320	1204950	975798	525566	339637	234425	216712	252537	269918	177625

Table 4.15 (Continued)

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

	YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
	AGE										
	3	6201	8196	4609	8460	257025	505412	84455	41066	17480	22668
	4	15153	4638	5914	3140	6456	183803	271000	65600	25816	13368
	5	58268	10100	2988	3111	1829	4248	95375	142698	45573	17596
	6	20112	27897	5246	1653	1811	1008	2568	31269	71063	26314
	7	2126	6949	11934	3061	1082	843	488	1575	8335	37624
	8	514	818	3339	6824	1832	603	380	215	947	3776
	9	447	276	362	1920	3608	932	364	201	118	554
	10	182	220	159	250	1133	1779	498	231	133	86
	+gp	2431	1788	737	1027	308	577	1194	1630	244	52
0	TOTAL	105433	60883	35288	29445	275086	699204	456322	284486	169709	122038

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

	YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	GMST 50-98	AMST 5C
	AGE													
	3	80793	205978	635562	272385	76433	79990	98518	45128	123821	58774	0	92850	182191
	4	16382	62567	156936	480411	203674	53042	39875	61089	32853	82871	45231	66302	127964
	5	9889	11640	39844	103441	347900	132228	34112	25751	34441	19957	37416	38690	74379
	6	12724	6399	7361	19311	55020	195994	74824	16941	13092	13652	11133	18872	36565
	7	17829	7832	3677	3534	8348	26229	94310	31934	7342	5567	7137	8753	17126
	8	24743	10605	4553	2136	1441	3828	12243	35040	15397	2823	2939	3864	7126
	9	2329	16278	6330	2563	1157	850	1452	5923	12810	6270	1179	1724	3008
	10	111	1548	10863	3272	1078	682	324	714	3844	8003	3755	739	1376
	+gp	90	116	2074	3520	2323	2986	948	714	2096	1417	5432		
0	TOTAL	164889	322963	867200	890573	697373	495830	356607	223235	245696	199334	114222		

Table 4.16

	Table 14	Stock biomass at age with SOP (start of year)	Tonnes
	YEAR	1950	
	AGE		
	3	19804	
	4	43355	
	5	55734	
	6	39904	
	7	59263	
	8	23827	
	9	7596	
	10	3890	
	+gp	16519	
0	TOTALBI(	269894	

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

	YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
	AGE										
	3	237753	20398	387813	47898	15852	61258	19316	27344	170497	133185
	4	34338	207854	25986	483407	45207	23075	71725	25527	44228	212155
	5	48839	30873	191395	26179	422644	65632	28301	86005	39680	55284
	6	38131	22195	20973	127633	16440	329341	55505	22915	68363	32229
	7	24971	11844	10057	13254	65187	11824	147685	39334	17433	40273
	8	25461	8374	4671	4920	5374	26366	6198	67331	18622	9521
	9	11367	6682	2444	2305	1487	3070	9677	3886	33452	11508
	10	5545	2098	1857	1492	454	1103	2066	5444	2350	14680
	+gp	9858	4751	9236	3960	708	1591	1592	4758	6427	6917
0	TOTALBI(	436263	315070	654431	711048	573353	523259	342063	282543	401051	515752

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

	YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	AGE										
	3	57598	118254	134114	129020	46459	103472	153561	9191	9210	81848
	4	133299	57716	123501	126029	171543	52513	139218	184570	11411	9994
	5	197698	108244	45158	74082	147049	181611	60835	145472	178931	12870
	6	34299	99578	40668	16009	45518	94815	130647	43425	89943	111290
	7	15807	14791	33811	11910	7440	21068	53192	76402	27351	46495
	8	21848	6085	6985	9840	5511	3412	10574	29771	36575	16348
	9	4109	7642	2237	2746	3866	2615	2196	5385	13414	18929
	10	3414	1422	2284	466	759	1250	1692	1460	3248	7452
	+gp	14481	6924	3264	4422	7717	2495	4086	3578	1746	4600
0	TOTALBI(	482553	420654	392021	374525	435862	463251	556002	499254	371829	309825

Table 4.16 (Continued)

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

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
3	62900	578566	147649	30179	26087	23238	57959	107405	101910	13117
4	118040	66760	535324	140607	28903	19969	26364	42457	113451	102662
5	15045	109123	61855	435201	133315	17657	18191	13068	37719	89580
6	14634	11612	39277	26110	291848	66975	12363	9594	7131	14366
7	88560	10211	4256	25045	12016	142188	39731	8709	7180	2672
8	34936	47963	5404	3148	12395	4870	74267	24698	4404	3775
9	13163	18304	23522	3912	1659	6150	2257	48556	16941	1810
10	16669	8109	8610	18188	1609	1024	3256	1550	28596	9178
+gp	13304	23204	14818	25953	17885	13273	4958	5965	6233	24809
0 TOTALBI(	377250	873852	840716	708344	525717	295345	239345	262002	323566	261969

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

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
3	4069	5144	2036	2300	108329	134924	17361	8744	4614	6475
4	15516	4543	5678	2846	4836	128637	111681	25195	10919	9263
5	103693	17193	4513	5296	3322	5862	86208	88029	30031	16081
6	47587	63139	10049	3896	4309	2056	5657	34970	69079	32734
7	6044	18900	28473	6449	2819	1720	1374	2460	11370	56970
8	1703	2590	10235	21371	5912	1809	1160	712	3037	6986
9	1643	971	1233	6682	12936	3110	1324	741	419	1333
10	797	925	643	1035	4841	7076	2162	1015	566	367
+gp	16617	11693	4663	6640	2050	3578	8070	11149	1483	344
0 TOTALBI(	197669	125097	67523	56515	149352	288771	234997	173014	131518	130553

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

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
3	29750	72212	191077	73959	17241	17980	21486	11671	39848	14022
4	12080	52618	127390	290290	76712	23681	18180	32326	21666	58978
5	12508	17396	59535	122477	290146	92572	27703	24968	38302	21082
6	17594	12981	15086	34211	82606	224715	85943	22421	21841	18301
7	30670	16847	8888	8227	17345	49193	147404	51904	13906	8425
8	48093	23963	12675	5718	3357	8643	26904	68744	29032	5091
9	5618	40062	19702	7850	3175	2466	4546	16781	31765	12595
10	329	5181	34347	9925	3026	1830	1120	1908	9370	19052
+gp	592	593	13431	15823	9167	12535	4091	2835	8380	5946
0 TOTALBI(	157234	241853	482129	568481	502774	433615	337378	233559	214111	163491

Table 4.17

Run title : Arctic Haddock (run: SVPAGE15/V15)

At 1/05/2001 19:42

Traditional vpa using file input for terminal F

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

	YEAR	1950
	AGE	
	3	0
	4	2168
	5	12819
	6	21149
	7	52152
	8	23351
	9	7596
	10	3890
	+gp	16519
0	TOTSPBI	139644

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

	YEAR	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	1717	10393	1299	24170	2260	1154	3586	1276	2211	10608
	5	11233	7101	44021	6021	97208	15095	6509	19781	9126	12715
	6	20209	11764	11116	67646	8713	174551	29417	12145	36232	17082
	7	21975	10423	8850	11664	57364	10405	129963	34613	15341	35440
	8	24952	8207	4577	4821	5267	25839	6074	65985	18250	9330
	9	11367	6682	2444	2305	1487	3070	9677	3886	33452	11508
	10	5545	2098	1857	1492	454	1103	2066	5444	2350	14680
	+gp	9858	4751	9236	3960	708	1591	1592	4758	6427	6917
0	TOTSPBI	106855	61418	83400	122079	173462	232807	188884	147888	123389	118280

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

	YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	6665	2886	6175	6301	8577	2626	6961	9228	571	500
	5	45471	24896	10386	17039	33821	41771	13992	33459	41154	2960
	6	18179	52776	21554	8485	24124	50252	69243	23015	47670	58983
	7	13910	13016	29754	10481	6547	18540	46809	67233	24069	40915
	8	21411	5963	6845	9643	5401	3344	10362	29176	35843	16021
	9	4109	7642	2237	2746	3866	2615	2196	5385	13414	18929
	10	3414	1422	2284	466	759	1250	1692	1460	3248	7452
	+gp	14481	6924	3264	4422	7717	2495	4086	3578	1746	4600
0	TOTSPBI	127639	115524	82499	59584	90813	122891	155342	172535	167715	150360

Table 4.17 (Continued)

Table 15	Spawning stock biomass with SOP (spawning time)			Tonnes						
YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	5902	3338	26766	7030	1445	998	1318	2123	5673	5133
5	3460	25098	14227	100096	30662	4061	4184	3006	8675	20603
6	7756	6154	20817	13838	154679	35497	6553	5085	3779	7614
7	77933	8985	3746	22039	10574	125125	34963	7664	6319	2351
8	34237	47004	5296	3085	12147	4773	72781	24204	4316	3700
9	13163	18304	23522	3912	1659	6150	2257	48556	16941	1810
10	16669	8109	8610	18188	1609	1024	3256	1550	28596	9178
+gp	13304	23204	14818	25953	17885	13273	4958	5965	6233	24809
0 TOTSPBI	172424	140197	117802	194143	230661	190902	130270	98151	80532	75198

Table 15	Spawning stock biomass with SOP (spawning time)			Tonnes						
YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
3	41	463	346	161	2167	0	0	0	0	0
4	1862	2499	3974	399	387	28300	1117	756	437	185
5	66363	12551	4513	1854	2657	3107	18104	29050	9009	4824
6	34739	58719	10049	1831	4007	1768	2998	17835	43520	17676
7	5802	18144	28473	4772	2706	1479	1374	2460	9324	43867
8	1703	2590	10235	21371	5912	1809	1160	712	3037	6078
9	1643	971	1233	6682	12936	3110	1324	741	419	1066
10	797	925	643	1035	4841	7076	2162	1015	566	367
+gp	16617	11693	4663	6640	2050	3578	8070	11149	1483	344
0 TOTSPBI	129567	108554	64129	44745	37662	50227	36309	63716	67794	74408

Table 15	Spawning stock biomass with SOP (spawning time)			Tonnes						
YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
3	0	1444	2866	0	0	0	0	0	398	0
4	846	6840	27898	4935	1534	0	545	1616	3683	5898
5	3752	8698	29172	15922	34817	9257	2770	6991	19151	6746
6	8797	8048	11465	14026	34694	80897	24923	11211	15507	10797
7	24536	12972	7021	7405	14049	38371	88442	34257	11264	6066
8	44246	19171	11154	5032	2954	7433	22062	55683	26419	4785
9	5618	37659	17338	7850	3175	2220	4546	15270	29223	11839
10	329	5181	29882	9925	2632	1702	930	1908	9370	18290
+gp	592	593	13431	15349	9167	11281	4091	2835	8380	5946
0 TOTSPBI	88716	100607	150227	80443	103024	151161	148310	129771	123397	70367

Table 4.18

Run title : Arctic Haddock (run: SVPAGE15/V15)

At 1/05/2001 19:42

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECR Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFA(	FBAR 4- 7
1950	66026	269894	139644	132125	.9462	.4545	.8469
1951	553019	436263	106855	120077	1.1237	.6514	.6431
1952	60283	315070	61418	127660	2.0785	.5127	.7546
1953	1023249	654431	83400	123920	1.4859	.5742	.5336
1954	120542	711048	122079	156788	1.2843	.6021	.3959
1955	50765	573353	173462	202286	1.1662	.4731	.5270
1956	167878	523259	232807	213924	.9189	.5529	.4730
1957	51537	342063	188884	123583	.6543	.5679	.4623
1958	67410	282543	147888	112672	.7619	.6146	.5602
1959	322648	401051	123389	88211	.7149	.8007	.4185
1960	240840	515752	118280	154651	1.3075	.8379	.5183
1961	108736	482553	127639	193224	1.5138	.8026	.6925
1962	240221	420654	115524	187408	1.6222	.7459	.8548
1963	273037	392021	82499	146224	1.7724	.7442	.9107
1964	316145	374525	59584	99158	1.6642	.6183	.6817
1965	100873	435862	90813	118578	1.3057	.6978	.5207
1966	237489	463251	122891	161778	1.3164	.6601	.6377
1967	293829	556002	155342	136397	.8780	.7919	.4462
1968	17580	499254	172535	181726	1.0533	.7921	.5344
1969	17381	371829	167715	130820	.7800	.8028	.4139
1970	164310	309825	150360	88257	.5870	.7547	.3794
1971	94310	377250	172424	78905	.4576	1.0105	.2589
1972	1020157	873852	140197	266153	1.8984	.8593	.7409
1973	270142	840716	117802	322226	2.7353	.8281	.5930
1974	52818	708344	194143	221157	1.1391	.8657	.5132
1975	48635	525717	230661	175758	.7620	.8127	.5390
1976	55919	295345	190902	137264	.7190	.6296	.7009
1977	113935	239345	130270	110158	.8456	.7708	.8451
1978	171171	262002	98151	95422	.9722	.9507	.6881
1979	136906	323566	80532	103623	1.2867	1.1278	.7141
1980	19199	261969	75198	87889	1.1688	1.0352	.5376
1981	6201	197669	129567	77153	.5955	.9942	.5900
1982	8196	125097	108554	46955	.4326	.9510	.4692
1983	4609	67523	64129	21607	.3369	.9205	.3830
1984	8460	56515	44745	17318	.3870	.9405	.3045
1985	257025	149352	37662	41270	1.0958	.9689	.3914
1986	505412	288771	50227	96585	1.9230	.9019	.4698
1987	84455	234997	36309	150654	4.1493	.9836	.5666
1988	41066	173014	63716	91745	1.4399	.9950	.5227
1989	17480	131518	67794	54859	.8092	.9634	.3900
1990	22668	130553	74408	25741	.3459	.9651	.1585
1991	80793	157234	88716	33605	.3788	.9589	.2454
1992	205978	241853	100607	53887	.5356	1.0132	.3015
1993	635562	482129	150227	77621	.5167	1.0021	.3856
1994	272385	568481	80443	128703	1.5999	1.1128	.4666
1995	76433	502774	103024	136064	1.3207	1.0347	.3615
1996	79990	433615	151161	169752	1.1230	1.0311	.3864
1997	98518	337378	148310	147160	.9922	1.0385	.5219
1998	45128	233559	129771	95949	.7394	1.0821	.4743
1999	123821	214111	123397	82346	.6673	1.0552	.6087
2000	58774	163491	70367	67953	.9657	1.0109	.4591
Arith. Mean	178626	371142	117577	121862	1.1230		.5254
0 Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)			

Table 4.19

The SAS System 16:15 Wednesday, May 2, 2001
North-East Arctic haddock (Sub-areas I and II)

Prediction with management option table: Input data

Year: 2001

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	290368.00	0.2414	0.0050	0.0000	0.0000	0.273	0.0829	0.685
4	45404.000	0.2063	0.0570	0.0000	0.0000	0.599	0.2227	1.080
5	37886.000	0.2189	0.4060	0.0000	0.0000	1.115	0.4672	1.330
6	11245.000	0.2048	0.6455	0.0000	0.0000	1.448	0.5528	1.570
7	7212.000	0.2000	0.7690	0.0000	0.0000	1.763	0.5937	1.730
8	2986.000	0.2000	0.9485	0.0000	0.0000	2.012	0.5809	1.860
9	1194.000	0.2000	0.9075	0.0000	0.0000	2.265	0.2896	2.085
10	3772.000	0.2000	0.9800	0.0000	0.0000	2.617	0.4165	2.415
11+	5452.000	0.2000	1.0000	0.0000	0.0000	4.025	0.4165	2.730
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	227502.00	0.2414	0.0050	0.0000	0.0000	0.273	0.0829	0.685
4	.	0.2063	0.0570	0.0000	0.0000	0.599	0.2227	1.080
5	.	0.2189	0.4060	0.0000	0.0000	1.115	0.4672	1.330
6	.	0.2048	0.6455	0.0000	0.0000	1.448	0.5528	1.570
7	.	0.2000	0.7690	0.0000	0.0000	1.763	0.5937	1.730
8	.	0.2000	0.9485	0.0000	0.0000	2.012	0.5809	1.860
9	.	0.2000	0.9075	0.0000	0.0000	2.265	0.2896	2.085
10	.	0.2000	0.9800	0.0000	0.0000	2.617	0.4165	2.415
11+	.	0.2000	1.0000	0.0000	0.0000	4.025	0.4165	2.730
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2003

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	168000.00	0.2414	0.0050	0.0000	0.0000	0.273	0.0829	0.685
4	.	0.2063	0.0570	0.0000	0.0000	0.599	0.2227	1.080
5	.	0.2189	0.4060	0.0000	0.0000	1.115	0.4672	1.330
6	.	0.2048	0.6455	0.0000	0.0000	1.448	0.5528	1.570
7	.	0.2000	0.7690	0.0000	0.0000	1.763	0.5937	1.730
8	.	0.2000	0.9485	0.0000	0.0000	2.012	0.5809	1.860
9	.	0.2000	0.9075	0.0000	0.0000	2.265	0.2896	2.085
10	.	0.2000	0.9800	0.0000	0.0000	2.617	0.4165	2.415
11+	.	0.2000	1.0000	0.0000	0.0000	4.025	0.4165	2.730
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANSAN06
Date and time: 02MAY01:16:15

Table 4.20

The SAS System 11:33 Thursday, May 3, 2001
North-East Arctic haddock (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	5.246	9035.416	2.804	7357.339	2.804	7357.339
0.0500	0.0230	0.077	137.422	4.864	7810.179	2.449	6172.986	2.449	6172.986
0.1000	0.0459	0.141	243.493	4.551	6839.856	2.162	5241.049	2.162	5241.049
0.1500	0.0689	0.193	326.680	4.291	6058.948	1.926	4496.242	1.926	4496.242
0.2000	0.0918	0.238	392.822	4.071	5421.761	1.730	3893.058	1.730	3893.058
0.2500	0.1148	0.277	446.049	3.883	4895.563	1.564	3398.937	1.564	3398.937
0.3000	0.1377	0.310	489.341	3.721	4456.376	1.424	2990.055	1.424	2990.055
0.3500	0.1607	0.339	524.893	3.580	4086.300	1.303	2648.651	1.303	2648.651
0.4000	0.1836	0.364	554.344	3.456	3771.749	1.199	2361.266	1.199	2361.266
0.4500	0.2066	0.387	578.936	3.346	3502.265	1.108	2117.559	1.108	2117.559
0.5000	0.2296	0.407	599.623	3.248	3269.697	1.028	1909.480	1.028	1909.480
0.5500	0.2525	0.425	617.142	3.160	3067.617	0.957	1730.697	0.957	1730.697
0.6000	0.2755	0.442	632.071	3.081	2890.908	0.895	1576.179	0.895	1576.179
0.6500	0.2984	0.457	644.868	3.009	2735.459	0.839	1441.894	0.839	1441.894
0.7000	0.3214	0.470	655.897	2.944	2597.941	0.789	1324.583	0.789	1324.583
0.7500	0.3443	0.483	665.449	2.884	2475.636	0.744	1221.596	0.744	1221.596
0.8000	0.3673	0.495	673.760	2.829	2366.312	0.704	1130.759	0.704	1130.759
0.8500	0.3902	0.505	681.023	2.778	2268.123	0.667	1050.281	0.667	1050.281
0.9000	0.4132	0.515	687.394	2.731	2179.534	0.633	978.677	0.633	978.677
0.9500	0.4361	0.525	693.004	2.687	2099.261	0.603	914.710	0.603	914.710
1.0000	0.4591	0.533	697.960	2.646	2026.225	0.575	857.342	0.575	857.342
1.0500	0.4821	0.542	702.350	2.608	1959.514	0.549	805.701	0.549	805.701
1.1000	0.5050	0.549	706.251	2.572	1898.354	0.525	759.050	0.525	759.050
1.1500	0.5280	0.556	709.725	2.538	1842.087	0.503	716.761	0.503	716.761
1.2000	0.5509	0.563	712.825	2.507	1790.147	0.483	678.302	0.483	678.302
1.2500	0.5739	0.570	715.597	2.477	1742.051	0.464	643.215	0.464	643.215
1.3000	0.5968	0.576	718.080	2.448	1697.379	0.447	611.110	0.447	611.110
1.3500	0.6198	0.582	720.306	2.421	1655.770	0.430	581.647	0.430	581.647
1.4000	0.6427	0.587	722.304	2.396	1616.909	0.415	554.535	0.415	554.535
1.4500	0.6657	0.593	724.099	2.371	1580.522	0.401	529.520	0.401	529.520
1.5000	0.6887	0.598	725.713	2.348	1546.369	0.387	506.382	0.387	506.382
1.5500	0.7116	0.603	727.163	2.326	1514.239	0.374	484.928	0.374	484.928
1.6000	0.7346	0.607	728.467	2.305	1483.947	0.362	464.991	0.362	464.991
1.6500	0.7575	0.612	729.638	2.284	1455.328	0.351	446.422	0.351	446.422
1.7000	0.7805	0.616	730.690	2.265	1428.239	0.340	429.090	0.340	429.090
1.7500	0.8034	0.620	731.634	2.246	1402.551	0.330	412.881	0.330	412.881
1.8000	0.8264	0.624	732.479	2.228	1378.148	0.321	397.694	0.321	397.694
1.8500	0.8493	0.628	733.234	2.211	1354.928	0.312	383.437	0.312	383.437
1.9000	0.8723	0.632	733.907	2.194	1332.800	0.303	370.031	0.303	370.031
1.9500	0.8952	0.635	734.506	2.178	1311.681	0.295	357.403	0.295	357.403
2.0000	0.9182	0.639	735.036	2.162	1291.497	0.287	345.490	0.287	345.490
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDAGE07
Date and time : 03MAY01:11:45
Computation of ref. F: Simple mean, age 4 - 7
F-0.1 factor : 0.5589
F-max factor : Not found
F-0.1 reference F : 0.2566
F-max reference F : Not found
Recruitment : Single recruit

Table 4.21
North-East Arctic haddock (Sub-areas I and II)

Prediction with management option table

Year: 2001					Year: 2002					Year: 2003	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.4703	0.6750	218069	79149	85000	0.0000	0.0000	267391	64037	0	417977	145865
.	.	.	.	.	0.0500	0.0230	.	64037	4654	413511	143437
.	.	.	.	.	0.1000	0.0459	.	64037	9237	409120	141056
.	.	.	.	.	0.1500	0.0689	.	64037	13750	404800	138723
.	.	.	.	.	0.2000	0.0918	.	64037	18195	400551	136437
.	.	.	.	.	0.2500	0.1148	.	64037	22572	396372	134195
.	.	.	.	.	0.3000	0.1377	.	64037	26884	392260	131998
.	.	.	.	.	0.3500	0.1607	.	64037	31131	388215	129843
.	.	.	.	.	0.4000	0.1836	.	64037	35315	384235	127731
.	.	.	.	.	0.4500	0.2066	.	64037	39436	380320	125660
.	.	.	.	.	0.5000	0.2296	.	64037	43497	376466	123630
.	.	.	.	.	0.5500	0.2525	.	64037	47498	372674	121639
.	.	.	.	.	0.6000	0.2755	.	64037	51440	368942	119686
.	.	.	.	.	0.6500	0.2984	.	64037	55325	365270	117772
.	.	.	.	.	0.7000	0.3214	.	64037	59153	361655	115894
.	.	.	.	.	0.7500	0.3443	.	64037	62926	358096	114052
.	.	.	.	.	0.8000	0.3673	.	64037	66644	354593	112246
.	.	.	.	.	0.8500	0.3902	.	64037	70310	351145	110474
.	.	.	.	.	0.9000	0.4132	.	64037	73923	347750	108736
.	.	.	.	.	0.9500	0.4361	.	64037	77485	344407	107031
.	.	.	.	.	1.0000	0.4591	.	64037	80996	341116	105358
.	.	.	.	.	1.0500	0.4821	.	64037	84458	337875	103716
.	.	.	.	.	1.1000	0.5050	.	64037	87871	334684	102106
.	.	.	.	.	1.1500	0.5280	.	64037	91237	331541	100526
.	.	.	.	.	1.2000	0.5509	.	64037	94556	328445	98976
.	.	.	.	.	1.2500	0.5739	.	64037	97829	325396	97454
.	.	.	.	.	1.3000	0.5968	.	64037	101057	322393	95961
.	.	.	.	.	1.3500	0.6198	.	64037	104241	319435	94495
.	.	.	.	.	1.4000	0.6427	.	64037	107381	316520	93057
.	.	.	.	.	1.4500	0.6657	.	64037	110479	313649	91645
.	.	.	.	.	1.5000	0.6887	.	64037	113535	310820	90259
.	.	.	.	.	1.5500	0.7116	.	64037	116549	308033	88899
.	.	.	.	.	1.6000	0.7346	.	64037	119523	305286	87563
.	.	.	.	.	1.6500	0.7575	.	64037	122458	302580	86252
.	.	.	.	.	1.7000	0.7805	.	64037	125353	299912	84965
.	.	.	.	.	1.7500	0.8034	.	64037	128211	297284	83701
.	.	.	.	.	1.8000	0.8264	.	64037	131030	294693	82460
.	.	.	.	.	1.8500	0.8493	.	64037	133813	292139	81241
.	.	.	.	.	1.9000	0.8723	.	64037	136559	289622	80044
.	.	.	.	.	1.9500	0.8952	.	64037	139269	287140	78869
.	.	.	.	.	2.0000	0.9182	.	64037	141945	284694	77714
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAN06
Date and time : 02MAY01:16:15
Computation of ref. F: Simple mean, age 4 - 7
Basis for 2001 : TAC constraints

Table 4.22 14:15 Wednesday, May 2, 2001

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	Sp.stock size (1 January)	Sp.stock biomass (1 January)	Sp.stock size (Spawning time)	Sp.stock biomass (Spawning time)
2001	1.4703	0.6750	73731	85018	405519	218069	45291	79149	45291	79149
2002	0.2500	0.1148	19774	22575	483663	267392	44471	64037	44471	64037
2003	0.2500	0.1148	31489	39634	537225	396373	103119	134196	103119	134196
2004	0.2500	0.1148	37571	52208	496734	474072	158193	222589	158193	222589
2005	0.2500	0.1148	38220	56993	460730	507048	186546	291123	186546	291123
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size (1 January)	Sp.stock biomass (1 January)	Sp.stock size (Spawning time)	Sp.stock biomass (Spawning time)
2001	1.4703	0.6750	73731	85018	405519	218069	45291	79149	45291	79149
2002	0.5000	0.2296	38292	43502	483663	267392	44471	64037	44471	64037
2003	0.5000	0.2296	57382	71436	520686	376467	96076	123630	96076	123630
2004	0.5000	0.2296	64009	87494	460271	422571	137207	189737	137207	189737
2005	0.5000	0.2296	60889	88638	407536	420919	150304	228683	150304	228683
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size (1 January)	Sp.stock biomass (1 January)	Sp.stock size (Spawning time)	Sp.stock biomass (Spawning time)
2001	1.4703	0.6750	73731	85018	405519	218069	45291	79149	45291	79149
2002	0.7624	0.3500	56495	63860	483663	267392	44471	64037	44471	64037
2003	0.7624	0.3500	79652	98032	504473	357223	89324	113601	89324	113601
2004	0.7624	0.3500	83266	111842	427384	376993	118775	161263	118775	161263
2005	0.7624	0.3500	74510	105660	363765	351709	121306	179575	121306	179575
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size (1 January)	Sp.stock biomass (1 January)	Sp.stock size (Spawning time)	Sp.stock biomass (Spawning time)
2001	1.4703	0.6750	73731	85018	405519	218069	45291	79149	45291	79149
2002	1.0000	0.4591	71979	81005	483663	267392	44471	64037	44471	64037
2003	1.0000	0.4591	96262	117263	490718	341117	83720	105358	83720	105358
2004	1.0000	0.4591	95352	126051	401574	341894	104694	139797	104694	139797
2005	1.0000	0.4591	81378	112638	332180	302981	100993	145783	100993	145783
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSAN02
Date and time : 02MAY01:16:20
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 4.23

North-East Arctic haddock (Sub-areas I and II)
Single option prediction: Detailed tables

Year: 2001 F-factor: 1.4703 Reference F: 0.6750

				1 January		Spawning time			
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.1219	29676	20328	290368	79125	1452	396	1452	396
4	0.3274	11520	12442	45404	27188	2588	1550	2588	1550
5	0.6869	17117	22766	37886	42232	15382	17146	15382	17146
6	0.8128	5735	9004	11245	16286	7259	10513	7259	10513
7	0.8729	3861	6699	7212	12712	5546	9775	5546	9775
8	0.8541	1576	2932	2986	6006	2832	5697	2832	5697
9	0.4258	378	788	1194	2704	1084	2454	1084	2454
10	0.6124	1581	3819	3772	9871	3697	9674	3697	9674
11+	0.6124	2286	6240	5452	21944	5452	21944	5452	21944
Total		73731	85018	405519	218069	45291	79149	45291	79149
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 0.7624 Reference F: 0.3500

				1 January		Spawning time			
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0632	12395	8491	227502	61994	1138	310	1138	310
4	0.1698	28574	30860	201918	120908	11509	6892	11509	6892
5	0.3562	7212	9592	26625	29679	10810	12050	10810	12050
6	0.4215	4796	7530	15314	22179	9885	14317	9885	14317
7	0.4526	1351	2344	4065	7164	3126	5509	3126	5509
8	0.4429	806	1499	2467	4962	2340	4706	2340	4706
9	0.2208	188	391	1041	2357	944	2139	944	2139
10	0.3175	158	382	639	1671	626	1638	626	1638
11+	0.3175	1015	2770	4094	16477	4094	16477	4094	16477
Total		56495	63860	483663	267392	44471	64037	44471	64037
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2003 F-factor: 0.7624 Reference F: 0.3500

				1 January		Spawning time			
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0632	9153	6270	168000	45780	840	229	840	229
4	0.1698	23741	25640	167764	100457	9563	5726	9563	5726
5	0.3562	37551	49942	138625	154526	56282	62737	56282	62737
6	0.4215	4692	7367	14981	21697	9670	14005	9670	14005
7	0.4526	2722	4722	8187	14430	6296	11096	6296	11096
8	0.4429	691	1286	2116	4257	2007	4038	2007	4038
9	0.2208	234	487	1297	2937	1177	2665	1177	2665
10	0.3175	169	409	683	1788	670	1752	670	1752
11+	0.3175	699	1909	2820	11352	2820	11352	2820	11352
Total		79652	98032	504473	357223	89324	113601	89324	113601
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.23 (Continued)

The SAS System 16:15 Wednesday, May 2, 2001

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

Single option prediction: Detailed tables

(cont.)

Year: 2004 F-factor: 0.7624 Reference F: 0.3500

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0632	5122	3508	94000	25615	470	128	470	128
4	0.1698	17531	18934	123886	74183	7061	4228	7061	4228
5	0.3562	31199	41495	115177	128388	46762	52125	46762	52125
6	0.4215	24430	38355	77998	112964	50348	72918	50348	72918
7	0.4526	2662	4619	8009	14116	6159	10855	6159	10855
8	0.4429	1393	2590	4263	8574	4043	8133	4043	8133
9	0.2208	201	418	1113	2520	1010	2287	1010	2287
10	0.3175	211	510	851	2228	834	2184	834	2184
11+	0.3175	518	1413	2088	8404	2088	8404	2088	8404
Total		83266	111842	427384	376993	118775	161263	118775	161263
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2005 F-factor: 0.7624 Reference F: 0.3500

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0632	5122	3508	94000	25615	470	128	470	128
4	0.1698	9809	10594	69317	41507	3951	2366	3951	2366
5	0.3562	23039	30642	85053	94809	34532	38492	34532	38492
6	0.4215	20297	31867	64805	93856	41831	60584	41831	60584
7	0.4526	13862	24050	41697	73495	32065	56518	32065	56518
8	0.4429	1362	2534	4170	8388	3955	7956	3955	7956
9	0.2208	404	842	2241	5076	2034	4606	2034	4606
10	0.3175	181	437	731	1912	716	1874	716	1874
11+	0.3175	434	1186	1752	7051	1752	7051	1752	7051
Total		74510	105660	363765	351709	121306	179575	121306	179575
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSAN02
Date and time : 02MAY01:16:20
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

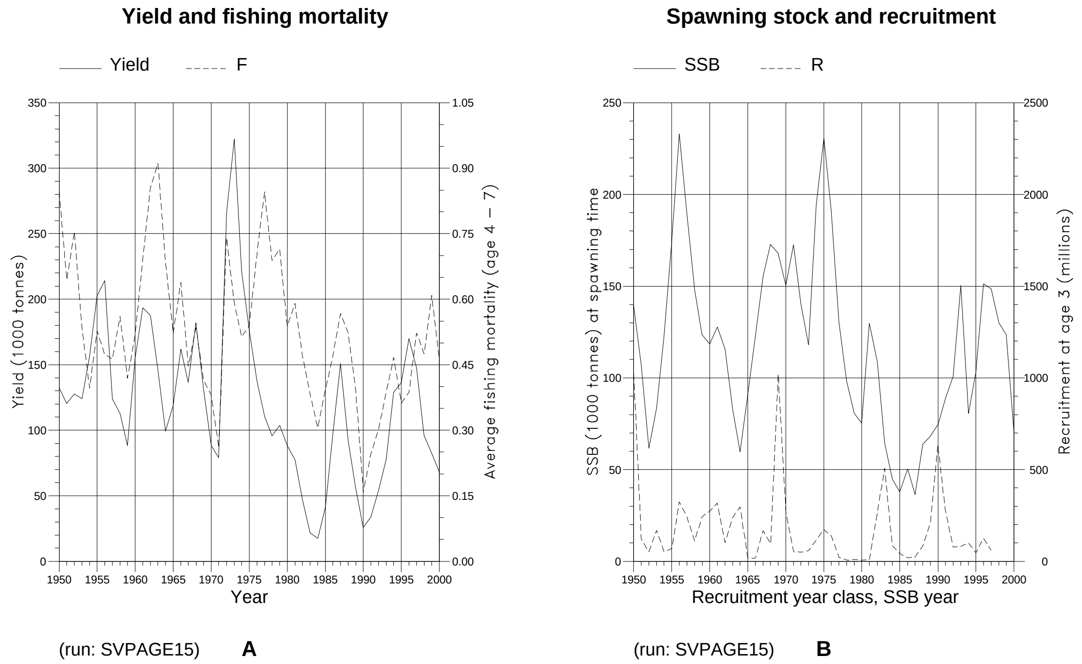


Figure 4.1 A-B Fish stock summary. North-east Arctic haddock (sub-areas I and II)

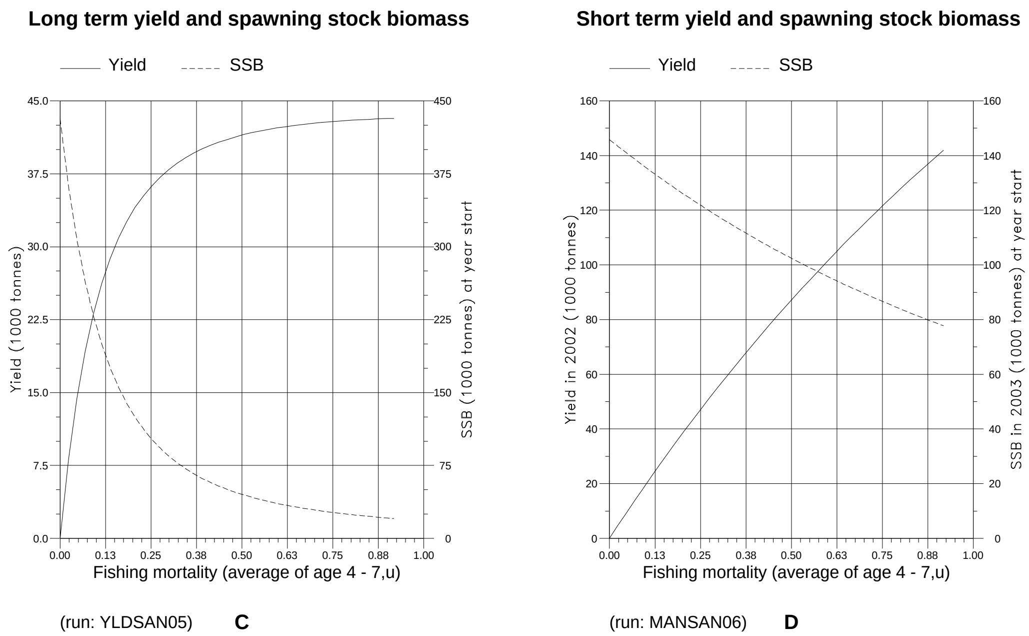


Figure 4.1 C-D Fish stock summary. North-east Arctic haddock (sub-areas I and II)

Fishing mortality (F_{bar} 4-7)

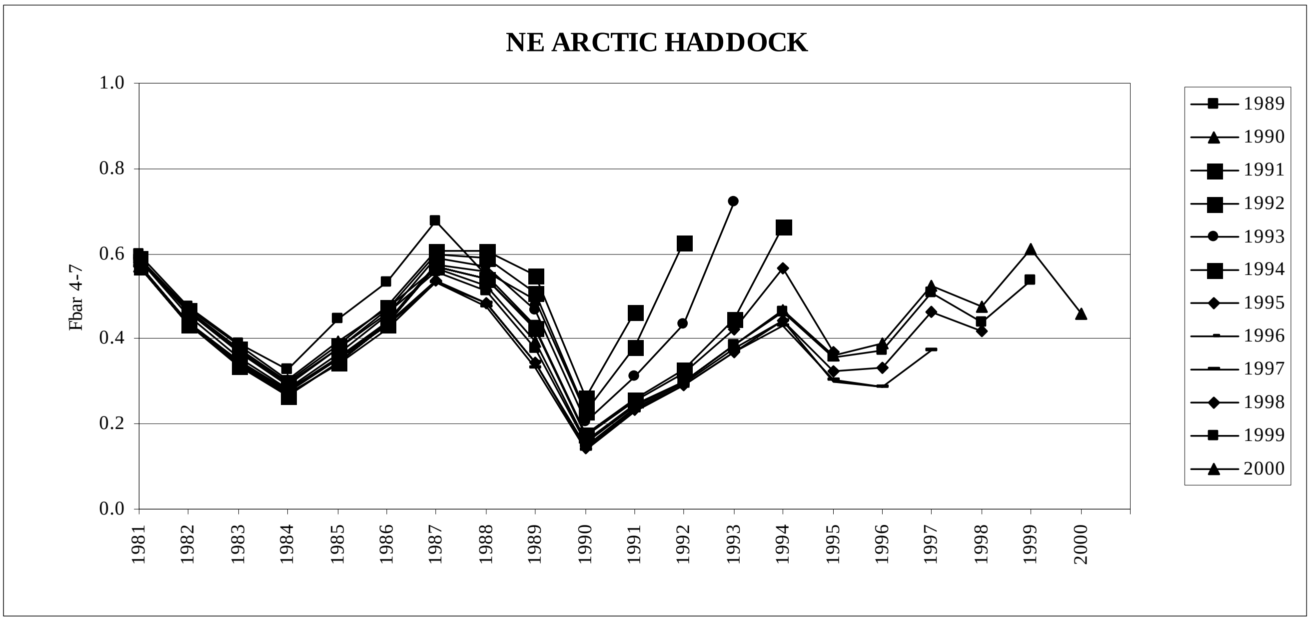


Figure 4.2 Retrospective assessment performance

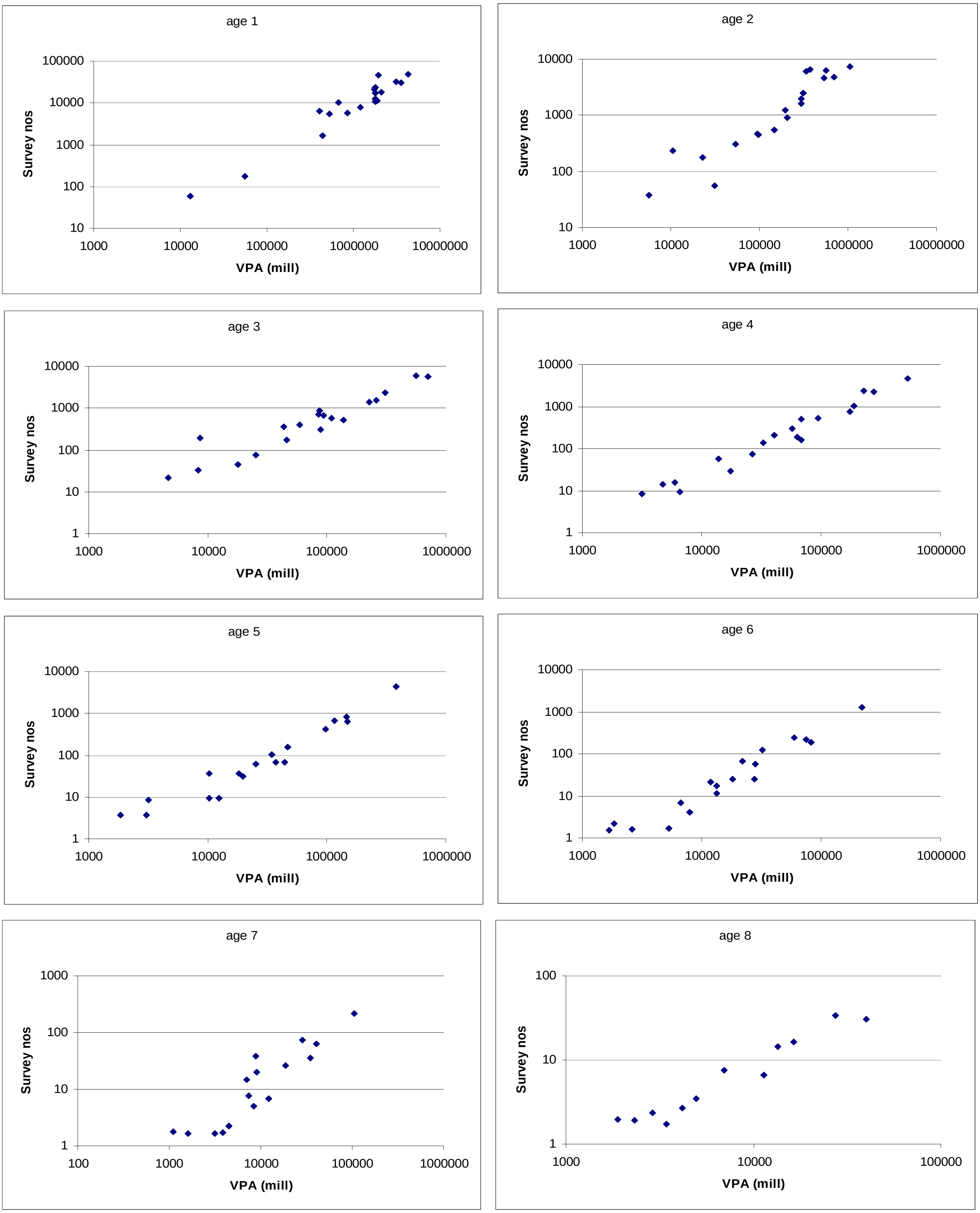


Figure 4.3.a NE Artic Haddock abundance index from the Norwegian bottom trawl survey plotted against VPA results on stock number at age.

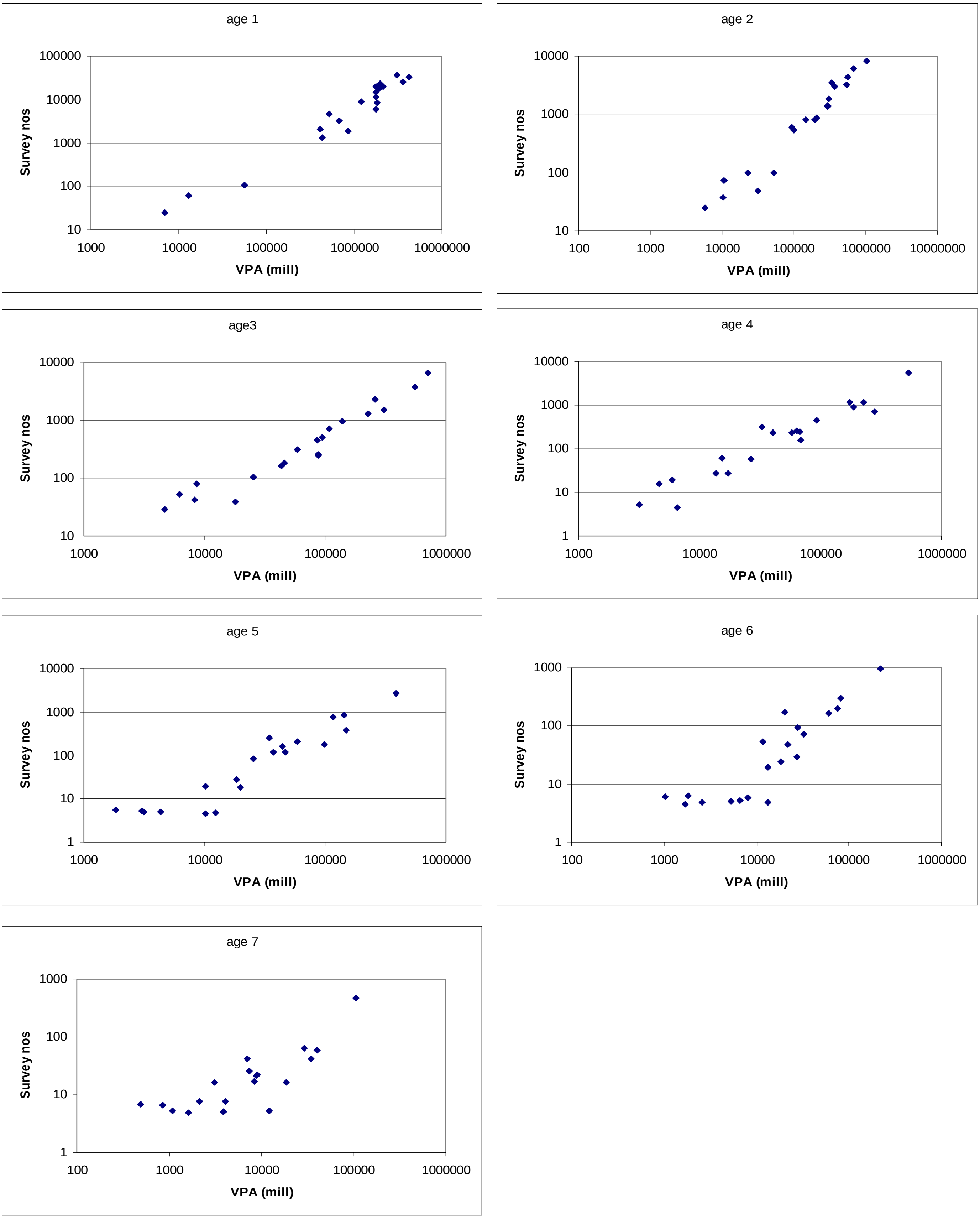


Figure 4.3.b NE Artic Haddock abundance index from Norwegian acoustic survey plotted against VPA results on stock number at age.

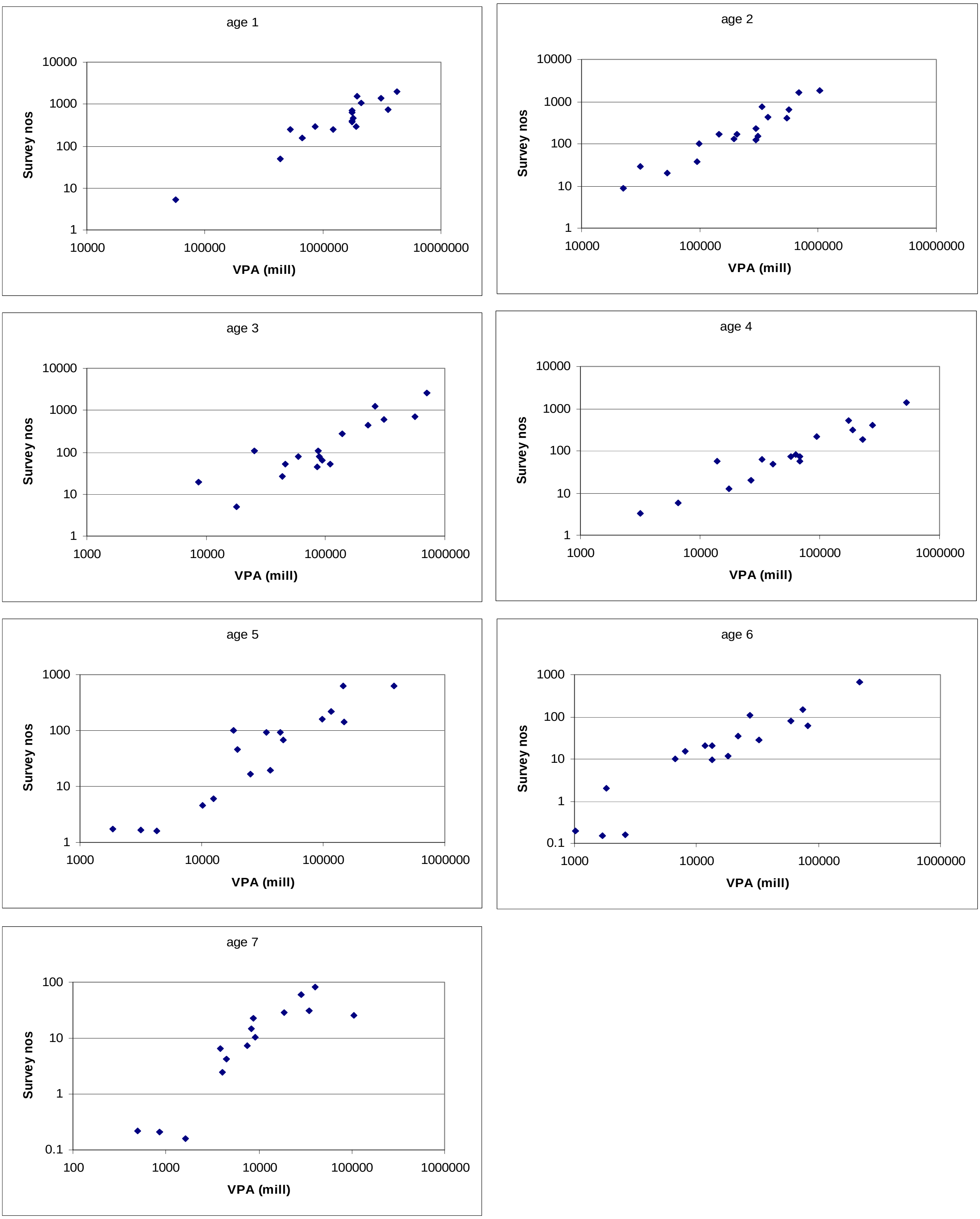


Figure 4.3.c NE Artic Haddock abundance index from the Russian bottom trawl survey plotted against VPA results on stock number.

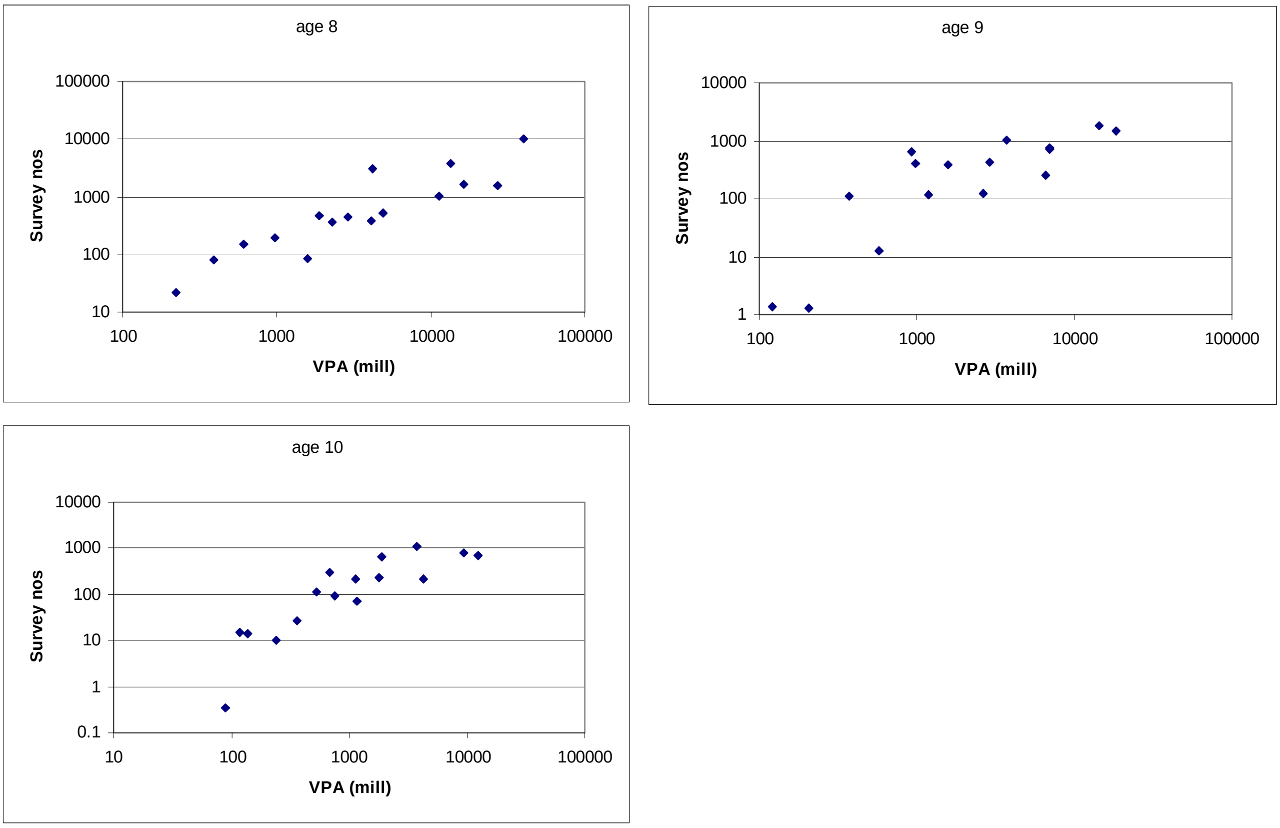


Figure 4.3.d NE Artic Haddock abundance index from the Norwegian bottom trawl commercial fleet plotted against VPA results on stock number.

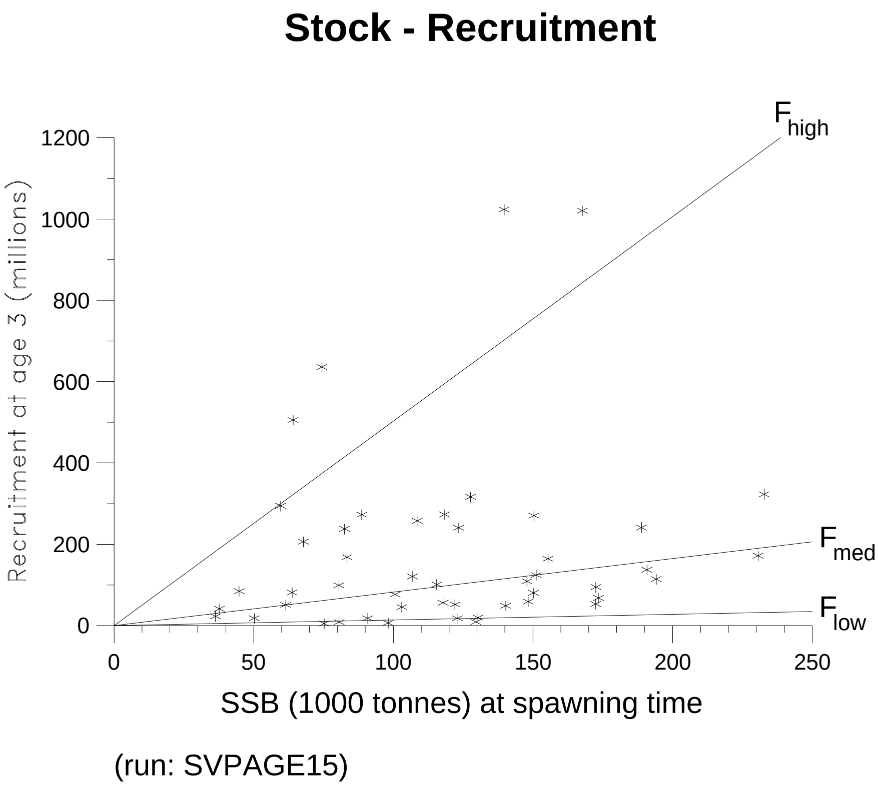

Stock - Recruitment
Recruitment at age 3 (millions)
1200
1000
800
600
400
200
0
0
50
100
150
200
250
SSB (1000 tonnes) at spawning time
Fhigh
Fmed
Flow
(run: SVPAGE15)

Figure 4.4

Figure 4.5 A Quantiles of the SSB distribution F=0.11

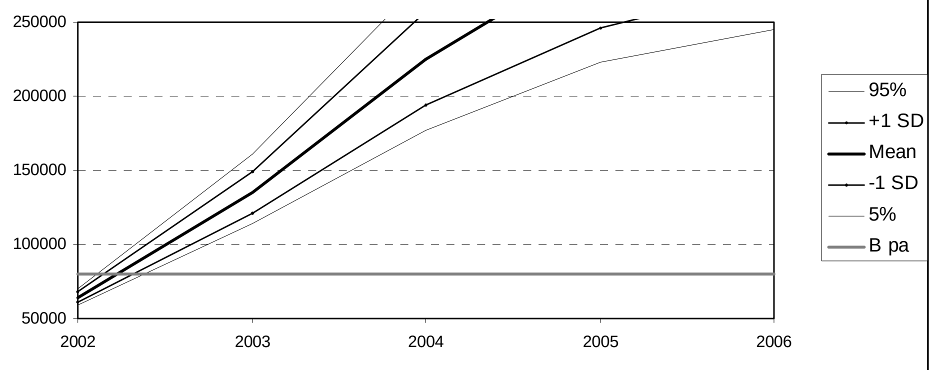


Figure 4.5 B Quantiles of the SSB distribution F=0.23

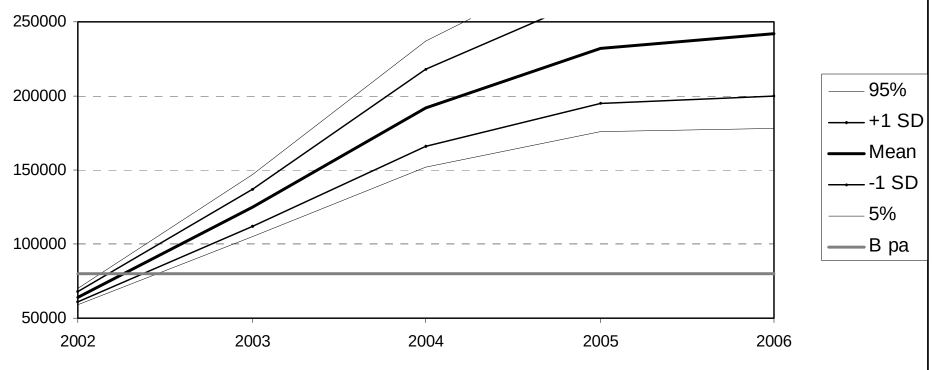


Figure 4.5 C Quantiles of the SSB distribution Fpa=0.35

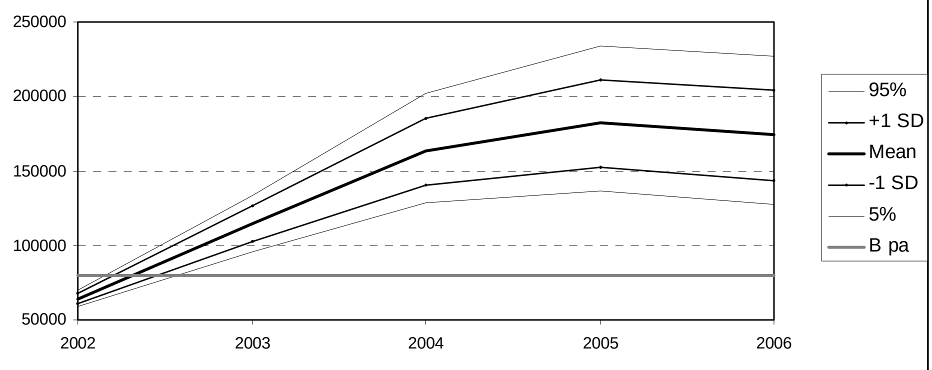
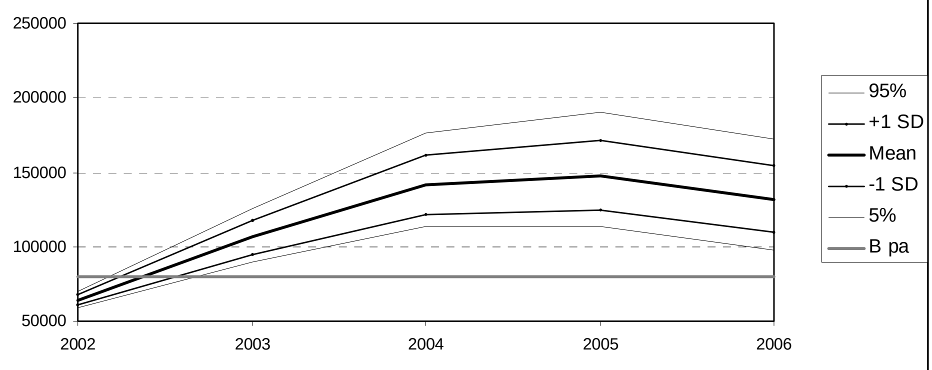


Figure 4.5 D Quantiles of the SSB distribution Fsq=0.46



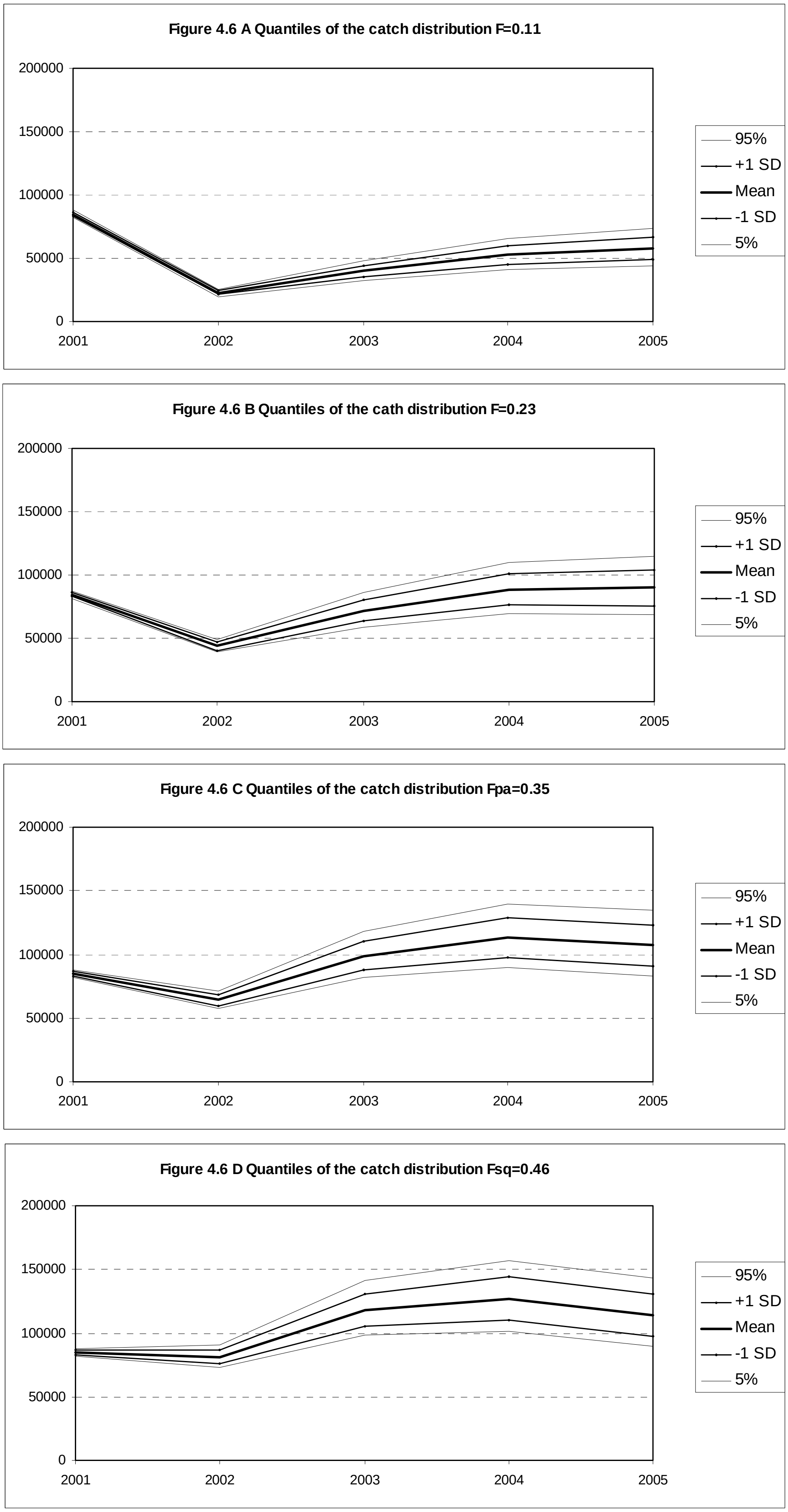


Figure 4.6 A Quantiles of the catch distribution F=0.11
200000
150000
100000
50000
0
2001
2002
2003
2004
2005
95%
+1 SD
Mean
-1 SD
5%
Figure 4.6 B Quantiles of the cath distribution F=0.23
Figure 4.6 C Quantiles of the catch distribution Fpa=0.35
Figure 4.6 D Quantiles of the catch distribution Fsq=0.46

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	0,8	0,3	0,7	0,2	1376,3
2001	1216,5	460,4	297	29,4	25,4	1,7	0,9	0,1	0,1	0,3	2031,8

[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).

	Age											
Year	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
2000	18,0	25,4	37,5	9,3	13,0	3,2	1,1	0,2	0,1	0,4		108,3
						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
2000	27,9	23,9	13,5	1,8	9,3	2,0	0,9	0,2	0,2	0,4		80,1

Cont'd

Table B2 (continued)

Year	0	1	2	3	4	5	6	7	8	9	Older	Total
						Age						
						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
2000	7,9	10,0	13,4	1,3	5,5	2,2	1,2	0,4	0,2	0,3		42,4
						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
2000	15,1	20,7	26,2	6	10,9	2,6	1,1	0,2	0,1	0,4		83,3

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	1 024	509	32	65	19	10	2	1	2	+	1 664
2001	976	316	210	23	22	1	1	+	+	1	1 550

[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
2000[1]	246	292	238	49	86	23	9	2	1	2	2	949

[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			
	2001	14,6	22,5	32,2	37,8	47,2	51,3	58,6			
Russia		0	1	2	3	4	5	6	7	8	9
	1984	-	24,1	35,8	44,4	56,4	62,8	64,8	-	-	-
	1985	16,5	22,4	30,9	44,1	53,8	61,3	64,7	-	-	-
	1986	17,0	20,7	28,1	35,4	46,7	62,0	-	68,0	-	-
	1987	12,1	21,5	27,8	32,3	37,3	48,6	-	-	-	-
	1988	13,7	23,2	29,7	33,7	39,3	46,2	51,2	-	-	-
	1989	14,9	22,2	26,5	38,5	44,5	49,3	53,0	57,7	64,1	-
	1990	17,0	24,5	30,9	40,4	50,6	53,2	55,7	59,7	63,8	67,7
	1991	17,2	24,2	30,5	39,7	53,4	55,4	58,3	60,5	62,7	70,2
	1992	16,0	22,8	31,1	44,6	53,8	63,8	61,2	66,4	69,0	69,6
	1993	15,3	21,7	28,7	38,3	48,3	54,3	60,9	64,2	63,2	65,0
	1994	15,7	22,5	28,1	33,0	44,1	54,9	61,5	67,5	67,7	67,8
	1995	15,5	22,5	28,5	33,3	39,7	49,9	58,2	63,1	66,3	69,5
	1996[2]	15,8	22,8	28,4	33,7	42,0	48,7	54,8	63,4	69,3	72,0
	1997[2]	13,8	23,5	29,3	36,1	45,3	50,0	54,6	58,9	69,4	66,0
	1998	15,0	22,0	29,0	38,3	47,7	52,1	54,5	57,8	63,4	-
	1999	-	22,8	27,4	40,1	47,4	50,9	54,6	55,9	58,0	61,6
	2000	15,0	22,7	30,4	35,2	49,3	55,1	57,8	62,4	63,3	63,6

[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
2001	28	106	337	557	1 100	1 439	2 073

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
2000	29	110	278	427	1 249	1 681	1 966	2 488	2 625	2 648	-

[1] Lengths adjusted to account for limited area coverage.
[2] Limited area coverage.

Table B6, continued

North-East Arctic HADDOCK. Weight data (g) from Norwegian surveys
in January-March in the Barents Sea and in March in Lofoten.*

Year	Age									
	3	4	5	6	7	8	9	10	11	12
1989	0.300	0.480	0.740	1.020	1.400	2.340				4.420
1990	0.410	0.830	0.990	1.290	1.550	1.830	2.270			
1991	0.480	0.870	1.300	1.350	1.810	1.820	2.300			
1992	0.400	0.970	1.380	2.140	2.040	2.140	2.290	3.080	2.260	2.600
1993	0.320	0.770	1.440	1.890	2.460	2.510	2.820	2.910	3.290	
1994	0.270	0.550	1.050	1.690	2.090	2.300	2.770	2.830	2.580	3.890
1995	0.230	0.390	0.770	1.300	1.760	1.590	2.370	2.390	2.550	3.000
1996	0.240	0.520	0.730	0.990	1.730	1.950	2.020	1.880	2.730	3.780
1997	0.210	0.530	0.820	1.060	1.360	1.790	2.810	2.800	2.610	3.590
1998	0.250	0.530	0.880	1.230	1.420	1.660	2.080	2.120	2.130	3.140
1999	0.380	0.680	1.020	1.680	1.900	1.660	2.160	2.310	2.780	2.980
2000	0.280	0.760	1.040	1.400	1.450	1.960	2.160	2.500	2.540	4.440
2001	0.340	0.560	1.120	1.460	2.090	1.990	2.460	3.110	2.790	3.410

*) Korsbrekke, (WD 21. 2000). Building a maturity model for North East arctic Haddock.
updated table in 2001

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 accounting for 60% in 2000 (Table 5.2). A traditional gill net fishery for spawning saithe accounts for about 22%. The remaining catches are taken by danish seine and handline in addition to minor by-catches in the longline fishery for other species. Some changes in recent regulations have led to less amounts taken by purse seine. 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 93% of the landings.

1 March 1999 the minimum landing size was increased from 35-40 cm to 45 cm for trawl and conventional gears, and to 40 cm (north of Lofoten) and 42 cm (between 62° N and Lofoten) 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 2001 (Table 5.1, Figure 5.1A)

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. Since then the annual landings have been 135,000-154,000 t.

The TAC for 2000 was set at 125,000 t. Provisional figures show that the landings in 2000 were approximately 135,000 t, which is 10,000 t more than expected by the WG last year.

5.1.3 Expected landings in 2001

In August 2000 a standard assessment was performed, but with revised tuning series for the purse seine fishery and the acoustic survey. This assessment showed a considerable reduction in Fs compared to the previous assessment. This was caused both by the revised CPUE tuning series but also by new catch at age data showing a better fishing pattern than in previous years. ACFM advised that the fishing mortality should be reduced to below F_{pa}, corresponding to catch in 2001 of less than 115,000 t. In later years the CPUE tuning series from the trawl fishery have showed a decreasing trend not accurately reflecting the changes in stock size (see below). There has also been a tendency to overestimate Fs in last year in the assessment year. Partly due to this Norwegian authorities set the TAC for 2001 to 135,000 t, which corresponded to the expected fishing mortality in 2000 of 0.31. Official landings in 2001 are expected to be around the TAC of 135,000 t, but there are several unofficial reports of increasing problems with bycatch and discards of saithe in the cod fishery.

5.2 Status of Research

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

Until 1999 indices of fishing effort in the purse seine fishery was based on the number of vessels of 20-24.9 m length and the effort (number of vessels) of this length category was raised by the catches to represent the total purse seine effort. The number of vessels taking part in the fishery almost doubled from 1997 to 1998 (Table C1), 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 that have taken part in the fishery the last decade have accounted for only a small fraction of the purse seine catches. 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 C1), and the new effort series show a smaller decrease in later years than the old one. Exploratory XSA runs showed higher scaled weights for the CPUE-series based on the new effort data (Mehl, WD 20 2000) and at the 2000 WG meeting it was decided to use the new data in the assessment.

Table C2 gives catch, effort and catch per unit effort for Norwegian trawlers since 1976 and 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. 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 and stayed low in 1999. This may at least partly be explained by the increasing problem with bycatch of saithe in the declining cod fishery in a period with good availability of saithe. Last year preliminary new estimates of CPUE indices by age based on the logbook database having daily resolution were presented (Mehl, WD 20 2000). These estimates have been further refined and are presented in Table C3. After some initial analyses it was decided to only include data from vessels larger than the median length since they showed the least noisy trends. One single CPUE observation from a given vessel is the total catch per day divided by the duration of all the trawl hauls that day. To increase the number of observations during a time period with decreasing directed saithe fishery, all days with 20% or more saithe were included. The effort (hours trawling) for each CPUE observation is standardised or calibrated to a standard vessel. The CPUE indices are splitted on age groups by quarterly weight, length and age data from the trawl fishery. A yearly index is than calculated by first averaging all CPUE observations for each month, and then averaging over the year. The new trawl CPUE indices by age were used in XSA runs at the present WG meeting.

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). At the previous WG meeting it was therefore decided to apply the extended series in the assessment. The results from the survey autumn 2000 showed a further decrease in the abundance of age 5 and older saithe (Korsbrekke and Mehl 2000). It is not known how well the survey covers the oldest age groups from year to year, but at least for precautionary reasons the 6+ group was kept in the tuning series.

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 that 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. At the WG meeting in 2000 analyses were done on combining these indices with indices from the regular saithe survey in the tuning series, but it did 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 1999 was revised, resulting in only minor changes. Age composition data for 2000 was available from Norway and Germany, accounting for 95% 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 a new and refined CPUE series from the trawl fisheries (see chapter 5.2.1).

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 (2000). It varies from year to year to what extent the 2 year old saithe (and in some years even 3 year olds) have migrated out from the near coast areas and are available for the acoustic saithe survey on the banks.

5.3.7 Prediction data (Table 5.14)

The input data to the predictions based on results from the XSA-analysis are given in Table 5.14. The stock number at age in 2001 was taken from the XSA for age 5 and older. The recruitment at ages 2 and 3 in 2001 (1997 and 1998 year classes) was estimated using RCT3 (Section 5.5.2). The corresponding numbers at age 3 and 4 in 2001 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 (1960-1998) of 208 million was used for the 1999 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 1998-2000 has been used, scaled to the 2000 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. Exploratory XSA runs revealed patterns in the logarithmic catchability (log q) residuals of the new trawl CPUE series over time. This only confirmed what has been said above about changes in trawler regulations and skipper behaviour, and it was decided to reduce the time series to 1994-2000, and the age span to ages 5-9. Generally the trawl CPUE series show negative residuals in recent years, while the acoustic survey series give positive residuals. 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.

To investigate the implications of use of different assessment methods, a trial run was made using ADAPT. The input data included the same catch at age and indices as used in the initial XSA formulation, but did not include a plus group. Ages 3 to 10 were estimated in the model, the relationships between age specific indices and catches were assumed to be proportional, and the Fs at the oldest age were assumed to be the average of the preceding three ages.

5.4.2 Recruitment (Tables 5.12-5.13, Figures 5.3 B-C)

Estimates of the recruiting year classes up to the 1996 year class from the XSA were accepted. Catches of age group 2 have declined to very low levels in recent years, except for an increase in 2000 probably due to a strong 1998 year class (Table 5.3). Also, retrospective analysis show 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 years catches of 3 year olds have also been reduced due to fishermen targeting bigger and more valuable fish which now are available in the stock, and due to the new minimum landing size introduced in 1999. RCT3-runs were therefore conducted to estimate both the 1997 and 1998 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 1999 was 0.32 which is well below the value of 0.37 from last year's assessment (Figure 5.3A). Using the RCT3 estimation of the 1997 year class gives a fishing mortality (F_{3-6}) in 2000 of 0.26, i.e. equal to current F_{pa}.

The XSA-estimates of the 1997-1998 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 1992 year class is well represented in the catches. The 1993 year class is average, while the 1994 year class seems to be above average. In the acoustic survey both 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 well above average in the XSA-estimate and one of the strongest in the survey.

The SOP corrected stock and spawning stock biomass (SSB) tables are included (Tables 5.9-5.11). The total biomass was at a maximum in 1993-1996 and the SSB in 1998. Since then both has decreased somewhat. There are considerable SOP discrepancies in the early part of the time series that 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.

The results of the trial ADAPT was generally consistent with a comparable XSA formulation that included the complete Norwegian trawl CPUE series.

5.5.2 Recruitment (Tables 5.12-5.13)

The RCT3 estimates (with 2 year olds as input, Table 5.12) of the 1998 year class is 322 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 1997 year class gives 219 million individuals. It was decided to use the RCT3 estimates for both the 1997 and 1998 year class and the long-term geometric mean of 210 million individuals for the 1999 and subsequent year classes in the predictions.

5.6 Reference points

5.6.1 Biomass reference points

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

5.6.2 Fishing mortality reference points (Tables 5.14,5.15, 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 0.11 and 0.23, respectively, which is slightly above the values of 0.09 and 0.17 obtained last year. The plot of SSB versus recruitment is shown in Figure 5.4. F_{low}, F_{med} and F_{high} were recalculated. The values obtained in 1998 were 0.17, 0.32 and 0.58, respectively, while the new values calculated this year were 0.18, 0.34 and 0.70, 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 2002 (short term predictions) (Table 5.16)

The management option table (Table 5.16) shows that the expected catch of 135,000 t in 2001 will maintain the fishing mortality at the F_{00} *(status quo)* level of 0.26, which also is equal to current F_{pa}. This is another example of that the fishing mortality in the assessment year tend to be overestimated for this stock since the same catch level in last assessment gave F=0.31. The *status quo* catch in 2002 is 152,000 t. The SSB is expected to increase in 2001 from 288,000 t to 304,000 t in the beginning of 2002. This is 50,000 t more than estimated in last year's assessment at the F_{pa} level, and well above the B_{pa} of 150,000 t.

5.8 Medium-term forecasts and management scenarios (Table 5.17a,b, Figure 5.1D)

The input data were the same as used for the short term predictions (Table 5.14). Single option predictions (detailed tables in Tab. 5.17b) for $F_{status\ quo}$ (= F_{pa} and F_{2000}) are given in Table 5.17a,b for the period 2001-2006. At $F_{status\ quo}$ the catch will increase to 165,000 t in 2004 followed by a small decrease to 157,000 t at the end of the period. The SSB will at the same fishing mortality increase to about 370,000 t in the years 2004-2006.

5.9 Comments on the assessment and the forecast

The suitability of the trawl CPUE series to show stock trends should be further explored. Trial XSA-runs using only the fishery independent acoustic survey series gave positive log q residuals. Only relying on the acoustic series therefore tended to overestimate the stock, but whether this is an artifact due to too heavy shrinkage should be further investigated.

In order to improve the consistency of the assessment, as wide area of saithe distribution as possible should be covered by the acoustic surveys. This includes the Russian EEZ where much saithe were distributed in 2000 (WD 20). A workshop for Norwegian and Russian acoustic specialists is planned to take place in Bergen in August 2001 to standardize the acoustic methodology to be used for demersal fish, incl. saithe.

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 appears now to be within safe biological limits. 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 together with growing interest to fish bigger saithe 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	197 426
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	-	110 247
1969	20	193	6 744	4 355	115 140	-	-	-	-	13 585	-	23	140 060
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	-	214 334
1973	7	11 320	12 015	30 338	148 789	23	-	2 411	2 115	6 593	248	-	213 859
1974	46	7 119	29 466	33 155	152 699	2 521	-	38 931	7 075	3 001	103	5	274 121
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	242 468
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	-	-	175 516
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	-	-	107 183
1986	426	308	-	3 470	66 152	-	-	27	-	54	21	-	70 458
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	-	127 516
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	181 [2]	638 [2]	655 [2]	2 473	141 828	-	18 [2]	3 929	35 [2]	339		178 [2]	150 274
2000 [1]	224 [2]	237 [2]	651 [2]	2 570 [6]	125 880	-	46	4 452	167 [2]	453		43 [2]	134 723

[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
[6] As reported by Working Group members

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	15,9	164,2
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	15,5	168,0
1983	54,1	68,2	19,6	15,0	156,9
1984	36,4	85,6	23,7	13,1	158,8
1985	31,1	49,9	14,6	11,6	107,2
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	12,1	122,3
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	12,3	127,5
1993	33,1	83,5	21,2	15,8	153,6
1994	30,2	81,7	21,1	13,5	146,5 [3]
1995	21,8	103,5	26,9	15,9	168,2 [4]
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	39,2	57,9	29,7	23,5	150,3
2000 [1]	28,2	53,5	29,5	23,5	134,7

[1] Provisional figures.
[2] Unresolved discrepancy between Norwegian catch by gear figures and the total reported to ICES for these years.
[3] Includes 4,300 tonnes not categorized by gear, proportionally adjusted.
[4] Reduced by 1,200 tonnes not categorized by gear, proportionally adjusted.

Table 5.3 Catch numbers at age.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE											
2,	7381	4936,	1246,	2815,	20308,	30430,	7450,	6952,	5297,	4090,	25952,,
3,	10509	17824,	37266,	42050,	9001,	37115,	22392,	29664,	25196,	77333,	43540,,
4,	13083	9131,	11131,	28925,	59601,	5001,	54537,	24836,	18384,	11949,	62846,,
5,	13545	12506,	4421,	5888,	13154,	26300,	13124,	35956,	5101,	16939,	13987,,
6,	5064	3799,	8290,	4650,	2718,	10142,	12899,	4125,	8282,	4747,	16189,,
7,	4883	1332,	2427,	3861,	3472,	2861,	4652,	5616,	787,	4798,	5122,,
8,	2401	968,	1024,	1099,	2655,	2110,	1374,	2916,	1913,	1126,	7950,,
9,	1315	520,	938,	1075,	1251,	2733,	933,	1413,	900,	1711,	2504,,
10,	743	405,	451,	697,	1221,	699,	965,	1397,	577,	675,	3697,,
+gp,	1525	1229,	1728,	1777,	3559,	3593,	2900,	3493,	1166,	511,	2799,,
0 TOTALNUM,	60449	52650,	68922,	92837,	116940,	120984,	121226,	116368,	67603,	123879,	184586,,
TONSLAND,	133515	05951,	120707,	148627,	197426,	185600,	203788,	181326,	110247,	140060,	264924,,
SOPCOF %,	126	138,	123,	121,	116,	108,	111,	95,	117,	97,	97,,

Run title : Arctic Saithe (run: XSAKHN09/X09)

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
2,	19842,	11608,	13829,	21159,	81601,	54151,	31662,	45758,	28334,	18226,
3,	77019,	65178,	76296,	36782,	60832,	125030,	99049,	48969,	61963,	40796,
4,	59280,	52389,	25206,	44027,	11691,	30576,	34317,	27685,	23328,	36644,
5,	26961,	29146,	26911,	15671,	16366,	7947,	10140,	12476,	14122,	9211,
6,	9556,	10186,	16031,	20419,	4436,	8712,	2062,	4534,	4400,	6379,
7,	9592,	5616,	7114,	12148,	7808,	3435,	4332,	1468,	2901,	3200,
8,	2901,	3547,	3935,	4802,	6789,	3212,	1456,	1848,	963,	1338,
9,	4352,	1865,	2871,	3258,	2914,	2679,	1606,	938,	1356,	147,
10,	2195,	2140,	2610,	2505,	2350,	1724,	963,	976,	438,	730,
+gp,	5490,	3149,	3924,	3821,	4140,	2880,	1134,	2150,	1192,	1629,
0 TOTALNUM,	217188,	184824,	178727,	164592,	198927,	240346,	186721,	146802,	138997,	118300,
TONSLAND,	241272,	214334,	213859,	274121,	233453,	242486,	182817,	154464,	164180,	144554,
SOPCOF %,	78,	84,	81,	101,	102,	100,	101,	103,	114,	94,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
2,	10467,	17225,	11638,	14624,	2216,	3311,	3867,	5017,	11157,	11543,
3,	83954,	34733,	17244,	41466,	48917,	22115,	17869,	8126,	12378,	21002,
4,	21822,	65052,	23768,	33233,	11974,	12895,	49829,	35847,	19915,	13463,
5,	21528,	13060,	32700,	12064,	7189,	6062,	4339,	32827,	32643,	8996,
6,	3619,	8212,	3226,	11204,	5279,	4525,	3118,	4560,	18751,	9152,
7,	2550,	1054,	3008,	1135,	3740,	2805,	3490,	2328,	1939,	7735,
8,	2008,	1251,	1177,	1772,	775,	1399,	755,	1219,	377,	1126,
9,	369,	461,	760,	560,	878,	351,	620,	966,	191,	154,
10,	279,	263,	247,	557,	134,	454,	257,	320,	179,	121,
+gp,	629,	448,	760,	897,	701,	285,	797,	102,	149,	253,
0 TOTALNUM,	147225,	141759,	94528,	117512,	81803,	54202,	84941,	91312,	97679,	73545,
TONSLAND,	175516,	168034,	156936,	158786,	107183,	70458,	92391,	114242,	122310,	95848,
SOPCOF %,	100,	98,	101,	100,	99,	99,	102,	99,	99,	100,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	6135,	14333,	3379,	1432,	70,	961,	326,	35,	91,	1182,
3,	73878,	49750,	26933,	9369,	16402,	10225,	14827,	3100,	9644,	9235,
4,	11619,	26640,	63451,	38499,	48351,	57448,	13295,	16261,	12220,	22625,
5,	5395,	4865,	26254,	48587,	37268,	18667,	43309,	11981,	22804,	7997,
6,	5066,	5594,	3427,	17617,	32240,	17805,	13029,	31918,	10321,	11352,
7,	2988,	4850,	1636,	1772,	4842,	17861,	11219,	8405,	18932,	5968,
8,	2009,	3353,	1263,	517,	572,	2765,	5837,	5556,	3384,	7964,
9,	272,	1480,	950,	305,	139,	485,	755,	2881,	3335,	2381,
10,	81,	291,	650,	275,	280,	202,	63,	731,	2293,	2562,
+gp,	132,	267,	106,	697,	305,	443,	160,	397,	589,	1216,
0 TOTALNUM,	107575,	111423,	128049,	119070,	140469,	126862,	102820,	81265,	83613,	72482,
TONSLAND,	107326,	127516,	153584,	146544,	168174,	171498,	143760,	153822,	150274,	134723,
SOPCOF %,	99,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

Table 5.4 Catch weights at age.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Table 2 Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE											
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,
3,	.7100,	.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,	1.1100,
5,	1.6300,	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,	2.3300,
7,	3.1600,	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,	4.0300,
9,	4.8700,	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,	5.6300,
+gp,	8.0300,	8.0390,	7.9240,	7.8510,	7.7810,	7.9590,	8.1060,	7.9940,	7.7160,	7.4790,	7.4040,
0 SOPCOFAC,	1.2559,	1.3848,	1.2272,	1.2075,	1.1644,	1.0782,	1.1067,	.9475,	1.1662,	.9734,	.9741,

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Table 2 Catch weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.4500,
3,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7900,
4,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.2700,
5,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	2.0300,
6,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.5500,
7,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.2900,
8,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.3400,
9,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	5.1500,
10,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.7500,
+gp,	7.0520,	7.4770,	7.3850,	7.2170,	7.1270,	7.3200,	7.3940,	7.5270,	7.8090,	6.9370,
0 SOPCOFAC,	.7841,	.8362,	.8099,	1.0131,	1.0155,	1.0020,	1.0062,	1.0278,	1.1384,	.9355,

Table 2 Catch weights at age (kg)

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
2,	.4300,	.5100,	.6000,	.5300,	.3800,	.3200,	.3400,	.3300,	.4500,	.5400,
3,	.7300,	.7700,	1.0500,	.7100,	.7500,	.5900,	.5300,	.6200,	.7400,	.7600,
4,	1.4000,	1.1200,	1.3300,	1.2600,	1.3300,	1.2200,	.8400,	.8700,	.9700,	1.0800,
5,	2.0500,	2.0200,	1.8600,	2.0200,	2.0700,	1.9700,	1.6600,	1.3100,	1.3900,	1.5600,
6,	2.7600,	2.6100,	2.8000,	2.7000,	2.6300,	2.3000,	2.3200,	2.4300,	1.8100,	2.1200,
7,	3.3000,	3.2700,	4.0000,	3.8800,	3.2800,	2.8700,	2.9700,	3.8700,	3.0200,	2.4000,
8,	4.3800,	3.9100,	4.1800,	4.4700,	3.9600,	3.7200,	4.0000,	5.3800,	3.7600,	3.6500,
9,	5.9500,	4.6900,	5.3300,	5.3600,	4.5400,	4.3000,	4.7200,	5.8300,	4.6400,	3.6000,
10,	6.3900,	5.6300,	5.6800,	6.0600,	5.5500,	4.6900,	5.4400,	5.3600,	4.7500,	6.3700,
+gp,	6.8410,	7.5580,	8.6650,	7.1900,	8.0120,	6.5970,	6.9040,	7.4480,	7.5000,	4.7950,
0 SOPCOFAC,	.9975,	.9794,	1.0089,	.9997,	.9933,	.9929,	1.0233,	.9879,	.9949,	1.0049,

Table 2 Catch weights at age (kg)

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	.4000,	.4500,	.4600,	.3500,	.5000,	.4000,	.3800,	.3500,	.6400,	.3700,
3,	.7200,	.7000,	.6300,	.5200,	.5600,	.5900,	.6200,	.6800,	.6700,	.6100,
4,	1.1900,	1.1000,	1.0200,	.7400,	.7800,	.8200,	.9200,	1.0000,	1.0500,	1.0200,
5,	1.7800,	1.9800,	1.7000,	1.2200,	1.2100,	1.3200,	1.1900,	1.4800,	1.4500,	1.6100,
6,	2.2400,	2.3400,	2.5000,	2.1600,	1.7400,	1.8300,	1.6600,	1.8700,	1.9300,	2.1200,
7,	2.8600,	2.8100,	2.8800,	3.1900,	2.8000,	2.4700,	2.3100,	2.5800,	2.2800,	2.6600,
8,	3.3200,	3.2500,	3.0900,	3.9700,	3.7400,	3.7200,	3.1000,	3.0700,	2.9700,	3.2100,
9,	4.5300,	4.0600,	3.7000,	4.6200,	4.4000,	4.4900,	4.3400,	4.1200,	3.6000,	3.7400,
10,	5.7000,	6.1900,	6.1900,	5.2800,	5.2800,	5.3000,	6.0400,	5.4500,	4.1100,	4.3400,
+gp,	7.1250,	7.3760,	8.1750,	6.0720,	7.4510,	7.0160,	7.6200,	8.0520,	5.5130,	5.9810,
0 SOPCOFAC,	.9912,	.9993,	1.0008,	1.0038,	.9999,	.9999,	1.0011,	1.0015,	1.0003,	.9992,

1

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Table 5.5 Tuning data.

North-East Arctic saithe (Sub-areas I and II) (run name: XSAKHN09)
103
FLT08: Norway Purse Seine reviced 2000 (Catch: Unknown) (Effort: Unknown)
1989 2000
1 1 0.00 1.00
3 7

119	5250	8521	18211	2880	24
56	7207	3319	2582	1845	673
99	43110	1907	453	162	95
89	29527	5214	89	45	38
72	8010	24251	1302	39	23
79	6365	16182	8997	1151	90
52	5524	13357	4368	1335	105
82	4053	36274	6022	2610	589
92	9665	6691	18403	1852	1329
130	1994	9690	5302	10330	1226
133	6420	5990	10422	2275	2749
126	8000	13535	1312	1246	281

FLT09: Norway Ac Survey extended 2000 (Catch: Unknown) (Effort: Unknown)
1988 2000
1 1 0.75 0.85
2 6

1	15.7	22.5	19.0	7.1	0.6
1	24.8	28.4	17.0	10.1	12.4
1	99.6	31.9	14.7	5.1	7.4
1	87.8	104.0	4.6	4.0	7.1
1	163.5	273.6	57.5	6.2	8.8
1	106.9	227.7	103.9	12.7	3.2
1	34.4	87.8	112.4	39.5	10.0
1	38.7	165.2	87.0	46.8	20.0
1	37.0	118.9	214.7	32.1	19.3
1	5.1	36.7	185.8	79.8	61.7
1	43.6	96.5	200.6	70.0	96.7
1	61.1	233.8	72.9	62.2	47.8
1	164.8	142.5	176.3	11.6	26.5

FLT10: Nor new trawl revised 2001 (Catch: Unknown) (Effort: Unknown)
1994 2000
1 1 0.00 1.00
5 9

1	3623	3008	495	242	49
1	2239	5419	728	92	0
1	1361	4698	1897	118	14
1	2988	2450	2900	1199	57
1	497	2582	919	653	396
1	1650	812	1725	401	190
1	644	1376	720	1350	718

Table 5.6 Tuning diagnostics.

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Arctic Saithe (run: XSAKHN09/X09)

CPUE data from file fleet

Catch data for 41 years. 1960 to 2000. Ages 2 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT08: Norway Purse ,	1989,	2000,	3,	7,	.000,	1.000
FLT09: Norway Ac Sur,	1988,	2000,	2,	6,	.750,	.850
FLT10: Nor new trawl,	1994,	2000,	5,	9,	.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 37 iterations

1

Regression weights

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

Fishing mortalities

Age,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000
2,	.014,	.047,	.016,	.004,	.001,	.006,	.005,	.000,	.001,	.002
3,	.442,	.153,	.118,	.056,	.053,	.114,	.119,	.055,	.070,	.067
4,	.507,	.281,	.297,	.246,	.447,	.268,	.212,	.185,	.315,	.234
5,	.374,	.412,	.496,	.392,	.400,	.309,	.332,	.301,	.426,	.351
6,	.407,	.855,	.577,	.746,	.492,	.338,	.369,	.438,	.461,	.391
7,	.366,	.884,	.659,	.679,	.466,	.562,	.370,	.433,	.509,	.534
8,	.413,	.932,	.601,	.446,	.484,	.534,	.358,	.316,	.310,	.416
9,	.345,	.618,	.761,	.279,	.204,	1.033,	.268,	.300,	.318,	.374
10,	.384,	.772,	.613,	.516,	.447,	.514,	.339,	.453,	.416,	.432

Table 5.6 (Continued)

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XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9	10
1991	4.81E+05	2.28E+05	3.23E+04	1.91E+04	1.68E+04	1.08E+04	6.56E+03	1.03E+03	2.81E+02
1992	3.43E+05	3.88E+05	1.20E+05	1.59E+04	1.08E+04	9.13E+03	6.11E+03	3.55E+03	5.98E+02
1993	2.38E+05	2.68E+05	2.73E+05	7.42E+04	8.64E+03	3.75E+03	3.09E+03	1.97E+03	1.57E+03
1994	4.27E+05	1.91E+05	1.95E+05	1.66E+05	3.70E+04	3.97E+03	1.59E+03	1.39E+03	7.54E+02
1995	1.29E+05	3.48E+05	1.48E+05	1.25E+05	9.17E+04	1.44E+04	1.65E+03	8.32E+02	8.59E+02
1996	1.80E+05	1.05E+05	2.70E+05	7.77E+04	6.86E+04	4.59E+04	7.38E+03	8.32E+02	5.56E+02
1997	7.91E+04	1.47E+05	7.69E+04	1.69E+05	4.67E+04	4.01E+04	2.14E+04	3.54E+03	2.42E+02
1998	1.92E+05	6.44E+04	1.07E+05	5.10E+04	9.94E+04	2.64E+04	2.27E+04	1.23E+04	2.22E+03
1999	1.93E+05	1.57E+05	5.00E+04	7.26E+04	3.09E+04	5.25E+04	1.40E+04	1.35E+04	7.44E+03
2000	6.11E+05	1.58E+05	1.20E+05	2.98E+04	3.88E+04	1.59E+04	2.58E+04	8.44E+03	8.06E+03

Estimated population abundance at 1st Jan 2001

	0.00E+00	4.99E+05	1.21E+05	7.77E+04	1.72E+04	2.15E+04	7.66E+03	1.40E+04	4.75E+03

Taper weighted geometric mean of the VPA populations:

	2.11E+05	1.51E+05	1.02E+05	5.60E+04	3.04E+04	1.35E+04	5.66E+03	2.29E+03	9.76E+02

Standard error of the weighted Log(VPA populations) :

	.6548	.6038	.6985	.8038	.8338	.9444	1.0927	1.1095	1.1553

1

Log catchability residuals.

Fleet : FLT08: Norway Purse

Age	1988	1989	1990
2	No data for this fleet at this age		
3	99.99	.37	1.50
4	99.99	.26	.52
5	99.99	1.58	.95
6	99.99	.75	1.57
7	99.99	-1.52	1.50
8	No data for this fleet at this age		
9	No data for this fleet at this age		

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2	No data for this fleet at this age									
3	1.41	.48	-.26	-.28	-.60	-.14	.28	-.85	-.59	-.32
4	-.43	-.74	.20	.01	.61	.47	-.11	-.42	-.11	-.15
5	-.91	-2.23	-.84	.15	.13	.43	.67	.26	.62	-.54
6	-1.18	-1.72	-1.55	.36	-.09	.35	.29	.94	.58	-.23
7	-.76	-1.18	-.67	.55	-.26	-.11	.64	.66	.79	-.23
8	No data for this fleet at this age									
9	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	-7.3700	-6.6578	-7.1549	-7.7669	-8.2977
S.E(Log q)	.7240	.4127	.9592	.9784	.8368

Table 5.6 (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
3,	1.06,	-.147,	7.09,	.40,	12,	.81,	-7.37,
4,	.86,	.833,	7.34,	.81,	12,	.36,	-6.66,
5,	.59,	2.074,	8.75,	.75,	12,	.49,	-7.15,
6,	.54,	2.691,	9.00,	.80,	12,	.41,	-7.77,
7,	.69,	1.677,	8.71,	.78,	12,	.53,	-8.30,

1

Fleet : FLT09: Norway Ac Sur

Age	1988	1989	1990
2	-.08,	.32,	.44
3	-.90,	-.25,	-.01
4	-1.38,	-.76,	-.44
5	-1.33,	-.47,	-.74
6	-2.15,	-.31,	-.37
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		

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2	-.21,	.78,	.69,	-1.04,	.28,	-.10,	-1.26,	.00,	.33,	.17
3	-.14,	.07,	.22,	-.44,	-.41,	.51,	-1.00,	.74,	.75,	.25
4	-1.42,	-.39,	-.61,	-.24,	-.06,	.10,	1.17,	.90,	.75,	.69
5	-.54,	.11,	-.64,	-.39,	.06,	.09,	.24,	1.29,	.91,	.06
6	-.21,	.81,	-.21,	-.39,	-.81,	-.67,	.90,	.65,	1.13,	.26
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									

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,	-8.2274,	-7.0413,	-6.8670,	-7.4753,	-7.0722,
S.E(Log q),	.6254,	.5675,	.8132,	.6807,	.8202,

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,	.85,	.592,	8.85,	.62,	13,	.55,	-8.23,
3,	1.19,	-.541,	6.10,	.47,	13,	.70,	-7.04,
4,	.94,	.167,	7.16,	.45,	13,	.80,	-6.87,
5,	.97,	.097,	7.57,	.58,	13,	.70,	-7.48,
6,	.94,	.199,	7.28,	.52,	13,	.81,	-7.07,

1

Table 5.6 (Continued)

```
 Fleet : FLT10: Nor new trawl

  Age  ,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999,  2000
     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 , 99.99, 99.99, 99.99,   .22,   .02,  -.04,  -.02,  -.63,   .27,   .19
     6 , 99.99, 99.99, 99.99,   .71,   .28,   .36,   .11,  -.56,  -.54,  -.27
     7 , 99.99, 99.99, 99.99,   .97,  -.03,  -.19,   .29,  -.42,  -.44,  -.11
     8 , 99.99, 99.99, 99.99,  1.27,   .28,  -.95,   .23,  -.46,  -.47,   .19
     9 , 99.99, 99.99, 99.99,  -.27, 99.99,  -.69, -1.06,  -.35, -1.17,   .65


 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
 Mean Log q,   -3.7612,   -2.7840,   -2.6421,   -2.8446,   -2.8446,
 S.E(Log q),     .3075,     .4832,     .4824,     .7102,     .8544,



 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,     .92,     .414,      4.38,     .84,      7,     .30,   -3.76,
  6,     .99,     .024,      2.87,     .49,      7,     .52,   -2.78,
  7,    1.69,   -2.548,     -2.46,     .74,      7,     .59,   -2.64,
  8,    1.43,   -1.298,       .17,     .66,      7,     .96,   -2.84,
  9,     .95,     .168,      3.56,     .77,      6,     .72,   -3.33,
1

 Terminal year survivor and F summaries :

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

 Year class = 1998

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT08: Norway Purse ,        1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT09: Norway Ac Sur,   592255.,   .653,       .000,    .00,   1,  .369,     .002
 FLT10: Nor new trawl,        1.,   .000,       .000,    .00,   0,  .000,     .000

   F shrinkage mean  ,   451696.,    .50,,,,                         .631,     .002

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    499185.,       .40,      .22,    2,    .542,   .002


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

 Year class = 1997

 Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT08: Norway Purse ,    87946.,   .758,       .000,    .00,   1,  .155,     .091
 FLT09: Norway Ac Sur,   160476.,   .439,       .043,    .10,   2,  .463,     .051
 FLT10: Nor new trawl,        1.,   .000,       .000,    .00,   0,  .000,     .000

   F shrinkage mean  ,    97390.,    .50,,,,                         .382,     .082

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    120793.,       .30,      .17,    4,    .570,   .067
```

Table 5.6 (Continued)

1

Age 4 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
FLT08: Norway Purse ,	60399.,	.375,	.184,	.49,	2,	.383,	.292
FLT09: Norway Ac Sur,	124610.,	.390,	.247,	.63,	3,	.341,	.152
FLT10: Nor new trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	61620.,	.50,,,,				.277,	.287

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
77724.,	.24,	.19,	6,	.786,	.234

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT08: Norway Purse ,	12442.,	.354,	.215,	.61,	3,	.221,	.458
FLT09: Norway Ac Sur,	18084.,	.347,	.460,	1.33,	4,	.238,	.337
FLT10: Nor new trawl,	20758.,	.329,	.000,	.00,	1,	.335,	.299
F shrinkage mean ,	16930.,	.50,,,,				.206,	.356

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17198.,	.19,	.16,	9,	.851,	.351

1

Age 6 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
FLT08: Norway Purse ,	18491.,	.343,	.218,	.64,	4,	.199,	.442
FLT09: Norway Ac Sur,	24387.,	.332,	.360,	1.08,	5,	.218,	.352
FLT10: Nor new trawl,	22916.,	.284,	.267,	.94,	2,	.363,	.370
F shrinkage mean ,	19538.,	.50,,,,				.220,	.422

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
21492.,	.18,	.13,	12,	.707,	.391

Age 7 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
FLT08: Norway Purse ,	7460.,	.341,	.131,	.38,	5,	.189,	.545
FLT09: Norway Ac Sur,	18161.,	.330,	.202,	.61,	5,	.152,	.260
FLT10: Nor new trawl,	5017.,	.259,	.167,	.65,	3,	.398,	.731
F shrinkage mean ,	8969.,	.50,,,,				.261,	.471

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7657.,	.19,	.14,	14,	.756,	.534

Table 5.6 (Continued)

```
1
 Age  8   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
 FLT08: Norway Purse ,     23253.,   .347,       .219,    .63,   5,  .149,     .270
 FLT09: Norway Ac Sur,     12969.,   .335,       .292,    .87,   5,  .122,     .442
 FLT10: Nor new trawl,     11500.,   .262,       .166,    .63,   4,  .414,     .487

   F shrinkage mean  ,     14520.,    .50,,,,                        .315,     .403

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     13952.,       .20,      .11,   15,    .529,   .416


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

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT08: Norway Purse ,      7548.,   .357,       .143,    .40,   5,  .126,     .251
 FLT09: Norway Ac Sur,      6159.,   .348,       .253,    .73,   5,  .103,     .300
 FLT10: Nor new trawl,      4436.,   .259,       .187,    .72,   5,  .437,     .396

   F shrinkage mean  ,      4035.,    .50,,,,                        .334,     .428

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4753.,       .21,      .10,   16,    .476,   .374


1
 Age 10   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
 FLT08: Norway Purse ,      5295.,   .354,       .152,    .43,   5,  .117,     .363
 FLT09: Norway Ac Sur,      4244.,   .352,       .240,    .68,   5,  .093,     .436
 FLT10: Nor new trawl,      3819.,   .259,       .260,   1.00,   5,  .377,     .474

   F shrinkage mean  ,      4493.,    .50,,,,                        .413,     .416

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4285.,       .23,      .10,   16,    .422,   .432


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```

Table 5.7 Fishing mortality (F) at age.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

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	1970
AGE											
2	.0694	.0259	.0039	.0259	.0628	.1742	.0347	.0409	.0160	.0131	.0785
3	.1412	.2383	.2772	.1747	.1080	.1562	.1876	.1886	.2041	.3402	.1880
4	.1843	.1755	.2297	.3606	.4012	.0805	.3616	.3278	.1709	.1406	.5146
5	.5007	.2695	.1204	.1825	.2760	.3093	.3131	.4319	.1024	.2354	.2432
6	.2407	.2519	.2882	.1797	.1198	.3557	.2447	.1522	.1649	.1307	.3709
7	.3847	.0915	.2530	.2108	.1978	.1786	.2736	.1595	.0391	.1356	.2034
8	.4184	.1206	.0942	.1734	.2195	.1772	.1219	.2757	.0747	.0721	.3480
9	.3585	.1479	.1645	.1355	.3055	.3690	.1106	.1777	.1274	.0885	.2271
10	.3832	.1770	.1849	.1771	.2248	.2795	.2138	.2406	.1020	.1330	.2800
+gp	.3832	.1770	.1849	.1771	.2248	.2795	.2138	.2406	.1020	.1330	.2800
0 FBAR 3- 6	.2667	.2338	.2289	.2244	.2262	.2254	.2767	.2751	.1606	.2117	.3292

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE										
2	.1052	.0472	.1396	.1204	.2763	.2181	.2178	.1964	.2067	.0582
3	.3511	.5893	.4905	.6669	.5962	.9054	.7860	.6157	.4446	.5172
4	.4216	.4299	.4766	.5911	.4590	.6942	.6807	.5240	.6834	.5183
5	.4348	.3782	.4110	.6231	.4556	.6609	.5207	.5675	.5606	.6404
6	.2610	.2894	.3693	.6370	.3552	.4704	.3522	.4670	.3990	.5356
7	.3929	.2409	.3373	.5334	.5379	.5163	.4538	.4574	.6257	.5720
8	.1697	.2451	.2654	.4017	.6560	.4431	.4306	.3556	.6249	.6730
9	.3262	.1569	.3210	.3673	.4563	.5920	.4163	.5508	.4824	.1765
10	.3188	.2635	.3429	.5166	.4960	.5409	.4378	.4833	.5429	.5237
+gp	.3188	.2635	.3429	.5166	.4960	.5409	.4378	.4833	.5429	.5237
0 FBAR 3- 6	.3671	.4217	.4369	.6295	.4665	.6827	.5849	.5435	.5219	.5529

Table 8 Fishing mortality (F) at age

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE										
2	.0788	.1461	.1145	.1250	.0091	.0181	.0422	.0725	.1494	.0447
3	.4112	.4041	.2136	.7504	.7853	.1175	.1280	.1172	.2570	.4627
4	.5843	.6567	.5383	.8221	.5013	.4847	.4204	.4074	.4654	.4933
5	.6681	.8679	.8439	.5835	.4109	.5149	.2961	.5455	.8195	.3960
6	.5631	.5849	.5394	.8089	.5506	.4955	.5500	.5841	.7055	.5704
7	.4246	.3133	.4394	.3671	.7089	.6474	.9266	1.1047	.5311	.7263
8	.8954	.3812	.6969	.5059	.4618	.6375	.3558	1.0526	.5095	.6873
9	.3907	.5211	.4220	.8806	.5083	.3926	.6591	1.1018	.4415	.4027
10	.5934	.5380	.5934	.6348	.5324	.5420	.5622	.8871	.6067	.5612
+gp	.5934	.5380	.5934	.6348	.5324	.5420	.5622	.8871	.6067	.5612
0 FBAR 3- 6	.5567	.6284	.5338	.7412	.5620	.4031	.3486	.4135	.5619	.4806

Table 8 Fishing mortality (F) at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	FBAR 98-**
AGE											
2	.0142	.0472	.0158	.0037	.0006	.0059	.0046	.0002	[.0005]	[.0021]	[.0010]
3	.4425	.1529	.1176	.0556	.0535	.1136	.1185	.0546	.0702	[.0669]	[.0639]
4	.5069	.2812	.2974	.2458	.4468	.2678	.2119	.1846	.3152	.2338	.2445
5	.3741	.4118	.4957	.3915	.3996	.3087	.3324	.3009	.4265	.3512	.3595
6	.4067	.8546	.5770	.7463	.4917	.3378	.3687	.4384	.4610	.3906	.4300
7	.3662	.8841	.6586	.6794	.4658	.5617	.3700	.4328	.5086	.5337	.4917
8	.4135	.9318	.6013	.4459	.4837	.5342	.3578	.3158	.3096	.4164	.3473
9	.3448	.6175	.7606	.2786	.2040	1.0335	.2685	.3003	.3178	.3738	.3306
10	.3836	.7721	.6130	.5157	.4468	.5136	.3387	.4529	.4162	.4324	.4338
+gp	.3836	.7721	.6130	.5157	.4468	.5136	.3387	.4529	.4162	.4324	
0 FBAR 3- 6	.4325	.4251	.3719	.3598	.3479	.2570	.2579	.2446	.3182	[.2606]	

1

Table 5.8 Stock number at age.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

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,	1970,
AGE											
2,	121650,	213269,	355505,	121815,	368899,	210354,	241202,	191872,	367843,	347431,	379815,
3,	88173,	92920,	170143,	289935,	97186,	283654,	144689,	190738,	150801,	296372,	280751,
4,	85921,	62681,	59948,	105582,	199330,	71425,	198653,	98200,	129322,	100667,	172675,
5,	38001,	58508,	43057,	39010,	60271,	109269,	53953,	113296,	57927,	89246,	71608,
6,	26165,	18857,	36586,	31252,	26611,	37443,	65664,	32298,	60225,	42811,	57741,
7,	16897,	16840,	12001,	22453,	21379,	19328,	21479,	42090,	22711,	41814,	30755,
8,	7761,	9416,	12582,	7630,	14890,	14362,	13236,	13376,	29379,	17882,	29893,
9,	4823,	4181,	6833,	9375,	5252,	9788,	9850,	9593,	8313,	22322,	13622,
10,	2580,	2759,	2953,	4746,	6703,	3168,	5541,	7220,	6576,	5992,	16728,
+gp,	5253,	8334,	11260,	12044,	19432,	16183,	16565,	17951,	13243,	4518,	12585,
0 TOTAL,	397223,	487765,	710869,	643841,	819953,	774974,	770831,	716635,	846340,	969055,	1066173,

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
2,	219524,	278465,	117299,	206220,	373549,	305466,	178776,	283591,	167693,	356254,
3,	287484,	161778,	217485,	83523,	149693,	232001,	201096,	117721,	190781,	111658,
4,	190463,	165683,	73477,	109026,	35101,	67515,	76814,	75020,	52073,	100132,
5,	84509,	102299,	88246,	37350,	49426,	18160,	27610,	31839,	36371,	21525,
6,	45971,	44795,	57383,	47900,	16400,	25658,	7677,	13430,	14779,	17000,
7,	32626,	28992,	27458,	32476,	20741,	9413,	13124,	4420,	6893,	8118,
8,	20546,	18033,	18655,	16044,	15597,	9916,	4599,	6825,	2290,	3019,
9,	17281,	14197,	11554,	11713,	8790,	6627,	5212,	2448,	3916,	1004,
10,	8887,	10210,	9936,	6862,	6642,	4560,	3002,	2814,	1155,	1979,
+gp,	22073,	14934,	14828,	10361,	11585,	7538,	3503,	6140,	3111,	4371,
0 TOTAL,	929364,	839385,	636320,	561474,	687525,	686854,	521415,	544249,	479063,	625061,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
2,	152598,	140068,	118912,	137543,	271686,	204400,	103478,	79261,	88859,	291666,
3,	275185,	115466,	99092,	86827,	99379,	220433,	164353,	81222,	60354,	62656,
4,	54504,	149338,	63108,	65527,	33568,	37102,	160465,	118392,	59146,	38213,
5,	48824,	24879,	63406,	30162,	23578,	16648,	18709,	86290,	64496,	30405,
6,	9289,	20495,	8552,	22324,	13779,	12799,	8145,	11392,	40945,	23268,
7,	8146,	4331,	9349,	4083,	8140,	6504,	6385,	3848,	5201,	16557,
8,	3751,	4362,	2592,	4933,	2316,	3280,	2787,	2070,	1044,	2503,
9,	1261,	1254,	2440,	1057,	2435,	1195,	1420,	1599,	591,	513,
10,	689,	699,	610,	1310,	359,	1199,	660,	601,	435,	311,
+gp,	1535,	1177,	1855,	2084,	1857,	745,	2026,	189,	358,	644,
0 TOTAL,	555783,	462068,	369915,	355849,	457096,	504306,	468428,	384863,	321428,	466737,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	GMST 60-98	AMST 60-98
AGE													
2,	480544,	343495,	237615,	426830,	128661,	180151,	79070,	191980,	[192767],	[611013],	[0],	207775,	232393,
3,	228351,	387885,	268261,	191485,	348163,	105275,	146625,	64442,	157148,	[157742],	[499185],	155106,	175488,
4,	32295,	120111,	272558,	195263,	148297,	270211,	76940,	106631,	49956,	119936,	[120793],	92449,	108497,
5,	19105,	15928,	74233,	165739,	125033,	77666,	169249,	50963,	72588,	29843,	77724,	49087,	59918,
6,	16754,	10760,	8638,	37022,	91732,	68647,	46697,	99382,	30884,	38796,	17198,	25748,	32750,
7,	10769,	9133,	3748,	3972,	14370,	45932,	40093,	26443,	52486,	15947,	21492,	13307,	17411,
8,	6556,	6113,	3089,	1588,	1648,	7384,	21444,	22674,	14044,	25842,	7657,	6868,	9899,
9,	1031,	3550,	1971,	1386,	832,	832,	3544,	12276,	13536,	8437,	13952,	3575,	5792,
10,	281,	598,	1567,	754,	859,	556,	242,	2218,	7444,	8065,	4753,	1910,	3461,
+gp,	454,	541,	253,	1893,	927,	1207,	611,	1194,	1896,	3794,	6301,		
0 TOTAL,	796140,	898113,	871933,	1025932,	860523,	757859,	584515,	578202,	[592750],	[1019415],	[769055],		

Table 5.9 Stock biomass at age with SOP.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

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,	1970,
AGE											
2,	51945,	100417,	148339,	50009,	146041,	77115,	90761,	61809,	145857,	114986,	125791,
3,	78624,	91362,	148254,	248558,	80344,	217148,	113693,	128310,	124867,	204829,	194168,
4,	119778,	96352,	81665,	141508,	257623,	85484,	244038,	103276,	167410,	108770,	186702,
5,	77793,	132069,	86132,	76777,	114389,	192041,	97329,	174971,	110117,	141603,	113696,
6,	76565,	60845,	104618,	87923,	72195,	94067,	169327,	71300,	163650,	97098,	131050,
7,	67059,	73693,	46542,	85671,	78663,	65854,	75118,	126017,	83696,	128619,	94669,
8,	39279,	52549,	62229,	37126,	69868,	62408,	59032,	51074,	138078,	70148,	117347,
9,	29501,	28199,	40840,	55127,	29783,	51397,	53087,	44264,	47214,	105820,	64618,
10,	18241,	21512,	20402,	32262,	43939,	19232,	34525,	38513,	43175,	32837,	91737,
+gp,	52973,	92783,	109503,	114172,	176053,	138875,	148606,	135959,	119172,	32895,	90764,
0 TOTALBIO,	611759,	749781,	848524,	929133,	1068897,	1003621,	1085517,	935494,	1143234,	1037604,	1210542,

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
2,	58523,	79166,	32299,	71031,	128978,	104063,	61158,	99100,	64907,	149972,
3,	160042,	96042,	125058,	60076,	107932,	165046,	143657,	85904,	154203,	82519,
4,	165767,	153775,	66054,	122600,	39567,	75090,	85788,	85586,	65801,	118963,
5,	108007,	139427,	116494,	61677,	81814,	29659,	45282,	53339,	67491,	40877,
6,	83986,	87271,	108284,	113064,	38805,	59901,	17998,	32162,	39201,	40553,
7,	80838,	76603,	70272,	103965,	66559,	29805,	41726,	14355,	24798,	24987,
8,	64922,	60765,	60886,	65501,	63832,	40041,	18648,	28269,	10508,	12257,
9,	65987,	57810,	45572,	57786,	43474,	32337,	25541,	12252,	21709,	4837,
10,	39229,	48066,	45303,	39139,	37972,	25725,	17003,	16285,	7405,	10645,
+gp,	122048,	93367,	88688,	75752,	83851,	55285,	26062,	47501,	27658,	28364,
0 TOTALBIO,	949348,	892291,	758910,	770592,	692785,	616953,	482863,	474754,	483682,	513974,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
2,	65455,	69963,	71985,	72875,	102552,	64943,	36001,	25840,	39782,	158267,
3,	200389,	87077,	104976,	61627,	74037,	129131,	89133,	49749,	44434,	47851,
4,	76117,	163812,	84683,	82537,	45348,	44943,	137926,	101757,	57079,	41472,
5,	99843,	49220,	118988,	60908,	48950,	32564,	31780,	111674,	89191,	47663,
6,	25574,	52389,	24159,	60256,	35996,	29229,	19337,	27347,	73732,	49569,
7,	26817,	13869,	37730,	15836,	26520,	18535,	19404,	14710,	15626,	39929,
8,	16391,	16706,	10931,	22041,	9132,	12115,	11408,	11000,	3883,	9182,
9,	7484,	5762,	13120,	5664,	10957,	5100,	6856,	9209,	2730,	1857,
10,	4391,	3852,	3495,	7935,	1974,	5584,	3677,	3184,	2055,	1993,
+gp,	10478,	8716,	16220,	14978,	15109,	4879,	14312,	1388,	2670,	3103,
0 TOTALBIO,	532940,	471365,	486288,	404658,	370574,	347025,	369835,	355858,	331182,	400886,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	190535,	154463,	109390,	149958,	64326,	72056,	30080,	67294,	[123408],	[225902],
3,	162974,	271327,	169140,	99950,	194958,	62109,	91008,	43886,	105321,	[96149],
4,	38095,	132028,	278232,	145044,	115664,	221561,	70863,	106790,	52469,	122241,
5,	33709,	31514,	126298,	202969,	151280,	102513,	201629,	75539,	105284,	48011,
6,	37199,	25160,	21613,	80270,	159603,	125617,	77602,	186122,	59625,	82185,
7,	30530,	25645,	10802,	12718,	40234,	113446,	92717,	68325,	119704,	42387,
8,	21577,	19854,	9552,	6329,	6164,	27467,	66552,	69712,	41724,	82888,
9,	4628,	14403,	7300,	6428,	3663,	3736,	15397,	50652,	48746,	31529,
10,	1588,	3698,	9710,	3998,	4534,	2946,	1465,	12107,	30603,	34975,
+gp,	3208,	3985,	2067,	11535,	6907,	8465,	4661,	9626,	10454,	22676,
0 TOTALBIO,	524043,	682077,	744105,	719198,	747334,	739916,	651974,	690053,	[697339],	[788945],

1

Table 5.10. Spawning stock biomass with SOP.

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

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,	1970,
AGE											
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1198,	964,	817,	1415,	2576,	855,	2440,	1033,	1674,	1088,	1867,
5,	42786,	72638,	47373,	42227,	62914,	105622,	53531,	96234,	60564,	77881,	62533,
6,	65081,	51718,	88925,	74734,	61365,	79957,	143928,	60605,	139102,	82533,	111393,
7,	65718,	72219,	45611,	83958,	77090,	64536,	73615,	123497,	82022,	126047,	92775,
8,	39279,	52549,	62229,	37126,	69868,	62408,	59032,	51074,	138078,	70148,	117347,
9,	29501,	28199,	40840,	55127,	29783,	51397,	53087,	44264,	47214,	105820,	64618,
10,	18241,	21512,	20402,	32262,	43939,	19232,	34525,	38513,	43175,	32837,	91737,
+gp,	52973,	92783,	109503,	114172,	176053,	138875,	148606,	135959,	119172,	32895,	90764,
0 TOTSPBIO,	314777,	392583,	415700,	441021,	523587,	522884,	568765,	551179,	631001,	529248,	633034,

Run title : Arctic Saithe (run: XSAKHN09/X09)

At 2/05/2001 16:13

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1658,	1538,	661,	1226,	396,	751,	858,	856,	658,	1190,
5,	59404,	76685,	64072,	33922,	44998,	16313,	24905,	29337,	37120,	22483,
6,	71388,	74180,	92041,	96105,	32985,	50915,	15299,	27338,	33320,	34470,
7,	79221,	75071,	68866,	101886,	65227,	29209,	40892,	14068,	24302,	24487,
8,	64922,	60765,	60886,	65501,	63832,	40041,	18648,	28269,	10508,	12257,
9,	65987,	57810,	45572,	57786,	43474,	32337,	25541,	12252,	21709,	4837,
10,	39229,	48066,	45303,	39139,	37972,	25725,	17003,	16285,	7405,	10645,
+gp,	122048,	93367,	88688,	75752,	83851,	55285,	26062,	47501,	27658,	28364,
0 TOTSPBIO,	503856,	487481,	466089,	471317,	372735,	250577,	169207,	175906,	162681,	138732,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	761,	1638,	847,	825,	453,	449,	1379,	1018,	571,	415,
5,	54913,	27071,	65444,	33499,	26922,	17910,	17479,	61421,	49055,	26215,
6,	21738,	44530,	20535,	51218,	30597,	24845,	16436,	23245,	62672,	42133,
7,	26281,	13592,	36975,	15519,	25989,	18164,	19016,	14416,	15313,	39131,
8,	16391,	16706,	10931,	22041,	9132,	12115,	11408,	11000,	3883,	9182,
9,	7484,	5762,	13120,	5664,	10957,	5100,	6856,	9209,	2730,	1857,
10,	4391,	3852,	3495,	7935,	1974,	5584,	3677,	3184,	2055,	1993,
+gp,	10478,	8716,	16220,	14978,	15109,	4879,	14312,	1388,	2670,	3103,
0 TOTSPBIO,	142438,	121867,	167567,	151680,	121134,	89047,	90564,	124879,	138950,	124028,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	381,	1320,	2782,	1450,	1157,	2216,	709,	1068,	525,	1222,
5,	18540,	17333,	69464,	111633,	83204,	56382,	110896,	41546,	57906,	26406,
6,	31620,	21386,	18371,	68230,	135663,	106775,	65962,	158204,	50681,	69857,
7,	29919,	25132,	10586,	12463,	39429,	111177,	90862,	66958,	117310,	41539,
8,	21577,	19854,	9552,	6329,	6164,	27467,	66552,	69712,	41724,	82888,
9,	4628,	14403,	7300,	6428,	3663,	3736,	15397,	50652,	48746,	31529,
10,	1588,	3698,	9710,	3998,	4534,	2946,	1465,	12107,	30603,	34975,
+gp,	3208,	3985,	2067,	11535,	6907,	8465,	4661,	9626,	10454,	22676,
0 TOTSPBIO,	111461,	107112,	129833,	222066,	280721,	319163,	356503,	409873,	357950,	311094,

Table 5.11 Summary (with SOP correction)

Run title : Arctic Saithe (run: XSAKHN09/X09) ,

At 2/05/2001 16:13

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 3- 6,
1960,	121650,	611759,	314777,	133515,	.4242,	1.2559,	.2667,
1961,	213269,	749781,	392583,	105951,	.2699,	1.3848,	.2338,
1962,	355505,	848524,	415700,	120707,	.2904,	1.2272,	.2289,
1963,	121815,	929133,	441021,	148627,	.3370,	1.2075,	.2244,
1964,	368899,	1068897,	523587,	197426,	.3771,	1.1644,	.2262,
1965,	210354,	1003621,	522884,	185600,	.3550,	1.0782,	.2254,
1966,	241202,	1085517,	568765,	203788,	.3583,	1.1067,	.2767,
1967,	191872,	935494,	551179,	181326,	.3290,	.9475,	.2751,
1968,	367843,	1143234,	631001,	110247,	.1747,	1.1662,	.1606,
1969,	347431,	1037604,	529248,	140060,	.2646,	.9734,	.2117,
1970,	379815,	1210542,	633034,	264924,	.4185,	.9741,	.3292,
1971,	219524,	949348,	503856,	241272,	.4789,	.7841,	.3671,
1972,	278465,	892291,	487481,	214334,	.4397,	.8362,	.4217,
1973,	117299,	758910,	466089,	213859,	.4588,	.8099,	.4369,
1974,	206220,	770592,	471317,	274121,	.5816,	1.0131,	.6295,
1975,	373549,	692785,	372735,	233453,	.6263,	1.0155,	.4665,
1976,	305466,	616953,	250577,	242486,	.9677,	1.0020,	.6827,
1977,	178776,	482863,	169207,	182817,	1.0804,	1.0062,	.5849,
1978,	283591,	474754,	175906,	154464,	.8781,	1.0278,	.5435,
1979,	167693,	483682,	162681,	164180,	1.0092,	1.1384,	.5219,
1980,	356254,	513974,	138732,	144554,	1.0420,	.9355,	.5529,
1981,	152598,	532940,	142438,	175516,	1.2322,	.9975,	.5567,
1982,	140068,	471365,	121867,	168034,	1.3788,	.9794,	.6284,
1983,	118912,	486288,	167567,	156936,	.9366,	1.0089,	.5338,
1984,	137543,	404658,	151680,	158786,	1.0468,	.9997,	.7412,
1985,	271686,	370574,	121134,	107183,	.8848,	.9933,	.5620,
1986,	204400,	347025,	89047,	70458,	.7912,	.9929,	.4031,
1987,	103478,	369835,	90564,	92391,	1.0202,	1.0233,	.3486,
1988,	79261,	355858,	124879,	114242,	.9148,	.9879,	.4135,
1989,	88859,	331182,	138950,	122310,	.8802,	.9949,	.5619,
1990,	291666,	400886,	124028,	95848,	.7728,	1.0049,	.4806,
1991,	480544,	524043,	111461,	107326,	.9629,	.9912,	.4325,
1992,	343495,	682077,	107112,	127516,	1.1905,	.9993,	.4251,
1993,	237615,	744105,	129833,	153584,	1.1829,	1.0008,	.3719,
1994,	426830,	719198,	222066,	146544,	.6599,	1.0038,	.3598,
1995,	128661,	747334,	280721,	168174,	.5991,	.9999,	.3479,
1996,	180151,	739916,	319163,	171498,	.5373,	.9999,	.2570,
1997,	79070,	651974,	356503,	143760,	.4033,	1.0011,	.2579,
1998,	191980,	690053,	409873,	153822,	.3753,	1.0015,	.2446,
1999,	218731,	713956,	357950,	150274,	.4198,	1.0003,	.3182,
2000,	322000,	694977,	311094,	134723,	.4331,	.9992,	.2585,
Arith. Mean ,	232393,	690630,	307324,	160406,	.6777		.3993,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 5.12 **RCT3-estimate of 2 year-olds.**

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

g:\kjell\2001\sei\rct32in.txt

NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds

Data for    1 surveys over   13 years :  1986 - 1998

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

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

Forecast/Hindcast variance correction used.

Yearclass =   1990

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur    1.04   1.23    .36   .899      4   5.10    6.55     .721     .601

                                       VPA Mean =    5.19     .885     .399


Yearclass =   1991

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .92   1.60    .40   .849      5   4.68    5.89     .592     .657

                                       VPA Mean =    5.32     .819     .343


Yearclass =   1992

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .90   1.60    .39   .817      6   3.57    4.81     .537     .652

                                       VPA Mean =    5.35     .734     .348


Yearclass =   1993

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur    1.20    .55    .80   .494      7   3.68    4.97    1.035     .325

                                       VPA Mean =    5.46     .718     .675


Yearclass =   1994

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur    1.23    .42    .75   .500      8   3.64    4.89     .944     .351

                                       VPA Mean =    5.39     .694     .649
```

Table 5.12 (Continued)

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
Ac-sur	1.22	.48	.70	.494	9	1.81	2.69	1.204	.224
					VPA Mean =		5.38	.647	.776

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
Ac-sur	.89	1.93	.61	.589	10	3.80	5.30	.727	.472
					VPA Mean =		5.28	.687	.528

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
Ac-sur	.88	1.95	.58	.585	11	4.13	5.59	.682	.473
					VPA Mean =		5.28	.646	.527

Yearclass = 1998

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction				---------I
Ac-sur	.88	1.98	.58	.582	11	5.11	6.46	.753	.421
					VPA Mean =		5.28	.643	.579

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	406	6.01	.56	.67	1.43	343	5.84
1991	297	5.70	.48	.27	.32	238	5.48
1992	148	5.00	.43	.26	.36	427	6.06
1993	200	5.30	.59	.23	.15	130	4.87
1994	184	5.22	.56	.24	.18	180	5.20
1995	118	4.78	.57	1.12	3.85	80	4.38
1996	197	5.29	.50	.01	.00	192	5.26
1997	227	5.43	.47	.16	.11		
1998	322	5.78	.49	.58	1.41		

Table 5.13 **RCT3-estimate of 3 year-olds.**

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

g:\kjell\2001\sei\rct33in.txt

NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds

Data for    1 surveys over   13 years :  1985 - 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 =   1990

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .83   1.45    .26   .932      5   5.43    5.95     .433     .789

                                       VPA Mean =    4.82     .838     .211


Yearclass =   1991

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .78   1.62    .25   .928      6   4.49    5.10     .339     .853

                                       VPA Mean =    4.95     .815     .147


Yearclass =   1992

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .79   1.60    .24   .922      7   5.11    5.61     .318     .848

                                       VPA Mean =    5.00     .752     .152


Yearclass =   1993

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .82   1.46    .25   .918      8   4.79    5.40     .306     .860

                                       VPA Mean =    5.12     .757     .140


Yearclass =   1994

         I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights

Ac-sur     .89   1.05    .38   .809      9   3.63    4.30     .480     .693

                                       VPA Mean =    5.08     .722     .307
```

Table 5.13 (Continued)

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Ac-sur	.89	1.15	.43	.741	10	4.58	5.22	.508	.639
					VPA Mean =		5.08	.676	.361

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Ac-sur	1.11	.04	.64	.569	11	5.46	6.12	.809	.426
					VPA Mean =		5.00	.697	.574

Yearclass = 1997

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I					I-----------Prediction---------I			
Ac-sur	1.13	-.13	.71	.491	12	4.97	5.46	.832	.385
					VPA Mean =		5.02	.658	.615

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	302	5.71	.38	.46	1.44	268	5.59
1991	159	5.07	.31	.05	.03	192	5.26
1992	249	5.52	.29	.22	.56	349	5.86
1993	212	5.36	.28	.10	.12	106	4.66
1994	93	4.54	.40	.36	.81	148	5.00
1995	175	5.17	.41	.07	.03	65	4.17
1996	238	5.48	.53	.55	1.09	157	5.06
1997	179	5.19	.52	.22	.18		

Table 5.14

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

Prediction with management option table: Input data

Year: 2001								
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	208000.00	0.2000	0.0000	0.0000	0.0000	0.453	0.0015	0.453
3	262564.00	0.2000	0.0000	0.0000	0.0000	0.653	0.0577	0.653
4	138219.00	0.2000	0.0100	0.0000	0.0000	1.023	0.2309	1.023
5	77724.000	0.2000	0.5500	0.0000	0.0000	1.513	0.3395	1.513
6	17198.000	0.2000	0.8500	0.0000	0.0000	1.973	0.4060	1.973
7	21492.000	0.2000	0.9800	0.0000	0.0000	2.507	0.4643	2.507
8	7657.000	0.2000	1.0000	0.0000	0.0000	3.083	0.3279	3.083
9	13952.000	0.2000	1.0000	0.0000	0.0000	3.820	0.3122	3.820
10	4753.000	0.2000	1.0000	0.0000	0.0000	4.633	0.4097	4.633
11+	6301.000	0.2000	1.0000	0.0000	0.0000	6.515	0.4097	6.515
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	208000.00	0.2000	0.0000	0.0000	0.0000	0.453	0.0015	0.453
3	.	0.2000	0.0000	0.0000	0.0000	0.653	0.0577	0.653
4	.	0.2000	0.0100	0.0000	0.0000	1.023	0.2309	1.023
5	.	0.2000	0.5500	0.0000	0.0000	1.513	0.3395	1.513
6	.	0.2000	0.8500	0.0000	0.0000	1.973	0.4060	1.973
7	.	0.2000	0.9800	0.0000	0.0000	2.507	0.4643	2.507
8	.	0.2000	1.0000	0.0000	0.0000	3.083	0.3279	3.083
9	.	0.2000	1.0000	0.0000	0.0000	3.820	0.3122	3.820
10	.	0.2000	1.0000	0.0000	0.0000	4.633	0.4097	4.633
11+	.	0.2000	1.0000	0.0000	0.0000	6.515	0.4097	6.515
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2003								
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	208000.00	0.2000	0.0000	0.0000	0.0000	0.453	0.0015	0.453
3	.	0.2000	0.0000	0.0000	0.0000	0.653	0.0577	0.653
4	.	0.2000	0.0100	0.0000	0.0000	1.023	0.2309	1.023
5	.	0.2000	0.5500	0.0000	0.0000	1.513	0.3395	1.513
6	.	0.2000	0.8500	0.0000	0.0000	1.973	0.4060	1.973
7	.	0.2000	0.9800	0.0000	0.0000	2.507	0.4643	2.507
8	.	0.2000	1.0000	0.0000	0.0000	3.083	0.3279	3.083
9	.	0.2000	1.0000	0.0000	0.0000	3.820	0.3122	3.820
10	.	0.2000	1.0000	0.0000	0.0000	4.633	0.4097	4.633
11+	.	0.2000	1.0000	0.0000	0.0000	6.515	0.4097	6.515
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANKHN05
Date and time: 02MAY01:10:03

Table 5.15

North-East Arctic saithe (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	5.517	13060.940	2.713	10868.416	2.713	10868.416
0.0500	0.0129	0.057	183.217	5.234	11578.677	2.438	9398.635	2.438	9398.635
0.1000	0.0259	0.104	320.290	4.998	10377.534	2.209	8209.715	2.209	8209.715
0.1500	0.0388	0.145	423.901	4.797	9389.054	2.016	7233.208	2.016	7233.208
0.2000	0.0517	0.179	502.816	4.624	8564.878	1.851	6420.761	1.851	6420.761
0.2500	0.0646	0.210	563.244	4.473	7869.923	1.708	5737.299	1.708	5737.299
0.3000	0.0776	0.236	609.670	4.341	7278.156	1.583	5156.795	1.583	5156.795
0.3500	0.0905	0.260	645.385	4.224	6769.878	1.473	4659.557	1.473	4659.557
0.4000	0.1034	0.281	672.840	4.119	6329.933	1.376	4230.435	1.376	4230.435
0.4500	0.1163	0.300	693.881	4.025	5946.487	1.289	3857.600	1.289	3857.600
0.5000	0.1293	0.317	709.916	3.940	5610.177	1.210	3531.697	1.210	3531.697
0.5500	0.1422	0.333	722.023	3.863	5313.514	1.140	3245.242	1.140	3245.242
0.6000	0.1551	0.347	731.039	3.792	5050.442	1.076	2992.182	1.076	2992.182
0.6500	0.1680	0.360	737.614	3.727	4816.018	1.018	2767.583	1.018	2767.583
0.7000	0.1810	0.372	742.258	3.667	4606.178	0.964	2567.383	0.964	2567.383
0.7500	0.1939	0.384	745.372	3.612	4417.549	0.916	2388.216	0.916	2388.216
0.8000	0.2068	0.394	747.274	3.561	4247.318	0.871	2227.273	0.871	2227.273
0.8500	0.2197	0.404	748.216	3.514	4093.118	0.829	2082.193	0.829	2082.193
0.9000	0.2327	0.413	748.399	3.469	3952.953	0.791	1950.981	0.791	1950.981
0.9500	0.2456	0.421	747.983	3.428	3825.122	0.756	1831.943	0.756	1831.943
1.0000	0.2585	0.429	747.096	3.389	3708.175	0.723	1723.634	0.723	1723.634
1.0500	0.2715	0.437	745.840	3.352	3600.867	0.692	1624.811	0.692	1624.811
1.1000	0.2844	0.444	744.298	3.318	3502.125	0.663	1534.406	0.663	1534.406
1.1500	0.2973	0.450	742.537	3.285	3411.021	0.636	1451.494	0.636	1451.494
1.2000	0.3102	0.457	740.609	3.255	3326.748	0.611	1375.273	0.611	1375.273
1.2500	0.3232	0.463	738.557	3.226	3248.603	0.588	1305.042	0.588	1305.042
1.3000	0.3361	0.468	736.416	3.198	3175.970	0.565	1240.189	0.565	1240.189
1.3500	0.3490	0.474	734.212	3.172	3108.308	0.544	1180.177	0.544	1180.177
1.4000	0.3619	0.479	731.969	3.147	3045.143	0.525	1124.534	0.525	1124.534
1.4500	0.3749	0.484	729.703	3.123	2986.053	0.506	1072.843	0.506	1072.843
1.5000	0.3878	0.488	727.429	3.100	2930.668	0.489	1024.736	0.489	1024.736
1.5500	0.4007	0.493	725.157	3.079	2878.656	0.472	979.884	0.472	979.884
1.6000	0.4136	0.497	722.897	3.058	2829.724	0.456	937.996	0.456	937.996
1.6500	0.4266	0.501	720.655	3.038	2783.609	0.441	898.812	0.441	898.812
1.7000	0.4395	0.505	718.437	3.019	2740.076	0.427	862.102	0.427	862.102
1.7500	0.4524	0.509	716.246	3.000	2698.915	0.413	827.656	0.413	827.656
1.8000	0.4653	0.513	714.086	2.983	2659.936	0.400	795.287	0.400	795.287
1.8500	0.4783	0.516	711.959	2.966	2622.970	0.388	764.829	0.388	764.829
1.9000	0.4912	0.520	709.866	2.950	2587.861	0.376	736.130	0.376	736.130
1.9500	0.5041	0.523	707.808	2.934	2554.473	0.365	709.052	0.365	709.052
2.0000	0.5171	0.526	705.787	2.919	2522.678	0.355	683.473	0.355	683.473
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDKHN05
Date and time : 02MAY01:09:40
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.4232
F-max factor : 0.8885
F-0.1 reference F : 0.1094
F-max reference F : 0.2297
Recruitment : Single recruit

Table 5.16

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

Prediction with management option table

Year: 2001					Year: 2002					Year: 2003	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0155	0.2625	752693	287730	135000	0.0000	0.0000	789096	303554	0	987481	504311
.	.	.	.	.	0.0500	0.0129	.	303554	8793	976978	495922
.	.	.	.	.	0.1000	0.0259	.	303554	17446	966644	487680
.	.	.	.	.	0.1500	0.0388	.	303554	25962	956477	479582
.	.	.	.	.	0.2000	0.0517	.	303554	34342	946473	471624
.	.	.	.	.	0.2500	0.0646	.	303554	42589	936630	463806
.	.	.	.	.	0.3000	0.0776	.	303554	50706	926945	456124
.	.	.	.	.	0.3500	0.0905	.	303554	58695	917416	448575
.	.	.	.	.	0.4000	0.1034	.	303554	66557	908039	441158
.	.	.	.	.	0.4500	0.1163	.	303554	74296	898812	433870
.	.	.	.	.	0.5000	0.1293	.	303554	81913	889732	426708
.	.	.	.	.	0.5500	0.1422	.	303554	89410	880797	419670
.	.	.	.	.	0.6000	0.1551	.	303554	96789	872004	412755
.	.	.	.	.	0.6500	0.1680	.	303554	104053	863352	405960
.	.	.	.	.	0.7000	0.1810	.	303554	111204	854836	399282
.	.	.	.	.	0.7500	0.1939	.	303554	118242	846456	392720
.	.	.	.	.	0.8000	0.2068	.	303554	125171	838208	386271
.	.	.	.	.	0.8500	0.2197	.	303554	131992	830091	379934
.	.	.	.	.	0.9000	0.2327	.	303554	138707	822101	373706
.	.	.	.	.	0.9500	0.2456	.	303554	145318	814238	367586
.	.	.	.	.	1.0000	0.2585	.	303554	151827	806499	361571
.	.	.	.	.	1.0500	0.2715	.	303554	158234	798881	355660
.	.	.	.	.	1.1000	0.2844	.	303554	164543	791383	349851
.	.	.	.	.	1.1500	0.2973	.	303554	170755	784002	344141
.	.	.	.	.	1.2000	0.3102	.	303554	176871	776737	338530
.	.	.	.	.	1.2500	0.3232	.	303554	182893	769586	333015
.	.	.	.	.	1.3000	0.3361	.	303554	188823	762546	327595
.	.	.	.	.	1.3500	0.3490	.	303554	194662	755616	322268
.	.	.	.	.	1.4000	0.3619	.	303554	200411	748793	317032
.	.	.	.	.	1.4500	0.3749	.	303554	206073	742077	311886
.	.	.	.	.	1.5000	0.3878	.	303554	211649	735465	306828
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANKHN05
Date and time : 02MAY01:10:03
Computation of ref. F: Simple mean, age 3 - 6
Basis for 2001 : TAC constraints

Table 5.17a

North-East Arctic saithe (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
2001	1.0000	0.2585	81238	133243	757860	752693	112474	287730	112474	287730
2002	1.0000	0.2585	95877	152400	755432	791158	129094	305137	129094	305137
2003	1.0000	0.2585	98570	165198	740297	807991	164462	362918	164462	362918
2004	1.0000	0.2585	95987	165045	725519	797923	166842	377048	166842	377048
2005	1.0000	0.2585	93093	161942	715749	788517	160869	374991	160869	374991
2006	1.0000	0.2585	90525	156917	710349	780565	155764	367780	155764	367780
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRKHN02
Date and time : 02MAY01:14:49
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Table 5.17b

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

Single option prediction: Detailed tables

Year: 2001 F-factor: 1.0000 Reference F: 0.2585

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	13355	8725	262564	171542	0	0	0	0
4	0.2309	25929	26534	138219	141444	1382	1414	1382	1414
5	0.3395	20394	30863	77724	117622	42748	64692	42748	64692
6	0.4060	5236	10333	17198	33937	14618	28847	14618	28847
7	0.4643	7291	18276	21492	53873	21062	52796	21062	52796
8	0.3279	1951	6015	7657	23609	7657	23609	7657	23609
9	0.3122	3409	13021	13952	53297	13952	53297	13952	53297
10	0.4097	1458	6755	4753	22022	4753	22022	4753	22022
11+	0.4097	1933	12593	6301	41053	6301	41053	6301	41053
Total		81238	133243	757860	752693	112474	287730	112474	287730
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.2585

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	8649	5651	170041	111093	0	0	0	0
4	0.2309	38065	38953	202917	207651	2029	2077	2029	2077
5	0.3395	23571	35670	89832	135946	49408	74770	49408	74770
6	0.4060	13798	27228	45316	89424	38519	76010	38519	76010
7	0.4643	3183	7978	9382	23518	9194	23047	9194	23047
8	0.3279	2818	8688	11061	34103	11061	34103	11061	34103
9	0.3122	1103	4215	4516	17253	4516	17253	4516	17253
10	0.4097	2564	11881	8360	38733	8360	38733	8360	38733
11+	0.4097	1843	12007	6008	39144	6008	39144	6008	39144
Total		95877	152400	755432	791158	129094	305137	129094	305137
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2003 F-factor: 1.0000 Reference F: 0.2585

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	8649	5651	170041	111093	0	0	0	0
4	0.2309	24652	25227	131412	134478	1314	1345	1314	1345
5	0.3395	34604	52367	131880	199579	72534	109768	72534	109768
6	0.4060	15947	31469	52376	103354	44519	87851	44519	87851
7	0.4643	8386	21022	24721	61968	24227	60729	24227	60729
8	0.3279	1230	3793	4828	14887	4828	14887	4828	14887
9	0.3122	1594	6089	6524	24922	6524	24922	6524	24922
10	0.4097	830	3846	2706	12538	2706	12538	2706	12538
11+	0.4097	2395	15607	7809	50878	7809	50878	7809	50878
Total		98570	165198	740297	807991	164462	362918	164462	362918
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.17b (Continued)

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

Single option prediction: Detailed tables

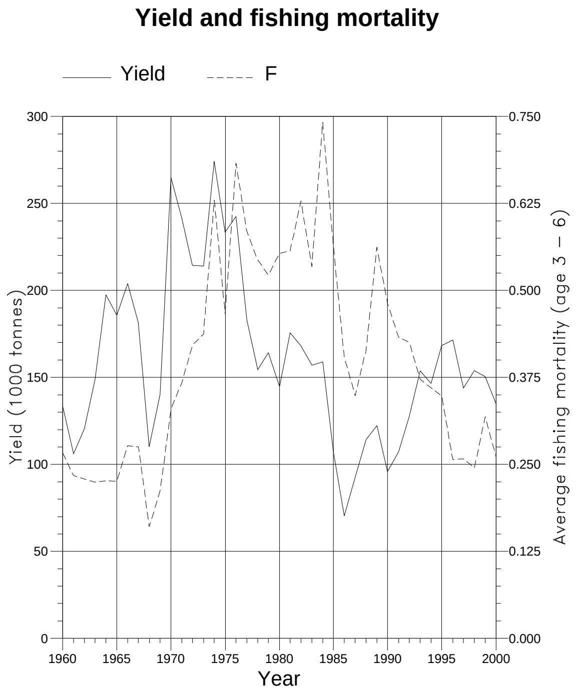
(cont.)

Year: 2004	F-factor: 1.0000		Reference F: 0.2585			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	8649	5651	170041	111093	0	0	0	0
4	0.2309	24652	25227	131412	134478	1314	1345	1314	1345
5	0.3395	22410	33914	85408	129251	46974	71088	46974	71088
6	0.4060	23412	46200	76891	151732	65358	128973	65358	128973
7	0.4643	9693	24297	28572	71621	28001	70189	28001	70189
8	0.3279	3241	9994	12722	39227	12722	39227	12722	39227
9	0.3122	696	2658	2848	10879	2848	10879	2848	10879
10	0.4097	1199	5556	3909	18112	3909	18112	3909	18112
11+	0.4097	1753	11422	5715	37236	5715	37236	5715	37236
Total		95987	165045	725519	797923	166842	377048	166842	377048
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

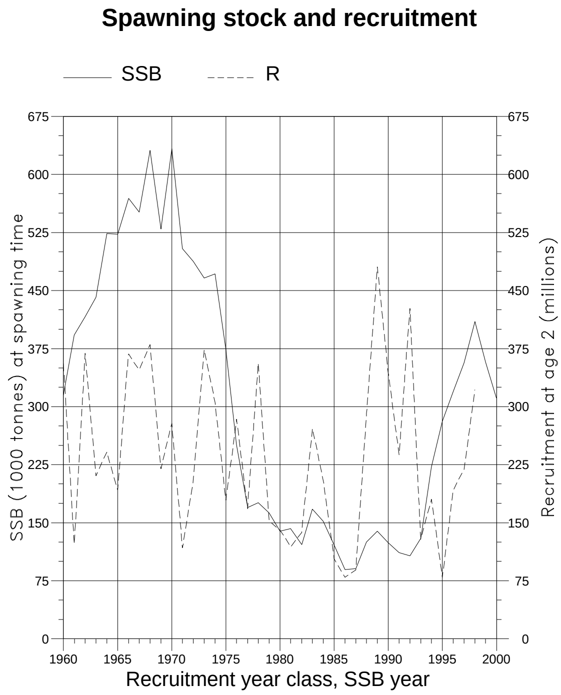
Year: 2005	F-factor: 1.0000		Reference F: 0.2585			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	8649	5651	170041	111093	0	0	0	0
4	0.2309	24652	25227	131412	134478	1314	1345	1314	1345
5	0.3395	22410	33914	85408	129251	46974	71088	46974	71088
6	0.4060	15162	29920	49796	98264	42327	83525	42327	83525
7	0.4643	14230	35669	41946	105146	41108	103043	41108	103043
8	0.3279	3746	11551	14704	45338	14704	45338	14704	45338
9	0.3122	1833	7004	7504	28666	7504	28666	7504	28666
10	0.4097	523	2425	1706	7906	1706	7906	1706	7906
11+	0.4097	1605	10454	5231	34080	5231	34080	5231	34080
Total		93093	161942	715749	788517	160869	374991	160869	374991
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2006	F-factor: 1.0000		Reference F: 0.2585			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0015	283	128	208000	94293	0	0	0	0
3	0.0577	8649	5651	170041	111093	0	0	0	0
4	0.2309	24652	25227	131412	134478	1314	1345	1314	1345
5	0.3395	22410	33914	85408	129251	46974	71088	46974	71088
6	0.4060	15162	29920	49796	98264	42327	83525	42327	83525
7	0.4643	9215	23100	27165	68094	26622	66732	26622	66732
8	0.3279	5500	16957	21587	66560	21587	66560	21587	66560
9	0.3122	2119	8095	8673	33132	8673	33132	8673	33132
10	0.4097	1379	6390	4496	20833	4496	20833	4496	20833
11+	0.4097	1157	7535	3771	24566	3771	24566	3771	24566
Total		90525	156917	710349	780565	155764	367780	155764	367780
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRKHN02
Date and time : 02MAY01:14:49
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors



(run: XSAKHN09) **A**



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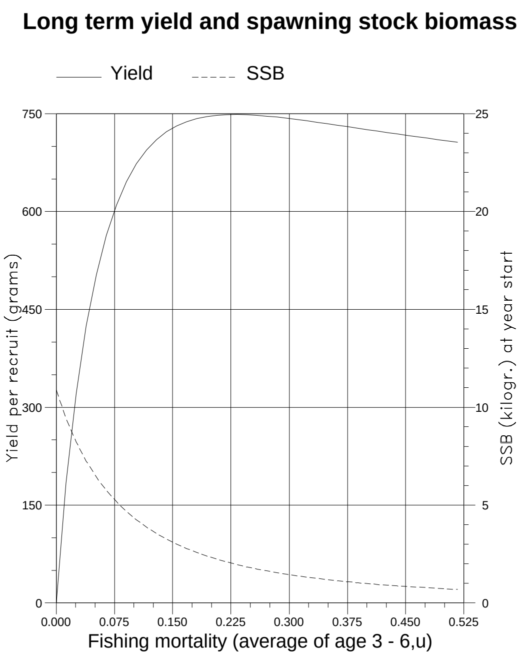
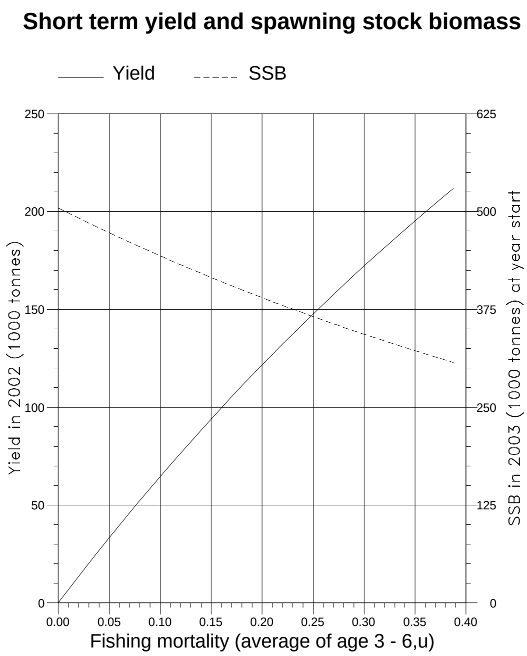


(run: YLDKHN05) **C**



(run: MANKHN05) **D**

Figure 5.1 A-D. Northeast Arctic Saithe.

Figure 5.2A. North-East Arctic Saithe - Acoustic survey vs VPA

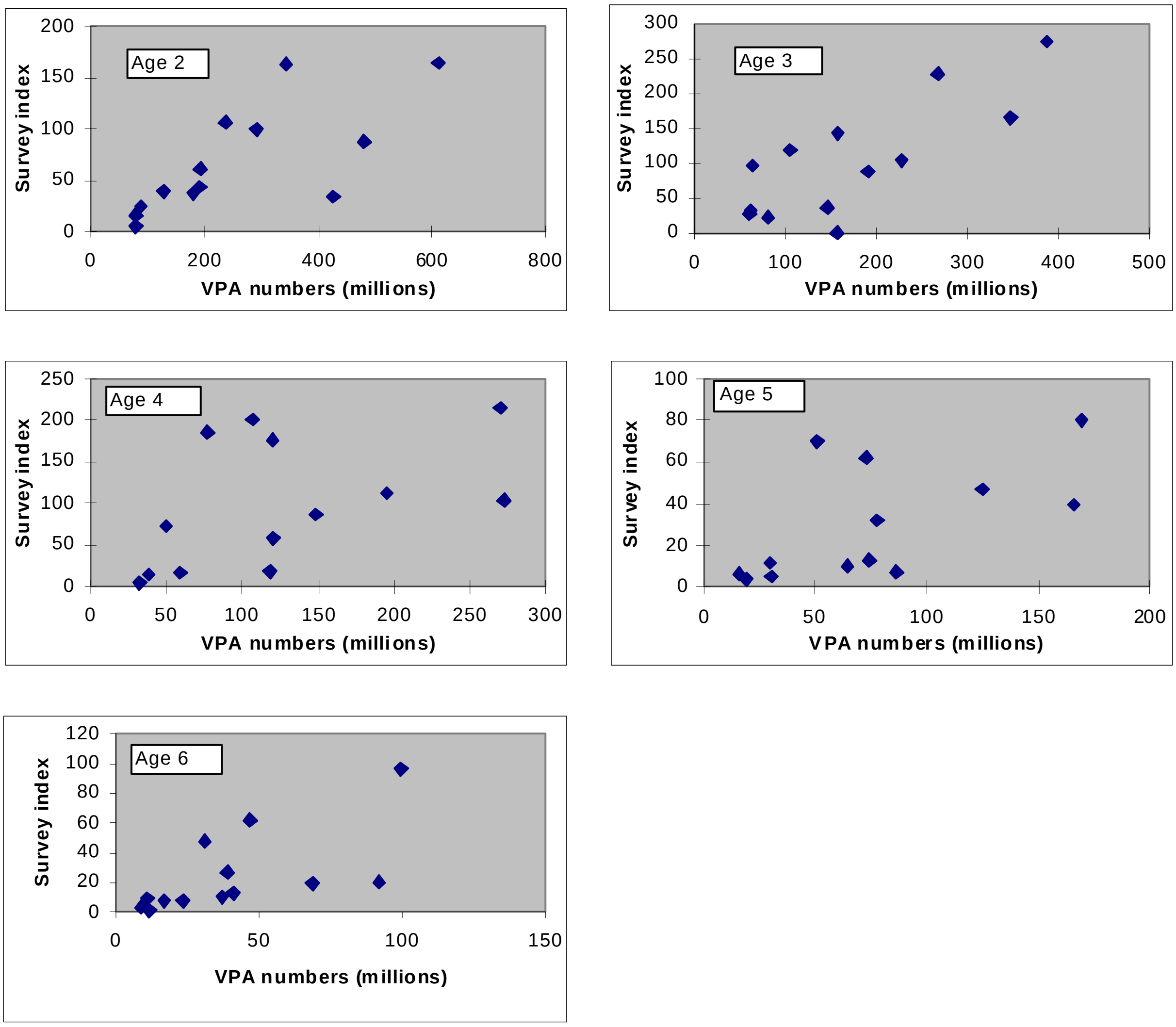


Figure 5.2B. North-East Arctic Saithe - Norwegian purse seine vs VPA

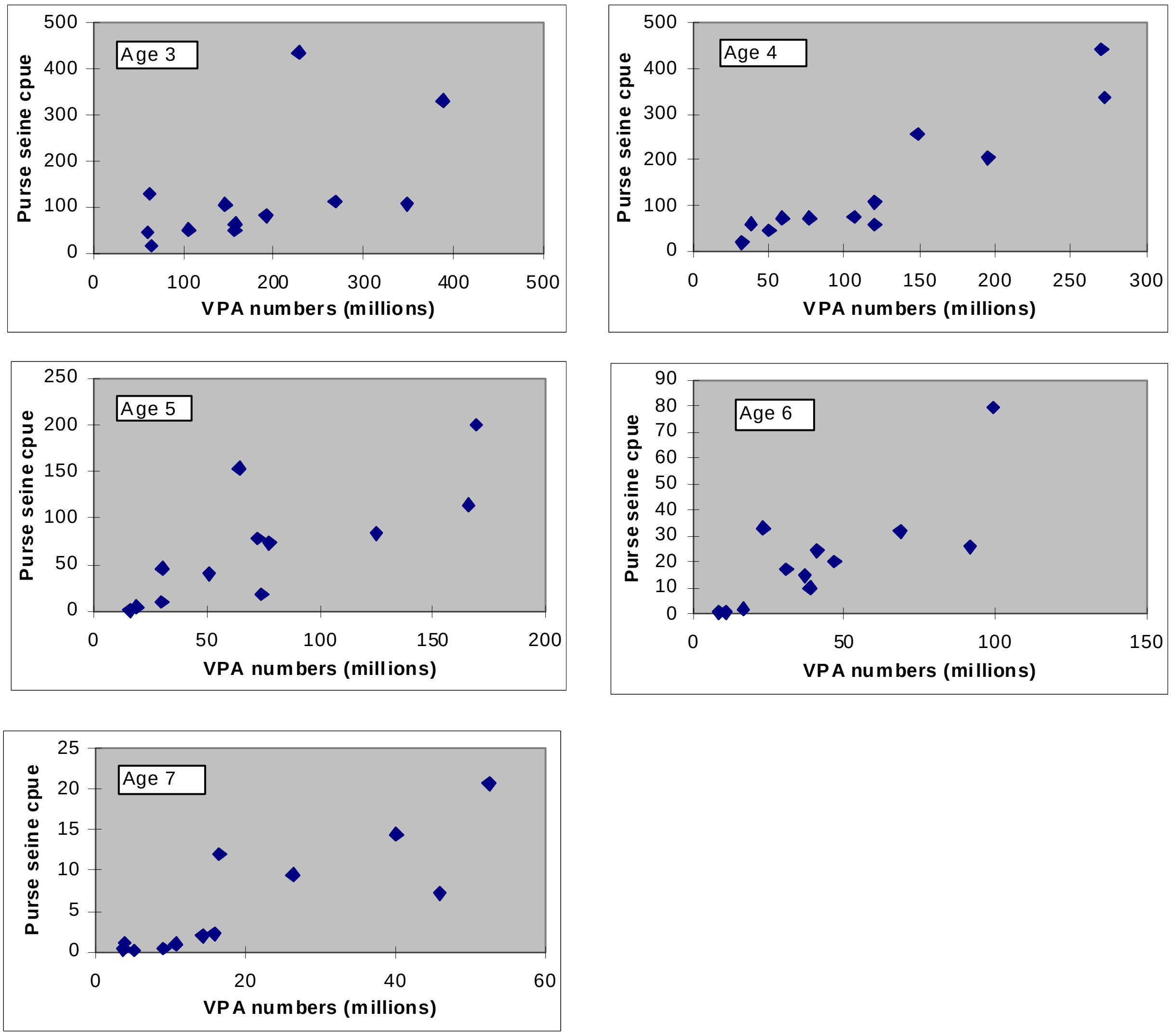
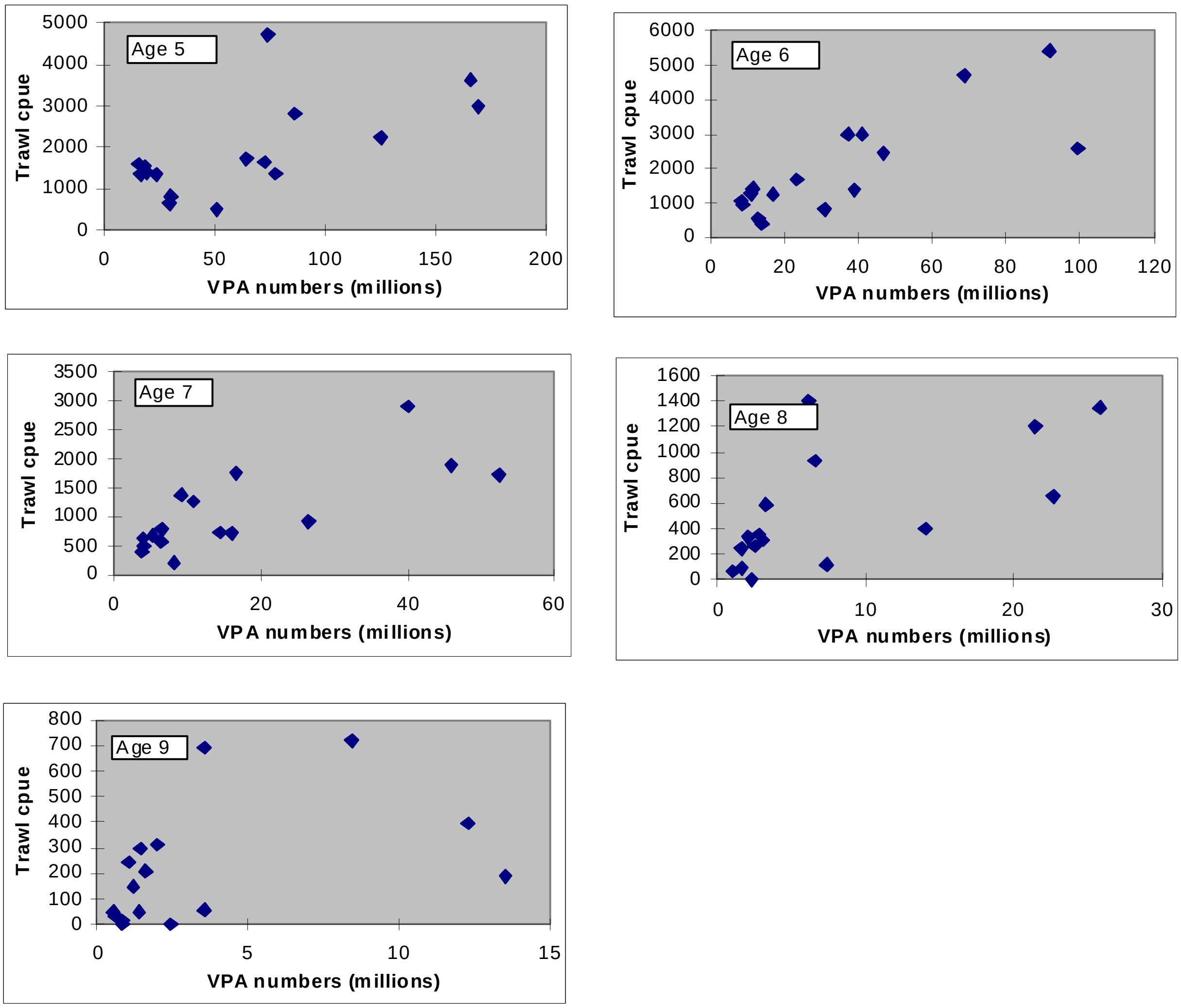


Figure 5.2C. North-East Arctic Saithe - Norwegian trawl vs VPA



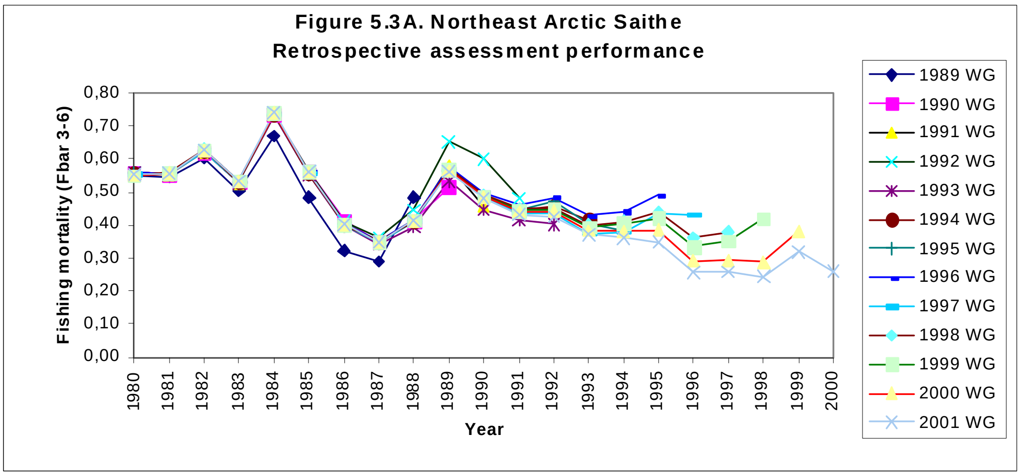


Figure 5.3A. Northeast Arctic Saithe
Retrospective assessment performance
Fishing mortality (Fbar 3-6)
0,00
0,10
0,20
0,30
0,40
0,50
0,60
0,70
0,80
Year
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG
1999 WG
2000 WG
2001 WG

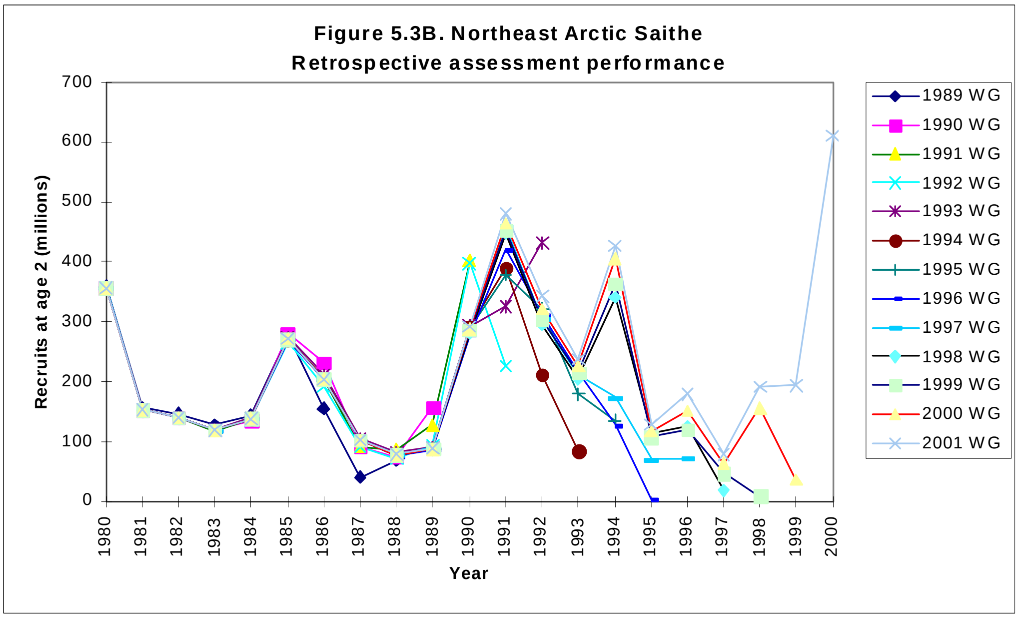


Figure 5.3B. Northeast Arctic Saithe
Retrospective assessment performance
Recruits at age 2 (millions)
0
100
200
300
400
500
600
700
Year
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG
1999 WG
2000 WG
2001 WG

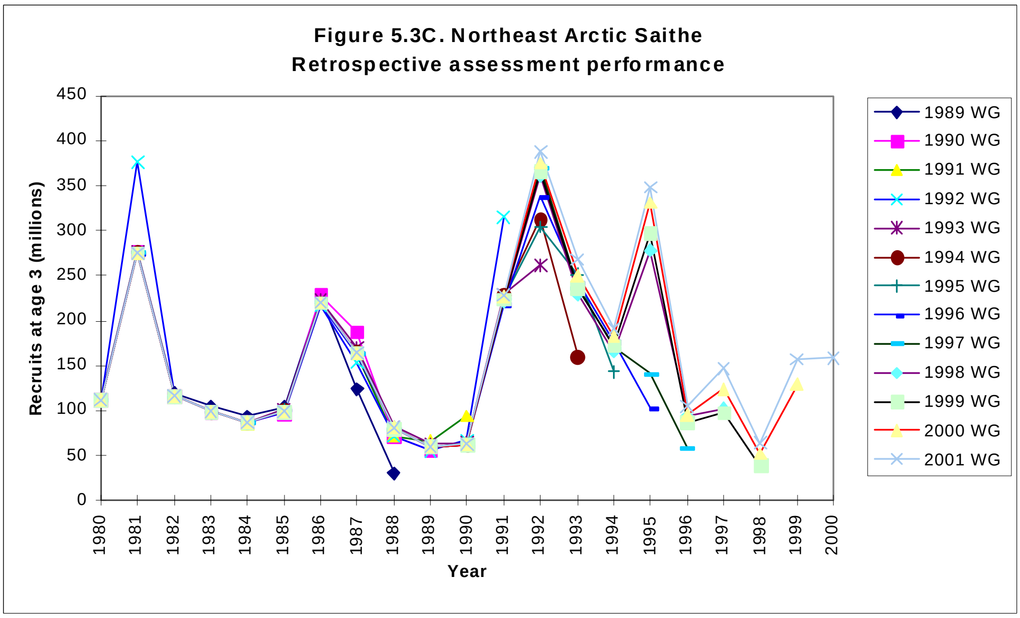


Figure 5.3C. Northeast Arctic Saithe
Retrospective assessment performance
Recruits at age 3 (millions)
0
50
100
150
200
250
300
350
400
450
Year
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG
1999 WG
2000 WG
2001 WG

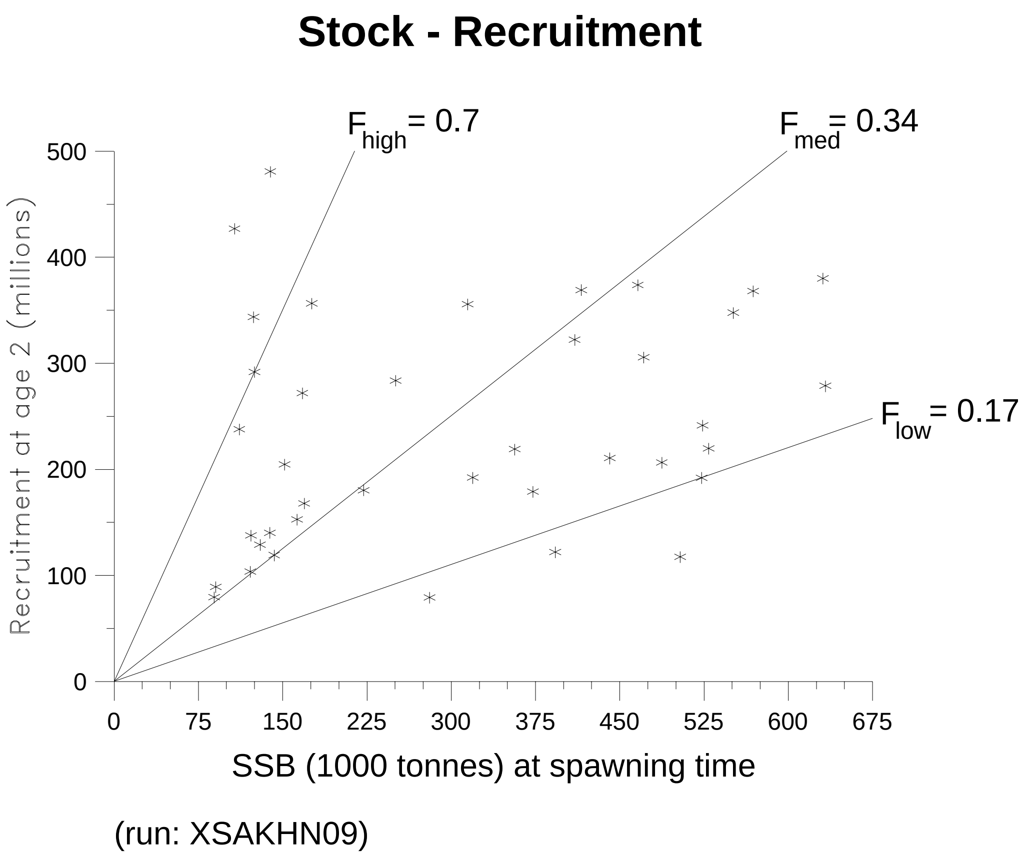


Figure 5.4. Northeast Arctic Saithe.

Table C.1 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

Year	No. of vessels with catch		Total catch (t) from vessels with catch			Catch in % from vessels with		No. vessels with > 100 t, scaled to total catch	Catch/Vessel for scaled no. of vessels
	< 100 t	> 100 t	< 100 t	> 100 t	Total	< 100 t	> 100 t		
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	212	115	5263	33792	39055	13	87	133	294
2000 [1]	200	102	5320	22922	28242	19	81	126	224

[1] Provisional figures.

Table C.2 Northeast Arctic saithe. Catch, effort, and catch per unit effort for Norwegian trawlers directing for saithe. Used in the assessment prior to 2001.

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. Trawl CPUE by agegroup.
Catch in numbers per trawlhour.

Year	Agegroup						
	3	4	5	6	7	8	9
1985	152	258	134	42	21	-	-
1986	36	206	134	54	79	59	15
1987	17	283	153	107	57	35	30
1988	5	61	281	142	62	33	21
1989	34	43	171	299	68	7	3
1990	29	64	81	169	176	27	5
1991	32	99	139	126	127	93	24
1992	1	315	159	128	137	140	69
1993	10	173	472	96	39	31	31
1994	2	17	362	301	50	24	5
1995	3	71	224	542	73	9	-
1996	7	40	136	470	190	12	1
1997	2	7	299	245	290	120	6
1998	0,2	16	50	258	92	65	40
1999	0,4	30	165	81	172	40	19
2000 [2]	19	85	64	138	72	135	72

[2] 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
2000	164,8	142,5	176,3	11,6	26,5	521,7

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. Only inner parts of areas A,C and D (which are not covered by IMR) are included.

	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
2000	0	6170	6617	9221	1463	4963	1565	1504	1163	8585	17780	41251

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 2001 (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* <u>and</u> *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 2000 show 8,228 t, which also was 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 2001

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 2001. In addition to this, and based on reports from the first months in 2001, a by-catch of approx. 2,500 t in other fisheries and areas should give an expected total Russian catch in 2001 of about 4,500 t. During winter 2001, Norwegian fishermen have reported on good catch rates along the continental slope outside the closed areas. Based on the landings of *S. mentella* from the three-four first months of the year, Norwegian landings in 2001 are therefore expected to increase to about 15,000 t. On this basis, and assuming unchanged catch level for other countries, the total landings of *S. mentella* for 2001 is expected to be **20,000 t**.

6.2 Data used in the Assessment

All input data sets were updated up to and including 2000.

6.2.1 Fishing effort and catch-per-unit-effort (Table D3, Figure 6.7)

Revised catch-per-hour-trawling data for the *S. mentella* fishery were available from two Russian trawl fleets (BMRT and PST) fishing in ICES Division IIa in March-May 1975-2000, representative for the directed Russian fishery accounting for 60-80% of the total Russian catch.(Table D3). However, the Working Group mean that the Russian trawl CPUE series do 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 since 1996 was carried out by one or two vessels on localised concentrations in the Kopytov area southwest of Bear Island. Because of this, the CPUEs have been plotted in Figure 6.7 only for the period after 1991. However, the commercial trawl CPUEs are confirmed by the Russian trawl-acoustic spring survey also covering the same area.

6.2.2 Catch at age (Table 6.5)

Since 1991, 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 1998–1999 was revised according to new catch data. Data on age for 2000 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 trawl in 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 2000 were available from Norway and from Russia in Division IIa (Table 6.6). The weight at age in the stock was set equal to the weight at age in the catch. It should be further investigated whether it would be better to use a constant weight-at-age series (e.g., based on survey information) instead of catch weight-at-age which may vary due to changes and selections in the fisheries and not due to growth changes in the stock.

6.2.4 Maturity at age (Tables 6.7 and D8)

Age-based maturity ogives for *S. mentella* (sexes combined) are available for 1986–1993, 1995 and 1997–2000 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:

The international 0-group survey in the Svalbard and Barents Sea areas in August-September (Table A14 and Figure 6.1).

Russian bottom trawl survey in the Svalbard and Barents Sea areas in October-December from 1978–2000 in fishing depths of 100–900 m (Table D4, Figure 6.2).

Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986–2000 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–2000 (Table D5a,b and Figure 6.3a,b).

Norwegian Barents Sea bottom trawl survey (February) from 1986–2001 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–2001 (Tables D6a,b and Figures 6.4a,b).

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 2000 year class was stronger than the preceding four 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. These results are supported by the observations of *S.mentella* along the continental slope during the Norwegian Greenland halibut survey (1996-2000) covering depths greater than 400 m.

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.

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 these year classes that are the main cause for the current improved catch rates in the fisheries.

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.

An exploratory XSA was run with settings recommended by people analysing previous trial analytical assessments. Only fishery independent tuning series were included, and the time series was reduced due to changed age reading method in 1991 and improved surveys since then. Log catchability residuals are shown in Figure 6.8, and these seem to be reasonable. Results from two exploratory runs are shown graphically in Figure 6.9. The stock trends fits with what are observed in the surveys, incl. confirming the relative strength of the 1987-1991 year classes. The different survey series estimate similar numbers of survivors of different age groups, and this is seen upon as a strength of the analysis (Figure 6.10).

This exploratory analytical assessment also shows that landings at a level of 20 000 t, which is expected for 2001, will have a serious impact on the stock over short time.

Possible alternative methods to conventional catch-at-age analyses, such as the FLEKSIBEST model, were discussed also for this redfish stock. This model is based on the BORMICON model which currently is used by the ICES North-Western WG on *S. marinus*. 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.

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 and urgent 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 to ensure that they can contribute as much as possible to the stock rebuilding.

Therefore the same advice should be maintained for 2002. Given the current depleted state of the stock it is imperative that data collection and surveys 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	Iceland	-	73	26	202	50	3
2000[1]	46	-	50	12	48	29	1

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	5	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	177	93	41	13,844
1999	7,777	6	65	2,731	29	112	28	11,102
2000[1]	4,177	2	115	3,519	99		130[5]	8,228

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.
[5] UK(E&W)+UK(Scot.)

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)	Iceland	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	69[2]	-	-	64	489	-	-	622
2000[1]	-	-	-	54	406	-	46	506

[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	-	16[2]	160[2]	50[2]	3[2]	7,487
2000[1]	50[2]	11[2]	34[2]	29[2]	-	4,028

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	55[2]	65[2]	41[2]	12,439
1999	56[2]	1,340	14[2]	94[2]	26[2]	9,246
2000[1]	98[2]	2,167	11[2]		103[6]	6,531

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

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	-	-	4[2]	10[2]	42[2]	-	-
2000[1]	-	-	-	1[2]	14[2]	-	1[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	122[2]	28[2]	1[2]	1,001
1999	226	6[2]	9[2]	902	15[2]	18[2]	2[2]	1,234
2000[1]	95	2[2]	17[2]	946	88[2]		27[7]	1,191

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.
[7] UK(E&W)+UK(Scot.)

Table 6.5.

Run title : Arctic S. mentella (run: XSAKLN15/X15)

At 3/05/2001 13:46

Catch numbers at age Numbers*10**-3

	YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE										
	6	1653	1873	159	738	662	223	122	34	6	1
	7	5453	2498	159	730	941	634	523	754	58	23
	8	7994	1898	174	722	1279	1699	1281	2605	437	382
	9	6781	1622	512	992	719	1554	1237	4029	1473	1349
	10	8226	1780	2094	2561	740	1236	1295	3970	2209	2737
	11	5344	1531	3139	2734	1230	1078	1234	2734	3265	2318
	12	6227	2108	2631	3060	2013	1146	872	1882	1834	1701
	13	9880	2288	2308	1535	4297	1413	1410	1385	1438	1191
	14	10824	2258	2987	2253	3300	1865	1784	1268	1437	802
	15	4049	2506	1875	2182	2162	880	1214	1579	1536	1230
	16	2105	2137	1514	3336	1454	621	534	1114	1391	592
	17	9603	1512	1053	1284	757	498	1165	772	1294	485
	18	6522	677	527	734	794	700	339	795	652	453
	+gp	19299	9258	6022	3257	2404	2247	3512	6199	3929	3934
0	TOTALNUM	103960	33946	25154	26118	22752	15794	16522	29120	20959	17198
	TONSLAND	48727	15590	12866	12721	10284	8075	8523	13844	11102	8228
	SOPCOF %	100	103	101	104	100	95	101	101	102	100

1

Table 6.6.

Run title : Arctic S. mentella (run: XSAKLN15/X15)

At 3/05/2001 13:46

Catch weights at age (kg)

	YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE										
	6	.1300	.1900	.1700	.1600	.1400	.2000	.1800	.1400	.1600	.1000
	7	.1800	.2200	.2300	.2200	.1600	.2000	.2100	.1900	.2200	.1500
	8	.2100	.2600	.2500	.2400	.1900	.2500	.2500	.2300	.2200	.2200
	9	.2700	.2800	.2800	.3000	.2100	.3100	.2900	.2900	.2800	.2700
	10	.3400	.3100	.3300	.3400	.2800	.4200	.3300	.3300	.3300	.3200
	11	.3500	.3300	.3800	.3700	.3200	.4400	.3800	.3800	.3700	.3600
	12	.4200	.3800	.4400	.4000	.3700	.4700	.4600	.4300	.4400	.4100
	13	.4600	.4600	.4700	.4400	.4100	.5900	.4800	.4800	.4900	.4400
	14	.5100	.4300	.5000	.4500	.4700	.6700	.5100	.5400	.5300	.4900
	15	.5800	.4300	.5700	.4900	.5300	.6900	.5500	.5900	.5600	.5400
	16	.5900	.4500	.5800	.5500	.5800	.7100	.6000	.6100	.6100	.6100
	17	.5800	.5200	.6200	.5800	.6600	.7400	.6600	.6400	.6600	.6400
	18	.5900	.5700	.6500	.6700	.7100	.7400	.6500	.6600	.6700	.6600
	+gp	.7000	.6700	.6620	.7900	.8060	.8470	.7870	.7530	.8050	.7090
0	SOPCOFAC	1.0032	1.0291	1.0052	1.0377	.9998	.9465	1.0103	1.0090	1.0190	1.0034

1

Table 6.7.

Run title : Arctic S. mentella (run: XSAKLN15/X15)

At 3/05/2001 13:46

Proportion mature at age

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
7	.0000	.0000	.0000	.0000	.0000	.0000	.0180	.0210	.0000	.0000
8	.0150	.0150	.0000	.0000	.0000	.0000	.0000	.0140	.0160	.0000
9	.0550	.0620	.0230	.0230	.0000	.0140	.0270	.0000	.0590	.0480
10	.1320	.1330	.1130	.1130	.0550	.0930	.1300	.0740	.1100	.0870
11	.2020	.2240	.2670	.2670	.1110	.2120	.3120	.1710	.3330	.2020
12	.4810	.4110	.4380	.4380	.3680	.3250	.2810	.2760	.5790	.3750
13	.5450	.5390	.5740	.5740	.5870	.5770	.5660	.6220	.6890	.4890
14	.7410	.7740	.8430	.8430	.6960	.7160	.7360	.7140	.7880	.7420
15	.8500	.8880	.9510	.9510	.7290	.7800	.8310	.8710	.8130	.8330
16	.9620	.9460	.9200	.9200	.7890	.8740	.9580	.9190	.9030	.9040
17	1.0000	.9920	.9890	.9890	1.0000	.9750	.9500	1.0000	.9230	1.0000
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

1

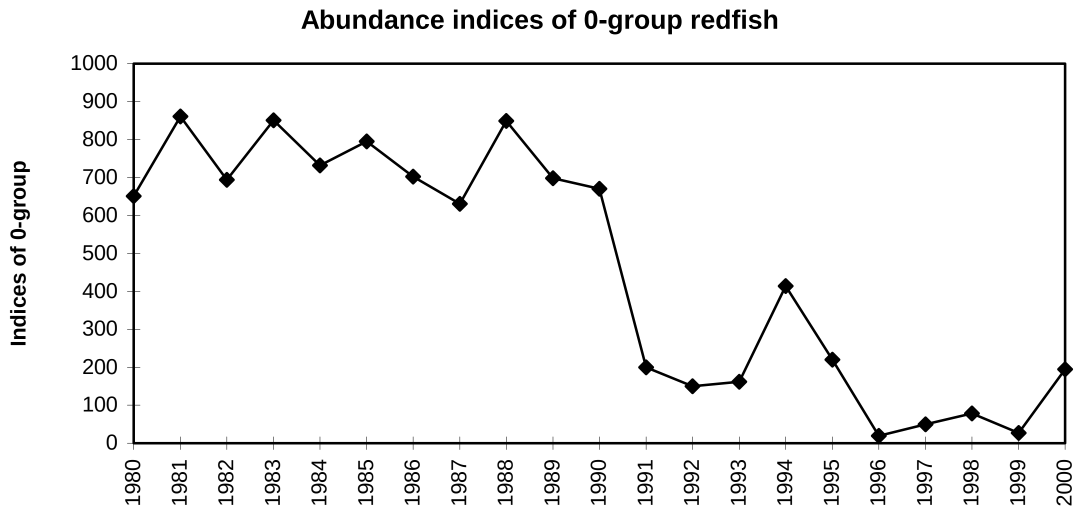


Figure 6.1. Abundance indices of 0-group redfish (believed to be mostly S.mentella) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-2000.

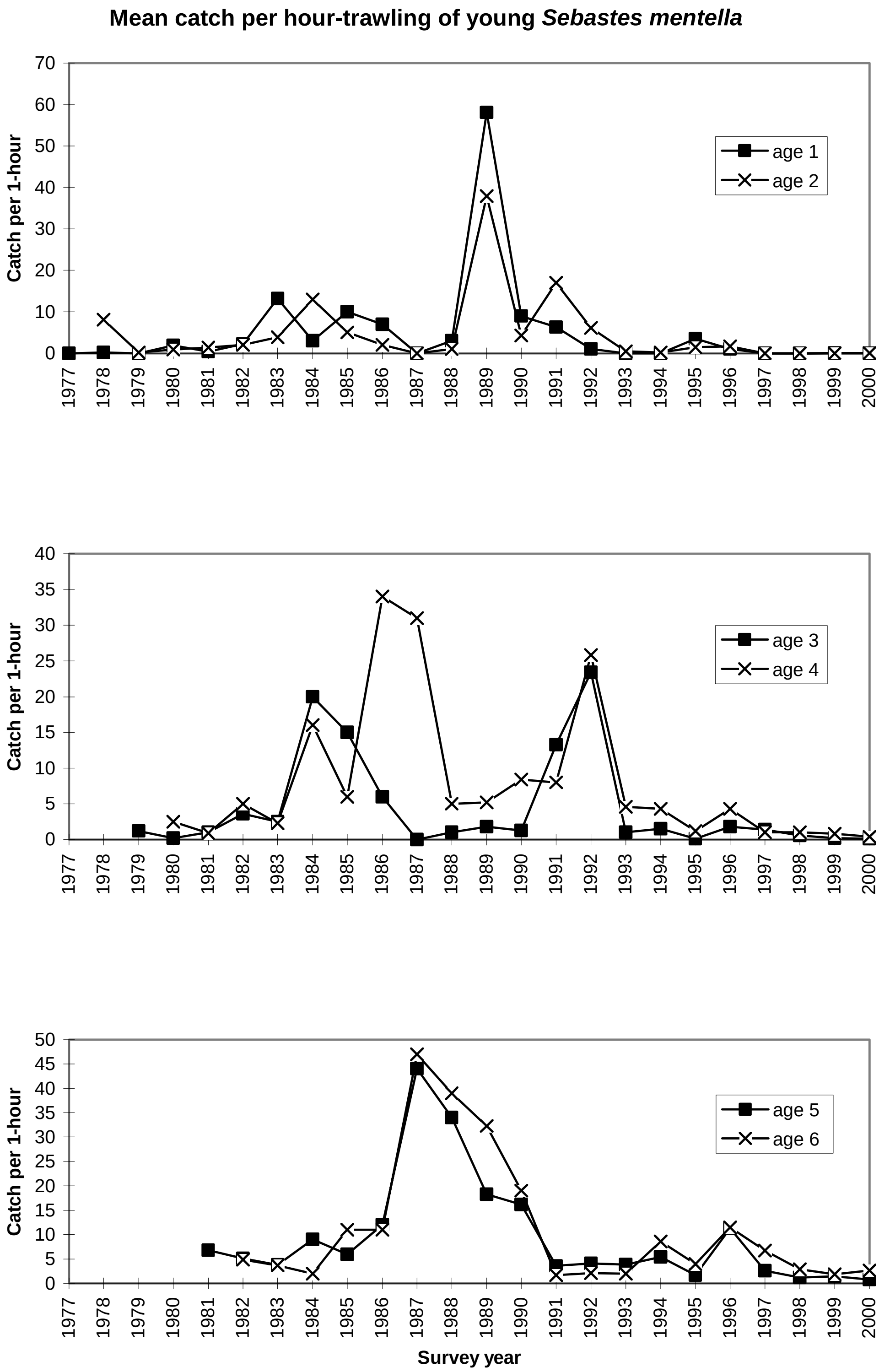
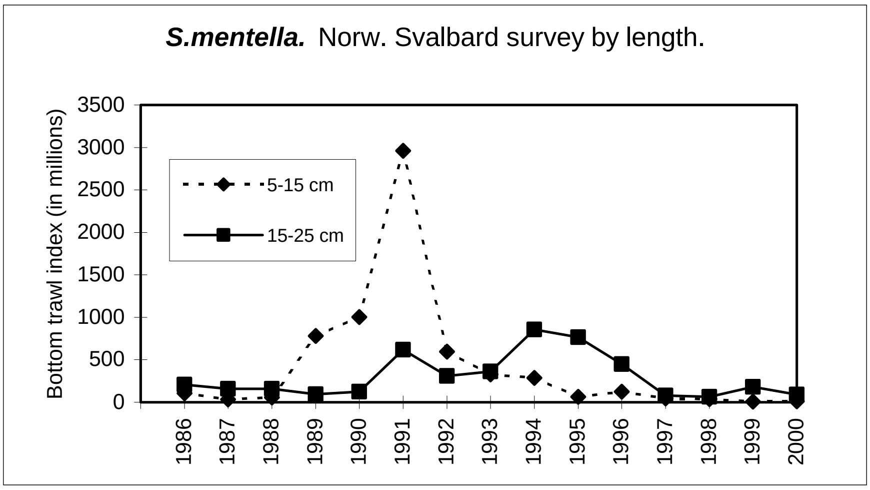


Figure 6.2. Catch (numbers of specimens) per hour trawling of different ages of Sebastes mentella in the Russian groundfish survey in the Barents Sea and Svalbard areas (ref. Table D4).



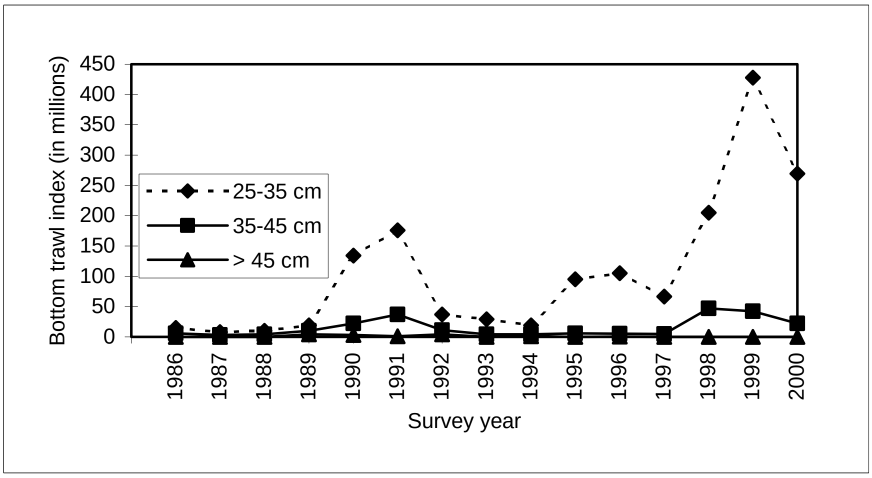
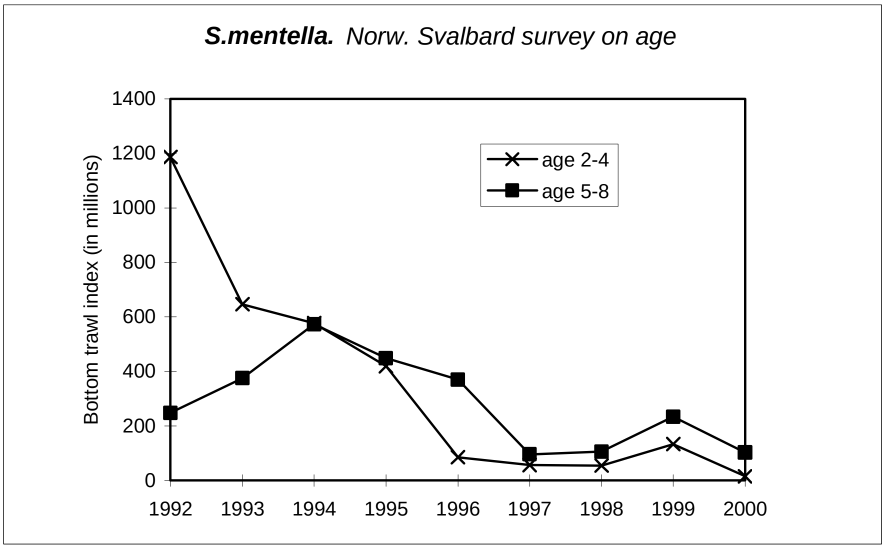


Figure 6.3a. *Sebastes mentella.* Abundance indices (on length) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-2000 (ref. Table D5a).



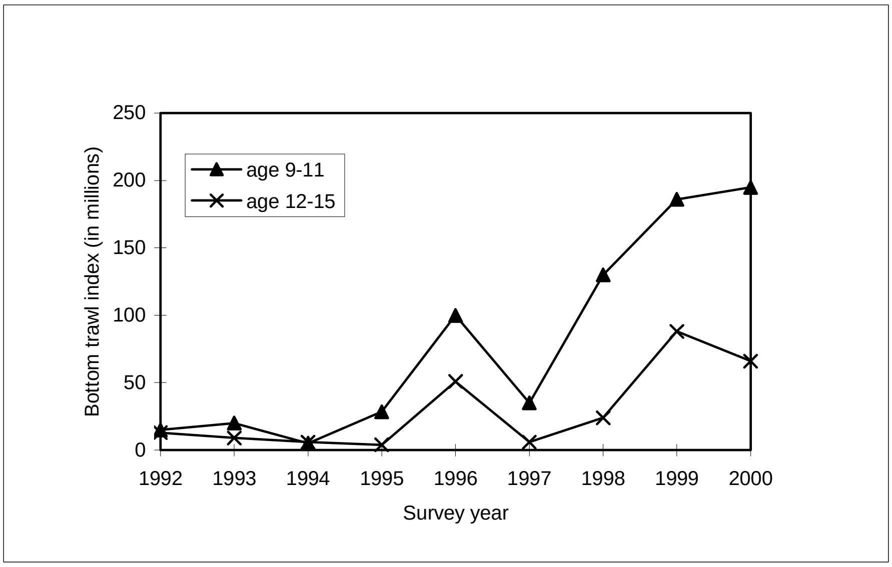
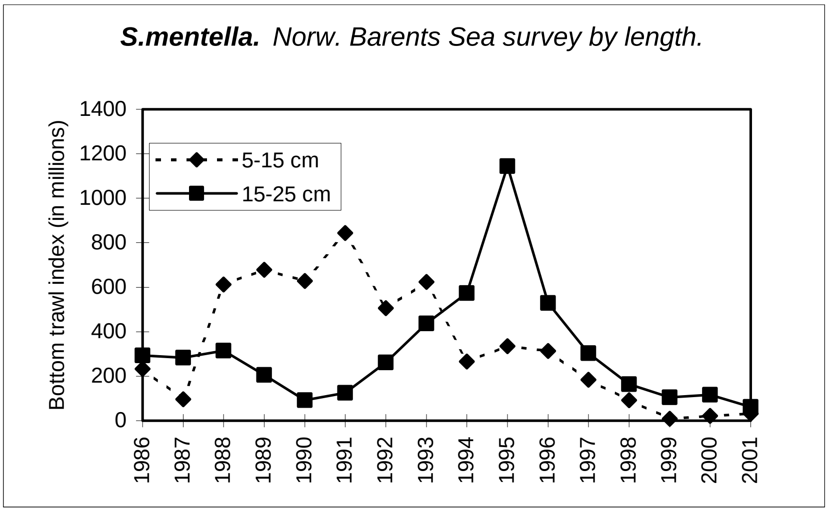


Figure 6.3b. *Sebastes mentella.* Abundance indices (on age) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1992-2000 (ref. Table D5b).



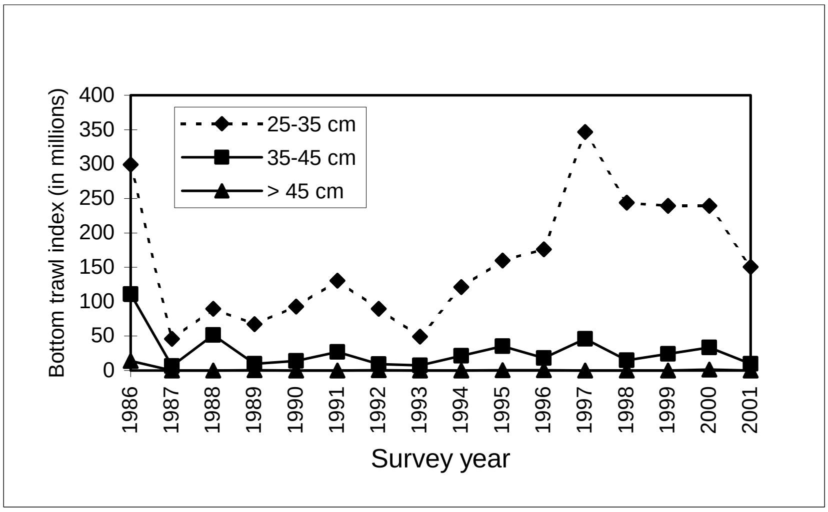
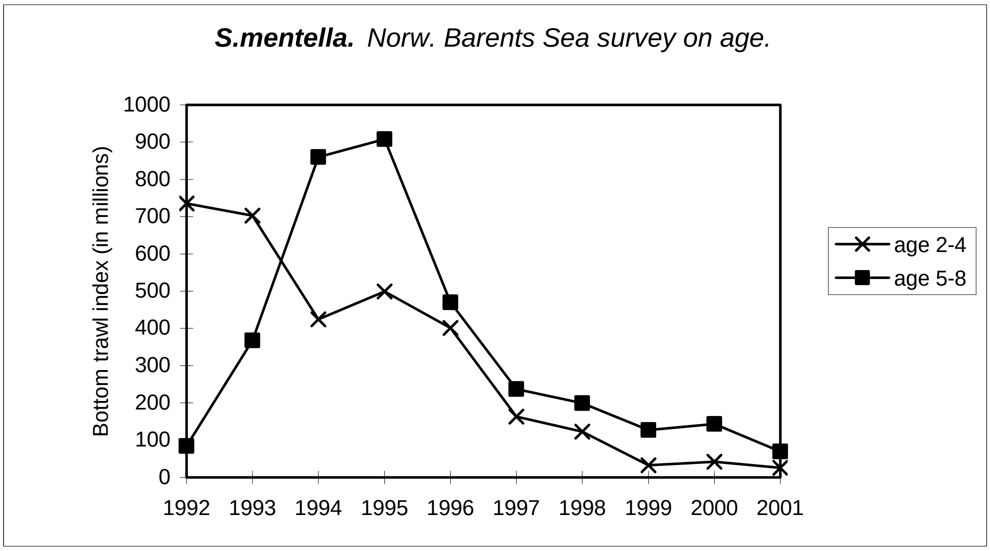


Figure 6.4a. *Sebastes mentella.* Abundance indices (**on length**) from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-2001 (ref. Table D6a).



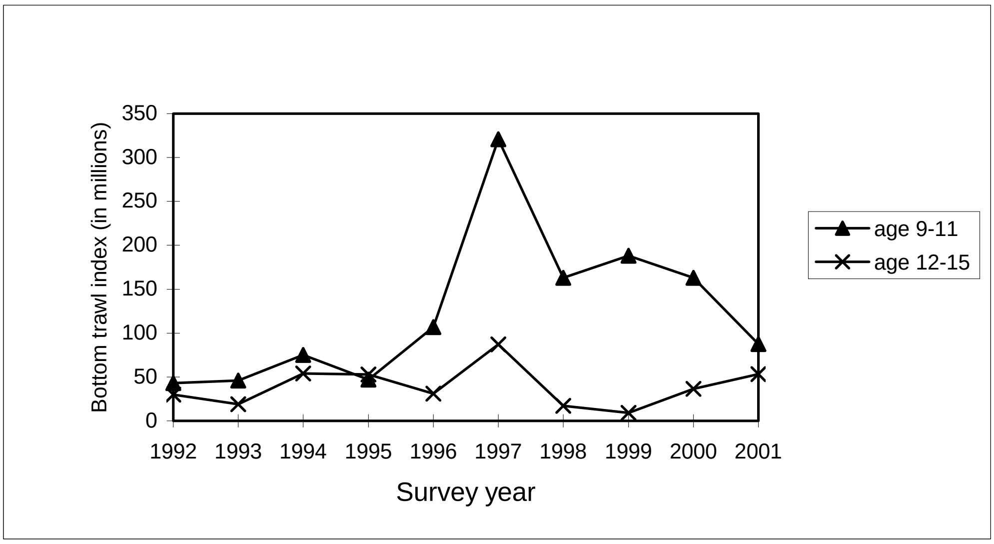
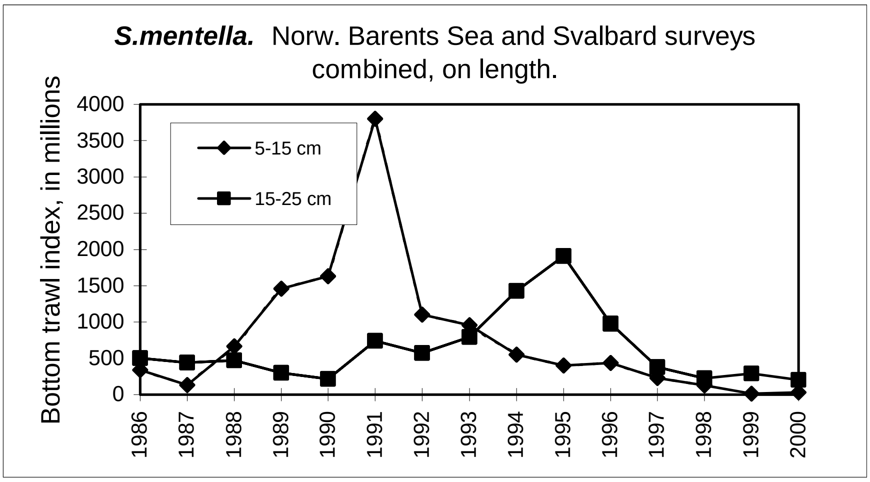


Figure 6.4b. *Sebastes mentella.* Abundance indices (**on age**) from the Norwegian bottom trawl survey in the Barents Sea in winter 1992-2001 (ref. Table D6b).



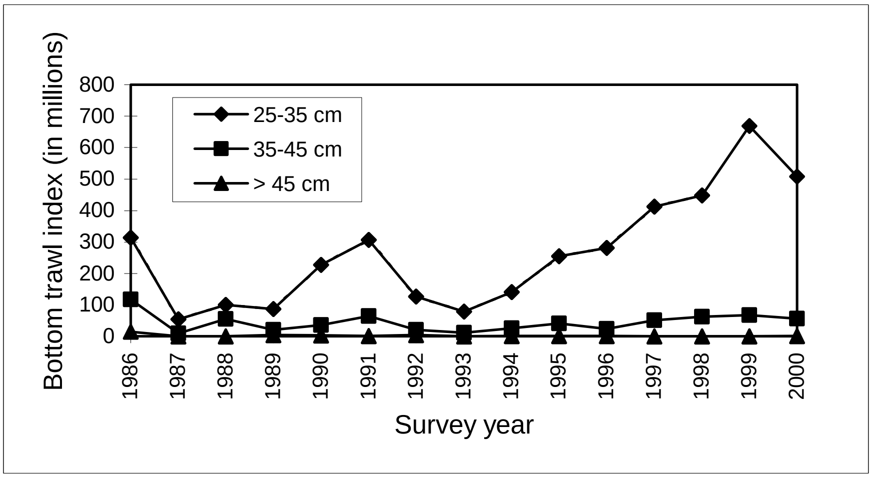
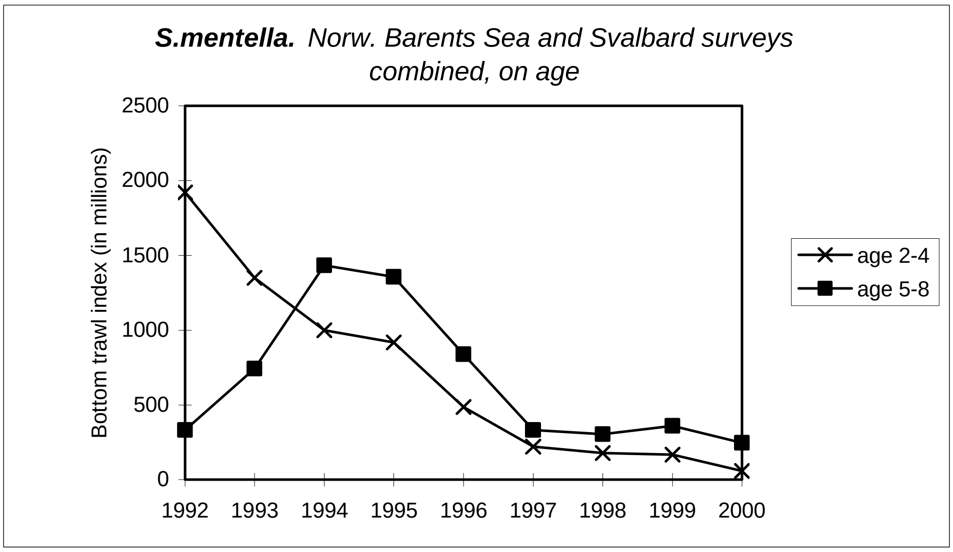


Figure 6.5a. *Sebastes mentella.* Abundance indices (**on length**) when combining the Norwegian bottom trawl surveys 1986-2000 at Svalbard (summer/fall) and in the Barents Sea (winter).



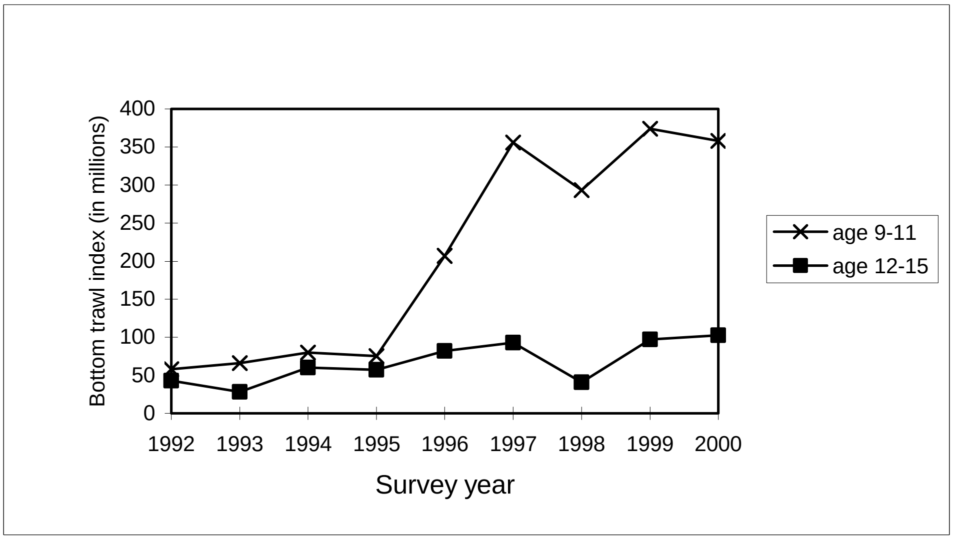


Figure 6.5b. *Sebastes mentella* . Abundance indices (**on age**) when combining the Norwegian bottom trawl surveys 1992-2000 at Svalbard (summer/fall) and in the Barents Sea (winter).

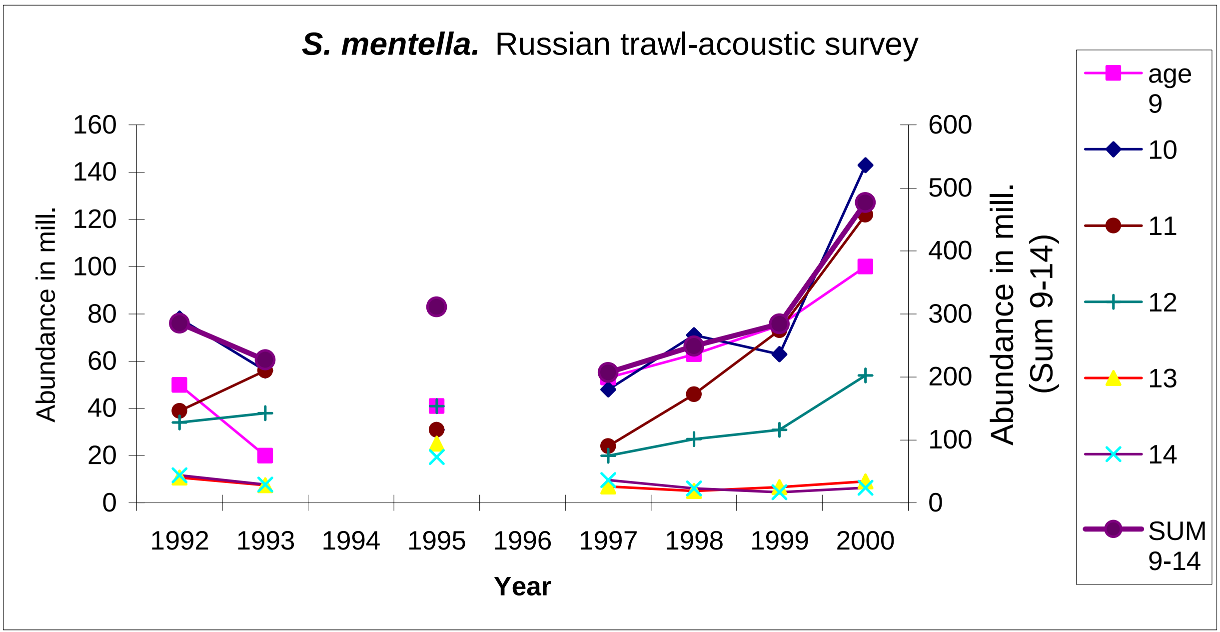


Figure 6.6. Results of the Russian trawl/acoustic redfish survey for ages 9-14 (ref. Table D7).

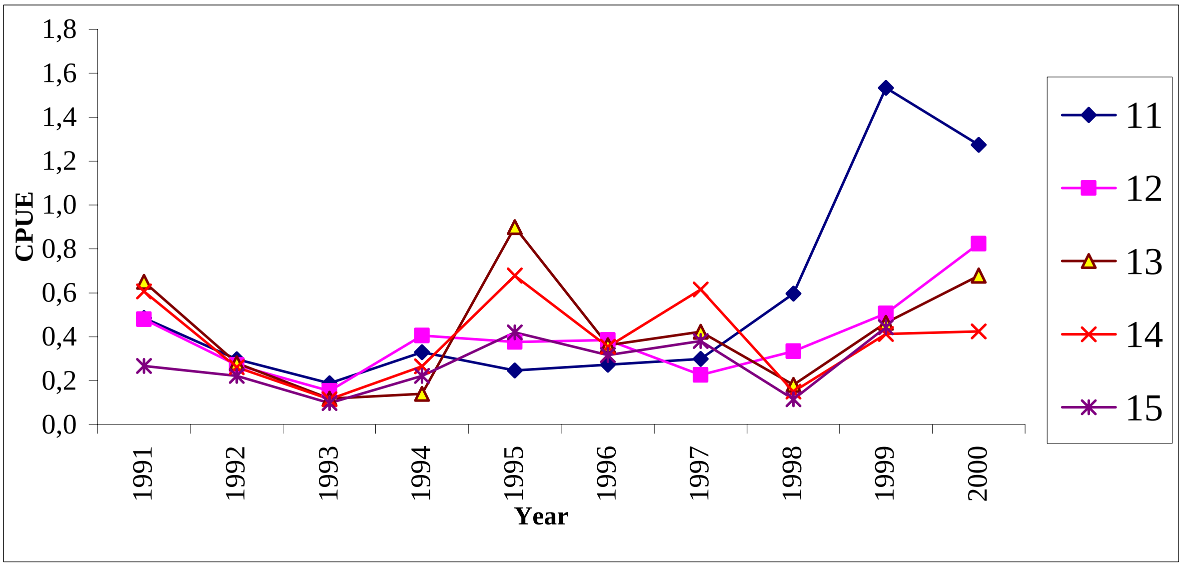


Figure 6.7. Russian trawl (BMRT) CPUE for ages 11-15.

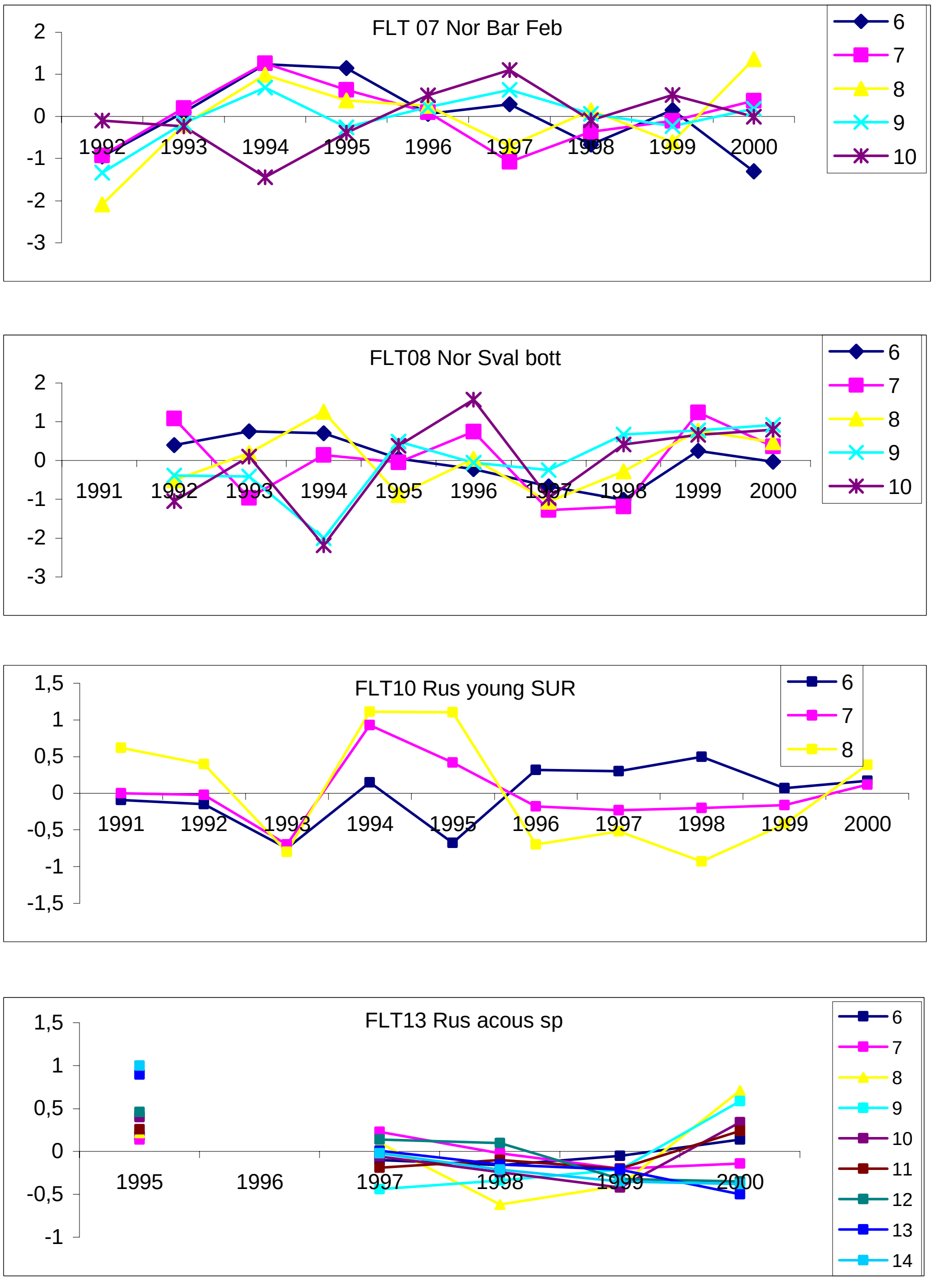
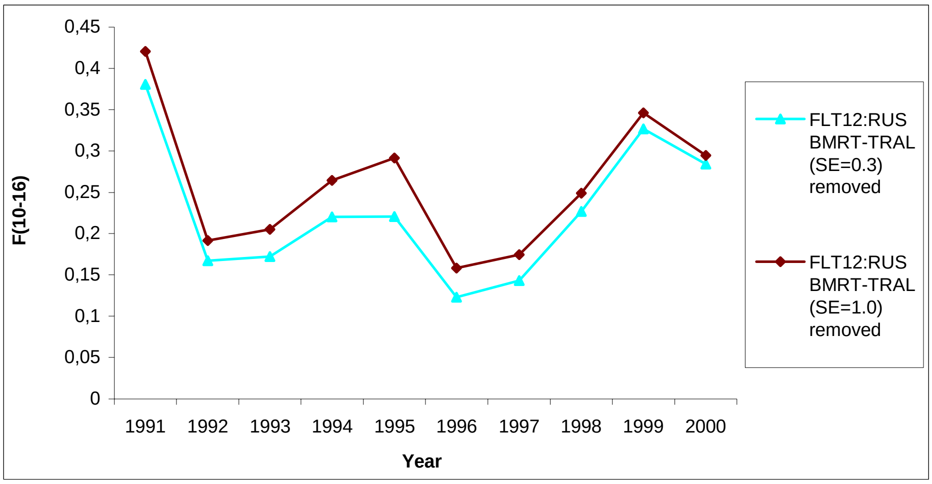
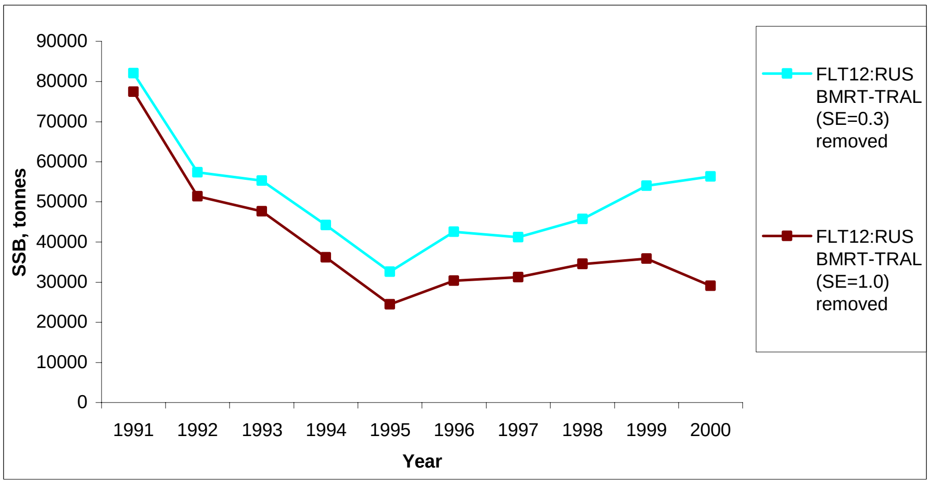


Fig 6.8. Log q residuals from different fleets included in the exploratory XSA runs.





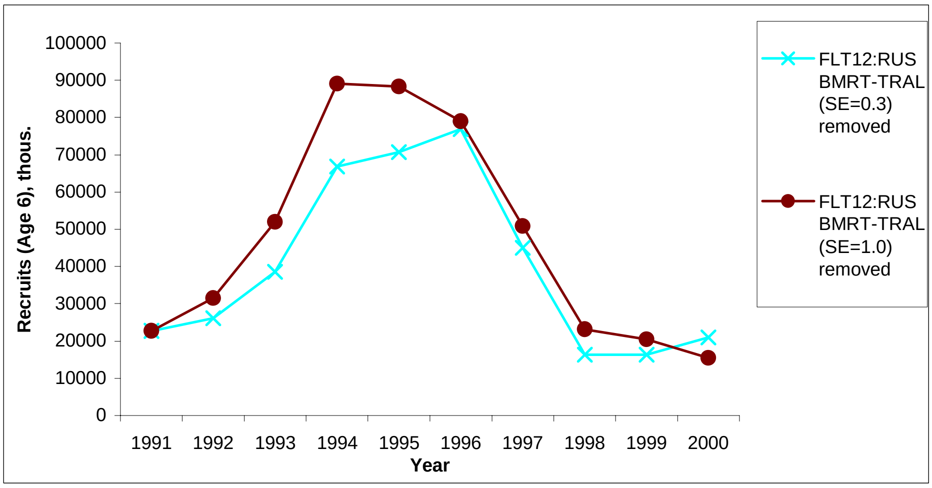


Fig. 6.9. Results from the exploratory XSA runs with different levels for minimum standard error for population estimation from each fleet. Only scientific survey series included in the tuning (see Fig. 6.10).

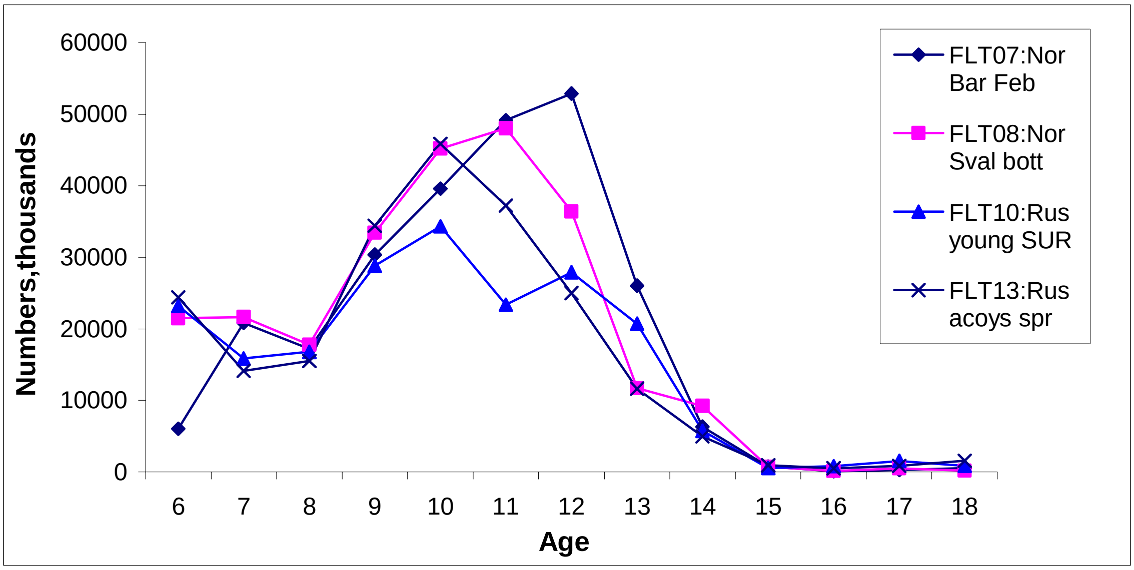


Fig. 6.10. Estimated survivors by the different survey series from the exploratory XSA run.

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	Can ada	Den mark	Faroe Islands	France	Ger many[4]	Green land	Ice land	Ire land	Nether lands	Nor way	Po land	Port ugal	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	228	211	94	33,175
1999	-	-	108	61[3]	430	97	14	10	-	24,624[2]	6	68	4,422	36	247	62	30,185
2000[1]	-	-	67[3]	25[3]	205	51[3]	62	1[3]	-	18,897[2]	2	131	4,631	108[2]		204[6]	24,384

[1] Provisional figures.
[2] Working Group figure.
[3] As reported to Norwegian authorities.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

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	3	52	1	n.a.	58	39	16	868[1]	67	465	1,569
2000[1]	5	41	n.a.	n.a.	19	n.a.	19	443	n.a.	619[3]	1,146

[1] Provisional figures.
[2] Working Group figure.
[1] UK(E/W/)+UK(Scotl)
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)		Total effort (USSR/Russia units)	
Year	BMRT[1]	PST[2]	BMRT[1]	PST[2]
1975	2.0	0.9	119,535	265,634
1976	1.7	1.11	158,198	242,285
1977	1.5	1.02	97,576	143,495
1978	0.9	0.75	102,901	123,482
1979	0.9	0.84	96,828	103,744
1980	1.8	1.25	44,085	63,483
1981	1.9	1.31	42,669	61,886
1982	1.8	1.59	64,102	72,568
1983	3.0	1.86	35,091	56,599
1984	1.8	1.42	40,519	51,362
1985	1.1	1.01	57,335	62,444
1986	0.8	0.81	28,890	28,533
1987	0.8	0.78	13,148	13,485
1988	0.8	0.71	19,483	21,952
1989	0.8	0.79	29,367	29,739
1990	0.8	0.72	43,838	48,708
1991	1.0	0.77	48,727	63,282
1992	0.5	0.70	31,180	22,271
1993	0.4	0.90	32,165	14,296
1994	1.1	0.83	11,565	15,327
1995	1.5	0.80	8,856	12,855
1996	1.5[3]	0.80[3]	5,383	10,094
1997	1.4	0.80	6,088	10,654
1998	1.4	1.00	9,889	13,844
1999	2.7		4,112	
2000	2.5		3,291	

[1]Side trawlers, 1900-2400 HP.
[2]Stern trawlers, 2200 HP.
[3] Average 1995 and 1997

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	1.3
1990	2.5	6.3	6.1	1.0	4.3	1.7	11.5	6.6	2.5	3.3	3.5	-
1991	0.3	1.0	0.5	1.5	1.2	11.3	6.7	4.0	2.5	2.3	-	-
1992	0.6	+	0.2	0.1	4.3	2.6	2.9	1.5	2.0	-	-	-
1993[1]	-	+	1.5	1.8	1.0	1.2	1.9	2.0	-	-	-	-
1994	0.3	3.5	1.7	1.4	1.0	1.4	2.7	-	-	-	-	-
1995	2.8	1.0	0.7	0.6	0.8	0.8	-	-	-	-	-	-
1996[2]	+	+	+	0.2	0.4	-	-	-	-	-	-	-
1997[3]	+	+	+	0.1	-	-	-	-	-	-	-	-
1998	+	0.1	0.1	-	-	-	-	-	-	-	-	-
1999	+	+	-	-	-	-	-	-	-	-	-	-
2000	0.2	-	-	-	-	-	-	-	-	-	-	-

[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 1986-2000 (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	4	3	121	62	259	169	42	1	0	661
2000	+	10	31	59	126	143	21	1	0	391

[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 1992-2000 (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
2000	4	6	6	14	35	22	31	54	81	60	24	24	10	8	379

[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 1986-2001 (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
2001	9,3	22,5	7,0	54,9	77,4	73,2	9,4	0,6	0,1	254,2

[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	9	12	21	17	9	39	77	73	50	41	14	10	7	6	385
2001	1	17	8	1	7	22	39	30	34	23	24	17	9	3	236

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.
[2] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D7. Sebastes mentella in Sub-areas I and II.
Results of the Russian trawl/acoustic redfish survey in the western Barents Sea in April-May 1992-2000. Abundance indices in millions.

Year	Period of survey	Age																		Total				Area of survey in
		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	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 2001 (Tables 7.1–7.5, D1 and D2)

Nominal catches of *S. marinus* by country for Sub-areas I and II combined are presented in Table 7.1 and the totals for both *S. marinus* and *S. mentella* in Tables D1 and D2. Landings of *S. marinus* showed a decrease in 1991–1992 from a level of 23,000–30,000 t in 1984–1990 to a stable level of about 16,000-19,000 t in the years 1991–1998. The provisional total landings figure for *S. marinus* in 2000 is 16,154 t. This is 1,154 t more than expected by last year's Working Group.

Information describing the splitting of the redfish landings by species and area is given in Section 6.1.2. The time series of *S. marinus* landings are given in Table 7.5 and shows a longterm mean of 17,600 t.

7.1.3 Expected landings in 2001

On the basis of reports from the first months of the year, the Norwegian landings in 2001 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 longterm 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 in periods of low quotas of cod and haddock .

7.2 Data Used in the Assessment

7.2.1 Fishing effort and catch-per-unit-effort (Tables D9, Figure 7.1)

Data for *S. marinus* were available for Norwegian freezer trawlers (ISSCFV-code 07, 250–499.9 GRT) since 1981 (Table D9). The total international effort was estimated from these data. This series is based on statistical (GLM) analysis of monthly data from five Norwegian statistical areas along the Norwegian coast. The series was not updated for this year's assessment. 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, Figure 7.1). A surplus production analysis was therefore considered to be of little value in the evaluation of stock parameters. The provisional figure for 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 1998-1999 were revised. Age composition data for 2000 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 2000. A SOP-correction of the weights was made to make the sum of products fit the total nominal catch.

7.2.4 Maturity at age

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

7.2.5 Survey results (Tables 7.6a,b, D10a,b-D11a,b, Figures 7.2–7.3)

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

Norwegian Barents Sea bottom trawl survey (February) from 1986–2001 in fishing depths of 100–500 m. Data on length for the years 1986–2001 are shown in Table D10a and Fig 7.2a. Data disaggregated on age for the years 1992–2001 are shown in Table D10b and Figure 7.2b. This survey covers important nursery areas for the stock. One single big catch during the 1998 survey extrapolated to a big area destroyed the dynamic in the figures and has therefore been removed in this year's assessment.

Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1985–2000 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–2000 (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.

Catch rates (numbers/nautical mile) and acoustic indices of *Sebastes marinus* from the Norwegian Coastal and Fjord survey in 1995-2000 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 especially 35-44 cm fish in the 1999-2000 surveys 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 1999-2000 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 FLEKSIBEST model, were discussed also for this redfish stock. This model is based on the BORMICON model which currently is used by the ICES North-Western WG on *S. marinus*. Preparatory work should 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 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 2001 despite the increased interest in the fishery due to reduced cod and haddock quotas give cause of concern. This concern is also expressed by the fishermen. Since both the fishermen are concerned about the current fishable biomass, and the survey show poor recruitment, then we already may be late in enforcing a strategy to rebuild the stock.

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	35	35	228	47	14	7	-
2000[1]	17	13	157	22	16	-	-

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	51	118	53	19,331
1999	16,847	3	1,691	7	135	34	19,083
2000[1]	14,270	16	1,112	9		74[4]	16,154

[1] Provisional figures.
[2] Includes former GDR prior to 1991.
[3] USSR prior to 1991.
[4] UK(E&W)+UK(Scot.)

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	35[2]	18[2]	9[2]	14[2]	1,973	360	11[2]	-	2,420
2000[1]	-	1[2]	-	16[2]	2,068	146		13[6]	2,243

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6]UK(E&W)+UK(Scot.)

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	51[2]	85[2]	52[2]	16,615
1999	-	35[2]	210[2]	38[2]	7[2]	-	14,855	3[2]	976	7[2]	122[2]	34[2]	16,287
2000[1]	17[2]	13[2]	156[2]	22[2]	-	-	12,632	16[2]	658	9[2]		61[6]	13,583

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6]UK(E&W)+UK(Scot.)

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	-	-	-	19	-	355	-	2[2]	-	376
2000[1]	-	-	-	20	-	308	-	-	-	328

[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 1908-2000 (thousand tonnes).

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
915	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	2000	16.15
1952	56.17	Average	17.62
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 1995-2000 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**	**2000**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	244	322	39	0	0	0	107	19	0	0	0	0	0	0	0	0	0	0
10-14	152	273	98	0	0	17	318	331	0	2	4	2	219	21	0	0	31	0
15-19	19	157	112	28	2	93	135	574	10	6	2	26	149	49	0	0	314	0
20-24	69	287	77	33	2	33	62	698	7	2	8	16	162	6	0	16	136	3
25-29	169	476	268	42	4	50	24	64	20	50	10	18	72	27	17	8	9	3
30-34	299	333	255	28	15	20	7	696	40	43	39	49	133	88	54	18	62	8
35-39	112	200	19	8	47	56	21	796	30	43	55	83	92	529	324	341	295	239
40-44	38	53	27	6	50	43	7	238	23	22	25	81	60	133	385	291	263	269
45-49	2	16	12	0	11	12	3	48	3	2	23	56	11	24	83	50	40	43
50-54	2	3	0	0	2	0	0	0	3	0	8	2	0	0	0	8	5	3
55-59	0	0	0	0	0	0	0	0	7	0	4	2	4	0	0	0	0	0
60-64	0	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Total	1106	2120	911	144	134	326	684	3463	142	170	178	335	903	878	864	731	1156	568
Measured	398	602	230	52	62	139	198	243	43	54	87	108	168	185	70	97	148	156
# trawls	23	17	19	16	25	25	15	16	20	21	25	25	13	14	17	15	22	19
# trawl with species	18	12	16	7	10	8	10	15	9	10	9	10	9	13	9	9	13	15
Area nm^2			4205						7303						9962			

	Area 0 - Vestfjord						Area 6 - Nordland						Area 7 - Møre					
Length range (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0-4	0	0	0	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	0	0	0
10-14	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	26	0
15-19	0	0	0	6	711	0	0	7	0	0	0	0	0	0	0	0	479	0
20-24	0	0	430	26	273	0	0	25	5	7	0	0	0	0	0	0	557	0
25-29	0	8	587	6	88	8	5	15	21	4	0	0	0	0	0	0	111	4
30-34	18	41	286	0	88	132	28	167	75	15	0	0	0	0	0	0	57	9
35-39	454	206	380	58	328	136	564	526	225	78	44	20	5	14	3	0	114	388
40-44	442	33	361	64	230	182	373	599	229	81	61	133	14	10	3	0	31	147
45-49	53	8	88	13	0	8	52	217	59	19	4	31	0	7	3	4	0	9
50-54	9	0	6	6	0	8	3	0	5	0	4	0	0	0	0	0	0	9
55-59	0	0	0	0	0	0	3	0	0	0	4	0	0	0	0	0	0	0
60-64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	976	296	2138	180	1772	474	1028	1556	620	204	118	184	19	31	10	4	1374	566
Measured	75	22	162	28	40	38	183	172	91	55	27	36	4	9	3	1	95	26
# trawls	10	6	11	7	5	6	22	16	12	15	13	12	11	15	16	13	12	12
# trawl with species	7	3	11	4	3	5	15	12	9	6	4	7	2	5	3	4	3	5
Area nm^2			5542						9316						7246			

	Total					
Length range (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0-4	0	0	0	0	0	0
5-9	41	34	4	0	0	0
10-14	118	87	9	0	19	19
15-19	59	124	12	4	242	119
20-24	54	151	64	12	160	52
25-29	38	67	112	16	34	83
30-34	69	210	96	17	43	218
35-39	214	415	178	110	151	922
40-44	157	209	190	96	117	855
45-49	21	64	45	18	15	159
50-54	2	0	2	3	4	22
55-59	1	0	1	0	2	2
60-64	0	0	0	0	0	2
Total	775	1361	715	277	786	2453
Measured	1026	1233	599	287	459	503
# trawls	94	84	95	87	102	99
# trawl with species	61	60	57	40	42	50

Table 7.7. Acoustic index of *Sebastes marinus* from the Norwegian Coastal Surveys in 1995-2000, within 5-cm length-groups and six subareas.

Areas 00 and 03-07						
Length (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
5-9	40519	1908	232	0	0	31
10-14	13627	7656	706	24	519	221
15-19	8161	11057	1207	96	6926	1112
20-24	9396	7983	6171	1500	5679	2661
25-29	4229	10275	12113	81	1183	4310
30-34	3914	10504	7382	2090	2423	3797
35-39	15711	34437	22440	9914	9082	14036
40-44	13960	19171	28846	5477	7881	14680
45-49	3431	4539	5653	499	1587	2278
50-54	657	8	230	0	376	709
55-59	519	0	147	0	179	40
60-64	0	0	20	0	0	18

Table 7.8.

Run title : Arctic S. marinus (run: XSAKHN03/X03)

At 3/05/2001 17:50

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

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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	1	0	0	0	0	0
6	0	2	0	0	4	0	0	0	0	0
7	0	5	0	46	60	9	9	28	78	5
8	142	22	24	7	85	119	98	51	593	15
9	88	78	193	292	230	313	157	203	855	81
10	520	114	359	640	672	361	322	464	572	292
11	321	394	406	816	908	879	689	716	1007	1270
12	350	549	1036	1930	1610	1234	1069	960	1232	1214
13	1387	783	1022	2096	2038	1638	1788	1506	1619	2134
14	2062	1718	1523	2030	2295	2134	2284	1731	1480	1595
15	1258	3102	2353	1601	1783	1675	2180	1575	1612	2338
16	2497	2495	1410	2725	1406	1614	1855	1040	1240	2306
17	1695	2104	1655	2668	785	1390	1426	1276	1407	1786
18	2472	1837	1678	1409	563	952	854	968	1558	771
19	1150	998	745	617	670	679	807	1019	1019	513
20	1026	858	716	733	593	439	610	848	394	460
21	617	688	534	514	419	560	513	443	197	133
22	425	547	528	256	368	334	206	764	459	234
23	659	268	576	177	250	490	335	488	174	245
+gp	3991	3110	3482	1508	3232	3135	2139	3402	2131	912
0 TOTAL	20660	19672	18240	20065	17972	17955	17341	17482	17627	16304
TONSL	19041	16185	16651	18120	15616	18043	17576	19331	19083	16155
SOPCO	101	97	104	100	100	105	100	100	104	100

Table 7.9.
Run title : Arctic S. marinus (run: XSAKHN03/X03)

At 3/05/2001 17:50

Table 2 Catch weights at age (kg)

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE										
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0200	.0200	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0300	.0300	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0530	.0530	.0000	.0000	.1600	.0000	.0000	.0000	.0000	.0000
6	.0780	.0800	.0000	.0000	.2400	.0000	.0000	.0000	.0000	.0000
7	.1330	.1800	.0000	.2500	.3300	.2200	.2300	.3700	.1400	.2000
8	.3700	.2900	.3300	.3700	.4300	.4900	.5100	.2100	.2600	.2400
9	.5100	.4800	.3600	.3800	.6400	.5600	.5300	.4700	.4400	.3300
10	.4600	.4200	.4300	.4900	.6100	.6500	.7400	.6200	.5700	.4600
11	.5300	.5000	.5100	.5100	.5900	.7100	.7200	.6700	.6900	.5500
12	.6100	.5900	.5100	.6400	.6500	.8100	.7800	.7700	.7800	.6500
13	.6400	.5800	.6400	.7400	.7400	.8400	.8000	.7700	.8600	.7600
14	.7100	.6500	.6400	.7600	.7900	.8800	.8600	.8500	1.0400	.8600
15	.7600	.6500	.7600	.8600	.8400	.9600	.9100	1.0500	1.0700	.9900
16	.8300	.7100	.8600	.9500	.9200	1.0000	.9900	.9600	1.1200	1.1400
17	.8400	.8200	.8900	1.0300	1.1200	1.0200	1.1600	1.2500	1.1800	1.2800
18	1.000C	.8400	.9800	1.0700	1.0100	1.0100	1.1800	1.2900	1.7100	1.3600
19	.9600	.9400	1.0000	1.1100	1.0100	1.0000	1.2100	1.3000	1.0900	1.5800
20	1.040C	1.0200	1.0300	1.1600	1.2100	1.0300	1.3400	1.2300	1.1800	1.0900
21	1.030C	1.0300	1.2100	1.1500	1.1400	1.0400	1.2800	1.8700	1.0400	1.3300
22	1.080C	1.1500	1.0300	1.1300	1.0900	1.1400	1.5400	1.4600	1.3400	1.3600
23	1.020C	1.2700	1.2000	1.0200	1.3000	1.0900	1.1900	1.7300	1.1800	1.1400
+gp	1.216C	1.2700	1.1400	1.3600	1.0100	1.1600	1.2900	1.2900	1.3400	1.2300
0 SOPC(	1.0135	.9702	1.0376	1.0038	.9998	1.0482	1.0040	1.0019	1.0400	1.0014

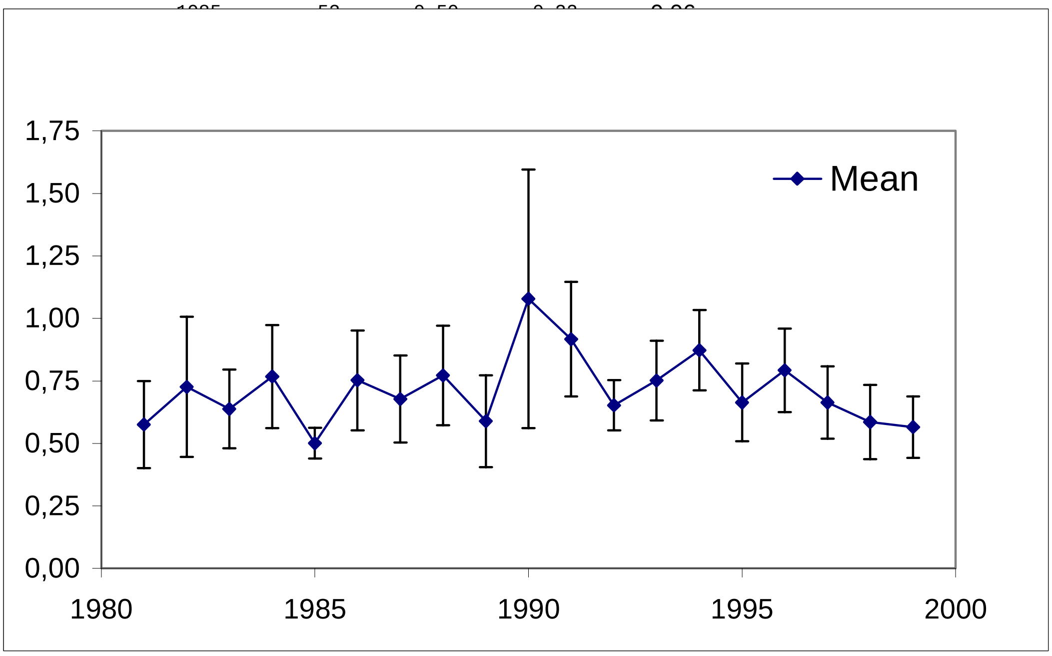
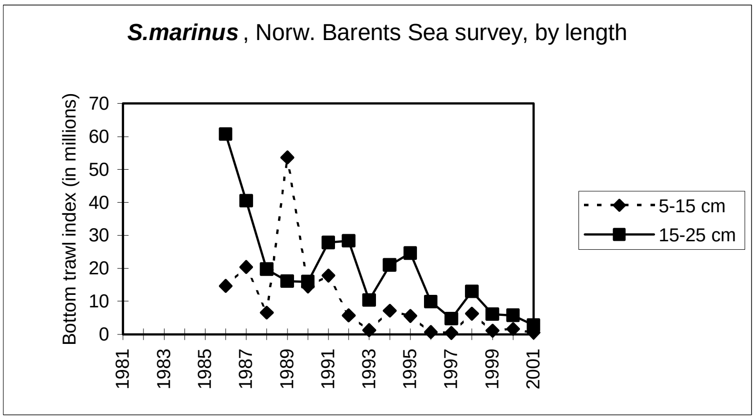


Figure 7.1. Plot of simple mean CPUEs with 2 st.errors based on logbook information from freezer trawlers. Only days where *S.marinus* composed more than 50% of total catch were included in the analysis. The CPUEs have been standardized and scaled to a certain area (03) and month (2).



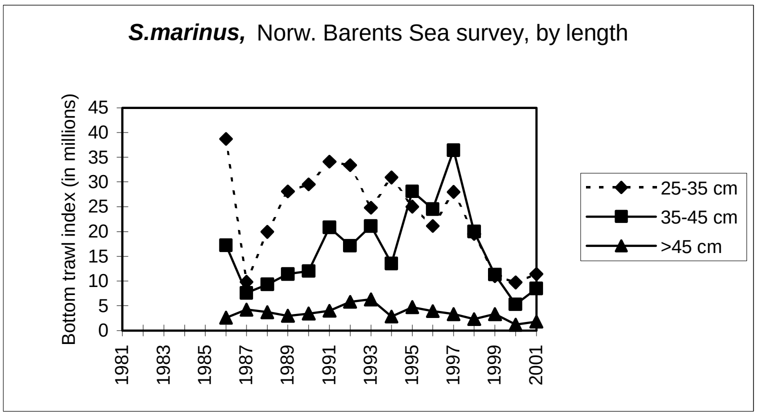


Figure 7.2a. *Sebastes marinus.* Abundance indices **(by length)** from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-2001 (ref. Table D11a).

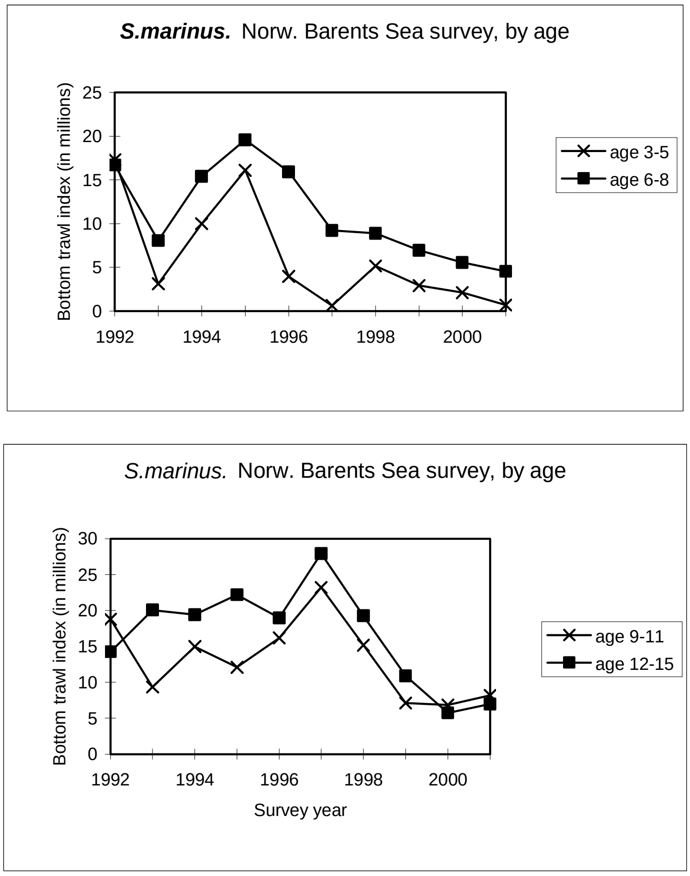


Figure 7.2b. *Sebastes marinus.* Abundance indices (by age) from the Norwegian bottom trawl surveys 1992-2001 in the Barents Sea (ref. Table D11b).

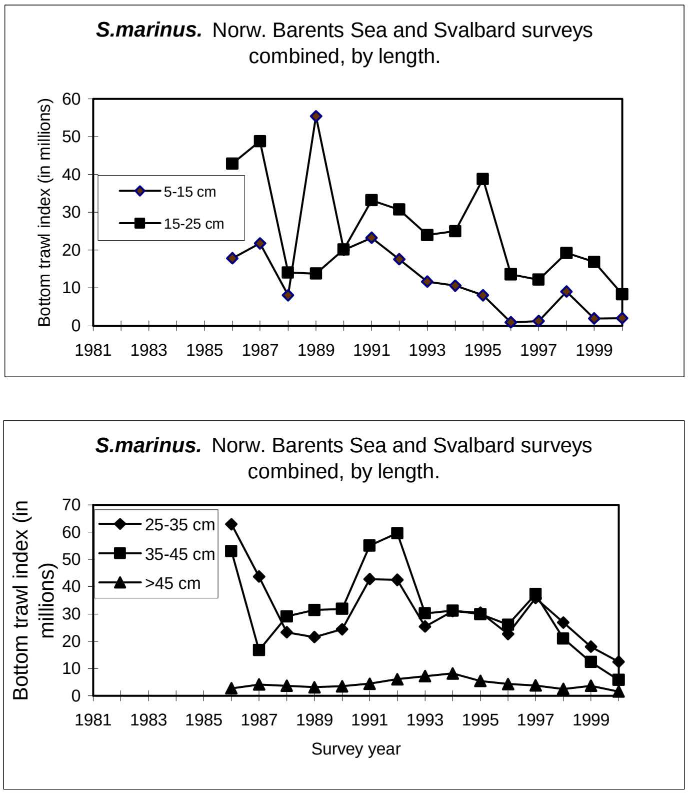
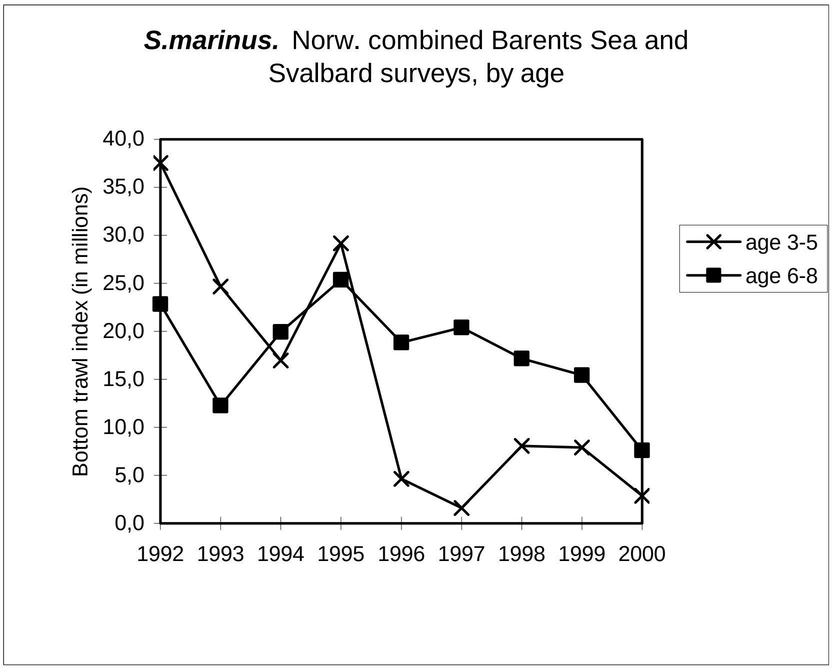


Figure 7.3a. *Sebastes marinus.* Abundance indices (**by length**) when combining the Norwegian bottom trawl surveys 1986-2000 in the Barents Sea (winter) and at Svalbard (summer/fall).



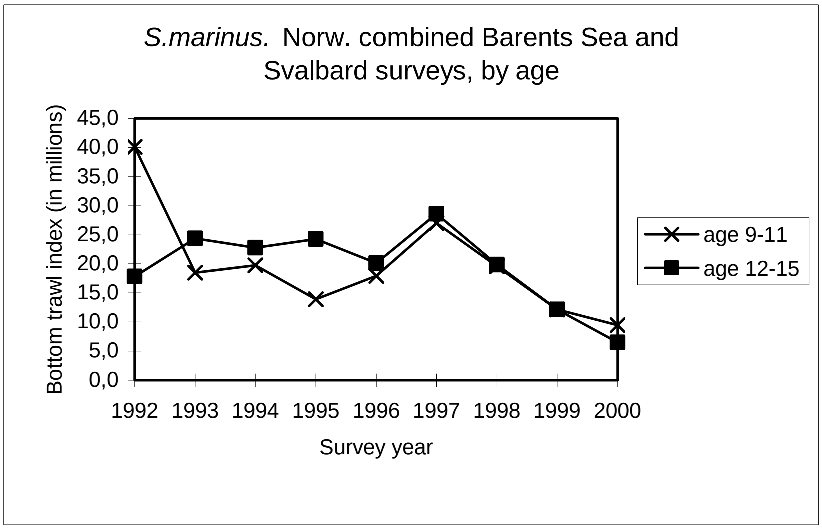


Figure 7.3b. *Sebastes marinus.* Abundance indices (**by age**) when combining the Norwegian bottom trawl surveys 1992-2000 in the Barents Sea (winter) and at Svalbard (summer/fall).

Table D9. *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 D10a. *Sebastes marinus*. Abundance indices **(on length)** from the bottom trawl surveys in the Barents Sea in the winter 1986-2001 (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	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	0.5	1.1	1.5	4.2	4.7	5.0	3.5	1.8	1.2	24.0
2001	0.1	0.4	0.4	2.4	5.8	5.6	5.0	3.5	1.8	25.0

[1] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D10b. *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	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	490	720	900	1,310	1,800	2,440	2,020	2,710	2,090	940	1,440	2,940	430	20,230
2001[1]	320	170	190	940	1,360	2,220	3,110	2,400	2,690	2,230	2,180	1,200	1,370	20,380

[1] Preliminary

Table D11a. *Sebastes marinus* in Division IIb. Abundance indices (**on length**) from the bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1985-2000 (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
2000	40	360	1,240	1,390	2,010	760	400	160	390	6,750

[1] - Old trawl equipment (bobbins gear and 80 meter sweep length)

Table D11b. *Sebastes marinus* in Sub-areas I and II. Norwegian bottom trawl survey indices **(on age)** in the Svalbard area (Division IIb) in summer/fall 1992-2000 (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
2000	40	20	400	350	840	480	730	1,670	620	340	510	100	80	70	6,250

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 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 about 80,000 t in the early 1970s. The total landings decreased steadily to 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 2000 total landings varied between 9 000-14 000 t with a peak in 1999 when landings 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 to autumn 1994 bycatch in each haul was not to exceed 10% by 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 further to 10% in each haul but only 5% of the landed catch. From 2001 the bycatch regulations again was changed to 12% in each haul and 7% 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 be attributable partly to the less restrictive bycatch regulations. The reduction in allowable bycatch likely lead to the decrease in trawler landings to 7,300 t in 2000. Landings of Greenland halibut from the directed longline and gillnet fisheries have also increased in recent years to 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 2001 (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. Some of the values in the tables vary slightly from the official statistics, and represents those presented to the Working Group by the members. 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 1999 is 19,350 t, which is about the same as used in the previous assessment. The preliminary estimate of total catch for 2000 is 14,139 t. This is almost equal to the projected catch of 14,200 t estimated by the Working Group during its 2000 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 increased to 2,670 t, the highest observed. In 2000 the catch decreased again to below the 1997-1998 landings, i.e. 1,052 t. The increase from 1973 to 1991 was due mainly 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 the period 1998 – 2000 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 2001

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 the beginning of April 2001 the total Norwegian catch was 1,524 t. This is well above the catch observed during this period in 2000, but below the catch observed in 1999. If this information is used to estimate the total Norwegian catch in 2001, the most likely estimate will be approximately 13,600 t. In addition 5,000 t is expected to be caught by Russian vessels and 600 t by other countries. Expected total landings (officially) for 2001 are thus 19,200 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 1984–2000 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 1989–2001 in fishing depths of less than 100 m and down to 500 m. In order to utilise the 2001 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 1984–2000 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 1992–2000 in fishing depths of 200–600 m. This series was revised at the 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 1996–2000 (Table E6).

7. Norwegian pelagic 0-group surveys from 1970–2000. (Table A14).

8. Spanish bottom trawl survey in the slope of Svalbard area, ICES Division IIb: 1997 – 2000 (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 more recent years there has been low but somewhat better representation of young fish in this survey (Figure 8.1 bottom). The 1995 and 1996 year classes were more abundant than any other year class since 1988, but the 1997 and 1998 year classes were down again to the 1990 level even if the 1997 year class is very strong as I-group. This is also the case for the 1999 year class.

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 1995-1999 year classes were not as abundant as in the survey above.

The Russian Barents Sea bottom trawl survey series from 1984–2000 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 1995-1999 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 five years. Very high abundance estimates were found for ages below 5 (Table E6). The time series is short and it is difficult to compare year class abundance, but it is noted that none of the year classes 1991-1999 were very different from the other. From 2000 this survey also has been revised and from this year the survey is conducted as a joint survey with the Russians. According to these changes it is expected that the area coverage will improve, better representing the distribution of juveniles and will provide a more comparable time series.

The strengths of the Greenland halibut year classes of 1970–1997 from the Norwegian pelagic 0-group surveys in 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. In 2000 there is a slight increase in the abundance of 0-group Greenland halibut and is the largest estimate since 1987.

The fishable and spawning stock biomass estimated from the Russian autumn bottom trawl survey shows an increasing trend from 1987 to 2000 (Smirnov, WD 30). 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 and a Spanish bottom trawl survey (Román and Paz, WD 32). Although the number of years in these surveys is limited, the trends generally follow that of the Russian survey except that the estimate in both the Spanish and Norwegian surveys in 2000 is below the values for 1999 (Fig. 8.5). A possible reason for this difference may be that the Russian survey at that time covers a larger area.

All in all, the surveys seem to indicate that the catchability of the 1990–1995 year classes increased 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, but improved considerably at older ages. The reason for this change in catchability is not clear. However, it is known 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 1990–1995 year classes to areas outside the survey area.

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 Norwegian 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. Since 1997 also two Russian trawlers conducted a limited research fishery for Greenland halibut.

The CPUE from the 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 Norwegian CPUE series has varied between 1200 and 1650 kg/h with the highest value in 2000 (Table E7). The Russian experimental CPUE series shows an increasing trend since 1997 and also this show 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 2000 data, but it is less apparent than last year. The low catches of nine-year-olds in the data correspond also to low catches of the length groups associated with that age. This may indicate that the problem is a combination of catchability, survey coverage, and stock composition and distribution by sex. In 2001 joint Norwegian-Russian work started on exchanging otoliths on a regular basis. This effort may hopefully improve precision and accuracy of the age reading.

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 are reported separately in Table 8.7.

8.3.1 Catch at age (Table 8.7 – 8.8)

The catch-at-age data for 1999 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 2000 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 8.8. 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 2000 (Table 8.9) 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.

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 sexes combined using Russian survey data were given for the years 1984–1990 and 1992–2000. An average ogive derived from 1984–1987 was used for 1964–1983. For 1984 -2000 a three-year running average was used.

8.3.5 Tuning data

In the previous assessment the following abundance indices were initially considered for tuning the VPA:

Fleet 1: Norwegian Svalbard bottom trawl surveys (autumn) from 1984–2000 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 1989–2001 for ages 5–12.

Fleet 3: Norwegian Greenland halibut surveys using a commercial vessel along the continental slope from 1994–2000 for ages 5–14.

Fleet 4: Experimental commercial fishery CPUE from 1992–2000 for ages 5–14.

Fleet 5: Russian trawl survey from 1984-2000 for ages 5-14.

Fleet 6: Norwegian Svalbard shrimp trawl surveys from 1988–2000 for ages 5–8.

However, a thorough exploration of the tuning fleet data indicated that fleets 1, 2 and 6 contributed little to the analytical assessment. These fleets are restricted in both area and depth coverage and therefore are not very representative of Greenland halibut distribution. They were therefore omitted from further analysis. Fleets 3 and 4 on the other hand are directed for Greenland halibut and fleet 5 covers most of the Greenland halibut distribution area. The Working Group again supported the rationale for using only these three fleets in tuning the current assessment. Nevertheless, preliminary analyses indicated an extremely strong and biased residual pattern in the fleet 5 data from 1984 – 91 that could not be explained. It was concluded therefore to include only 1992 – 2000 data for this fleet, which improved the diagnostics of the assessment considerably. The truncated series is now identified as fleet 7 in the IFAP data files.

8.3.6 Recruitment indices (Tables A14, E1-E6)

In addition to the indices mentioned in Section 8.3.5, all surveys in Section 8.2.1 may provide 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. Nevertheless, the relative size of the individual year classes still is poorly estimated and estimates would probably vary between sexes. Therefore, recruitment estimates from these sources were considered to be too unreliable to provide 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 three indices agreed above. The final 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 0.5. The catchability was considered to be independent on stock size for all ages and independent on age for ages 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 Figure 8.6-8.7.

8.5 Results of the Assessment

Using the tuning fleets described above, the diagnostics of the assessment indicate that it is rather robust, largely unbiased and describes the development of the stock reasonably well. The survivor estimates for 2001 for most of the important year-classes are determined primarily from the tuning fleet data and in most instances each tuning fleet contributes significantly to the determinations with little effect from inclusion of F shrinkage means in the tuning process. Varying settings such as catchability constraints and standard error thresholds also did not introduce either instability or high variability in the overall estimates.

8.5.1 Results of the 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 prosecuted by the fishery.

Until 1976 the spawning stock was well above 100,000 t, then it was relatively stable at around 75,000 t until the late 1980's after which it declined markedly. It reached an all time low of 28,000 t in 1992 before gradually improving to around 46,000 t in 1998. It has subsequently declined and by the beginning of 2001 is again at a low of 28,000 t. Using age 10+ as a proxy for female spawner biomass, however, the assessment suggests that the spawning stock has fluctuated within a range of 7,500-12,000 t over the past 10 years which in all cases is still well below anything previously observed.

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 0.67. After the reduction the fishing mortality has averaged around 0.3. The high catch in 1999 resulted in an increase in fishing mortality to 0.46 before declining to 0.34 in 2000.

Recruitment at age 5 has been relatively low in recent years, and since 1990 lower than in all previous years. However, the reduction is not especially dramatic and the 1990-2000 average is about 70% of the average during 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 2002

The input data for the prediction based on the results from XSA-analysis are as follows (Table 8.17):

The stock numbers at age in 2001 were taken from the XSA for ages 6 and older. The recruitment at age 5 in 2001 was estimated using the mean from 1990 to 1997 following the argument that recruitment at age 5 shows a sharp reduction in the most recent 2-3 years in the previous assessments, which is not believed to reflect the true recruitment. The natural mortality and the maturity ogive are the same as used in the assessment. For the exploitation pattern the average of 1998-2000 has been used, scaled to the 2000 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.

The management option table (8.18) shows that the expected catch of 19,200 t in 2001 will increase the fishing mortality (F_{2001}=0.57). The total stock biomass and the SSB will be further reduced with 14% and 20 %, respectively (50,000 t and 24,000 t). The *status quo* catch in 2002 (F_{2000}) is 10,500 t, and leads to a slight increase of the total stock biomass (53,900 t) and the SSB (25,700 t). To rebuild the SSB to the 1999 level in the near future fishing mortality has to be reduced substantially.

8.6 Comments to the assessment

Confining the assessment to ages 5 and older reduces the influence of erroneously low survey indices of the younger ages as discussed both above and in recent assessment reports for this stock. In addition, using only the three tuning fleets believed to better represent the area and depth distribution of Greenland halibut as well as truncating the Russian survey series prior to 1991 has improved the reliability and robustness of the assessment considerably. Some of the surveys, however, showed different trends in the last year compared to the results from the XSA. Concerns were also raised that the catches used in the assessment were underestimated in recent years. There is therefore a need to correct the catch statistics for recent years. Although not quantified, it is important to acknowledge that as a result the fishing mortality during this period may be underestimated while the population sizes are overestimated.

The maturity ogives that have been used are combined by sex. 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. 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. The strong systematic trends in the maturity ogives can cause extreme variation in the SSB over a relatively short time period. However, despite the high variability in maturity rates used here no evidence was forthcoming to doubt its reliability. Nevertheless, the trend in age 10+ biomass should provide a reasonable approximation to the development of the SSB.

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	1 106	115	7	11 734
1996	0	0	2	219	81	123	70	0	0	11 623	0	79	1 576	200	317	57	14 347
1997	0	0	27	253	56	0	62	2	0	7 879 [2]	12	50	1 038	157 [2]	67	25	9 628
1998	0	0	57	67	34	0	23	2	0	9 236 [2]	31	99	2 659	72 [2]	182	45	12 507
1999 [1]	0	0	94	0	34	38	7	2	0	15 033 [2]	8	49	3 823	123 [2]	94	45	19 350
2000 [1]	0	0	0	0	15	0	42	0	0	9 006 [2]	3	19	4 568	375 [2]	111	0	14 139

[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 (Scot land)	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	84	-	-	1 743
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]	-	91	-	13	7	1094 [2]	1203	-	+	-	2 408
2000 [1]	-		+		42	933 [2]	1169	-	1	-	2 145

[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]	-	9 508	55	466	4	278	57	10 744
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]	2	13 127 [2]	33	734	1	63	45	14 050
2000 [1]				10	[4]		7 613 [2]		690	1	64		8 378

[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	Den mark	Estoni a	Faroe Islands	Franc e	Fed. rep. Germ.	Irela nd	Lithu ania	Norway	Pola nd	Portug al	Russia[4]	Spain	UK (Engl. & Wales)	UK (Scot land)	Total
1984	-		-	-	1 900	-		80	-	-	9 641	-	5	-	11 626
1985	-		-	-	3 746	-		71	-	-	3 221	-	2	-	7 040
1986	-		36	-	2 620	-		944	-	-	6 032	-	+	-	9 632
1987	+		-	-	1 947	-		572	-	-	4 735	-	7	10	7 271
1988	-		-	-	590	-		239	-	-	5 008	-	19	+	5 856
1989	-		-	-	496	-		533	-	-	3 366	-	-	-	4 395
1990	-		23 [2]	-	942	-		7 706	-	-	3 197 [2]	-	9	-	11 877
1991	11	1 000	-	-	80	-	-	14 369	-	-	1 663 [2]	132	+	1	17 256
1992	-	-	-	3 [2]	12	-	-	1 732	-	16	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	1022	32	5	3 047
1996	+	-	-	-	47	-	-	1 204	-	24	912	196	39	+	2 422
1997	-	-	12	-	33	2	-	1 216 [2]	12	9	534	156 [2]	46	+	2 020
1998	-	-	10	-	18	1	-	931 [2]	31	19	1638	67 [2]	106	4	2 825
1999 [1]	-	-	3	-	14	-	-	812 [2]	8	16	1886	122 [2]	31	-	2 892
2000 [1]	-	-		-	5		-	460 [2]	3	19	2709	374 [2]	46	-	3 616

[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	9 981	19 350
2000	1 706	5 060	7 374	14 139

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	0,71	-	1,23	1,60	-	-	-	-	-
1998	0,71	-	0,98	1,35	-	-	-	-	-
1999	0,84	-	0,82	1,77	-	-	-	-	-
2000	0,94	-	1,38	1,92	-	-	-	-	-

[1] Side trawlers, 800-1000 hp. From 1983 onwards, side trawlers (SRTM), 1,000 hp. From 1997 based on research fishing.

[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.

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Run title : Arctic Green.halibut (run: XSAAAG13/X13)
At  1/05/2001  10:15
   Table  1     Catch numbers at age                              Numbers*10**-3
   YEAR,         1964,    1965,    1966,    1967,    1968,    1969,    1970,
   AGE
     3,            18,      44,      54,      54,      12,      27,       1,
     4,           101,      91,      69,     121,      57,     233,      34,
   YEAR,         1971,    1972,    1973,    1974,    1975,    1976,    1977,    1978,    1979,    1980,
   AGE
     3,             1,       1,       1,       1,      22,       1,      62,      78,      88,      64,
     4,             1,     461,      19,     276,     334,      98,     755,     532,     887,     275,
   YEAR,         1981,    1982,    1983,    1984,    1985,    1986,    1987,    1988,    1989,    1990,
   AGE
     3,           664,      48,     314,       0,      88,     141,      50,       5,     214,     155,
     4,          1146,     551,    1212,      36,     461,     985,     435,     233,     924,     793,
   YEAR,         1991,    1992,    1993,    1994,    1995,    1996,    1997,    1998,    1999,    2000,
   AGE
     3,           389,      98,      10,       0,       0,       3,       2,       1,     104,      11,
     4,          2084,     437,     224,      73,      75,      48,      32,      79,     122,      90,


   Table  2     Catch weights at age (kg)
   YEAR,         1964,    1965,    1966,    1967,    1968,    1969,    1970,
   AGE
     3,          .1400,   .1400,   .1400,   .1400,   .1400,   .1400,   .2000,
     4,          .2600,   .2600,   .2600,   .2600,   .2600,   .2600,   .4410,

   YEAR,         1971,    1972,    1973,    1974,    1975,    1976,    1977,    1978,    1979,    1980,
   AGE
     3,          .2000,   .2000,   .2000,   .2000,   .2000,   .2000,   .2000,   .2000,   .3000,   .2000,
     4,          .4410,   .4410,   .4410,   .4410,   .4410,   .4410,   .4410,   .4410,   .6000,   .4820,

   YEAR,         1981,    1982,    1983,    1984,    1985,    1986,    1987,    1988,    1989,    1990,
   AGE
     3,          .2000,   .2700,   .3100,   .3000,   .3000,   .3400,   .3070,   .4140,   .3100,   .2800,
     4,          .5000,   .6200,   .4500,   .4800,   .3800,   .4700,   .5740,   .5540,   .6300,   .5500,

   YEAR,         1991,    1992,    1993,    1994,    1995,    1996,    1997,    1998,    1999,    2000,
   AGE
     3,          .2900,   .2200,   .3400,   .2600,   .4400,   .1800,   .3000,   .3000,   .2200,   .3400,
     4,          .6000,   .4600,   .5400,   .5200,   .5600,   .4700,   .5000,   .5200,   .4700,   .5300,


   Table  5     Proportion mature at age
   YEAR,         1964,    1965,    1966,    1967,    1968,    1969,    1970,
   AGE
     3,          .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
     4,          .1700,   .1700,   .1700,   .1700,   .1700,   .1700,   .1700,

   YEAR,         1971,    1972,    1973,    1974,    1975,    1976,    1977,    1978,    1979,    1980,
   AGE
     3,          .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
     4,          .1700,   .1700,   .1700,   .1700,   .1700,   .1700,   .1700,   .1700,   .1700,   .1700,

   YEAR,         1981,    1982,    1983,    1984,    1985,    1986,    1987,    1988,    1989,    1990,
   AGE
     3,          .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,
     4,          .1700,   .1700,   .1700,   .1705,   .2405,   .1705,   .1300,   .0000,   .0300,   .0305,

   YEAR,         1991,    1992,    1993,    1994,    1995,    1996,    1997,    1998,    1999,    2000,
   AGE
     3,          .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0000,   .0200,   .0100,   .0100,
     4,          .0405,   .2605,   .2410,   .2710,   .0910,   .1400,   .1400,   .1300,   .0600,   .0500,
```

Table 8.8

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	372,	253,	170,	156,	114,	1064,	526,
6,	1480,	853,	563,	332,	283,	2420,	2792,
7,	2808,	1735,	1106,	623,	452,	3208,	10464,
8,	5674,	3868,	2715,	2006,	1976,	6288,	18562,
9,	4951,	4203,	4054,	3237,	3923,	4921,	10034,
10,	3981,	3799,	2499,	2409,	2950,	4431,	6671,
11,	1853,	1799,	1284,	1718,	2234,	2381,	2517,
12,	1018,	1002,	783,	871,	792,	812,	1250,
13,	364,	372,	246,	315,	146,	229,	616,
14,	251,	282,	261,	155,	43,	100,	1104,
+gp,	76,	50,	28,	19,	7,	30,	281,
0 TOTALNUM,	22828,	18216,	13709,	11841,	12920,	25884,	54817,
TONSLAND,	40391,	34751,	26321,	24267,	26168,	43789,	89484,
SOPCOF %,	100,	100,	101,	100,	100,	103,	94,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	80,	1109,	212,	917,	840,	830,	2037,	1897,	2218,	731,
6,	4486,	3521,	1117,	2519,	2337,	2982,	3255,	3589,	3155,	1138,
7,	12712,	9605,	3923,	6204,	6520,	5824,	4200,	4118,	2727,	1665,
8,	12283,	6438,	3515,	3838,	4118,	5002,	2524,	2365,	1234,	1341,
9,	6130,	2775,	2551,	1834,	2265,	3000,	1610,	1509,	495,	944,
10,	4339,	1734,	1919,	1942,	1654,	1350,	1104,	946,	319,	473,
11,	2703,	1368,	1536,	1622,	1857,	915,	1062,	934,	296,	511,
12,	1660,	1234,	1127,	1338,	1536,	1212,	858,	438,	243,	275,
13,	1044,	675,	716,	734,	1122,	698,	595,	349,	103,	242,
14,	300,	200,	251,	531,	600,	526,	384,	147,	45,	145,
+gp,	143,	80,	126,	216,	368,	358,	180,	112,	51,	78,
0 TOTALNUM,	45880,	28739,	16993,	21695,	23217,	22697,	17809,	16404,	10886,	7543,
TONSLAND,	79034,	43055,	29938,	37763,	38172,	36074,	28827,	24617,	17312,	13284,
SOPCOF %,	104,	98,	92,	98,	88,	93,	101,	105,	104,	109,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	1896,	1304,	1543,	915,	1219,	1672,	1212,	907,	2080,	2139,
6,	1917,	1494,	1864,	3698,	2874,	3335,	2972,	2540,	4453,	5163,
7,	1919,	1276,	1851,	3350,	2561,	2712,	3572,	3141,	3655,	4642,
8,	933,	1208,	2287,	1938,	1548,	1531,	1746,	2096,	1657,	1932,
9,	484,	1493,	1491,	1064,	972,	1128,	752,	1182,	801,	1221,
10,	448,	1258,	1228,	1191,	1037,	997,	828,	860,	318,	499,
11,	482,	838,	713,	602,	614,	530,	362,	481,	228,	264,
12,	380,	502,	488,	340,	363,	434,	202,	313,	126,	314,
13,	384,	324,	247,	171,	161,	314,	186,	133,	120,	42,
14,	150,	108,	201,	132,	120,	305,	63,	140,	140,	96,
+gp,	62,	46,	64,	71,	63,	239,	7,	47,	28,	44,
0 TOTALNUM,	9055,	9851,	11977,	13472,	11532,	13197,	11902,	11840,	13606,	16356,
TONSLAND,	15018,	16789,	22147,	21883,	19945,	22875,	19112,	19587,	20138,	23183,
SOPCOF %,	107,	100,	98,	100,	99,	98,	101,	100,	103,	102,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
5,	3312,	1098,	1140,	631,	846,	1034,	330,	359,	433,	376,
6,	3889,	1195,	1088,	708,	992,	2083,	921,	1116,	1905,	739,
7,	4716,	1069,	1608,	1252,	1719,	3795,	1822,	2466,	3955,	1885,
8,	2355,	778,	1118,	817,	990,	1426,	953,	1464,	1810,	1440,
9,	1031,	360,	140,	310,	405,	262,	342,	527,	914,	721,
10,	1284,	600,	976,	642,	726,	655,	822,	924,	1905,	1277,
11,	774,	188,	444,	416,	461,	270,	231,	237,	380,	443,
12,	673,	150,	144,	330,	371,	132,	150,	122,	237,	301,
13,	177,	79,	36,	88,	154,	29,	18,	15,	67,	41,
14,	266,	89,	20,	39,	56,	22,	41,	29,	42,	27,
+gp,	517,	56,	4,	3,	8,	1,	1,	15,	7,	12,
0 TOTALNUM,	18994,	5662,	6718,	5236,	6728,	9709,	5631,	7274,	11655,	7262,
TONSLAND,	33320,	8602,	11933,	9226,	11734,	14347,	9628,	12507,	19350,	14139,
SOPCOF %,	105,	95,	102,	99,	101,	101,	101,	105,	101,	101,

Table 8.9

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

Table 2 Catch weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	.4200,	.4200,	.4200,	.4200,	.4200,	.4200,	.5670,
6,	.6400,	.6400,	.6400,	.6500,	.6600,	.6400,	.7370,
7,	.9000,	.9000,	.9100,	.9300,	.9600,	.9100,	1.0790,
8,	1.2000,	1.2200,	1.2400,	1.2700,	1.3100,	1.2500,	1.4210,
9,	1.6300,	1.6600,	1.7000,	1.7100,	1.7400,	1.6400,	1.8480,
10,	2.2600,	2.2300,	2.2200,	2.2000,	2.1900,	2.2500,	2.2810,
11,	3.1100,	3.0000,	2.9400,	2.8400,	2.7900,	2.9900,	2.8870,
12,	3.7400,	3.4900,	3.3900,	3.3000,	3.1900,	3.6300,	3.2470,
13,	4.5700,	4.4000,	4.3800,	4.2700,	4.2700,	4.6800,	4.3030,
14,	5.0100,	4.9100,	4.8400,	4.8800,	5.0000,	5.3800,	4.9310,
+gp,	5.9400,	5.8900,	5.8800,	5.8000,	5.9900,	5.9900,	5.7940,
0 SOPCOFAC,	.9986,	1.0046,	1.0054,	1.0024,	.9994,	1.0262,	.9436,

Table 2 Catch weights at age (kg)

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.9000,	.7020,
6,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	1.2000,	.8720,
7,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.5000,	1.1410,
8,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.8000,	1.4680,
9,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	2.2000,	1.7780,
10,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.6000,	2.3020,
11,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	3.0000,	2.6640,
12,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.5000,	3.0460,
13,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.1000,	3.3680,
14,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.8000,	4.2850,
+gp,	5.8410,	6.0370,	6.0060,	5.9640,	5.9100,	5.9230,	6.0270,	5.9060,	6.1760,	5.3460,
0 SOPCOFAC,	1.0434,	.9752,	.9231,	.9825,	.8805,	.9255,	1.0095,	1.0485,	1.0364,	1.0894,

Table 2 Catch weights at age (kg)

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	.6600,	.6900,	.7500,	.6300,	.6000,	.6200,	.7090,	.7400,	.7600,	.7100,
6,	.8400,	.8400,	1.0400,	.9600,	.8900,	.9200,	1.0030,	.9620,	1.0300,	1.0600,
7,	1.1500,	1.0300,	1.3400,	1.1800,	1.2000,	1.2800,	1.2660,	1.2490,	1.3200,	1.2900,
8,	1.5600,	1.3100,	1.5700,	1.5300,	1.8500,	1.9000,	1.6830,	1.6260,	1.8000,	1.7000,
9,	2.0400,	1.7400,	1.9700,	2.3100,	2.5900,	2.4800,	2.4820,	2.1640,	2.4200,	2.1000,
10,	2.5700,	2.2400,	2.7300,	2.8700,	3.1800,	3.1100,	2.9820,	2.8970,	3.1300,	2.6100,
11,	2.9800,	2.7700,	3.2900,	3.4600,	3.6200,	3.3500,	3.5470,	3.4060,	3.3700,	2.8700,
12,	3.4300,	3.3700,	4.2200,	3.7700,	3.9500,	3.7200,	3.8000,	3.6610,	4.0500,	3.4500,
13,	4.1300,	4.3200,	4.7100,	3.9900,	4.4800,	4.0000,	4.5600,	4.2470,	4.2900,	3.7200,
14,	4.6800,	5.3500,	6.0800,	4.3500,	4.2500,	4.1800,	5.0020,	4.1870,	4.5000,	4.0900,
+gp,	5.9990,	5.8330,	6.1220,	4.5250,	4.8250,	4.5260,	5.9530,	4.4630,	4.7200,	4.5200,
0 SOPCOFAC,	1.0680,	1.0038,	.9783,	1.0009,	.9858,	.9782,	1.0116,	.9973,	1.0346,	1.0204,

Table 2 Catch weights at age (kg)

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
5,	.7700,	.6800,	.7900,	.7200,	.7300,	.7700,	.7700,	.7300,	.7000,	.7800,
6,	1.0500,	.9700,	1.0200,	.9400,	.9400,	.9700,	.9400,	.9300,	.9500,	1.0000,
7,	1.3800,	1.2700,	1.3500,	1.2700,	1.2500,	1.3100,	1.2800,	1.3000,	1.2700,	1.3500,
8,	1.7500,	1.7600,	1.8800,	1.7200,	1.7400,	1.7400,	1.6400,	1.6100,	1.5500,	1.6500,
9,	2.2000,	2.2100,	2.4600,	2.1900,	2.0900,	2.2400,	2.0700,	2.1200,	2.0000,	2.1400,
10,	2.6000,	2.5600,	2.6700,	2.5200,	2.5100,	2.5900,	2.5900,	2.5700,	2.4600,	2.6300,
11,	2.7900,	3.1100,	3.4300,	2.9700,	2.9500,	3.2900,	3.3000,	3.2500,	3.2200,	3.4000,
12,	3.2800,	3.5900,	4.2900,	3.2900,	3.3400,	4.0200,	4.0100,	3.9100,	3.8500,	4.0500,
13,	3.8900,	3.8300,	5.0800,	3.8400,	3.8300,	4.7500,	4.8300,	4.9000,	4.6100,	5.2000,
14,	4.3800,	4.2500,	6.3300,	4.9500,	4.9800,	6.2400,	5.9500,	5.6600,	5.8400,	5.7600,
+gp,	5.2900,	4.8000,	8.9100,	6.6800,	8.1500,	6.0900,	6.2600,	4.9100,	5.9800,	6.9600,
0 SOPCOFAC,	1.0470,	.9519,	1.0183,	.9937,	1.0095,	1.0066,	1.0079,	1.0498,	1.0085,	1.0076,

Table 8.10

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

Table 5 Proportion mature at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
13,	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,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
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,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	.3600,	.3600,	.3600,	.4500,	.4300,	.3500,	.2100,	.0500,	.0700,	.0700,
6,	.7200,	.7200,	.7200,	.7700,	.7500,	.7200,	.6400,	.6600,	.6200,	.6000,
7,	.8000,	.8000,	.8000,	.7900,	.7900,	.8400,	.7900,	.7800,	.7400,	.7000,
8,	.8400,	.8400,	.8400,	.8300,	.8400,	.8500,	.8300,	.7900,	.7900,	.6800,
9,	.9000,	.9000,	.9000,	.8600,	.8900,	.9300,	.9200,	.9100,	.9000,	.8500,
10,	.9500,	.9500,	.9500,	.9200,	.9400,	.9800,	.9800,	.9700,	.9600,	.9000,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	1.0000,	.9900,	.9900,	.9800,	1.0000,
12,	.9900,	.9900,	.9900,	.9800,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
5,	.1200,	.2800,	.3200,	.3800,	.3800,	.4800,	.5700,	.4600,	.2100,	.1500,
6,	.2800,	.4600,	.4900,	.5200,	.4900,	.6000,	.7600,	.7100,	.4800,	.3900,
7,	.3900,	.5200,	.5700,	.6200,	.5900,	.6300,	.7100,	.7100,	.5900,	.5200,
8,	.4900,	.6100,	.6700,	.6700,	.6500,	.7000,	.7300,	.6700,	.5500,	.5200,
9,	.7100,	.8900,	.8900,	.8600,	.7900,	.7900,	.7500,	.6600,	.5500,	.4800,
10,	.9200,	.9500,	.9000,	.9100,	.9000,	.9400,	.8900,	.8700,	.7600,	.7200,
11,	1.0000,	.9800,	.9800,	.9800,	1.0000,	.9800,	.9500,	.9500,	.8700,	.8300,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	.9700,
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

   30/04/2001  11:20

 Extended Survivors Analysis

 Arctic Green.halibut (run: XSAAAG12/X12)

 CPUE data from file fleet

 Catch data for  37 years. 1964 to 2000. Ages  5 to  15.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 FLT03: Norwegian G. ,   1994, 2000,   5,    14,   .620,   .670
 FLT04: Experimental ,   1992, 2000,   5,    14,   .380,   .440
 FLT07: Russian trawl,   1992, 2000,   5,    14,   .750,   .920
æ

 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   37 iterations

1


 Regression weights
       ,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000



 Fishing mortalities
    Age,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999,  2000

      5,  .122,  .104,  .041,  .059,  .069,  .022,  .030,  .051,  .040
      6,  .183,  .161,  .083,  .079,  .192,  .077,  .093,  .204,  .108
      7,  .240,  .376,  .267,  .278,  .453,  .242,  .284,  .511,  .302
      8,  .300,  .400,  .315,  .330,  .370,  .183,  .296,  .329,  .332
      9,  .134,  .076,  .172,  .239,  .128,  .133,  .138,  .287,  .199
     10,  .382,  .601,  .546,  .717,  .710,  .688,  .594,  .976,  .778
     11,  .374,  .511,  .524,  .930,  .603,  .551,  .403,  .491,  .592
     12,  .757,  .516,  .858, 1.253,  .715,  .765,  .599,  .859,  .874
     13,  .852,  .379,  .654, 1.336,  .258,  .181,  .143,  .741,  .319
     14,  .712,  .503,  .870, 1.146,  .626,  .659,  .463,  .696,  .721
```

Table 8.11 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 5	6	7	8	9	10	11	12	13	14
1992	1.03E+04	7.71E+03	5.40E+03	3.23E+03	3.09E+03	2.04E+03	6.50E+02	3.04E+02	1.49E+02	1.88E+02
1993	1.24E+04	7.87E+03	5.52E+03	3.66E+03	2.06E+03	2.33E+03	1.20E+03	3.85E+02	1.23E+02	5.45E+01
1994	1.71E+04	9.62E+03	5.76E+03	3.26E+03	2.11E+03	1.65E+03	1.10E+03	6.17E+02	1.98E+02	7.24E+01
1995	1.58E+04	1.41E+04	7.62E+03	3.80E+03	2.05E+03	1.53E+03	8.21E+02	5.60E+02	2.25E+02	8.85E+01
1996	1.68E+04	1.28E+04	1.12E+04	4.97E+03	2.35E+03	1.39E+03	6.42E+02	2.79E+02	1.38E+02	5.09E+01
1997	1.61E+04	1.35E+04	9.12E+03	6.14E+03	2.95E+03	1.78E+03	5.88E+02	3.02E+02	1.17E+02	9.15E+01
1998	1.33E+04	1.36E+04	1.07E+04	6.16E+03	4.40E+03	2.22E+03	7.70E+02	2.92E+02	1.21E+02	8.43E+01
1999	9.47E+03	1.11E+04	1.07E+04	6.96E+03	3.94E+03	3.30E+03	1.06E+03	4.43E+02	1.38E+02	9.03E+01
2000	1.02E+04	7.75E+03	7.79E+03	5.50E+03	4.31E+03	2.55E+03	1.07E+03	5.57E+02	1.62E+02	5.67E+01

Estimated population abundance at 1st Jan 2001

0.00E+00	8.44E+03	5.99E+03	4.96E+03	3.40E+03	3.04E+03	1.01E+03	5.09E+02	2.00E+02	1.01E+02

Taper weighted geometric mean of the VPA populations:

1.43E+04	1.17E+04	8.66E+03	5.11E+03	3.12E+03	2.10E+03	9.91E+02	5.19E+02	2.27E+02	1.34E+02

Standard error of the weighted Log(VPA populations) :

.2633	.2840	.2787	.2760	.2970	.2664	.3578	.5214	.7326	.9276

1

Log catchability residuals.

Fleet : FLT03: Norwegian G.

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000
5	99.99	99.99	.26	.35	.08	-.06	-.26	-.20	-.12
6	99.99	99.99	-.06	-.28	.24	.04	-.28	.21	.11
7	99.99	99.99	.13	.15	.05	-.15	-.07	-.07	-.01
8	99.99	99.99	.29	.24	.18	-.56	-.34	.21	.01
9	99.99	99.99	-.01	.53	.03	-.48	-.60	-.15	.70
10	99.99	99.99	.00	.37	.16	-.10	-.10	.07	-.39
11	99.99	99.99	-.52	-.02	-.51	-.32	-.41	-.73	-.97
12	99.99	99.99	-.92	-.19	-.33	.04	.44	.40	-.78
13	99.99	99.99	-1.15	-.67	-1.03	-1.33	-3.28	.02	-.70
14	99.99	99.99	-.47	-.25	-.06	-.13	-.07	.01	-.40

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	-.1445	.3431	1.1361	.6449	-.3162	1.2403	1.2403	1.2403	1.2403	1.2403
S.E(Log q)	.2317	.2160	.1110	.3307	.4841	.2381	.6207	.5682	1.6379	.2772

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	.61	2.008	3.79	.85	7	.11	-.14
6	1.62	-.946	-6.36	.32	7	.35	.34
7	1.36	-1.539	-4.84	.79	7	.14	1.14
8	3.01	-1.459	-19.07	.10	7	.91	.64
9	1.45	-.488	-3.17	.19	7	.75	-.32
10	1.59	-1.215	-6.43	.47	7	.36	1.24
11	2.89	-1.459	-14.86	.11	7	.80	.74
12	11.41	-1.618	-74.74	.00	7	5.38	1.06
13	.37	.984	3.16	.33	7	.38	.07
14	.82	.663	-.09	.74	7	.16	1.05

Table 8.11 (Continued)

Fleet : FLT04: Experimental

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000
5	-.33	.27	.04	.22	.44	.50	-.92	-.38	.15
6	-.43	-.16	-.01	-.26	.63	.01	-.17	.01	.30
7	-.68	-.09	-.06	-.02	.24	.01	-.05	-.03	.55
8	-.30	.06	.17	.19	.12	-.22	-.04	-.17	.17
9	-1.02	-.97	-.49	.75	.25	.52	.37	-.44	.74
10	-.64	-.10	.12	.58	-.12	.35	-1.12	.26	.58
11	-.38	-.33	-.39	.07	-.82	.44	-1.08	-1.11	-.88
12	-.01	-.34	-1.01	.04	-.78	.36	-.88	.55	.06
13	-.50	-.10	-.87	-.31	99.99	.15	99.99	-.47	.45
14	-1.49	-.34	-.47	.14	-.22	-.10	99.99	-.07	99.99

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	-4.4214	-3.8110	-3.0621	-3.5716	-4.9552	-3.3950	-3.3950	-3.3950	-3.3950	-3.3950
S.E(Log q)	.4680	.3146	.3155	.1852	.6945	.5702	.7605	.6129	.5112	.6305

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	1.325	6.84	.54	9	.23	-4.42
6	.88	.289	4.47	.47	9	.30	-3.81
7	.68	1.263	4.98	.70	9	.21	-3.06
8	1.22	-.775	2.49	.65	9	.23	-3.57
9	.66	.631	5.99	.34	9	.48	-4.96
10	1.07	-.086	3.08	.17	9	.66	-3.40
11	3.45	-.970	-3.07	.02	9	1.86	-3.90
12	.85	.261	3.98	.31	9	.51	-3.61
13	3.65	-.912	-.15	.03	7	1.67	-3.62
14	4.16	-1.684	1.58	.06	7	1.85	-3.73

Fleet : FLT07: Russian trawl

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000
5	1.66	.54	-.13	-.58	-.48	-.99	-.13	-.04	.46
6	.79	.50	.12	-.23	-.02	-.59	-.34	-.28	.24
7	.38	.43	-.07	-.05	.06	-.22	-.29	-.27	.15
8	.09	.06	-.18	.08	-.01	-.17	.00	-.19	.32
9	-.79	-.22	-.16	.18	.62	-.22	.13	.16	.14
10	-.56	-.12	.19	.12	-.88	-.04	.24	.33	.60
11	.28	-.25	-.56	-.06	-.71	.34	.76	-.08	.98
12	.28	.33	-.13	.06	-.77	-.38	.71	.43	.93
13	-.48	-.26	-.40	-.27	-.36	.59	.46	1.02	-.53
14	-5.04	.73	.78	-1.53	-.22	-.17	.00	-.01	1.06

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	-.2566	.6796	1.1066	1.4306	.9022	.5211	.5211	.5211	.5211	.5211
S.E(Log q)	.7525	.4311	.2619	.1687	.3819	.4579	.5825	.5699	.5736	1.8323

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	-.85	-2.383	17.30	.20	9	.50	-.26
6	-2.20	-4.508	31.22	.23	9	.50	.68
7	2.81	-2.653	-19.39	.25	9	.55	1.11
8	1.12	-.470	-2.57	.72	9	.20	1.43
9	.95	.108	-.48	.44	9	.39	.90
10	.51	1.824	3.45	.68	9	.20	.52
11	1.13	-.142	-1.60	.15	9	.70	.61
12	.65	.841	1.63	.47	9	.36	.69
13	-3.56	-1.500	24.62	.02	9	1.89	.51
14	-.34	-4.102	5.89	.59	9	.34	.10

Table 8.11 (Continued)

Terminal year survivor and F summaries :

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

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	7453.,	.300,	.000,	.00,	1,	.531,	.046
FLT04: Experimental ,	9817.,	.495,	.000,	.00,	1,	.195,	.035
FLT07: Russian trawl,	13423.,	.795,	.000,	.00,	1,	.075,	.026
F shrinkage mean ,	8527.,	.50,,,,				.199,	.040

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
8445.,	.22,	.10,	4,	.448,	.040

1

Age 6 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. ,	5755.,	.212,	.156,	.74,	2,	.478,	.113
FLT04: Experimental ,	6590.,	.276,	.309,	1.12,	2,	.285,	.099
FLT07: Russian trawl,	7135.,	.395,	.121,	.31,	2,	.139,	.092
F shrinkage mean ,	4269.,	.50,,,,				.098,	.149

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5985.,	.15,	.10,	7,	.682,	.108

Age 7 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. ,	4865.,	.174,	.132,	.76,	3,	.412,	.307
FLT04: Experimental ,	5493.,	.214,	.366,	1.71,	3,	.279,	.276
FLT07: Russian trawl,	5071.,	.240,	.130,	.54,	3,	.232,	.296
F shrinkage mean ,	3559.,	.50,,,,				.077,	.400

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4960.,	.12,	.11,	10,	.955,	.302

1

Age 8 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. ,	3105.,	.162,	.062,	.38,	4,	.345,	.358
FLT04: Experimental ,	3687.,	.181,	.109,	.60,	4,	.307,	.309
FLT07: Russian trawl,	3412.,	.194,	.208,	1.07,	4,	.276,	.330
F shrinkage mean ,	3624.,	.50,,,,				.072,	.314

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3397.,	.10,	.07,	13,	.670,	.332

Table 8.11 (Continued)

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	3538.,	.155,	.121,	.78,	5,	.346,	.173
FLT04: Experimental ,	3128.,	.174,	.138,	.80,	5,	.280,	.194
FLT07: Russian trawl,	2537.,	.176,	.113,	.64,	5,	.309,	.234
F shrinkage mean ,	2810.,	.50,,,,				.065,	.214

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3039.,	.10,	.07,	16,	.743,	.199

1

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	862.,	.147,	.122,	.83,	6,	.383,	.865
FLT04: Experimental ,	1187.,	.173,	.146,	.85,	6,	.234,	.692
FLT07: Russian trawl,	1097.,	.170,	.131,	.77,	6,	.275,	.732
F shrinkage mean ,	983.,	.50,,,,				.109,	.791

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1007.,	.10,	.07,	19,	.728,	.778

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	395.,	.159,	.169,	1.06,	7,	.341,	.713
FLT04: Experimental ,	436.,	.194,	.158,	.81,	7,	.220,	.664
FLT07: Russian trawl,	640.,	.188,	.175,	.93,	7,	.275,	.496
F shrinkage mean ,	725.,	.50,,,,				.164,	.449

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
509.,	.12,	.10,	22,	.837,	.592

1

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	154.,	.179,	.149,	.83,	7,	.299,	1.034
FLT04: Experimental ,	175.,	.208,	.184,	.88,	8,	.220,	.954
FLT07: Russian trawl,	244.,	.193,	.158,	.82,	8,	.270,	.763
F shrinkage mean ,	258.,	.50,,,,				.211,	.734

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
200.,	.14,	.09,	24,	.667,	.874

Table 8.11 (Continued)

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	103.,	.213,	.125,	.59,	7,	.208,	.315
FLT04: Experimental ,	128.,	.269,	.140,	.52,	9,	.284,	.260
FLT07: Russian trawl,	105.,	.244,	.175,	.72,	9,	.300,	.308
F shrinkage mean ,	68.,	.50,,,,				.207,	.444

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
101.,	.15,	.09,	26,	.575,	.319

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian G. ,	18.,	.249,	.107,	.43,	7,	.461,	.878
FLT04: Experimental ,	17.,	.279,	.156,	.56,	8,	.121,	.900
FLT07: Russian trawl,	40.,	.265,	.198,	.75,	9,	.140,	.487
F shrinkage mean ,	34.,	.50,,,,				.278,	.556

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
24.,	.19,	.10,	25,	.532,	.721

1

Table 8.12

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

Table 8 Fishing mortality (F) at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	.0094,	.0053,	.0032,	.0024,	.0019,	.0207,	.0139,
6,	.0484,	.0255,	.0138,	.0072,	.0051,	.0484,	.0660,
7,	.1146,	.0699,	.0397,	.0180,	.0116,	.0691,	.2864,
8,	.2531,	.2160,	.1411,	.0891,	.0694,	.2081,	.6556,
9,	.4566,	.2848,	.3476,	.2356,	.2381,	.2332,	.5603,
10,	.7003,	.7254,	.2583,	.3382,	.3302,	.4350,	.5339,
11,	.6375,	.7606,	.5421,	.2684,	.5685,	.4571,	.4457,
12,	.5666,	.8214,	.8585,	.8373,	.1802,	.3905,	.4362,
13,	.4065,	.3910,	.4515,	1.0092,	.2945,	.0686,	.5466,
14,	.5568,	.6004,	.4943,	.5409,	.3237,	.3182,	.5074,
+gp,	.5568,	.6004,	.4943,	.5409,	.3237,	.3182,	.5074,
0 FBAR 6-10,	.3146,	.2643,	.1601,	.1376,	.1309,	.1988,	.4204,

Table 8 Fishing mortality (F) at age

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	.0027,	.0363,	.0074,	.0378,	.0410,	.0413,	.0973,	.1046,	.1294,	.0433,
6,	.1492,	.1510,	.0442,	.1079,	.1211,	.1895,	.2135,	.2347,	.2396,	.0860,
7,	.4473,	.5110,	.2370,	.3447,	.4197,	.4666,	.4177,	.4306,	.2660,	.1815,
8,	.6021,	.4033,	.3335,	.3623,	.3818,	.6252,	.3558,	.4143,	.2075,	.1913,
9,	.4392,	.2444,	.2597,	.2744,	.3558,	.5001,	.3928,	.3522,	.1333,	.2294,
10,	.4739,	.1999,	.2516,	.3041,	.4017,	.3509,	.3250,	.3981,	.1095,	.1724,
11,	.4037,	.2511,	.2585,	.3298,	.5023,	.3824,	.4848,	.4739,	.1957,	.2425,
12,	.5627,	.3063,	.3191,	.3546,	.5618,	.6829,	.7082,	.3552,	.2024,	.2658,
13,	.7562,	.4414,	.2765,	.3347,	.5355,	.5074,	.8181,	.6674,	.1239,	.3006,
14,	.5302,	.2898,	.2741,	.3209,	.4740,	.4874,	.5490,	.4517,	.1534,	.2430,
+gp,	.5302,	.2898,	.2741,	.3209,	.4740,	.4874,	.5490,	.4517,	.1534,	.2430,
0 FBAR 6-10,	.4223,	.3019,	.2252,	.2787,	.3361,	.4265,	.3410,	.3660,	.1912,	.1721,

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Table 8 Fishing mortality (F) at age

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	.1215,	.0772,	.0917,	.0570,	.0684,	.0953,	.0697,	.0436,	.1150,	.1736,
6,	.1449,	.1259,	.1431,	.3112,	.2409,	.2551,	.2314,	.1933,	.2931,	.4329,
7,	.1934,	.1285,	.2145,	.3876,	.3478,	.3548,	.4487,	.3851,	.4408,	.5320,
8,	.1388,	.1697,	.3363,	.3440,	.2933,	.3409,	.3836,	.4879,	.3396,	.4158,
9,	.0925,	.3241,	.3081,	.2435,	.2735,	.3405,	.2637,	.4584,	.3274,	.4250,
10,	.1533,	.3465,	.4554,	.4079,	.3742,	.4697,	.4245,	.5124,	.2006,	.3291,
11,	.2520,	.4464,	.3184,	.3983,	.3590,	.3141,	.2916,	.4415,	.2309,	.2412,
12,	.2706,	.4258,	.4792,	.2328,	.4197,	.4381,	.1784,	.4156,	.1851,	.5371,
13,	.6809,	.3679,	.3616,	.2881,	.1557,	.7427,	.3198,	.1618,	.2608,	.0820,
14,	.2910,	.3840,	.3864,	.3154,	.3178,	.4635,	.2968,	.3999,	.2418,	.3242,
+gp,	.2910,	.3840,	.3864,	.3154,	.3178,	.4635,	.2968,	.3999,	.2418,	.3242,
0 FBAR 6-10,	.1446,	.2189,	.2915,	.3388,	.3059,	.3522,	.3504,	.4074,	.3203,	.4269,

Table 8 Fishing mortality (F) at age

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	FBAR 98-**
AGE											
5,	.3355,	.1217,	.1043,	.0407,	.0593,	.0688,	.0223,	.0295,	.0505,	.0405,	.0402,
6,	.5116,	.1829,	.1614,	.0827,	.0788,	.1922,	.0766,	.0928,	.2044,	.1084,	.1352,
7,	.8555,	.2400,	.3765,	.2667,	.2785,	.4535,	.2425,	.2844,	.5112,	.3020,	.3659,
8,	.5343,	.3001,	.3998,	.3145,	.3297,	.3703,	.1832,	.2959,	.3292,	.3317,	.3189,
9,	.3851,	.1340,	.0760,	.1724,	.2394,	.1279,	.1334,	.1383,	.2874,	.1990,	.2082,
10,	1.0414,	.3822,	.6011,	.5457,	.7171,	.7096,	.6880,	.5941,	.9756,	.7777,	.7824,
11,	1.2115,	.3738,	.5112,	.5244,	.9302,	.6035,	.5505,	.4028,	.4905,	.5915,	.4950,
12,	1.6495,	.7573,	.5163,	.8585,	1.2532,	.7147,	.7651,	.5988,	.8587,	.8739,	.7771,
13,	.6267,	.8519,	.3795,	.6537,	1.3362,	.2577,	.1807,	.1433,	.7405,	.3193,	.4011,
14,	.9910,	.7116,	.5031,	.8696,	1.1463,	.6265,	.6594,	.4633,	.6957,	.7208,	.6266,
+gp,	.9910,	.7116,	.5031,	.8696,	1.1463,	.6265,	.6594,	.4633,	.6957,	.7208,	
0 FBAR 6-10,	.6656,	.2478,	.3229,	.2764,	.3287,	.3707,	.2647,	.2811,	.4615,	.3437,	

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Table 8.13

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	42840,	51685,	57828,	70442,	64280,	55931,	41112,
6,	33792,	36528,	44251,	49615,	60486,	55220,	47153,
7,	27961,	27712,	30648,	37565,	42396,	51798,	45284,
8,	27353,	21461,	22243,	25353,	31755,	36072,	41607,
9,	14559,	18279,	14883,	16626,	19961,	25498,	25213,
10,	8521,	7938,	11833,	9049,	11307,	13541,	17381,
11,	4237,	3641,	3307,	7867,	5554,	6995,	7544,
12,	2537,	1928,	1465,	1656,	5177,	2707,	3812,
13,	1175,	1239,	730,	534,	617,	3721,	1577,
14,	634,	673,	721,	400,	168,	395,	2990,
+gp,	190,	118,	77,	49,	27,	118,	756,
0 TOTAL,	163799,	171202,	187987,	219156,	241726,	251997,	234428,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	31549,	33554,	31060,	26640,	22537,	22095,	23679,	20588,	19692,	18581,
6,	34897,	27080,	27852,	26537,	22078,	18619,	18247,	18491,	15960,	14892,
7,	37995,	25874,	20042,	22936,	20504,	16835,	13259,	12685,	12585,	10810,
8,	29268,	20909,	13359,	13610,	13985,	11599,	9087,	7515,	7098,	8302,
9,	18590,	13796,	12024,	8238,	8154,	8217,	5343,	5479,	4274,	4964,
10,	12392,	10314,	9300,	7982,	5389,	4917,	4289,	3105,	3316,	3220,
11,	8771,	6641,	7269,	6224,	5069,	3104,	2979,	2667,	1795,	2558,
12,	4158,	5042,	4447,	4831,	3852,	2640,	1822,	1579,	1429,	1270,
13,	2121,	2039,	3195,	2782,	2917,	1891,	1148,	773,	953,	1005,
14,	786,	857,	1128,	2085,	1713,	1470,	980,	436,	341,	725,
+gp,	372,	341,	564,	844,	1044,	993,	456,	330,	386,	388,
0 TOTAL,	180900,	146447,	130239,	122709,	107242,	92377,	81288,	73649,	67830,	66715,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	17863,	18908,	18980,	17796,	19865,	19822,	19407,	22926,	20643,	14467,
6,	15314,	13616,	15065,	14905,	14468,	15967,	15509,	15579,	18891,	15838,
7,	11762,	11403,	10333,	11237,	9398,	9787,	10649,	10592,	11052,	12129,
8,	7760,	8343,	8631,	7176,	6564,	5713,	5907,	5852,	6202,	6122,
9,	5902,	5813,	6060,	5307,	4379,	4213,	3497,	3465,	3092,	3801,
10,	3397,	4631,	3618,	3833,	3580,	2867,	2580,	2312,	1885,	1918,
11,	2332,	2508,	2819,	1975,	2194,	2120,	1543,	1452,	1192,	1328,
12,	1728,	1560,	1382,	1765,	1141,	1319,	1333,	992,	804,	814,
13,	838,	1135,	877,	736,	1203,	646,	732,	960,	563,	575,
14,	640,	365,	676,	526,	475,	886,	264,	458,	703,	374,
+gp,	263,	155,	214,	282,	248,	690,	29,	153,	140,	170,
0 TOTAL,	67800,	68437,	68654,	65537,	63516,	64029,	61450,	64740,	65168,	57536,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	GMST 64-98	AMST 64-98
AGE													
5,	12524,	10327,	12406,	17067,	15832,	16765,	16132,	13294,	9471,	10217,	0,	23496,	26832,
6,	10467,	7707,	7870,	9620,	14105,	12842,	13470,	13578,	11109,	7750,	8445,	19552,	22757,
7,	8842,	5401,	5525,	5764,	7623,	11220,	9121,	10740,	10652,	7795,	5985,	14783,	17985,
8,	6133,	3235,	3657,	3263,	3800,	4967,	6136,	6160,	6956,	5499,	4960,	9729,	12748,
9,	3477,	3093,	2063,	2110,	2051,	2352,	2952,	4397,	3944,	4308,	3397,	6260,	8346,
10,	2139,	2036,	2329,	1645,	1529,	1389,	1781,	2223,	3296,	2547,	3039,	4160,	5414,
11,	1188,	650,	1196,	1099,	821,	642,	588,	770,	1057,	1069,	1007,	2409,	3218,
12,	898,	304,	385,	617,	560,	279,	302,	292,	443,	557,	509,	1395,	1909,
13,	410,	149,	123,	198,	225,	138,	117,	121,	138,	162,	200,	740,	1090,
14,	456,	188,	55,	72,	88,	51,	92,	84,	90,	57,	101,	429,	656,
+gp,	875,	117,	11,	6,	12,	2,	2,	43,	15,	25,	34,		
0 TOTAL,	47407,	33207,	35617,	41462,	46646,	50646,	50694,	51704,	47171,	39984,	27678,		

1

Table 8.14

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	17993,	21708,	24288,	29586,	26998,	23491,	23310,
6,	21627,	23378,	28321,	32250,	39921,	35341,	34752,
7,	25165,	24941,	27890,	34936,	40701,	47136,	48861,
8,	32823,	26182,	27581,	32199,	41599,	45089,	59123,
9,	23731,	30343,	25301,	28430,	34732,	41817,	46594,
10,	19258,	17701,	26270,	19908,	24761,	30467,	39646,
11,	13178,	10923,	9724,	22341,	15494,	20915,	21779,
12,	9488,	6728,	4965,	5463,	16515,	9828,	12376,
13,	5368,	5452,	3196,	2281,	2634,	17415,	6786,
14,	3175,	3306,	3491,	1952,	838,	2128,	14746,
+gp,	1131,	697,	452,	282,	163,	707,	4378,
0 TOTALBIO,	172936,	171359,	181479,	209627,	244354,	274334,	312352,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	17888,	19025,	17611,	15105,	12779,	12528,	13426,	11673,	17723,	13044,
6,	25719,	19958,	20527,	19558,	16272,	13722,	13448,	13628,	19152,	12986,
7,	40997,	27919,	21625,	24748,	22124,	18165,	14306,	13688,	18878,	12334,
8,	41590,	29712,	18984,	19340,	19873,	16482,	12912,	10679,	12776,	12188,
9,	34355,	25495,	22220,	15223,	15068,	15185,	9873,	10126,	9404,	8827,
10,	28267,	23526,	21212,	18208,	12291,	11215,	9783,	7082,	8622,	7412,
11,	25322,	19172,	20984,	17968,	14634,	8960,	8602,	7701,	5384,	6815,
12,	13501,	16370,	14438,	15686,	12508,	8572,	5917,	5128,	5003,	3869,
13,	9126,	8772,	13746,	11970,	12551,	8135,	4939,	3324,	3907,	3384,
14,	3875,	4226,	5564,	10283,	8448,	7247,	4831,	2150,	1637,	3105,
+gp,	2171,	2060,	3388,	5034,	6168,	5883,	2746,	1949,	2381,	2076,
0 TOTALBIO,	242812,	196235,	180300,	173123,	152716,	126093,	100784,	87127,	104868,	86039,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	11789,	13047,	14235,	11211,	11919,	12289,	13759,	16965,	15689,	10271,
6,	12864,	11437,	15667,	14308,	12877,	14689,	15556,	14987,	19458,	16788,
7,	13526,	11745,	13846,	13260,	11277,	12527,	13481,	13229,	14589,	15646,
8,	12105,	10929,	13550,	10980,	12143,	10854,	9942,	9515,	11164,	10407,
9,	12040,	10115,	11939,	12258,	11341,	10449,	8679,	7498,	7482,	7983,
10,	8731,	10373,	9878,	11000,	11386,	8917,	7694,	6698,	5902,	5006,
11,	6951,	6948,	9273,	6834,	7942,	7101,	5472,	4947,	4017,	3811,
12,	5927,	5258,	5830,	6652,	4509,	4906,	5064,	3632,	3256,	2810,
13,	3461,	4902,	4132,	2938,	5391,	2583,	3340,	4075,	2417,	2139,
14,	2997,	1953,	4110,	2288,	2019,	3705,	1323,	1917,	3162,	1528,
+gp,	1581,	902,	1310,	1274,	1198,	3123,	174,	682,	661,	770,
0 TOTALBIO,	91971,	87609,	103771,	93004,	92001,	91142,	84484,	84144,	87797,	77160,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
5,	9643,	7022,	9801,	12289,	11558,	12909,	12421,	9705,	6630,	7969,
6,	10990,	7475,	8027,	9043,	13258,	12457,	12662,	12628,	10554,	7750,
7,	12202,	6859,	7458,	7320,	9529,	14698,	11675,	13961,	13528,	10523,
8,	10732,	5694,	6875,	5613,	6611,	8642,	10063,	9918,	10782,	9073,
9,	7649,	6837,	5074,	4622,	4286,	5268,	6110,	9322,	7888,	9219,
10,	5561,	5212,	6217,	4146,	3837,	3598,	4613,	5714,	8108,	6697,
11,	3315,	2021,	4102,	3263,	2421,	2113,	1941,	2504,	3402,	3636,
12,	2945,	1093,	1651,	2031,	1870,	1120,	1213,	1141,	1707,	2255,
13,	1594,	569,	624,	759,	862,	654,	567,	593,	636,	841,
14,	1997,	801,	345,	358,	441,	318,	545,	477,	527,	326,
+gp,	4627,	564,	96,	37,	101,	14,	14,	213,	89,	174,
0 TOTALBIO,	71256,	44146,	50270,	49481,	54775,	61791,	61824,	66177,	63850,	58463,

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Table 8.15

Run title : Arctic Green.halibut (run: XSAAAG12/X12)

At 30/04/2001 11:21

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,
AGE							
5,	6477,	7815,	8744,	10651,	9719,	8457,	8392,
6,	15572,	16832,	20391,	23220,	28743,	25446,	25022,
7,	20132,	19953,	22312,	27948,	32560,	37709,	39089,
8,	27572,	21993,	23168,	27047,	34943,	37875,	49663,
9,	21358,	27309,	22771,	25587,	31258,	37635,	41935,
10,	18295,	16816,	24957,	18912,	23523,	28943,	37664,
11,	13046,	10813,	9627,	22118,	15339,	20705,	21561,
12,	9393,	6661,	4916,	5409,	16350,	9729,	12252,
13,	5368,	5452,	3196,	2281,	2634,	17415,	6786,
14,	3175,	3306,	3491,	1952,	838,	2128,	14746,
+gp,	1131,	697,	452,	282,	163,	707,	4378,
0 TOTSPBIO,	141518,	137647,	144024,	165407,	196071,	226750,	261487,

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

YEAR,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,
AGE										
5,	6440,	6849,	6340,	5438,	4600,	4510,	4833,	4202,	6380,	4696,
6,	18518,	14370,	14779,	14082,	11716,	9880,	9683,	9812,	13790,	9350,
7,	32797,	22335,	17300,	19798,	17699,	14532,	11445,	10950,	15103,	9867,
8,	34935,	24958,	15946,	16246,	16693,	13845,	10846,	8971,	10732,	10238,
9,	30920,	22945,	19998,	13701,	13562,	13666,	8886,	9113,	8463,	7944,
10,	26854,	22350,	20152,	17298,	11677,	10655,	9294,	6728,	8191,	7041,
11,	25069,	18980,	20774,	17789,	14487,	8870,	8516,	7624,	5330,	6747,
12,	13366,	16206,	14294,	15530,	12383,	8486,	5858,	5076,	4953,	3830,
13,	9126,	8772,	13746,	11970,	12551,	8135,	4939,	3324,	3907,	3384,
14,	3875,	4226,	5564,	10283,	8448,	7247,	4831,	2150,	1637,	3105,
+gp,	2171,	2060,	3388,	5034,	6168,	5883,	2746,	1949,	2381,	2076,
0 TOTSPBIO,	204071,	164051,	152282,	147166,	129984,	105709,	81877,	69899,	80867,	68278,

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

YEAR,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,
AGE										
5,	4244,	4697,	5125,	5045,	5125,	4301,	2889,	848,	1098,	719,
6,	9262,	8235,	11280,	11017,	9658,	10576,	9956,	9891,	12064,	10073,
7,	10821,	9396,	11077,	10475,	8909,	10523,	10650,	10319,	10796,	10952,
8,	10168,	9181,	11382,	9113,	10200,	9226,	8252,	7517,	8820,	7077,
9,	10836,	9103,	10745,	10542,	10094,	9718,	7984,	6823,	6734,	6785,
10,	8294,	9854,	9384,	10120,	10702,	8738,	7540,	6497,	5666,	4506,
11,	6881,	6879,	9181,	6765,	7863,	7101,	5418,	4898,	3937,	3811,
12,	5867,	5206,	5772,	6519,	4464,	4906,	5064,	3632,	3256,	2810,
13,	3461,	4902,	4132,	2938,	5391,	2583,	3340,	4075,	2417,	2139,
14,	2997,	1953,	4110,	2288,	2019,	3705,	1323,	1917,	3162,	1528,
+gp,	1581,	902,	1310,	1274,	1198,	3123,	174,	682,	661,	770,
0 TOTSPBIO,	74412,	70307,	83497,	76098,	75622,	74499,	62590,	57098,	58610,	51170,

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

YEAR,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,
AGE										
5,	1157,	1966,	3136,	4670,	4392,	6196,	7080,	4464,	1392,	1195,
6,	3077,	3439,	3933,	4702,	6497,	7474,	9623,	8966,	5066,	3023,
7,	4759,	3567,	4251,	4539,	5622,	9260,	8289,	9913,	7981,	5472,
8,	5259,	3473,	4606,	3761,	4297,	6049,	7346,	6645,	5930,	4718,
9,	5431,	6085,	4516,	3975,	3386,	4162,	4583,	6153,	4338,	4425,
10,	5116,	4952,	5596,	3773,	3454,	3382,	4106,	4971,	6162,	4822,
11,	3315,	1980,	4020,	3198,	2421,	2071,	1844,	2379,	2960,	3018,
12,	2945,	1093,	1651,	2031,	1870,	1120,	1213,	1141,	1672,	2187,
13,	1594,	569,	624,	759,	862,	654,	567,	593,	636,	841,
14,	1997,	801,	345,	358,	441,	318,	545,	477,	527,	326,
+gp,	4627,	564,	96,	37,	101,	14,	14,	213,	89,	174,
0 TOTSPBIO,	39277,	28488,	32774,	31802,	33343,	40700,	45209,	45915,	36755,	30201,

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Table 8.16

Run title : Arctic Green.halibut (run: XSAAAG12/X12) ,

At 30/04/2001 11:21

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	SSB 10+,	LANDINGS,	YIELD/SSB,	FBAR 6-10,
1964,	42840,	172936,	141518,	50408,	40391,	.2854,	.3146,
1965,	51685,	171359,	137647,	43745,	34751,	.2525,	.2643,
1966,	57828,	181479,	144024,	46639,	26321,	.1828,	.1601,
1967,	70442,	209627,	165407,	50954,	24267,	.1467,	.1376,
1968,	64280,	244354,	196071,	58847,	26168,	.1335,	.1309,
1969,	55931,	274334,	226750,	79627,	43789,	.1931,	.1988,
1970,	41112,	312352,	261487,	97387,	89484,	.3422,	.4204,
1971,	31549,	242812,	204071,	80461,	79034,	.3873,	.4223,
1972,	33554,	196235,	164051,	72594,	43055,	.2624,	.3019,
1973,	31060,	180300,	152282,	77918,	29938,	.1966,	.2252,
1974,	26640,	173123,	147166,	77904,	37763,	.2566,	.2787,
1975,	22537,	152716,	129984,	65714,	38172,	.2937,	.3361,
1976,	22095,	126093,	105709,	49276,	36074,	.3413,	.4265,
1977,	23679,	100784,	81877,	36184,	28827,	.3521,	.3410,
1978,	20588,	87127,	69899,	26851,	24617,	.3522,	.3660,
1979,	19692,	104868,	80867,	26399,	17312,	.2141,	.1912,
1980,	18581,	86039,	68278,	26183,	13284,	.1946,	.1721,
1981,	17863,	91971,	74412,	29081,	15018,	.2018,	.1446,
1982,	18908,	87609,	70307,	29696,	16789,	.2388,	.2189,
1983,	18980,	103771,	83497,	33889,	22147,	.2652,	.2915,
1984,	17796,	93004,	76098,	29904,	21883,	.2876,	.3388,
1985,	19865,	92001,	75622,	31637,	19945,	.2637,	.3059,
1986,	19822,	91142,	74499,	30156,	22875,	.3071,	.3522,
1987,	19407,	84484,	62590,	22859,	19112,	.3054,	.3504,
1988,	22926,	84144,	57098,	21701,	19587,	.3430,	.4074,
1989,	20643,	87797,	58610,	19099,	20138,	.3436,	.3203,
1990,	14467,	77160,	51170,	15564,	23183,	.4531,	.4269,
1991,	12524,	71256,	39277,	19594,	33320,	.8483,	.6656,
1992,	10327,	44146,	28488,	9959,	8602,	.3020,	.2478,
1993,	12406,	50270,	32774,	12332,	11933,	.3641,	.3229,
1994,	17067,	49481,	31802,	10156,	9226,	.2901,	.2764,
1995,	15832,	54775,	33343,	9149,	11734,	.3519,	.3287,
1996,	16765,	61791,	40700,	7559,	14347,	.3525,	.3707,
1997,	16132,	61824,	45209,	8289,	9628,	.2130,	.2647,
1998,	13294,	66177,	45915,	9774,	12507,	.2724,	.2811,
1999,	9471,	63850,	36755,	12046,	19350,	.5265,	.4615,
2000,	10217,	58463,	30201,	11368,	14139,	.4682,	.3437,
Arith. Mean ,	25914,	121396,	95283,	36241,	26452,	.3077,	.3083,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),	(Tonnes),		

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Table 8.17

The SAS System 09:23 Tuesday, May 1, 2001

Greenland halibut in Sub-areas I & II

Prediction with management option table: Input data

Year: 2001

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
5	14440.000	0.1500	0.1500	0.0000	0.0000	0.737	0.0382	0.737
6	8445.000	0.1500	0.3900	0.0000	0.0000	0.960	0.1283	0.960
7	5985.000	0.1500	0.5200	0.0000	0.0000	1.307	0.3473	1.307
8	4960.000	0.1500	0.5200	0.0000	0.0000	1.603	0.3027	1.603
9	3397.000	0.1500	0.4800	0.0000	0.0000	2.087	0.1976	2.087
10	3039.000	0.1500	0.7200	0.0000	0.0000	2.553	0.7426	2.553
11	1007.000	0.1500	0.8300	0.0000	0.0000	3.290	0.4698	3.290
12	509.000	0.1500	0.9700	0.0000	0.0000	3.937	0.7376	3.937
13	200.000	0.1500	1.0000	0.0000	0.0000	4.903	0.3807	4.903
14	101.000	0.1500	1.0000	0.0000	0.0000	5.753	0.5947	5.753
15+	34.000	0.1500	1.0000	0.0000	0.0000	5.950	0.5947	5.950
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
5	14440.000	0.1500	0.1500	0.0000	0.0000	0.737	0.0382	0.737
6	.	0.1500	0.3900	0.0000	0.0000	0.960	0.1283	0.960
7	.	0.1500	0.5200	0.0000	0.0000	1.307	0.3473	1.307
8	.	0.1500	0.5200	0.0000	0.0000	1.603	0.3027	1.603
9	.	0.1500	0.4800	0.0000	0.0000	2.087	0.1976	2.087
10	.	0.1500	0.7200	0.0000	0.0000	2.553	0.7426	2.553
11	.	0.1500	0.8300	0.0000	0.0000	3.290	0.4698	3.290
12	.	0.1500	0.9700	0.0000	0.0000	3.937	0.7376	3.937
13	.	0.1500	1.0000	0.0000	0.0000	4.903	0.3807	4.903
14	.	0.1500	1.0000	0.0000	0.0000	5.753	0.5947	5.753
15+	.	0.1500	1.0000	0.0000	0.0000	5.950	0.5947	5.950
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2003

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
5	14440.000	0.1500	0.1500	0.0000	0.0000	0.737	0.0382	0.737
6	.	0.1500	0.3900	0.0000	0.0000	0.960	0.1283	0.960
7	.	0.1500	0.5200	0.0000	0.0000	1.307	0.3473	1.307
8	.	0.1500	0.5200	0.0000	0.0000	1.603	0.3027	1.603
9	.	0.1500	0.4800	0.0000	0.0000	2.087	0.1976	2.087
10	.	0.1500	0.7200	0.0000	0.0000	2.553	0.7426	2.553
11	.	0.1500	0.8300	0.0000	0.0000	3.290	0.4698	3.290
12	.	0.1500	0.9700	0.0000	0.0000	3.937	0.7376	3.937
13	.	0.1500	1.0000	0.0000	0.0000	4.903	0.3807	4.903
14	.	0.1500	1.0000	0.0000	0.0000	5.753	0.5947	5.753
15+	.	0.1500	1.0000	0.0000	0.0000	5.950	0.5947	5.950
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANAAG02
Date and time: 01MAY01:09:24

Table 8.18

The SAS System 09:23 Tuesday, May 1, 2001

Greenland halibut in Sub-areas I & II

Prediction with management option table

Year: 2001					Year: 2002					Year: 2003	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.6684	0.5734	56446	28406	19200	0.0000	0.0000	50331	23790	0	66140	34268
.	.	.	.	.	0.0500	0.0172	.	23790	642	65392	33736
.	.	.	.	.	0.1000	0.0344	.	23790	1269	64660	33216
.	.	.	.	.	0.1500	0.0516	.	23790	1883	63945	32709
.	.	.	.	.	0.2000	0.0687	.	23790	2483	63245	32215
.	.	.	.	.	0.2500	0.0859	.	23790	3070	62562	31734
.	.	.	.	.	0.3000	0.1031	.	23790	3645	61893	31264
.	.	.	.	.	0.3500	0.1203	.	23790	4207	61239	30806
.	.	.	.	.	0.4000	0.1375	.	23790	4757	60600	30358
.	.	.	.	.	0.4500	0.1547	.	23790	5295	59974	29922
.	.	.	.	.	0.5000	0.1719	.	23790	5822	59362	29496
.	.	.	.	.	0.5500	0.1890	.	23790	6338	58763	29081
.	.	.	.	.	0.6000	0.2062	.	23790	6843	58177	28675
.	.	.	.	.	0.6500	0.2234	.	23790	7338	57603	28279
.	.	.	.	.	0.7000	0.2406	.	23790	7822	57041	27892
.	.	.	.	.	0.7500	0.2578	.	23790	8297	56491	27514
.	.	.	.	.	0.8000	0.2750	.	23790	8762	55952	27145
.	.	.	.	.	0.8500	0.2921	.	23790	9218	55425	26785
.	.	.	.	.	0.9000	0.3093	.	23790	9664	54908	26433
.	.	.	.	.	0.9500	0.3265	.	23790	10102	54402	26089
.	.	.	.	.	1.0000	0.3437	.	23790	10531	53905	25752
.	.	.	.	.	1.0500	0.3609	.	23790	10952	53419	25424
.	.	.	.	.	1.1000	0.3781	.	23790	11364	52943	25102
.	.	.	.	.	1.1500	0.3953	.	23790	11768	52476	24788
.	.	.	.	.	1.2000	0.4124	.	23790	12165	52018	24481
.	.	.	.	.	1.2500	0.4296	.	23790	12554	51569	24180
.	.	.	.	.	1.3000	0.4468	.	23790	12936	51129	23887
.	.	.	.	.	1.3500	0.4640	.	23790	13310	50697	23599
.	.	.	.	.	1.4000	0.4812	.	23790	13678	50274	23318
.	.	.	.	.	1.4500	0.4984	.	23790	14038	49858	23043
.	.	.	.	.	1.5000	0.5156	.	23790	14392	49450	22773
.	.	.	.	.	1.5500	0.5327	.	23790	14740	49050	22510
.	.	.	.	.	1.6000	0.5499	.	23790	15081	48658	22251
.	.	.	.	.	1.6500	0.5671	.	23790	15416	48272	21999
.	.	.	.	.	1.7000	0.5843	.	23790	15745	47894	21751
.	.	.	.	.	1.7500	0.6015	.	23790	16068	47523	21509
.	.	.	.	.	1.8000	0.6187	.	23790	16386	47158	21271
.	.	.	.	.	1.8500	0.6358	.	23790	16698	46800	21039
.	.	.	.	.	1.9000	0.6530	.	23790	17004	46448	20811
.	.	.	.	.	1.9500	0.6702	.	23790	17305	46103	20588
.	.	.	.	.	2.0000	0.6874	.	23790	17601	45763	20369
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name          : MANAAG02
       Date and time     : 01MAY01:09:24
       Computation of ref. F: Simple mean, age 6 - 10
       Basis for 2001    : TAC constraints
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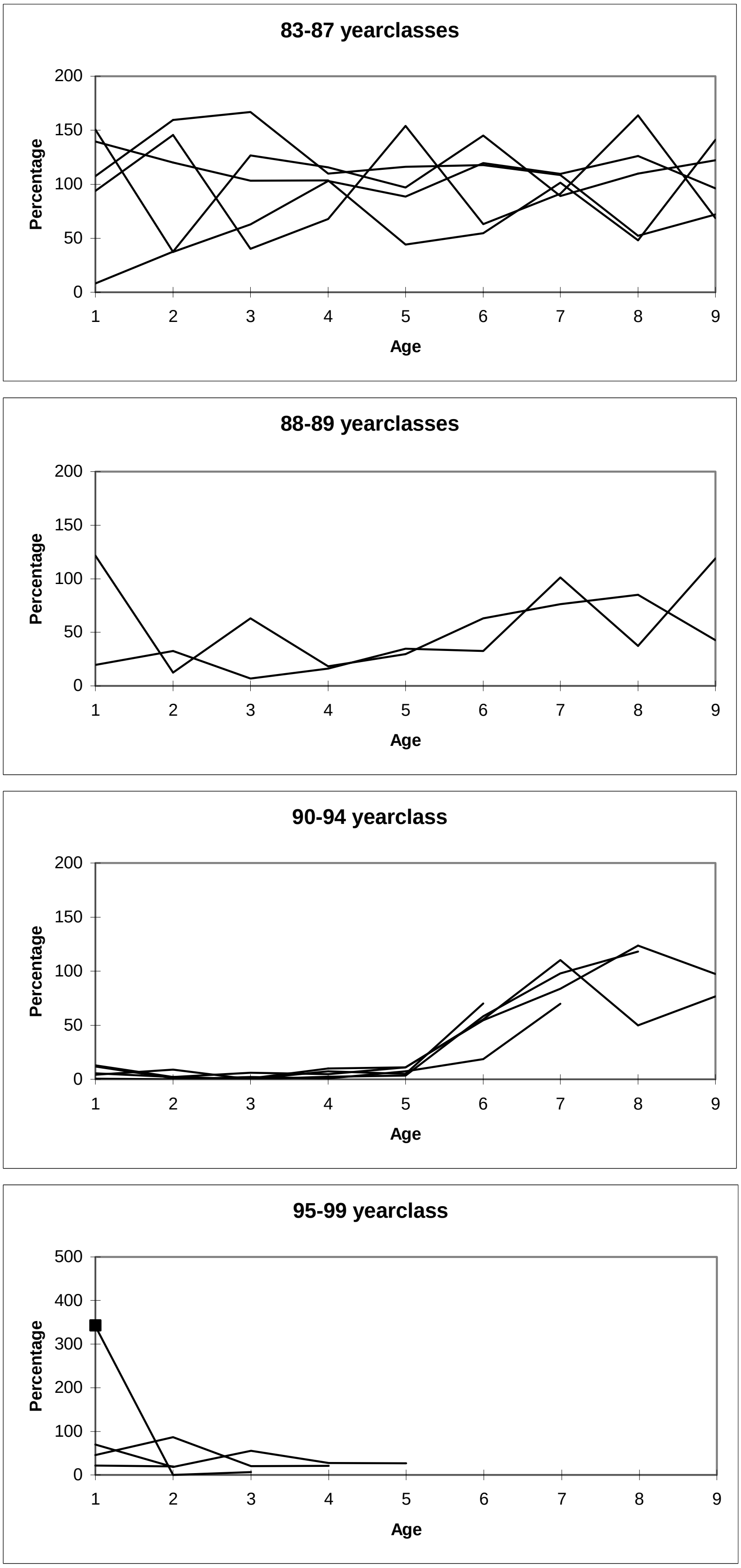


Figure 8.1. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Svalbard area (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

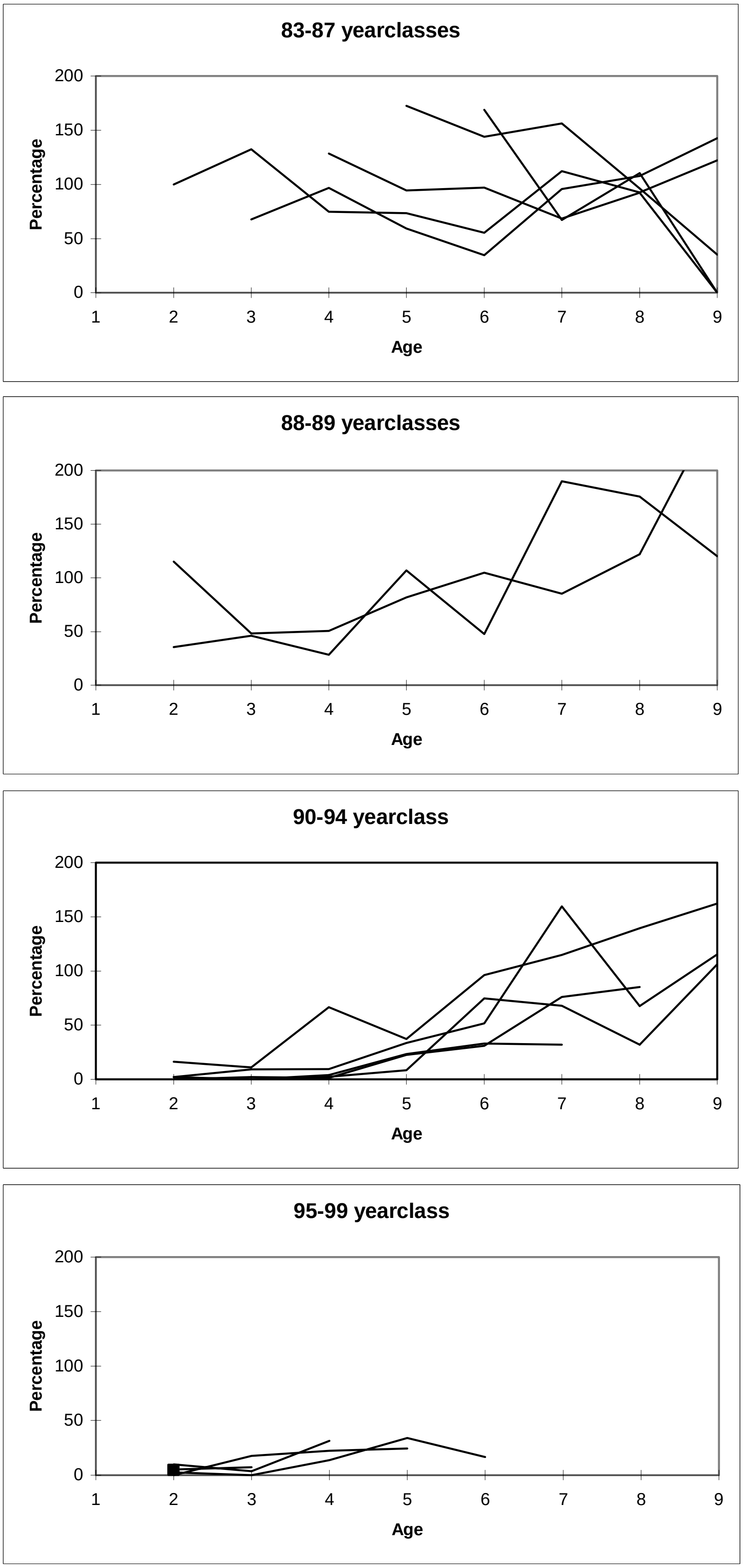


Figure 8.2. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Barents Sea (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

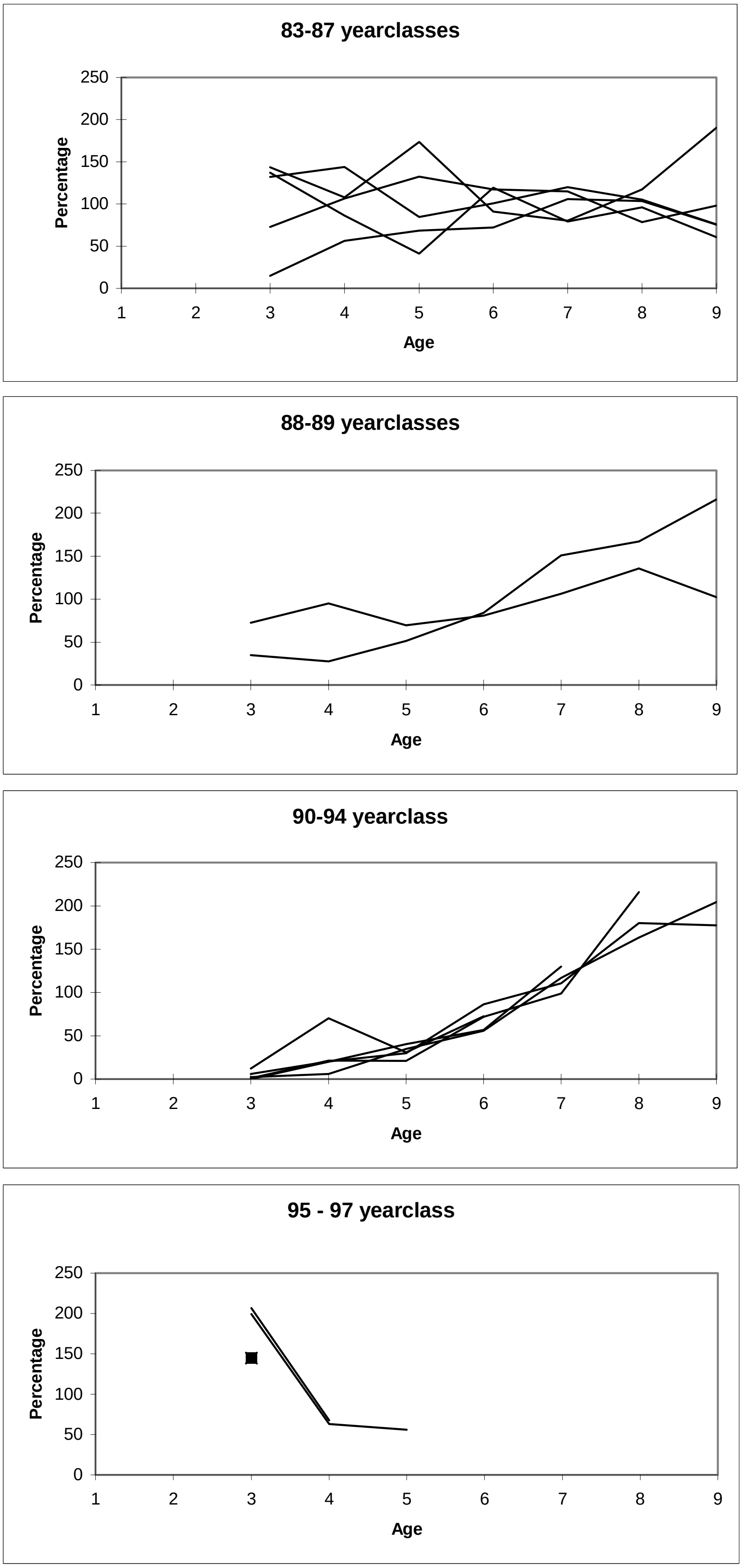


Figure 8.3. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Russian bottom-trawl survey in the Barents Sea (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

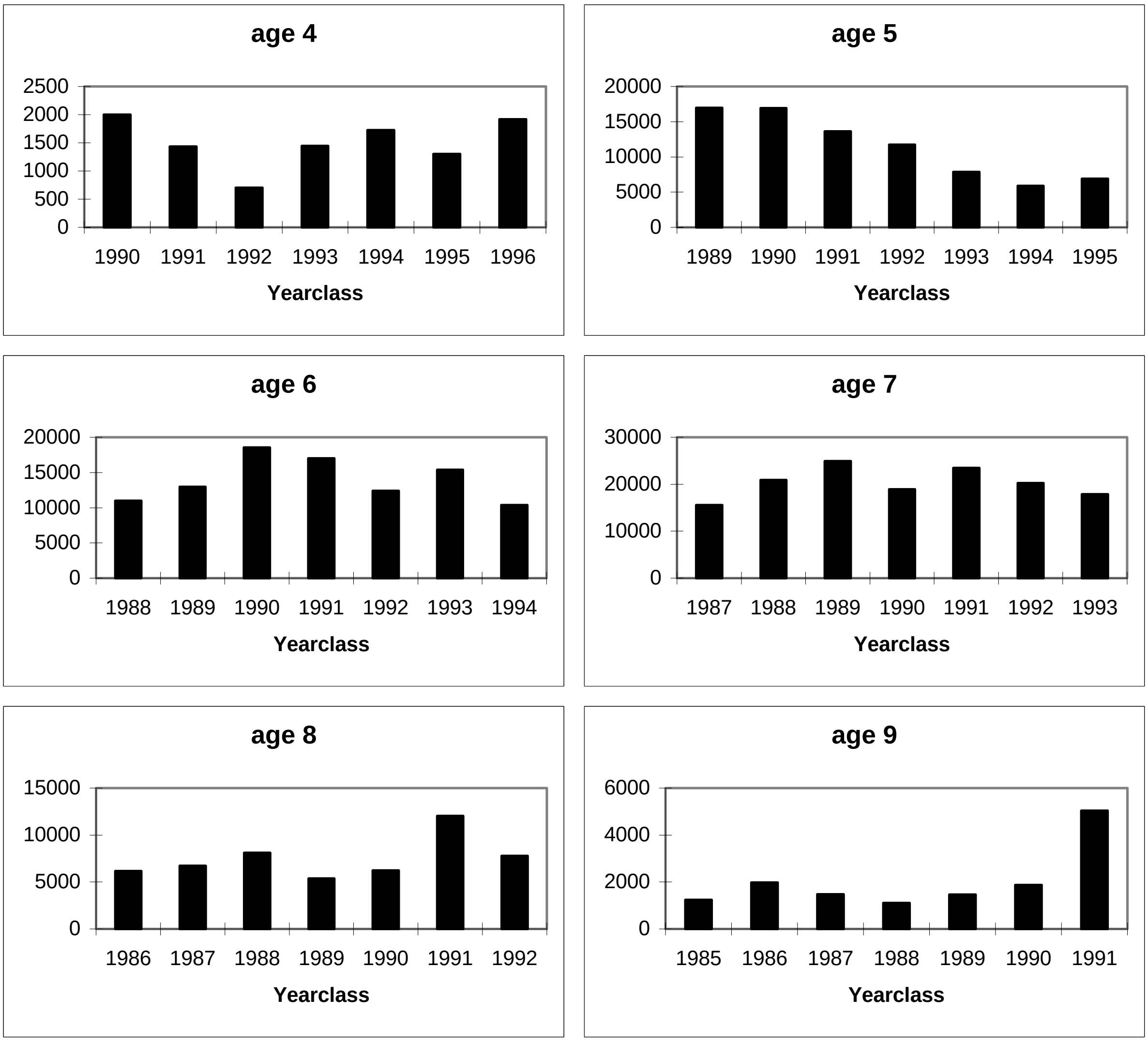


Figure 8.4. GREENLAND HALIBUT in Sub-area I and II:
Abundance at age from the Norwegian stratified Greenland halibut survey. Data for consecutive yearclasses at selected ages.

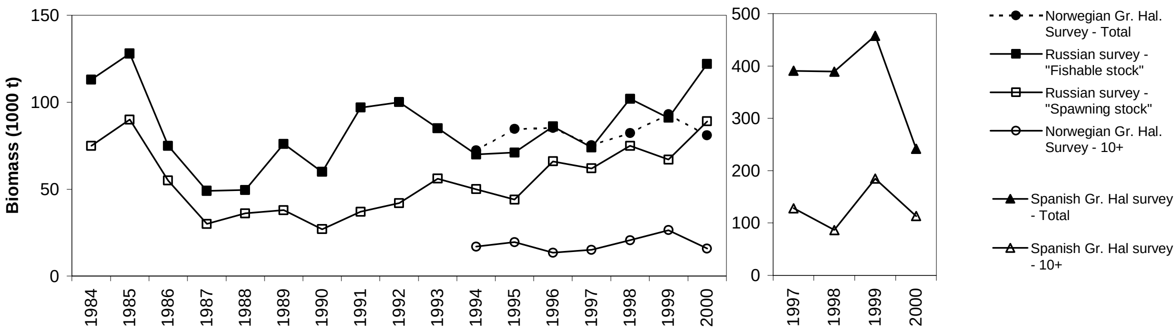


Figure 8.5. Biomass estimates of North-east Arctic Greenland halibut (*Reinhardtius hippoglossoides*) based on swept area calculations from Russian, Norwegian and Spanish surveys along the continental slope

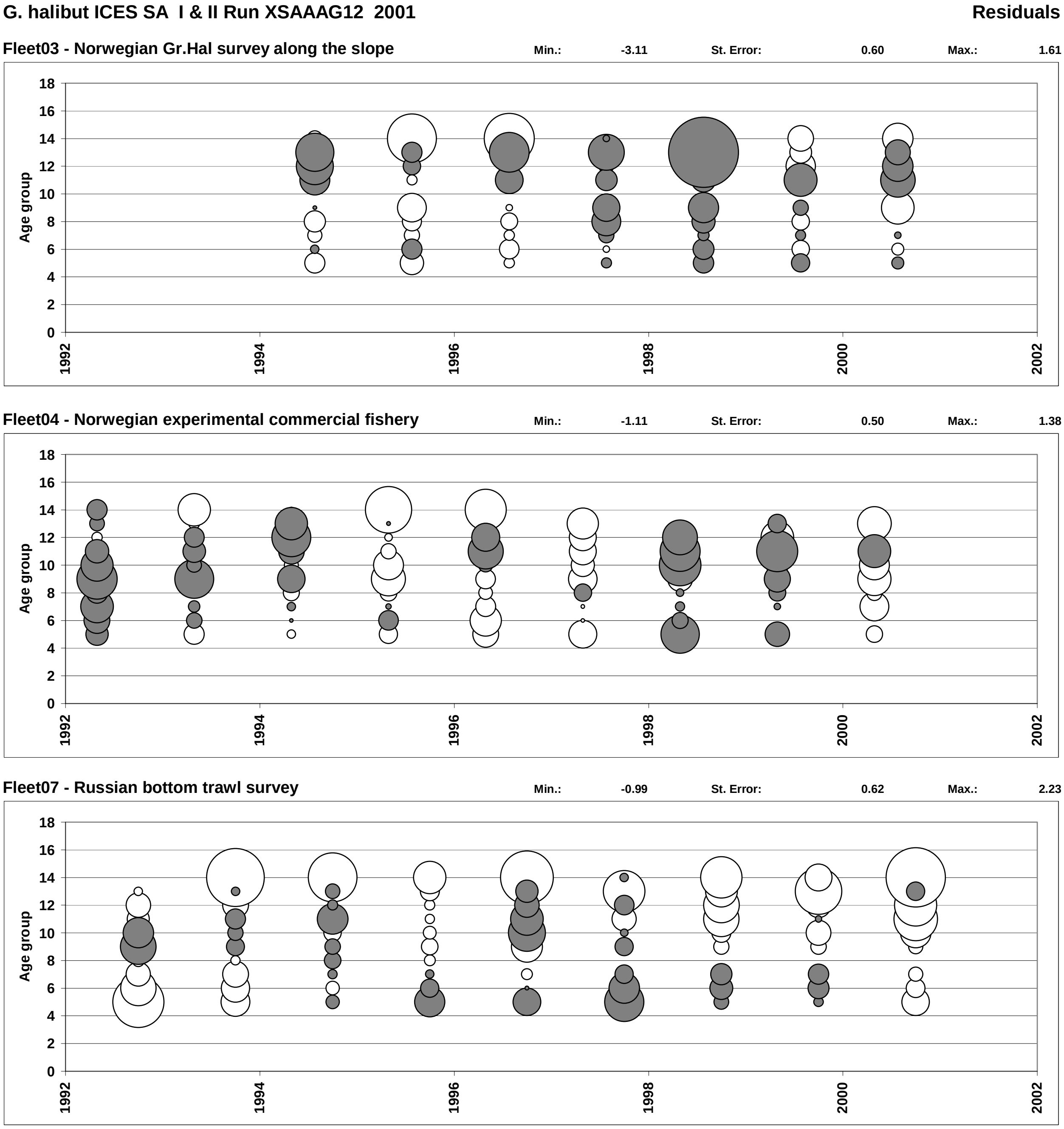
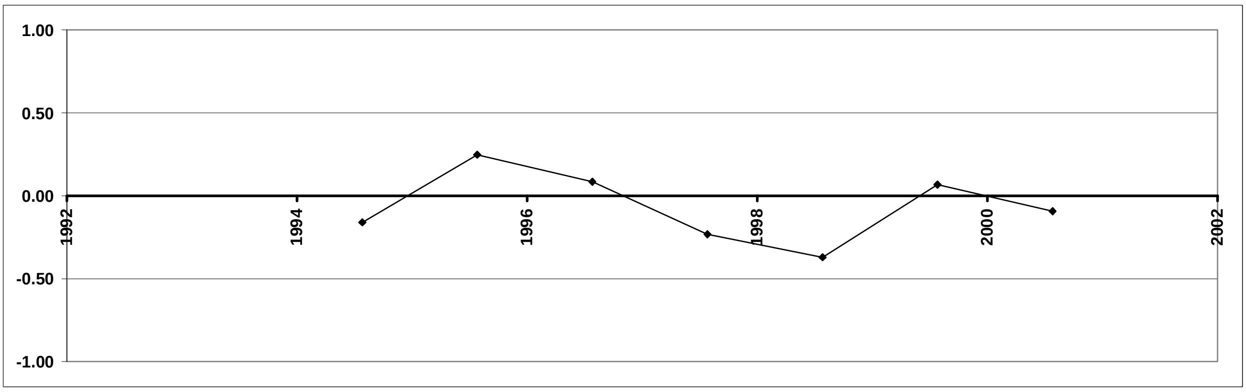


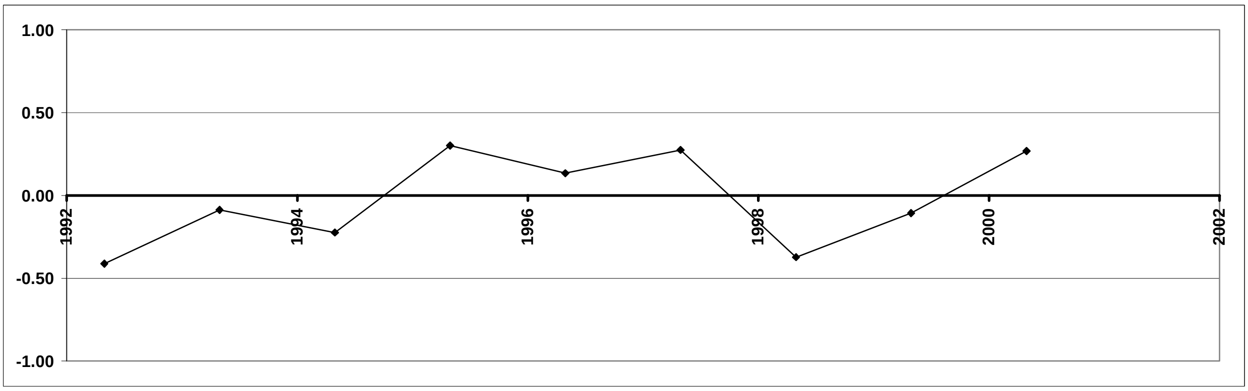
Figure 8.6. Log catchability residuals by age and year for the tuning fleets included in the assessment. All graphs are normalized to the same maximum bubble size. Open bubbles=positive values; filled bubbles=negative values

G. halibut ICES SA I & II Run XSAAAG12 2001 **Residuals - Averaged by year**

Fleet03 - Norwegian Gr.Hal survey along the slope



Fleet04 - Norwegian experimental commercial fishery



Fleet07 - Russian bottom trawl survey

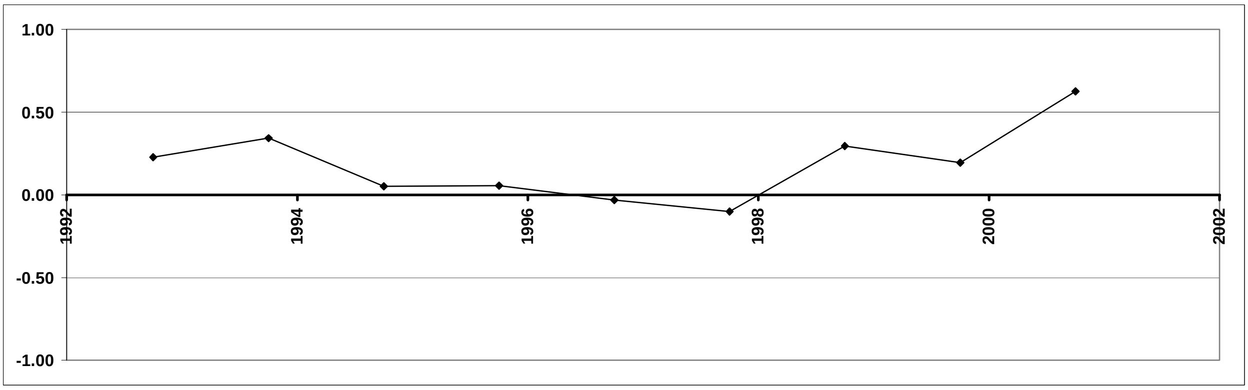


Figure 8.7. Log catchability residuals averaged by year for the tuning fleets included in the assessmen

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 1	2	3	4	5	6	7	8	9+	Total
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
2000 [1]	2	2 009	540	323	1 347	2 135	2 634	1 784	1 197	530	12 499

[1] New standard trawl equipment (rockhopper gear and 40 meter sweep length).
[2] In millions.

Table E2. GREENLAND HALIBUT in Sub-area I and II. Abundance indices from bottom trawl surveys in the Barents Sea in winter (in thousands).

A: Restricted area surveyed every year; **B**: Enlarged area (includes the restricted one) surveyed since 1993

A

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1989	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
2001	19	36	112	558	517	260	497	697	267	478	43	42	30	3 556

B

Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
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
2001	69	250	363	2 046	4 250	2 730	2 983	1 123	416	1 148	111	137	94	15 720

[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
2000	2 841	5 327	10 718	15 719	18 694	21 235	9 155	3 593	2 580	1 011	108	133	120	91 234

[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 1998-2000. Numbers in thousands.

A: Only western area for the years 1988-97; **B**: Including areas east of Bear Island for the years 1992-2000.

A	Age									Total
Year	1	2	3	4	5	6	7	8	9+	
1988 [1]	4 163	14 278	8 259	8 354	2 594	144				37 792
1989 [2]	4 653	9 777	9 943	4 855	4 057	1 054	542	83	372	35 336
1990	247	1 569	8 324	9 800	6 910	2 148	295	245	175	29 713
1991	25	577	2 465	4 969	5 362	2 541	1 380	158	278	17 755
1992	95	57	505	1 780	2 914	1 129	713	333	200	7 726
1993 [3]	39	54	50	814	1 572	433	589	395	512	4 458
1994 [3]	0	13	43	446	2 214	1 218	1 764	485	797	6 980
1995 [3]	24	26	31	407	1 081	592	521	151	159	2 992
1996 [3]	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	Age									Total
Year	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
2000 [3]	1 512	1 940	762	2 675	4 138	5 284	3 923	3 079	1 277	24 590

[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	0	0	383	1 920	6 901	10 352	17 885	7 795	5 038	3 284	867	458	204	75	16	55 178

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	15 271	14 140	2 803	403	434	36 466
1998	8 482	18 718	9 463	5 161	1 166	932	43 922
1999	5 370	9 074	3 328	2 271	1 492	954	22 489
2000	9 529	16 844	8 007	6 274	1 746	722	43 122

B Year	Age						Total
	1	2	3	4	5	6+	
1998	10 210	28 020	17 186	6 380	1 551	932	64 279
1999	7 514	16 159	8 045	3 067	2 401	954	38 140
2000	No coverage in Russian EEZ						

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

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	-	238
1990	-	10	30 [1]	3	-	29	-	4	-	76
1991	-	48	291 [1]	1	-	216	-	2	-	558
1992	1	15	416 [1]	3	-	626	-	+	1	1 062
1993	1	-	78 [1]	1	-	858	-	10	+	948
1994	+	103	84 [1]	4	-	724	-	6	-	921
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	1 510
1998	+	-	71	10	10	804 [1]	-	35	435	1 365
1999	+	-		1	18	2 250 [1]	-	43	358	2 670
2000 [1]	+			10		783 [1]	-		259	1 052

[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, 74,000 t in 1999 and 79,000 t in 2000. 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 by-catch limits given as number of individuals in 10 kg of shrimp are exceeded. In 2001 the values are set to ten for cod and haddock, eight for redfish and three for Greenland halibut.

9.1.3 Landings (Table 9.1, Figure 9.1)

Final reported landings for all countries show a substantial increase of catches between 1996 (33,000 t) and 2000 (79,000 t) (Table 9.1 and Figure 9.1). In 2000 Norway landed 55,000 t, Russia 19,000 t and others 5,000 t.

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, ICES 2001). Additionally evaluations of the Norwegian surveys have been conducted (Aschan and Sunnanå 1997, Harbitz *et al.* 1998).

9.2.2 Samples from commercial catches

In 2000 observers collected samples on board commercial Spanish vessels in the Svalbard zone. Length and sex distribution data and data on by-catch was obtained (Casas 2001 WD:25). Length distribution data and by-catch data is collected by the Norwegian surveillance since 1995. However, this sampling is not continuous in time and space.

9.2.3 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 and a further decline in 2000. However, the Norwegian CPUE does not follow the survey index as does the Russian CPUE (vessels < 1300hp).

Probably this is a consequence of the use of double trawl. The effort has increased for both countries since 1997. Germany and Spain have delivered catch and effort data for the years 1999 and 2000 respectively.

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 24 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 (vessels<1300hp) has fluctuated in accordance with the shrimp biomass (Berenboim *et al.* 2001). It should be noted that the Russian fleet is also under development.

9.2.4 Survey results (Tables 9.3–9.4, Figure 9.3–9.4)

There is a strong correlation between the Norwegian and the 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 for the Barents Sea 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 weak 1996 year class (Aschan *et al.* 2000). The Goose Bank is the only area that shows an increase in biomass in 2000.

9.2.5 Population structure

Genetic investigations have been conducted by Kartavtsev *et al.* (1991) on *Pandalus borealis* in the Barents Sea and the Bering Sea. Norwegian scientists 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 reveal that the majority of shrimp larvae settle approximately 80 km from the spot where hatched (Pedersen *et al*. in prep).

9.2.6 Age determination

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 2001, Hansen and Aschan 2001).

Scientists agree on how the available length-at-age data should be implemented in the production of recruitment indices, maturity-at-age and catch at age data.

9.2.7 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 first time spawning females with headroe (Stage 4). When the females mate, the roe is moved under the abdomen (Stage 5) where the eggs stay until hatched (Stage 6). Some females then take a resting period (Stage 7), but the majority starts 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 2001). 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 (area A) grew quickly and changed sex at an age of four years, whereas shrimp in the central and northern Barents Sea grew slowly (areas B, C and E) and changed sex at an age of 5 years or greater (Aschan 2001). In the Svalbard area, shrimp were between 6 and 10 years at sex change (Hansen and Aschan 2001). Data from Spanish commercial catches indicate a sex change at 5-6 years in the Svalbard zone (Casas 2001 WD 26). 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.

9.2.8 Recruitment (Table 9.5)

Since the growth 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, 3 and 4 year old shrimp in the whole area (Table 9.5) (Aschan *et al.* 2000). Russian scientists have used these age-length data in further modelling of the stock (Korzhev and Berenboim 2001 WD 23, 2001 WD 24). A common procedure for dividing shrimp into age groups has been agreed upon.

Since very few shrimp < 15 mm CL are caught in the trawl, it is suggested that a mesh bag is attached to the underbelly of the survey trawl (Aschan and Sunnanå 1997, Nilssen *et al.* 1986).

9.2.9 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 (*Reinhardtius hippoglossoides*), 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 2001, Dolgov 2001 WD 5). Shrimp consumption rates may have been overestimated. 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. The following potential problems have been identified (Aschan 2000 WD 6):

1) cod feeding on shrimp while in the survey trawl;
2) calibrating the use of digestion rate;
3) the effect of spatial and temporal aggregation level;
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 9.6)

The great plasticity in growth of shrimp and age at sex change, as well as a lack of biological data and length distributions from the catches make it difficult to apply traditional analytical fishery assessment methods to the data.

Spreadsheet performance reports (Caddy 1999, Koeller *et al.* in press; see Table 9.6)

Production models

1) Shaefer and Fox stock models;
2) stock production model including predation (Stefánsson *et al.* 1994, Berenboim and Korzhev 1997); and
3) age-structured production model (Shepherd 1991);biomass dynamic models (Hilborn and Walters 1996).

Catch at age analysis (cohort models)

1) single species virtual population analysis;
2) multi species virtual population analysis.

Length at age analysis

1) Jones´ analysis (for sustainable stock);
2) Analysis including stochastic growth (Sullivan et al. 1991, Kunzlik 1991);
3) Fleksibest (Froeysa *et al.* 2001);
4) Bormicon – multispecies analysis (Stefánsson and Pálsson 1997).

The experience with some of the models is described below:

<u>Production models</u>

Shaefer and Fox production models were used to assess the MSY of the Barents Sea shrimp (Korzhev and Berenboim 2001 WD 23). Since cod consumption is not included in this model the Stefánsson production model is to be preferred.

The production model elaborated by Stefánsson *et al*. (1994) for shrimp of north Icelandic water was applied to Barents Sea shrimp data (Korzhev and Berenboim 2001 WD 23). This model considers cod and shrimp populations without dividing them into age or length groups.

<u>Catch at age analysis (cohort models)</u>

For these models it is important to apply reasonable values for the natural mortality coefficient as a function of age and year, because these parameters are important in shrimp models due to high cod consumption.

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 multispecies model), or
- to introduce the predator as an additional fleet.

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 in the model. Cod stomach data is obtained from the Joint Russian-Norwegian stomach data base. Methods used in parameter estimation and preparation of input files are described in Bulgakova *et al.* (1995 a,b,c) and ICES (1996). The MSVPA is developed in the MAWG ICES (Sparre 1984). A new version is being developed by H. Gislason (pers. comm.) for the Barents Sea community.

<u>Length at age analysis</u>

Application of the Jones cohort analysis on the Barents Sea shrimp stock has demonstrated that the absence of data on size distribution in commercial catches does not allow a reliable assessment (Korzhev and Berenboim 2001 WD 24).

Bulgakova *et al*. (2001 WD22) made an attempt to apply the dynamic catch at length analysis on the basis of Sullivan's algorithm (1991) to shrimp stock assessment.

9.4 Status of the Stock (Table 9.2–9.4, Figure 9.3–9.5)

Norwegian and Russian CPUE indices indicated a decline in the stock from 1998 to 2000 (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). 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 to the fishery in 2001. The increased shrimp consumption by cod will probably also result in a reduction in the shrimp stock in 2001 (Figure 9.5).

Recommendations for further work

- Scientists should evaluate the procedures used in estimating the shrimp consumed by cod;
- 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, especially the use of single, double and triple trawls;
- 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.
- Catch and effort statistics should be delivered to the ICES by all countries involved in the shrimp fishery in the Barents Sea and the Svalbard area.
- A joint NAFO-ICES Working Group on shrimp will meet in October 2002. This WG will give the advice to ICES ACFM in the future.

9.5 Further Cooperation

The shrimp stock in the Barents Sea and the Svalbard area has been assessed in the Arctic Fisheries Working Group in 2000 and 2001. One of the aims was to include the interaction between the shrimp stock and the cod stock. Still the cod consumption needs to be evaluated. For assessment of shrimp it is believed that a Shrimp Working Group would be the best. A joint NAFO-ICES Working Group on shrimp is therefore planned to meet in October 2002.

Table 9.1 Nominal shrimp catches (t) by country (Sub-areas I and II combined). Data were provided by ICES and Working Group members.

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	43,950	4,895	4,197[1]	53,042
1999	53,197	10,765	9,615[2]	73,577
2000	54,574	19,462	5,003[3]	79,039

[1] catches reported by Faroe Island, Iceland, Portugal, Spain and UK(Eng.Wal.NI)
[2] catches reported by Faroe Islands, Germany, Greenland, Iceland, Portugal and UK(Eng.Wal.NI)
[3] catches reported by Estonia, Lithuania, Portugal, Spain and UK.

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 1300hp.

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
2000	49,000	174,810	280

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
2000	12,204	71,784	170

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 Recruitment index for shrimp in the Barents Sea defined as size groups according to carapace length at age in the Hopen area (whole mm). Norwegian survey data.

CL (mm)	age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
<9	1	0.2	4.2	2.8	3.8	4.2	0.1	0.2	0.2	0.1	0.9	0.5
9<cl<12	2	4.5	28.1	42.9	31.7	16.1	12.3	14.0	13.7	2.8	7.4	21.1
12<cl<15	3	32.6	92.1	127.9	112.8	60.6	66.9	77.9	84.4	85.7	26.4	70.6
15<cl<18	4	343.0	299.6	361.9	415.7	247.2	305.5	468.0	561.2	544.7	342.5	191.2

Table 9.6 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 43,000 t in 87. Catches fluctuated between 81,000 t in 90 and 26,000 in 95. During 96–00 catches increased continuously to 79,000 t.
Effort	The total Norwegian and Russian effort was stable (approx. 140,000 h) from 94–98 but increased in 99 and 00 to 247,000 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 8 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 in 2000.

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 in the years 99 and 00 for both fleets. 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 in 99 and 00.	–
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 observed low numbers of small shrimp in the catches in 2000.	?
Sex inversion	According to data from Spanish commercial catches the age at sex change is 5-6 years.	The lack of previous information in commercial catches does not permit any interpretation.	?

Table 9.6 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 is weak. 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 catchable size in 2001.	**?**
Spawning stock (females)	Has been a stable proportion of the stock through the 90's; female abundance vary with the biomass index. Possible decrease in 2001 SSB index due to the weak 96 year class.	Female biomass/abundance have 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 9.6 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. Cod consumption has increased to 401 thousand t in 2000. Other predators are e.g. Greenland halibut and thorny skate (*Raja radiata*)	Consumption is still high and increased from 99 to 2000.	–
Environment	The 95–98 temperatures in the Barents Sea were below the long term mean. Since the beginning of 1998, temperatures have increased and have stayed above the long term mean. This may 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 were good, though somewhat lower than 1999. In the first quarter of 2001 the Russian shrimp fishery indicates that the catch rate is lower than in 2000.		?

Table 9.6 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. The increased shrimp consumption by cod will probably also result in a eduction in the shrimp stock in 2001	?	

Concerns for current status/future prospects –

Uncertainty regarding index quality or impact ?

Positive evaluation ✚

<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>

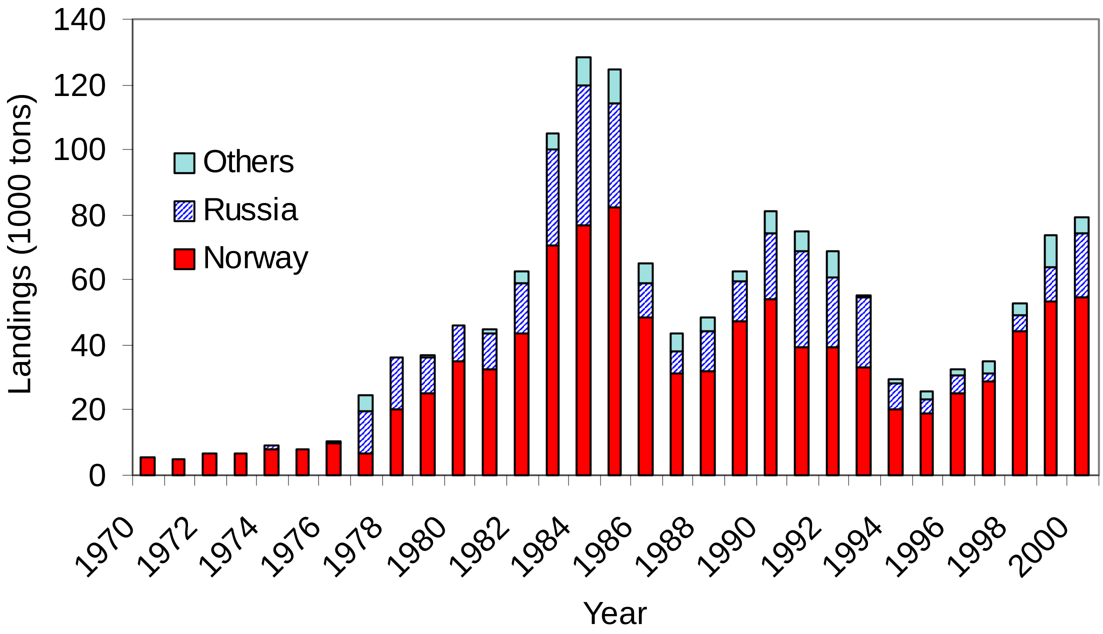


Figure 9.1. Shrimp landings from ICES areas I, IIa and IIb by Norway, Russia and other countries in the period 1970–2000.

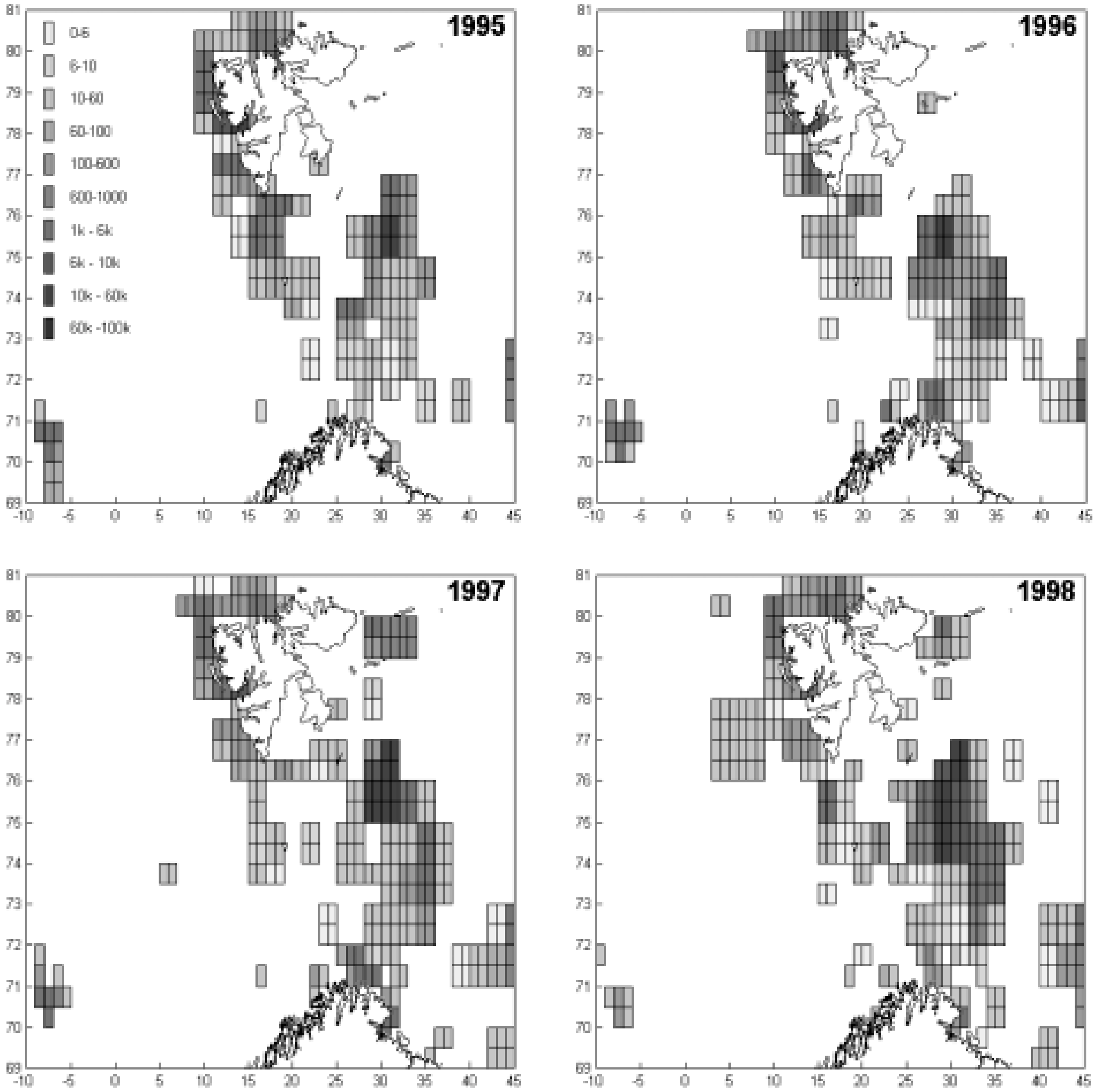


Figure 9.2 Norwegian annual catch by statistical grid in 1995–1998.

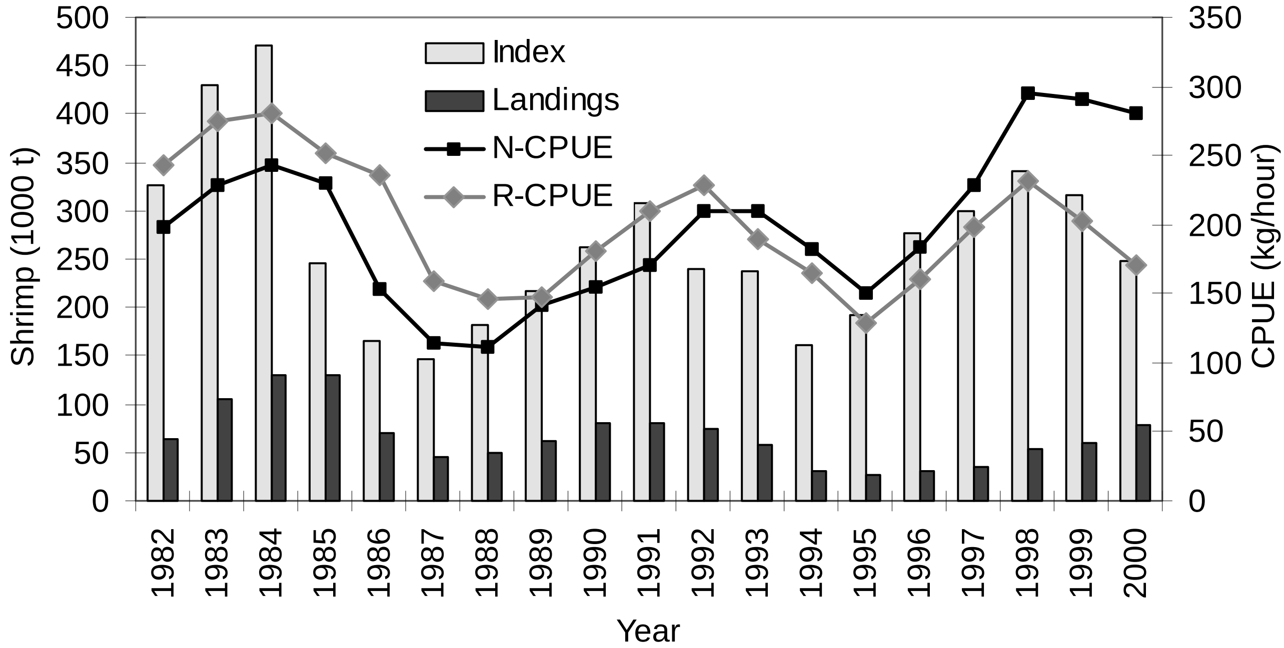


Figure 9.3 Biomass indices from the Norwegian surveys, total landings and Norwegian and Russian CPUE for ICES areas I, IIa and IIb.

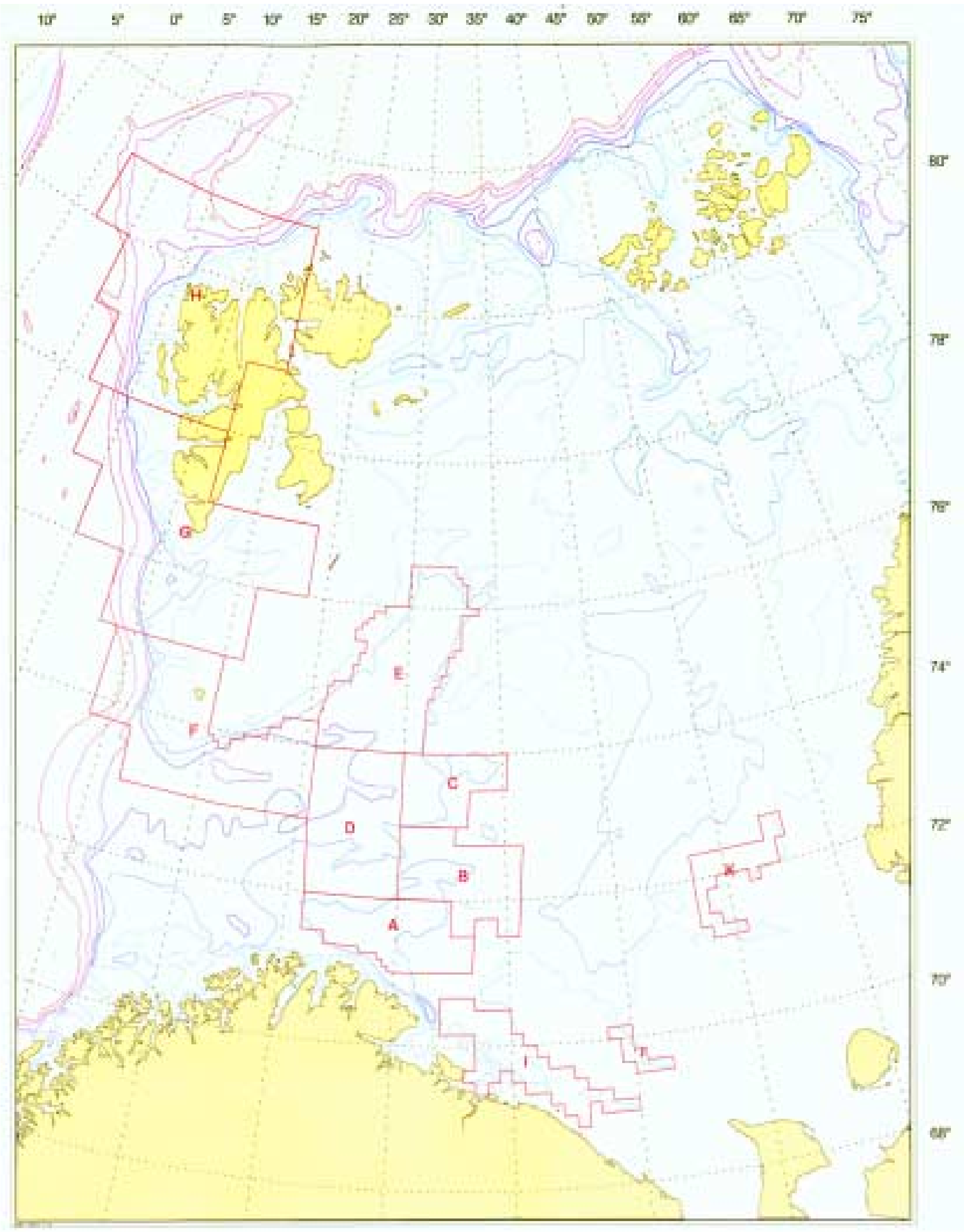


Figure 9.4 Survey strata are combined to 10 larger areas marked with letters A to K. East Finnmark (A), Tiddly Bank (B), Thor Iversen Bank (C), Hopen (E), Bear Island (F), Storfjord Trench (G), Spitsbergen (H), Kola coast (I) and the Goose Bank (K).

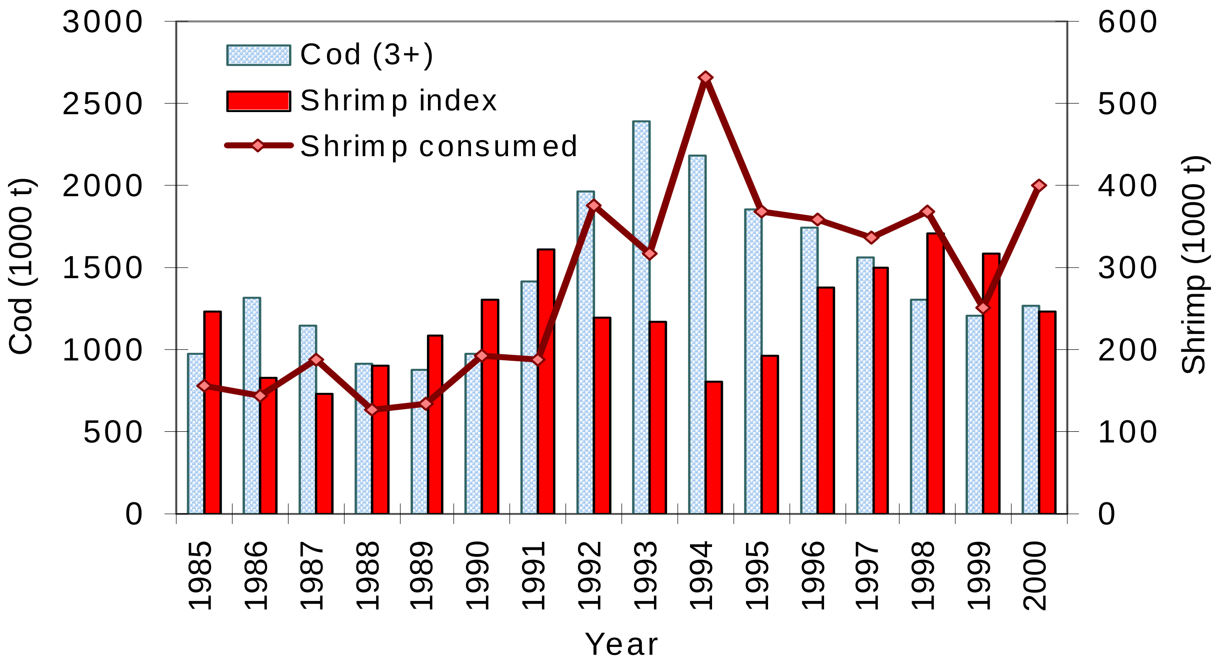


Figure 9.5 Biomass indices from the Norwegian surveys, biomass estimate for cod (age 3 years and older) and the shrimp consumed by the cod in the Barents Sea (Table A16).

10 BIOLOGICAL REFERENCE POINTS FOR NORTHEAST ARCTIC COD

10.1 Introduction

In August 2000, the Russian government requested that the Arctic Fisheries Working Group evaluate the appropriateness of the $\mathbf{B}_{pa}$ value of 500,000 t taking into account stock conditions and other factors. This issue was discussed by the Arctic Fisheries Working Group in August 2000. At that time, it was decided to address the issue by developing historical time series for weight- and maturity-at-age and re-estimating SSB by replacing the constant values used for the pre-survey time period with the reconstructed values. Consequently, one of the terms of reference for the April/May 2001 meeting of the ICES Arctic Fisheries WG was:

- *when historic data on maturity and weights become available revisit the appropriateness of the biological reference points for cod*

In the intersessional period scientists at both PINRO and IMR directed considerable effort towards compiling and summarizing data on growth and maturity from historical sources (Ajiad and Jakobsen WD1, Gusev *et al*. WD2, Yaragina WD3). As a result, time series for weights at age and maturity at age for the time period preceding the surveys were available at this years WG meeting.

At the 2001 WG meeting a study group compared the Russian and Norwegian time series and developed a combined time series that was subsequently used in the assessment. This chapter:

- describes how reconstructed time series for weight and maturity were developed;
- summarizes the effects of the reconstruction on the assessment;
- reviews the reference points for NA cod;
- makes recommendations for future work on related issues.

10.2 Weight at age in stock

10.2.1 Russian data (Table 10.1)

Russia and the former USSR have conducted annual surveys for young cod and haddock in the southern Barents Sea since 1946. In 1957 the geographical coverage of these surveys was expanded to include the Bear Island-Spitsbergen area. Observations from these surveys describing the age, length, weight of individual cod are not presently archived in an electronic form. Therefore, the historical weights at age were reconstructed using the secondary sources of information (e.g., age/length keys) that are available. To cover the complete length distribution, the survey database was supplemented with observations from sampling the commercial catch in the 4th and 1st quarters.

Sampling details for the Russian survey are provided in Gusev *et al*. (WD2). One feature of the sampling methodology used in the early years of the juvenile fish surveys is that there was a tendency to exclude fish longer than 36 cm from the samples. Thus, it is more likely that mean weights for ages 3-4 are underestimated. In 1951, 1955, 1956, 1960 and 1962 there were few observations for fish larger than 36 cm. Consequently, these years were deleted from the time series. There were no data for 1952. Visual inspection of the time series suggested that in 1959 the weights at age for ages 5 and 8 were anomalously high. These years also had low numbers of observations (Table 10.1). Consequently, they were deleted. As a result of missing data and excluded data the resulting time series had some gaps. These missing observations were replaced by the arithmetic average of adjacent values.

10.2.2 Norwegian data (Table 10.2)

The Norwegian database on historical weights and maturities was constructed from sampling of the commercial catch in Lofoten which began in 1932. This database has been used previously in the analysis of Jørgensen (1990). A second database from the spring (primarily longline) fishery around the Finnmark coast was also available. Whereas the Lofoten data describe primarily mature individuals, the Finnmark data reflect both the immature and mature fractions of the stock.

The criteria used for subsampling the Lofoten and Finnmark databases for weight observations are described in more detail in Ajiad and Jakobsen (WD1). The number of observations by year and age class is given for the Lofoten database (Table 10.2). In the case of the Lofoten database, weight was missing for 1959-1988, however, length and age information were available. The missing weight-at-age values were calculated from the length-at-age using the following equation:

log Weight at age = -5.19 + 3.08 log Length at age

Mean weight at age from Finmark were missing from 1940-1948. For these years estimates were based on the ratio to Lofoten weights before and after this period. Otherwise the procedure concerning missing values was similar to what has been used for Lofoten.

To represent the stock weight at age the Lofoten and Finnmark databases were combined. An average weight at age was calculated by weighting the weight-at-age estimates for the Lofoten and Finnmark areas by the year-specific proportion mature and immature, respectively. Estimation of these proportions is described in Section 10.3.2.

The reconstructed weights at age were used to recalculate the SOP correction factor for the Norwegian catch. In general, the SOP was less than 10%, however, the period 1965-1968 was notable for having SOP values on order 30-40%.

10.2.3 Combined data (Figures 10.1-10.4)

The Russian and Norwegian time series describe weight at age in the 4th and 1st quarter, respectively. Prior to combining them, the Russian values were shifted forward by one year and one age class so that they would correspond to the Norwegian data. This is consistent with the current practice used for combining the Russian and Norwegian survey weights at age (Section 3.3.2). The Russian and Norwegian time series were combined into a single time series by arithmetically averaging the two series with the following exceptions:

- for ages 14 and 15 only the Norwegian time series was available;
- Norwegian values for ages 11-13 were used when the corresponding Russian value was missing;
- for 1946 the age-specific average of 1947-1949 were used.

Comparing the two time series (ages 3 to 9 are shown in Fig. 10.1) it can be seen that the Russian estimates are usually lower, particularly for the younger age classes. This systematic difference has also been noted for the survey time period (Fig. 10.2). This could be due to the Russian samples including a higher proportion of slower growing fish, the size-selectivity of the Lofoten fishery and/or differences in the timing of sampling (4th quarter Russian data, 1st quarter Norwegian data).

The full time period (reconstruction + survey) for ages 3-9 is shown in Fig. 10.3. An increase in the weight at age occurred during the post-war period. Periods of low weights at age were observed, e.g., the mid-1960’s and late-1980’s. The late-1950’s/early-1960’s, the early- to mid-1980’s and the early-1990’s were characterized by high weights at age. A long-term increase in weight at age is noted for the oldest age classes (ages 8 and 9).

The reconstructed time series for ages 3-9 are shown in comparison to the time series that has previously been used in the assessment (Fig. 10.4). The constant values used from 1946 to 1982 were consistently higher than the reconstructed values for ages 3, 4, and 5 and usually higher than the reconstructed values for ages 6 to 9 (Fig. 10.4). For ages 3, 4, and 5 values for the reconstructed time period fall within the range of variation observed during the survey time period.

10.3 Proportion mature at age

10.3.1 Russian data (Table 10.3, Figure 10.5)

Following the development of a maturity scale by Sorokin (1957, 1960) visual inspection of gonad maturity was routinely undertaken. Thus, the reconstructed time series presented in Yaragina (WD3) dates from 1959 onwards. Limited data on maturity exists for earlier years (Glebov 1963) but was not included here. Samples were obtained from research surveys and sampling of commercial catch during November to February. The number of observations are given by year and age class in Table 10.3. At the time of year corresponding to when the observations were collected, the gonads of mature individuals are easily distinguished from those of immature individuals. According to the Sorokin maturity scale, immature fish are in stages 1 and 2 whereas mature fish are in stages 3 to 6.

The Russian proportions mature at age (ages 3 to 13) for the time period 1959-1999 are shown in Figure 10.5. Some events were reasonably synchronous across age classes, e.g., the abrupt declines in proportions mature at age observed in the late-1960's and in the mid-1970's (Fig. 10.5). For younger age classes the proportions mature increased suddenly at the beginning of the early 1980's, i.e., coincident with the start of survey observations of maturity. There is a long-term trend towards increasing proportion mature for the oldest age classes (ages 7 and older).

10.3.2 Norwegian data (Figures 10.6 - 10.7)

Only the Lofoten database was used to construct the Norwegian ogives. This database contains information on age at first spawning as determined from a spawning check in the otolith. These data have been previously used by Jørgensen (1990) to construct maturity ogives for individual cohorts according to the Gulland method (Gulland 1964). The Gulland method can only be used for cohorts which have fully recruited to the fishery. The calculation requires the following to be estimated:

k = age when all fish of the cohort are mature
r_i = proportion of recruit spawners of age i
m_i = proportion of mature fish at age i

Given that the proportion of recruit spawners at age k were immature the year before:

$m_{k-1} = 1 - r_k$
$m_{k-2} = (1-r_{k-1})(1-r_k)$

This method will give biased results if immature and mature fish of the same age experience different rates of mortality. The method used here to correct for differential mortality assumed that the correction factor should be proportional to the ratio of mature to immature individuals (Ajiad and Jakobsen WD1). By adjusting this ratio it was found that improved fits between the Gulland method ogives and the survey-based ogives could be obtained.

The proportions mature at age determined using the Gulland method for the full time period are shown in Fig. 10.6. There were synchronous reductions in the proportions mature in the late-1950's, the late-1960's, and the mid-1970's. Overall, there is a long-term trend towards increasing proportion mature for the ages 7 and older. For ages 5 and 6 low values were observed for the reconstruction time period but higher values for the survey time period.

The proportions mature at age obtained by the Gulland method were compared to the values estimated from the Norwegian Barents Sea and Lofoten surveys combined. For ages 5 and 6, the Gulland method tends to give systematically lower values (Fig. 10.7). The Gulland method also did not reflect the large reduction in proportions mature at age observed in 1987 that resulted from cod being in unusually poor condition. In general, the range of variation observed in the Gulland time series was less than the survey-based time series.

10.3.3 Combined data (Figures 10.8 – 10.9)

The Russian and Norwegian time series for the time period 1959-1999 are shown along with the survey time period in Fig. 10.8. In the early-1980's the proportion mature increased abruptly for ages 5, 6, 7 and 8 by approximately 0.2-0.3 (i.e., 20 to 30%). Consequently, the variation across years is larger than variation observed within years between Russian and Norwegian values (Fig. 10.8). For the early years the Russian values were systematically larger than the Norwegian values which is somewhat unexpected given that the Norwegian data were obtained from the Lofoten fishery and should be biased towards faster maturing fraction of the stock. However, as noted in Fig. 10.7, the Gulland method appears to systematically underestimate the proportions mature compared to values obtained from visual examination of gonads.

For the time period 1946-1958 only the Norwegian data (Gulland method) were available. To generate a comparable time series for these years, the Gulland values were increased by a correction factor that reflects the fact that the Gulland values were generally lower than the Russian values in the time period 1959-1981 (Fig. 10.8). The value of this correction factor was determined as follows: the difference between the combined value of proportion mature (the arithmetic average of the Russian and Norwegian value) and the Norwegian value was estimated for each year of the time period 1959 to 1981 and for each age class. The average difference was then calculated for each age class. This value ranged from a minimum of –0.04 (age 10) to a maximum of +0.07 (age 8). These values were added to the Gulland values for 1946-1958 to give a corrected time series.

The reconstructed time series of proportion mature at age used in the assessment are shown in Fig 10.9. Three distinct periods of differing data sources are indicated: Gulland only (1946-1958); Gulland + Russian (1959-1981); and Russian + Norwegian surveys. Some discontinuity between periods is suggested, particularly between the 1959-1981 and 1982-

present periods. However, examination of the Gulland and Russian data for the full time period (Fig 10.8) suggests that the increase could be real rather than artifactual.

10.4 Comparing temporal trends in growth (Figures 10.10-10.11)

A comparison of the time series for weights and proportions mature at age suggesting that the two are somewhat consistent in their representation of long-term trends in growth (Fig. 10.10). For example, a long-term increase in both weights and maturities is observed for the older age classes (ages 8 and 9).

The reconstructed time series for weight and proportion mature were also compared to historical data describing long-term variation in the condition, represented by the liver condition index of cod 61-70 cm in length (Yaragina and Marshall 2000), and capelin stock biomass. The latter was reconstructed back to 1946 using observed values of the frequency of occurrence of capelin in cod stomachs (Marshall and Yaragina WD 14). The trends in weight at age show a degree of synchrony with both the liver condition index and capelin stock biomass for ages 5 and 6 (Fig. 10.11).

10.5 Comparison of SOP factors (Figure 10.12)

Including the reconstructed weight and proportion mature at age changed the pattern in SOP correction factors (Fig. 10.12). Using constant values of weight and proportion mature at age gave SOP values that were consistently less than one until 1971 which is consistent with having used weights at age that were higher than the probable values (Fig. 10.4).

10.6 Revised S/R relationship (Figures 10.13 – 10.14)

The new stock/recruitment relationship is shown in Fig. 10.13. As was the case for the previous S/R relationship, it shows no easily discernable functional relationship. To circumvent this problem the S/R data were re-expressed by sorting the data in order of increasing SSB value and estimating the cumulative frequency of recruitment falling below the average value of recruitment (583 million) for each SSB. Thus, at the lowest observed SSB only one recruitment observation was used to calculate the probability of being below the mean while at the highest observed SSB all of the observations for recruitment were used. Figure 10.14 presents the frequency of below average recruitment as function of this "upper bound" of SSB. This frequency of below average recruitment is 1.0 for the five lowest SSB values and then decreases. The frequency levels off above approximately 400 000 t.

10.7 Revision of biomass reference points

According to the information provided to the WG by ACFM, the $\mathbf{B}_{\text{lim}}$ value can be defined as the limit spawning stock biomass, below which recruitment is impaired or the dynamics of the stock are unknown (ACFM May 2000 Working Paper). This definition proved to be problematic in the context of the S/R plot for Northeast Arctic cod. The S/R plot (Fig. 10.13) could be interpreted as showing evidence of impaired recruitment below a value of SSB. Alternatively, the S/R plot could be interpreted as having a threshold value such that the behaviour below this value is unknown.

As a result, it was not possible to identify reference points unambiguously. A consensus was reached on revised values for $\mathbf{B}_{\text{lim}}$ and $\mathbf{B}_{\text{pa}}$. However, there were dissenting opinions regarding the proposed values. These opinions are summarized in the text that follows the description of the technical basis for the revised reference points that were agreed upon by the WG.

10.7.1 Revision of $\mathbf{B}_{\text{lim}}$ and $\mathbf{B}_{\text{pa}}$ (Table 10.4)

The values 102 000 t (lowest observed SSB), 115 000 t (average of five lowest SSB), 140 000 t (the SSB below which the recruitment is low) 170 000 t, 200 000 t, and 250 000 t were considered as possible $\mathbf{B}_{\text{lim}}$ values (Table 10.4). These values were then used as the starting point in the following estimation of $\mathbf{B}_{\text{pa}}$:

$$\mathbf{B}_{\text{pa}} = \mathbf{B}_{\text{lim}}\, e^{1.645\,\sigma} \times 1.4$$

where 1.4 is a bias correction factor reflecting the degree to which the converged SSB values deviate from the unconverged values on average (see Section 10.7.2). The value of $\mathbf{B}_{\text{pa}}$ was estimated for each of the $\mathbf{B}_{\text{lim}}$ values using a variety of σ values (Table 10.4). A $\mathbf{B}_{\text{lim}}$ of 140 000 t gave a $\mathbf{B}_{\text{pa}}$ value of 378 000 t. At SSBs below this $\mathbf{B}_{\text{lim}}$ only weak year-classes have been observed (Fig. 10.14). Furthermore, a $\mathbf{B}_{\text{pa}}$ value of 378 000 t is also close to the level at which the frequency of below average recruitment reaches a relatively stable value (Fig. 10.14). On this basis, the $\mathbf{B}_{\text{lim}}$ and $\mathbf{B}_{\text{pa}}$ values were proposed to be 140 000 and 375 000 t, respectively.

Compared to many other stocks the relative distance between the proposed $\mathbf{B}_{lim}$ and $\mathbf{B}_{pa}$ values is quite large. The justification for this is the high degree of uncertainty of the assessment (reflected in σ being set at 0.4) and the systematic pattern of downward revisions of SSB (introduction of bias correction factor of 1.4).

Table 10.4: Comparison of $\mathbf{B}_{pa}$ values estimated using alternative $\mathbf{B}_{lim}$ values. A bias correction factor of 1.4 was included in the estimate of $\mathbf{B}_{pa}$. All values are in thousand t.

σ	$\mathbf{B}_{lim}$ **= 102**	$\mathbf{B}_{lim}$ **= 115**	$\mathbf{B}_{lim}$ **= 140**	$\mathbf{B}_{lim}$ **= 170**	$\mathbf{B}_{lim}$ **= 200**	$\mathbf{B}_{lim}$ **= 250**
0.2	198	224	272	331	389	486
0.3	234	264	321	390	459	573
0.4	276	311	378	460	541	676
0.5	325	366	446	542	637	797

10.7.2 Concerns about the proposed values of $\mathbf{B}_{lim}$

When comparing estimates of SSB from the 2001 assessment with estimates from previous assessments, it is evident that SSB has most often been overestimated by the annual assessment. For example, the average ratio between the converged values from the 2001 assessment and the unconverged estimates from previous assessments is 0.71 with values ranging from 0.68 to 0.78 for the period 1993-1997. Until the cause of this bias is identified and corrected, the SSB values from the assessment should be viewed critically. Bias corrections should be applied to either the SSB estimates (multiply by 0.7) or the values of $\mathbf{B}_{lim}$ and $\mathbf{B}_{pa}$ (multiply by 1.4). Taking this into account, a bias correction factor was included in the formulation of $\mathbf{B}_{pa}$ (Section 10.7.1). However, this correction applies to the estimate of $\mathbf{B}_{pa}$ and some members of the WG held the opinion that it should also be applied to $\mathbf{B}_{lim}$.

The approach recommended by the Study Group on the Precautionary Approach in 1998 for the NEA cod was to set $\mathbf{B}_{lim} = \mathbf{B}_{loss}$. This approach has been used until present and some members of the WG felt that there were no grounds for changing the approach. It seems possible to use **B** as a value for $\mathbf{B}_{lim}$, which is set either at the lowest SSB observed for the whole study period or at the average of the lowest SSB values. For NA cod there is a group of points on the SSB/R plot representing the 1965, 1966, 1967, 1980 and 1987 year classes which are associated with the average value of 116 000 t. In these five years, the low level of SSB (102 300 – 129 800 t) did not lead to the stock collapse and the SSB was rebuilt fairly quickly despite being exploited at a high level.

10.8 Related issues

Weight at age in catch vs. weight at age in stock – for the historical period the same data were used for both weight at age in catch and weight at age in stock. These values could possibly be less than the true weight at age in catch and higher than the true weight at age in stock, especially for the youngest age groups. This distinction has not been properly evaluated by this study group. Developing separate historical time series for weight at age in catch and in the stock should be a future goal.

Incorporating information on reproductive potential – the reconstruction of historical weights and proportions mature has clarified long-term trends in growth. This development, in conjunction with the development of a general fecundity model (Thorsen and Kjesbu WD13), will be of considerable benefit ongoing efforts to estimate reproductive potential of the stock on historical time scales. Such estimates of reproductive potential will account for the quantity and quality of the spawning stock. Alternative definitions of spawner biomass could also be considered. For example, the biomass of cod ages 8+ has been proposed as an alternative index for constructing a S/R relationship (Nakken WD11). If the scatter in the S/R plot can be reduced to a marked degree then additional reference points based on reproductive potential will be developed.

Alternative recruitment time series – the inclusion of cannibalism into the assessment model beginning in 1984 creates a discontinuity in the recruitment time series that could have important consequences for the S/R plot. A statistical model has been developed to predict mortality due to cannibalism from length at age, capelin stock biomass and cod biomass. This model is currently used to predict cannibalism for the upcoming assessment year. In future, this model could be used to reconstruct historical mortality due to cannibalism as has been done for weights and maturities at age. This would take advantage of the reconstructed time series of capelin stock biomass (Figure 10.11). In addition, recruitment time series for age 1 should be made readily available for recruitment research. The fact that the recruitment index used is for age 3 instead of age 1 is often commented upon when research results are presented.

Fishing mortality reference points – the assessment for NA cod evaluated the appropriateness of the current reference points for F using PASoft (Section 3.6.2) and consequently these reference points were not reviewed by the study group. However, there was discussion of the appropriateness of using an average F for ages 5 to 10 when the relative contribution of older cod to the catch has declined over time. An alternative averaging procedure was discussed, e.g. F_{4-8}. The appropriateness of the existing reference points for a revised definition of average fishing mortality should be reviewed at the next meeting.

Modelling the growth of NA cod – recent WG reports have highlighted the need to develop a predictive model for weight and mature at age which could be used in stock projections. The reconstruction of historical time series for weight and proportion mature should benefit the development of such models.

10.9 Acknowledgements

The reconstructed time series for weight and proportion mature at age used by the study group were made possible through the combined efforts of many scientists at PINRO and IMR. Special thanks are extended to A. Ajiad, K. Drevetnyak, E. Gusev, T. Jakobsen, and N. Yaragina.

Table 10.1. Northeast Arctic cod. Number of observations used to estimate mean weight at age for the Russian database

Year\age	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1946	394	431	34	43	121	81	26	27	42
1947	48	5	4	140	276	67	43	19	26
1948	29	28	105	192	139	178	92	45	12
1949	185	100	28	104	302	175	116	22	15
1950	219	101	147	134	129	33	11	1	
1951	286	236	48	1					
1952									
1953	6	350	569	512	179	36	14	3	7
1954	45	36	244	185	98	40	12	2	1
1955	189	122	9						
1956	412	220	4						
1957	409	495	106	63	118	221	91	93	40
1958	730	491	453	154	123	98	47	22	21
1959	2517	853	37	8	1	4	2	2	3
1960	846	321	8						
1961	1854	1129	257	40	5	3	2	1	
1962	1672	1859	279	4					
1963	367	829	720	221	132	90	42	46	29
1964	262	513	2606	2927	1078	295	65	11	6
1965	289	956	1413	2009	1105	351	181	54	12
1966	5437	7115	1553	620	720	727	299	73	19
1967	132	6570	6763	2286	434	211	170	57	22
1968	18	167	3000	2490	1360	444	121	35	18
1969	202	149	1076	4580	2818	1454	500	100	35
1970	1612	554	291	210	937	1333	566	101	21
1971	1640	701	161	84	63	277	704	334	15
1972	4702	927	517	195	42	18	138	290	48
1973	3198	5358	1062	255	69	12	4	3	
1974	4834	1479	204	51	12	3			
1975	920	757	196	243	112	16		2	
1976	402	917	746	335	423	248	64	23	5
1977	1069	889	1372	1279	637	384	212	71	26
1978	136	3686	1124	594	283	125	92	43	15
1979	66	551	3696	2727	815	364	129	41	7
1980	8	17	71	427	220	74	46	32	2
1981	1024	138	95	151	459	172	48	12	1

Table 10.2. Northeast Arctic cod. Number of observations used to estimate mean weight at age for the Lofoten database.

Year\age	6	7	8	9	10	11	12	13+
1946		3	31	538	234	157	186	203
1947		6	19	117	481	155	67	203
1948	1	10	36	84	274	763	179	321
1949	3	42	174	172	225	270	753	599
1950	1	82	545	647	321	201	201	762
1951	12	87	792	1609	1033	376	164	766
1952	4	78	405	1905	1923	1029	325	496
1953	37	166	517	1170	2148	1058	335	218
1954	64	354	573	711	749	848	351	214
1955	21	591	1177	1181	928	525	426	273
1956	117	410	1942	1226	638	387	149	216
1957	11	369	482	1262	574	283	133	133
1958	11	78	801	786	664	265	96	50
1959	20	52	348	1185	758	286	86	40
1960	23	62	131	398	1074	475	115	56
1961	40	278	669	591	912	1301	391	193
1962	93	402	1345	1224	503	425	337	133
1963	101	487	854	1281	490	241	172	284
1964	32	161	503	489	471	138	68	160
1965	30	302	525	547	289	241	83	189
1966	27	427	1064	515	182	70	53	36
1967	27	490	1339	830	223	105	57	82
1968	58	257	1051	785	161	42	16	23
1969	423	459	616	1001	377	59	12	8
1970	369	2556	933	467	328	98	21	20
1971	117	2251	3630	763	200	136	63	36
1972	12	300	2070	1034	144	36	25	16
1973	51	175	916	2725	683	102	28	74
1974	282	476	527	1093	1638	676	136	147
1975	367	786	544	171	166	275	258	169
1976	908	1046	671	293	74	42	83	124
1977	97	1102	547	173	64	17	20	72
1978	106	385	1697	528	107	28	7	29
1979	95	353	648	2233	466	101	42	44
1980	96	416	470	287	463	60	15	20
1981	1491	1573	1378	931	405	240	38	9

Table 10.3. Northeast Arctic Cod. Number of observations used to estimate maturity ogives for the Russian database

Year\age	2	3	4	5	6	7	8	9	10	11	12
1959	3	86	356	864	324	136	170	119	94	80	34
1960	29	169	845	1075	999	468	187	108	90	54	30
1961	13	495	1404	1359	764	645	237	112	98	131	104
1962	0	68	784	1380	1041	401	255	140	56	40	25
1963	0	51	1045	1925	978	374	98	32	1	6	0
1964	0	42	597	1722	1343	681	307	113	71	41	11
1965	57	97	586	2391	2068	611	164	33	3	0	1
1966	7	306	944	1190	1615	880	164	19	11	1	0
1967	0	84	3062	1469	391	374	412	238	54	14	5
1968	0	33	3044	5374	1747	366	196	137	45	13	1
1969	2	13	163	2637	1875	992	262	80	26	10	2
1970	0	52	90	687	2658	1587	739	263	58	23	13
1971	4	204	353	255	237	987	1350	567	99	21	8
1972	11	544	668	271	136	59	152	205	90	23	4
1973	2	1088	1317	1260	790	238	95	343	293	124	29
1974	3	66	3107	1490	361	93	16	4	2	1	0
1975	1	247	659	2438	1542	379	106	27	7	5	1
1976	1	379	1203	902	1138	706	166	36	10	3	1
1977	37	186	2233	1670	832	710	595	222	49	11	8
1978	1	1067	873	1338	1245	624	368	192	67	18	12
1979	1	136	3687	1123	590	281	126	90	43	15	3
1980	0	46	358	2235	1434	422	183	63	21	5	5
1981	0	39	323	591	2589	807	160	60	38	22	4

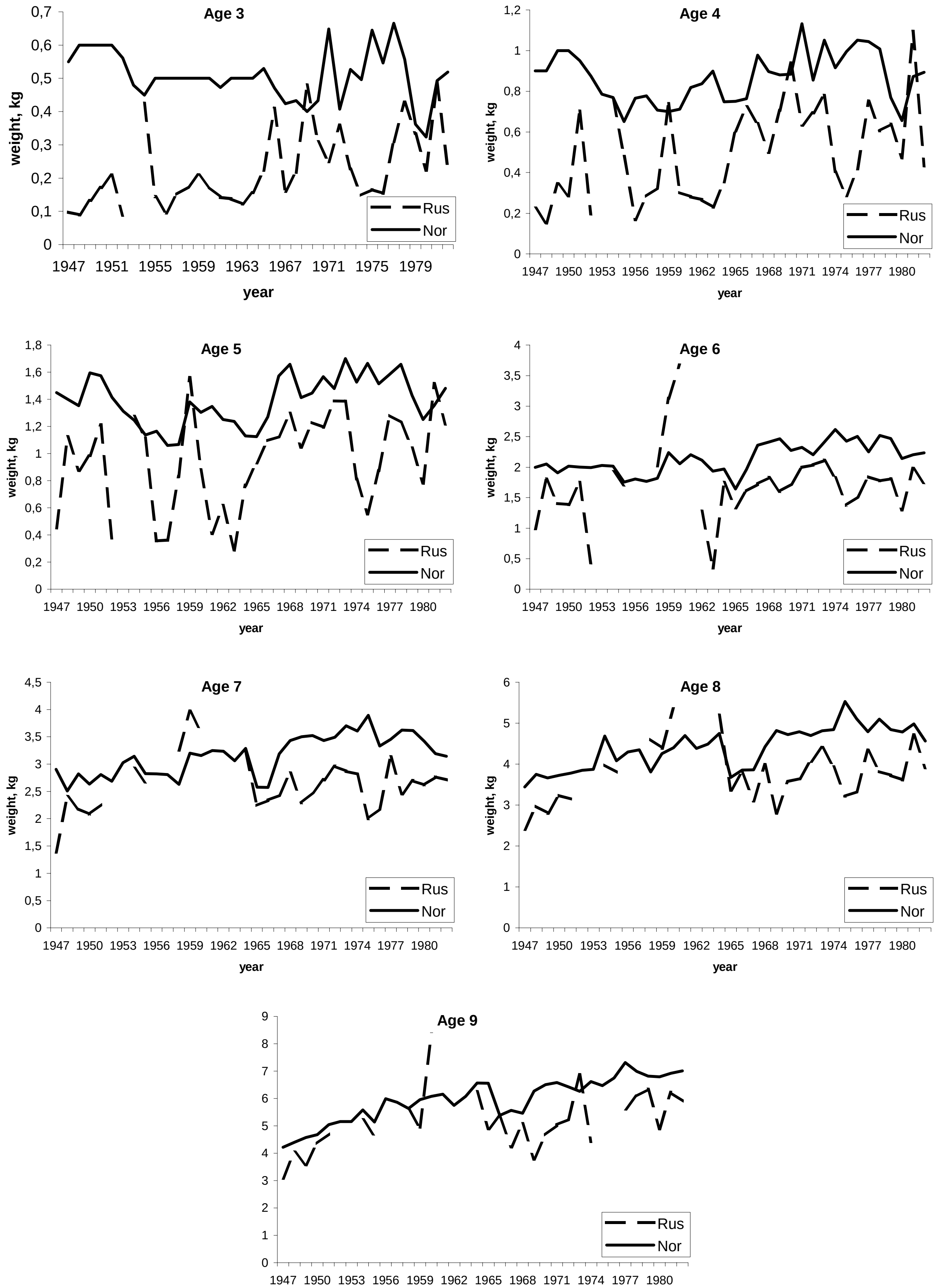


Figure 10.1: Time series comparing reconstructed weight at age estimates from Russian and Norwegian sources.

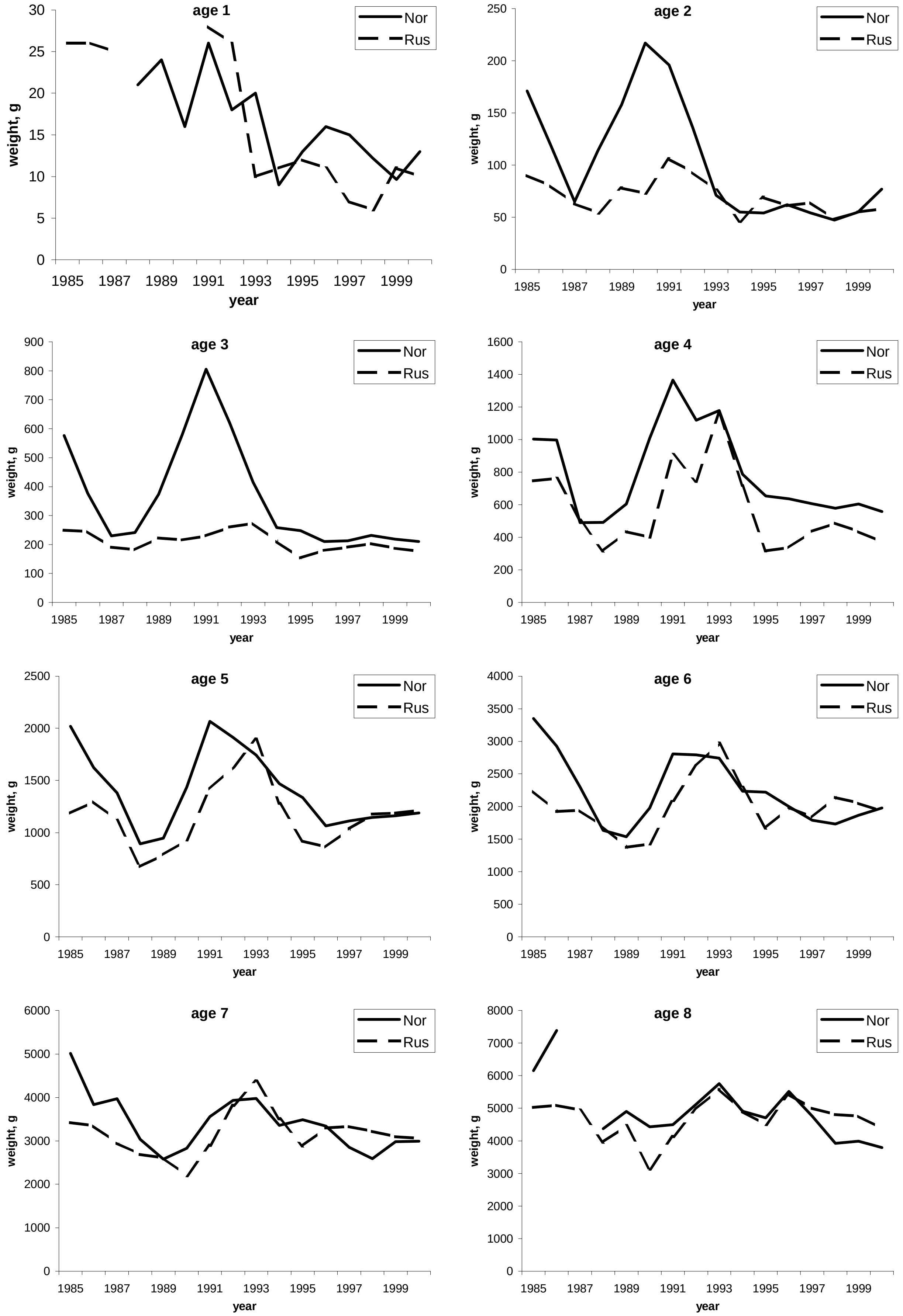


Figure 10.2: Time series comparing weight at age estimates from Russian and Norwegian surveys.

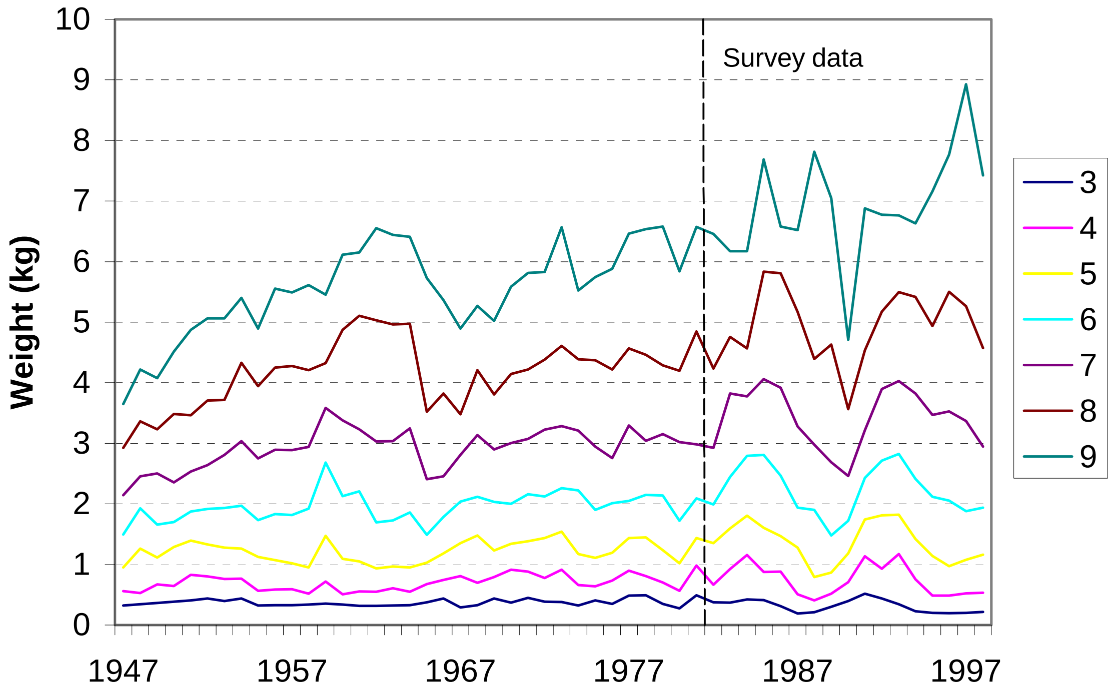


Figure 10.3: Full time series for weights at age (reconstructed + survey)

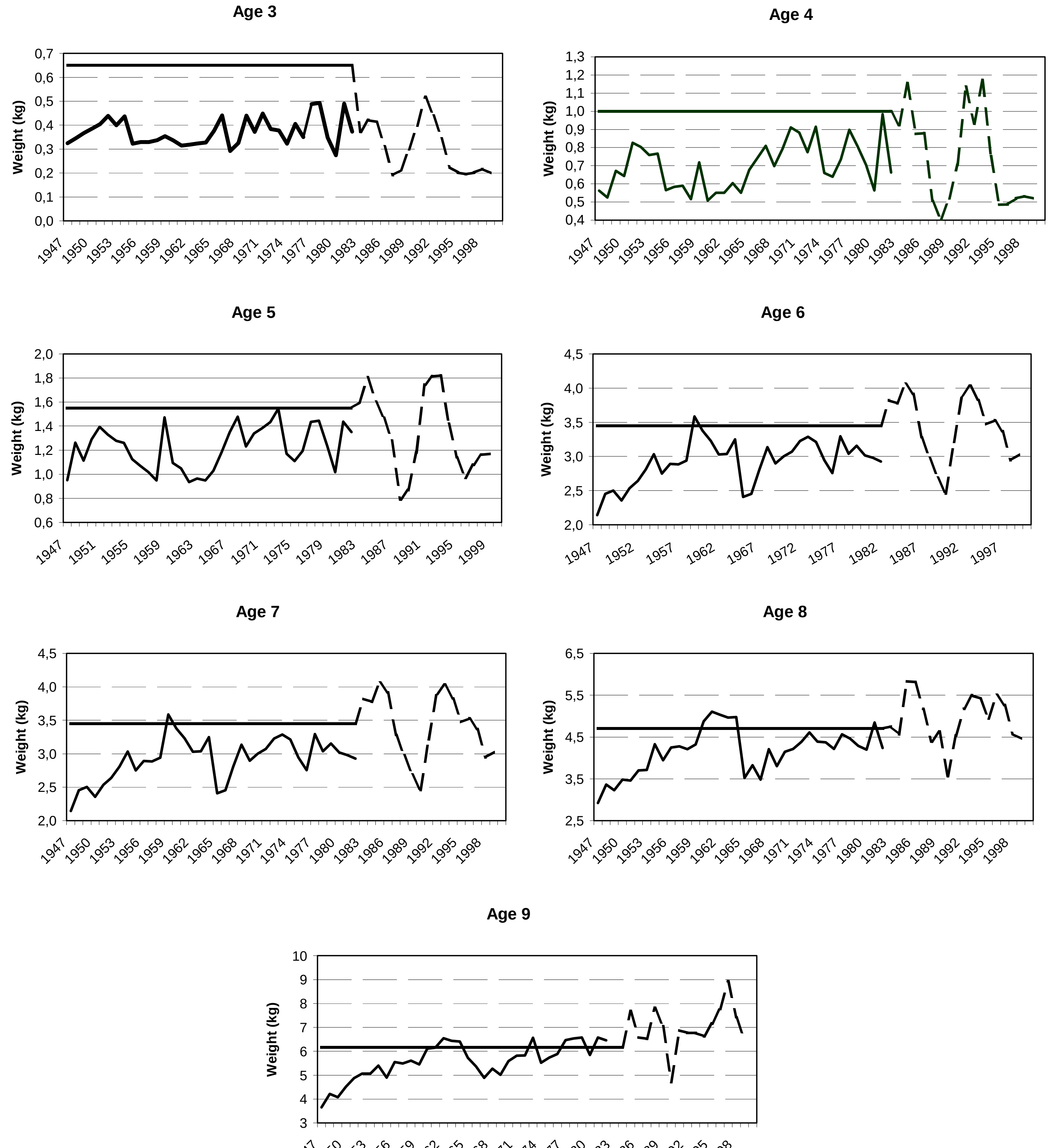


Figure 10.4: Time series showing reconstructed time series in comparison to previous values and survey time period. The dashed and solid lines correspond to the reconstructed and previous values, respectively.

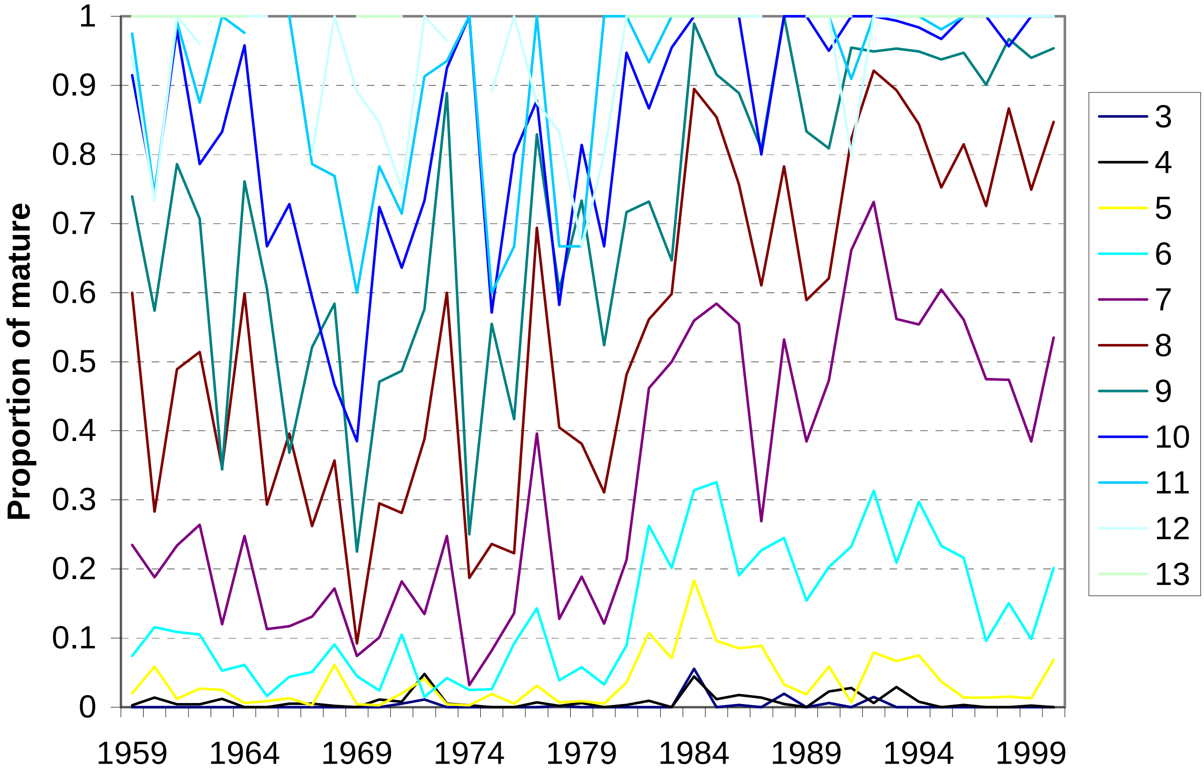


Figure 10.5 Time series showing the proportions mature estimated from Russian sampling programs.

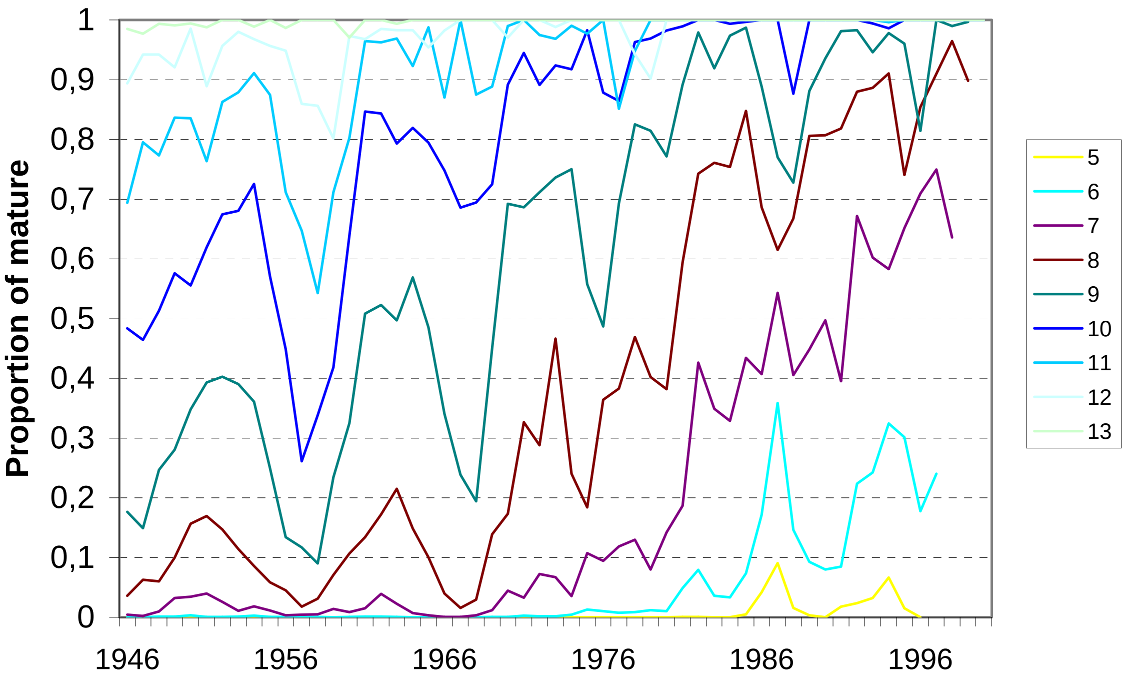


Figure 10.6 Time series showing the proportions mature estimated using the Gulland method.

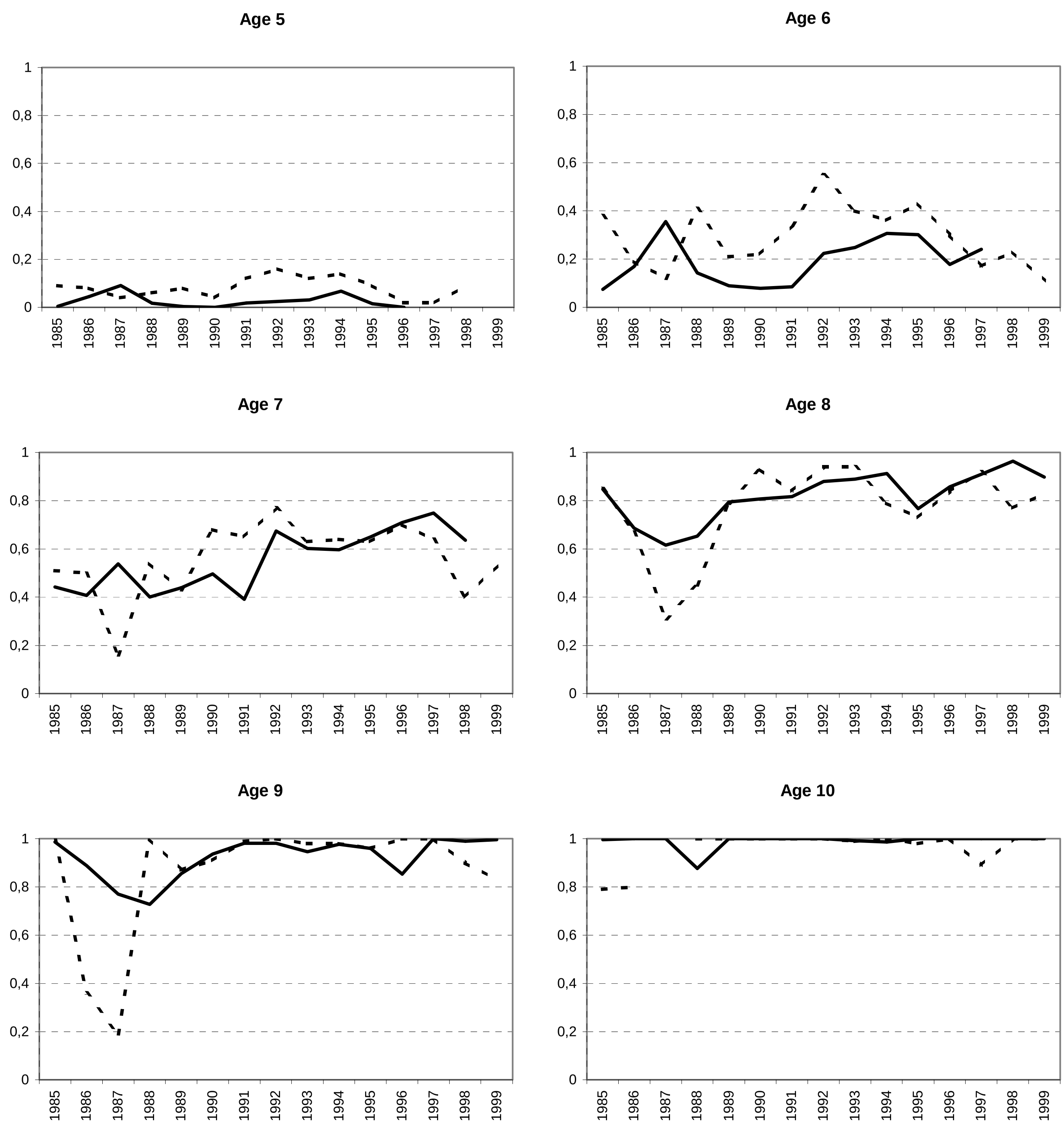


Figure 10.7: Time series comparing the proportions mature estimated by the Gulland method (solid line) and by the surveys (dashed lines).

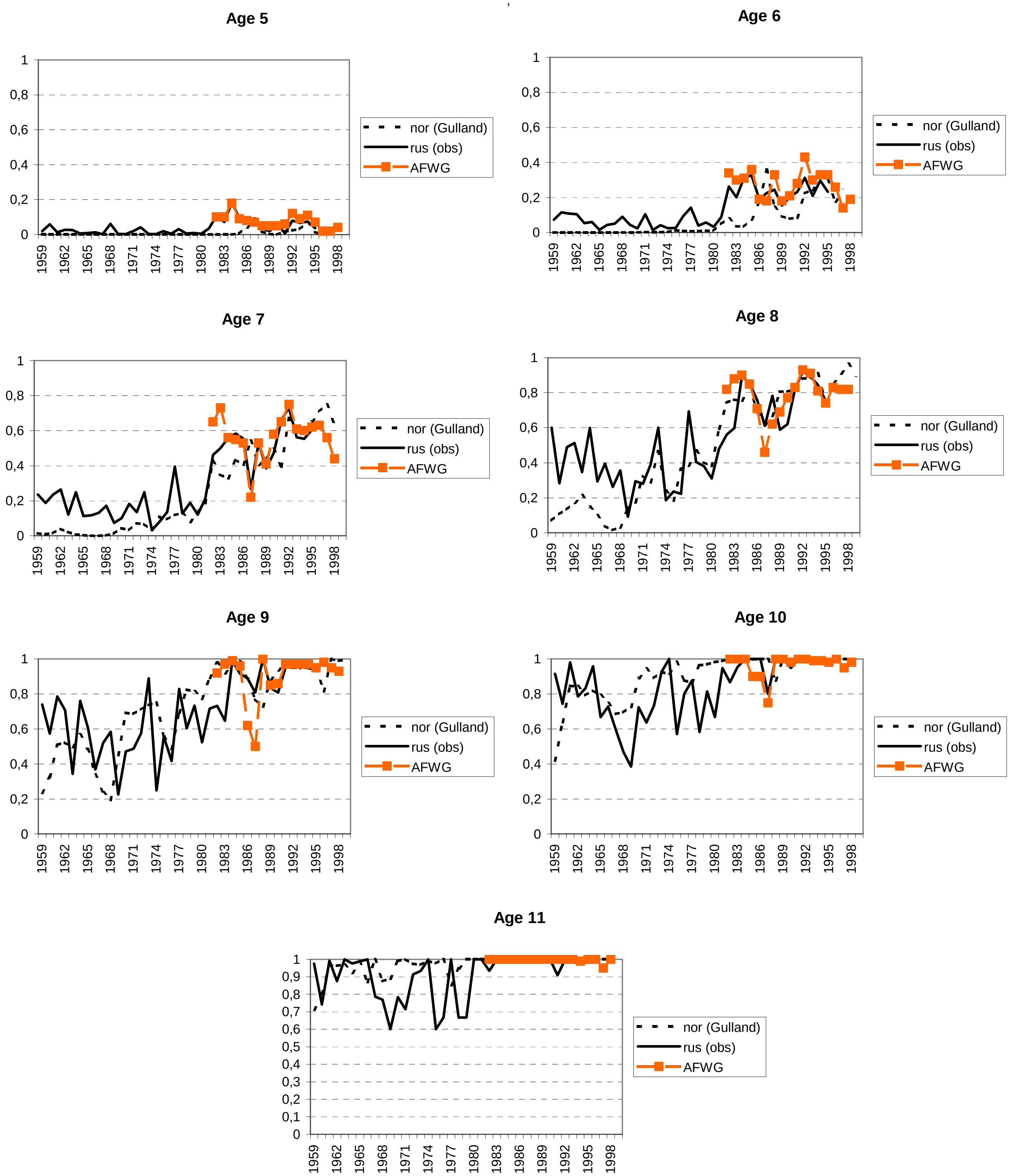


Figure 10.8: Time series of Russian and Norwegian reconstructed proportions mature in comparison to the values used by the assessment (AFWG) for the survey time period.

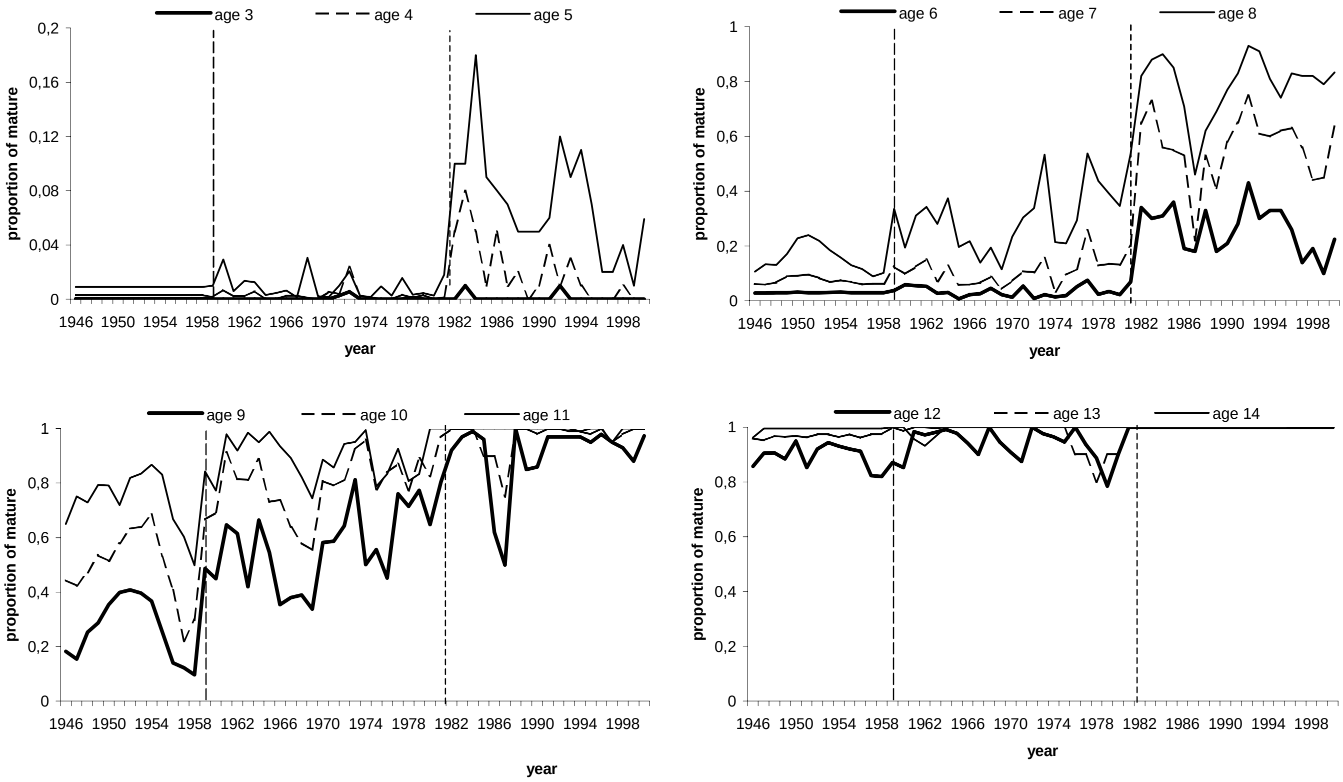


Figure 10.9: Time series of proportions mature by age. Dashed vertical lines indicate three time periods having different data series.

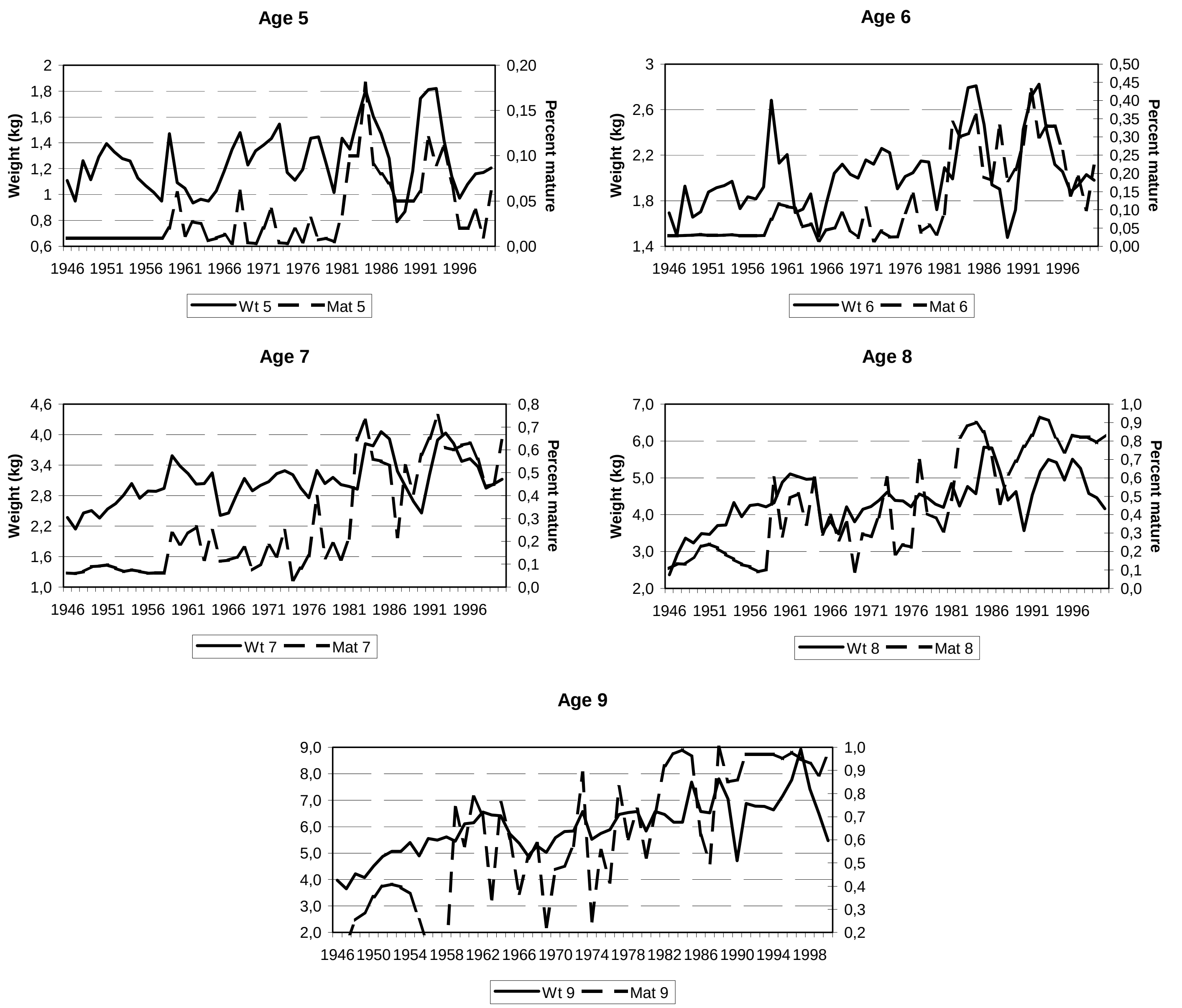


Figure 10.10: Time series comparing weight and proportion mature at age for ages 5 through 9.

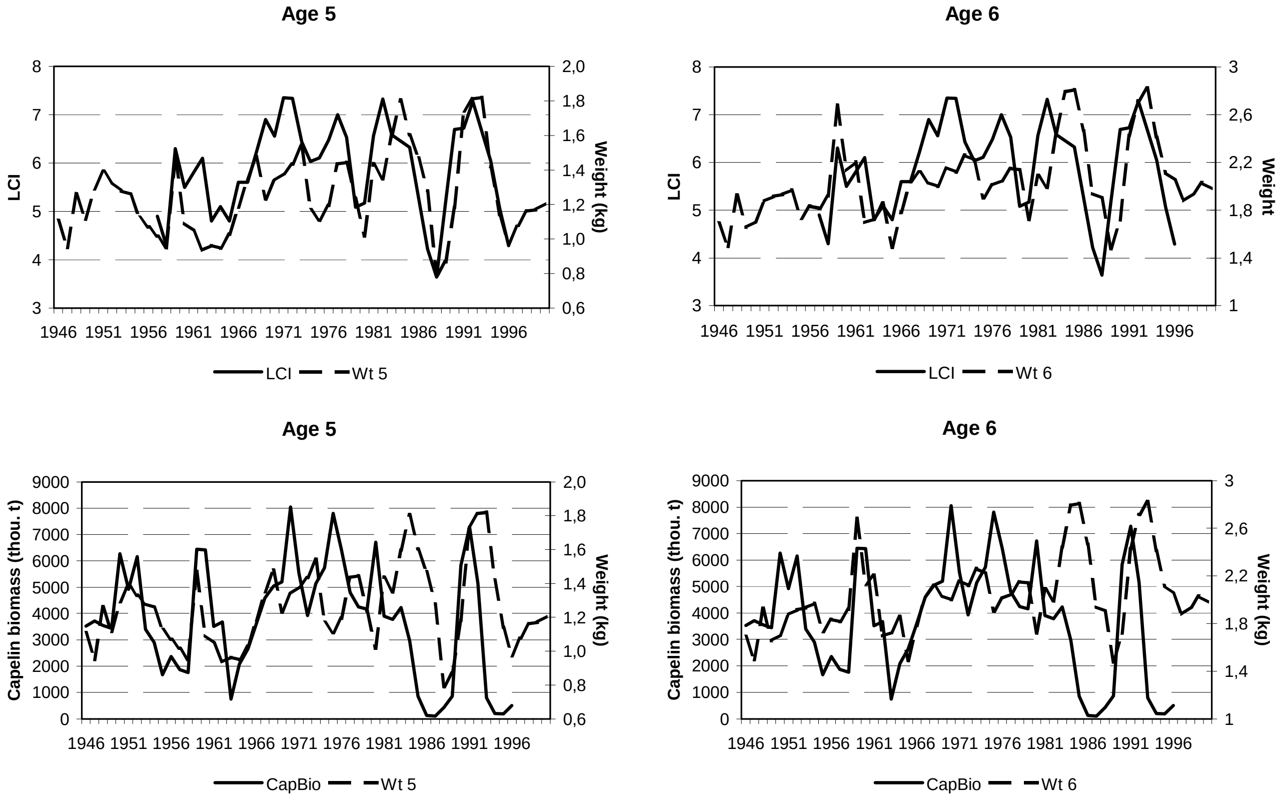


Figure 10.11: Time serie comparing the liver condition index (LCI) and capelin stock biomass (thou. t) to weight-at-age for ages 5 and 6.

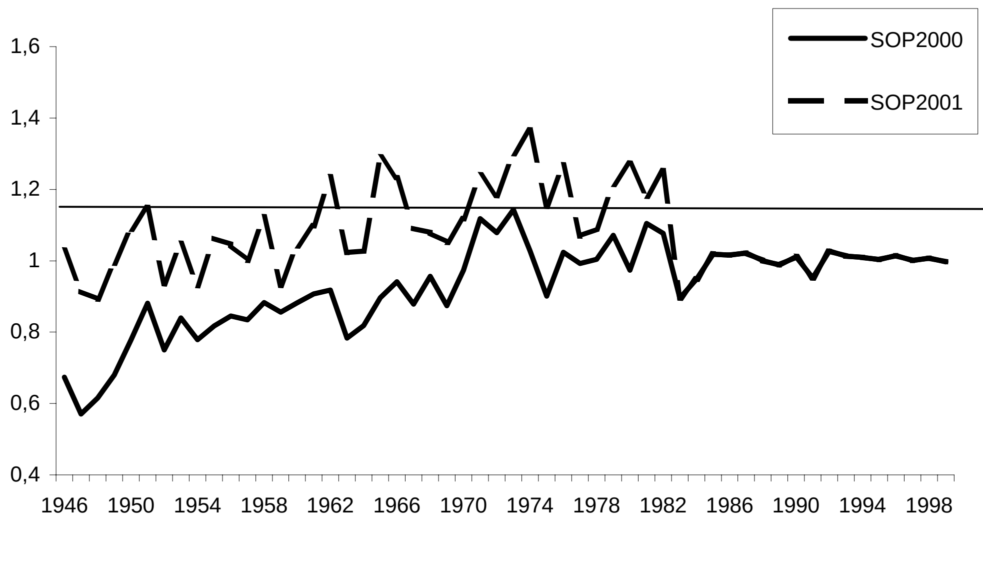


Figure 10.12: Time series of SOP correction factors from the 2000 and 2001 assessments.

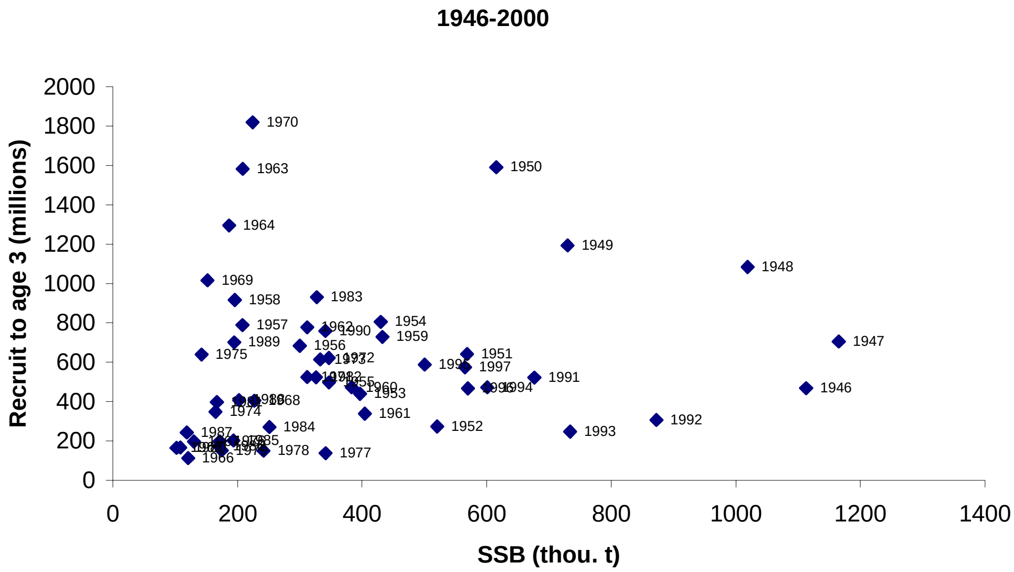


Figure 10.13: The revised stock/recruitment relationship for Northeast Arctic cod.

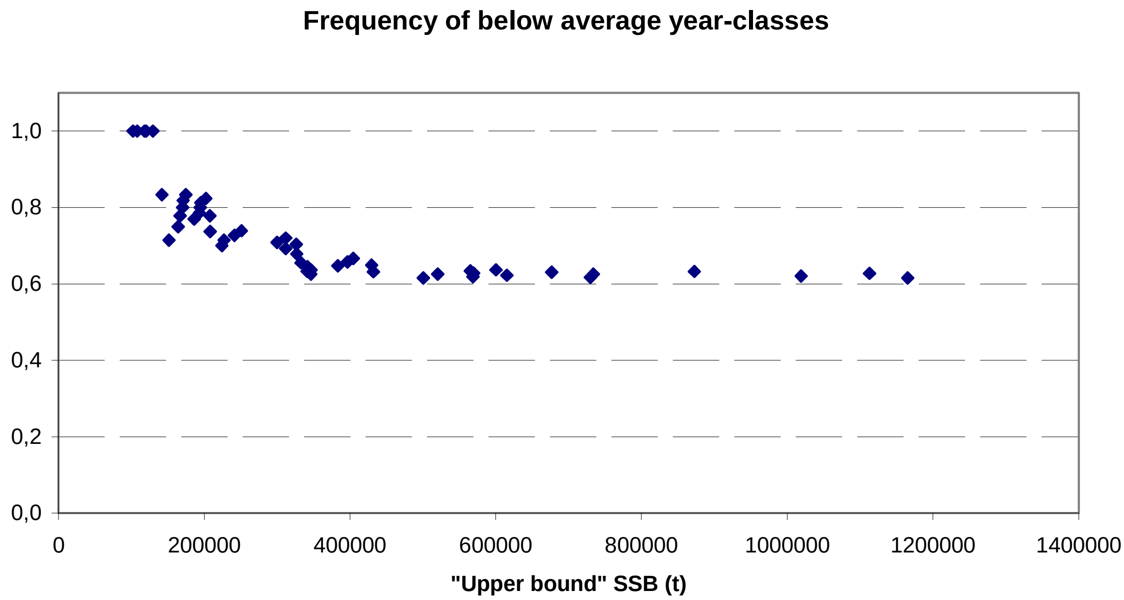


Figure 10.14: The frequency of below average year-class strength plotted against the "upper bound" spawner biomass.

11 REFERENCES

Aglen, A. 1999. Report on demersal fish surveys in the Barents Sea and Svalbard area 1996 and 1997. Fisken og havet 7–1999, Institute of Marine Research, Bergen, Norway.

Albert, O.T., Nilssen, E.M., Nedreaas, K.H., and Gundersen, A.C., 1997. Recent variations in recruitment of Northeast Atlantic Greenland Halibut (Reinhardtius hippoglossoides) in relation to physical factors. ICES CM 1997/EE:06, 22ppAnon. 1997. Protocol of the co-operation meeting held in Tromsø 12–13 June 1997.

Anon. 1998. Protocol of the co-operation meeting held in Tromsø 18–19 June 1998.

Anon. 1999. Protocol of the co-operation meting held in Kirkenes, 11–13 October, 1999.

Anon. 2001. Havets Miljø 2001. FiskenHav. Særnr. 2, 2001. Institute of Marine Research, Bergen, Norway. In Norwegian with English subtitles.

Aschan, M. 2001. Spatial variability in length frequency distribution and growth of shrimp (*Pandalus borealis* Krøyer 1838) in the Barents Sea. J. Northw. Atl. Fish. Sci. Vol.27: 77-89.

Aschan, M., Berenhoim, B., Mukhin, S. and Sunnanå, K. 1993. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis)* in the Barents Sea and Svalbard area in 1992. ICES CM 1993/K:9.

Aschan, M., Berenboim, B. and Mukhin, S. 1994. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis*) in the Barents Sea and the Svalbard area 1993, compared with earlier studies. ICES CM 1994/K:37.

Aschan, M., Berenboim, B. and Mukhin, S. 1995. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis*) in the Barents Sea and the Svalbard area 1994. ICES CM 1995/K:11.

Aschan, M., Berenboim, B. and Mukhin, S. 1996. Results of Norwegian and Russian investigations of Shrimp (*Pandalus borealis*) in the Barents Sea and in the Svalbard area 1995. ICES CM 1996/K:6.

Aschan, M., Ådlandsvik, B. and Tjelmeland, S. 2000. Spatial and temporal patterns in Recruitment of shrimp *Pandalus borealis* in the Barents Sea. ICES CM 2000/N:32.

Aschan, M. and Sunnanå, K. 1997. Evaluation of the Norwegian Shrimp Surveys conducted in the Barents Sea and the Svalbard area 1980–1997. ICES CM 1997/Y:07.

Berg, E., Eriksen, I.A. and Eliassen, J.E. 1998. Catch-statistics on Norwegian Coastal cod 1984-1997, data and methods. Fiskeriforskning Tromsø, report 10/1998. 13 pp.

Barnett, TP, Pierce DW, Schnur R (2001) Detection of anthropogenic climate change in the world's oceans. Science 292: 270-274

Berenboim B.I.1982. Reproduction of the shrimp *Pandalus borealis* in the Barents Sea. Oceanology 22(1): 85–89.

Berenboim, B.I., Lysy, A. Yu. and Salmov, V.Z. 1986. Soviet investigations on shrimp (*Pandalus borealis*) in the Barents Sea and Spitsbergen area in May 1985. ICES CM 1986/K:11.

Berenboim, B.I., Mukhin, S.G. and Sheveleva, G.K. 1989. Soviet investigations of shrimp *Pandalus borealis* in the Barents Sea and off the Spitsbergen in 1988. ICES CM 1989/K:14.

Berenboim, B.I., Mukhin, S.G. and Sheveleva, G.K. 1990. Soviet investigations of shrimp *Pandalus borealis* in the Barents Sea and off the Spitsbergen in 1989. ICES CM 1990/K: 4.

Berenboim, B., Mukhin, S. and Sunnanå, K. 1992. Results from Norwegian and Soviet investigations of shrimp *Pandalus borealis* in the Barents Sea. ICES CM 1991/K:14.

Berenboim, B. and Korzhev, V. 1997. On possibility of using Stefansson’s production model to assess the northern shrimp (*Pandalus borealis*) stock in the Barents Sea. ICES CM 1997/Y.

Berenboim, B.I., Dolgov, A.V., Korzhev, V.A. and Yaragina N.A. 2000. The impact of cod on the dynamics of Barents Sea shrimp (*Pandalus borealis*) as determined by multispecies models. J. Northw. Atl. Fish. Sci. 27: 1–7.

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

Bogstad, B. and Mehl, S. 1997. Interactions between cod (*Gadhus morhua*) and its prey species in the Barents Sea. International Symposium on the Role of Forage Fishes in Marine Ecosystems, Anchorage, Alaska 13–16 November 1996.

Caddy, J.F. 1999. Deciding on precautionary management measures for a stock based on a suite of limit reference points (LRPs) as a basis for a multi-LRP harvest law. NAFO Sci. Coun. Studies, 32: 55–68.

Deriso, R. B., Quinn, T. J. and Neal, P. R. 1985. Catch-age analysis with auxiliary information. Can. J. fish. Aquat. Sci., 42: 815–824.

Drengstig, A., Fevolden S.E, Galand P.E, and Aschan, M.M. 2000. Population structuring of the deep sea shrimp (*Pandalus borealis*) in the NE Atlantic based on allozymic differentiation. Aquat. Living Resour. 13:1–9.

Dolgov A.V. 1997. Distribution, abundance, biomass and feeding of thorny skate, *Raja radiata*, in the Barents Sea. ICES CM 1997/GG: 04.

Dolgova N.V and Dolgov A.V. 1997. Stock status and predation of long rough dab (*Hippoglossoides platessoides*) in the Barents and Norwegian Seas. (In: International Symposium on the Role of Forage Fishes in Marine Ecosystems, Anchorage, Alaska 13–16 November 1996.

Fournier, D. and Archibald, C. P. 1982. A general theory for analysing catch at age data. Can. J. Fish. Aquat. Sci., 39: 1195–1207.

Frøysa, K.G., Bogstad, B., and Skagen, D.W. 2001. Fleksibest – an age-length structured fish stock assessment tool with application to North-east Arctic cod (*Gadus morhua* L.) Fisheries research (accepted).

Gjøsæter, H. Studies on the Barents Sea Capelin (Mallotus villosus Muller), With Emphasis on Growth, Institute of Fisheries and Marine Biology, University of Bergen, 1999.

Gjøsæter, H., and Bogstad, B. 1998. Effects of the presence of herring on the stock-recruitment relationship of Barents Sea capelin (*Mallotus villosus*). Fisheries Research 38: 57-71.

Gjøsæter, H, Loeng H (1987) Growth of the Barents Sea capelin, Mallotus villosus, in relation to climate. Environ. Biol. Fish. 20: 293-300

Glebov, T.I. 1963. Cod of the Murman coast. Trudy PINRO 15: 69-130 (in Russian).

Grimsmo, L.1993. Biology and management of *Pandalus borealis* in the Barents Sea. Thesis at the University of Tromsø. -86 pp. (in Norwegian).

Gulland, J.A. 1964. The abundance of fish stocks in the Barents Sea. Rapp. P.-v. Reun. Cons. int. Explor. Mer 155: 126-137.

Gundersen, A.C., Nedreaas, K.H., Smirnov, O.V., Albert, O.T., and Nilssen, E.M., 1997. Extention of the Greenland halibut (Reinhardtius hippoglossoides) recruitment and nursery areas into the Arctic. In submission to ICES Journal of Marine Science.

Hamre J., 1994. Biodiversity and exploitation of the main fish stocks in the Norwegian – Barents Sea ecosystem. *Biodiversity and Conservation* 3, 473-492 (1994).

Hansen, H.Ø., and Aschan, M. In press. Growth performance, size and age at maturity of shrimp *Pandalus borealis*, in the Svalbard area related to environment. J. Northw. Atl. Fish. Sci.

Hansen, R. and Ådlandsvik B. 1996. Application of a hydrodynamical model on transport of larvae of polar cod in the northern Barents Sea. Fisken og Havet nr.27–1996. 65 pp.

Harbitz, A., Aschan, M. and Sunnanå, K. 1998. Optimum stratified sampling design for biomass estimates in large area trawl surveys - exemplified by shrimp surveys in the Barents Sea. Fisheries research 37:107–113.

Helland-Hansen B, Nansen F (1909) The Norwegian Sea. FiskDir. Skr. Ser. HavUnders 2: 1-360

Hilborn, R. and Walters, C.J. 1996. Biomass dynamic models. User's manual. FAO computerized information series (fisheries). No. 10. Rome, FAO. 62p.

Hylen, A., Tveranger, B. and Øynes, P. 1984. Norwegian investigations on the deep Sea shrimp (*Pandalus borealis*) in the Barents Sea in April - May 1984 and in the Spitsbergen area in July - August 1984. ICES CM 1984/K:21.

Hylen, A. and Øynes, P. 1986. Results of stratified trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea and in the Svalbard region in 1986. ICES CM 1986/K:34.

Hylen, A., Jacobsen, J. A. and Øynes, P. 1987. Results of stratified trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea and the Svalbard region in 1987. ICES CM 1987/K:39.

Hylen, A. and Øynes, P. 1988. Results of stratified trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea and the Svalbard region in 1988. ICES CM 1988/K:18.

Hylen, A., Sunnanå, K. and Øynes, P. 1989. Results of stratified trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea and the Svalbard region in 1989. ICES CM 1989/K:26.

Hylen, A. and Ågotnes, P. 1990. Results of stratified shrimp trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea and the Svalbard region in 1990. Survey Report.

ICES, 1993. Report of the study group on life histories and assessment of *Pandalus* stocks in the North Atlantic. ICES CM 1994.

ICES, 1994. Report of the study Group on the Life Histories and Assessment of Pandalus Stocks in the North Atlantic.ICES C.M.1994/K:8, 34 pp.

ICES. 1996. Report of the multispecies assessment working group. Bergen, Norway, 21 – 28 June 1995. ICES CM 1996/Assess:3.

ICES 1996. Report of the Arctic Fisheries Working Group. ICES CM 1996/ACFM: 4. 311 pp.

ICES 1997. Report of the Arctic Fisheries Working Group. ICES CM 1997/ACFM: 4. 326 pp.

ICES 1998. Report of the Arctic Fisheries Working Group. ICES CM 1998/ACFM: 2. 366 pp.

ICES 1998. ACFM:10

ICES 1999. Report of the Arctic Fisheries Working Group. ICES CM 1999/ACFM: 3. 276 pp.

ICES 1999. Report of the Workshop Standard Assessment Tools for Working Groups. Aberdeen 3-5 March 1999. ICES CM 1999/ ACFM:25, 19pp.

ICES 2000. Extract of the Report of The Advisory Committee on Fishery Management. Part 1. November 2000. 221 pp.

ICES 2000. Report of the Arctic Fisheries Working Group. ICES CM 2000/ACFM: 3. 312 pp.

ICES. 2000. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES CM 2000/ACFM: 16.

ICES 2001. ICES Annual Report for 2000. ISSN 0906-0596. 276 pp.

ICES 2001. Report of the Arctic Fisheries Working Group. ICES CM 2001/ACFM:02. 340 pp.

ICES 2001. Report of the Workshop on Fleksibest – an age and length based assessment tool. ICES CM 2001/ACFM:09. 61 pp.

ICES C.M. 2001. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. Reykjavík, Iceland, 18-25 April 2001. ICES C.M. 2001/ACFM:17.

Ingvaldsen, R., Asplin, L., and Loeng, H (1999) Short time variability in the Atlantic inflow to the Barents Sea. ICES C.M. 1999/L:05.

Ingvaldsen, R., Loeng, H., and Asplin, L (2001) Variability in the Atlantic inflow to the Barents Sea based on a one-year time series from moored current meters. Continental Shelf Research, submitted.

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

Jørgensen, T. 1990. Long-term changes in age at sexual maturity of Northeast Arctic cod (*Gadus morhua* L.). J. Coun. Int. Explor. Mer 46: 235-248.

Kartavtsev, V.P., Berenboim, B. and Zugurovsky, K.I. 1991. Population genetic differentiation on the pink shrimp *Pandalus borealis* Krøyer 1838, from the Barents and Bering Seas. J. Shell. Res. 10 (2): 333–339.

Koeller, P., Savard, L., Parsons, D.G. and Fu, C. In press. A precautionary approach to assessment and management of shrimp stocks in the Northwest Atlantic. J. Northw. Atl. Fish. Sci.

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

Kunzlik P.A. 1991. An Introduction to Sullivan, Lai and Gallucci's Catch at Size Analysis (CASA). Working Paper to the 1991 Nephrops Ass.WG. : 21pp.

Lassen H. and Sparholt H., 2000. ICES Framework for the Implementation of the Precautionary Approach. Working Paper on ACFM Working Group on Precautionary Approach Terminology, May 2000.

Lassen, H. and Sparholt, H. 2001a. The ICES Quality Handbook. Draft. Int. doc. ICES.

Lassen, H. and Sparholt, H. 2001b. Quality Handbook Annex. Draft. Standard Procedures for Assessment XSA/ICA Type. Int. doc. ICES.

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

Levitus S. et al. (2001) Anthropogenic warming of Earth's climate system. Science 292: 267-270.

Loeng, H (2001) Hydrographic conditions in the northern North Sea, Norwegian Sea and Barents Sea in 2000/2001. In Report of the ICES Working Group on Oceanic Hydrography.

Loeng, H. og Ingvaldsen, R (2001) Nye trekk ved strømmønstret ut og inn av Barentshavet og effekten på økosystemet. In Anon. 2001.

Loeng H, Bjørke H, Ottersen G (1995) Larval fish growth in the Barents Sea. Can. Spec. Publ. Fish. Aquat. Sci.691-698

Lysy, A.Y. 1981. Distribution of larvae of deep-sea prawn (*Pandalus borealis* Krøyer) in Norwegian and Barents Seas in 1979. Annales biol., 3:107–108.

Lysy, A.Y. 1983. Distribution, abundance, and development of deep-water shrimp (*Pandalus borealis*) larvae in the Norwegian and Barents Seas in 1980. Ann. Biol. Copenh. 37:107–108.

Macdonald, P.D.M., and T.J. Pitcher. 1979. Age groups from size-frequency data: a versatile and efficient method of analysing distribution mixtures. J. Fish. Res. Board Can., 36: 987–1001.

Marshall, C.T., Kjesbu, O.S., Yaragina, N.A., Solemdal, P., and Ulltang, Ø. 1998. Is spawner biomass a sensitive measure of the reproductive and recruitment potential of Northeast Arctic cod? Can. J. Fish. Aquat. Sci. 55: 1766–1783.

Martinez, I., Skjeldal, T.O., Dreyer, B. and Aljanabi, S.M. 1997. Genetic structuring of *Pandalus borealis* in the NE-Atlantic. II. RAPD analysis. ICES CM 1997/T:24.

Mehl, S. 1999. Demersal fish investigations in the Barents Sea winter 1999. Fisken og Havet 13-1999. (In Norwegian with table and figure text also in English).

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

Michalsen K, Ottersen G, Nakken O (1998) Growth of North-east arctic cod (Gadus morhua L.) in relation to ambient temperature. Ices J. Mar. Sci. 55: 863-877.

MRAG. 1997. Core program development for the modelling management strategies. Final Report of EC Study Project 94/110.

Mukhin, S.G. and Sheveleva, G.K. 1991. Soviet investigations on shrimp in the Barents Sea and off the Spitsbergen in 1990. ICES CM 1991/K:14.

Nilssen E.M. 1990. Demography, Fecundity, Growth and mortality of the deep-water prawn from Isfjord, Spitsbergen. ICES 1990/Shell No 109.

Nilssen, E.M. and Hopkins, C.C.E. 1991. Population parameters and life histories of the deep-water prawn *Pandalus borealis* from different regions. ICES CM 1991/K:2.

Nilssen, E.M., Larsen, R.B. and Hopkins, C.C.E. 1986. Catch and size selection of *Pandalus borealis* in a bottom trawl and implications for population dynamic analyses.ICES CM 1986/K:4.

Ottersen G, Loeng H (2000) Covariability in early growth and year-class strength of Barents Sea cod, haddock and herring: The environmental link. ICES J. Mar. sci. 57: 339-348

Ottersen G, Michalsen K, Nakken O (1998) Ambient temperature and distribution of north-east Arctic cod. ICES J. Mar. Sci. 55: 67-85.

Ottersen G, Sundby S (1995) Effects of temperature, wind and spawning stock biomass on recruitment of Arcto-Norwegian cod. Fish. Oceanogr. 4: 278-292

Ottersen G, Ådlandsvik B, Loeng H (2000) Predictability of Barents Sea temperature. Fisheries Oceanography 9: 121-135

Pedersen, O. P., Aschan, M., Tande, K., Slagstad, D. and Rasmussen, T. In prep. The advection and population dynamics of *Pandalus borealis* investigated by a Lagrangian partickle tracking model.

Pennington, M. (ed). 1999. Report of the workshop on comparison of stock assessment model strategies, with application to Northeast Arctic cod, Bergen 1–4 December 1998. Fisken og havet 4–1999, Institute of Marine Research, Bergen, Norway.

Rasmussen, T., Thollesson, M. and Nilssen, E.M. 1993. Preliminary investigations on the population genetic differentiation of the deep water prawn, *Pandalus borealis* Krøyer 1838, from Northern Norway and the Barents Sea. ICES CM 1993/K:11.

Ricker, W.E. 1979. Assessment methods and interpretation of biological parameters of fish populations. – Moscow, Pishchevaya Promyshlennost Press. – 407 pp (in Russian).

dos Santos, J and Jobling, M. 1995. Test of a food consumption model for the Atlantic cod. ICES J. mar. Sci., 52:209–219.

Shepherd, J.G. 1991. Simple methods for short-term forecasting of catch and biomass. ICES J. mar. Sci., 48: 67–78.

Shevelev MS, Tereschenko VV, Yaragina NA (1987) Distribution and behaviour of of demersal fishes in the Barents and Norwegian seas, and the factors influencing them. In H. Loeng (ed) Proceedings of the third Soviet-Norwegian symposium, Murmansk, 26-28 May 1986 181-190.

Stefánsson, G. and Pálsson, Ó.K. 1997. Bormicon. A boreal migration and consumption model. Report no. 58, Marine Research Institute, Reykjavik, Iceland.

Stefánsson, G. and Pálsson, Ó. K.1998. A framework for multispecies modelling of Arcto-boreal systems. Rev. Fish. Biol. Fish. 8,101–104.

Stefánsson, G., Skúladóttir, U. and Pétursson, G. 1994. The use of a stock production type model in evaluating theoffshore *Pandalus borealis* stock of North Icelandic waters, including the predation of Northern shrimp by cod. ICES CM 1994/K:25.

Sorokin, V.P. 1957. Ovogenesis and sexual cycle in cod (*Gadus morhua morhua* L.) Trudy PINRO, 10: 125 – 144 (in Russian). (English translation No.72F49, Ministry of Agriculture, Fisheries and Food, United Kingdom 1961).

Sorokin, V.P. 1960. Sexual cycle and spermatogenesis in cod. Trudy PINRO, 12: 71- 87 (in Russian).

Sullivan,P.J., Lai H.L., Gallucci V.F. 1991. A catch-at-length analysis that incorporates a stochastic model of growth.Can. J. Fish. Aquat. Sci. 47: 184-198.

Sætersdal G, Loeng H (1987) Ecological adaptation of reproduction in Northeast Arctic cod. Fish. Res. 5 253-270.

Tavares, A. M. and Øynes, P. 1980. Results of a stratified bottom trawl survey for shrimps (*Pandalus borealis*) in the Barents Sea and the Spitsbergen area in May-June 1980. ICES CM 1980/K:22.

Teigsmark G.1983. Populations of the deep-sea shrimp (*Pandalus borealis* Krøyer) in the Barents Sea. Fiskedir. Skr. Ser. HavUnders., 17: 377–430.

Teigsmark, G. and Øynes, P. 1981. Results of a stratified bottom trawl survey for shrimps (*Pandalus borealis*) in the Barents Sea in May - June 1981. ICES CM 1981/K:21.

Teigsmark, G. and Øynes, P. 1982. Norwegian investigations on the deep Sea shrimp(*Pandalus borealis*) in the Barents Sea in 1982. ICES CM 1982/K:12.

Teigsmark, G. and Øynes, P. 1983a. Results of a stratified bottom trawl survey for shrimps (*Pandalus borealis*) in the Spitsbergen area in July 1982. ICES CM 1983/K:17.

Teigsmark, G. and Øynes, P. 1983b. Norwegian investigations on the deep Sea shrimp (*Pandalus borealis*) in the Barents Sea in April - May 1983 and in the Spitsbergen area in July 1983. ICES CM 1983/K:46.

Toresen R, Østvedt OJ (2000) Variation in abundance of Norwegian spring-spawning herring (*Clupea harengus*, Clupeidae) throughout the 20th century and the influence of climatic fluctuations. Fish and Fisheries 1: 231-256.

Tretyak VL, Ozhigin VK, Yaragina NA, Ivshin VA. (1995 Role of oceanographic conditions in Arcto-Norwegian cod recruitment dynamics. COPENHAGEN-DENMARK ICES.

Tveranger, P. and Øynes, P. 1985. Results of stratified trawl surveys for shrimps (*Pandalus borealis*) in the Barents Sea in May and in the Svalbard region in July - August 1985. ICES CM 1985/K:50.

Yaragina N.A.and Marshall C.T. 2000. Trophic influences on interannual and seasonal variation in the liver condition index of Northeast Arctic cod (*Gadus morhua).* J Mar.Sci ICES 56: 42-55.

Ådlandsvik, B. and Sundby, S. 1994. Modelling the transport of cod larvae from the Lofoten area.ICES Mar. Sci. Symp. 198: 379–392.

Zasosov, A.V. 1976. Abundance dynamics of commercial stocks. Moscow. Pishchevaya Promyshlennost Press. – 312p. (in Russian)

11.1 WORKING DOCUMENTS

WD#	Title	Authors
1	Historical time series for Northeast Arctic Cod	Ajiad, A. M. and Jakobsen, T.
2	Restoration of the data on average weight of cod on materials of the Russian bottom trawl surveys for 1946-1981	Gusev E., Drevetnyak K. and Yaragina N.
3	North - East Arctic cod maturity ogives for 1959-1983 (by PINRO data)	Yaragina N.A.
4	Short status of the results from Norwegian-Russian cod age readings	Nedreaas, K. and Yaragina, N.A.
5	Feeding and food consumption by cod in 1984 – 2000	Dolgov A.V.
6	Prognosis for development of the Barents Sea capelin stock	Gjøsæter, H.
7	The Spanish NE Arctic cod fishery in 2000	Murua, H., Casas, J.M., Motos, L. and Paz, X.
8	Changes in estimates of biological reference points for North – East Arctic cod related to changes of its population parameters	Kovalev Yu. A., Tretyak V.L.
9	Trends in variation of North – East Arctic cod SSB and MBAL	Tretyak V.L., Kovalev Yu. A.
10	On the “reliability” of catch statistics for Northeast Arctic cod	Nakken, O.
11	Northeast Arctic cod. Stock and recruitment	Nakken, O.
12	On factors affecting NEA cod yearclasses strength	Borisov, V.M. and Elizarov, A.A.
13	Potential fecundity in Northeast Arctic cod – a multiple regression approach	Thorsen, A. and Kjesbu, O.S.
14	Variation in condition and capelin stock biomass: implications for the reconstruction of historical weights and maturities of Northeast Arctic cod.	Marshall, T. and Yaragina, N.A.
15	A model for size preferences in cannibalism in Northeast Arctic cod (*Gadus morhua* L.)	Bogstad, B.
16	Fleksibest used on NEA cod in 1985-1999, some results	Frøysa, K. G., Bogstad, B. and Åsnes, M. N.
17	On the relation between “true” numbers of Northeast Arctic cod and VPA- or survey-based abundance estimates	Nakken, O. and Pennington, M.
18	Using Fleksibest for prognosis	Åsnes, M. N., Bogstad, B. and Frøysa, K. G.
19	On the possibility to forecast yearclass abundance of the Northeast Arctic haddock	Lepesevich Yu.M. and Bochkov Yu.A.
20	Research saithe in Murman coastal zone	Shevelev, M.S.
21	Revised Russian trawl CPUE series for *Sebastes Mentella* of the Norwegian – Barents Seas population	Drevetnyak K.V.
22	A possibility to use Dynamic analysis of catch-at -size data for the Barents Sea boreal shrimp (*Pandalus borealis*) stock assessment	Bulgakova, T., Berenboim, B and Bakanev, S.
23	On applying the production models to estimate shrimp fisheries in the Barents Sea	Korzhev V.A. and Berenboim B.I.

WD#	Title	Authors
24	Application the Jones cohort analyses for assessment of abundance and biomass of the Barents Sea shrimp	Korzhev V.A. and Berenboim B.I.
25	The Spanish NE Arctic shrimp fishery in 2000	Casas, J.M.
26	Length distribution, sex ratio and length-at-maturity of shrimp, Pandalus borealis, in the Svalbard Area and Barents Sea (Hopen Bank)	Casas, J.M.
27	Results from Joint Russian-Norwegian winter survey in the Barents Sea, winter 2001	Aglen, A.
28	Results from the Russian survey on bottom fish stocks in the Barents Sea and adjacent waters in October-December 2000	Sokolov A.M.
29	Results from the Russian trawl-acoustic survey of bottom fish in the Barents Sea in February 2001	Lepesevich Yu.M. and Russkih A.A.
30	Results of the Russian survey of Greenland halibut in the Barents Sea in 2000	Smirnov O.V.
31	Results from Russian investigations of Greenland halibut in the Northern Barents Sea in 2000	Smirnov O.V.
32	Spanish bottom trawl survey “Fletán Árctico 2000” in the slope of Svalbard Area, ICES Division IIb.	Román, E. And Paz, X.
33	Hydrographic conditions in the Barents and Norwegian Seas	Loeng, H., Ottersen, G. and Ingvaldsen, R.