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ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

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0 Introduction

0.1 Participants

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0.2 Planning of Working Group activities 2007-2009

Specific ToRs

a) assess the status of and provide management options for the year 2008 for the stocks of cod, haddock, saithe, Greenland halibut, and redfish in Subareas I and II, taking into account interactions with other species;

b) update the data files on Barents Sea capelin and oversee the process of providing inter-sessional assessment and predictions on the stock;

c) for the stocks mentioned in a) and b) perform the tasks described in C.Res. 2006/2/ACFM01.

Term of reference	Year	Comments
(1) set appropriate deadlines for submission of data. Data submitted after the deadline can be disregarded at the discretion of the WG Chair.	2007	Data usually made available at the start of the meeting
(2) compile all relevant fisheries data, including data on different catch components (landings, discards, bycatch) and data on fishing effort. Data should be disaggregated by fisheries/fleets.	2007	Regularly done by the WG in terms of landings, bycatch and fishery descriptions. In the future disaggregated by fisheries/fleets data will be exchanged through InterCatch.
(3) assess the state of the stocks according to the schedule for benchmark and update assessments as shown below.	2007	This will be carried out in 2007 as standard.

Term of reference	Year	Comments
(4) provide specific information on possible deficiencies in the 2007 assessments and forecasts, • any major inadequacies in the data on landings, effort or discards; • any major expertise that was lacking • any major inadequacies in research vessel surveys data, • any major difficulties in model formulation or available software. The consequences of these deficiencies for both the assessment of the status of the stocks and the projection should be clarified	2007	This will be carried out in 2007 as standard.
(5) consider knowledge on important environmental drivers for stock productivity (based on input from e.g. WGRED and for the North Sea NORSEPP). If such drivers are considered important for management advice, incorporate such knowledge into assessment and prediction and comment on the consequences for long term targets of high yield and low risk.	2007	A comprehensive description of the Barents Sea ecosystem is providing by the group on annual basis (chapter 1 of the report). A results of studies of environmental drivers on stocks productivity are reflected at the same chapter of the report and incorporated into predictions when they are considered to be relevant.
(6) consider existing knowledge of important impacts of fisheries on the ecosystem	2007	Also is a part of the report's chapter 1. Will be updated in 2007
(7) Evaluate existing management plans and develop options for management strategies including target and limit reference points. If mixed fisheries are considered important consider the consistency of target reference points and management strategies	2007	The management plan for NEA saithe will be evaluated in 2007.
(8) assess the influence of individual fleet activities on the stocks. For mixed fisheries, assess the technical interactions;	2007	Low priority. There are no requests from client (JRNC). The general observation of the problem have been done in report and updated annually.
(9) provide an overview of major regulatory changes (technical measures, TACs, effort control and management plans) and evaluate or assess their (potential) effects.	2007	Is done annually and will be updated
(10) where misreporting and/or discarding is considered significant provide qualitative and where possible quantitative information, by fisheries and the describe the methods used to obtain the information and its influence on the assessment and predictions.	2007	Estimates of NEA cod and haddock unreported landings in 2002-2005 included into assessments.
(11) present an overview of the sampling on a national basis of the basic assessment data for the stocks considered according to the template that is supplied by the Secretariat	2007	Will be done through Intercatch in 2007
(12) implement the roadmap for medium and long term strategy of the group as developed in AMAWGC	2007	This is a routine task for the WG

0.3 General comments

The host (Centro Oceanográfico de Vigo, Spain) provided excellent facilities, assistance and transportation, which allowed the meeting to proceed effectively and efficiently. Daily provision of lunch at the institute and an unforgettable dinner at a Vigo restaurant stimulated people to work hard for long hours.

0.4 Management strategy for NEA saithe

Autumn 2004 The Norwegian Directorate of Fishery proposed a management strategy for Northeast Arctic saithe, and the Norwegian Ministry of Fisheries and Coastal Affairs February 2007 asked ICES to evaluate whether the harvest control rule for setting the annual fishing quota (TAC) is consistent with the precautionary approach. AFWG 2007 evaluated the HCR and found it to be consistent with the precautionary approach for all simulated data and settings, included a rebuilding situation. The highest long-term yield was obtained for an exploitation level of 0.32, i.e. a little below the target F used in the HCR (F_{pa}), and ICES recommends using a lower value in the HCR. The results of that evaluation are presented in Section 5.10.

0.5 Unreported landings

Two analyses of potential unreported landings of cod and haddock, provided to ICES by national delegates from Russia and Norway, were made available to the AFWG for consideration.

The estimates by Norway for 2006 were derived based on the same methodological approach applied to obtain such estimates for 2002-2005. The Russian analysis provided estimates of potential unreported landings for 2004-2006.

The Norwegian method was based on the following: information from inspections at sea of fishing and transport vessels in the Norwegian Economic Zone, including species composition of catches and amounts of transshipped fish products, analysis of data on landings in the Norwegian ports and ports of third countries; information on transshipments at sea and VMS data from the Norwegian Economic Zone.

The Russian method used the following: VMS data on operations of fishing and transport vessels in the Barents and Norwegian Seas, information on landings in Russian and Norwegian ports and ports of third countries; daily reports by fishing vessels, including on species composition of catches, amounts of transshipped fish products, time of fishing, daily catch rates by vessel type and fishing area. Such information is available from all areas of cod and haddock fisheries. The Russian estimation takes into account, that a considerable amount (57-59%) of resources fished in the Barents Sea (polar cod, Kamchatka crab) and Norwegian Sea (herring, blue whiting, mackerel, redfish) and, correspondingly, produce carried through NEZ, are not cod and haddock.

The Norwegian method gave considerably higher estimates of unreported catches. It is, in the first place, based on independent inspections of vessels fishing in or transporting fish through the Norwegian Economic Zone. Results from these inspections that covered more than 50% of trips, are scaled to the total number of vessels in traffic through these parts of the NEZ, but excluding those vessels where there is no kind of information about species transported, and those where there is information showing that other species than cod and haddock (pelagic fish, crab etc.) are transported.

The AFWG was not able to agree on which of the estimates to use, and found no justification for combining the two estimates in any way. The AFWG, therefore, decided to undertake two runs of stock assessment for cod and two for haddock, and correspondingly, two sets of calculations for each of the species to recommend TAC for 2008.

Considering possible misreporting by skippers of fishing and transport vessels of information on catch and/or transshipped fish products, the AFWG, in anticipation of strengthening of port state control soon, considers it highly preferable for the future to use verified statistics on landings of cod and haddock. The AFWG acknowledged that, following the decision of the 35th session of JRNFC, a special Working Group on Unreported Catch was established with a mandate to analyze data provided by the two Parties on catches, transportations and transshipments of cod and haddock in order to come to an agreed estimate, that could be as close as possible to the actual catch. The AFWG expects that the Working Group on Unreported Catch will provide AFWG with correct catch figures in the future, allowing for a more precise assessment of the stocks of cod and haddock to be made.

0.6 Other inadequacies in the data and possible deficiencies in the assessments

At recent AFWG meetings it has been recognized that there is growing evidence of both substantial discarding and mis-/unreporting of catches throughout the Barents Sea for most groundfish stocks in recent years (ICES CM 2002/ACFM:18, ICES CM 2001/ACFM:02, ICES CM 2001/ACFM:19, Dingsør WD 13 2002 WG, Hareide and Garnes WD 14 2002 WG, Nakken WD 10 2001 WG, Nakken WD8 2000 WG, Schöne WD4 1999 WG, Sokolov, WD 9 2003 WG, Ajiad *et al*. WD18 and 24 2004 WG). In addition to these WDs, Dingsør (2001) estimated discards in the commercial trawl fishery for Northeast Arctic cod (*Gadus morhua* L.) and some effects on assessment, and Sokolov (2004) estimated cod discard in the Russian bottom trawl fishery in the Barents Sea in 1983-2002. This work should be continued, updated and presented annually to the AFWG.

While the area coverage of the winter surveys was incomplete in 1997 and 1998, the coverage was normal for these surveys in 1999-2002. In the autumn 2002, 2006 and winter 2003, 2007 however, surveys have again been incomplete due to lack of access to both the Norwegian and Russian Economic Zones. This affects the reliability of some of the most important survey time series for cod and haddock and consequently also the quality of the assessments. In some years, the permission to work in the Norwegian and Russian Economic Zones, respectively, has been received so late that the work has been severely hampered, e.g., the Russian survey in autumn 2003 and 2006. There is no acceptable way around this problem except asking the Norwegian and Russian authorities to give each other's research vessels full access to the respective economical zones when assessing the joint resources, as, e.g., was the case for Norwegian winter surveys in 2004 and 2005.

In 1992, PINRO, Murmansk and IMR, Bergen began a routine exchange program of cod otoliths in order to validate age readings and ensure consistency in age interpretations (WDs # 21). Later, a similar exchange program has been established for haddock, Greenland halibut and capelin otoliths. Once a year the age readers come together and evaluate discrepancies, which are seldom more than 1 year, and the results show an improvement over the time period, despite still observed discrepancies for cod in the magnitude of 15-30%. An even more positive development is seen for haddock age readings showing that the frequency of a different reading (usually ±1 year) has decreased from above 25% in 1996-1997 to less than 10% at present. The discrepancies are always discussed and a final agreement on the exchanged cod and haddock otoliths is at present achieved for all otoliths except ca. 2%.

The otoliths of Greenland halibut are not easy to read especially for older fish. Consequently the readers have difficulties in interpreting real age zones when the fish become older than 5 years (e.g., AFWG2005, WD 8). Comparative readings among three Norwegian age readers, and also between Russian and Norwegian age readers show good agreement and low CV. However, even with acceptable between reader precisions, there are strong evidences of low accuracy of the age estimates. Since last year, validation work has been continued and the

Norwegian age readings have been done using the new approach described in last years report. This has caused that only Russian age readings have been comparable with the historic data series, thus only Russian age readings have been used in this years assessment for the 2006 data. The validation work continues and in the future the historic time series will be converted to the new age understanding. However, this work is very time consuming and it is difficult to estimate when a full assessment can be conducted using the new approach.

For capelin otoliths there is a very good correspondence between the Norwegian and Russian age readings, with a discrepancy in less than 5% of the otoliths.

From 2006 onwards, an exchange of *Sebastes mentella* otoliths is conducted annually between the Norwegian and Russian laboratories.

0.7 ICES Quality Handbook

Following the guidelines as adopted by ACFM in October 2002, in 2004 WG a stock specific template was filled out for all AFWG stocks, describing how the annual assessment calculations and projections are performed, as well as the biological stock dynamic, ecosystem aspect, and the fisheries relevant for fisheries management, and the report has been re-structured accordingly. In this report there are no changes in Quality Handbooks. They were not included in this report. The final versions are presented as appendices to the 2006 working group report (ICES 2006/ACFM:25).

0.8 Scientific Presentations

WD 4 (presented by S. Mehl) describes the background, population model, data and preliminary simulations and evaluation of the proposed management strategy (harvest control rule) for Northeast Arctic saithe. The strategy was suggested by the Norwegian Directorate of Fishery in autumn 2004 and was sent on a public hearing by The Norwegian Ministry of Fisheries and Coastal Affairs. After adjusting some of the settings of the HCR, the ministry winter 2007 asked ICES to evaluate whether the harvest control rule is consistent with the precautionary approach. A number of long-term simulations as well as some recovery cases are presented. It is concluded that the rule is consistent with the precautionary approach for the data and situations tested.

WD 6 (presented by S. Mehl) describes the status of the Norwegian 0-group observer program. The program started summer 2000 with 25 observers distributed along the Norwegian coast from 62° N to the Varanger fjord. At the moment about 17 of the observers are still active. The 2000 – 2005 year class indexes are all just above average strength and do not seem to reflect the variation in year-class strength to the same extent as the surveys and stock assessment do. At the moment there is only three years with overlapping 0-group indices and XSA-estimates of year class strength at age 3 (2000-2002). It is therefore recommended that the program is run for another couple of years, and that an evaluation is done in connection with the next NEA saithe benchmark assessment.

WD 7 (presented by O.A.Bulatov) presents a new approach for estimation of NEA cod biomass, based on fishery information, including daily reports by fishing vessels, latitude, longitude, catches and their species composition, fishing gear and duration of fishing operations. Fishable biomass was estimated using cod density (in tonns/sq. km) in each of the rectangles (0.5° of latitude x 2°of longitude). Estimate of the biomass was derived for each 15-day period in 2000-2006. The mean annual biomass was calculated as an arithmetic mean of average monthly values for the period from April to December. Year-to-year variability of fishable biomass was from 1.9 x 10^6 t in 2003 to 2.8 x 10^6 t in 2004, the average cod biomass was estimated at 2.3 x 10^6 t. On the basis of a “new” assessment of biomass, new forecasts for a TAC values were made, 2006 was taken as a starting year. The abundance of fishing stock in

2006 was estimated based on a "new" assessment of stock biomass and abundance by age computed by AFWG. According to the estimates provided by the authors a TAC for 2008-2010 can be, at least, 800,000 t.

WD 10 (presented by T.Bulgakova) is a realization of the ISVPA cohort model made for the NEA haddock. In this model unknown parameters are estimated by means of minimization of a loss function with distinct statistical meaning using robust statistics principles to decrease the effect of data noise on results. The model allows getting unbiased parameter estimations. In the ISVPA runs the model tuning was carried out with 3 and 4 survey data series, three files were the same as in XSA run, but for all years, where the information was available. The fourth series represented the stock index according to Russian acoustic surveys for years 1995-2005. The model showed the stock increasing very rapidly after 2000, SSB estimate was as high as 773 000 tons in terminal year 2005.

WD 14 (presented by J.E. Stiansen and A. Filin) describes the status of the Barents Sea ecosystem. It includes a general description, monitoring overview, the present and expected situation, risk factors, description of mixed fisheries, and impact of the fisheries on the ecosystem. The working document includes relevant ecosystem factors for the AFWG assessment, such as conditions in climate, pollution, phytoplankton, bottom fauna, marine mammals and seabirds, as well as trophic relations and mixed fisheries information.

WD 18 (presented by N.Yaragina) Long-term dynamics of the main element in reproductive strategy and abundance dynamics of the Northeast Arctic cod population, the rate of year-classes maturation, was studied. Its variation provides the adaptation of the population to historically formed high rate of the stock exploitation and variable hydrographic conditions of the Barents Sea. Nevertheless it has a threshold value outside the limit of which the collapse of the stock starts. The hypothesis on population mechanism of cod abundance regulation in the conditions of intensive exploitation was statistically verified and developed.

WD 19 (presented by K.H. Nedreaas) "Population structure of *S. mentella* in the North Atlantic with regard to international waters in the Norwegian Sea" presents the results from genetic analyses of 1,146 fish that were sampled at sea in late 2006 or early 2007. For microsatellite screening, DNA was extracted and screened for variation at 12 microsatellite loci. The results demonstrate clearly that S. mentella inhabiting the international waters of the Norwegian Sea is NOT a separate stock but genetically related to other stocks that in the North Atlantic that are already managed. The results also confirm the significant genetic separation of a shallow and a deep component/stock of the pelagic S. mentella in the Irminger Sea.

WD 20 (presented by K.H. Nedreaas), "Geographic variation in otolith shapes of deep-sea redfish (*Sebastes mentella*) in ICES Sub-areas I and II and Sub-areas V, XII and XIV: preliminary results" shows that the Norwegian Sea sample (containing pelagic S. mentella) was situated in-between the Barents Sea and Norwegian shelf samples. The Irminger Sea samples separated from the Northeast Arctic S. mentella moderately (68% correct classification), which also has previously been observed. Pelagic S. mentella in the Irminger Sea, especially those from shallower layers, seem to display a morphological pattern that differs slightly from that of the shelf S. mentella in the Greenland-Iceland-Faroes region and the Northeast Arctic S. mentella (demersal and pelagic).

WD 21 (presented by K.H. Nedreaas) describes the status of the PINRO - IMR's routine exchange program of cod and haddock otoliths which started in 1992. The age reading procedure has to a great extent been standardized except for the fact that the IMR readers prefer reading the opaque summer growth while the PINRO readers read the hyaline winter growth. This may lead to a bias where PINRO reads one year more than IMR, and this seems to be area/season related. The results show increased percentage agreement in age readings over the whole time period both for cod and haddock. But differences in age reading vary by years, showing 80-85% agreement for cod in recent period (2005). The percentage of haddock age readings shows better results with full agreement in more than 90% of the otoliths. All in all, the effort invested by PINRO and IMR in harmonizing the age readings among the readers has given positive results, and should thus be continued.

WD 22 (presented by K.H. Nedreaas) presents some information about unreported landings of cod fished in the Barents Sea 'loop-hole' by flag-of-convenience vessels, and also the Norwegian Coast Guard inspections and reactions in 2006 (2005). Only one such vessel was operating in 2006 catching about 220 t cod, a reduction from four such vessels in 2005 catching about 2000 t. The Norwegian coast-guard made 856 inspections of Norwegian and international vessels in the NEZ north of 65°N in 2006. Such annual statistics from the Coast Guard (similar statistics also available from the Directorate of Fisheries concerning port controls of fish landings) should be further explored to find possibilities to utilize this information for monitoring and quantifying irregularities/errors in the official catch statistics.

0.9 Time of Next Meeting

The Working Group proposes to meet next time in the ICES HQ (Copenhagen) at April 15 – 24, 2008.

1 Ecosystem considerations (Figures 1.1–1.30, Tables 1.1–1.21)

The stock size of commercial species in the Barents Sea is subject to significant year-to-year variations, which is reflected in the level of harvest. Certainly, fishing mortality has a significant impact on the population dynamics of commercial species. But it should be remembered that abundance fluctuations are also an adaptive response of a population to environmental impact. Sudden variations in abundance are typical not only of those species, which are exposed to impact of intensive fisheries but also in non-target species as well as species under minor exploitation. Along with this there are a lot of examples of species in a depleted condition that were capable of producing strong year classes.

A new element in changing landscape of fishery management policy is the "ecosystem approach". The ecosystem approach is variously defined, but principally puts emphasis on a management regime that maintains the health of the ecosystem alongside appropriate use of the marine environment, for the benefit of current and future generations (Jennings, 2004).

Changes in the Barents Sea ecosystem are, in the first place, caused by variations of the ocean climate. Increased impact of warm Atlantic water in the Barents Sea contributes to advection of zooplankton, faster growth rate in fish and emergence of abundant year classes (Dalpadado *et al.* 2002). A cold period is, conversely, characterized by reduced primary biological production in the Barents Sea and emergence of weak year classes of commercial species. In addition to climatic conditions, which govern the formation of primary biological production and feeding conditions for fish as well as the survival of their offspring, an important factor that influences the abundance dynamics of commercial species, is inter-specific trophic relations.

Movement towards "an ecosystem approach to the fishery management" in the Barents Sea should include: (Filin and Røttingen 2005):

1) More extensive use of ecosystem information in the population parameters applied in assessment and prognosis,
2) Expansion of the use of multi-species models for fishing management.

The aim of this chapter is to identify important ecosystem information influencing the fish stocks, and further try to implement this knowledge into the fish stock assessment and predictions. There has been a steadily development in this aspect over the last few years and the work is still in a developing phase. Hopefully, the gathering of information on the ecosystem in this chapter will lead to a better understanding of the complex dynamics and interactions that takes place in the ecosystem, and also participate in reaching an ecosystem based management of the Barents Sea.

This chapter was in general based on WD 14 ("Ecological considerations for AFWG 2007"). Text, figures and tables taken from this WD are not further cited in this chapter.

1.1 General description of the Barents Sea ecosystem (Figures 1.1–1.13, Tables 1.1–1.11)

The Barents Sea is a shelf area of approx. 1.4 million km^2, which borders to the Norwegian Sea in the west and the Arctic Ocean in the north, and is part of the continental shelf area surrounding the Arctic Ocean. The extent of the Barents Sea is limited by the continental slope between Norway and Spitsbergen in west, the top of the continental slope against the Arctic Ocean in north, Novaja Zemlya in east and the coast of Norway and Russia in the south (Figure 1.1). The average depth is 230 m, with a maximum depth of about 500 m at the western entrance. There are several bank areas, with depths around 50-200 m.

Climate

The general circulation pattern (Figure 1.1) is strongly influenced by topography. Warm Atlantic water from the Norwegian Atlantic Current with a salinity of approx. 35 flows in through the western entrance. This current divides into two branches, one southern branch, which follows the coast eastwards against Novaja Zemlya and one northern branch, which flow into the Hopen Trench. The relative strength of these two branches depends on the local wind conditions in the Barents Sea. South of the Norwegian Atlantic Current and along the coastline flows the Norwegian Coastal Current. The Coastal Water is fresher than the Atlantic water, and has a stronger seasonal temperature signal. In the northern part of the Barents Sea fresh and cold Arctic water flows from northeast to southwest. The Atlantic and Arctic water masses are separated by the Polar Front, which is characterised by strong gradients in both temperature and salinity. In the western Barents Sea the position of the front is relatively stable, but in the eastern part the position of this front has large seasonal, as well as year- to-year, variations. In general, the Barents Sea is characterised by large year-to-year variations in both heat content and ice conditions. The most important cause of this is variation in amount and temperature of the Atlantic water that enters the Barents Sea (Figures 1.2-1.6).

Phytoplankton

The Barents Sea is a spring bloom system and during winter the primary production is close to zero. The timing of the phytoplankton bloom is variable throughout the Barents Sea, and has also high interannual variability. In early spring, the water is mixed but even though there are nutrients and light enough for production, the main bloom does not appear until the water becomes stratified. The stratification of the water masses in the different parts of the Barents Sea may occur in different ways; through fresh surface water along the marginal ice zone due to ice melting, through solar heating of the surface waters in the Atlantic water masses, and through lateral spreading of coastal water in the southern coastal (Rey 1981). The dominating algal group in the Barents Sea is diatoms like in many other areas (Rey 1993). Particularly, diatoms dominate the first spring bloom, and the most abundant species is *Chaetoceros socialis*. The concentrations of diatoms can reach up to several million cells per litre. The diatoms require silicate and when this is consumed other algal groups such as flagellates take over. The most important flagellate species in the Barents Sea is *Phaeocyctis pouchetii*. However, in individual years other species may dominate the spring bloom.

Zooplankton

Zooplankton biomass has shown large year-to-year variation among years in the Barents Sea (e.g. Figures 1.7-1.10). Crustaceans form the most important group of zooplankton, among which the copepods of the genus Calanus play a key role in the Barents Sea ecosystem. *Calanus finmarchicus*, which is the most abundant in the Atlantic waters, is the main contributor to the zooplankton biomass. *Calanus glacialis* is the dominant contributor to zooplankton biomass of the Arctic region of the Barents Sea. The Calanus species are predominantly herbivorous, feeding especially on diatoms (Mauchlin 1998). Krill (euphausiids) is another group of crustaceans playing a significant role in the Barents Sea ecosystem as food for both fish and sea mammals. The Barents Sea community of euphausiids is represented by four abundant species: neritic shelf boreal *Meganyctiphanes norvegica*, oceanic arcto-boreal *Thysanoessa longicaudata*, neritic shelf arcto-boreal *Th. inermis* and neritic coastal arcto-boreal *Th. raschii* (Drobysheva 1994). The two latter species make up 80-98% of the total euphausiids abundance. Species ratio in the Barents Sea euphausiid community is characterized by year-to-year variability, most probably due to climatic changes (Drobysheva 1994). Observations have shown that after a cooling period the abundance of *Th. raschii* increases and of *Th. inermis* – decreases, and contrary after a period of warm years the abundance of *Th. inermis* grows and the number of cold-water species becomes smaller

(Drobysheva, 1967). The advection of species brought from the Norwegian Sea is determined by the intensity of the Atlantic water inflow (Drobysheva 1967, Drobysheva *et al*. 2003).

Three abundant amphipod species are found in the Barents Sea; *Themisto abyssorum* and *T. libellula* are common in the western and central Barents Sea, while *T. compressa* is less common in the central and northern parts of the Barents Sea. *T. abyssorum* is predominant in the sub-arctic waters. In contrast, the largest in size of the Themisto species, *T. libellula*, is mainly restricted to the mixed Atlantic and Arctic water masses. Very high abundance of *T. libellula* is often formed close to the Polar Front.

The results from long-term investigations of macroplankton in autumn-winter indicate that the abundance of euphausiids (Figure 1.9), as well as the distribution and specific composition, is affected by interannual dynamics. This leads to changes in the feeding conditions of fish. Possible reasons for the large year-to-year variations in biomass plankton in the Barents Sea are the differences in advective transport and predation pressure. Figure 1.10 shows the total biomass of zooplankton together with capelin stock size (million tonnes). There seems to be an inverse relationship between capelin stock size and zooplankton biomass, indicating capelin to exercise strong feedback control on the system through its predation pressure on zooplankton. Other plankton feeding fish, which is found in high numbers in the Barents Sea, are polar cod, young herring and young blue whiting.

Variation in climate factors can have strong impact on the lower trophic levels in the ecosystem. Plankton is always subject to the surrounding physical environment. Limited self-motion compared to surrounding currents sets strong limitations on the ability to avoid or seek better climate condition. This is especially the case for climatic factors, which vary slowly and/or over large scale in space and time (*e.g.* temperature in the open waters). However, many plankton organisms have mechanisms allowing some kind of vertical motion and may thereby move to more profitable vertical layers. The influences on plankton from climatic factors with strong vertical gradients (*e.g.* turbulence and light) are therefore also dependent on the individual's behaviour. Different climatic factors may also affect individual plankton differently at different stages of its life cycle, and for fish also in nekton stages. Climate variation also affects the trophic interactions on different scales in time and space. The total effect of climate variation on plankton (and also nekton) is therefore a complicated matter.

Fish

The Barents Sea is a relatively simple ecosystem with few fish species of potentially high abundance. These are Northeast Arctic cod, haddock, Barents Sea capelin, polar cod and immature Norwegian Spring-Spawning herring. There have been significant variations in abundance of these species (Figures 1.11-1.12). These variations are due to a combination of fishing pressure and environmental variability. The last few years there has in addition been a relatively strong increase of blue whiting migrating into the Barents Sea. Until the 1970's the redfish (*Sebastes mentella*) was an abundant stock in the Barents Sea. Due to heavy overfishing the stock declined strongly during the 1980's, and has since then stayed at a low level. The recruitment of the Barents Sea fish species has also shown a large year-to-year variability (Tables 1.1-1.4). The most important reasons for this variability are variations in the spawning biomass, climate conditions, food availability and predator abundance and distribution. Variation in the recruitment of some species, including cod and herring, has been associated with changes in the influx of Atlantic waters into the Barents Sea.

Cod, together with capelin and herring, is a key species among fish in the Barents Sea ecosystem. The mature cod has an annual spawning migration from the Barents Sea to the western coast of Norway. The main spawning occurs in the Lofoten area in March/April. The cod larvae are advected with the Norwegian coastal current and Norwegian Atlantic current back to the Barents Sea where they settle at the bottom around October. Cod is the most important predator fish species in the Barents Sea. It feeds on a large range of prey, including the larger zooplankton species, most of the available fish species and shrimp (Tables 1.5-1.8). Cod prefer capelin as a prey, and feed on them heavily as the capelin spawning migration brings them into the southern and central Barents Sea. Fluctuations of the capelin stock (Tabs. 1.9) have a strong effect on growth, maturation and fecundity of cod, as well as on cod recruitment because of cannibalism. The role of euphausiids for cod feeding increases in the years when capelin stock is at a low level (Ponomarenko and Yaragina 1990). Also, according to Ponomarenko (1973, 1984) interannual changes of euphausiid abundance is important for the survival rate of cod during the first year of life.

Capelin is a key species because it feeds on the zooplankton production near the ice edge and is usually the most important prey species for top predators in the Barents Sea, serving as a major transporter of biomass from the northern Barents Sea to the south (von Quillfeldt and Dommasnes, 2005). During summer they migrate northwards as the ice retreats, and thus have continuous access to new zooplankton production in the productive zone recently uncovered by the ice. They often end up at 78-80˚N by September-October, and then they start a southward migration to spawn on the northern coasts of Norway and Russia. During spawning migration capelin is considerably preyed on by cod. Capelin also is important prey for other predatory fishes as well as for several species of marine mammals and birds.

The herring spawns along the Norwegian western coast and the larvae drifts into the Barents Sea. The juveniles of the Norwegian spring-spawning herring stock are distributed in the southern parts of the Barents Sea. They stay in this area for about three years before they migrate west and southwards along the Norwegian coast and mix with the adult part of the stock. The presence of young herring in the area has a profound effect on the recruitment of capelin, and it has been shown that when rich year classes of herring enters to the Barents Sea, the recruitment to the capelin stock is poor, and in the following years the capelin stock collapses (Gjøsæter and Bogstad, 1998). This happened after the rich 1983 and 1992 year-classes of herring entered the Barents Sea. Also when medium sized year classes of herring are spread into the area there is a clear sign of reduction in recruitment to the capelin stock, In this way, the herring impact both on the capelin stock (directly) and the cod stock (indirectly).

Haddock is also a common species, and migrates partly out of the Barents Sea. The stock has large natural variations in stock size. Food composition of haddock consists mainly of benthic organisms (Figure 1.13, Table 1.10). Totally the mean weight percent of polychaets, mollusks and echinoderms was up to 40 %. Capelin is the dominant prey among fish species. Zooplankton and other fish species are of only marginal importance. There are not any clear differences in the food composition of haddock between various length groups. The total annual food biomass consumed by haddock shows large variation (from 348 thousand tonnes to 1268 thousand tonnes, with a mean value of 736 thousand tonnes according to Dolgov, WD29, AFWG 2006).

Saithe is found mainly along the Norwegian coast, but also occurs in the Norwegian Sea and in the southern Barents Sea. The 0-group saithe drifts from the spawning grounds to inshore waters. 2-3 years old the saithe gradually moves to deeper waters, and at age 3-6 it is found at typical saithe grounds. It starts to mature at age 5-7, and in early winter a migration towards the spawning grounds further out and south starts. The smaller individuals feed on crustaceans, while larger saithe depends more on fish as prey. Gastropods and cephalopods are also found in saithe stomachs (Dolgov, WD 29, AFWG 2006; Mehl, WD7, AFWG 2005). The main fish prey is young herring, Norway pout, haddock, blue whiting and capelin, while the dominating crustacean prey is krill. The importance of fish is highest in north, while in south the importance of crustaceans increases.

Polar cod is a cold-water species found particularly in the eastern Barents Sea and in the north. It seems to be an important forage fish for several marine mammals, but to some extent also for cod. There is little fishing on this stock.

Deep-sea redfish and golden redfish used to be important elements in the fish fauna in the Barents Sea, but presently the stocks are severely reduced. Young redfish are plankton eaters, but larger individuals take larger prey, including fish. Until 1990 huge amounts of redfish postlarvae filled the pelagic Barents Sea every summer and autumn. These 0-group redfish utilized the plankton production and contributed themselves to the diet of other predators. We don't know whether other planktoneaters have taken over this niche. Since the redfish species are ovoviparous giving birth to live larvae, it is believed to be a strong relationship between the size and age composition of the mature stock and the recruitment. Lack of larvae and juvenile redfish in the sea is therefore a confirmation of low "spawning" stocks. On the other hand is a rebuilding of the mature stock expected to give an immediate and correspondingly increase in the amounts of larvae in the sea. Fishing on these two redfish species is at present severely restricted in order to rebuild the stocks.

Greenland halibut is a large and voracious fish predator with the continental slope between the Barents Sea and the Norwegian Sea as its most important area, but it is also found in the deeper parts of the Barents Sea. Investigations in the period 1980-1990 showed that cephalopods (squids, octopuses) dominated in the Greenland halibut stomachs, as well as fish, mainly capelin and herring (Figure 1.13). However, the largest portion of the stomach contents constituted by fisheries wastes (heads, guts etc). Ontogenetic shift in prey preference was clear with decreasing proportion of small prey (shrimps and small capelin) and increasing proportion of larger fish with increasing predator length. The largest Greenland halibut (length more than 65-70 cm) had a rather big portion of cod and haddock in the diet.

The blue whiting has its main distribution area in the Norwegian Sea and Northeast Atlantic, and the marginal northern distribution is at the entrance to the Barents Sea. Usually the blue whiting population in the Barents Sea is small. In years with warm Atlantic water masses the blue whiting may enter the Barents Sea in large numbers, and the blue whiting is a dominant species in the western areas. This situation occurred in 2001, and the blue whiting has since been present in high numbers. In 2004 the abundance of blue whiting were estimated to be 1.4 mill tonnes, mostly age 1-4. This makes it the second most abundant pelagic plankton feeding fish after young herring in the Barents Sea, followed by polar cod and capelin. In general these four species have minor overlapping distributions; with the blue whiting in the west, the herring in the south, the polar cod in the east (except for an overlapping part of the stock in the Svalbard region) and the capelin in the north. In southwestern areas blue whiting and herring partly overlap. However, they occupy different parts of the water column. The competitive effect for food by blue whiting on the other three species for the local zooplankton production is assumed to be low. However, the blue whiting is situated as a filter of zooplankton in their main advection pathway from the Norwegian Sea into the Barents Sea. What affect this has on the total zooplankton production, and thereby indirect on the whole ecosystem in the Barents Sea is not known.

However, zooplankton is the most important prey at young ages of blue whiting (age < 5), which is the dominant part of the stock present in the Barents Sea (Anon. 2004a). Among fishes, the pelagic species were the most important (*i.e.* polar cod, capelin, haddock, saithe and redfish). The analysis of diet dynamics in blue whiting from different length groups showed a clear downward trend in the proportion of zooplankton by weight (copepods, hyperiids and euphausiids) and an increasing importance of fish. It should be noted that fish became the dominant part of blue whiting diet when it reached a length of about 27 cm. (Dolgov, WD 29, AFWG 2006). Cod juveniles occurred in the stomachs of blue whiting with a length of approximately 25 cm.

When present in the western Barents Sea the blue whiting is not the main prey for any other fish species. In these periods the blue whiting can account for approximately 2-7% (Dolgov, WD 29, AFWG 2006) of the diet of cod and Greenland halibut. Due to the high numbers of cod, this is then the main fish predator on blue whiting. Other fishes, like larger saithe and haddock, may also prey on blue whiting, but the proportion of the diet is low (<1%). Information on predation of mammals on blue whiting in the Barents Sea is at present lacking.

Long rough dab is a typical ichthyobenthophage, which main food is benthos (ophiura, polychaetes etc.) and different fish species (Dolgov, WD 29, AFWG 2006). At older stages the proportion of fish increases (polar cod and cod, capelin and juvenile redfish). The larger long rough dab also feed on their own juveniles and juvenile haddock. Mean annual food consumption by long rough dab is estimated to be 240 thousand tonnes. Among commercial species, capelin (33 thousand tonnes), juvenile cod (27 thousand tonnes) and polar cod (24 thousand tonnes) as well as euphausiids and shrimp were consumed most intensively (Dolgov,WD 29, AFWG 2006).

Thorny skate preys primarily on fish and large crustaceans, shrimps and crabs (Dolgov, WD 29, AFWG 2006), but may also in a lesser extent feed on fish. The most common fish species are young cod and capelin. Mean annual biomass of food consumed by thorny skate during 1994–2000 was calculated at 165.7 thousand tonnes, of which 73.7 thousand tonnes comprised commercial fishes and invertebrates. The major items of food were northern shrimp and cod at 31.8 and 16.4 thousand tonnes, respectively. Round skate fed mainly on benthos, especially Polychaeta and *Gammaridae*. Northern shrimp and fisheries waste are also major components of their diets. Fish (mostly capelin and young cod) occurred in small quantities. Arctic skate feed mainly on fish and shrimp (herring, capelin, redfish and northern shrimp). Blue skate diet consists largely of fish, mainly young cod and haddock, redfish, and long rough dab). Spinytail skate also prey mostly on fish, which included haddock, redfish and long rough dab. Total food consumption by all skate species, except thorny skate, was 31.4 thousand tonnes, of which 18.2 thousand tonnes was commercial species (Dolgov, WD 29, AFWG 2006).

Mammals

Marine mammals, as top predators, are significant ecosystem components. About 24 species of marine mammals regularly occur in the Barents Sea, comprising 7 pinnipeds (seals), 12 large cetaceans (large whales) and 5 small cetaceans (porpoises and dolphins). Some of these species have temperate mating and calving areas and feeding areas in the Barents Sea (*e.g.* minke whale *Balaenoptera acutorostrata*), others reside in the Barents Sea all year round (*e.g.* white-beaked dolphin *Lagenorhynchus albirostris* and harbour porpoise *Phocoena phocoena*). The currently available abundance estimates of the most abundant cetaceans in the north-east Atlantic (*i.e.* comprising the North, Norwegian, Greenland and Barents Seas) are: minke whales 107,205; fin whales *B. physalus* 5,400; humpback whales *Megaptera novaeangliae* 1,200; sperm whales *Physeter catodon* 4,300 (Skaug *et al.* 2002, Øien 2003, Skaug *et al.* 2004). *Lagenorhyncus* dolphins are the most numerous smaller cetaceans, with an abundance of 130,000 individuals (Øien 1996), while harp seals are the most numerous seal in the Barents Sea with approximately 2.2 million seals.

In the Barents Sea the marine mammals may eat 1.5 times the amount of fish caught by the fisheries. Minke whales and harp seals may consume 1.8 million and 3,5 million tonnes of prey per year, respectively (*e.g.*, crustaceans, capelin, herring, polar cod and gadoid fish; Folkow *et al.* 2000, Nilssen *et al.* 2000). Functional relationships between marine mammals and their prey seem closely related to fluctuations in the marine systems. Both minke whales and harp seals are thought to switch between krill, capelin and herring depending on the availability of the different prey species (Lindstrøm *et al.* 1998, Haug *et al.* 1995, Nilssen *et al.* 2000).

The consumption by minke whale (Folkow *et al.* 2000) and by harp seal (Nilssen *et al.* 2000) is given in Table 1.11. These consumption estimates are based on stock size estimates of 85 000 minke whales in the Barents Sea and Norwegian coastal waters (Schweder *et al*. 1997) and of 2 223 000 harp seals in the Barents Sea (ICES 1999/ACFM:7). The consumption by harp seal is calculated both for situations with high and low capelin stock, while the consumption by minke whale is calculated for a situation with a high herring stock and a low capelin stock. Food consumption by harp seals and minke whales combined is at about the same level as the food consumption by cod, and the predation by these two species needs to be considered when calculating the mortality of capelin and young herring in the Barents Sea.

In the period 1992-1999, the mean annual consumption of immature herring by minke whales in the southern Barents Sea varied considerably (640 t –118 000 t) (Lindstrøm *et al.* 2002). The major part of the consumed herring belonged to the strong 1991 and 1992 year classes and there was a substantial reduction in the dietary importance of herring to whales after 1995, when a major part of both the 1991 and 1992 year classes migrated out of the Barents Sea. In 1992-1997, minke whales may have consumed 230 000 t and 74 000 t, corresponding to 14.6 billion and 2.8 billion individuals of the herring year classes of 1991 and 1992, respectively. The dietary importance of herring to whales appeared to increase in a non-linear relation with herring abundance.

Seabirds

The Barents Sea holds one of the largest concentrations of seabirds in the world (Norderhaug *et al.* 1977; Anker-Nilssen *et al.* 2000). About 20 million seabirds harvest approximately 1.2 million tonnes of biomass annually from the area (Barrett *et al.* 2002). About 40 species are thought to breed regularly around the northern part of the Norwegian Sea and the Barents Sea. The most typical species belong to the auk and gull families. There are about 1 750 000 breeding pairs of Brünnich's guillemot (*Uria lomvia*) in the Barents region. They feed on fish, particularly polar cod, and other ice fauna species. The population of common guillemots (*Uria aalge*) is about 140 000 breeding pairs. Capelin is the most important food source all the year round. There are thought to be more than 1.3 million pairs of little auk (*Alle alle*) in the Barents Sea. It is found throughout most of the year and many probably winter along the ice margin between Greenland and Svalbard and in the Barents Sea. Small pelagic crustaceans are the main food for this species, but they may also feed on small fish. The black-legged kittiwake (*Rissa tridactyle*) breeds around the whole of Svalbard, but like the Brünnich's guillemot it is most common on Bjørnøya, Hopen and around Storfjorden. Its most important food items in the Barents Sea are capelin, polar cod and crustaceans. The breeding population seems stable, comprising 850 000 pairs in the Barents region. The northern fulmar (*Fulmarus glacialis*) is an abundant Arctic and sub-Arctic species living far out to sea except in the breeding season. It lives on plankton and small fish taken from the surface. The population estimates are uncertain, but high (100 000 - 1 000 000 pairs).

Benthos

Red king crab (*Paralithodes camtschatica*) was introduced to the Barents Sea in the 1960s. The stock is growing and expanding eastwards but more dominantly along the Norwegian coast westwards. Adult red king crabs are opportunistic omnivores. Decapods (i.e. crabs and lobsters) are known predators of benthic bivalves, including epibenthic species such as the commercial Iceland scallop *Chlamys islandica*. Both the red king crab and the scallop have a sub-Arctic distribution, and as the Iceland scallop has a life span of 30 years, and matures after 3-6 years, it might be particularly exposed to risk of local extinction with increasing numbers of king crabs (Jørgensen 2005).

1.2 Monitoring of the ecosystem

Monitoring of the Barents Sea started already in 1900 (initiated by Nicolai Knipovich), with regular measurement of temperature in the Kola section. Since then monitoring of ecosystem components in the Barents Sea on a regular basis have been conducted by IMR and PINRO at several standard sections and fixed stations as well as by area covering surveys. In addition there are conducted many short time special investigation, designed to study specific processes or knowledge gaps. Also the quality of large hydrodynamical numeric models are now at a level where they are useful for filling observation gaps in time and space for some parameters. Satellite data and hindcast global reanalysed datasets are also useful information sources.

1.2.1 Standard sections (Figure 1.14, Tables 1.12)

Some of the longest ocean time series in the world are along standard sections (Figure 1.14) in the Barents Sea. The monitoring of basic oceanographic variables for most of the sections goes back 30-50 years, with the longest time series stretching over one century. In the last decades also zooplankton is sampled at some of these sections. An overview of length, observation frequency and present measured variables for the standard sections in the Barents Sea is given in Table 1.12. Specific considerations for the most important sections are giving in the following text.

Kola section

The Kola section was taken quarterly in the period 1900-1921, and monthly afterwards. The Kola section is situated partly in the coastal water masses and partly in the Atlantic water masse, and is the section most representative for the Atlantic branch going eastwards parallel to the coastline, i.e. the southern part of the Barents Sea. Some holes in the time series exists, but in general the section has been taken quite regularly. Even during World War II the section was taken 2-3 times a year.

Vardø-North section

The Vardø-N section has been monitored in August regularly since 1953, and increased in observation frequency to 4 times per year in 1977. Situated in the central Barents Sea it is the most representative section for the Atlantic branch going into the Hopen Trench, i.e. the central part of the Barents Sea. The northern part of the sections usually is in Arctic water masses.

Fugløya-Bear Island section

The Fugløya-Bear Island section is situated at the western entrance to the Barents Sea, where the inflow of Atlantic water from the Norwegian Sea takes place. The section is therefore representative for the western part of the Barents Sea. It has been monitored regularly in August since 1964, and increased observation frequency to 6 times per year in 1977. Zooplankton monitoring began in 1987.

1.2.2 Fixed stations

IMR operates one fixed station, Ingøy, related to the Barents Sea. The Ingøy station is situated in the coastal current along the Norwegian coast. Temperature and salinity is monitored 1-4 times a month. The observations were obtained in two periods, 1936-1944 and 1968-present.

1.2.3 Area coverage (Table 1.13)

Area surveys are conducted throughout the year. The number of vessels in each survey differs, not only between surveys but may also change from year to year for the same survey.

However, most surveys are conducted with only one vessel. It is not possible to measure all ecosystem components during each survey. Effort is always put on measuring as many parameters as possible on each survey, but available time put restrictions on what is possible to accomplish. Also, an investigation should not take to long time in order to give a synoptic picture of the conditions. Therefore the surveys must focus on a specific set of parameters/species. Other measured parameters may therefore not have optimal coverage and thereby increased uncertainty, but will still give important information. An overview of the measured parameters/species on each main survey is given in Table 1.13. Specific considerations for the most important surveys are giving in the following text.

Norwegian/Russian winter survey

The survey is carried out during February-early March, and covers the main cod distribution area in the Barents Sea. The coverage is in some years limited by the ice distribution. Three vessels are normally applied, two Norwegian and one Russian. The main observations are mad with bottom trawl, pelagic trawl, echo sounder and ctd. Plankton studies have been done in some years. Cod and haddock are the main targets for this survey. Swept area indices are calculated for cod, haddock, Greenland halibut, *S. marinus* and *S. mentella*. Acoustic observations are made for cod, haddock, capelin, redfish, polar cod and herring. The survey started in 1981.

Lofoten survey

The main spawning grounds of North East Arctic cod are in the Lofoten area. Echosounder equipment was first used in 1935 to detect concentrations of spawning cod, and the first attempt to map such concentrations was made in 1938 (Sund, 1938). Later investigations have provided valuable information on the migratory patterns, the geographical distribution and the age composition and abundance of the stock.

The current time series of survey data starts in 1985. Due to the change in echo sounder equipment in 1990 results obtained earlier are not directly comparable with later results. The survey is designed as equidistant parallel acoustic transects covering 3 strata (North, South and Vestfjorden). In most surveys previous to 1990 the transects are not parallel, but more as parts of a zig-zag pattern across the spawning grounds aimed at mapping the distribution of cod. Trawl samples are not taken according to a proper trawl survey design. This is due to practical reasons. The spawning concentrations can be located with echosounder thus effectively reduce the number of trawl stations needed. The ability to properly sample the composition of the stock (age, sex, maturity stage etc.) is limited by the amount of fixed gear (gillnets and longlines) in the different areas.

Norwegian coastal surveys

In 1985-2002 a Norwegian acoustic survey specially designed for saithe was conducted annually in October-November (Nedreaas 1998). The survey covered 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 was to support the stock assessment with fishery-independent data of the abundance of the youngest saithe. The survey mainly covered the grounds where the trawl fishery takes place, normally dominated by 3 - 5(6) year old fish. 2-year-old saithe, mainly inhabiting the fjords and more coastal areas, were also represented in the survey, although highly variable from year to year. In 1995-2002 a Norwegian acoustic survey for coastal cod was conducted along the coast and in the fjords from Varanger to Stad in September, just prior to the saithe survey described above. This survey covered coastal areas not included in the regular saithe survey. Autumn 2003 the saithe- and coastal cod surveys were combined.

Joint ecosystem autumn survey

The survey is carried out from early August to early October, and covers the whole Barents Sea. Five vessels are normally applied, three Norwegian and two Russian. Most aspects of the ecosystem are covered, from physical and chemical oceanography, primary and secondary production, fish (both young and adult stages), sea mammals, benthos and birds. Many kinds of methods and gears are used, from water sampling, plankton nets, pelagic and demersal trawls, grabs and sledges, acoustics, directs observations (birds and sea mammals). The survey has developed from joint surveys on 0-group, capelin and juvenile Greenland halibut, through general acoustic surveys including observations of physical oceanography and plankton, gradually developing into the ecosystem survey carried out in recent years. The predecessor of the survey dates back to 1972 and has been carried out every fall since.

Russian Autumn-winter trawl-acoustic survey

The survey is carried out in October-December, and cover the whole Barents Sea up to the continental slope. Two Russian vessels are usually used. The survey has developed from a young cod and haddock trawl survey, started in 1946. The current trawl-acoustic time series of survey data starts in 1984, targeting both young and adult stages of bottom fish. The surveys include observations of physical oceanography and meso- and macro-zooplankton.

Norwegian Greenland halibut survey

The survey is carried out in August, and 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 survey was run the first time in 1994, and is now part of the Norwegian Combined survey index for Greenland halibut.

1.2.4 Numerical models

Large 3D hydrodynamic numeric models for the Barents Sea are run at both IMR and PINRO. These models have, through validation with observations, proved to be a useful tool for filling observation gaps in time and space. The hydrodynamic models have also proved useful for scenario testing, and for study of drift patterns of various planktonic organisms.

Sub-models for phytoplankton and zooplankton are now implemented in some of the hydrodynamic models. However, due to the present assumptions in these sub-models care must be taken in the interpretation of the model results.

1.2.5 Other information sources

Satellites can be for several monitoring tasks. Ocean colour spectre can be used to identify and estimate the amount of phytoplankton in the skin (~1 m) layer. Several climate variables can be monitored (e.g. ice cover, cloud cover, heat radiation, sea surface temperature). Marine mammals, ice bears and seabirds can be traced with attached transmitters.

Aircraft surveys can also be used for monitoring several physical parameters associated with the sea surface as well as observations of mammals at the surface.

Several international hindcast databases (e.g.. NCEP, ERA40) are available. They use a combination of numerical models and available observations to estimate several climate variables, covering the whole world.

Along the Norwegian coast ship-of-opportunity supply weekly the surface temperature along their path.

1.2.6 Monitoring divided by ecosystem components

Climate

In order to evaluate the state of the physical environment several sources of information are used. Area surveys of temperature and salinity are conducted in January-February at the joint winter survey and in August-October at the joint ecosystem survey. The standard sections also form an important base for the evaluation of temperature and salinity. Especially the seasonal development is monitored at the Kola and Fugløya-Bear Island section, and at the fixed station Ingøy. In the Fugløya-Bear Island section a series of current meters monitors give a high resolution of the flow through the western entrance of the Barents Sea. In addition hydrodynamic numeric models give insight into horizontal and vertical variation of temperature, water masses distribution and transports.

Phytoplankton

The bloom situation in the Barents Sea is covered on a regular basis both during the survey coverage in August-October and on the standard sections Fugløya-Bear Island and Vardø-Nord. During these surveys the chlorophyll concentration is measured as fluorescence in water samples taken from standard depths down to 100 m depth. This gives an indication on the primary production in the area. In addition to the chlorophyll concentration, which is a measure of the phytoplankton production, analyses in 2005 included species composition. In addition to observations, the primary production is simulated using numerical models.

Zooplankton

Zooplankton area coverage is monitored during the joint autumn ecosystem survey. Joint investigations have taken place since 2002. Regular sampling by IMR began in 1979.

Monitoring of zooplankton along the Fugløya-Bear Island section by IMR started in 1987 and are now conducted 5-6 times each year usually in January, March/April, May/June, July/August and September/October. However, the data prior to 1994 are scarce and does not give a full seasonal coverage. The WP2 plankton net has been used regularly during this monitoring since 1987. In addition some vertically stratified MOCNESS stations are also taken each year.

Regular macroplankton area surveys have been conducted by PINRO in the Barents Sea since 1952. Surveys involve annual monitoring of the total abundance and distribution of euphausiids (krill) in autumn-winter trawl-acoustic survey. In the survey the trawl net was attached to the upper headline of the bottom trawl. During winter crustaceans are concentrated in the near-bottom layer and have no pronounced daily migrations, and the consumption by fish is minimal. Therefore sampling of euphausiids during autumn-winter survey can be used to estimate year-to-year dynamics of their abundance in the Barents Sea. Annually 200-300 samples of macroplankton are collected during this survey, and both species and size composition of the euphausiids are determined.

Fish

Most of the area surveys mentioned above have monitoring of commercial fish species as their main objective. The different fish stocks and life stages are targeted at these surveys. In addition to catch data the surveys are the main data source for the assessment of the stocks.

Among additional sources of information are biological data collected by observers onboard commercial fishing vessels, and some regular fishing vessels with special reporting demands acting as reference fishing vessels.

Mammals

Abundance and distribution of some marine mammal species in the Barents Sea are regularly monitored. Sighting surveys of pelagic cetaceans provide abundance estimates every 6 years, while harp and hooded seal abundances in the Greenland Sea are monitored every 5 years. Since 2002 distribution of marine mammals in the Barents Sea are observed from research vessels during ecosystem survey. In addition aircraft observations and observations from fishing vessels with observer are used. In the White Sea aircraft observations are used to estimate the abundance of harp seals.

Benthos

The main monitoring of the benthos community takes place during the joint autumn ecosystem survey.

1.3 State and expected situation of the ecosystem

1.3.1 Climate (Figures 1.2-1.6)

Processes of both external and local origin operating on different time scales govern the climate in the Barents Sea. Important factors that influence the temperature regime are the advection of warm Atlantic water masses from the Norwegian Sea, the temperature of this water masses, local heat exchange with the atmosphere and the density difference in the ocean itself. The volume flux into the Barents Sea from the Norwegian Sea is influenced by the wind conditions in the western Barents Sea, which again is related to the Norwegian Sea wind field (Ingvaldsen *et al.*, 2004). Thus, both slowly moving advective propagation and rapid barotropic responses due to large-scale changes in air pressure must be considered when describing the variation in the climate of the Barents Sea.

Current atmospheric situation

The air temperature over the Barents Sea was above the long-term mean during 2006. In the early 2006, the air temperature was well above normal, with maximal values of positive anomalies (4.0-5.0 ºC) in the eastern sea. In summer and autumn temperature anomalies decreased. Insignificant positive anomalies of air temperature were registered in the western Barents Sea and, in the eastern part of the sea, negative anomalies (0.4-0.7 ºC) were observed in June-July and October. In November-December, over the most of sea, air temperature was, on average, 2.0-3.0 ºC higher than the long-term mean. Record high yearly average air temperatures were recorded at the Bear Island and Spitsbergen weather stations in 2006.

Current situation of temperature and salinity

Temperatures in the Barents Sea have been relatively high since the 1990s (Figures 1.2-1.3). There was a continuous warm period from 1989-1995, followed by a short period with below average conditions. Since 1998 the temperature has, with few exceptions, stayed well above average.

In 2006 the average temperature in the Barents Sea was the highest ever observed (Figures 1.2-1.3), with anomalies ranging between 0.8 and 1.7 ^{o}C above the long-term average throughout the year.

In 2006, over most of the Barents Sea area, the sea surface temperature (SST) was higher than normal, with maximum anomalies of 0.6-1.1ºC in the central and eastern areas. In May-June, the weakened radiation warming of the surface layer became a reason of decrease in SST anomalies. As a result, there was a transition from positive to negative SST anomalies in the western and eastern parts of the sea in July and in the central part – in August. In autumn-winter period, SST anomalies increased again to well above normal values. In that period, the maximum positive anomalies (1.0-1.3 ºC) were observed in the southern sea.

The bottom layer of the Barents Sea water masses with positive temperature anomalies occupied more than 80% of the surveyed area (Figure 1.4), and in about 30% of these the anomalies were the highest since 1951. The highest anomalies of temperature in bottom layer (over 3 ºC) were observed in the Spitsbergen Bank area. In the North Cape and Murman Currents, the positive anomalies of bottom temperature were 1.0-2.0 ºC. In the northeastern sea, negative anomalies down to 0.5 ºC were registered, which was about 1 ºC lower than last year's level.

The time series from the coastal waters at the fixed station Ingøy show that except for at surface in June-August, all temperatures were above the long-term mean. The highest deviations were in 250 m depth January-March 2006 when the anomalies were more than 2^{o}C.

At the Fugløya-Bear Island section, which represents the western part of the Barents Sea, a positive temperature anomaly of 1.44°C was observed in January 2006, and this is an all time high since the time series started in 1977 (Figure 1.3). The temperature stayed high throughout 2006, and all observations except October were all time high. In January 2007 the temperature anomaly was 1.55°C, a new all time high for this section. The salinity variations are similar to those in temperature, and there has been a high salinity in the last 6 years. The Vardø-N section, which represents the central part of the Barents Sea, shows much the same as the Fugløya-Bear Island section, but the anomalies are a smaller.

In the Kola Section (Figure 1.2), which represents the southern part of the Barents Sea, sea temperature in the active layer (0-200 m), was significantly higher than the long-term mean throughout the year. From January to May, the temperature in the coastal waters (St. 1-3 of the Kola section) in all the layers was maximal during the whole period of observations since 1951, and in the Murman Current (St.3-7 of the Kola section), in 0-200 m and 50-200 m layers, the extremely high water temperatures were registered in the period from May to October. Since May, in the coastal waters, the positive anomalies were gradually decreasing. In 0-200 m layer, they decreased from 1.4 ºC to 0.6 ºC. In the Murman Current, some decrease of temperature anomaly was recorded from August to December, however throughout the year, it exceeded 1.0 ºC.

The salinity in both the Vardø-N and Fugløya-Bear Island section (Figure 1.2) was the highest observed (since 1977). In the Kola section the salinity was closer to the long-term mean, with slightly higher anomalies in the Murmansk current and slightly lower anomalies in the coastal waters. In both these parts of the section the salinity decreased throughout the year

Current situation of inflow of Atlantic water

The temperature and the volume flux of the inflowing Atlantic Water in the Fugløya-Bear Island section do not always vary in phase. The temperature is mainly determined by variations upstream in the Norwegian Sea, while the volume flux to a large degree varies with the wind conditions in the western Barents Sea. During the winter of 2006 the volume flux of Atlantic Water was the highest recorded since the observations started in 1997 (Figure 1.5). The inflow decreased towards spring, as it usually does in this area. This is also consistent with volume flux anomalies from a wind-driven numerical model. The observational time series has for the moment only data until June 2006, but the modelled flux show that the inflow was relatively high also during the rest of 2006.

There is a significant increasing trend in the observed volume flux from 1997 to present, and the calculated trend indicates that the mean Atlantic flux increased by almost 50%. The measurements started in a period with generally low inflow, but the increase is still stronger than expected.

Current situation of ice conditions

During 2006 the sea ice extent was much less than the long-term mean (Figure 1.6), and in January, May-July and December, it was the lowest for corresponding seasons since 1951. In 2006, the greatest ice coverage was observed in March and amounted to 44%, which was 17% less than normal and the least – in August when there was no ice in the sea area. In the late September-October, with the prevalence of northerly and northeasterly winds and the decrease in air temperature the ice formation and shift southward became more actuated. In that period, the total ice extent increased to 10% (however, it remained being 7% lower than the long-term mean). In November-December, with the increase in the southern wind repeatability and high air temperature, the ice coverage again was at the level of significantly less than normal.

Expected situation

Prediction of Barents Sea temperature is complicated by the variation being governed by processes of both external and local origin operating on different time scales. The volume flux of Atlantic water masses flowing in from the Norwegian Sea is an important factor. It is influenced by the wind conditions in the western Barents Sea, which again is related to the Norwegian Sea wind field (Ingvaldsen *et al.* 2004). Also the temperature of these water masses as well as local heat exchange with the atmosphere, possibly linked to atmospheric teleconnections, is important in determining the temperature of the Barents Sea (Ådlandsvik and Loeng 1991, Loeng *et al*. 1992). Furthermore, also density differences in the ocean itself are of importance. Thus, both slowly moving advective propagation and rapid barotropic responses due to large-scale changes in air pressure must be considered.

According to a PINRO model, based on harmonic analysis of the Kola section temperature time series, the temperature of warm Atlantic water of Murman current in 2007 is expected to be higher than the mean long-term level, but most likely lower than 2006. The prognosis for the annual temperature in 2007 and 2008 is 4.6 and 4.5 ^{o}C, respectively.

Based on the expectations of still high temperature conditions the ice conditions in the Barents Sea in 2006 are expected to still be low.

1.3.2 Phytoplankton

Current situation

In 2006 low concentrations of phytoplankton was observed on the Fugløya-Bear Island in March, followed by a faint increase in diatoms close to Fugløya. In May, highest concentrations of chlorophyll on the Fugløya-Bear Island section were observed in the central parts of the section close to the coasts. Typical spring species of diatoms dominated in the central area. Close to Bear Island, the phytoplankton community was a mix of diatoms and *Phaeocystis pouchetti*, which is a common species in the Barents Sea during spring. In June, high concentrations of chlorophyll were observed on the stations close to Fugløya while lower concentrations were observed in the central part and also towards Bear Island. Diatoms (*Chaetocerus*) dominated in the area with high chlorophyll concentrations and this was most likely the last part of the spring bloom. Close to Bear Island *Phaeocystis* was the dominating phytoplankton species.

On the Vardø-north section there was a more even distribution of chlorophyll. On most stations a mix of phytoplankton species were observed in addition to microzooplankton.

During some years such as autumn 2005, large blooms of *Emiliana huxleyi* has been observed in the Barents Sea. This species was also observed in 2006 but in much lower concentrations than in 2005.

Simulations of the primary production in the Barents Sea using the ROMS numerical model showed that there was considerable interannual variation in timing of the spring bloom at the Fugløya-Bjørnøya section during the years 1982 to 2006. The model results showed that the peak of the bloom may vary with about one month from year to year and in 2006 the results indicates that the bloom was relatively early. Spatially the bloom was earliest at the western entrance of the Barents Sea. Also close to some of the bank areas, the bloom started early. Some of these banks are very shallow and water masses may be trapped there. The bank may therefore act as a barrier to downward transport of plankton cells in the same way as a stratification of the water masses.

Expected situation

With the present knowledge it is not possible to predict whether the onset of the spring boom or which algae's that will dominate the system. In addition to available nutrients the onset of the spring boom depend heavily on factors such as stratification and light. Stratification depends further on solar heating (again dependant on cloud cover) and wind mixing, while the light conditions depends on the cloud covers, which are factors that change on very short timescale. However, with expectations of still high temperatures it is perhaps most likely that there will not be any major changes in 2007 from the phytoplankton situation in 2006.

1.3.3 Zooplankton (Figure 1.8-1.10)

Current situation

Mesoplankton. The horizontal distribution of mesozooplankton, sampled during the ecosystem survey in August-September from bottom-0 m in 2006, are shown in Figure 1.8. The plankton distribution in 2006 is quite similar to 2005. The highest abundances of plankton were observed in the western part of the Barents Sea and in the central northern part of the region. In 2005, a low abundance region in the south was observed, extending northwards a significant distance from the Norwegian coast. Such a situation could not be observed in 2006. The southern and western distribution of high zooplankton biomass in 2006 is probably associated with influx of warmer Atlantic water penetrating north and east into the Bear Island trench, resulting in higher zooplankton concentrations here compared to 2005. Biomass estimates differed in geographic position and as well as on different depths.

From 2005 to 2006 there was observed an increase in average biomass from 7. 7 to 8.6 dry weight, g m^{-2}g (Figure 1.9). Preliminary analysis of zooplankton samples collected in autumn ecosystem survey showed predominance of *Calanus* of three species (*Calanus finmarchicus, Calanus glacialis and Calanus hyperboreus*) at older stages of development.

Macroplankton. The survey conducted in autumn and winter showed that the abundance of pre-spawning euphausiids by the beginning of 2006 was almost 1.5 times higher than the long-term mean in both southern and in the north-west area (Figure 1.10). It was observed an increase in the abundance of euphausiids in the central, coastal and northwestern areas of the sea, while in the eastern and western parts a slight decrease was observed.

As in previous years, the main concentrations of euphausiids were formed by Arcto-boreal species *T. inermis* and *T. raschii*; samples included euphausiids of the three age groups (0+, 1+ and 2+) being 8-40 mm long. The rest of species: *T. longicaudata*, *T. raschii*, *M. norvegica* and *N. megalops* made up a minor supplement.

Expected situation

Taking into consideration the hydrographic conditions and the long-term dynamics of feeding plankton development, in 2007, the spawning of main zooplankton organisms (copepods and euphausiids) from the southwestern areas of the Barents Sea is expected to start in the middle of April. Overwintering crustaceans, together with the warm water species transported from the Norwegian Sea, will form local zones with high density of plankton distribution in the northwestern and western sea areas, resulting in good food supply for the pelagic predators. In late May-June, after spawning, euphausiids will descend to the bottom layers where they will form the feeding grounds for adult cod.

It is expected that 2007 will be similar to 2006, concerning distribution and periods of forming fish feeding areas by plankton.

1.3.4 Fish (Tables 1.5 – 1.8, 1.10)

Current situation

The current situation of the commercial stocks in the Barents Sea addressed by the AFWG is given in later chapters. In this part the focus is therefore only on special conditions about fish species that deviates from the general situation, and is related to trophic relations and distribution aspects.

<u>NEA cod diet</u>

Food composition of cod in 1984-2006 is presented in table 1.5-1.6. According to joint cod stomach base data the main prey items for cod in 2006 were capelin, herring, haddock, cod and shrimp. In comparison with 2005 the importance of capelin increased, while the role of hyperiids and polar cod decreased.

The consumption calculations made by IMR show that the total consumption by age 1 and older cod in 2006 was about 4 million tonnes (Table 1.5), while similar calculations by PINRO (table 1.6) gave about 3 million tonnes. According to the calculation by PINRO (WD 2) the consumption per cod increased for the young age groups (1 – 4 year old) (Table 1.7 – 1.8). The consumption of capelin by cod increased from 2005 to 2006, while consumption of cod and haddock decreased (Table 1.5-1.6). However the consumption of haddock in 2006 was very high in comparison to the long-term mean. The consumption of cod by cod remained at a low level in 2006.

<u>Blue whiting diet and abundance</u>

The increased abundance of blue whiting in the Barents Sea in recent years may be due to increased temperature. Blue whiting has been observed in the western and southern Barents Sea for many years, but never in such quantities, and never as far east and north in this area as in 2004-2005. In autumn 2005, the acoustic abundance of blue whiting was estimated to 1.1 million tonnes, mainly age 1-5 fish. The blue whiting fed mainly on macroplankton species (Table 1.10), in particular *Themisto abyssorum* and Euphausiids. Blue whiting also fed on fish, with other blue whiting being the most important species of fish in the diet. Stomach data from the winter survey 2006 blue whiting stomachs showed that some of them contained capelin. During autumn 2006, a noticeable decrease in the amount of blue whiting was found. The decrease was primarily caused by a lack of 1-year-olds.

<u>Abundance of herring and capelin</u>

During the 2006 Joint Norwegian/Russian Ecosystem Survey the abundance of juvenile herring had decreased considerably compared to the previous two years, and was only one fourth of the stock size registered in 2005. The capelin abundance is still very low.

Expected situation

There is not any evidence that capelin stock will rebuild in 2007 after the collapse in 2003 (Section 9). However, according to the results of the 0-group investigations during autumn 2006, the 2006 year class of capelin may be very much stronger than the preceding ones, and if the survival to age 1 and further is normal, the stock size of capelin will increase considerable in the coming years because of this. The herring abundance in the Barents Sea has decreased considerably from 2004 and 2005, but will probably be at an intermediate level at least until spring 2007, since the 2004 year class is relatively strong. The situation is fairly similar to that in the mid-1990s, but the period with high abundance of herring may, however, be at least one year longer this time.

An increased amount of larger blue whiting in the Barents Sea may imply competition with other predators on capelin, especially cod. PINRO studies (Dolgov et al., WD11, AFWG 2002) show that blue whiting will not have a significant impact on the recruitment of cod and other commercial fishes (haddock and redfishes). Increased competition between blue whiting and juvenile commercial fishes grazing on zooplankton is possible. Concerning blue whiting as prey, we mainly know about the diet of cod. In this time series (Table 1.5) we can see that blue whiting appears at the end of the period (2001-2005). We may conclude that a 'new' prey species has become available for cod, and then mainly for larger individuals (ages 5 and older). Since blue whiting is nutritious prey, it may influence cod growth positively, at least in periods with low capelin abundance.

Recruitment seems to be strong for most fish species, so that, in addition to young herring, also haddock, blue whiting, polar cod and cod are abundant in the Barents Sea, although both the herring and the blue whiting stock have shown signs of poorer recruitment in recent years. It is thus likely that cod and other predators, except capelin specialists like guillemot, has alternative fish prey available, as in the mid-1990s. So far, the consequences of this capelin collapse have been modest, and this situation is likely to continue. Another interesting phenomenon is that the collapse of the capelin stock is less abrupt this time than in the two previous collapses, because the recruitment failure has not been so drastic. We also note that recruitment of 0-group capelin has been around or above average in 2002-2004, while the survival from 0-group to age 1 seems to be poor. Whether this is due to predation by herring on 0-group capelin after the survey on 0-group capelin in August-September, is unknown.

1.3.5 Marine mammals (Figures 1.14–1.15)

Current situation of distribution and abundance

During the ecosystem survey in the Barents Sea in 2006, 455 observations of 1,766 marine mammal individuals comprising 18 identified species were recorded. Additionally, 900 observations of marine mammals were obtained during the summer 2007. The lower number of observations in 2006, compared to previous years, is because no aerial survey was conducted.

The most abundant cetacean in terms of individuals was the_white-beaked dolphin, which was observed over large parts of the Barents Sea (Figure 1.14). The white beaked dolphins prey on pelagic fish such as capelin and herring, and hence their wide distributions are determined by the wide distributions of pelagic fish species in the Barents Sea.

Among of the baleen whales, minke, fin and humpback whales were most numerous. Minke whales were observed in most parts of the Barents Sea. A large feeding aggregation of more than 200 individuals was observed on the Kanin Bank and Murmansk Shallows, as well as an aggregation of unknown number of Novaya Zemlya (Figure 1.15). These aggregations were probably associated with high abundance of herring and polar cod. The aggregations of minke whales in northern and western areas typically occurred were capelin and herring was available. Humpback whales were observed in aggregations in northwestern Barents Sea around the Bear Island and the Hopen trough. Their presence in this area seems mostly related to concentrations of capelin and possibly krill. Fin whales generally inhabit the deeper areas along the continental slopes, west of Spitsbergen and in the Storfjorden trough. However, both in 2005 and 2006 fin whales were also observed in the central and northern Barents Sea, thus expanding the general distribution area. Fin whales are associated with both pelagic fish and 0-group fish, but the causes of this range expansion remain unknown.

Northern bottlenose whales were, as in previous years, observed in the western Barents Sea along the continental slope. It was observed that whales from this aggregation followed fishing vessels and fed on fish from both trawls and long-lines during fishing operations. More observations of bottlenose whales were registered in 2006 than in previous years, and with the eastern occurrences of this species the geographic distribution of this species have expanded considerably. The causes of this expansion remain unknown.

The harbour porpoise is a coastal fish-eating species. In 2006, larger feeding aggregations in southern Barents Sea were recorded, and some of these aggregations were in open water north of the coastal regions.

Harp seals were observed north of Spitsbergen in autumn, which are their expected main distributional area at this time of the year. However, the number of harp seals recorded this year was much less than last year, when very large groups were observed along the ice edge. In 2006, there were no airborne surveys at the breeding grounds in the White Sea to estimate harp seal pup production. However, based on airborne surveys in previous years and at sea surveys conducted in the White Sea in 2006 the number of pups was estimated to 110 thousand pups (SE=19 thousand), which is 10% less than the estimated pup numbers in 2005. These numbers indicate that a reduction in pup production on the whelping grounds, which started in 2004, is continuing, although at a lower rate.

The distributions of marine mammals in summer/autumn in the Barents Sea are probably a consequence of both a warm ocean climate and low capelin abundance. At the present time the spatial associations between the marine mammals and potential prey species have not yet been properly quantified and assessed. Also, effects of varying observer effort and weather conditions needs to be taken into account before any firm conclusions regarding distributions can be drawn, as some baleen whale species are difficult to observe under windy conditions. Weather conditions may thus severely influence the observed distributions.

Predation by mammals

Analyses of consumptions by marine mammals in the Barents Sea for 2006 are not available.

1.3.6 Long-term trends (Figure 1.16)

According to ACIA (ACIA 2005, Arctic Climate Impact Assessment) the air temperature in the world is on expected to increase by 1-2 ^{o}C during the next 100 years. An important assumption for this prediction is a continuing increase in the CO2 outlet to the atmosphere at a rate giving a doubling of the CO2 level in 100 year compared with today's level. For the Arctic region the effect is assumed to be higher, with air temperatures increasing between 2-7 ^{o}C. This is mainly associated with the connected retreat of the ice cover. In the summer the ice cover may disappear, but the effect in the winter is not expected to be so drastic. However, ice habitat species may suffer dramatically under such circumstances. In the Barents Sea the water temperature is expected to increase by 1-2 ^{o}C throughout the water column. The recently released IPCC4 (Intergovernmental Panel on Climate Change, 4th assessment report, IPCC 2007) report indicates that the temperature increase will be both higher and more rapid than the ACIA report conclude, and the human-induced warming of the Arctic is expected to be about twice as large as the global average warming. Even if drastic cuts are made in the CO2 emission the temperature is still expected to increase for the next 20-30 years.

The recent warming period in the North Atlantic region (including the Barents Sea) opens for the question about regime shifts in the ecosystem. The question if the ecosystem has reached a different state, which may be irreversible, or is just at a maximum in a natural cycle, is hard to evaluate. However, a similar warming period took place in the 1930's. The whole ecosystem responds to long-term changes (e.g. temperature). This is illustrated in Figure 1.16, which shows a collection of time series from the Barents Sea ecosystem. Each time series have been normalised, and positive and negative anomalies coloured red and blue, respectively. From this figure it looks like several, but not all, factors responds within a few years to cycles in the system. More knowledge is needed before any conclusions on possible regime shifts can be drawn.

1.3.7 Main conclusions

Climate

- The air temperature was above the long-term mean during 2006. Especially it was high in the eastern parts during winter. Record high yearly average was recorded at Bear Island and Spitsbergen weather stations.
- The sea temperature in the whole Barents Sea was the warmest ever observed in 2006. The temperature in the Atlantic water masses was between +0.8-1.7 ^{o}C above the long-term mean throughout the water column through the year. The Coastal water masses showed the same pattern as the Atlantic waters, with anomalies between +0.7-1.5 ^{o}C above the long-term mean. At the beginning of 2007 the temperatures were still high.
- Inflow of Atlantic waters varied strongly during 2006. Highest inflow occurred in the beginning of the year, and was the highest observed (since 1997). The inflow decrease in the spring but was still above average (1997-2006).
- The temperature in 2007 is expected to remain high with some reduction at the end of the year.
- The ice coverage in 2006 was low. It was the first time the winter ice cover did not get south of 76^{o}N. Due to expected high temperatures ice conditions are expected to be low in 2007.

Phytoplankton

- Model results indicate that spring bloom in 2006 was early.
- The phytoplankton situation in 2007 is expected to be similar to 2006. However, this prediction is highly uncertain due to the dependence on the rapid changes in local water vertical stability.

Zooplankton

- The average zooplankton biomass in 2006 was higher than long-term mean. Abundance indices of krill in the beginning of 2006 were higher than the long-term mean.
- As in previous years *Calanus finmarchicus* was the dominant species in mesoplankton and *T. inermis* and *T. raschii* formed the main concentrations of krill
- The zooplankton production in 2007 is expected to be comparable to 2006, probably providing good feeding conditions for capelin, herring and demersal juvenile fish.

Fish

- Capelin was at a low level in 2006, and is expected to remain at a low level in 2007. However, the 2006 yearclass may be better than the previous ones, and increase the stock size from 2007 onwards.
- Young herring is presently at a high level. The 2004 year class which seems to be strong will remain in the Barents Sea also in 2007.
- An expected low capelin level may affect the growth of cod, although herring may partly replace capelin as an energy-rich prey for cod.
- Blue whiting is still abundant in the western areas in 2006, but is decreasing due to lower recruitment in the last couple of years.
- Blue whiting prey mainly on krill, amphipods and shrimps. Larger individuals prey also on fish, mainly polar cod and capelin. Blue whiting is not a common prey item, and are only found in small amounts in cod and Greenland halibut stomachs.

Mammals

- In 2006 the most abundant and widely distributed cetaceans were white-beaked dolphins, minke whales and humpback whales, while harbour porpoises were abundant along the coast.
- Deep-water species such as fin whales and northern bottlenose whales were observed more frequently in central and eastern Barents Sea in 2006 than in previous years.
- Both high temperatures and low capelin abundance are likely to have influenced the marine mammal distributions in 2006 in the Barents Sea. Although the most abundant marine mammals were observed associated with capelin, their distributions also overlapped with herring and polar cod, and likely with krill.
- The expert estimated number of harp seal pups on whelping grounds in the White Sea in 2006 indicates a continuing decrease in their pup production.

1.4 Impact of the fisheries on the ecosystem

1.4.1 General description of the fisheries and mixed fisheries (Tables 1.14-1.15, Figures 1.18-1.27)

The major demersal stocks in the Northeast Arctic include cod, haddock, saithe, and shrimp. In addition, redfish, Greenland halibut, wolffish, and flatfishes (*e.g.*, long rough dab, plaice) are common on the shelf and at the continental slope, with ling and tusk also found at the slope and in deeper waters. In 2005, catches slightly more than 1.0 million tonnes are reported from the stocks of cod, haddock, saithe, redfish, and Greenland halibut, which is an increase of about 10% compared to 2004. An additional catch of about 100 000 tonnes was taken from other demersal stocks, including crustaceans, not assessed at present. The annual fishing mortalities F (the mortality rate is linked to the proportion of the population being fished by $1-e^{-F}$) for the assessed demersal fish stocks shows large temporal variation within species and large differences across species from 0.1 (≈10% mortality) for some years for *Sebastes marinus* to above 1 (≈63% mortality) for some years for cod (Figure 1.18). The major pelagic stocks are capelin, herring, and polar cod. There was no fishery for capelin in the area in 2004 - 2006 due to a stock in poor condition, and there is no directed fishery for herring in the area. The highly migratory species blue whiting and mackerel extend their feeding migrations into this region, but there is no directed fishery for the species in the area. Species with relatively small landings include salmon, halibut, hake, pollack, whiting, Norway pout, anglerfish, lumpsucker, argentines, grenadiers, flatfishes, horse mackerel, dogfishes, skates, crustaceans, and molluscs.

The most widespread gear used in the central Barents Sea is bottom trawl, but also long line and gillnets for the demersal fisheries, and purse seine and pelagic trawl for the pelagic fisheries. Other gears more common along the coast include handline and Danish seine. Gears used in a relatively minor degree are float line (used in a small but directed fishery for haddock along the coast of Finnmark in Norway) and various pots and traps for fish and crabs. The variety of the gears varies with time, space and countries, with Norway having the largest variety caused by the coastal fishery. For Russia, the most common gear is trawl, but a longline fishery is present (mainly directed for cod and wolffish). The other countries mainly use trawl.

For most of the exploited stocks an agreed quota is decided (TAC). In addition to an agreed quota, a number of additional regulations are applied. The regulation differs among gears and species and may be different from country to country, and a non-exhaustive list is summarised in Table 1.14. A description of the major fisheries in the Barents Sea is summarised by species in Table 1.14.

The demersal fisheries are highly mixed, usually with a clear target species dominating, and with low linkage to the pelagic fisheries (Table 1.15). Although the degree of mixing may be high, the effect of the fisheries will vary among the species. More specifically, the coastal cod stock and the two redfish stocks are presently at very low levels. Therefore, the effect of the mixed fishery will be largest for these stocks. In order to rebuild these stocks, further restrictions in the regulations should be considered (*e.g.* closures, moratorium, restrictions in gears).

Successful management of an ecosystem includes being able to predict the effect on having a mixed fishery on the individual stocks and ICES is requested to provide advice which is consistent across stocks for mixed fisheries. Work on incorporating mixed fishery effects in ICES advice is ongoing and various approaches have been evaluated (ICES 2006/ACFM:14). At present such approaches are largely missing due to a need for improving methodology combined with lack of necessary data. However, technical interactions between the fisheries can be explored by the correlation in fishing mortalities among species. The correlation in fishing mortality is positive for Northeast Arctic cod and coastal cod ($p=0.004$), haddock and coastal cod ($p=0.059$) and Northeast Arctic cod and *Sebastes marinus* ($p=0.218$) confirming the linkage in these fisheries (Figure 1.19). There is also a significant relationship between Saithe and Greenland halibut ($p=0.021$) although the linkage in these fisheries is believed to be small (Table 1.15). The relationships between the other fishing mortalities are scattered and inconclusive. In case of strong dependencies in fishing mortalities this method can in principle be used to produce consistent advice across species concerning fishing mortality, but is considered too simple since the correlation this correlation is influenced by too many confounding factors whose effect cannot be removed without a detailed analyses on a higher resolution of the data (e.g. saithe and Greenland halibut, Figure 1.19) and on e.g. changes in distribution of the stocks (ICES 2006/ACFM:14).

A further quantification of the degree of mixing and impact among species requires detailed information about the target species and mix per catch/landing and gear. Such data exist for some fleets (*e.g.* the trawler fleet), but is incomplete for other fleets. In 2005 and 2006 the composition of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species caught by the Russian and Norwegian trawl fleet shows spatial differences in both catch compositions and catch sizes as well as large differences between the countries (Figures 1.20 -1.27). In the north eastern part of the Barents Sea the major part of the catches consists of cod. In the western part of the Barents Sea the composition of the Norwegian catches consists of other species while the Russian catches mainly consist of cod. The main reason for this difference is the difference in spatial resolution of the data; the strata for the Norwegian system extends more westerly and cover the fishing grounds for Greenland halibut, while the Russian strata do not. The Norwegian trawl fishery along the Norwegian coast includes areas closer to the coast and is also more southerly distributed where other species is more dominating the catches (e.g. saithe).

Estimates of unreported catches of cod and haddock in 2002 - 2005 indicate that this is a considerable problem (section 0.5). Discarding of cod, haddock and saithe is thought to be significant in periods although discarding of these, and a number of other species, is illegal in Norway and Russia. Data on discarding are scarce, but attempts to obtain a better quantification of this matter continue.

1.4.2 Impact of fisheries

In order to conclude on the total impact of trawling, an extensive mapping of fishing effort and bottom habitat would be necessary. However, its qualitative effects have been studied to some degree. The most serious effects of otter trawling have been demonstrated for hard-bottom habitats dominated by large sessile fauna, where erected organisms such as sponges, anthozoans and corals have been shown to decrease considerably in abundance in the pass of the ground gear. In sandy bottoms of high seas fishing grounds trawling disturbances have not produced large changes in the benthic assemblages, as these habitats may be resistant to trawling due to natural disturbances and large natural variability. Studies on impacts of shrimp trawling on clay-silt bottoms have not demonstrated clear and consistent effects, but potential changes may be masked by the more pronounced temporal variability in these habitats (Løkkeborg, in press). The impacts of experimental trawling have been studied on a high seas fishing ground in the Barents Sea (Kutti *et al.*, 2005.) Trawling seems to affect the benthic assemblage mainly through resuspension of surface sediment and through relocation of shallow burrowing infaunal species to the surface of the seafloor.

Lost gears such as gillnets may continue to fish for a long time (ghostfishing). The catching efficiency of lost gillnets has been examined for some species and areas, but at present no estimate of the total effect is available. Other types of fishery-induced mortality include burst net, and mortality caused by contact with active fishing gear such as escape mortality. Some small-scale effects are demonstrated, but the population effect is not known.

The harbour porpoise is common in the Barents Sea region south of the polar front and is most abundant in coastal waters. The harbour porpoise is subject to by-catches in gillnet fisheries (Bjørge and Kovacs, in prep). In 2004 Norway initiated a monitoring program on by-catches of marine mammals in fisheries. Several bird scaring devices has been tested for long-lining, and a simple one, the bird-scaring line (Løkkeborg 2003), not only reduces significantly bird by-catch, but also increases fish catch, as bait loss is reduced. This way there is an economic incentive for the fishermen, and where bird by-catch is a problem, the bird scaring line is used without any forced regulation.

1.4.3 Main conclusions

1) The most widespread gear is trawl.

2) The fisheries for the demersal species are mixed fisheries currently with largest effect on coastal cod and redfish due to stocks in a poor condition.

3) The fisheries for the pelagic species are less mixed with low linkage to the demersal fisheries (reported by-catch of young pelagic stages of demersal species in some fisheries).

4) A significant quantity of unreported catches is documented for cod and haddock.

5) The total effect of trawling has largest effect on hard bottom habitats, the demonstrated effects on other habitats are not clear and consistent.

6) Fishery induced mortality (lost gillnets, contact with active fishing gears, etc.) on fish is a potential problem but not quantified at present.

1.5 Ecosystem information with potential for implementation in fisheries management in the Barents Sea (Tables 1.16-1.21, Figures 1.28-1.30)

1.5.1 Overview

The main method for including ecosystem information into fisheries management decisions is through mathematic modelling including both fish parameters and other environmental parameters. There are several examples of application of regression models, with prognostic possibility, of the change in population parameters and distribution of commercial species in the Barents Sea under the influence of variation environmental factors. Development of complex models designed to improve fisheries management in the Barents Sea based on species interactions stated in the mid 1980s. At the first stage, the work was focused on models that included maximum number of species interacting through to their trophic relations. This approach was used in IMR to develop such models as MULTSPEC, AGGMULT and SYSTMOD (Tjelmeland and Bogstad, 1998; Hamre and Hatlebakk, 1998). In PINRO this approach was employed for development of the MSVPA model (Korzhev and Dolgov, 1999). All these models can give quantitative characteristics of species interaction between cod and other species in the Barents Sea and can be useful to solve some theoretical problems of multispecies harvest management. However, the use of these models for practical tasks of fisheries management is limited by high level of uncertainty in calculations due to assumptions employed in the models and incomplete data, which are needed for the estimation of model parameters.

Therefore, since the second part of the 1990s some more simple, in structural sense, models have been prioritized. An overview of multispecies models for the Barents Sea currently in use is given below.

At present, predation by cod on cod, haddock and capelin is included in the assessment for those stocks. However, capelin is the only of these stocks for which predation by cod is modelled in the prediction. There is a need for also including predation by cod in short/medium term stock predictions of cod, haddock and herring. Also, harvest control rules and precautionary reference points should be studied in a multispecies context.

1.5.2 Multispecies models

EcoCod

This model has been developed since 2005 as the main task of the first stage of the joint PINRO-IMR Programme of Estimation of Maximum Long-Term Yield of North-East Arctic Cod taking into account the effect of ecosystem factors (Filin and Tjelmeland, 2005). This 10-year research programme was initiated following a request from the Russian-Norwegian Fishery Commission. EcoCod is a stepwise extension of a single species model for cod (CodSim; Kovalev and Bogstad, 2005), where cod growth, maturation, cannibalism and recruitment is modeled, to a multispecies model. Preliminary sub-models for cod growth, fecundity and malformation of eggs have been implemented in EcoCod. EcoCod also contains a biomass-based cod-capelin-plankton sub-model. Recruitment scenarios from the herring assessment model SeaStar (Røttingen and Tjelmeland, 2003; Tjelmeland and Lindstrøm, 2005) will be used in the modeling of recruitment in the capelin sub-model.

Bifrost

The Bifrost (Boreal integrated fish resource optimization and simulation tool) is a multispecies model for the Barents Sea (Tjelmeland and Lindstrøm, 2005) with main emphasis on the cod-capelin dynamics. The prey items for cod are cod, capelin and other food. The predation model is estimated by comparing simulated consumption to consumption calculated from individual stomach content data using the dos Santos evacuation rate model with a parameterization where the initial meal size is excluded. The capelin partly shields the cod juveniles from cannibalism, and by including this effect the recruitment relation for cod is significantly improved.

In prognostic mode Bifrost is coupled to the assessment model for herring – SeaStar (Tjelmeland and Lindstrøm, 2005) – and the negative effect of herring juveniles on capelin recruitment is modeled through the recruitment function for capelin. Bifrost is also used to evaluate cod-capelin-herring multispecies harvesting control rules.

STOCOBAR

The STOCOBAR (STOck of Cod in the BARents Sea) is a model that describes stock dynamics of cod in the Barents Sea, taking into account trophic interactions and environmental influence (Filin, 2005). It can be used for predictions and historical analysis of the cod stock as well as for estimation of effectiveness of different harvest strategies.

The STOCOBAR model is spatially unstructured, and the time step can be set to either one year or half a year. The model includes cod as predator of seven prey species (capelin, shrimp, polar cod, herring, krill and juveniles of haddock and cod). All species except for shrimp and krill are divided in age groups. The recruitment function is use for cod only. Imitation of the influence of a complex of ecosystem factors on the year-to-year dynamics of cod population parameters are realized in the model by using stochastic ecosystem scenarios.

The first version of STOCOBAR was developed at PINRO in 2001. The current work on improvement of this model is continued. The last updated version of the model is presented in WD 13. The work on the development of the STOCOBAR model is part of the Barents Sea Case Study within the EU project UNCOVER (2006-2010) and the joint PINRO-IMR Program of Estimation of Maximum Long-Term Yield of North-East Arctic Cod taking into accounts the effect of ecosystem factors (2005-2007).

GADGET

A multi-species Gadget age-length structured model (www.hafro.is/gadget ; Begley and Howell, 2004, developed during the EU project dst^2 (2000-2003)), is being used for modeling the interactions between cod, herring, capelin and minke whale in the Barents Sea as part of the EU projects BECAUSE (2004-2007) and UNCOVER (2006-2010). This is a multi-area, multi-species model, focusing on predation interactions within the Barents Sea. The predator species are minke whale and cod, with capelin, immature cod, and juvenile herring as prey species. Krill is included as an exogenous food for minke whales (Lindstrøm et al. in prep.). The cod model employed is based on the model presented at AFWG.

The modeling approach taken has many similarities to the MULTSPEC approach (Bogstad et al., 1997). Work is ongoing to enhance the modeling of recruitment processes during the EU project UNCOVER. An FLR routine has been written that can run Gadget models as FLR Operating Models. It is intended to explore this further during the UNCOVER project. This also gives the possibility of using Gadget as an operating model to test the performance of various assessment programs under a range of scenarios.

1.5.3 Statistical models

Recruitment of commercial fish

Predictions of the recruitment in fish stocks are essential for predicting harvesting of the fish stocks, both in a single-species and multi-species context. Traditionally prediction methods have been based on spawning stock biomass and survey indices of juvenile fish and have not included effects of climate variability. Multiple linear regression models can be used to incorporate both climate and parental fish stock parameters. Especially interesting are the cases where there exists a time lag between the predictor and response variables as this gives the opportunity to make a prediction (e.g. Bulgakova, 2005; Stiansen *et al*., 2005; Titov *et al*., 2005, Svendsen et al., submitted).

Maturation of cod

The decrease in capelin stock biomass potentially impacts the maturation dynamics of Northeast Arctic cod by delaying the onset of maturation and/or increasing the incidence of skipped spawning. The relationship between weight- and length-at age shows that for a given length, weight-at-length is positively correlated with proportion mature-at-length for the period 1985-2001 (Marshall *et al*., 2004).

Estimates of weight-at-length were multiplied by the Russian liver condition index at length (Yaragina and Marshall, 2000) to derive estimates of liver weights in grams for cod at a standard length (see Marshall et al. 2004 for details of the calculation). This analysis indicated that for the 1985-2001 period there is a consistently significant, positive relationship between liver weight and proportion mature.

Growth of fish

Large interannual variations in growth rate are observed for all commercial species in the Barents Sea. The most important causes are temperature change, density dependence and changes in prey availability. Variation in growth rate can contribute substantially to variability in stock biomass. This needs to be taken into account when setting fishing targets and reference points. Variation in growth and condition can have a large impact on reproductive output.

Cod. The Northeast arctic cod is characterized by significant year-to-year variations in the growth rate. In different years the mean weight of fish at the same age may differ 2-3 times. Regressions of weight at age of cod to temperature, capelin and the cod stock itself are used in EcoCod model. The full documentation of these regressions is found on the web site www.assessment.imr.no/request/index.html .

Capelin. By using the data from the winter macro-plankton survey conducted by PINRO the most statistically significant relationship between length/weight of capelin and euphausiid abundance indices was revealed for fish at age 2. The closest relationships between indices of euphausiid abundance and absolute/relative increments in length and weight of capelin were registered in fish at the fourth year of life (age 3+). For younger age groups no statistically significant correlation coefficients were revealed. However, all obtained regression equations have low determination coefficient.

By using the data from the autumn ecosystem survey on capelin growth in a given year is more closely correlated with the estimate of zooplankton abundance in the previous autumn than with that in the present autumn (Gjøsæter et al., 2002). Growth of the youngest capelin is well correlated with abundance of the smallest zooplankton, whereas growth of older capelin is more closely correlated with abundance of the larger zooplankton. Mean growth in length during the last growth season shows positive relationships with total zooplankton density for all age-classes. The correlation coefficients are generally low, but they are statistically significant for one-, two- and four-year-olds. Three-year-old capelin growth rates during the last season do not correlate well with estimated total zooplankton density. One-year-old length, weight and growth were all significantly correlated with zooplankton density. Growth of one- and two-year-old capelin was negatively related with total capelin biomass.

1.5.4 Consumption models

When calculating the prey consumption by a given predator, both the overall consumption level and the prey composition in the diet are used. The prey composition is usually derived from stomach content data, while the overall consumption level can be calculated using two approaches:

1) A bioenergetic approach (as is usually the case for marine mammals and seabirds as predators)

2) By combining data on stomach content weight with models for stomach evacuation rate, based on experiments.

As shown in Johannesen *et al*, WD 20, AFWG 2006 different methods of type 2) for calculation of cod consumption give significantly different results, and thus further work is needed.

It is also important to compare results from these two approaches, as they supplement each other. For cod both methods have been applied (e.g. Ajiad 1996, Bogstad and Mehl, 1997), and the results were in good agreement with each other.

1.5.5 Expected impact of ecosystem factors on dynamics of stock parameters in the Barents Sea (Tables 1.16-1.21, Figures 1.28-1.30)

Prediction of NEA cod growth rate by STOCOBAR model

Table 1.16 presents the prognosis of cod growth parameters by cod for 2006-2009 from the STOCOBAR model, where 2005 was used as initial year. The model parameters were estimated from historical data (1984-2004). The input data is presented in the Table 1.17. Prognoses of the current and expected capelin stock were derived using data from the capelin assessment ("2007 report of joint Russian-Norwegian meeting to assess the Barents Sea capelin", Anon., 2007). The PINRO prognosis on annual temperature on Kola section for 2007 and 2008 was used in model runs. For the period 2007-2008 an average of the previous three years were used for the fishing mortality and recruitment of cod at age 1.

According to the prognosis it is not expected strong changes in cod growth during 2006-2008. There are expected to be around the long-term mean. Probably the negative consequences of shortcoming of capelin for cod growth for age 4-7 is compensated by high temperature that positively affect cod growth especially at age 1-3. The most pronounced increasing in cod individual weight in the beginning of 2007, in comparison with 2006, is expected for age 2 and 3. In the beginning 2008 and 2009 it is also expected an increasing individual weight of cod at age 4.

For the quantification of consequences of possible changing in temperature and capelin stock a modeling analysis was made of variations in cod growth rate under different temperature and capelin stock scenarios. Along with available prognosis of temperature and capelin for 2007 and 2008 3 alternative scenarios were chosen:

1) Temperature in 2007 and 2008 is kept at the level of 2006 (5.1^{o}C); development of capelin stock according to available prognosis,

2) Capelin stock in 2007 and 2008 is kept at the low level, which correspondents to the lower level in probabilistic prognosis of capelin stock size (352 and 888 thousand tones, respectively); temperature in 2007 and 2008 will be according to the available prognosis

3) Capelin stock will be recovered in 2007 and 2008 according to the higher level from the probabilistic prognosis of capelin stock dynamics (902 and 3274 thousand tones, respectively); temperature in 2007 and 2008 will be according to the available prognosis.

According to the results the strongest differences in cod growth, compared with the available prognosis (table 1.16), is from the scenario 1, and the smallest from the scenario 2 (Figure 1.28). The change in temperature has the close effect on all age groups, while change in capelin stock has different consequences for cod growth at different ages. The maximum variations in cod weight at the beginning of the year, compared with the available prognosis (table 1.16), will not be over 5 % for 2008 and 9% for 2009.

Prediction of NEA cod recruitment.

Several statistical models, which use multiple linear regressions, have been developed for North East Arctic cod.

Stiansen et al. (2005) developed a model for the period 1984-2005, with 2 year prediction possibility:

R3~ Temp(-3) + Age1(-2) + MatBio(-2)

Where R3 is the VPA age3 NEA cod (with cannibalism). Temp is the Kola yearly temperature (0-200m), Age1 is the winter survey bottom trawl index for cod age 1, and MatBio the maturing biomass of capelin. The number in parenthesis is the time lag in years. Two other similar models can be made by substituting the term Age1(-2) with Age2(-1) and Age 3(0), respectively (winter survey bottom trawl index for cod age 2 and age 3, respectively). The Age1 model is showed in Figure (1.29) and prognosis from all three models are shown in table 1.18.

Svendsen et al. (submitted) used a model based on numerical model data from the ROMS hydro-dynamical model. The model is for the period 1985-2006, with 3 year prognosis possibility:

R3~ Phyto(-3) + Inflow(-3)

Where R3 is the VPA age3 NEA cod (with cannibalism), Phyto is the modelled phythoplankton production in the whole Barents Sea and Inflow is the modelled inflow through the western entrance to the Barents Sea in the autumn. The number in parenthesis is the time lag in years.

The model is shown in Figure 1.30, and prognosis in table 1.18

Cannibalism mortality for cod

An alternative approach for prediction of NEA cod cannibalism based on the linear relationship between the natural mortality of cod at ages 3-5 and the biomass of cod spawning stock with minus 3-year lag was proposed by Kovalev (2004). Using this approach the predicted natural mortality coefficient for cod including cannibalism for resent years seems to be higher compared to “the standard” assessment and prediction (sec. 3.3.7).

Because the mechanism of the cod SSB influence on the level of own young natural mortality in 3-4 years is unclear the WG decided not to use this approach for prediction before it will be further tested.

Table 1.19 shows the proportion of cod in the cod diet, by predator age and year. This proportion increases by predator age.

Values for the years 2004 to 2007, predicted by the regression, are given in the table 1.20.

Expected stock parameters based on qualitative analysis of ecosystem impact factors

An alternative approach for looking at the future development of the commercial fish stocks is to give qualitatively assignments on different stock parameters from major impact factor. Then an overall effect on the specific stock can be given. The overall effect, together with the impact factors and the stock parameters are shown in Table 1.21.

1.5.6 Main conclusions

1) According to simulation of the STOCOBAR model, based on available prognosis of temperature and capelin stock development, it is not expected any strong changes in cod growth during 2007-2008.

2) Analysis by the STOCOBAR model shows that if the temperature continues at the current historically high level, then this will have a more significant impact on cod growth rates than variations in capelin stock.

3) According to multiple regressions, which include both stock and environmental parameters, the cod recruitment in 2007 is expected to be close to the long-term mean and above it in 2008-2009.

4) According to qualitative analysis of impact of different ecosystem factors the growth, maturation and cannibalism in cod stock are expected to be around the long term mean in the Barents Sea in 2007. For the capelin the growth, maturation and natural mortality are expected at to be well above the long-term mean.

Table 1.1. Abundance indices of 0-group fish in the Barents Sea and adjacent waters in 1965-2005. Indices for 1965-1985 adjusted according to Nakken and Raknes (1996).

Year	Capelin[1]	Cod[2]	Haddock[2]	Herring[3]	Polar cod		Redfish	Greenland halibut	Long rough dab
					West	East			
1965	37	11	13	-	0		159	-	66
1966	119	2	2	-	129		236	-	97
1967	89	62	76	-	165		44	-	73
1968	99	45	14	-	60		21	-	17
1969	109	211	186	-	208		295	-	26
1970	51	1097	208	-	197		247	1	12
1971	151	356	166	-	181		172	1	81
1972	275	225	74	-	140		177	8	65
1973	125	1101	87	-	26		385	3	67
1974	359	82	237	-	227		468	13	93
1975	320	453	224	-	75		315	21	113
1976	281	57	148	-	131		447	16	96
1977	194	279	187	-	157	70	472	9	72
1978	40	192	110	-	107	144	460	35	76
1979	660	129	95	-	23	302	980	22	69
1980	502	61	68	-	79	247	651	12	108
1981	570	65	30	-	149	93	861	38	95
1982	393	136	107	-	14	50	694	17	150
1983	589	459	219	-	48	39	851	16	80
1984	320	559	293	-	115	16	732	40	70
1985	110	742	156	-	60	334	795	36	86
1986	125	434	160	-	111	366	702	55	755
1987	55	102	72	-	17	155	631	41	174
1988	187	133	86	-	144	120	949	8	72
1989	1330	202	112	-	206	41	698	5	92
1990	324	465	227	-	144	48	670	2	35
1991	241	766	472	-	90	239	200	1	28
1992	26	1159	313	-	195	118	150	3	32
1993	43	910	240	188	171	156	162	11	55
1994	58	899	282	120	50	448	414	20	272
1995	43	1069	148	73	6	0	220	15	66
1996	291	1142	196	378	59	484	19	5	10
1997	522	1077	150	390	129	453	50	13	42
1998	428	576	593	524	144	457	78	11	28
1999	722	194	184	242	116	696	27	13	66
2000	303	870	417	213	76	387	195	28	81
2001	221	212	394	77	110	146	11	32	86
2002	327	1055	412	315	179	588	28	34	173
2003	630	694	705	277	164	337	57	9	58
2004	288	983	977	639	62	355	98	29	35
2005	348	972	1103	205	154	273	247	8	89
1985-2005	315	698	352		114	266	305	18	111
1965-2005	290	494	243				368	18	94

[1] Assessment for 1965-1978 in Anon. 1980 and for 1979-1993 in Ushakov and Shamray 1995

[2] Indices for 1965-1985 for cod and haddock adjusted according to Nakken and Raknes (1996)

[3] Calculated by Prozorkevich (2001)

Table 1.2. 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 1965-2004. Not calculated for 2005-2006.

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
2001	0.13	0.04	0.25	0.23	0.12	0.36	0.67	0.52	0.84
2002	0.53	0.36	0.73	1.22	0.97	1.50	0.99	0.75	1.25
2003	0.51	0.36	0.68	0.85	0.63	1.10	0.85	0.61	1.12
2004	1.20	0.92	1.51	1.92	1.67	2.19	1.44	1.19	1.71

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

Table 1.3 . New abundance indices (in millions) with 95% confidence limits, without correction for catching efficiency. Note that all values have been revised since last year.

Year	Capelin			Cod			Haddock			Herring			Redfish		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	197278	131674	262883	72	38	105	59	38	81	4	1	8	277873	0	701273
1981	123870	71852	175888	48	33	64	15	7	22	3	0	8	153279	0	363283
1982	168128	35275	300982	651	466	835	649	486	812	202	0	506	106140	63753	148528
1983	100042	56325	143759	3924	1749	6099	1356	904	1809	40557	19526	61589	172392	33352	311432
1984	68051	43308	92794	5284	2889	7679	1295	937	1653	6313	1930	10697	83182	36137	130227
1985	21267	1638	40896	15484	7603	23365	695	397	992	7237	646	13827	412777	40510	785044
1986	11409	98	22721	2054	1509	2599	592	367	817	7	0	15	91621	0	184194
1987	1209	435	1983	167	86	249	126	76	176	2	0	5	23747	12740	34755
1988	19624	3821	35427	507	296	718	387	157	618	8686	3325	14048	107027	23378	190675
1989	251485	201110	301861	717	404	1030	173	117	228	4196	1396	6996	16092	7589	24595
1990	36475	24372	48578	6612	3573	9651	1148	847	1450	9508	0	23943	94790	52658	136922
1991	57390	24772	90007	10874	7860	13888	3857	2907	4807	81175	43230	119121	41499	0	83751
1992	970	105	1835	44583	24730	64437	1617	1150	2083	37183	21675	52690	13782	0	36494
1993	330	125	534	38015	15944	60086	1502	911	2092	61508	2885	120131	5458	0	13543
1994	5386	0	10915	21677	11980	31375	1695	825	2566	14884	0	31270	52258	0	121547
1995	862	0	1812	74930	38459	111401	472	269	675	1308	434	2182	11816	3386	20246
1996	44268	22447	66089	66047	42607	89488	1049	782	1316	57169	28040	86299	28	8	47
1997	54802	22682	86922	67061	49487	84634	600	420	780	45808	21160	70455	132	0	272
1998	33841	21406	46277	7050	4209	9890	5964	3800	8128	79492	44207	114778	755	23	1487
1999	85306	45266	125346	1289	135	2442	1137	368	1906	15931	1632	30229	46	14	79
2000	39813	1069	78556	26177	14287	38068	2907	1851	3962	49614	3246	95982	7530	0	16826
2001	33646	0	85901	908	152	1663	1706	1113	2299	844	177	1511	6	1	10
2002	19426	10648	28205	19157	11015	27300	1843	1276	2410	23354	12144	34564	130	20	241
2003	94902	41128	148676	17304	10225	24383	7910	3757	12063	28579	15504	41653	216	0	495
2004	16701	2541	30862	19157	13987	24328	19144	12649	25638	133350	94873	171826	849	0	1766
2005	41808	12316	71300	21532	14732	28331	33283	24377	42190	26332	1132	51532	12332	631	24034
2006	166400	102749	230050	7860	3658	12061	11421	7553	15289	66819	22759	110880	20864	10057	31671

Table 1.3. (cont.). New abundance indices (in millions) for 0-group fish with 95% confidence limits, without correction for catching efficiency. Note that all values have been revised since last year.

Year	Saithe			Greenland halibut			Long rough dab			Polar cod (east)			Polar cod (west)		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	3	0	6	111	35	187	1273	883	1664	28958	9784	48132	9650	0	20622
1981	0	0	0	74	46	101	556	300	813	595	226	963	5150	1956	8345
1982	143	0	371	39	11	68	1013	698	1328	1435	144	2725	1187	0	3298
1983	239	83	394	41	22	59	420	264	577	1246	0	2501	9693	0	20851
1984	1339	407	2271	31	18	45	60	43	77	127	0	303	3182	737	5628
1985	12	1	23	48	29	67	265	110	420	19220	4989	33451	809	0	1628
1986	1	0	2	112	60	164	6846	4941	8752	12938	2355	23521	2130	180	4081
1987	1	0	1	35	23	47	804	411	1197	7694	0	17552	74	31	117
1988	17	4	30	8	3	13	205	113	297	383	9	757	4634	0	9889
1989	1	0	3	1	0	3	180	100	260	199	0	423	18056	2182	33931
1990	11	2	20	1	0	2	55	26	84	399	129	669	31939	0	70847
1991	4	2	6	1	0	2	90	49	131	88292	39856	136727	38709	0	110568
1992	159	86	233	9	0	17	121	25	218	7539	0	15873	9978	1591	18365
1993	366	0	913	4	2	7	56	25	87	41207	0	96068	8254	1359	15148
1994	2	0	5	39	0	93	1696	1083	2309	267997	151917	384078	5454	0	12032
1995	148	68	229	15	5	24	229	39	419	1	0	2	25	1	49
1996	131	57	204	6	3	9	41	2	79	70134	43196	97072	4902	0	12235
1997	78	37	120	5	3	7	97	44	150	33580	18788	48371	7593	623	14563
1998	86	39	133	8	3	12	27	13	42	11223	6849	15597	10311	0	23358
1999	136	68	204	14	8	21	105	1	210	129980	82936	177023	2848	407	5288
2000	206	111	301	43	17	69	233	120	346	116121	67589	164652	22740	14924	30556
2001	20	0	46	51	20	83	162	78	246	3697	658	6736	13490	0	28796
2002	553	108	998	51	0	112	731	342	1121	96954	57530	136378	27753	4184	51322
2003	65	0	146	13	0	34	78	45	110	11211	6100	16323	1627	0	3643
2004	1395	860	1930	70	28	113	36	20	52	37156	19040	55271	367	125	610
2005	55	36	73	9	4	14	200	109	292	6540	3196	9884	3216	1269	5162
2006	142	60	224	11	1	20	710	437	983	26016	9996	42036	2078	464	3693

Table 1.4 New abundance indices (in millions) for 0-group fish with 95% confidence limits, corrected for catching efficiency. Note that all values have been revised since last year.

Year	Capelin			Cod			Haddock			Herring		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	740289	495187	985391	276	131	421	265	169	361	77	12	142
1981	477260	273493	681026	289	201	377	75	34	117	37	0	86
1982	599596	145299	1053893	3480	2540	4421	2927	2200	3655	2519	0	5992
1983	340200	191122	489278	19299	9538	29061	6217	3978	8456	195446	69415	321477
1984	275233	161408	389057	24326	14489	34164	5512	3981	7043	27354	3425	51284
1985	63771	5893	121648	66630	32914	100346	2457	1520	3393	20081	3933	36228
1986	41814	642	82986	10509	7719	13299	2579	1621	3537	93	27	160
1987	4032	1458	6607	1035	504	1565	708	432	984	49	0	111
1988	65127	12101	118153	2570	1519	3622	1661	630	2693	60782	20877	100687
1989	862394	690983	1033806	2775	1624	3925	650	448	852	17956	8252	27661
1990	115636	77306	153966	23593	13426	33759	3122	2318	3926	15172	0	36389
1991	169455	74078	264832	40631	29843	51419	13713	10530	16897	267644	107990	427299
1992	2337	250	4423	166276	92113	240438	4739	3217	6262	83909	48399	119419
1993	952	289	1616	133046	58312	207779	3785	2335	5236	291468	1429	581506
1994	13898	70	27725	70761	39933	101589	4470	2354	6586	103891	0	212765
1995	2869	0	6032	233885	114258	353512	1203	686	1720	11018	4409	17627
1996	136674	69801	203546	280916	188630	373203	2632	1999	3265	549608	256160	843055
1997	189372	80734	298011	294607	218967	370247	1983	1391	2575	463243	176669	749817
1998	113390	70516	156263	24951	15827	34076	14116	9524	18707	476065	277542	674589
1999	287760	143243	432278	4150	944	7355	2740	1018	4463	35932	13017	58848
2000	140837	6551	275123	108093	58416	157770	10906	6837	14975	469626	22507	916746
2001	90181	0	217345	4150	798	7502	4649	3189	6109	10008	2021	17996
2002	67130	36971	97288	76146	42253	110040	4381	2998	5764	151514	58954	244073
2003	340877	146178	535575	81977	47715	116240	30792	15352	46232	177676	52699	302653
2004	53950	11999	95900	65969	47743	84195	39303	26359	52246	773891	544964	1002819
2005	148466	51669	245263	72137	50662	93611	91606	67869	115343	125927	20407	231447
2006	515770	325776	705764	25061	11469	38653	28505	18754	38256	294649	102788	486511

Table 1.4 (cont.). New abundance indices (in millions) for 0-group fish with 95% confidence limits, corrected for catching efficiency. Note that all values have been revised since last year.

Year	Saithe			Polar cod (east)			Polar cod (west)		
	Abundance index	Confidence limit		Abundance index	Confidence limit		Abundance index	Confidence limit	
1980	21	0	47	203226	69898	336554	82871	0	176632
1981	0	0	0	4882	1842	7922	46155	17810	74500
1982	296	0	699	1443	154	2731	10565	0	29314
1983	562	211	912	1246	0	2501	87272	0	190005
1984	2577	725	4430	871	0	2118	26316	6097	46534
1985	30	7	53	143257	39633	246881	6670	0	13613
1986	4	0	9	102869	16336	189403	18644	125	37164
1987	4	0	10	64171	0	144389	631	265	996
1988	32	11	52	2588	59	5117	41133	0	89068
1989	10	0	23	1391	0	2934	164058	15439	312678
1990	29	4	55	2862	879	4846	246819	0	545410
1991	9	4	14	823828	366924	1280732	281434	0	799822
1992	326	156	495	49757	0	104634	80747	12984	148509
1993	1033	0	2512	297397	0	690030	70019	12321	127716
1994	7	1	12	2139223	1230225	3048220	49237	0	109432
1995	415	196	634	6	0	14	195	0	390
1996	430	180	679	588020	368361	807678	46671	0	116324
1997	341	162	521	297828	164107	431550	62084	6037	118131
1998	182	91	272	96874	59118	134630	95609	0	220926
1999	275	139	411	1154149	728616	1579682	24015	3768	44262
2000	851	446	1256	916625	530966	1302284	190661	133249	248072
2001	47	0	106	29087	5648	52526	119023	0	252146
2002	2112	134	4090	829216	496352	1162079	215572	36403	394741
2003	286	0	631	82315	42707	121923	12998	0	30565
2004	4779	2810	6749	290686	147492	433879	2892	989	4796
2005	176	115	237	44663	22890	66436	25970	9987	41953
2006	280	116	443	182713	73645	291781	15965	3414	28517

Table 1.5. The North-east arctic cod stock's consumption of various prey species in 1984-2006 (1000 tonnes), based on Norwegian consumption calculations.

Year	Other	Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Blue whiting	Total
1984	506	27	112	436	722	78	15	22	50	364	0	0	2332
1985	1157	169	57	155	1619	183	3	32	47	225	0	1	3649
1986	665	1223	108	142	835	133	141	83	110	313	0	0	3754
1987	680	1084	67	191	229	32	205	25	4	324	1	0	2843
1988	407	1236	317	129	339	8	92	9	3	223	0	4	2767
1989	722	799	241	131	571	3	32	8	10	228	0	0	2746
1990	1448	137	83	194	1601	7	6	19	15	243	0	87	3842
1991	1075	65	75	188	2888	8	12	26	20	311	7	10	4685
1992	1015	102	158	373	2455	331	97	55	106	188	20	2	4901
1993	782	253	715	315	3031	163	278	285	71	100	2	2	5997
1994	669	563	704	518	1085	147	582	225	49	79	0	1	4622
1995	853	981	515	362	629	115	254	393	116	193	1	0	4411
1996	639	631	1157	340	538	47	104	536	69	96	0	10	4167
1997	429	379	516	310	903	5	113	340	41	36	0	55	3127
1998	429	363	456	325	714	87	151	155	32	9	0	13	2733
1999	390	146	274	252	1735	129	222	62	26	16	1	31	3286
2000	407	167	466	451	1728	53	194	76	51	8	0	38	3640
2001	719	171	368	277	1730	71	251	66	49	6	1	151	3859
2002	377	96	262	230	1926	85	272	108	124	1	0	227	3708
2003	598	279	514	237	2137	209	270	114	168	3	0	75	4602
2004	638	705	405	259	1375	96	443	99	127	2	13	98	4259
2005	685	356	441	241	1134	177	331	113	325	2	3	109	3917
2006	707	143	769	239	1298	185	88	67	301	9	1	107	3914

Table 1.6. The North-east arctic COD stock's consumption of various prey species in 1984-2006 (1000 tonnes), based on Russian consumption calculations.

Year	Euphausiids	Hyperiids	Shrimp	Herring	Capelin	Polar cod	Cod	Haddock	Blue whiting	Norway pout	Redfish	Long rough dab	Greenland halibut	Other fish	Other food	Total consumption
1984	92.9	31.1	351.1	33.3	591.9	17.1	13.2	49.7	4.7	1.2	194.9	51.5	0.0	269.3	285.5	1987.3
1985	30.0	431.8	202.1	24.4	989.5	0.0	97.8	34.3	17.7	14.9	97.2	22.8	0.0	518.8	198.0	2679.3
1986	54.6	832.9	141.4	45.6	785.5	154.3	27.7	102.6	3.5	26.5	155.2	24.0	0.7	362.3	163.2	2880.0
1987	69.5	510.9	202.4	7.5	162.8	105.8	26.9	1.9	10.3	14.7	118.9	5.7	0.4	270.3	189.6	1697.6
1988	211.2	170.2	118.9	18.6	294.7	0.0	19.9	93.6	0.0	0.0	128.2	20.2	0.0	241.0	244.1	1560.6
1989	168.5	293.4	104.9	3.8	686.9	34.1	34.5	2.1	0.0	0.0	159.3	56.7	0.0	203.7	250.7	1998.6
1990	101.9	29.9	273.4	65.1	1268.5	7.6	21.7	16.6	39.6	14.8	234.8	79.5	0.0	102.3	168.4	2423.9
1991	54.9	84.4	289.6	28.4	3324.5	44.1	52.7	22.6	6.7	6.1	145.3	46.1	5.5	134.0	159.3	4404.3
1992	215.5	38.3	266.1	379.2	2043.1	192.3	84.8	38.1	0.0	77.6	122.2	44.0	0.8	297.7	422.8	4222.6
1993	188.1	176.5	223.3	178.6	2802.1	171.9	147.4	154.4	3.9	25.6	41.2	48.0	4.9	160.8	380.9	4707.8
1994	355.2	290.5	450.2	102.8	1281.9	468.0	367.7	70.0	1.2	1.3	56.1	40.2	0.1	95.2	344.1	3924.4
1995	377.8	436.9	523.5	188.3	663.0	183.9	528.3	126.3	0.3	0.6	111.4	52.3	2.5	146.5	343.2	3684.7
1996	942.8	349.8	191.5	75.2	460.0	73.1	440.9	58.0	8.3	35.7	70.4	46.7	0.1	459.2	164.6	3376.5
1997	386.4	84.9	206.5	49.4	497.5	109.6	408.9	33.6	2.9	0.1	36.6	33.2	1.7	96.1	399.4	2346.7
1998	598.6	186.8	244.4	66.0	798.6	121.8	126.8	21.7	23.3	18.2	15.2	18.5	0.0	50.2	213.8	2503.8
1999	454.0	75.2	239.7	73.8	1401.8	162.6	47.9	14.3	25.0	0.8	13.1	8.5	0.5	58.1	107.4	2682.8
2000	394.4	110.4	361.9	48.2	1652.6	156.0	56.4	28.3	26.1	8.1	4.2	20.1	0.1	35.1	179.5	3081.3
2001	366.0	71.0	296.2	87.4	1423.0	140.5	58.8	48.6	137.1	28.1	4.0	30.7	2.2	142.8	181.0	3017.5
2002	303.6	42.6	185.3	49.2	2218.4	278.3	92.0	75.9	102.6	3.5	3.5	16.4	0.0	40.8	165.1	3577.3
2003	214.8	137.5	196.6	137.2	1107.2	201.1	128.5	300.8	26.6	5.0	1.6	38.7	0.0	85.3	261.9	2842.7
2004	270.8	312.5	198.5	103.2	890.3	296.7	74.8	141.5	42.9	17.6	6.5	54.6	14.7	148.6	223.6	2797.0
2005	407.7	102.3	173.5	134.9	741.4	249.5	103.6	220.2	53.0	33.6	6.2	40.4	2.3	131.0	159.2	2558.6
2006	663,7	40,8	151,0	168,7	848,2	77,8	65,8	187,9	69,9	60,4	11,0	69,6	0,3	64,9	237,5	2717,3
Mean	301,0	210,5	243,1	90,0	1171,0	141,1	131,6	80,1	26,3	17,2	75,5	37,8	1,6	178,9	236,6	2942,3

Table 1.7 Consumption per cod by cod age group (kg/year), based on Norwegian consumption calculations.

Year/Age	1	2	3	4	5	6	7	8	9	10	11+
1984	0,247	0,814	1,686	2,527	3,953	5,213	8,037	8,554	9,213	9,947	10,019
1985	0,304	0,761	1,833	3,111	4,678	7,364	11,305	12,033	12,562	13,822	13,936
1986	0,161	0,489	1,349	3,168	5,628	6,834	11,062	11,978	12,787	13,553	13,785
1987	0,219	0,601	1,275	2,055	3,538	5,466	7,044	8,112	8,923	9,344	9,296
1988	0,164	0,703	1,149	2,149	3,745	5,880	10,103	11,226	12,579	13,131	13,355
1989	0,223	0,716	1,611	2,720	3,987	5,621	7,706	8,527	9,630	10,231	10,678
1990	0,397	1,058	2,071	3,698	4,954	5,839	8,572	9,516	10,538	10,801	11,399
1991	0,293	0,974	2,185	3,564	5,346	7,111	9,531	10,303	11,364	12,417	12,059
1992	0,216	0,663	2,103	3,137	4,143	5,094	7,896	9,069	9,440	10,166	10,212
1993	0,112	0,528	1,547	3,046	4,811	6,289	9,423	11,286	11,813	12,303	11,959
1994	0,130	0,408	0,922	2,521	3,512	4,541	6,411	8,923	9,731	10,038	10,238
1995	0,103	0,296	0,921	1,821	3,363	5,271	7,735	10,458	12,411	12,816	13,265
1996	0,108	0,356	0,929	1,848	3,071	4,437	7,426	11,254	15,010	15,190	15,588
1997	0,138	0,310	0,937	1,769	2,694	3,537	5,242	8,223	12,756	13,667	13,269
1998	0,117	0,398	0,984	1,943	2,924	4,190	5,749	8,079	11,574	12,099	12,154
1999	0,163	0,505	1,093	2,718	3,720	5,446	6,970	9,189	11,031	12,036	12,137
2000	0,170	0,499	1,244	2,462	4,254	5,656	7,980	9,429	12,750	13,539	13,582
2001	0,171	0,456	1,309	2,440	3,685	5,304	7,554	11,328	13,731	14,444	14,771
2002	0,199	0,551	1,168	2,441	3,381	4,723	6,367	9,082	10,449	11,793	11,146
2003	0,207	0,653	1,313	2,391	4,002	5,968	8,453	10,449	13,002	13,622	14,567
2004	0,174	0,578	1,247	2,665	3,860	5,664	7,751	11,519	16,432	18,294	17,765
2005	0,188	0,653	1,377	2,594	3,924	5,599	7,201	9,864	13,560	14,518	15,328
2006	0,187	0,623	1,607	2,810	4,185	5,812	7,538	11,293	13,849	14,857	15,793

Table 1.8 Consumption per cod by cod age group (kg/year), based on Russian consumption calculations.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13+
1984	0.262	0.893	1.612	2.748	3.848	5.486	6.99	8.563	10.574	13.166	12.437	14.282	15.272
1985	0.295	0.752	1.656	2.683	4.264	6.601	8.242	9.743	10.975	14.447	16.499	16.061	17.343
1986	0.179	0.515	1.461	3.467	4.956	5.913	6.477	8.156	9.766	11.455	12.5	13.577	14.772
1987	0.145	0.431	0.844	1.561	3.078	4.346	7.279	9.683	12.703	14.482	15.014	15.115	16.377
1988	0.183	0.704	1.075	1.627	2.392	4.387	8.208	9.978	10.867	16.536	14.352	15.765	16.511
1989	0.282	0.91	1.468	2.207	3.244	4.799	6.581	8.725	11.134	15.799	15.95	17.909	17.643
1990	0.288	1.007	1.696	2.694	3.278	3.833	5.584	6.871	10.716	11.428	12.66	15.053	16.064
1991	0.241	0.936	2.67	4.473	6.038	7.846	9.59	11.542	14.97	19.294	17.509	20.109	22.109
1992	0.178	0.969	2.475	2.866	3.995	5.138	6.724	7.414	8.754	12.304	13.518	13.744	14.908
1993	0.133	0.476	1.512	2.865	3.944	5.108	7.372	8.945	10.343	11.6	14.067	14.893	15.922
1994	0.18	0.512	1.212	2.402	3.517	5.359	7.56	10.001	11.818	12.896	13.554	15.902	16.806
1995	0.194	0.497	0.962	1.819	3.204	4.847	7.332	9.688	13.835	15.247	16.960	18.230	19.202
1996	0.17	0.498	1.028	1.916	3.059	4.189	6.987	10.212	12.185	13.614	14.581	16.214	16.876
1997	0.119	0.341	0.992	1.908	2.668	3.503	4.954	7.98	12.174	21.523	20.666	21.822	24.237
1998	0.232	0.528	1.081	2.016	2.823	4.089	5.469	7.346	9.586	13.012	14.455	15.579	16.201
1999	0.261	0.431	1.128	2.49	3.676	5.222	6.398	8.22	9.194	13.364	15.325	16.918	17.567
2000	0.186	0.545	1.288	2.551	4.387	6.559	8.833	10.483	11.522	15.132	17.155	19.717	20.514
2001	0.15	0.413	1.163	2.110	3.43	5.571	6.835	10.233	12.457	15.130	17.374	19.322	20.559
2002	0.252	0.677	1.303	2.699	3.847	5.591	7.846	10.796	13.238	18.787	17.902	20.202	21.027
2003	0.233	0.633	1.326	2.075	3.629	4.836	6.865	9.138	13.743	14.809	19.948	19.660	20.466
2004	0.238	0.621	1.34	2.437	3.661	5.373	7.338	10.563	15.101	19.718	20.588	23.592	24.580
2005	0.243	0.644	1.458	2.365	3.699	5.018	6.768	8.960	12.737	17.596	19.746	20.387	21.151
2006	0.321	0.830	1.703	2.542	3.612	4.874	6.637	9.339	11.776	17.624	19.970	20.553	21.369

Table 1.9. Capelin stock history from 1973 and prognosis for capelin biomass in 2007. M output biomass is the estimated biomass of the capelin removed from the stock by natural mortality.

Year	Total stock number, billions (Oct. 1)	Total stock biomass in 1000 tonnes (Oct. 1)	Maturing biomass in 1000 tonnes (Oct. 1)	M output biomass (MOB) during year (1000 tonnes)
1973	961	5144	1350	5504
1974	1029	5733	907	4542
1975	921	7806	2916	4669
1976	696	6417	3200	5633
1977	681	4796	2676	4174
1978	561	4247	1402	3782
1979	464	4162	1227	5723
1980	654	6715	3913	5708
1981	660	3895	1551	5658
1982	735	3779	1591	3729
1983	754	4230	1329	3884
1984	393	2964	1208	3051
1985	109	860	285	1975
1986	14	120	65	681
1987	39	101	17	200
1988	50	428	200	80
1989	209	864	175	537
1990	894	5831	2617	415
1991	1016	7287	2248	3307
1992	678	5150	2228	7745
1993	75	796	330	4631
1994	28	200	94	982
1995	17	193	118	163
1996	96	503	248	261
1997	140	911	312	828
1998	263	2056	931	915
1999	285	2776	1718	2070
2000	595	4273	2099	2464
2001	364	3630	2019	3906
2002	201	2210	1290	2939
2003	104	533	280	3195
2004	82	628	293	812
2005	42	324	174	819
2006	88	787	437	748
2007*		2154	324	

*** Prognosis, includes the 2006 year class, which size is estimated from a regression on an 0-group index**

Table 1.10. Diet composition of main fish species in 2005, % by weight (Data from Dolgov, WD 28 and WD 29, AFWG 2006)

PREY SPECIES	PREDATORS SPECIES						
	Cod (3+)	haddock	Greenland halibut	Thorny skate	Long rough dab	Saithe	Blue whiting
Euphausiidae	5,2	21,7	0,4	0,8	0,1	24,4	44,4
Hyperiidae	4,1	0,2	3,8	0	0	0,3	18,2
Cephalopoda	0	0	2,1	0	0	0	0
Pandalus borealis	4,6	1,2	1,4	15,8	1,4	0,2	1,4
Echinodermata	0	24,1	0	0	4,7	0	0
Mollusca	0	7,9	0	0	3,6	0	0
Polychaeta	0	9,2	0	4,2	2,9	0	0
Cod	4,5	0,4	0,2	0	0,5	0,3	1,7
Herring	8,9	0,2	1,3	0,5	0,6	3,0	0
Capelin	11,6	2,1	8,7	30,8	17,5	54,9	0,9
Haddock	10,7	0,2	6,6	0,6	10,1	8,0	0
Polar cod	10,4	0	16,5	0	11,6	0,2	4,7
Blue whiting	4,8	0	2,6	0	0	0	0
Greenland halibut	0,2	0	1,4	0	0	0	0
Redfish	0,4	0	0,1	0	0	0	0
Long rough dab	1,8	0,1	4,8	2,9	0	0	0
Other fish	23,6	3,7	31,9	31,6	7,8	7,0	25,5
Other food	8,9	22,4	0,3	7,9	7,2	0	2,6
Fishery waste	0	4,1	17,7	4,9	31,4	0,9	0
Undetermined	0	2,4	0,2	1,4	0,7	0,5	0,3
Total number of stomachs	12209	7078	5223	432	2221	776	575
Percentage of empty stomachs	28,9	21,1	71,5	23,8	54,4	34,1	33,4
Average filling degree	1,7	1,6	0,7	1,9	1,1	1,6	1,7
Mean index of stomach fullness	213,8	110,5	84,4	182,7	139,0	116,3	111,2

Table 1.11. Annual consumption by minke whale and harp seal (thousand tonnes). The figures for minke whales are based on data from 1992-1995, while the figures for harp seals are based on data for 1990-1996.

PREY	MINKE WHALE CONSUMPTION	HARP SEAL CONSUMPTION (LOW CAPELIN STOCK)	HARP SEAL CONSUMPTION (HIGH CAPELIN STOCK)
Capelin	142	23	812
Herring	633	394	213
Cod	256	298	101
Haddock	128	47	[1]
Krill	602	550	605
Amphipods	0	304	313 [2]
Shrimp	0	[1]	[1]
Polar cod	[1]	880	608
Other fish	55	622	406
Other crustaceans	0	356	312
Total	1817	3491	3371

[1] the prey species is included in the relevant 'other' group for this predator.

[2] only Parathemisto

Table 1.12. Overview of the standard sections monitored by IMR and PINRO in the Barents Sea, with observed parameters. Parameters are: T-temperature, S-Salinity, N-nutrients, chla-chlorophyll, zoo-zooplankton.

SECTION	INSTITUTION	TIME PERIOD	OBSERVATION FREQUENCY	PARAMETERS
Fugløya-Bear Island	IMR	1977-present	6 times pr year	T,S,N,chla,zoo
North cape-Bear Island	PINRO	1950's-present	yearly	T,S
Bear Island-East	PINRO	1950's-present	yearly	T,S
Vardø-North	IMR	1977-present	4 times pr year	T,S,N,chla
Kola	PINRO	1921-present	monthly	T,S,O,N
Kanin	PINRO	1950's-present	yearly	T,S
Sem Islands	IMR	1970's-present	Intermittently*	T,S

*** The Sem Island section is not observed each year, and have not been observed the last 3-4 years.**

Table 1.13. Overview of conducted monitoring surveys by IMR and PINRO in the Barents Sea, with observed parameters and species. For zooplankton, mammals and benthos abundance and distribution for many species are investigated. Therefore, in the table it is only indicated whether sampling is conducted. Parameters are: T-temperature, S-Salinity, N-nutrients, chla-chlorophyll.

SURVEY	INSTITUTION	PERIOD	CLIMATE	PHYTO-PLANKTON	ZOO-PLANKTON	JUVENILE FISH	TARGET FISH STOCKS	MAMMALS	BENTHOS
Winter	Joint	Feb-Mar	T,S	N, chla	intermittent	All commercial species and some additional	Cod, Haddock	-	-
Lofoten	IMR	Mar-Apr	T,S	-	-		Cod, haddock, saithe	-	-
Ecosystem survey	Joint	Aug-Oct	T,S	N,chla	Yes	All commercial species and some additional	All commercial species and some additional	Yes	Yes
Norwegian coastal surveys	IMR	Oct-Nov	T,S	N,chla	Yes	Herring, sprat, demersal species	Saithe, coastal cod	-	-
Autumn-winter trawl-acoustic survey	PINRO	Oct-Des	T,S	-	Yes	Demersal species	Demersial species	-	-
Norwegian Greenland halibut survey	IMR	Aug	-	-	-	-	Greenland halibut, redfish	-	-

Table 1.14. Description of the fisheries by gears. The gears are abbreviated as: trawl roundfish (TR), trawl shrimp (TS), longline (LL), gillnet (GN), handline (HL), purse seine (PS), Danish seine (DS) and trawl pelagic (TP). The regulations are abbreviated as: Quota (Q), mesh size (MS), sorting grid (SG), minimum catching size (MCS), minimum landing size (MLS), maximum by-catch of undersized fish (MBU), maximum by-catch of non-target species (MBN), maximum as by-catch (MB), closure of areas (C), restrictions in season (RS), restrictions in area (RA), restriction in gear (RG), maximum by-catch per haul (MBH), as by-catch by maximum per boat at landing (MBL), number of effective fishing days (ED), number of vessels (EF), restriction in effort combined with quota and tonnage of the vessel (ER).

SPECIES	DIRECTED FISHERY BY GEAR	TYPE OF FISHERY	LANDINGS IN 2005 (TONNES)	AS BY-CATCH IN FLEET(S)	LOCATION	AGREEMENTS AND REGULATIONS
Capelin	PS, TP	seasonal	1[1]	TR, TS	Northern coastal areas to south of 74°N	bilateral agreement, Norway and Russia
Coastal cod	GN, LL, HL, DS	all year	30936	TS, PS, DS, TP	Norwegian coast line	Q, MS, MCS, MBU, MBN, C, RS, RA
Cod	TR, GN, LL, HL	all year	641276	TS, PS, TP, DS	North of 62°N, Barents Sea, Svalbard	Q, MS, SG, MCS, MBU, MBN, C, RS, RA
Wolffish[2]	LL	all year	21081[3]	TR, (GN), (HL)	North of 62°N, Barents Sea, Svalbard	Q, MB
Haddock	TR, GN, LL, HL	all year	154116	TS, PS, TP, DS	North of 62°N, Barents Sea, Svalbard	Q, MS, SG, MCS, MBU, MBN, C, RS, RA
Saithe	PS, TR, GN	seasonal	176129	TS, LL, HL, DS, TP	Coastal areas north of 62°N, southern Barents Sea	Q, MS, SG, MCS, MBU, MBN, C, RS, RA
Greenland halibut[4]	LL, GN	Seasonal	19248	TR	deep shelf and at the continental slope	Q, MS, RS, RG, MBH, MBL
Sebastes mentella	No directed fishery	all year	7511	TR	deep shelf and at the continental slope	C, SG, MB
Sebastes marinus	GN, LL,HL	all year	7557	TR	Norwegian coast	SG, MB MCS, MBU, C
Shrimp	TS	all year	43590[3]		Spitsbergen, Barents Sea, Coastal	ED, EF, SG, C, MCS

[1]On a research quota

[2]The directed fishery for wolffish is mainly Russian EEZ and in ICES area IIB, and the regulations are mainly restricted to this fishery

[3]The total catch in 2004

[4]The only directed fishery for Greenland halibut is by a limited Norwegian fleet, comprising vessels less than 28 m.

Table 1.15. Flexibility in coupling between the fisheries. Fleets and impact on the other species (H, high, M, medium, L, low and 0, nothing). The lower diagonal indicates what gears couples the species, and the strength of the coupling is given in the upper diagonal. The gears are abbreviated as: trawl roundfish (TR), trawl shrimp (TS), longline (LL), gillnet (GN), handline (HL), purse seine (PS), Danish seine (DS) and trawl pelagic (TP).

Species	Cod	Coastal cod	Haddock	Saithe	Wolffish	*S. mentella*	*S. marinus*	Greenland halibut	Capelin	Shrimp
Cod		H	H	H	M	M	M	M	L	M-H juvenile cod
Coastal cod	TR, PS, GN, LL, HL, DS		H	H	L	L	M-L	L	0-L	L
Haddock	TR, PS, GN, LL, HL, DS	TR, PS, GN,LL, HL, DS		H	M	M	M	L	0-L	M-H juvenile haddock
Saithe	TR, PS, GN, LL, HL, DS	TR, PS, GN,LL, HL, DS	TR, PS, GN, LL, HL, DS		L	L	M	0	0	0
Wolffish	TR, GN, LL, HL	TR,GN, LL, HL	TR, GN, LL, HL	TR, GN, LL, HL		M	M	M	0	M juvenile wolffish
S. mentella	TR	TR	TR	TR	TR		M	H	H juvenile Sebastes	H juvenile Sebastes
S. marinus	TR,GN, LL	TR,GN, LL	TR,GN, LL	TR,GN	TR, LL	TR		L	0	L-M juvenile Sebastes
Greenland halibut	TR, GN, LL,DS	TR,GN, LL	TR, GN, LL,DS	TR, GN, LL,DS	TR, LL	TR	TR		0	M-H juvenile
Capelin	TR, PS, TS, TP	PS, TP	TR, PS, TS, TP	PS	TP	TP	TP	None		L
Shrimp	TS	TS	TS	TS	TS	TS	TS	TS	TS	

Table 1.16 Prognoses of NEA cod growth rate for 2007 – 2009 by the STOCOBAR model.

Age	Weight in stock			Weight in catch			Length in stock		
	2007	2008	2009	2006	2007	2008	2007	2008	2009
2	0,08	0,10	0,09				24,3	24,0	23,8
3	0,32	0,35	0,32				34,2	34,8	34,5
4	0,59	0,70	0,75	1,12	1,12	1,23	51,5	43,9	44,4
5	1,24	1,20	1,35	1,72	1,67	1,63	60,8	61,1	53,4
6	2,06	1,96	1,90	2,31	2,49	2,44	71,4	70,0	70,2
7	3,09	3,21	3,17	3,52	3,46	3,60	80,2	80,7	79,3
8	4,81	4,61	4,75	5,20	5,30	5,12	90,4	89,5	89,9
9	7,24	7,17	6,89	6,23	6,84	6,81	100,8	99,8	98,9
10	8,70	9,16	9,06	7,47	7,88	8,20	107,4	110,0	108,9

Table 1.17 Input data used in the prognosis on growth of cod

Data	2006	2007	2008
Weight at age 1	0,010	0,015	0,015
Abundance at age 1	$1216*10^6$	$1216*10^6$	$1216*10^6$
Capelin stock size	$549*10^3$	$611*10^3$	$1757*10^3$
Temperature	5,1	4,6	4,5

Table 1.18. Overview of available prognoses of NEA cod recruitment (million age 3 fish) from different models (sections 1.5.3 and 1.5.5) together with the 2007 assessment estimates (Section 3.5.2, 3.10.2). Note that the given month in the third column indicates when the prognoses can be extended for another year.

MODEL	PROGNOSTIC YEARS	PROGNOSES AVAILABLE	2007 PROGNOSES	2008 PROGNOSES	2009 PROGNOSES
Titov (WD 16, AFWG 2005)	4	At assessment	839 **	800 **	
Bulgakova (WD20, AFWG 2005)	3	Before assessment	532 *		
Stiansen et al., WD14	2 (3 [1])	November (March [1])	561	642	634 [1]
Stiansen et al., WD14	1 (2 [1])	November (March [1])	462	517 [1]	
Stiansen et al., WD14	0 (1 [1])	November (March [1])	559 [1]		
Svendsen et al WD 14	3	Februar	455	689	659
Gadget Assessment 2007	1	At assessment	229		
RCT3 Assessment 2007 (Nor-IUU-Run/Rus-IUU-Run)	3	At assessment	565/ 501	535/ 476	461/ 406
RCT3 Assessment 2006	3	At assessment	533	546	

[1] **Based on prognosis estimate of capelin maturing biomass for October 1 2007, thereby allowing for an additional year.**

* **Numbers were calculated before the 2005 assessment (ICES, 2005), and have not been updated for the 2007 assessment.**

** **Numbers were updated for the 2006 assessment, but not for the 2007 assessment.**

Table 1.19 Proportion of cod in the diet of cod

COD (PREDATOR)AGE	1	2	3	4	5	6	7	8	9	10	11
Year											
1984	0,0000	0,0000	0,0032	0,0000	0,0437	0,0263	0,0326	0,0356	0,0364	0,0387	0,0371
1985	0,0015	0,0009	0,0014	0,0017	0,0313	0,0076	0,0818	0,0824	0,0832	0,0837	0,0842
1986	0,0000	0,0022	0,0015	0,0004	0,0129	0,1761	0,1757	0,1755	0,1751	0,1746	0,1735
1987	0,0000	0,0000	0,0007	0,0051	0,0103	0,0246	0,0377	0,0400	0,0418	0,0405	0,0435
1988	0,0000	0,0000	0,0000	0,0002	0,0058	0,0014	0,0038	0,0036	0,0032	0,0038	0,0036
1989	0,0000	0,0006	0,0016	0,0019	0,0027	0,0040	0,0035	0,0035	0,0039	0,0038	0,0041
1990	0,0000	0,0000	0,0000	0,0007	0,0010	0,0010	0,0170	0,0175	0,0187	0,0186	0,0182
1991	0,0000	0,0005	0,0000	0,0003	0,0032	0,0020	0,0221	0,0228	0,0231	0,0235	0,0237
1992	0,0000	0,0021	0,0037	0,0128	0,0250	0,0475	0,0119	0,0158	0,0230	0,0230	0,0228
1993	0,0000	0,0413	0,0368	0,0515	0,0536	0,1156	0,0498	0,0799	0,0798	0,0798	0,0816
1994	0,0000	0,0038	0,0917	0,0347	0,0284	0,0779	0,1245	0,1328	0,2675	0,2694	0,2663
1995	0,0069	0,0811	0,0744	0,1101	0,0924	0,1119	0,1382	0,2520	0,2537	0,2545	0,2558
1996	0,0000	0,1492	0,2548	0,2059	0,1321	0,1265	0,1839	0,2062	0,2411	0,2421	0,2416
1997	0,0000	0,0720	0,0767	0,1139	0,1587	0,1559	0,2348	0,2252	0,2849	0,2783	0,2800
1998	0,0000	0,0135	0,0272	0,0417	0,1041	0,0981	0,1080	0,1489	0,2701	0,2710	0,2719
1999	0,0000	0,0000	0,0049	0,0137	0,0147	0,0338	0,0620	0,1116	0,1933	0,1938	0,1839
2000	0,0000	0,0000	0,0286	0,0147	0,0134	0,0266	0,0496	0,0562	0,2706	0,2678	0,2712
2001	0,0000	0,0158	0,0116	0,0082	0,0131	0,0241	0,0494	0,0374	0,3221	0,3185	0,3223
2002	0,0000	0,0384	0,0589	0,0151	0,0187	0,0285	0,0358	0,0624	0,1561	0,1539	0,1552
2003	0,0000	0,0194	0,0198	0,0199	0,0206	0,0188	0,0454	0,1037	0,2216	0,2251	0,2229
2004	0,0000	0,0069	0,0099	0,0185	0,0206	0,0318	0,0303	0,0592	0,1097	0,1096	0,1101
2005	0,0000	0,0267	0,0229	0,0259	0,0154	0,0240	0,0482	0,0820	0,1635	0,1628	0,1640
2006	0,0000	0,0089	0,0008	0,0127	0,0305	0,0117	0,0378	0,0313	0,0820	0,0826	0,0827
Average	0,0004	0,0210	0,0318	0,0309	0,0371	0,0511	0,0689	0,0863	0,1445	0,1443	0,1444

Table 1.20 Cannibalism in cod

	M2 AGE 3	M2 AGE 4
	by regression	
2006	0.41	0.27
2007	0.48	0.30
2008	0.45	0.29
2009	0.44	0.28
	values used in assessment	
2007-2009	0.29	0.21

Table 1.21. Qualitative analysis of effects of ecosystem impact factors on some stocks in the Barents Sea for 2007.

Species	Stock parameters	Ecosystem parameters									Total expectation
		Temperature of water	Zooplankton biomass	Capelin biomass	Herring biomass	Polar cod biomass	Blue whiting biomass	Cod biomass	Harp seal abundance	Whales abundance	
NEA Cod	Abundance at age 0+	+	++	+	−	?	−	+ −	?	?	M
	Cannibalism	++	−	+	−	−	−	+	?	?	M
	Rate of growth	++	+ −	− −	++	− +	+	−	+ −	−	M
	Rate of maturation	+ −	+ −	− −	+	?	+	+ −	?	?	M
Capelin	Abundance at age 0+	+	++	− −	− −	−	−	−	?	?	L
	Natural mortality	++	− −	− −	+	−	+ −	+	+ −	++	H
	Rate of growth	++	+	++	−	−	−	+ −	?	?	H
	Rate of maturation	++	+	++	−	−	−	+ −	?	?	H

H – high, M – medium and L – low expectation of stock parameters.

+ positive (++ strongly positive) influence of ecosystem parameters on stock parameters;

+ − Influence of ecosystem parameter on stock parameter without clear positive or negative effects;

− negative (-- strongly negative) influence of ecosystem parameters on stock parameters;

? Knowledge is not available.

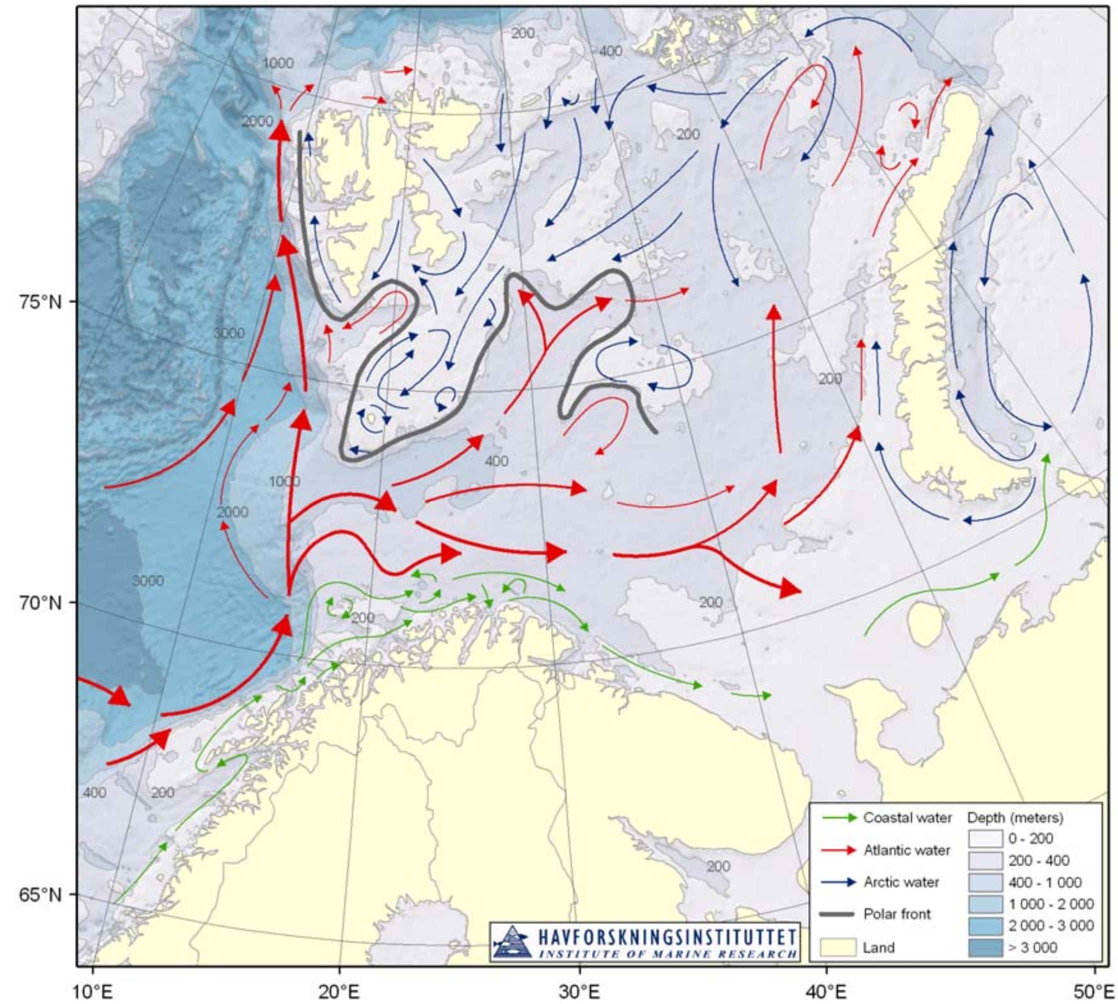


Figure 1.1. The main features of the circulation and bathymetry of the Barents Sea.

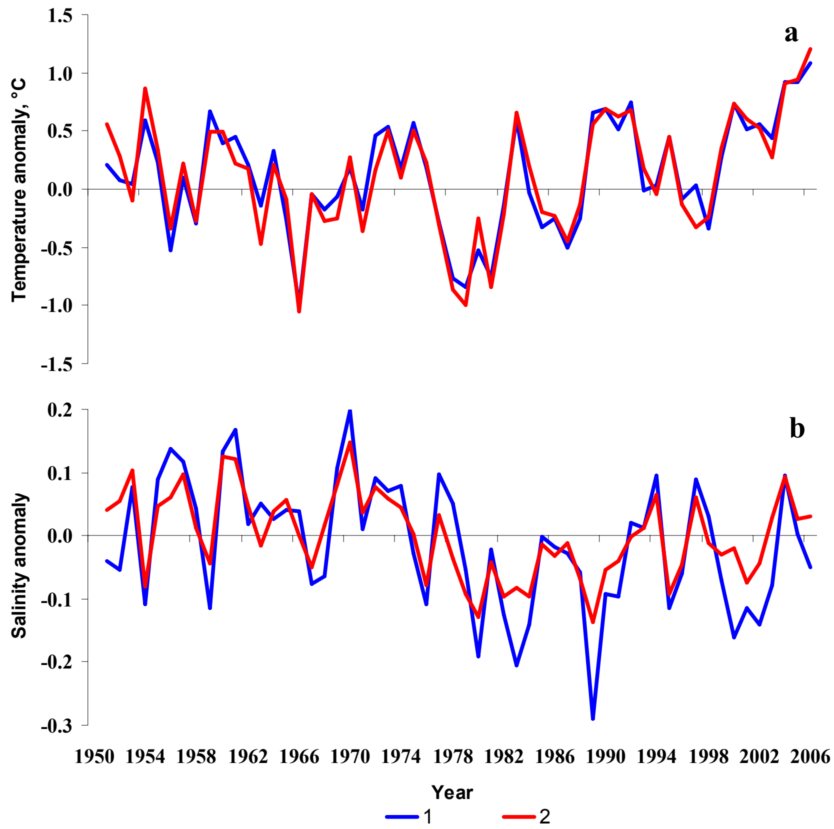


Figure 1.2. Mean annual temperature (a) and salinity (b) anomalies in the 0-200 m of the Kola section in 1951-2006. 1 – coastal waters, 2 –the Murmansk Current (Anon., 2007)

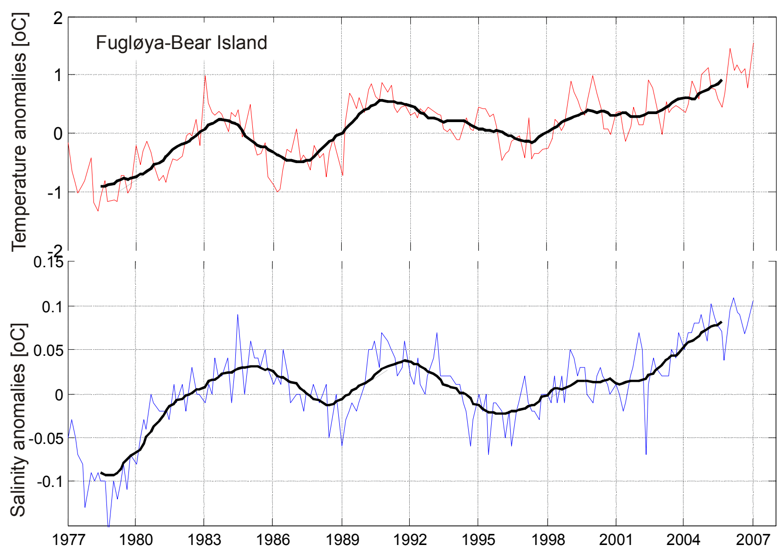


Figure 1.3. Temperature (upper) and salinity (lower) anomalies in the 50-200 m layer of the Fugløya-Bear Island section.

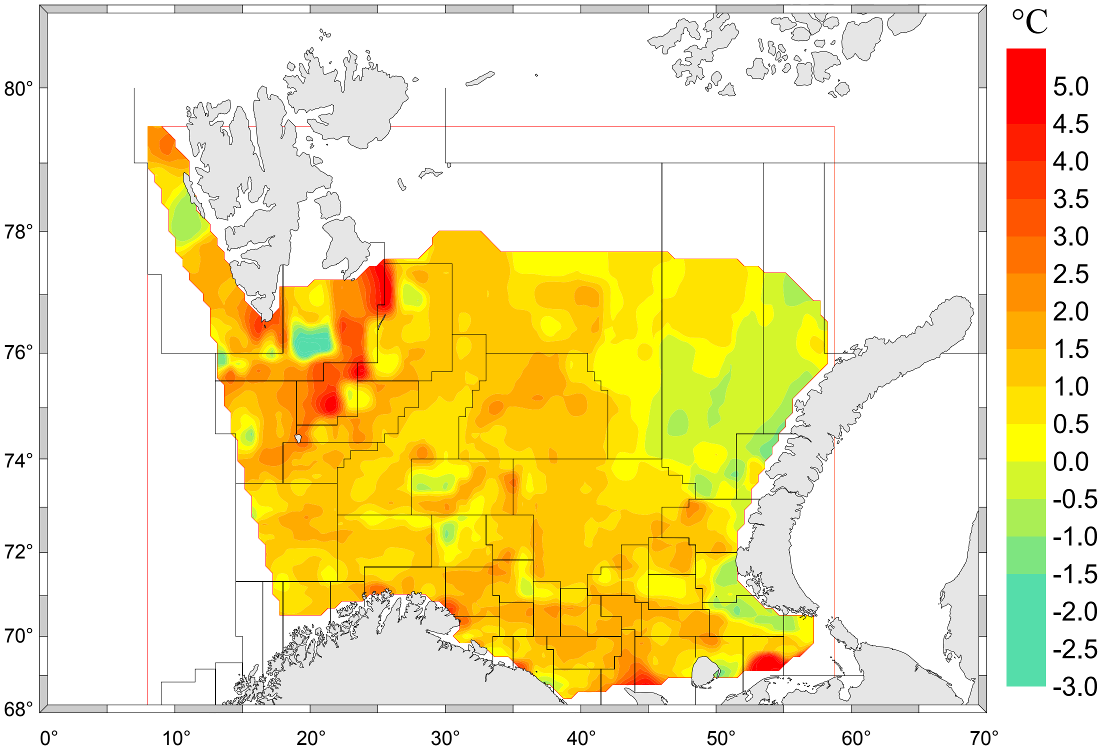


Figure 1.4. Bottom temperature anomalies in the Barents Sea in August-September 2006 (Anon., 2007).

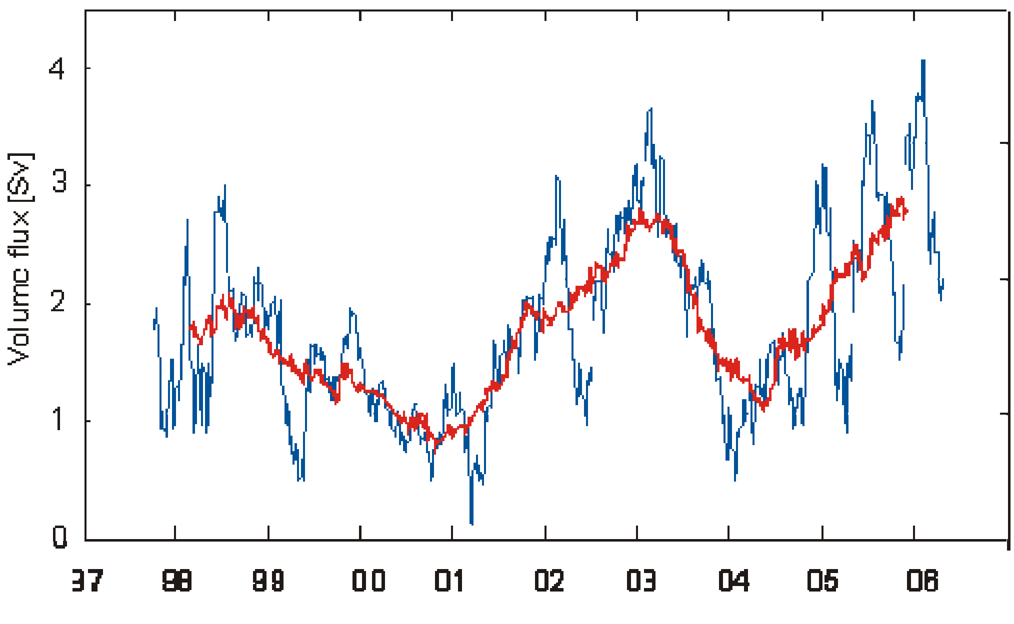


Figure 1.5. Observed Atlantic Water volume flux through the Fugløya-Bear Island section in 1998-2006 estimated from current meter moorings. Three months (blue line) and 12-months (red line) running means are shown.

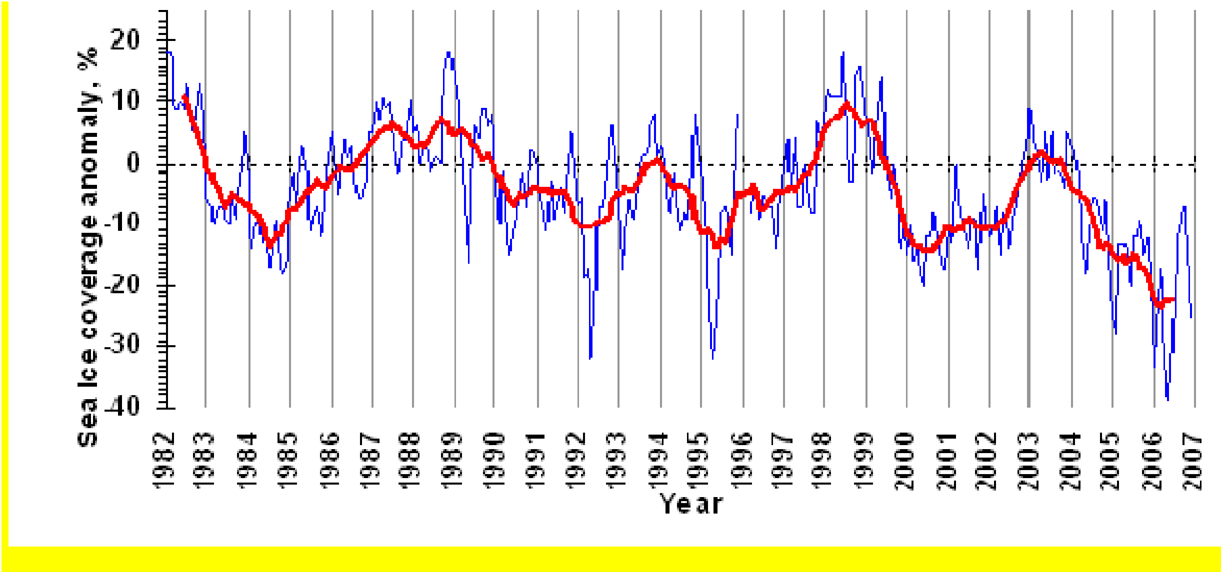


Figure 1.6. Anomalies of mean monthly ice extent in the Barents Sea in 1982-2006. The blue line shows monthly values, the red one – 11-month moving average values (Anon., 2007)

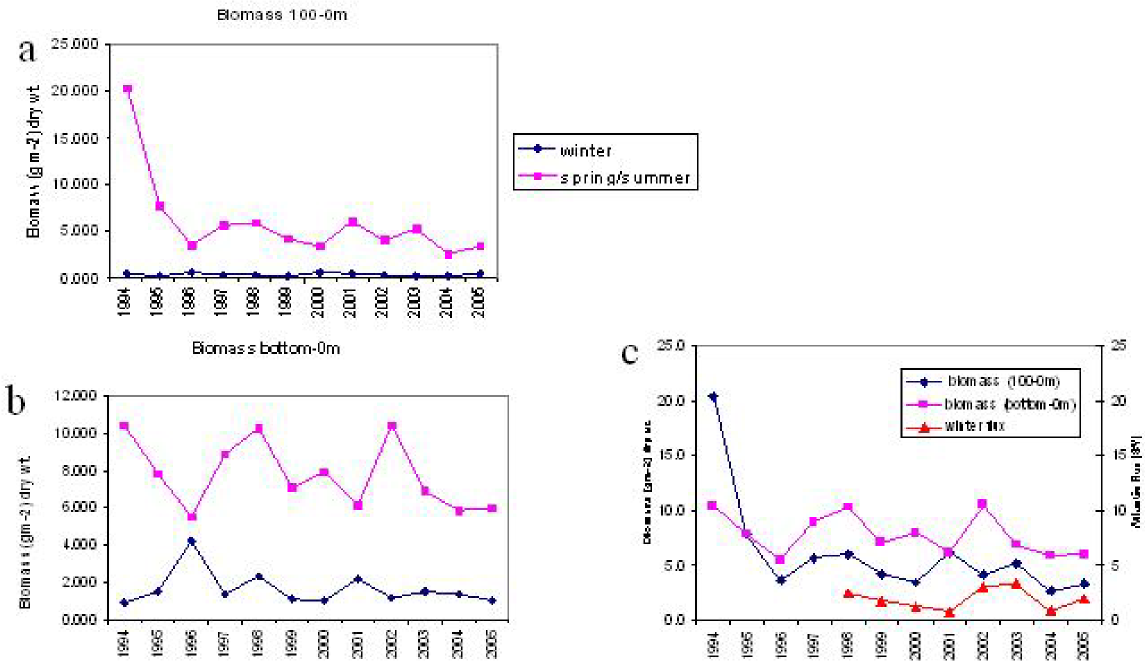


Figure 1.7. Mean annual zooplankton biomass (gm^{-2} dry weight) in the Fugløya-Bjørnøya transect a) 100-0m, and b) bottom-0m during winter (January-March) and spring/summer (May-August), c) Spring/summer biomass in upper 100m together with winter (January-March) Atlantic flux, from bottom-0m

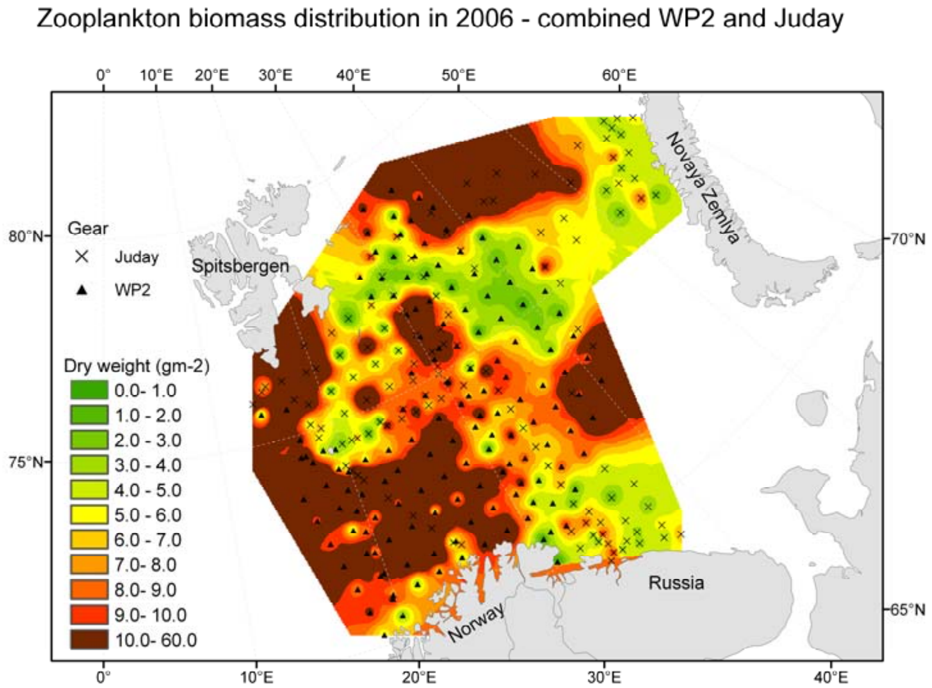


Figure 1.8. Horizontal distribution of zooplankton in 2006 (g m^{-2} of dry weight from bottom-0 m).

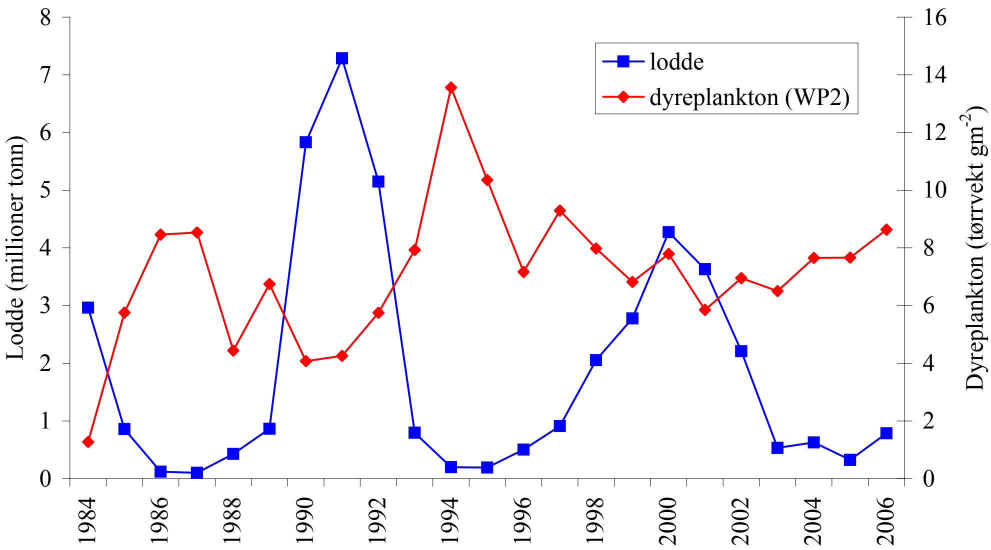


Figure 1.9. Average zooplankton biomass (dry weight, g m^{-2}, red line) together with biomass of one year old and older capelin (million tones, blue line) during 1984 – 2006, in the Barents Sea (from Dalpadado et al. 2002, updated with data for 2001-2006).

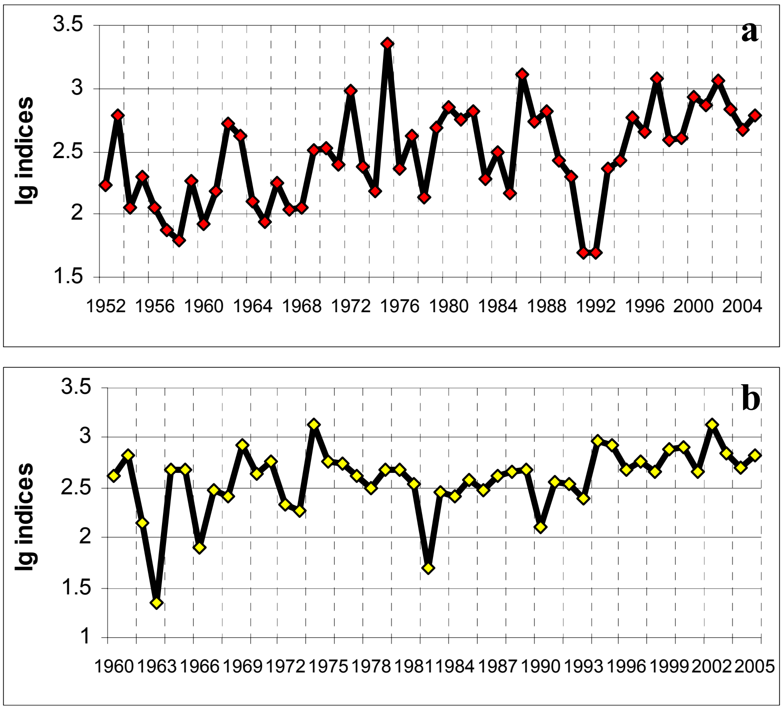


Figure 1.10. Indices of krill abundance in the southern (A) and in the northwestern part of the Barents Sea (B). More details of area definitions can be found in Drobysheva et al. (2003).

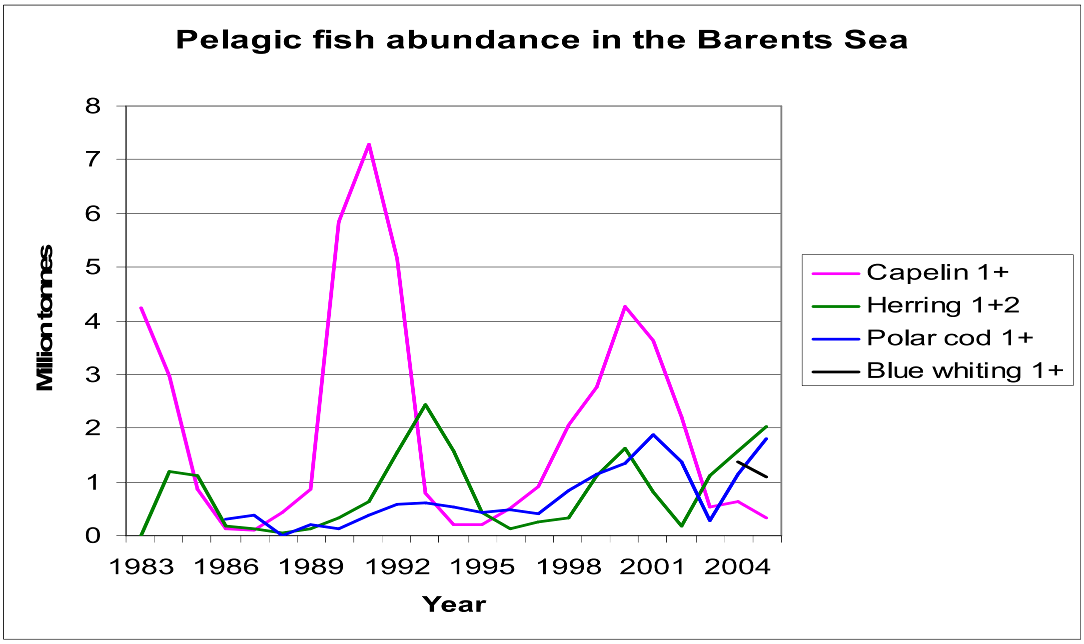


Figure 1.11. Abundance of pelagic fish species in the Barents Sea. The data are taken from; capelin: Acoustic estimates in September-October, age 1+ (ICES, 2005; Anon., 2005;, herring: VPA estimates of age 1 and 2 herring (ICES, 2006) using standard weights at age (9 g for age 1 and 20g for age 2); polar cod: Acoustic estimates in September-October, age 1+ (Anon., 2005); blue whiting: Acoustic estimates in September-October, age 1+ (Anon., 2004; Anon., 2005).

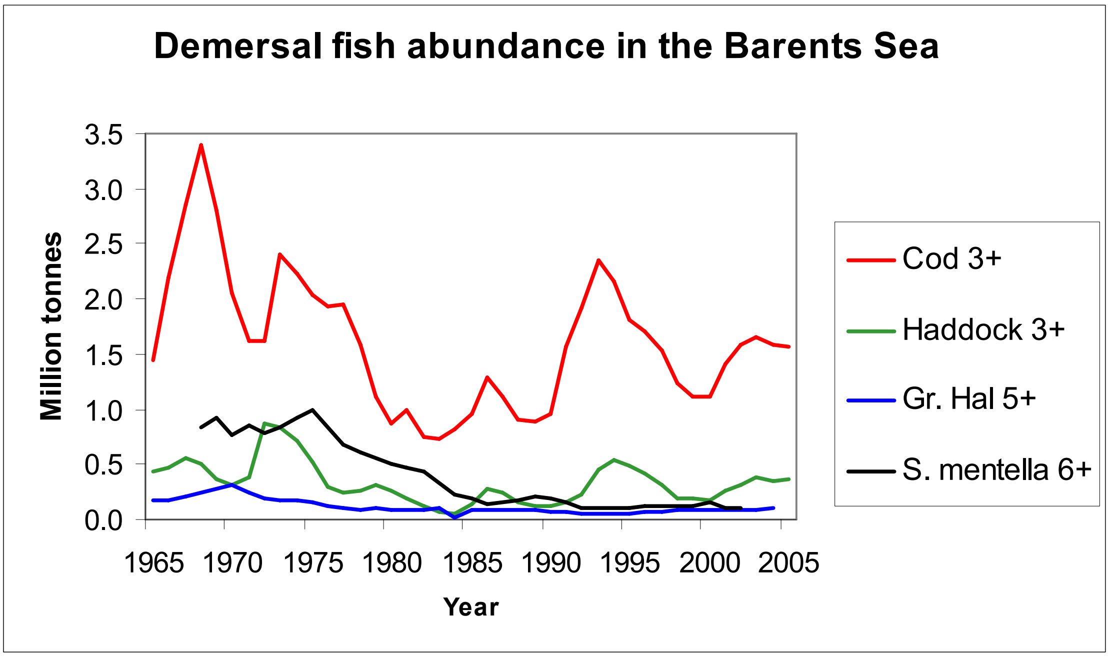
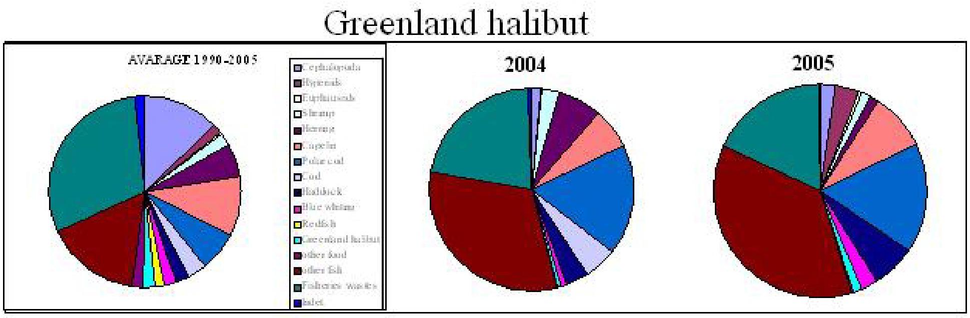


Figure 1.12. Abundance of demersal fish species in the Barents Sea. The data are taken from; cod: VPA estimates, age 3+ (ICES, 2005); haddock: VPA estimates, age 3+ (ICES, 2005); Greenland halibut: VPA estimates, age 5+ (ICES, 2005); *Sebastes mentella*: VPA estimates, age 6+ (ICES, 1995 for the years 1968-1990; ICES, 2003 for the years 1991-2002).



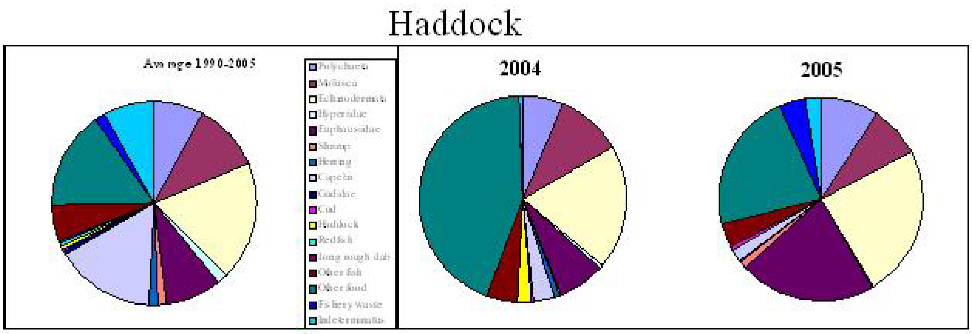


Figure 1.13. Stomach contents in Greenland halibut and Haddock from Russian data.

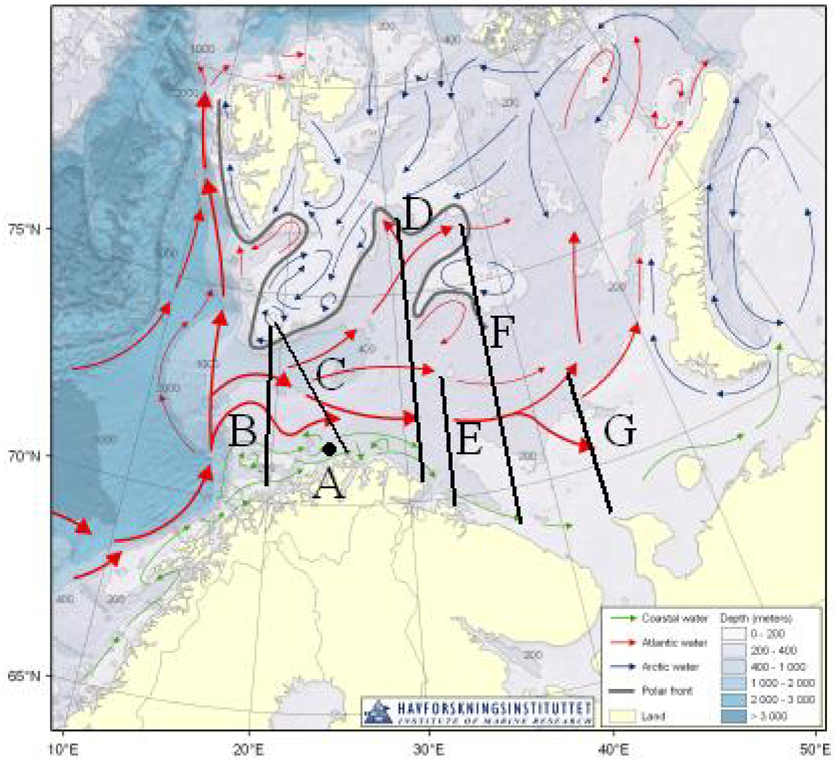


Figure 1.14. Positions of the standard sections monitored in the Barents Sea. A is fixed station Ingøy, B is Fugløya-Bear Island, C is North cape-Bear Island, D is Vardø-North, E is Kola, F is Sem Island-North and G is Kanin section.

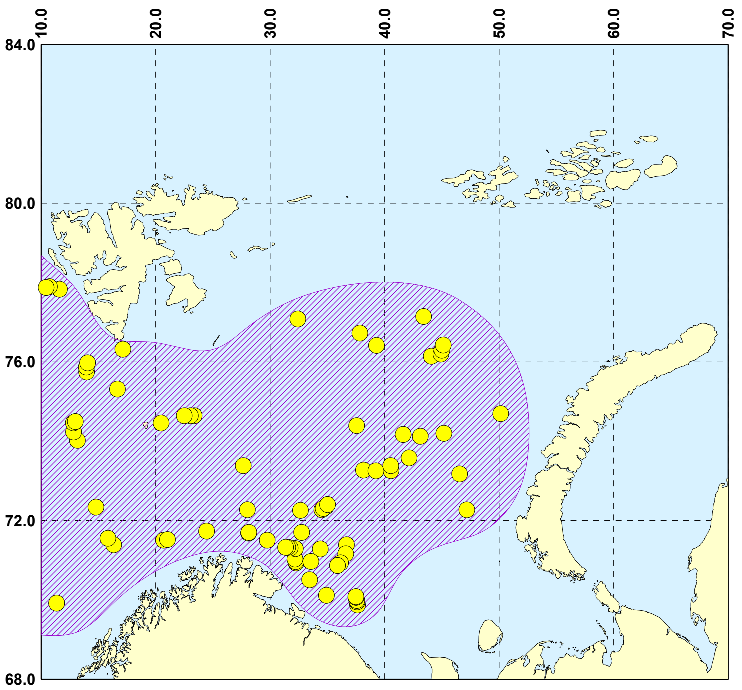


Figure 1.15. Distribution pattern of the white-beaked dolphin in the Barents Sea in spring and autumn 2006. General boundary of the distribution area is shown.

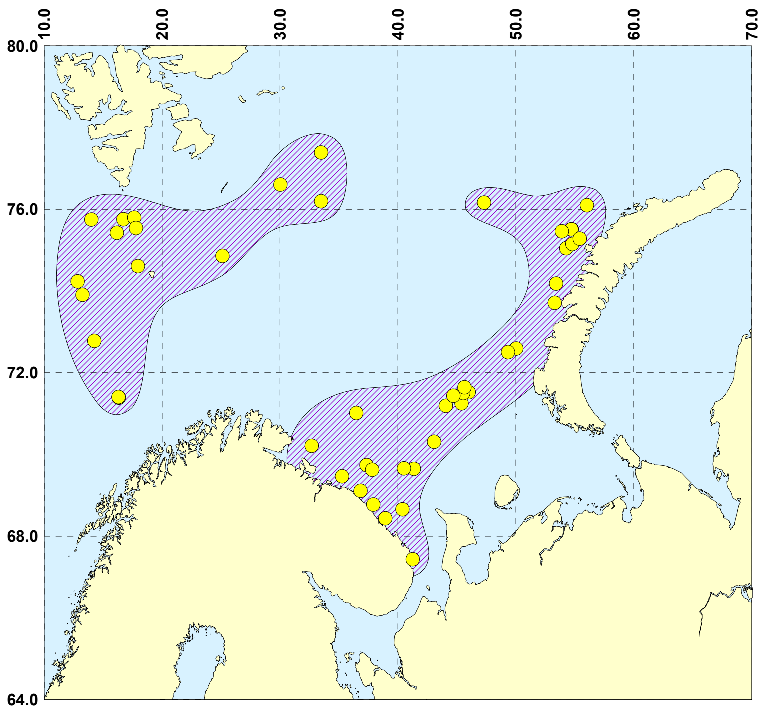


Figure 1.16. Distribution of Minke whale in the Barents Sea in summer and autumn 2006. Areas of the main feeding aggregations are shown.

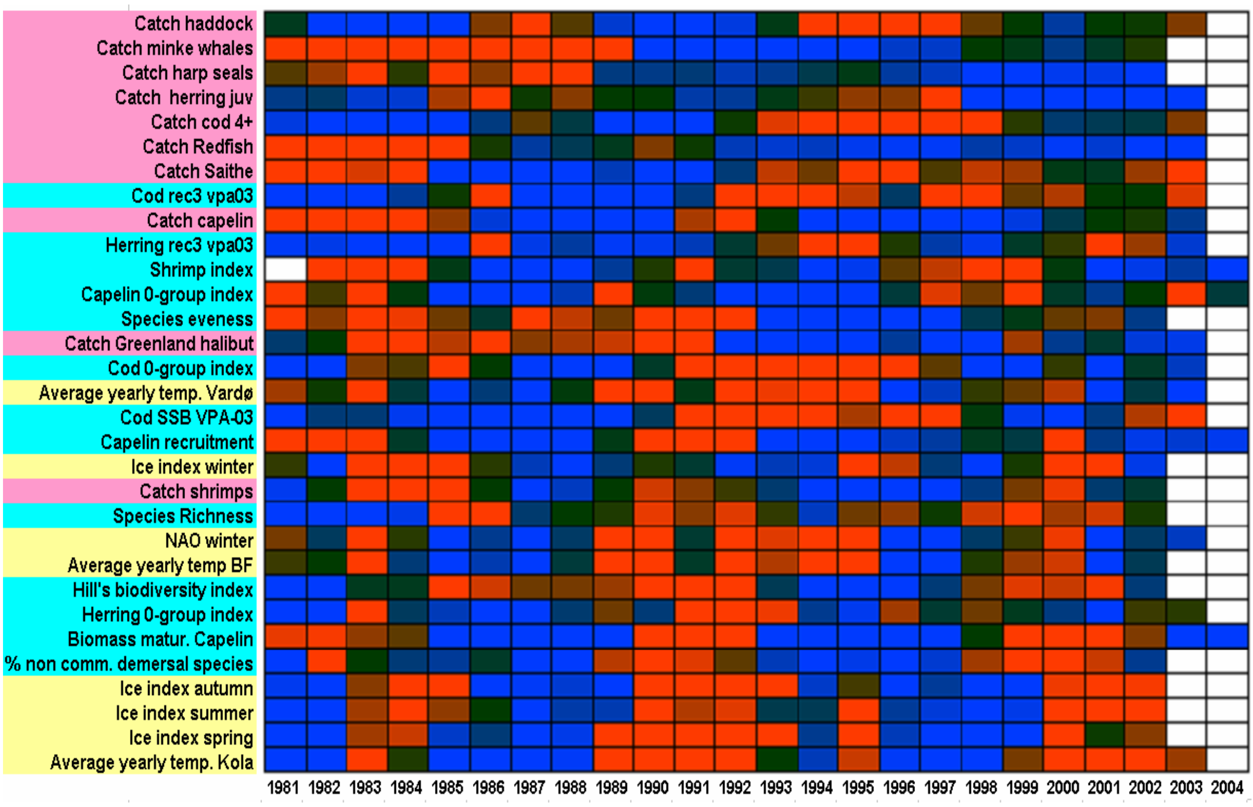


Figure 1.17. Normalized time series from the Barents Sea Ecosystem 1981 to 2004. Blue colour is negative deviation and red colour is positive deviations.

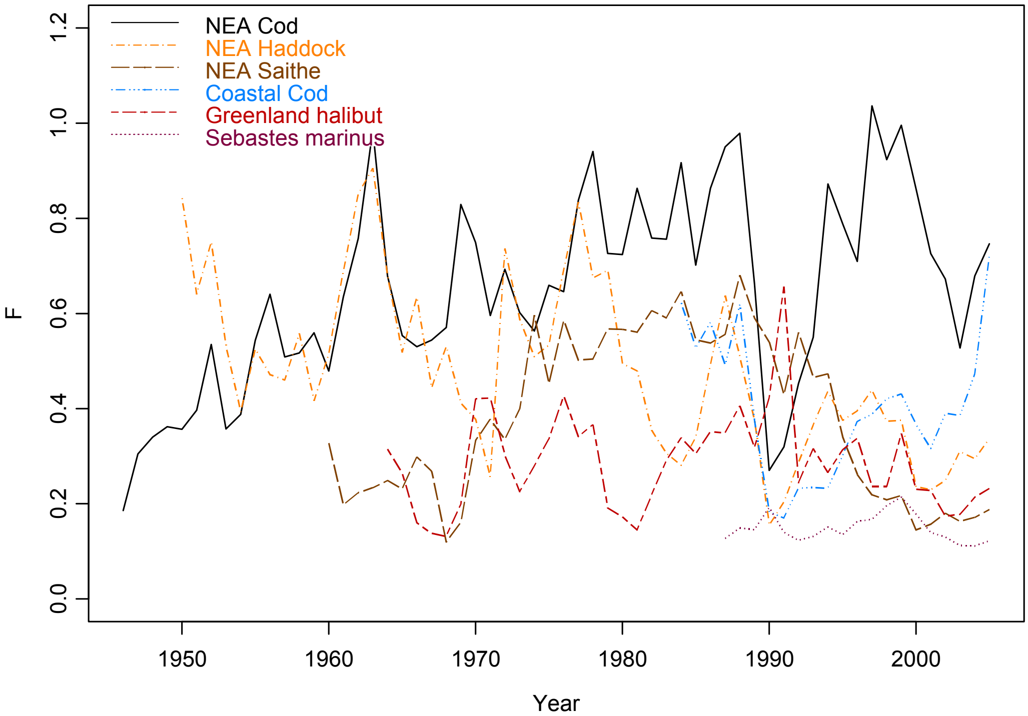


Figure 1.18. Time series of annual average fishing mortalities for Northeast Arctic cod (time period 1946-2005, average for ages 5-10), Northeast Arctic haddock (time period 1950-2005, average for ages 4-7), Northeast Arctic saithe (time period 1960-2005, average for ages 4-7), coastal cod (1984-2005, average for ages 4-7) and Greenland halibut (time period 1964-2005, average for ages 6-10) and *Sebastes marinus* (time period 1987-2005, average for ages 12-19).

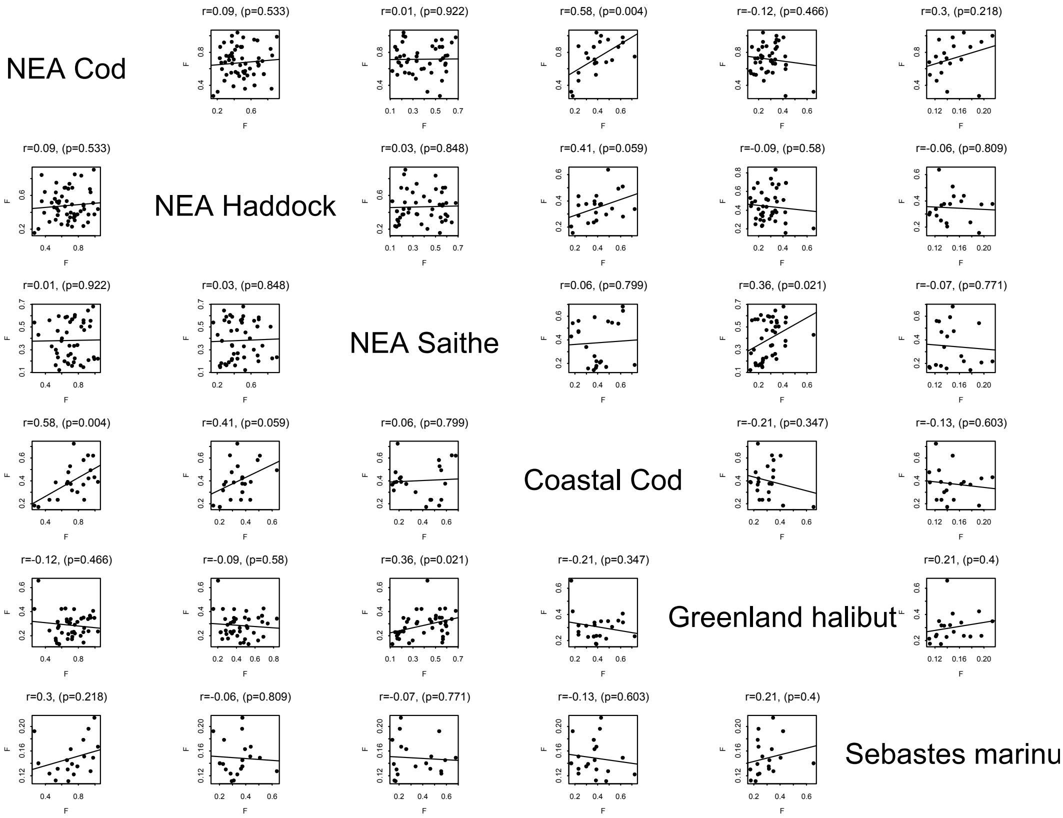


Figure 1.19. Pairwise plots of annual average fishing mortalities for overlapping time periods for Northeast Arctic cod (time period 1946-2005, average for ages 5-10), Northeast Arctic haddock (time period 1950-2005, average for ages 4-7), Northeast Arctic saithe (time period 1960-2005, average for ages 4-7), coastal cod (1984-2005, average for ages 4-7), Greenland halibut (time period 1964-2005, average for ages 6-10) and Sebastes marinus (time period 1987-2005, average for ages 12-19). The correlation and the corresponding p-value are given in the legend.

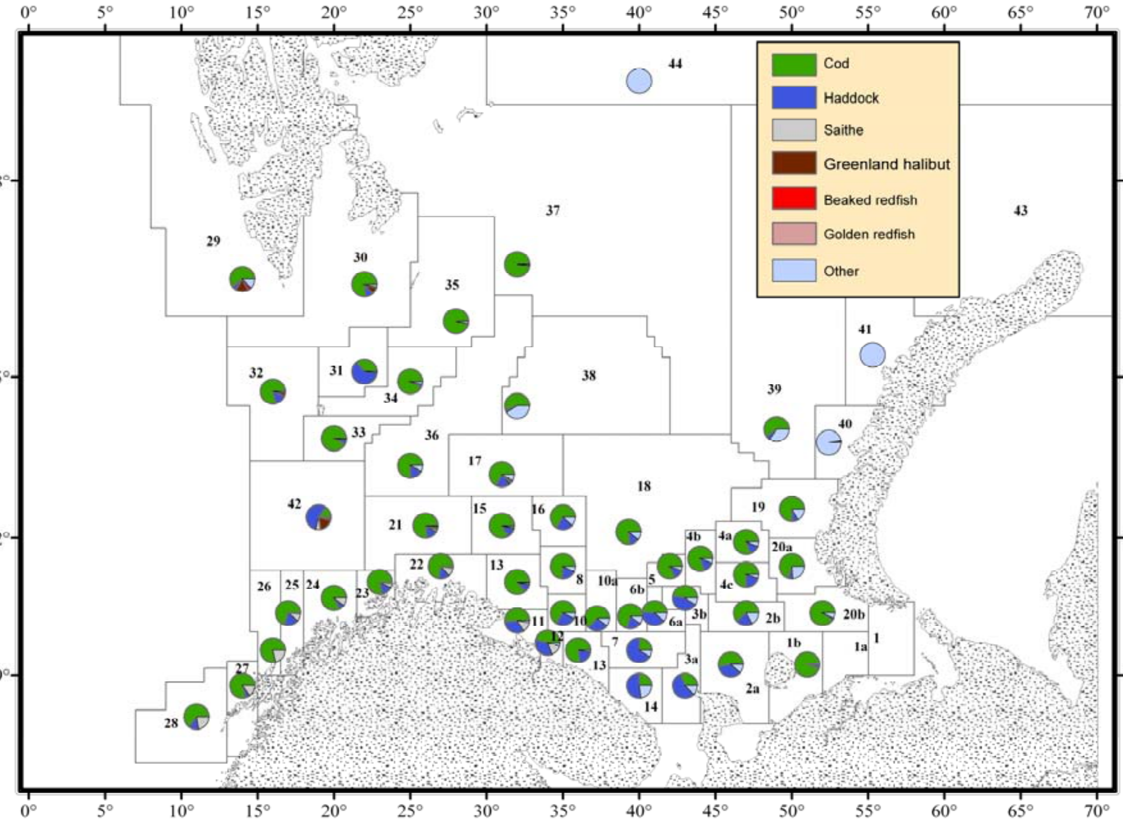


Figure 1.20. Relative distribution of composition of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by Russian bottom trawl in 2005 per main areas for the Russian strata system.

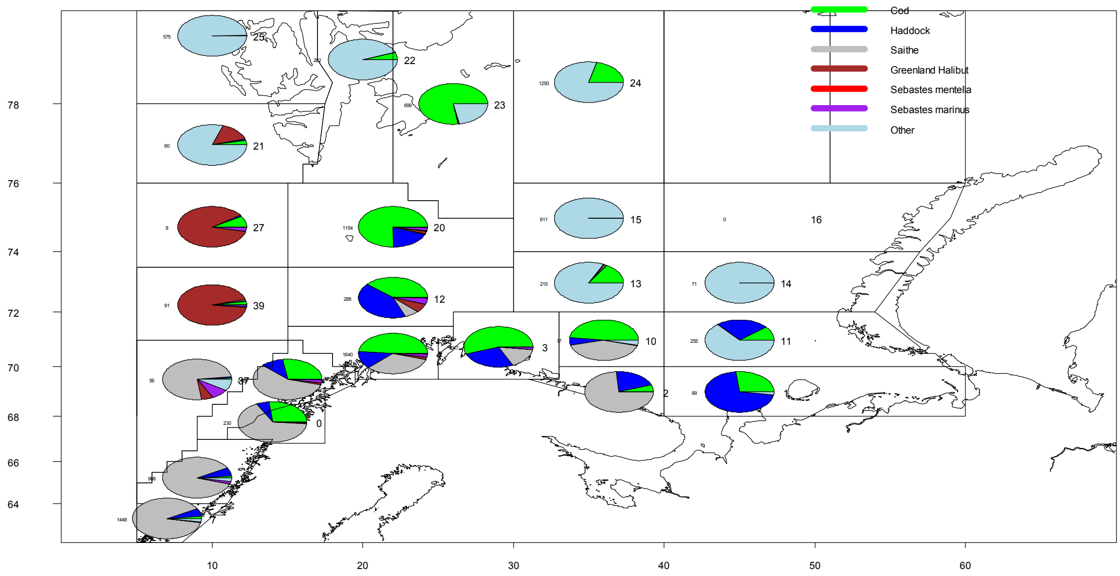


Figure 1.21. Relative distribution of composition of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by Norwegian bottom trawl in 2005 per main areas for the Norwegian strata system. The large numbers to the right of the pie diagrams are the name of the stratum, while the small numbers to the left is the number of vessel days recorded in the area.

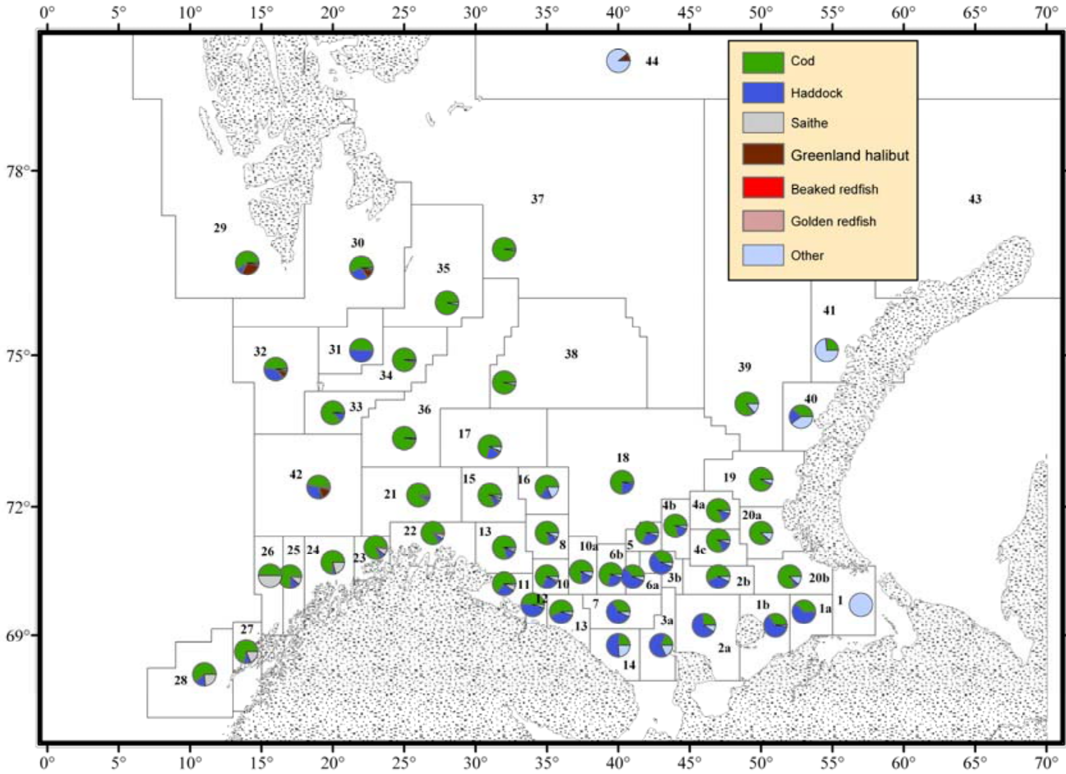


Figure 1.22. Relative distribution of composition of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by Russian bottom trawl in 2006 per main areas for the Russian strata system.

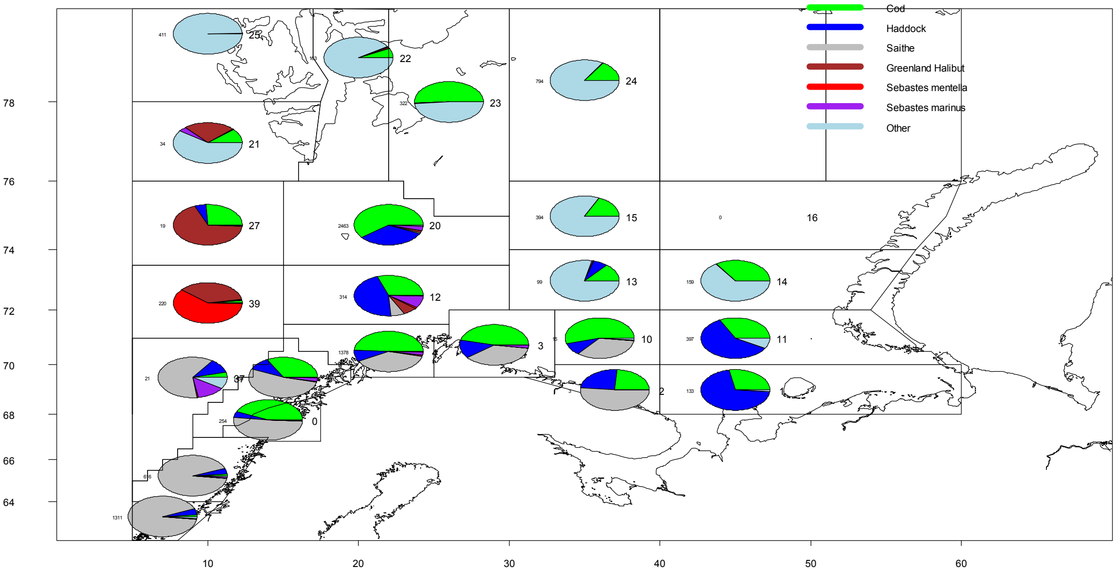


Figure 1.23. Relative distribution of composition of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by Norwegian bottom trawl in 2006 per main areas for the Norwegian strata system. The large numbers to the right of the pie diagrams are the name of the stratum, while the small numbers to the left is the number of vessel days recorded in the area.

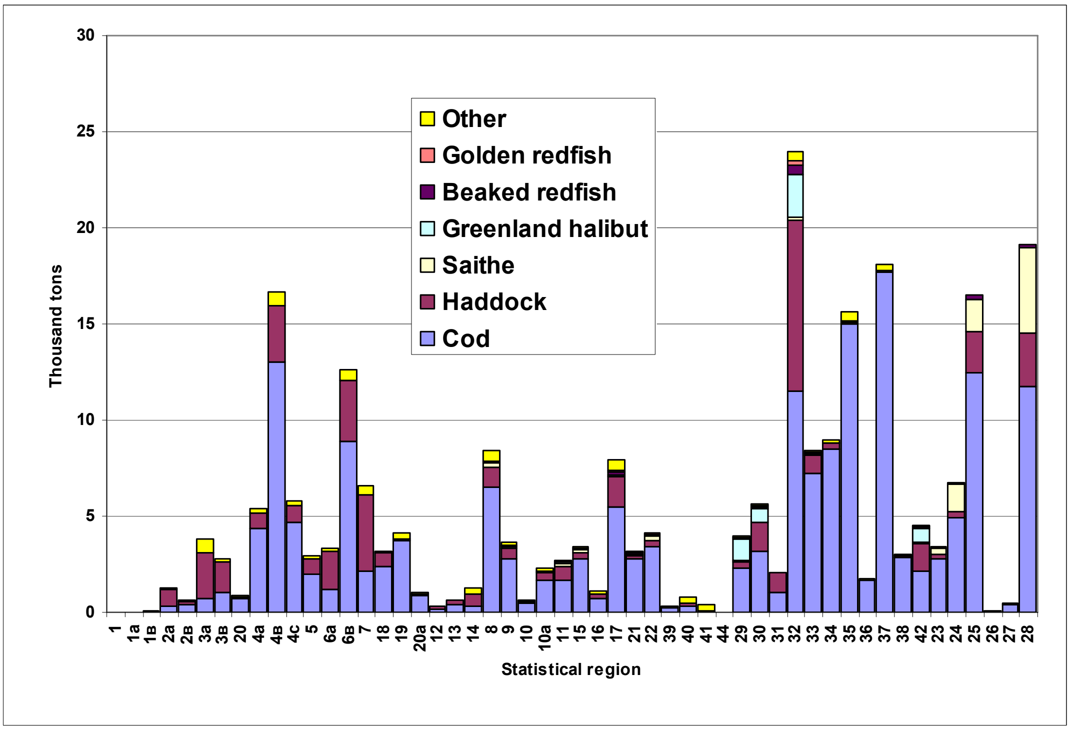


Figure 1.24. The Russian catch of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by bottom trawl by main statistical areas in 2005, thousand tons. The statistical areas correspond to the areas shown in Figure 1.20.

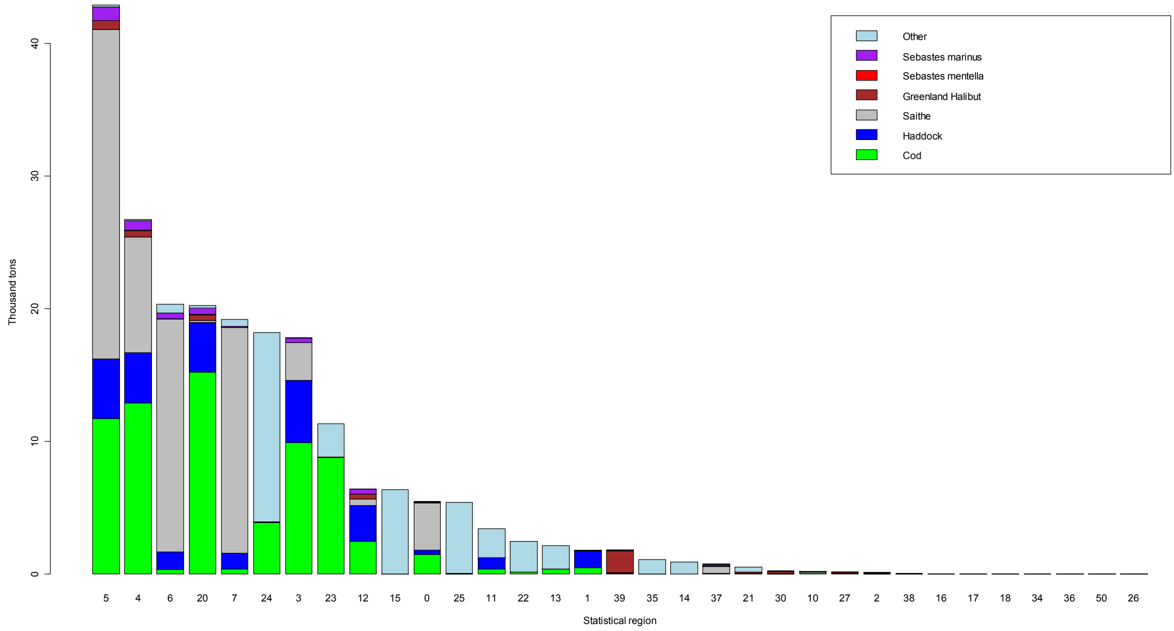


Figure 1.25. The Norwegian catch of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by bottom trawl by main statistical areas in 2005, thousand tons. The statistical areas correspond to the areas shown in Figure 1.21.

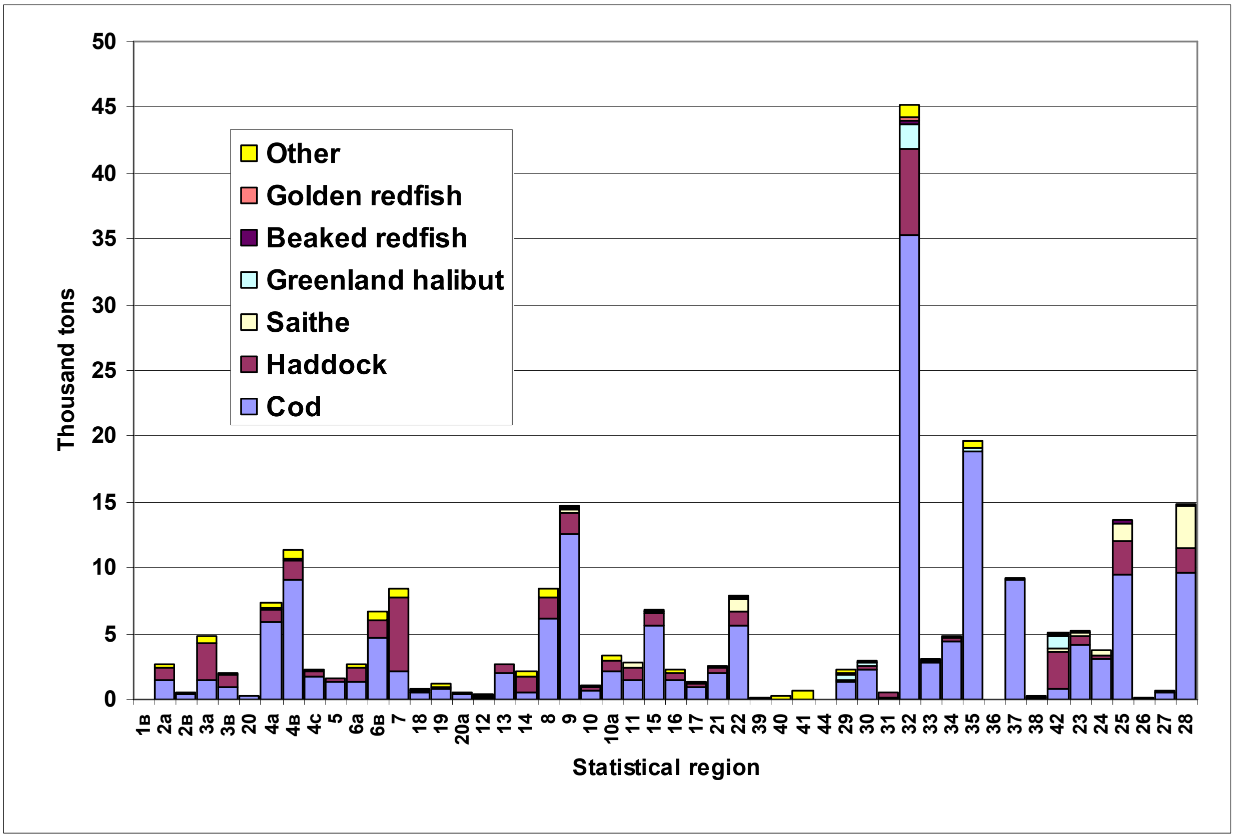


Figure 1.26. The Russian catch of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by bottom trawl by main statistical areas in 2006, thousand tons. The statistical areas correspond to the areas shown in Figure 1.22.

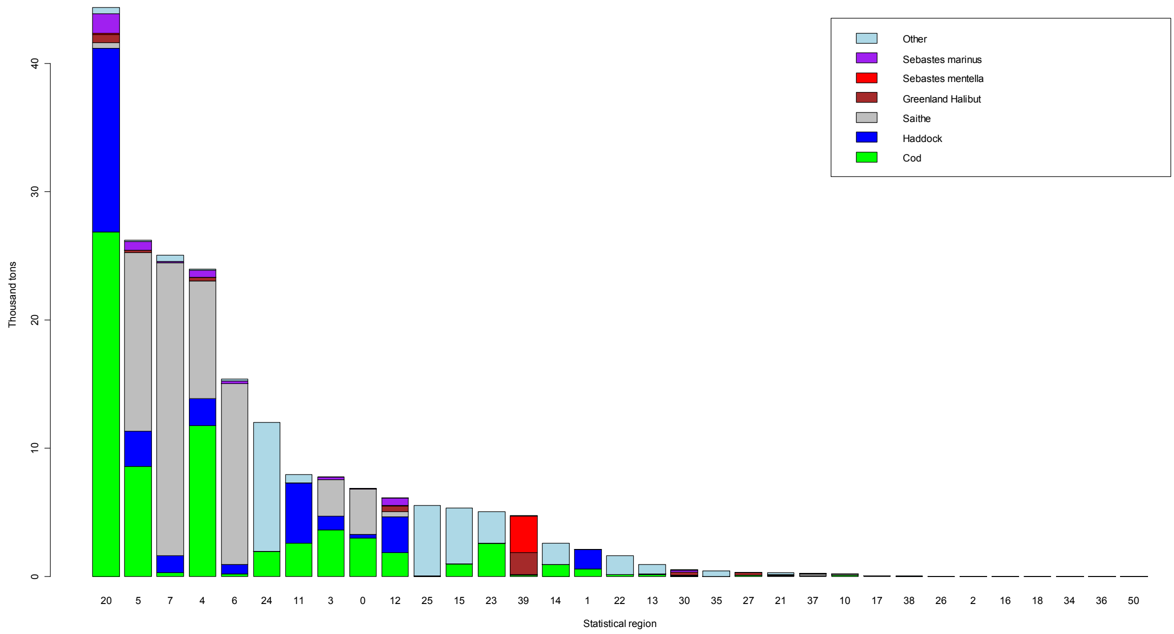


Figure 1.27. The Norwegian catch of cod, haddock, saithe, Greenland halibut, *Sebastes marinus*, *Sebastes mentella* and other species taken by bottom trawl by main statistical areas in 2006, thousand tons. The statistical areas correspond to the areas shown in Figure 1.23.

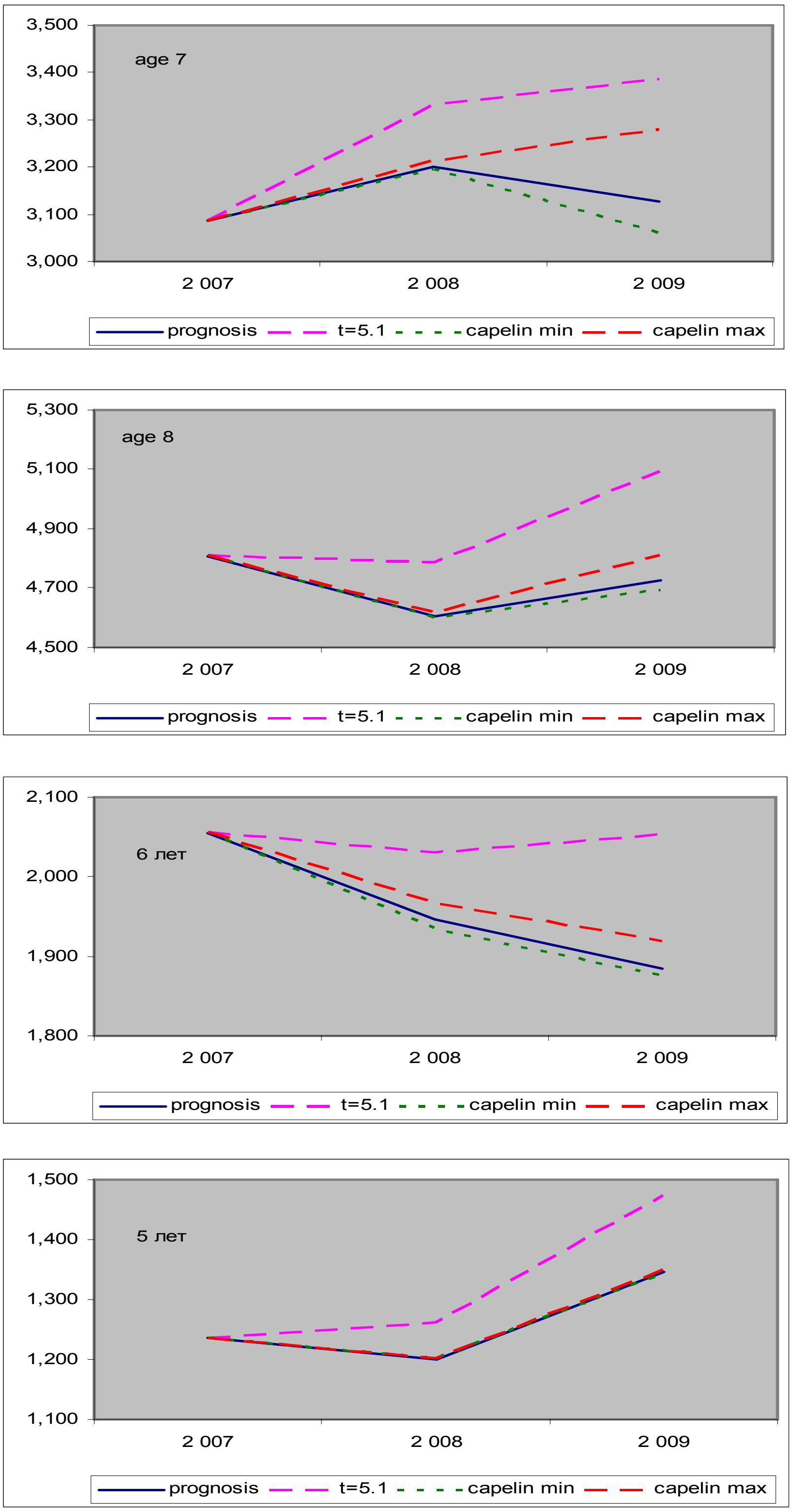


Figure 1.28. Body weight of cod at age 5-8 at the beginning of the year under different scenarios of temperature and capelin stock size (explanation in section 1.5.5.).

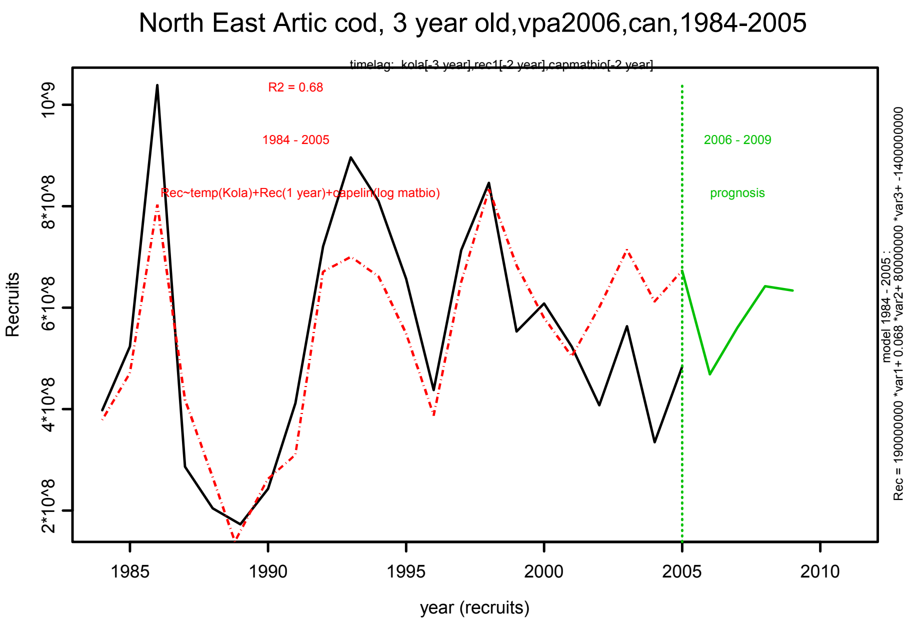


Figure 1.29. Modeled cod age 3 recruitment from Stiansen et al. (2005). Red line is model, green line is model prediction and black line is VPA from 2006 assessment.

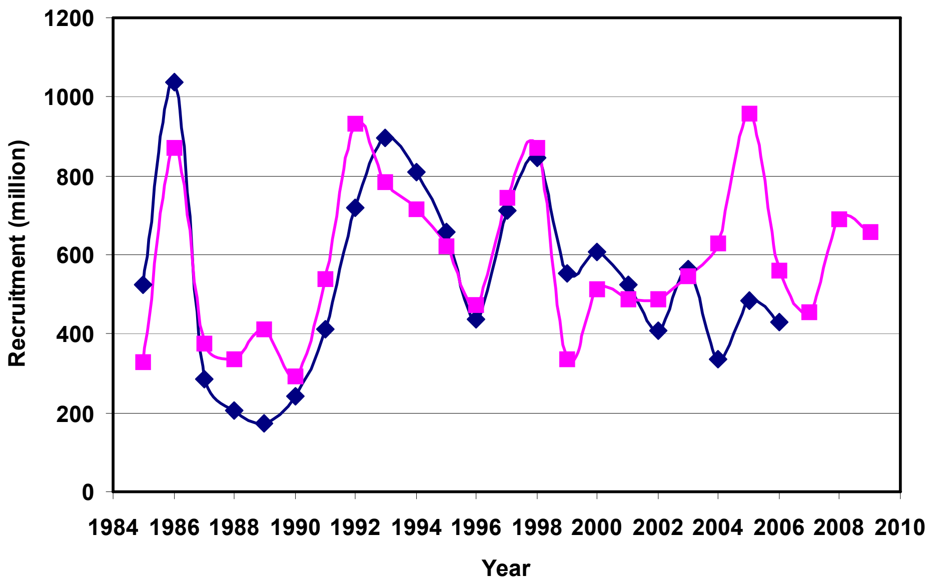


Figure 1.30. Modeled cod age 3 recruitment from Svendsen et al. (submitted). Purple line is model, with predictions and blue line is VPA from 2006 assessment.

2 Norwegian coastal cod in Subareas I and II

A benchmark assessment was scheduled for this stock. The data exploration has revealed inconsistencies between survey indices at age and landings at age. These problems have not been fully resolved and the current assessment is considered as exploratory rather than benchmark. General information regarding the stock and earlier assessments are given in the Quality Handbook Stock Annex of the 2006 report.

2.1 Status of the Fisheries

2.1.1 Landings prior to 2007 (Tables 2.1-2.2, 2.1a-d)

The catches of Norwegian Coastal cod (NCC) have been calculated back to 1984. During this period the catches have been between 22,000 and 75,000 t. The estimated landings of NCC in 2005 reported to the Working Group is 22,432 t and the provisional figure for 2006 is 26,134 t (Table 2.1, Figure 2.1d) The landings in 2006 increased compared with 2005.

The basis for estimating coastal cod catches is the total catches of cod inside the 12 n.mile zone in the Norwegian statistical areas 03, 04, 05, 00, 06, 07 (Figures 2.1a and 2.1b). Catches are separated to type of cod by the structure of the otoliths in commercial samples. A total of 12,530 otoliths were collected from the commercial catches (Table 2.2a) separated into quarter of catch and fishing gear. Approximately 34 % of the otoliths in these coastal areas were classified as coastal cod. Table 2.2b shows the estimated catches of coastal cod by statistical area and quarter for the years 2003-2006. The corresponding fractions of coastal cod in cod catches are also shown. In the southern areas (06/07) the proportion is close to 1.0 in all quarters, except for a few cases when some NEA cod spawn far to the south in quarter 1 and 2. In the other areas the proportions are lower in quarter 1 and 2 in all years due to the spawning migration of NEA cod. In area 03 (eastern Finnmark) a considerable proportion of NEA cod is present also during autumn.

The precision and accuracy of the separation method has been investigated by comparison of different otolith readers and results from genetic investigation of cod. The results indicate high accuracy using in the otolith method (Berg *et al*., 2005). A low percentage misclassification of large catches of pure NEA cod could, however, lead to significant overestimation of coastal cod catches.

The landings in 2004 and 2005 have been recalculated this year, using a different approach than previous. The recalculation has been done for the Norwegian statistical area 00 (Vestfjord, the area south of Lofoten archipelago, figure 2.1c) in quarter 1 and 2. The area has historically been an important spawning area for Northeast Arctic cod. In the period 2004-2006 a major part of the Northeast Arctic cod was spawning in the south-western part of the area, and almost nothing in the north-eastern part. Most of the commercial catches in the area were taken in the south-western part (locations 03 and 04, Figure 2.1c) where the density of cod was much higher than in the north-eastern part. In the same period most of the samples in this area have been taken from the catches in the north-eastern part (locations 46 and 48) where coastal cod dominated. (In most of this north-eastern area the fishery was restricted to vessels below 15m and use of Danish seine was not allowed). The catch reporting has not been sufficiently accurate to split the catches between those locations. Merging all samples in the whole area is therefore considered to overestimate landings of coastal cod. In order to obtain a more realistic catch in the area for the years 2004-2006, only samples taken from the south-western part has now been used for separating the total catch in the area between coastal cod and Northeast Arctic cod. Similar problems might have occurred in some earlier years, and this requires some further investigations.

2.1.2 Expected landings in 2007

The quota for Norwegian coastal cod was reduced from 40,000 t. in 2003 to 20,000 t. in 2004 and 21,000 t. in 2005, 2006 and 2007. To achieve a reduction in landings of coastal cod new technical regulations in coastal areas were adopted in 2004 and extended in 2005. These have been kept with small modifications in 2006 and 2007. In the new regulations lines are drawn along the coast to close most fjords for direct cod fishing with vessels larger than 15 meter. In addition, all trawl fishing for cod are restricted to areas outside 6 n.mile from shore. Since the coastal cod is fished under a merged coastal cod/north-east arctic cod quota, these regulations are supposed to turn the traditional coastal fishery over from catching coastal cod in the fjords to catch more cod outside the fjords where the proportion of Northeast Arctic cod is higher.

During winter/spring 2007 the amount and distribution of Northeast Arctic cod at the spawning migration near the Norwegian coast was similar to the situation in 2006. The regulations of the coastal fisheries are also similar. Based on these considerations and the estimated landing in recent years it is assumed that the catches of coastal cod in 2007 will be similar to those in 2006 (26,000 tonnes).

2.2 Status of Research

2.2.1 Survey results (Tables 2.3-2.11)

A new trawl-acoustic survey along the Norwegian coast from Varanger to Stadt in October-November was established in 2003. This is a combined survey covering the distribution of coastal cod and Northeast Arctic saithe and replaces two other surveys (saithe survey and coastal survey). In 2003-2006 the survey covered a larger area than the coastal surveys in 1995-2002. However, the survey indices are calculated the same way as previous years using the same covering area as for previous surveys. The survey indices will not be recalculated before the time series from the new survey is extended.

The results of the 2006 survey are presented in Tables 2.3-2.6 for the area inside 12 n.miles in the Norwegian statistical areas 03, 04, 05, 00, 06, and 07 (Figures 2.1a and b). The trawl-acoustic coastal survey in 2006 estimated a total survey biomass of NCC of about 39,000 t (21 million fish) from Varanger to Stadt at 62^{o} N (Tables 2.3 and 2.4). The spawning biomass accounted for 21,000 t (7 million fish) of the total (Tables 2.5 and 2.6). The bulk of the spawning biomass was comprised of ages 5-7.

The survey time series of estimated numbers of NCC per age groups is given in Table 2.9. The total numbers was higher in 2006 compared to the 2005 survey. For age groups 1-7 the numbers increased and for age groups 8-10+ the numbers decreased from 2005 to 2006. Figure 2.2 show the time series by age groups. Ages 2 and 3 have declined more, and over a longer period, compared to the older fish. The reduction of older age groups has stopped, and there are even some signs of increase in the most recent survey. With a steady decline in recruitment and rather moderate reduction of catches one should expect further decline also for the older fish.

Figures 2.3-2.8 show the time series of stock number within each statistical area. In areas 03, 04 and 05 the decline since the late 90-ies is rather parallel. In the other three areas the year-to- year variation is larger, but similar trends as for the other areas are indicated. These latter areas contribute less to the total estimate.

2.2.2 Age reading and stock separation (Tables 2.2b, 2.4, 2.8-2.10)

Age readings of the cod both from the surveys and from the catches, are done the same way as for the NEA cod. A total of 1566 cod otoliths were sampled during the 2006 survey, and separated into NCC type (1323) and NEA cod (243).

As in previous years, NCC was found throughout the survey area. The 2006 survey data shows the same pattern as the 1995-2005 surveys. The sampling showed a higher proportion of NCC in the fjords and to the south compared with the northern and outer areas. The proportion of the NCC increases going from north to south along the Norwegian coast. Table 2.8 and Figure 2.9 show the proportions of coastal cod in the survey samples by age and statistical areas in 2006. Nearly all otoliths collected south of 67^o N (Norwegian statistical areas 06 and 07) were NCC type. Although the proportion is lower, there is significant biomass of NCC north of 67^o N (Table 2.4).

Table 2.10a and Figure 2.9 also show the proportions of coastal cod in the survey samples by age for the total area in the years 2003-2006. The proportion is rather stable between years, but is consistently higher for young fish compared to old; around 0.85 for ages 2 and 3, dropping linearly to about 0.5 for age 10.

Table 2.10b shows, for the coastal cod survey, the estimated numbers of NEA cod in number and biomass by age and statistical areas during the 2006, 2005, 2004 and 2003.

It must be emphasised that the Norwegian coastal surveys have been conducted in August-November, and there is usually more NEA cod in the coastal areas at other times of the year, especially during the spawning season in the late winter. This is reflected in the commercial sampling as shown in Table 2.2b.

2.2.3 Weight-at-age (Tables 2.7 and 2.11)

As observed in the 2006 survey (Tables 2.7) there is a general tendency for costal cod to have higher weight-at-age when caught in the southernmost area. The same tendency is found for the surveys in 1995-2006. The earlier method of calculating mean weight at age within each of the 7 statistical areas of the survey introduced some noise due to a low number of cod sampled in some statistical areas. Table 2.11 show the survey time series of weight calculated from weights by area. The table also show an alternative series based on merged data.

2.2.4 Maturity-at-age (Tables 2.6, 2.12)

The maturity-at-age is estimated from the data collected at the coastal survey. The age at 50% maturity (M_{50}) for the NCC was near 5 in 2006 survey (Tables 2.6, 2.12). As for the weights at age (sec. 2.2.3) the estimates of maturity are influenced by uncertain values in areas where few fish are sampled. In addition, the survey is conducted in the period October/November, a period when maturation stages are difficult to interpret. Therefore, much of the year to year variation observed might not be real, and a fixed long term average could be a reasonable alternative.

2.3 Data available for the Assessment

2.3.1 Catch-at-age (Table 2.9)

The catches of coastal cod are calculated splitting the total catches of cod caught inside the 12 n.mile zone into coastal cod and Northeast Arctic cod based on commercial catch samples. The proportion coastal cod is estimated by classification of the otoliths (see chapter 2.2.2).

The catch-at-age (2-10+) for the period 1984-2005 is given in Table 2.1.

The total landings of coastal cod are expected to be severely underestimated. In addition to the official landings from commercial vessels an unknown amount of coastal cod is landed both from tourist fishing, and from recreational fishing activity by Norwegian citizen. Two different investigations have estimated the amount of cod landed from these two activities and the reports were published in 2003 (in Norwegian). A summary of these two reports was presented as a WD to the 2005 WG (WD 23). The unreported catch of coastal cod in 2003 was estimated to approximately 9.300 tonnes from the recreational fishing activity and 500-800 tonnes from the tourist fishing. This sums up to almost 30% of the official landings of coastal cod in 2003. There have also been conducted two investigations trying two estimate the level of discarding and misreporting from the coastal vessels in two periods (2000 and 2002-2003, WD 14 at 2002 WG). The amount of the discard was calculated and the report from the 2000-investigation concluded there was both discard and misreport by species in 2000. Landings of cod with gillnet should be increased by approximately 8-10%. 1/3 of this is probably Coastal cod. The last report concluded that misreporting in the Norwegian coastal gillnet fisheries have been reduced significantly since 2000.

Dependent on financing, the Institute of Marine Research in co-operation with other organizations plan to conduct an improved enquiry about every fifth year to estimate and monitor the more general recreational fishing activity. The Institute of Marine Research in cooperation with the Directorate of Fisheries, Statistics Norway and relevant tourist organizations have this year started a 3-year project “Coastal fish resources: the foundation for tourist fishing and related commerce”, financed by the Norwegian Research Council (NRC), to estimate the catches taken by tourists in Norway.

Although it certainly has been unreported catches for a long period, there are no available data for other years. It is also unknown whether the amount of unreported catch fluctuates with the stock size or with other factors. The WG therefore considered that unreported landings should not be included in the assessment until data is available for a longer time period.

2.3.2 Weight-at-age (Table 2.10, 2.11)

Weights at age in catches are derived from the commercial sampling and is shown in table 2.13

The weight-at-age in the stock is obtained from the Norwegian coastal survey (Table 2.11). The survey is covering the distribution area of the stock. Weight-at-age from the survey is therefore assumed to be a relevant measure of the weight-at-age in the stock at survey time (October). These weights will, however, overestimate the stock biomass at start of the year.

2.3.3 Natural mortality

A fixed natural mortality of 0.2 is assumed.

2.3.4 Maturity-at-age (Tables 2.6, 2.12)

The maturity ogive data in 2005 is obtained from the Norwegian coastal survey (Tables 2.6, 2.13). The observed maturity at age does not show any strong time trends, and a fixed long term average could be a reasonable alternative.

2.3.5 Tuning data (Table 2.7)

In previous assessments (until 2002) the acoustic indices (age 2-9) from the Norwegian coastal survey conducted late autumn (1995-2001) has been used in the tuning (Table 2.7). ACFM proposed in 2002 to exclude age group 9 from the tuning fleet due to high S.E. (log q) for this age group. The S.E. (log q) was slightly lower for several ages when excluding age 9, and the WG in 2003 therefore decided to exclude it in the tuning in the 2003 assessment. The same age groups are used in the 2004, 2005 and this year’s assessment.

2.4 Data screening and exploratory runs

2.4.1 Data screening

The survey section (2.3) gives some screening of the survey data by age and statistical areas and by otolith type.

Catch at age. Log catch number by cohort is shown for the age span 2-9 in and for the age span 4-9 in Figure 2.10. For age span 2-9 the figure is difficult to read, but it illustrates that catches of age 2 and 3 are rather low and not well related to cohort size. Also the older ages (ages 4-9) shows some large variation in exploitation at age. Some of this variation might be caused by uncertainties both in total landings and the age composition. In the fishing years 1991-1997 the maximum catch of the cohorts (1984-1990 year-classes) is obtained rather late in their life and does not drop very much even at age 9. This could be linked to rather low total cod quotas in the first years of the period, allowing for high survival to older ages, but the shifts in Figure 2.10 occurs unreasonably sudden between the year-classes 1982 and 1983 and between the year-classes 1990 and 1991. The same series of year-classes also differs from the rest of the series in Figure 2.11, a plot of average log catch ratios for ages 4-7 compared to F(4-7) taken from an exploratory xsa-run, both calculated along cohorts.

The log catch ratio at age R_a for a cohort has been calculated as:

$R_a=\ln(C_a/C_{a+1})$ where C_a and C_{a+1} are the catch numbers at age a and a+1

This is a function of mortality, selection pattern and fishing power. Any of these might have varied. In addition, changes in geographical distribution and possible misclassification of otoliths could have contributed to this.

2.4.1.1 Exploratory XSA runs;

The 2005 xsa run was updated by use of the revised catch numbers for 2004-2005 and a run with the same settings including 2006 catches and survey was made….

The survey plots (Figure 2.2) shows that the variations seen in age 2 is not well reflected in ages 3 and 4 in following years, indicating that the tuning series might improve by leaving out this age group. Plots of residual log catchability (q) further indicate a declining trend (Figure 2.13, 2.14). A particular high positive residual is observed for most ages in 1997. This implies that the tuning results could be sensitive to the length and yearly weighting (time taper) of the tuning series. A series of runs were made with starting years changed from 1995 (earlier used) stepwise to 2001 and with tricubic time taper (earlier used) and uniform taper (equal weight for all years). In these runs the catchability plateau were kept at age 8 and shrinkage kept at 1.0 (both as used earlier), while age 2 was left out from the survey data. The results are shown in Figures 2.12-2.14. Clear trends in residual log catchability is observed. Thereby when leaving out (or down-weighting by strong taper) the early years in the time series, the stock development in later years appear more optimistic. In particular, reducing the effect of the 1997 survey has strong effect on the results. It is also observed that the relative catchability at age and Rsquare values are quite sensitive to the shortening of the time series.

The patterns seen in the catch matrix (figures 2.10-2.11) could indicate that some of the revealed problems may derive from the catch matrix, and the survey series itself is considered as a more relevant stock indicator than the xsa results. Further studies both on the catches and the survey data is required for improving the basis for stock assessment.

The xsa shrinkage and the catchability plateau have been questioned in some earlier assessments. The exploratory run indicates declining catchability with age from a maximum around age 5 and 6. As seen in both the surveys and catch at age there could be some inconsistencies in the data on old fish. Some exploratory sensitivity analyses were made with plateau at age 7 and 6 compared to the earlier used 8. The shrinkage was also changed to 0.5 and 2.0, compared to 1.0 used last year. Figure 2.12. The change in shrinkage alone had small impact compared to changing both shrinkage and plateau simultaneously.

2.5 Methods Used in the updated xsa-run

2.5.1 VPA and tuning (Table 2.12-13)

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 independent for all ages..

2) Catchability was set to be age independent for ages 8 and older.

3) The survivors estimate was shrunk towards the mean F of the final 2 years since the exploitation pattern has changed in the last few years (see 2.4.2.2). The 4 oldest ages are used in the shrinkage to stabilize fluctuations in historical F-values for ages 8 and above.

4) The standard error of the mean to which the survivor estimates are shrunk was set to 1.0 (Table 2.8). It was set above the default level because the coastal survey has shown a steadily decline in the latest years. The WG assumes the survey is reflecting the development of the stock and more weight is therefore assigned to the survey.

2.6 Results of the Assessment

2.6.1 Indicators of stock biomass and mortality trends (Table 2.9 and 2.13, Figure 2.15-16)

Figures 2.15 and 12.16 compares stock trends in survey and xsa. In spite of the data problems discussed there are some overall agreements. The main difference appears for the recent years where the survey gives a slightly more optimistic impression than the xsa. The retrospective xsa-pattern described in last years report concluded that the recent tendency for the xsa has been to overestimate F and underestimate SSB. The conclusion is that the resent trend in th survey is more reliable than the xsa. Even with this in mind the conclusion is clear that the stock is at a considerably lower level than in the mid 90-ies.

2.6.2 Recruitment (Tables 2.7, 2.15, 2.19)

The survey estimates of young age groups (2-4) in 2006 is quite low, but not quite as low as in the 3 preceding years. There is therefore no signs of rebuilding of the stock.

2.7 Comments to the Assessment

2.7.1 Comparison of this years assessment with last years assessment

Fishing mortalities in the assessment year tend to be overestimated while SSB tends to be underestimated as seen in the table below. The 2006 updated assessment is also compared to the 2005, updated with revised catches for 2004 and 2005 and revised stock weights (2005 upd):

Assessment year	F_{4-7} (2005)	SSB year 2005	Total stock biomass 2005	Recruits age 2 year 2005
2005	0.72	35943	62163	4248
2005 upd	0.63	34236	55296	3969
2006	0.36	51438	84297	7539

2.7.2 Uncertainties in the assessment

- The landings of Coastal cod are severely underestimated (see 2.3.1). Although unreported catches have certainly existed for a long period, there are no available data for years other than 2003. Also, it is unknown whether the amount of unreported catch fluctuates with the stock size or with other factors. The WG therefore considered that unreported landings should not be included in the assessment until data is available for a longer time period.
- The Norwegian coastal survey is the only survey covering the distribution area of the stock. The survey is conducted in the period October/November. In this period the maturity ogive can be difficult to define exactly and might influence the estimation of maturity-at-age and hence the estimation of SSB.
- The catches and survey indices are estimated by separating coastal cod and Northeast Arctic cod by inspection of the otoliths. The precision and accuracy of the method has been investigated by comparison of different otolith readers and results from genetic investigation of the same otoliths. Preliminary results indicate more than 95 % accuracy in the estimates (Berg et al., 2005).
- The retrospective pattern shows an overestimation of the F-values in the assessment year. The stock has been steadily declining for several years now. However, the catches are quite high, which tends to push the historical stock upwards and the fishing mortality downwards. The accuracy of the estimated number might therefore be uncertain in the assessment year.
- The Norwegian coastal survey in 2003-2005 covered a larger area than the coastal surveys in 1995-2002. However, the survey indices are calculated the same way as previous years using the same covering area as in the previous surveys. The survey index in 2003-2005 might still suffer from this.

The substantial level of unreported landings of coastal cod (WD 23, 2005 WG) increases the uncertainty on the absolute level of both the total stock, SSB, recruitment and fishing mortality considerably. Assuming the amount of unreported landings has fluctuated with the official landings and the age composition in the unreported landings is equal to the official landings, the assessment is considered to show the trends in the stock. This assumption is supported by the fact that the trend in the total stock, the SSB and recruitment is the same in the survey. The assessment is therefore considered to reflect the trend in the stock. The level of SSB and recruitment is uncertain but considered to show a clear stock-recruitment pattern. The 5 last and lowest observed year classes are all produced by the 5 last and lowest observed SSB. The recruitment is therefore clearly impaired at the SSB levels observed the last few years.

2.8 Reference points

No reference points have been established for this stock. The WG has not tried to calculate reference points for this stock during this years meeting. Although the exact amount is unknown, the historical unreported landings are considered to be rather high compared with the official landings. The historical level of the total stock, SSB and recruitment are therefore considered to be severely underestimated.

The level of SSB and recruitment is uncertain but considered to show a clear stock-recruitment pattern. The 5 last and lowest observed year classes are all produced by the 5 last and lowest observed SSB. The recruitment is therefore clearly impaired at the SSB levels observed the last few years. At present, the SSB is well below the level where recruitment is impaired and below any $\mathbf{B}_{\text{lim}}$ candidate with or without taking the unreported catch into consideration.

2.9 Management considerations

Although the absolute level in SSB is uncertain, the survey indices for all years after 2001 are consistently much lower than the indices in the late 90-ies. This applies both for the recruits and older age groups.

New regulations for coastal cod became operative in May 2004 and extended in 2005 and has been slightly modified in 2006 and 2007 (see chapter 2.1.2). In accordance with the precautionary approach and the state of the stock, the new regulations should be closely evaluated. These regulations have reduced the effort from vessels larger than 15 m in the inner coastal areas and fjords. The estimated catch has declined somewhat over those years with additional regulations. As described there are uncertainties in catch estimation. It seems, however, rather clear that the fisheries have to be much more restricted to bring the catches down towards zero.

2.10 Response to ACFM technical minutes

The working group appreciated the suggestions from the last review group, and have tried to follow up their suggestions. Some catch curve analyses are made. More details on survey results are presented. The time and space variations in coastal cod /arctic cod ratios is better documented both for survey samples and commercial samples.

Table 2.1. Norwegian coastal cod. Estimated landings in numbers ('000) at age, and total tonnes by year.

	Age									Tonnes
	2	3	4	5	6	7	8	9	10+	landed
1984	829	3478	6954	7278	6004	4964	2161	819	624	74824
1985	396	7848	7367	8699	7085	3066	705	433	264	75451
1986	4095	4095	12662	8906	5750	3868	1270	342	407	68905
1987	170	940	8236	12430	4427	2649	1127	313	149	60972
1988	110	1921	3343	6451	6626	4687	1461	497	333	59294
1989	41	1159	1434	2299	5197	2720	949	236	86	40285
1990	7	349	1233	1330	1129	3456	773	141	73	28127
1991	125	607	1452	3114	1873	1297	873	132	94	24822
1992	40	665	3160	4422	2992	1945	898	837	279	41690
1993	4	369	1706	2343	2684	3072	1871	627	690	52557
1994	332	573	1693	4302	2467	3337	1514	777	798	54562
1995	810	896	2345	5188	5546	3270	1455	557	433	57207
1996	1193	2376	2480	4930	4647	4160	2082	898	543	61776
1997	1326	3438	3150	2258	2490	3935	3312	959	684	63319
1998	554	2819	4786	4023	2272	1546	1826	975	343	51572
1999	252	1322	2346	4263	2773	1602	751	774	320	40732
2000	156	971	3664	3807	2671	1104	326	132	152	36715
2001	44	505	1837	2974	1998	1409	542	187	119	29699
2002	192	893	2331	2822	2742	1538	915	325	377	40994
2003	81	1107	2094	2506	2158	1374	598	258	99	34635
2004	12	306	924	1713	1820	1444	609	226	264	24547
2005	15	474	1299	1828	1436	1115	513	188	143	22432
2006	71	315	1656	1695	1695	1246	671	326	224	26134

Table 2.2a Number of otoliths sampled from commercial catches in the period 1985-2006. CC=coastal cod, NEAC=Northeast Arctic cod.

YEAR	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4		TOTAL		
Year	CC	NEAC	CC	NEAC	CC	NEAc	CC	NEAC	CC	NEAC	% CC
1985	1451	3852	777	1540	1277	1767	1966	730	5471	7889	41
1986	940	1594	1656	2579	0	0	669	966	3265	5139	39
1987	1195	2322	937	3051	638	1108	1122	1137	3892	7618	34
1988	257	546	160	619	87	135	55	44	559	1344	29
1989	556	1387	72	374	65	501	97	663	790	2925	21
1990	731	2974	61	689	252	97	265	674	1309	4434	23
1991	285	1168	92	561	77	96	279	718	733	2543	22
1992	152	619	281	788	79	82	272	672	784	2161	27
1993	314	1098	172	1046	0	0	310	541	796	2685	23
1994	317	1605	179	923	21	31	126	674	643	3233	17
1995	188	1591	232	1682	2095	1057	752	1330	3267	5660	37
1996	861	5486	591	1958	1784	1076	958	2256	4194	10776	28
1997	1106	5429	367	2494	1940	894	1690	1755	5103	10572	33
1998	608	4930	552	1342	489	1094	2999	2217	4648	9583	33
1999	1277	4702	493	2379	202	717	961	1987	2933	9785	23
2000	1283	4918	365	2112	386	1295	472	668	2506	9993	20
2001	1102	5091	352	2295	126	786	432	983	2012	9155	18
2002	823	5818	321	1656	503	831	897	1355	2544	9660	21
2003	821	4197	445	2850	790	936	1112	1286	3168	9269	25
2004	1511	7539	758	2565	532	685	531	1317	3332	12106	22
2005	1583	6219	767	4383	473	258	877	1258	3700	12188	23
2006	2244	5087	1329	2819	590	271	119	71	4282	8248	34

Table 2.2b. Landings in tonnes of Coastal cod by area and quarter 2003-2006 (upper 4 tables) Proportion (of total) coastal cod in landings by area and quarter 2003-2006 (lower 4 tables).

Year	2003 Landings					
Qu./Area	03	04	00	05	06-07	Total
1	190	3374	8358	3554	5300	**20777**
2	529	1018	1688	381	1829	**5444**
3	432	1572	348	571	525	**3448**
4	582	2066	1090	856	371	**4966**
Total	**1734**	**8030**	**11484**	**5363**	**8025**	**34635**

Year	2004 Landings					
Qu./Area	03	04	00	05	06-07	Total
1	616	4693	3516	3942	2622	**15389**
2	1104	989	608	315	1315	**4330**
3	360	951	431	438	439	**2619**
4	182	611	881	204	331	**2209**
Total	**2262**	**7243**	**5436**	**4899**	**4707**	**24547**

Year	2005 Landings					
Qu./Area	03	04	00	05	06-07	Total
1	587	2972	2449	1245	3131	**10384**
2	1741	1851	610	872	1579	**6652**
3	287	826	341	225	484	**2164**
4	553	785	830	684	378	**3230**
Total	**3169**	**6434**	**4230**	**3027**	**5572**	**22432**

Year	2006 Landings					
Qu./Area	03	04	00	05	06-07	Total
1	291	3483	2677	3150	4169	**13769**
2	1485	2298	601	507	1388	**6279**
3	343	893	338	635	564	**2774**
4	253	1232	444	1071	312	**3312**
Total	**2372**	**7906**	**4059**	**5363**	**6434**	**26134**

Year	2003 Proportion CC in landings					
Qu./Area	03	04	00	05	06-07	Total
1	0,05	0,21	0,27	0,13	0,96	**0,25**
2	0,10	0,10	0,33	0,08	0,71	**0,19**
3	0,20	0,57	0,79	0,76	0,99	**0,52**
4	0,19	0,76	0,77	0,36	0,99	**0,50**
Total	**0,12**	**0,25**	**0,30**	**0,16**	**0,89**	**0,27**

Year	2004 Proportion CC in landings					
Qu./Area	03	04	00	05	06-07	Total
1	0,08	0,23	0,12	0,14	0,68	**0,17**
2	0,09	0,12	0,12	0,09	0,78	**0,14**
3	0,32	0,53	0,78	0,52	0,89	**0,55**
4	0,09	0,49	0,78	0,39	0,96	**0,42**
Total	**0,10**	**0,23**	**0,16**	**0,15**	**0,74**	**0,19**

Year	2005 Proportion CC in landings					
Qu./Area	03	04	00	05	06-07	Total
1	0,09	0,22	0,12	0,05	0,89	**0,15**
2	0,11	0,14	0,12	0,16	1,00	**0,16**
3	0,26	0,70	0,91	0,50	0,89	**0,59**
4	0,23	0,52	0,92	0,50	0,97	**0,49**
Total	**0,12**	**0,22**	**0,16**	**0,10**	**0,93**	**0,19**

Year	2006 Proportion CC in landings					
Qu./Area	03	04	00	05	06-07	Total
1	0,05	0,20	0,13	0,13	0,88	**0,19**
2	0,20	0,16	0,13	0,10	0,96	**0,19**
3	0,35	0,81	0,91	0,95	0,98	**0,75**
4	0,10	0,85	0,91	0,95	0,99	**0,56**
Total	**0,15**	**0,23**	**0,15**	**0,17**	**0,91**	**0,23**

Table 2.3 Estimated survey number (x1000) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 2006.

	AGE									
Area	1	2	3	4	5	6	7	8	9	10 +	Total
03 East Finnmark	476	672	684	786	573	321	233	90	71		3906
04 W. Finnm./Troms	930	819	1186	1649	1412	1045	890	123	82	10	8146
05 Lofoten/Vesterålen	132	176	314	67	106	79	38	4		3	919
00 Vestfjord	169	121	347	239	294	210	98	66	2		1546
06 Nordland	222	684	1312	781	812	753	524	104	74		5266
07 Møre		53	206	261	275	101	28	12			936
Total	1929	2525	4049	3783	3472	2509	1811	399	229	13	20719

Table 2.4 Estimated survey biomass (tonnes) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 2006.

	Age										
Area	1	2	3	4	5	6	7	8	9	10+	Total
03 East Finnmark	29	182	601	1102	995	851	991	565	450	0	5766
04 W. Finnm./Troms	89	423	1334	3165	3325	3411	2935	477	567	73	15799
05 Lofoten/Vesterålen	18	112	408	120	285	294	196	14	0	16	1463
00 Vestfjord	23	92	532	544	1121	1000	593	414	12	0	4331
06 Nordland	32	372	1201	1156	1402	1735	2211	592	490	0	9191
07 Møre	0	40	353	610	1028	517	189	44	0	0	2781
Total	191	1221	4429	6697	8156	7808	7115	2106	1519	89	39331

Table 2.5 Estimated survey spawning stock number (x1000) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 2006.

	Age										
Area	1	2	3	4	5	6	7	8	9	10+	Total
03 East Finnmark	0	0	0	157	298	180	200	64	62	0	961
04 West Finnmark/Troms	0	0	24	181	748	784	801	113	82	10	2743
05 Lofoten/Vesterålen	0	0	0	11	32	60	38	4	0	0	145
00 Vestfjord	0	0	0	84	185	174	98	66	2	0	609
06 Nordland	0	0	0	31	406	602	482	89	74	0	1684
07 Møre	0	0	0	86	154	90	28	12	0	0	370
Total	0	0	24	550	1823	1890	1647	348	220	10	6512

Table 2.6 Estimated survey spawning stock biomass (tonnes) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 2006.

	Age										
Area	1	2	3	4	5	6	7	8	9	10+	Total
03 East Finnmark	0	0	0	220	517	477	852	401	396	0	2863
04 West Finnmark/Troms	0	0	27	348	1762	2558	2642	439	567	73	8416
05 Lofoten/Vesterålen	0	0	0	19	86	223	196	14	0	0	538
00 Vestfjord	0	0	0	190	706	830	593	414	12	0	2745
06 Nordland	0	0	0	46	701	1388	2034	509	490	0	5168
07 Møre	0	0	0	201	576	460	189	44	0	0	1470
Total	0	0	27	1024	4348	5936	6506	1821	1465	73	21200

Table 2.7 Weight (gram)-at-age (year) for Norwegian Coastal cod from the Norwegian coastal survey during the autumn 2006.

AGE										
Area	1	2	3	4	5	6	7	8	9	10+
03 East Finnmark	58	278	807	1402	1672	2987	3970	5479	8104	
04 West Finnmark/Troms	111	503	1101	1863	2607	3544	3423	3892	7618	14650
05 Lofoten/Vesterålen	133	589	1282	1823	2712	3802	5780	4574		
00 Vestfjord	138	766	1602	2368	3576	4969	6215	5819	5330	
06 Nordland	143	538	890	1474	1752	2335	3161	6031	5405	
07 Møre		616	1877	2263	3767	6004	7724	3625		
Weighted average	105	474	1080	1746	2430	3326	3684	5125	7028	14650

Table 2.8 Percent mature at age for Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 2006.

AGE										
Area	1	2	3	4	5	6	7	8	9	10+
03 East Finnmark	0	0	0	20	52	56	86	71	88	
04 West Finnmark/Troms	0	0	2	11	53	75	90	92	100	100
05 Lofoten/Vesterålen	0	0	0	16	30	76	100	100		
00 Vestfjord	0	0	0	35	63	83	100	100	100	
06 Nordland	0	0	0	4	50	80	92	86	100	
07 Møre		0	0	33	56	89	100	100		
Weighted average	0	0	0	14	52	75	91	87	96	100

Table 2.9 Estimated survey numbers at age (x1000) of Norwegian Coastal cod from the coastal surveys from 1995-2006.

AGE											
YEAR	1	2	3	4	5	6	7	8	9	10+	Biom 4+
1995	28707	20191	13633	15636	16219	9550	3174	1158	781	579	118469
1996	1756	17378	22815	12382	12514	6817	3180	754	242	5	79497
1997	30694	18827	28913	17334	12379	10612	3928	1515	26	663	117886
1998	14455	13659	15003	13239	7415	3137	1578	315	169	128	52184
1999	6850	11309	12171	10123	7197	3052	850	242	112	54	44766
2000	9587	11528	11612	8974	7984	5451	1365	488	85	97	57961
2001	8366	6729	7994	7578	4751	2567	1493	487	189	116	41607
2002	1329	2990	4103	4940	3617	2593	1470	408	29	128	31598
2003	2084	2145	3545	3880	2788	2389	1144	589	364	80	33174
2004	3217	3541	3696	4320	2758	1940	783	448	98	110	24716
2005	1443	1843	3525	3198	3217	1700	1120	552	330	78	27415
2006	1929	2525	4049	3783	3472	2509	1811	399	229	13	30852

Table 2.10a. Proportion coastal cod among sampled cod during the coastal survey by age and statistical areas in the years 2004-2006.

Year	Area/Age	2	3	4	5	6	7	8	9	10+
2003	3	0,86	0,79	0,77	0,78	0,71	0,76	0,58	0,49	0,06
2003	4	0,97	0,95	0,92	0,87	0,84	0,80	0,79	0,72	0,65
2003	5	1,00	0,95	0,84	0,90	0,97	0,92	1,00	0,55	0,12
2003	0	0,99	0,80	0,92	0,88	0,88	0,70	0,51	0,65	0,89
2003	6	0,74	0,79	0,72	0,71	0,77	0,64	0,69	0,84	0,00
2003	7	0,50	0,54	0,87	0,66	0,76	0,93	0,83	0,80	
2003	Weighted average	0,91	0,86	0,84	0,80	0,81	0,74	0,68	0,64	0,38
2004	3	0,61	0,62	0,35	0,43	0,39	0,34	0,45	0,33	0,69
2004	4	0,84	0,83	0,74	0,76	0,77	0,47	0,77	0,44	0,44
2004	5	0,80	0,89	0,82	0,79	0,62	0,85	0,75	0,50	0,20
2004	0	1,00	0,94	0,94	0,60	0,85	1,00	1,00	1,00	0,07
2004	6	0,85	0,94	0,86	0,85	0,74	0,77	0,64		1,00
2004	7	0,98	0,96	0,99	0,97	0,90	0,91	0,75	1,00	
2004	Weighted average	0,77	0,80	0,68	0,69	0,70	0,60	0,68	0,40	0,55
2005	3	0,63	0,54	0,54	0,45	0,35	0,30	0,20	0,48	0,03
2005	4	0,96	0,91	0,76	0,74	0,71	0,60	0,76	0,81	0,50
2005	5	0,00	0,54	0,65	0,68	0,52	1,00	1,00		0,67
2005	0	0,11	0,39	0,70	0,61	0,70	0,85	0,50		1,00
2005	6	1,00	1,00	0,93	0,87	0,81	0,81	0,59	0,96	
2005	7	1,00	1,00	1,00	1,00	1,00	0,86	0,67		0,00
2005	Weighted average	0,83	0,84	0,80	0,72	0,67	0,71	0,56	0,84	0,37
2006	3	0,79	0,77	0,63	0,59	0,45	0,37	0,30	0,39	0,00
2006	4	1,00	0,88	0,84	0,79	0,68	0,63	0,82	0,40	0,42
2006	5	1,00	0,98	0,81	0,88	0,77	0,63	0,80	0,00	0,50
2006	0	0,99	0,99	0,95	0,87	0,86	0,89	0,85	0,33	
2006	6	1,00	1,00	0,95	0,99	0,80	0,72	1,00	0,67	
2006	7	1,00	0,97	0,95	0,98	0,89	1,00	0,50		
2006	Weighted average	0,93	0,92	0,81	0,80	0,69	0,61	0,61	0,45	0,38

Table 2.10 b. Estimated number (x1000) of Northeast Arctic cod in the coastal survey autumn 2006

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	0	0	1	2	12	44	34	12	12	4	.	121
3	5	11	181	204	462	395	396	399	206	111	5	2375
4	46	5	4	157	315	384	487	520	27	123	14	2081
5	0	0	0	6	16	15	23	22	1	6	3	92
6	0	52	0	0	45	10	186	200	0	37	.	531
7	0	.	0	6	13	6	12	0	12	.	.	50
All	51	68	185	375	863	855	1138	1154	258	282	21	5250

Table 2.10 b. Estimated biomass (tonnes) of Northeast Arctic cod in the coastal survey autumn 2006

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	0	0	0	5	41	173	156	66	66	24	.	531
3	0	1	48	196	887	867	1123	2224	1366	881	52	7646
4	0	1	1	142	599	997	1594	1860	91	1533	76	6894
5	0	0	0	8	23	40	81	140	5	45	16	357
6	0	13	0	0	197	23	590	693	0	132	.	1648
7	0	.	0	18	36	18	44	0	44	.	.	161
All	0	16	49	369	1784	2118	3587	4982	1573	2615	143	17237

Table 2.10 b. Estimated number (x1000) of Northeast Arctic cod in the coastal survey autumn 2005

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	59	8	169	33	26	184	17	20	56	.	0	572
3	727	448	168	540	353	395	333	137	141	26	60	3328
4	2752	20	22	103	279	359	264	158	57	31	16	4061
5	77	9	22	12	37	72	62	0	0	.	25	315
6	214	25	3	0	87	212	153	108	177	7	.	985
7	0	0	0	0	0	0	0	38	6	.	32	76
All	3829	510	383	689	781	1222	828	461	437	64	134	9337

Table 2.10 b. Estimated biomass (tonnes) of Northeast Arctic cod in the coastal survey autumn 2005

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	1	0	139	27	87	529	35	134	174	.	0	1125
3	5	23	57	405	429	760	785	430	570	143	813	4420
4	17	1	11	102	517	872	943	854	202	110	289	3918
5	1	0	11	18	78	150	213	0	0	.	718	1189
6	2	1	0	0	181	490	422	272	1298	13	.	2679
7	0	0	0	0	0	0	0	356	65	.	638	1059
All	26	25	218	552	1292	2802	2398	2045	2309	266	2458	14391

Table 2.10 b. Estimated number (x1000) of Northeast Arctic cod in the coastal survey autumn 2004

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	0	40	0	21	43	170	78	0	0	0	13	365
3	2185	322	574	474	1369	611	316	183	72	90	22	6217
4	787	118	363	353	406	234	221	237	61	53	19	2852
5	2	0	17	22	57	44	40	12	18	4	35	251
6	0	10	78	40	171	170	150	76	57	.	0	752
7	4	0	1	5	3	5	8	5	1	0	.	33
All	2978	490	1033	915	2050	1234	812	513	210	146	89	10470

Table 2.10 b. Estimated biomass (tonnes) of Northeast Arctic cod in the coastal survey autumn 2004

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10	Tot
0	0	2	0	26	73	676	273	1	1	1	206	1259
3	39	11	178	372	1507	1143	960	689	558	585	86	6129
4	5	26	169	335	627	527	752	1161	352	356	229	4539
5	0	0	11	25	136	167	211	64	131	17	631	1392
6	0	2	21	39	300	336	438	257	372	.	0	1765
7	0	0	0	6	3	28	32	28	12	0	.	109
All	44	41	380	803	2646	2877	2666	2201	1426	959	1152	15193

Table 2.10 b. Estimated number (x1000) of Northeast Arctic cod in the coastal survey autumn 2003

Area	0	1	2	3	4	5	6	7	8	9	10	Tot
	Age											
0	37	28	3	55	59	49	88	91	84	24	1	519
3	21	268	102	286	300	222	204	63	70	36	47	1618
4	27	45	29	67	124	140	147	120	75	59	35	868
5	14	2	0	9	44	11	4	3	0	82	23	192
6	3	1	86	178	194	243	96	119	49	5	23	999
7	.	.	3	6	12	14	11	1	2	1	0	50
All	102	344	223	601	734	679	550	396	281	208	128	4246

Table 2.10 b. Estimated biomass (tonnes) of Northeast Arctic cod in the coastal survey autumn 2003

Area	0	1	2	3	4	5	6	7	8	9	10	Tot
	Age											
0	0	1	1	52	74	103	358	520	656	281	16	2063
3	0	15	26	178	312	400	616	291	341	249	808	3239
4	0	6	8	80	202	346	452	468	344	406	598	2909
5	0	0	0	12	94	26	9	7	1	918	488	1555
6	0	0	71	152	229	507	213	461	200	12	260	2105
7	.	.	3	7	28	52	51	10	26	13	0	189
All	1	22	109	480	939	1434	1699	1757	1568	1881	2171	12060

Table 2.11 Mean weight at age calculated from survey data. The upper series based on area means has been used in earlier assessments.

Weighted average of mean weights by statistical rectangle									
Year	2	3	4	5	6	7	8	9	10
1984-94	0.32	0.76	1.48	2.14	2.81	4.72	6.69	6.98	9.72
1995	0.39	0.79	1.53	2.22	2.88	4.67	6.98	6.76	9.90
1996	0.25	0.72	1.43	2.05	2.75	4.72	6.69	6.93	9.72
1997	0.24	0.68	1.36	1.89	2.82	4.43	6.41	7.81	10.83
1998	0.37	0.88	1.46	2.11	2.95	4.32	5.63	8.32	12.47
1999	0.32	0.84	1.68	2.19	2.86	4.54	6.58	9.45	12.90
2000	0.37	0.81	1.55	2.54	3.05	4.35	6.20	8.53	12.07
2001	0.40	0.97	1.52	2.31	3.32	3.70	6.14	8.77	12.47
2002	0.43	0.90	1.74	2.43	3.13	4.27	4.40	7.76	12.99
2003	0.38	0.74	1.31	2.10	3.04	3.88	4.81	6.08	9.95
2004	0.35	0.83	1.69	2.26	3.31	4.15	4.59	6.49	9.73
2005	0.37	0.79	1.50	2.18	3.18	4.01	4.70	6.29	9.84
2006	0.47	1.08	1.75	2.43	3.34	3.68	5.13	7.03	14.65
Direct mean weights of all fish sampled (merged data)									
1984-94	0.32	0.76	1.48	2.14	2.81	4.72	6.69	6.98	9.72
1995	0.30	0.70	1.34	1.97	2.65	4.16	7.05	6.41	14.33
1996	0.27	0.72	1.44	2.04	2.69	4.82	6.28	11.37	15.67
1997	0.23	0.68	1.36	1.90	2.82	3.83	5.85	9.60	13.04
1998	0.32	0.83	1.37	2.08	3.01	4.26	5.31	8.35	18.02
1999	0.32	0.80	1.56	2.04	2.80	4.68	7.15	8.96	18.34
2000	0.35	0.78	1.46	2.30	2.74	4.05	7.01	9.22	12.28
2001	0.35	0.88	1.54	2.21	2.86	3.32	4.85	7.34	11.54
2002	0.43	0.88	1.70	2.45	3.54	4.40	4.19	7.05	15.62
2003	0.31	0.69	1.30	2.15	3.14	4.05	5.01	5.79	10.07
2004	0.34	0.83	1.61	2.27	3.29	4.12	4.72	4.98	6.36
2005	0.41	0.85	1.75	2.20	2.69	3.82	3.80	5.34	14.83
2006	0.49	1.13	1.81	2.56	3.58	3.96	4.82	7.33	14.65

Table 2.12. Diagnostics of the updated xsa

```
Lowestoft VPA Version 3.1
   24/04/2007   9:58
 Extended Survivors Analysis
 Norwegian Coastal Cod,COMBSEX,PLUSGROUP
 CPUE data from file c:\coast-9.txt
 Catch data for  23 years. 1984 to 2006. Ages  2 to  10.
      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 Norw. Coast. survey ,   1995, 2006,    0,     8,   .750,   .850
 Time series weights :
      Tapered time weighting applied
      Power =    3 over  20 years
 Catchability analysis :
      Catchability independent of stock size for all ages
      Catchability independent of age for ages >=    8
 Terminal population estimation :
      Survivor estimates shrunk towards the mean F
      of the final   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   30 iterations


 Total absolute residual between iterations
 29 and  30 =     .00679

 Final year F values
 Age          ,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 29,  .0081,  .0582,  .2918,  .5365,  .7007,  .6060,  .6052,  .5226
 Iteration 30,  .0081,  .0582,  .2917,  .5361,  .7002,  .6060,  .6031,  .5191



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



 Fishing mortalities
    Age,  1997,  1998,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006

      2,  .045,  .020,  .011,  .008,  .002,  .014,  .008,  .001,  .002,  .008
      3,  .126,  .127,  .061,  .054,  .030,  .063,  .105,  .039,  .058,  .058
      4,  .189,  .260,  .148,  .238,  .136,  .191,  .204,  .120,  .231,  .292
      5,  .254,  .392,  .390,  .380,  .310,  .319,  .322,  .257,  .368,  .536
      6,  .480,  .439,  .518,  .454,  .352,  .525,  .432,  .412,  .357,  .700
      7,  .682,  .630,  .643,  .401,  .463,  .505,  .550,  .582,  .480,  .606
      8,  .787,  .807,  .735,  .254,  .350,  .629,  .374,  .505,  .420,  .603
      9,  .764,  .562, 1.028,  .265,  .227,  .367,  .359,  .235,  .285,  .519
```

Table 2.12. Diagnostics of the updated xsa….cont

```
1
 XSA population numbers (Thousands)

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

 1997 ,    3.34E+04, 3.20E+04, 2.02E+04, 1.11E+04, 7.22E+03, 8.80E+03, 6.72E+03, 1.98E+03,
 1998 ,    3.09E+04, 2.61E+04, 2.31E+04, 1.37E+04, 7.07E+03, 3.66E+03, 3.64E+03, 2.51E+03,
 1999 ,    2.54E+04, 2.48E+04, 1.88E+04, 1.46E+04, 7.58E+03, 3.73E+03, 1.60E+03, 1.33E+03,
 2000 ,    2.30E+04, 2.06E+04, 1.91E+04, 1.33E+04, 8.08E+03, 3.70E+03, 1.61E+03, 6.27E+02,
 2001 ,    1.99E+04, 1.87E+04, 1.60E+04, 1.23E+04, 7.45E+03, 4.20E+03, 2.03E+03, 1.02E+03,
 2002 ,    1.52E+04, 1.63E+04, 1.48E+04, 1.14E+04, 7.42E+03, 4.29E+03, 2.17E+03, 1.17E+03,
 2003 ,    1.09E+04, 1.23E+04, 1.25E+04, 1.00E+04, 6.80E+03, 3.59E+03, 2.12E+03, 9.45E+02,
 2004 ,    1.14E+04, 8.83E+03, 9.04E+03, 8.35E+03, 5.96E+03, 3.62E+03, 1.70E+03, 1.19E+03,
 2005 ,    7.54E+03, 9.36E+03, 6.95E+03, 6.56E+03, 5.29E+03, 3.23E+03, 1.65E+03, 8.38E+02,
 2006 ,    9.78E+03, 6.16E+03, 7.23E+03, 4.51E+03, 3.72E+03, 3.03E+03, 1.64E+03, 8.90E+02,

 Estimated population abundance at 1st Jan 2007

    ,     0.00E+00, 7.95E+03, 4.76E+03, 4.43E+03, 2.16E+03, 1.51E+03, 1.35E+03, 7.37E+02,

 Taper weighted geometric mean of the VPA populations:

    ,     1.94E+04, 1.75E+04, 1.53E+04, 1.17E+04, 7.91E+03, 4.81E+03, 2.52E+03, 1.30E+03,

 Standard error of the weighted Log(VPA populations) :

    ,        .5866,    .5694,    .4927,    .4865,    .4525,    .4719,    .5095,    .5079,
1
```

Table 2.12. Diagnostics of the updated xsa (Contd)

Log catchability residuals.

Fleet : Norw. Coast. survey

Age	1995	1996
2	.57	.26
3	.28	.57
4	.40	.40
5	.17	.66
6	-.13	-.11
7	-.05	-.39
8	.02	-.21

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2	.54	.28	.28	.39	.00	-.54	-.54	-.09	-.33	-.27
3	.67	.22	.01	.14	-.15	-.65	-.48	-.16	-.26	.30
4	.53	.18	.03	-.04	-.11	-.42	-.48	-.11	-.06	.12
5	.71	.10	.01	.20	-.31	-.49	-.62	-.50	-.02	.57
6	1.19	-.04	-.07	.39	-.36	-.21	-.28	-.37	-.42	.59
7	.38	.31	-.32	-.03	-.02	-.02	-.06	-.42	-.03	.61
8	.23	-.71	-.21	.10	-.06	-.08	.11	.16	.33	.16

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

Age	2	3	4	5	6	7	8
Mean Log q	-.9192	-.5144	-.3711	-.2414	-.2649	-.4843	-.9304
S.E(Log q)	.3944	.3993	.3023	.4593	.4739	.3142	.2739

Table 2.12. Diagnostics of the updated xsa….cont

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	.63	4.375	4.19	.94	12	.15	-.92
3	.78	1.207	2.56	.77	12	.30	-.51
4	.82	.930	2.00	.76	12	.25	-.37
5	1.06	-.155	-.31	.43	12	.51	-.24
6	1.21	-.453	-1.52	.36	12	.60	-.26
7	1.14	-.502	-.60	.61	12	.37	-.48
8	1.19	-.856	-.35	.71	12	.33	-.93

1

Terminal year survivor and F summaries :

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

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Norw. Coast. survey	6072.	.413	.000	.00	1	.853	.011
F shrinkage mean	38134.	1.00				.147	.002

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7949.	.38	.70	2	1.844	.008

Table 2.12. Diagnostics of the updated xsa (Contd)

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

 Year class = 2003

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,      4679.,   .294,       .315,   1.07,   2,  .916,     .059

   F shrinkage mean  ,      5742.,   1.00,,,,                        .084,     .048

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4760.,       .28,      .22,    3,    .770,   .058


1
 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 2002

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,      4271.,   .215,       .110,    .51,   3,  .940,     .301

   F shrinkage mean  ,      7768.,   1.00,,,,                        .060,     .176

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      4427.,       .21,      .12,    4,    .576,   .292
```

Table 2.12. Diagnostics of the updated xsa….cont

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

 Year class = 2001

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,      2052.,   .198,       .209,   1.06,   4,  .925,     .558

   F shrinkage mean  ,      4153.,   1.00,,,,                        .075,     .314

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      2164.,       .20,      .20,    5,   1.007,   .536


1
 Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 2000

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,      1399.,   .188,       .197,   1.05,   5,  .906,     .740

   F shrinkage mean  ,      3247.,   1.00,,,,                        .094,     .387

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1514.,       .19,      .20,    6,   1.045,   .700
```

Table 2.12. Diagnostics of the updated xsa (Contd)

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

 Year class = 1999

 Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,      1336.,   .173,       .237,   1.37,   6,  .927,     .612

   F shrinkage mean  ,      1592.,   1.00,,,,                        .073,     .535

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1353.,       .18,      .21,    7,   1.189,   .606


1
 Age  8   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
 Norw. Coast. survey ,       719.,   .166,       .105,    .63,   7,  .931,     .612

   F shrinkage mean  ,      1022.,   1.00,,,,                        .069,     .466

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       737.,       .17,      .10,    8,    .592,   .603

Table 2.12. Diagnostics of the updated xsa….cont


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

 Year class = 1997

 Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 Norw. Coast. survey ,       448.,   .171,       .136,    .80,   7,  .901,     .506

   F shrinkage mean  ,       346.,   1.00,,,,                        .099,     .617

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       437.,       .18,      .12,    8,    .677,   .519
```

Table 2.13. Results of the updated xsa.

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

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

YEAR,	1984,	1985,	1986,
AGE			
2,	829,	396,	4095,
3,	3478,	7848,	4095,
4,	6954,	7367,	12662,
5,	7278,	8699,	8906,
6,	6004,	7085,	5750,
7,	4964,	3066,	3868,
8,	2161,	705,	1270,
9,	819,	433,	342,
+gp,	624,	264,	407,
0 TOTALNUM,	33111,	35863,	41395,
TONSLAND,	74824,	75451,	68905,
SOPCOF %,	100,	100,	100,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	170,	110,	41,	7,	125,	40,	4,	332,	810,	1193,
3,	940,	1921,	1159,	349,	607,	665,	369,	573,	896,	2376,
4,	8236,	3343,	1434,	1233,	1452,	3160,	1706,	1693,	2345,	2480,
5,	12430,	6451,	2299,	1330,	3114,	4422,	2343,	4302,	5188,	4930,
6,	4427,	6626,	5197,	1129,	1873,	2992,	2684,	2467,	5546,	4647,
7,	2649,	4687,	2720,	3456,	1297,	1945,	3072,	3337,	3270,	4160,
8,	1127,	1461,	949,	773,	873,	898,	1871,	1514,	1455,	2082,
9,	313,	497,	236,	141,	132,	837,	627,	777,	557,	898,
+gp,	149,	333,	86,	73,	94,	279,	690,	798,	433,	543,
0 TOTALNUM,	30441,	25429,	14121,	8491,	9567,	15238,	13366,	15793,	20500,	23309,
TONSLAND,	60972,	59294,	40285,	28127,	24822,	41690,	52557,	54562,	57207,	61776,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	1326,	554,	252,	156,	44,	192,	81,	12,	15,	71,
3,	3438,	2819,	1322,	971,	505,	893,	1107,	306,	474,	315,
4,	3150,	4786,	2346,	3664,	1837,	2331,	2094,	924,	1299,	1656,
5,	2258,	4023,	4263,	3807,	2974,	2822,	2506,	1713,	1828,	1695,
6,	2490,	2272,	2773,	2671,	1998,	2742,	2158,	1820,	1436,	1695,
7,	3935,	1546,	1602,	1104,	1409,	1538,	1374,	1444,	1115,	1246,
8,	3312,	1826,	751,	326,	542,	915,	598,	609,	513,	671,
9,	959,	975,	774,	132,	187,	325,	258,	226,	188,	326,
+gp,	684,	343,	320,	152,	119,	377,	99,	264,	143,	224,
0 TOTALNUM,	21552,	19144,	14403,	12983,	9615,	12135,	10275,	7318,	7011,	7899,
TONSLAND,	63319,	51572,	40732,	36715,	29699,	40994,	34635,	24547,	22432,	26134,
SOPCOF %,	100,	99,	100,	100,	100,	102,	100,	100,	100,	100,

1

Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,
AGE			
2,	.2480,	.2140,	.2270,
3,	.6190,	.7120,	.5250,
4,	1.1490,	1.4150,	1.0800,
5,	1.7340,	2.0360,	1.7060,
6,	2.3250,	2.7370,	2.2560,
7,	3.4860,	4.0120,	3.3530,
8,	4.8450,	6.1160,	4.8380,
9,	5.6080,	6.4600,	5.8380,
+gp,	8.8400,	10.7550,	7.0530,
0 SOPCOFAC,	1.0002,	1.0000,	1.0001,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.3310,	.2460,	.3000,	.3450,	.1640,	.1680,	.2410,	.2540,	.3020,	.2740,
3,	.6730,	.6340,	.6610,	1.1740,	.9220,	.5560,	.6450,	.8050,	.7100,	.9210,
4,	1.1200,	1.1700,	1.8360,	1.5150,	1.6080,	1.3590,	1.7100,	1.4760,	1.3350,	1.4640,
5,	1.6930,	1.7270,	2.1700,	1.6780,	2.1080,	2.2670,	2.5910,	2.0970,	1.8420,	1.9790,
6,	2.3590,	2.3280,	2.4480,	2.7080,	2.5070,	2.9570,	3.5880,	3.2870,	2.4670,	2.5160,
7,	3.7430,	3.2560,	4.3910,	3.8980,	3.4690,	3.9030,	4.3660,	4.0950,	4.1910,	3.4610,
8,	5.3260,	4.7000,	4.8990,	6.5150,	4.9760,	5.3170,	5.8990,	5.5920,	5.7780,	4.8660,
9,	6.1290,	5.4500,	6.6610,	7.2990,	5.7340,	4.5580,	6.4940,	7.2170,	6.3760,	5.3910,
+gp,	11.6230,	8.2020,	11.6080,	13.9240,	11.0590,	7.0320,	7.5090,	8.3310,	9.9030,	8.8540,
0 SOPCOFAC,	1.0001,	1.0001,	1.0000,	1.0002,	1.0003,	1.0001,	1.0000,	1.0000,	1.0001,	1.0001,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 2 Catch weights at age (kg)

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	.2770,	.3760,	.4670,	.5150,	.1640,	.4910,	.9440,	.8240,	.8200,	1.2740,
3,	.9700,	.9780,	1.1550,	1.3050,	.9520,	1.1790,	1.5520,	1.3740,	1.3170,	1.5990,
4,	1.5540,	1.5180,	1.6330,	2.2720,	1.6370,	1.8000,	2.1460,	1.8770,	2.0940,	1.8940,
5,	1.9700,	2.2810,	2.1710,	2.5550,	2.8810,	2.4850,	3.0820,	2.6790,	2.7950,	2.6870,
6,	2.8970,	3.1250,	3.2490,	3.2830,	3.4240,	3.8600,	3.5940,	3.3650,	3.4930,	3.5620,
7,	3.7160,	3.9000,	4.0950,	4.5040,	4.0380,	4.7600,	4.9530,	4.0130,	4.0870,	4.0290,
8,	4.8290,	5.5200,	5.0130,	5.4000,	5.3970,	5.1950,	5.7360,	4.8470,	4.8360,	5.1820,
9,	6.3490,	6.3330,	6.0180,	6.3790,	7.2080,	5.5070,	6.4770,	5.5540,	6.2640,	5.9050,
+gp,	9.2670,	9.3370,	6.2550,	6.4200,	6.8810,	9.1830,	9.6860,	6.3430,	5.1150,	6.2130,
0 SOPCOFAC,	1.0003,	.9919,	1.0002,	.9999,	1.0004,	1.0181,	1.0001,	.9997,	1.0001,	.9999,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 3 Stock weights at age (kg)

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

Table 2.13. Results of the updated xsa.(Contd)

Table 3 Stock weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,	.2980,	.2700,
3,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,	.7000,	.7170,
4,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.3380,	1.4350,
5,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	1.9730,	2.0440,
6,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.6490,	2.6940,
7,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.1640,	4.8170,
8,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	7.0510,	6.2800,
9,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.4130,	11.3650,
+gp,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	14.3260,	15.6700,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 3 Stock weights at age (kg)

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	.2320,	.3230,	.3180,	.3460,	.3470,	.4300,	.3080,	.3390,	.4070,	.4900,
3,	.6770,	.8340,	.8040,	.7770,	.8780,	.8800,	.6860,	.8340,	.8460,	1.1250,
4,	1.3630,	1.3660,	1.5590,	1.4580,	1.5430,	1.6980,	1.2990,	1.6140,	1.7480,	1.8120,
5,	1.9030,	2.0750,	2.0420,	2.2960,	2.2130,	2.4520,	2.1490,	2.2690,	2.2000,	2.5590,
6,	2.8160,	3.0130,	2.7980,	2.7350,	2.8620,	3.5380,	3.1350,	3.2900,	2.6930,	3.5790,
7,	3.8330,	4.2550,	4.6780,	4.0480,	3.3210,	4.3970,	4.0480,	4.1240,	3.8170,	3.9640,
8,	5.8490,	5.3050,	7.1510,	7.0110,	4.8490,	4.1910,	5.0080,	4.7180,	3.7970,	4.8220,
9,	9.6000,	8.3500,	8.9590,	9.2240,	7.3390,	7.0460,	5.7890,	4.9760,	5.3440,	7.3320,
+gp,	13.0370,	18.0160,	18.3400,	12.2770,	11.5420,	15.6190,	10.0690,	6.3580,	14.8290,	14.6500,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 4 Natural Mortality (M) at age

YEAR,	1984,	1985,	1986,
AGE			
2,	.2000,	.2000,	.2000,
3,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 4 Natural Mortality (M) at age

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

Table 2.13. Results of the updated xsa.(Contd)

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Table 5 Proportion mature at age

YEAR,	1984,	1985,	1986,
AGE			
2,	.0100,	.0100,	.0100,
3,	.0600,	.0600,	.0600,
4,	.2400,	.2400,	.2400,
5,	.4900,	.4900,	.4900,
6,	.7200,	.7200,	.7200,
7,	.8800,	.8800,	.8800,
8,	.9500,	.9500,	.9500,
9,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,

Table 2.13. Results of the updated xsa.

Table 5 Proportion mature at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,
3,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,
5,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,
8,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.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,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 5 Proportion mature at age

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,
3,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,
5,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,	.4900,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,
8,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.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,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 6 Proportion of M before Spawning

YEAR,	1984,	1985,	1986,
AGE			
2,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,

Table 6 Proportion of M before Spawning

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 2.13. Results of the updated xsa.(Contd)

Table 6 Proportion of M before Spawning

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 7 Proportion of F before Spawning

YEAR,	1984,	1985,	1986,
AGE			
2,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,

Table 7 Proportion of F before Spawning

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Table 7 Proportion of F before Spawning

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
9,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
+gp,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,

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Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,
AGE			
2,	.0105,	.0059,	.1357,
3,	.0744,	.1298,	.0775,
4,	.2169,	.2229,	.3190,
5,	.3337,	.4622,	.4601,
6,	.6283,	.6366,	.6430,
7,	1.3095,	.7883,	.9003,
8,	1.0724,	.6332,	.9339,
9,	.8447,	.6358,	.7415,
+gp,	.8447,	.6358,	.7415,
0 FBAR 4- 7,	.6221,	.5275,	.5806,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.0051,	.0030,	.0010,	.0002,	.0023,	.0009,	.0001,	.0142,	.0265,	.0332,
3,	.0416,	.0733,	.0399,	.0107,	.0195,	.0149,	.0102,	.0256,	.0484,	.1010,
4,	.2205,	.2040,	.0719,	.0544,	.0564,	.1341,	.0481,	.0592,	.1387,	.1837,
5,	.5989,	.2693,	.2108,	.0882,	.1892,	.2433,	.1392,	.1645,	.2589,	.4812,
6,	.4380,	.7635,	.3625,	.1517,	.1728,	.2802,	.2284,	.2134,	.3306,	.3906,
7,	.7087,	1.2403,	.8545,	.4383,	.2612,	.2734,	.5202,	.4937,	.4862,	.4447,
8,	.7333,	1.1865,	.9353,	.6324,	.1860,	.2909,	.4612,	.5289,	.4154,	.6674,
9,	.6253,	.8742,	.5960,	.3298,	.2033,	.2736,	.3396,	.3527,	.3758,	.4914,
+gp,	.6253,	.8742,	.5960,	.3298,	.2033,	.2736,	.3396,	.3527,	.3758,	.4914,
0 FBAR 4- 7,	.4915,	.6193,	.3749,	.1832,	.1699,	.2328,	.2340,	.2327,	.3036,	.3750,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	FBAR **-**
AGE											
2,	.0449,	.0200,	.0110,	.0075,	.0024,	.0141,	.0083,	.0012,	.0022,	.0081,	.0038,
3,	.1263,	.1270,	.0607,	.0535,	.0303,	.0626,	.1051,	.0391,	.0576,	.0582,	.0516,
4,	.1889,	.2600,	.1481,	.2379,	.1358,	.1905,	.2045,	.1199,	.2314,	.2917,	.2143,
5,	.2539,	.3922,	.3901,	.3803,	.3096,	.3188,	.3224,	.2571,	.3678,	.5361,	.3870,
6,	.4800,	.4389,	.5180,	.4544,	.3518,	.5253,	.4318,	.4118,	.3569,	.7002,	.4896,
7,	.6816,	.6296,	.6434,	.4005,	.4630,	.5049,	.5498,	.5823,	.4800,	.6060,	.5561,
8,	.7866,	.8068,	.7345,	.2542,	.3501,	.6293,	.3738,	.5055,	.4199,	.6031,	.5095,
9,	.7636,	.5621,	1.0282,	.2650,	.2266,	.3667,	.3592,	.2348,	.2850,	.5191,	.3463,
+gp,	.7636,	.5621,	1.0282,	.2650,	.2266,	.3667,	.3592,	.2348,	.2850,	.5191,	
0 FBAR 4- 7,	.4011,	.4302,	.4249,	.3683,	.3151,	.3849,	.3771,	.3428,	.3590,	.5335,	

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

Table 9 Relative F at age

YEAR,	1984,	1985,	1986,
AGE			
2,	.0168,	.0112,	.2337,
3,	.1196,	.2461,	.1335,
4,	.3487,	.4226,	.5495,
5,	.5364,	.8761,	.7924,
6,	1.0100,	1.2069,	1.1075,
7,	2.1050,	1.4944,	1.5506,
8,	1.7238,	1.2004,	1.6084,
9,	1.3578,	1.2052,	1.2771,
+gp,	1.3578,	1.2052,	1.2771,
0 REFMEAN,	.6221,	.5275,	.5806,

Table 2.13. Results of the updated xsa.(Contd)

Table 9 Relative F at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.0104,	.0049,	.0027,	.0010,	.0134,	.0039,	.0006,	.0612,	.0872,	.0884,
3,	.0846,	.1184,	.1065,	.0586,	.1151,	.0639,	.0436,	.1099,	.1596,	.2694,
4,	.4487,	.3294,	.1918,	.2968,	.3321,	.5762,	.2055,	.2543,	.4567,	.4898,
5,	1.2185,	.4348,	.5623,	.4818,	1.1134,	1.0452,	.5951,	.7070,	.8528,	1.2830,
6,	.8911,	1.2329,	.9668,	.8283,	1.0170,	1.2039,	.9761,	.9171,	1.0890,	1.0414,
7,	1.4418,	2.0028,	2.2791,	2.3930,	1.5374,	1.1747,	2.2233,	2.1217,	1.6015,	1.1858,
8,	1.4919,	1.9160,	2.4945,	3.4525,	1.0947,	1.2498,	1.9712,	2.2732,	1.3683,	1.7797,
9,	1.2721,	1.4116,	1.5896,	1.8004,	1.1966,	1.1755,	1.4515,	1.5161,	1.2377,	1.3103,
+gp,	1.2721,	1.4116,	1.5896,	1.8004,	1.1966,	1.1755,	1.4515,	1.5161,	1.2377,	1.3103,
0 REFMEAN,	.4915,	.6193,	.3749,	.1832,	.1699,	.2328,	.2340,	.2327,	.3036,	.3750,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

Table 9 Relative F at age

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	MEAN **-**
AGE											
2,	.1119,	.0465,	.0259,	.0204,	.0078,	.0365,	.0219,	.0034,	.0061,	.0151,	.0082,
3,	.3149,	.2952,	.1428,	.1453,	.0962,	.1626,	.2787,	.1140,	.1604,	.1091,	.1278,
4,	.4711,	.6044,	.3485,	.6460,	.4311,	.4951,	.5422,	.3498,	.6445,	.5467,	.5137,
5,	.6330,	.9117,	.9181,	1.0326,	.9827,	.8283,	.8550,	.7500,	1.0245,	1.0049,	.9265,
6,	1.1967,	1.0203,	1.2191,	1.2338,	1.1167,	1.3649,	1.1450,	1.2014,	.9940,	1.3124,	1.1693,
7,	1.6992,	1.4636,	1.5143,	1.0876,	1.4695,	1.3118,	1.4579,	1.6989,	1.3370,	1.1360,	1.3906,
8,	1.9610,	1.8756,	1.7287,	.6902,	1.1112,	1.6350,	.9912,	1.4747,	1.1694,	1.1304,	1.2582,
9,	1.9039,	1.3067,	2.4200,	.7197,	.7192,	.9528,	.9525,	.6849,	.7939,	.9731,	.8173,
+gp,	1.9039,	1.3067,	2.4200,	.7197,	.7192,	.9528,	.9525,	.6849,	.7939,	.9731,	
0 REFMEAN,	.4011,	.4302,	.4249,	.3683,	.3151,	.3849,	.3771,	.3428,	.3590,	.5335,	

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,
AGE			
2,	87938,	74574,	35663,
3,	53607,	71247,	60698,
4,	39415,	40743,	51231,
5,	28351,	25978,	26692,
6,	14224,	16627,	13398,
7,	7515,	6213,	7202,
8,	3631,	1661,	2312,
9,	1587,	1017,	722,
+gp,	1191,	613,	847,
0 TOTAL,	237458,	238672,	198764,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	36854,	40102,	44147,	42334,	60965,	49132,	30637,	25943,	34267,	40426,
3,	25493,	30020,	32733,	36107,	34654,	49801,	40190,	25080,	20940,	27323,
4,	45990,	20021,	22840,	25751,	29246,	27823,	40172,	32571,	20015,	16333,
5,	30487,	30201,	13367,	17402,	19968,	22631,	19920,	31346,	25135,	14265,
6,	13795,	13714,	18889,	8864,	13044,	13530,	14528,	14189,	21771,	15884,
7,	5766,	7289,	5232,	10763,	6236,	8985,	8370,	9466,	9385,	12807,
8,	2397,	2324,	1726,	1823,	5685,	3932,	5596,	4073,	4730,	4725,
9,	744,	942,	581,	555,	793,	3864,	2406,	2889,	1965,	2556,
+gp,	350,	621,	209,	285,	562,	1280,	2629,	2945,	1516,	1531,
0 TOTAL,	161876,	145234,	139725,	143884,	171152,	180979,	164449,	148502,	139725,	135851,

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Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,
AGE			
2,	879,	746,	357,
3,	3216,	4275,	3642,
4,	9460,	9778,	12295,
5,	13892,	12729,	13079,
6,	10241,	11971,	9646,
7,	6613,	5467,	6338,
8,	3449,	1578,	2197,
9,	1587,	1017,	722,
+gp,	1191,	613,	847,

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	334,	309,	254,	230,	199,	152,	109,	114,	75,	98,
3,	1921,	1568,	1489,	1236,	1122,	976,	736,	530,	562,	370,
4,	4853,	5545,	4521,	4590,	3837,	3564,	3004,	2169,	1668,	1736,
5,	5453,	6715,	7147,	6518,	6049,	5599,	4924,	4092,	3217,	2212,
6,	5197,	5089,	5458,	5820,	5361,	5339,	4897,	4291,	3807,	2679,
7,	7744,	3218,	3284,	3253,	3698,	3773,	3160,	3182,	2844,	2666,
8,	6385,	3462,	1516,	1525,	1927,	2057,	2013,	1611,	1571,	1556,
9,	1985,	2506,	1332,	627,	1019,	1170,	945,	1194,	838,	890,
+gp,	1396,	872,	541,	717,	645,	1347,	360,	1387,	633,	605,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR,	1984,	1985,	1986,
	AGE			
	2,	28228,	23938,	11448,
	3,	40634,	54005,	46009,
	4,	58295,	60259,	75771,
	5,	60587,	55515,	57040,
	6,	40026,	46788,	37701,
	7,	35484,	29337,	34008,
	8,	24271,	11103,	15459,
	9,	11078,	7100,	5039,
	+gp,	11576,	5957,	8238,
0	TOTALBIO,	310179,	294002,	290712,

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

	YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
	AGE										
	2,	11830,	12873,	14171,	13589,	19570,	15771,	9835,	8328,	10212,	10915,
	3,	19324,	22755,	24812,	27369,	26268,	37749,	30464,	19011,	14658,	19591,
	4,	68019,	29611,	33780,	38086,	43255,	41150,	59414,	48172,	26781,	23439,
	5,	65152,	64540,	28565,	37188,	42671,	48362,	42570,	66987,	49591,	29159,
	6,	38819,	38591,	53155,	24943,	36706,	38074,	40880,	39929,	57673,	42793,
	7,	27229,	34416,	24708,	50822,	29444,	42427,	39525,	44696,	39079,	61690,
	8,	16022,	15537,	11541,	12186,	38003,	26283,	37411,	27231,	33353,	29673,
	9,	5194,	6578,	4055,	3872,	5535,	26973,	16797,	20165,	12603,	29052,
	+gp,	3403,	6043,	2035,	2773,	5463,	12447,	25561,	28632,	21713,	23985,
0	TOTALBIO,	254990,	230944,	196821,	210828,	246914,	289238,	302457,	303151,	265663,	270296,

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Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	7743,	9991,	8089,	7960,	6914,	6532,	3348,	3880,	3068,	4794,
3,	21677,	21788,	19957,	16005,	16414,	14320,	8413,	7361,	7919,	6928,
4,	27560,	31560,	29369,	27887,	24666,	25214,	16257,	14589,	12147,	13109,
5,	21178,	28437,	29783,	30539,	27318,	28016,	21594,	18950,	14442,	11551,
6,	20328,	21297,	21210,	22110,	21308,	26237,	21321,	19606,	14240,	13316,
7,	33731,	15561,	17455,	14966,	13954,	18853,	14534,	14911,	12337,	12010,
8,	39312,	19334,	11408,	11255,	9834,	9075,	10611,	8003,	6279,	7896,
9,	19052,	20925,	11930,	5780,	7481,	8243,	5470,	5940,	4477,	6523,
+gp,	18194,	15710,	9913,	8805,	7447,	21033,	3623,	8817,	9389,	8864,
0 TOTALBIO,	208775,	184603,	159114,	145306,	135335,	157523,	105170,	102056,	84297,	84991,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,
AGE			
2,	282,	239,	114,
3,	2438,	3240,	2761,
4,	13991,	14462,	18185,
5,	29688,	27202,	27950,
6,	28819,	33687,	27145,
7,	31226,	25817,	29927,
8,	23057,	10548,	14686,
9,	11078,	7100,	5039,
+gp,	11576,	5957,	8238,
0 TOTSPBIO,	152154,	128252,	134044,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	118,	129,	142,	136,	196,	158,	98,	83,	102,	109,
3,	1159,	1365,	1489,	1642,	1576,	2265,	1828,	1141,	879,	1175,
4,	16325,	7107,	8107,	9141,	10381,	9876,	14259,	11561,	6427,	5625,
5,	31924,	31624,	13997,	18222,	20909,	23698,	20859,	32824,	24300,	14288,
6,	27949,	27785,	38271,	17959,	26429,	27414,	29434,	28749,	41524,	30811,
7,	23961,	30286,	21743,	44724,	25911,	37335,	34782,	39333,	34390,	54287,
8,	15221,	14760,	10964,	11576,	36103,	24969,	35541,	25870,	31686,	28189,
9,	5194,	6578,	4055,	3872,	5535,	26973,	16797,	20165,	12603,	29052,
+gp,	3403,	6043,	2035,	2773,	5463,	12447,	25561,	28632,	21713,	23985,
0 TOTSPBIO,	125255,	125678,	100802,	110044,	132501,	165135,	179160,	188357,	173624,	187522,

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Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	77,	100,	81,	80,	69,	65,	33,	39,	31,	48,
3,	1301,	1307,	1197,	960,	985,	859,	505,	442,	475,	416,
4,	6614,	7574,	7049,	6693,	5920,	6051,	3902,	3501,	2915,	3146,
5,	10377,	13934,	14594,	14964,	13386,	13728,	10581,	9285,	7076,	5660,
6,	14636,	15334,	15271,	15919,	15342,	18890,	15351,	14116,	10253,	9587,
7,	29684,	13694,	15360,	13170,	12280,	16591,	12790,	13121,	10857,	10569,
8,	37346,	18367,	10838,	10692,	9342,	8621,	10081,	7603,	5965,	7501,
9,	19052,	20925,	11930,	5780,	7481,	8243,	5470,	5940,	4477,	6523,
+gp,	18194,	15710,	9913,	8805,	7447,	21033,	3623,	8817,	9389,	8864,
0 TOTSPBIO,	137282,	106945,	86233,	77063,	72251,	94082,	62335,	62864,	51438,	52315,

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Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR,	1984,	1985,	1986,
	AGE			
	2,	28233,	23939,	11448,
	3,	40641,	54007,	46012,
	4,	58304,	60261,	75775,
	5,	60597,	55517,	57044,
	6,	40033,	46789,	37704,
	7,	35490,	29338,	34010,
	8,	24275,	11103,	15459,
	9,	11080,	7100,	5039,
	+gp,	11578,	5957,	8238,
0	TOTALBIO,	310230,	294011,	290729,

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

	YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
	AGE										
	2,	11831,	12874,	14171,	13592,	19576,	15773,	9834,	8328,	10213,	10916,
	3,	19325,	22756,	24812,	27374,	26276,	37753,	30463,	19011,	14660,	19592,
	4,	68023,	29613,	33780,	38092,	43268,	41154,	59411,	48172,	26784,	23440,
	5,	65155,	64544,	28565,	37194,	42683,	48367,	42568,	66987,	49597,	29160,
	6,	38821,	38593,	53154,	24947,	36717,	38078,	40878,	39929,	57679,	42795,
	7,	27230,	34419,	24708,	50831,	29453,	42431,	39523,	44696,	39084,	61694,
	8,	16023,	15538,	11541,	12188,	38014,	26286,	37410,	27231,	33357,	29675,
	9,	5194,	6579,	4055,	3873,	5537,	26976,	16796,	20165,	12604,	29054,
	+gp,	3403,	6043,	2035,	2773,	5464,	12448,	25560,	28632,	21716,	23987,
0	TOTALBIO,	255006,	230959,	196820,	210863,	246987,	289266,	302443,	303152,	265692,	270314,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

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Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
	AGE										
	2,	7745,	9910,	8090,	7959,	6917,	6650,	3348,	3879,	3069,	4793,
	3,	21682,	21612,	19961,	16003,	16421,	14579,	8413,	7358,	7920,	6928,
	4,	27567,	31304,	29375,	27884,	24677,	25670,	16258,	14585,	12149,	13107,
	5,	21184,	28207,	29788,	30536,	27330,	28522,	21595,	18944,	14444,	11550,
	6,	20333,	21124,	21213,	22108,	21318,	26711,	21322,	19600,	14242,	13314,
	7,	33740,	15435,	17458,	14964,	13960,	19194,	14535,	14906,	12339,	12009,
	8,	39322,	19178,	11410,	11254,	9838,	9239,	10612,	8001,	6280,	7895,
	9,	19057,	20756,	11932,	5779,	7484,	8392,	5470,	5938,	4478,	6522,
	+gp,	18198,	15583,	9915,	8804,	7450,	21414,	3623,	8814,	9390,	8864,
0	TOTALBIO,	208829,	183107,	159143,	145292,	135395,	160371,	105176,	102025,	84309,	84983,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR,	1984,	1985,	1986,
	AGE			
	2,	282,	239,	114,
	3,	2438,	3240,	2761,
	4,	13993,	14463,	18186,
	5,	29693,	27203,	27951,
	6,	28823,	33688,	27147,
	7,	31231,	25817,	29929,
	8,	23061,	10548,	14687,
	9,	11080,	7100,	5039,
	+gp,	11578,	5957,	8238,
0	TOTSPBIO,	152180,	128256,	134052,

Table 2.13. Results of the updated xsa.(Contd)

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	118,	129,	142,	136,	196,	158,	98,	83,	102,	109,
3,	1159,	1365,	1489,	1642,	1577,	2265,	1828,	1141,	880,	1176,
4,	16326,	7107,	8107,	9142,	10384,	9877,	14259,	11561,	6428,	5626,
5,	31926,	31627,	13997,	18225,	20915,	23700,	20858,	32824,	24302,	14289,
6,	27951,	27787,	38271,	17962,	26436,	27416,	29433,	28749,	41529,	30813,
7,	23963,	30288,	21743,	44731,	25918,	37339,	34781,	39333,	34394,	54291,
8,	15222,	14761,	10964,	11578,	36113,	24971,	35539,	25870,	31689,	28191,
9,	5194,	6579,	4055,	3873,	5537,	26976,	16796,	20165,	12604,	29054,
+gp,	3403,	6043,	2035,	2773,	5464,	12448,	25560,	28632,	21716,	23987,
0 TOTSPBIO,	125262,	125687,	100801,	110062,	132541,	165151,	179151,	188357,	173644,	187535,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP

At 24/04/2007 9:59

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,
AGE										
2,	77,	99,	81,	80,	69,	67,	33,	39,	31,	48,
3,	1301,	1297,	1198,	960,	985,	875,	505,	442,	475,	416,
4,	6616,	7513,	7050,	6692,	5922,	6161,	3902,	3500,	2916,	3146,
5,	10380,	13821,	14596,	14963,	13392,	13976,	10581,	9282,	7077,	5660,
6,	14640,	15210,	15274,	15918,	15349,	19232,	15352,	14112,	10254,	9586,
7,	29691,	13583,	15363,	13169,	12285,	16891,	12790,	13117,	10858,	10568,
8,	37356,	18219,	10840,	10691,	9346,	8777,	10081,	7601,	5966,	7500,
9,	19057,	20756,	11932,	5779,	7484,	8392,	5470,	5938,	4478,	6522,
+gp,	18198,	15583,	9915,	8804,	7450,	21414,	3623,	8814,	9390,	8864,
0 TOTSPBIO,	137318,	106079,	86248,	77055,	72283,	95784,	62338,	62845,	51445,	52309,

1

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP ,

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 7,
,						
1984,	87938,	310179,	152154,	74824,	.4918,	.6221,
1985,	74574,	294002,	128252,	75451,	.5883,	.5275,
1986,	35663,	290712,	134044,	68905,	.5140,	.5806,
1987,	36854,	254990,	125255,	60972,	.4868,	.4915,
1988,	40102,	230944,	125678,	59294,	.4718,	.6193,
1989,	44147,	196821,	100802,	40285,	.3996,	.3749,
1990,	42334,	210828,	110044,	28127,	.2556,	.1832,
1991,	60965,	246914,	132501,	24822,	.1873,	.1699,
1992,	49132,	289238,	165135,	41690,	.2525,	.2328,
1993,	30637,	302457,	179160,	52557,	.2934,	.2340,
1994,	25943,	303151,	188357,	54562,	.2897,	.2327,
1995,	34267,	265663,	173624,	57207,	.3295,	.3036,
1996,	40426,	270296,	187522,	61776,	.3294,	.3750,
1997,	33375,	208775,	137282,	63319,	.4612,	.4011,
1998,	30930,	184603,	106945,	51572,	.4822,	.4302,
1999,	25437,	159114,	86233,	40732,	.4724,	.4249,
2000,	23006,	145306,	77063,	36715,	.4764,	.3683,
2001,	19924,	135335,	72251,	29699,	.4111,	.3151,
2002,	15191,	157523,	94082,	40994,	.4357,	.3849,
2003,	10869,	105170,	62335,	34635,	.5556,	.3771,
2004,	11446,	102056,	62864,	24547,	.3905,	.3428,
2005,	7539,	84297,	51438,	22432,	.4361,	.3590,
2006,	9784,	84991,	52315,	26134,	.4996,	.5335,
Arith. Mean ,	34369,	210146,	117623,	46576,	.4135,	.3863,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

1

Table 2.13. Results of the updated xsa.(Contd)

Run title : Norwegian Coastal Cod,COMBSEX,PLUSGROUP ,

At 24/04/2007 9:59

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,	87938,	310230,	152180,	74824,	.4917,	1.0002,	.6221,
1985,	74574,	294011,	128256,	75451,	.5883,	1.0000,	.5275,
1986,	35663,	290729,	134052,	68905,	.5140,	1.0001,	.5806,
1987,	36854,	255006,	125262,	60972,	.4868,	1.0001,	.4915,
1988,	40102,	230959,	125687,	59294,	.4718,	1.0001,	.6193,
1989,	44147,	196820,	100801,	40285,	.3996,	1.0000,	.3749,
1990,	42334,	210863,	110062,	28127,	.2556,	1.0002,	.1832,
1991,	60965,	246987,	132541,	24822,	.1873,	1.0003,	.1699,
1992,	49132,	289266,	165151,	41690,	.2524,	1.0001,	.2328,
1993,	30637,	302443,	179151,	52557,	.2934,	1.0000,	.2340,
1994,	25943,	303152,	188357,	54562,	.2897,	1.0000,	.2327,
1995,	34267,	265692,	173644,	57207,	.3295,	1.0001,	.3036,
1996,	40426,	270314,	187535,	61776,	.3294,	1.0001,	.3750,
1997,	33375,	208829,	137318,	63319,	.4611,	1.0003,	.4011,
1998,	30930,	183107,	106079,	51572,	.4862,	.9919,	.4302,
1999,	25437,	159143,	86248,	40732,	.4723,	1.0002,	.4249,
2000,	23006,	145292,	77055,	36715,	.4765,	.9999,	.3683,
2001,	19924,	135395,	72283,	29699,	.4109,	1.0004,	.3151,
2002,	15191,	160371,	95784,	40994,	.4280,	1.0181,	.3849,
2003,	10869,	105176,	62338,	34635,	.5556,	1.0001,	.3771,
2004,	11446,	102025,	62845,	24547,	.3906,	.9997,	.3428,
2005,	7539,	84309,	51445,	22432,	.4360,	1.0001,	.3590,
2006,	9784,	84983,	52309,	26134,	.4996,	.9999,	.5335,
Arith. Mean ,	34369,	210222,	117669,	46576,	.4133		.3863,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

1

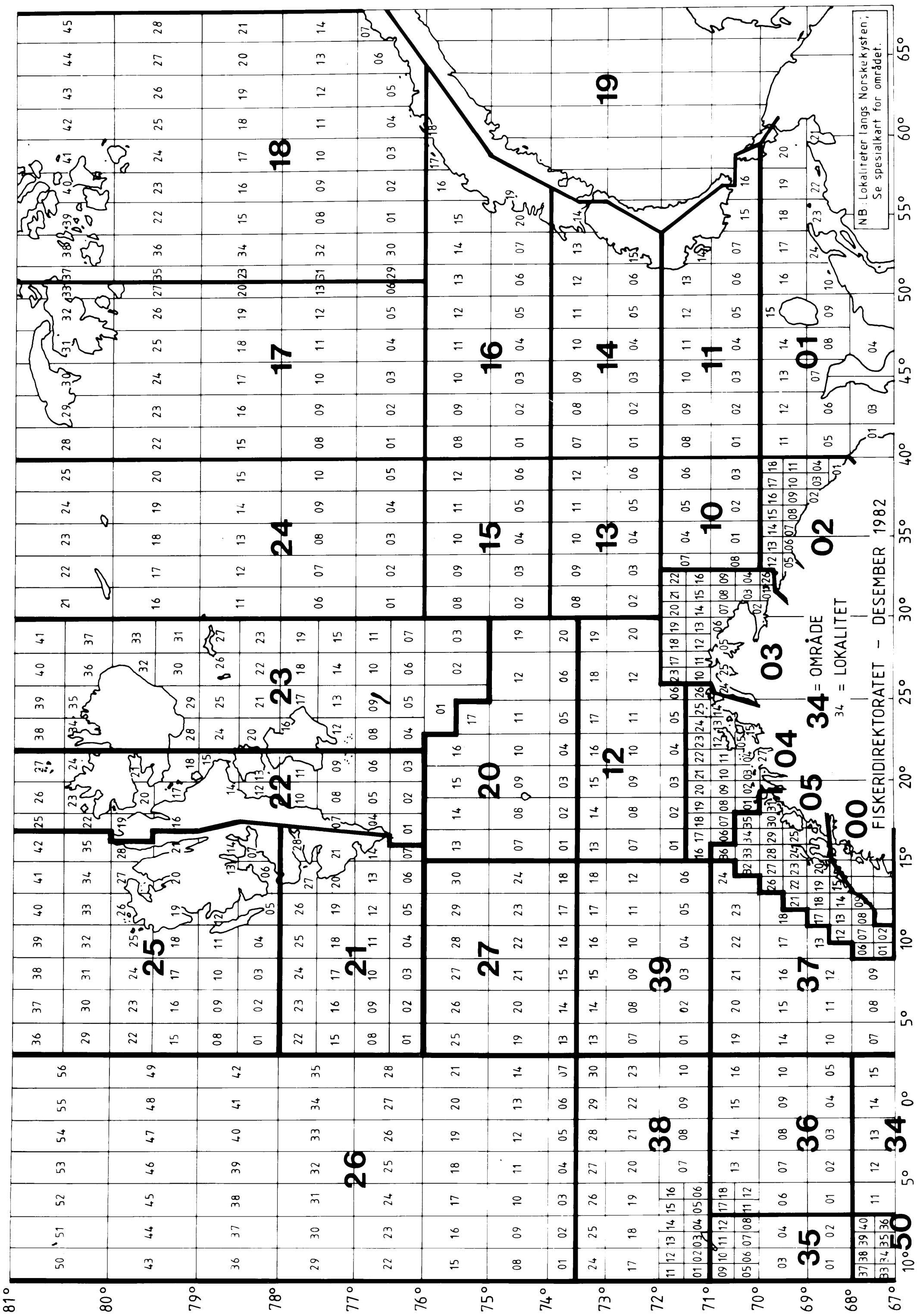


Figure 2.1a. Norwegian statistical rectangles in the Barents Sea. Coastal cod catches are estimated from the total cod catch taken inside 12 n.mile in areas 03 and 04. The same areas are also refered to in the survey results (sec. 2.3).

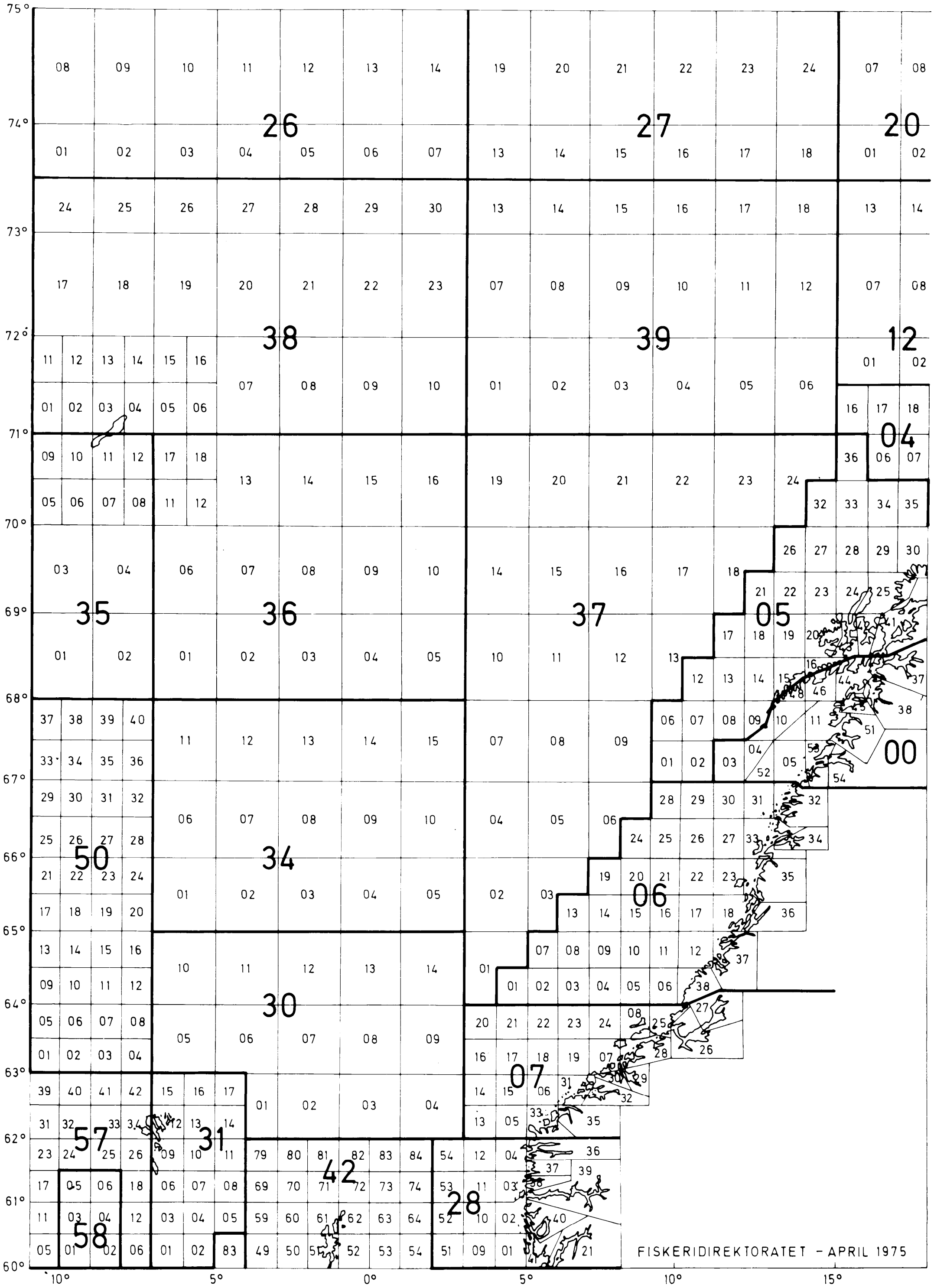


Figure 2.1b. Norwegian statistical rectangles in the Norwegian Sea. Coastal cod catches are estimated from the total cod catch taken inside 12 n.mile in areas 05, 00, 06 and 07. The same areas are also refered to in the survey results (sec. 2.3).

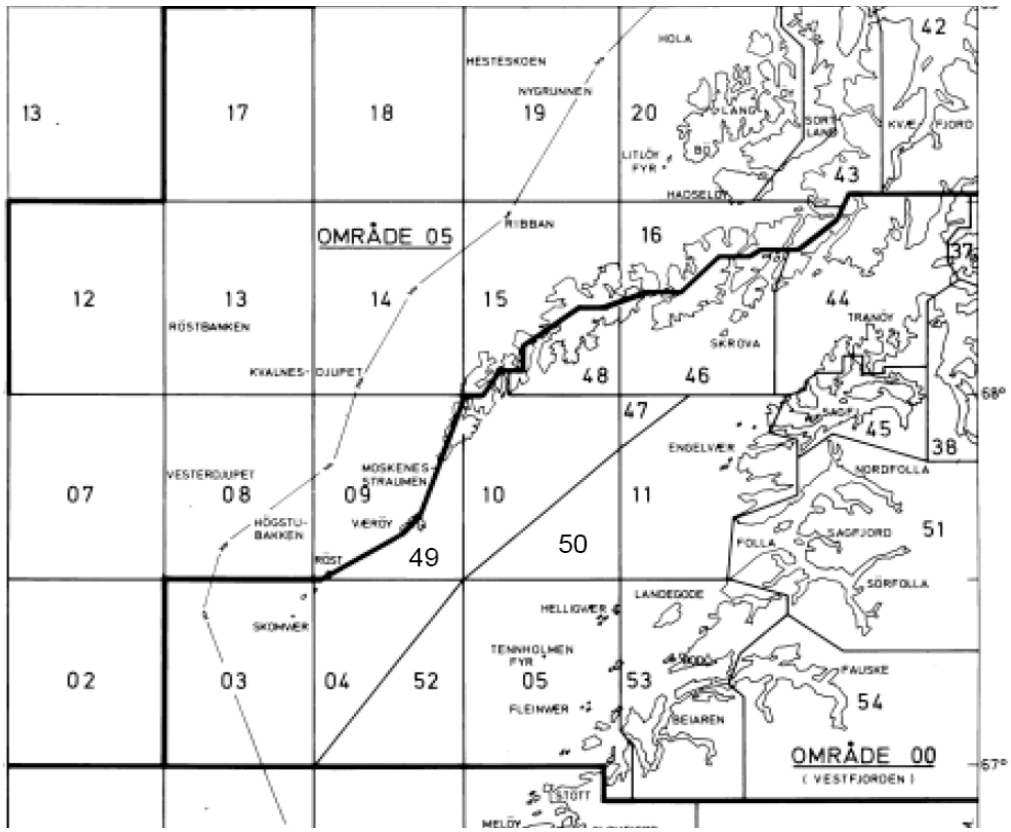


Figure 2.1c. Map showing Vestfjorden, the Norwegian statistical area 00 ("OMRÅDE 00") with the south-western location 03 and 04 and the north-eastern locations 46 and 48.

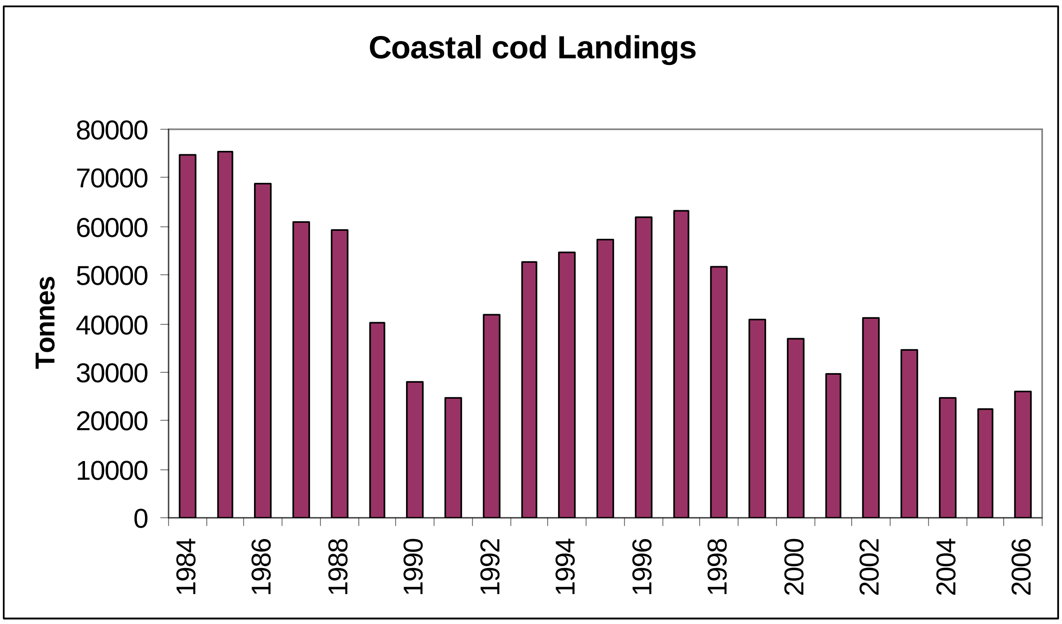
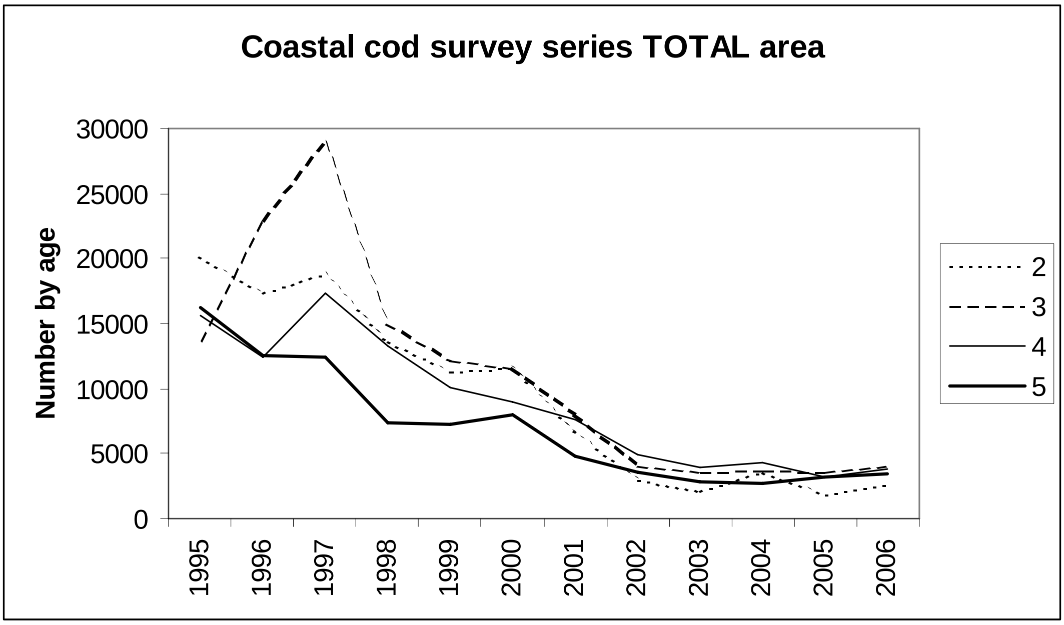


Figure 2.1d. Estimated landings of Norwegian coastal cod.



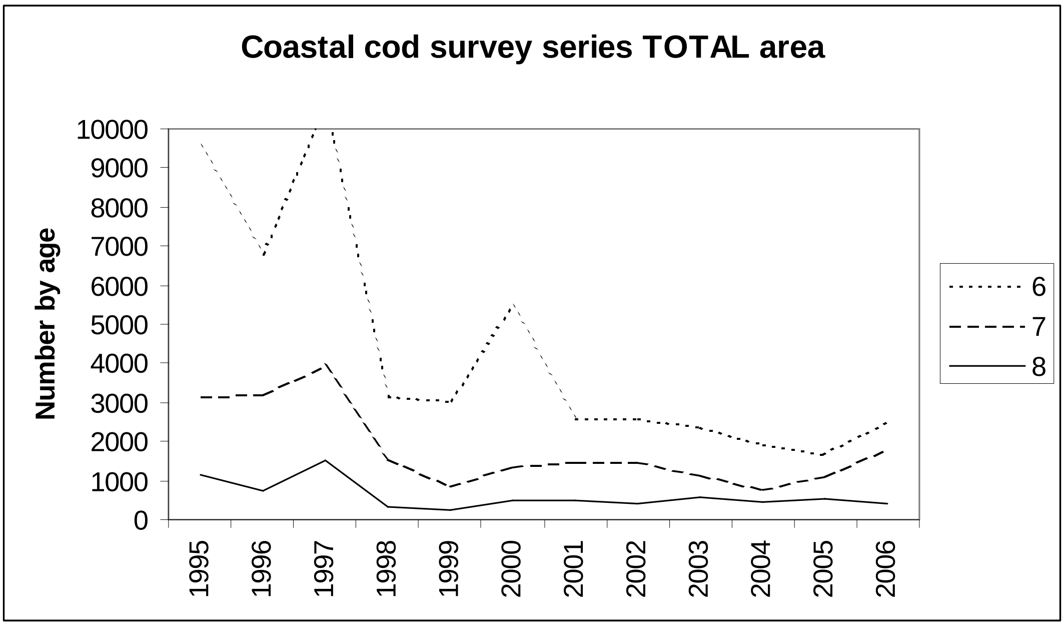
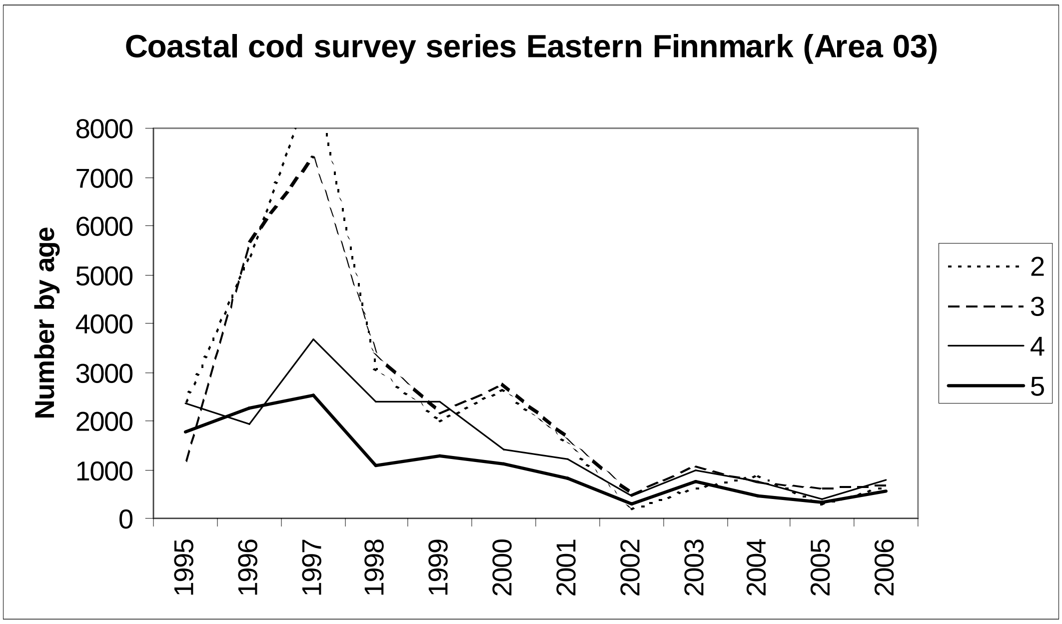


Figure 2.2 Coastal cod. Abundance at age in the total survey. Upper: ages 2-5, Lower: ages 6-8.



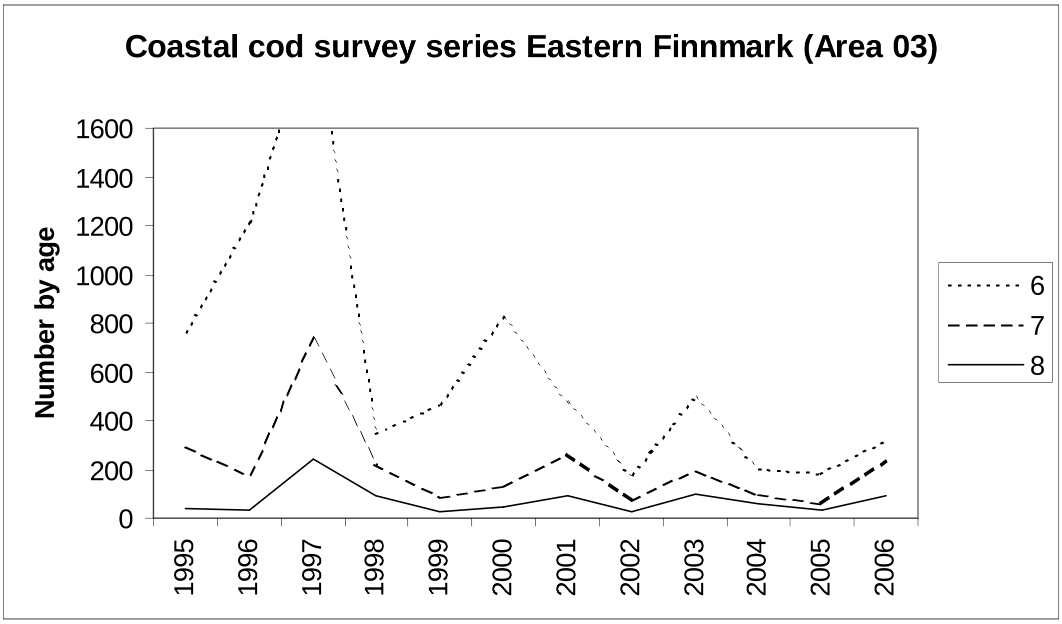
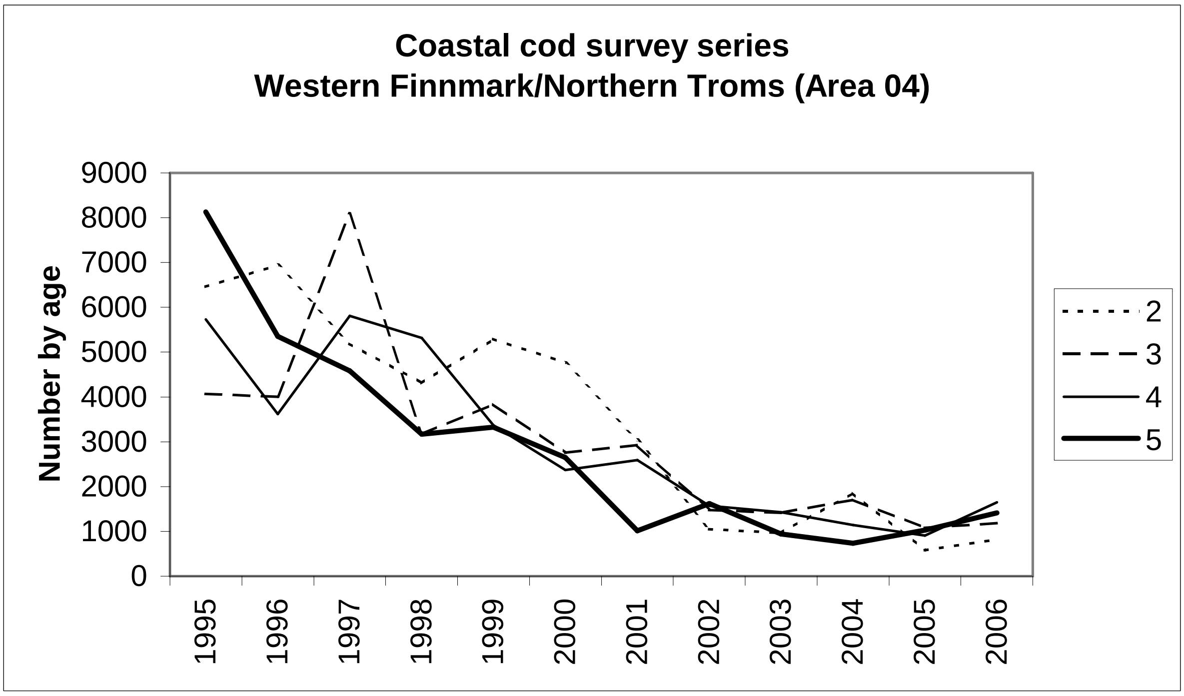


Figure 2.3 Coastal cod. Abundance at age in the survey, statistical area 03.

Upper: ages 2-5, Lower: ages 6-8.



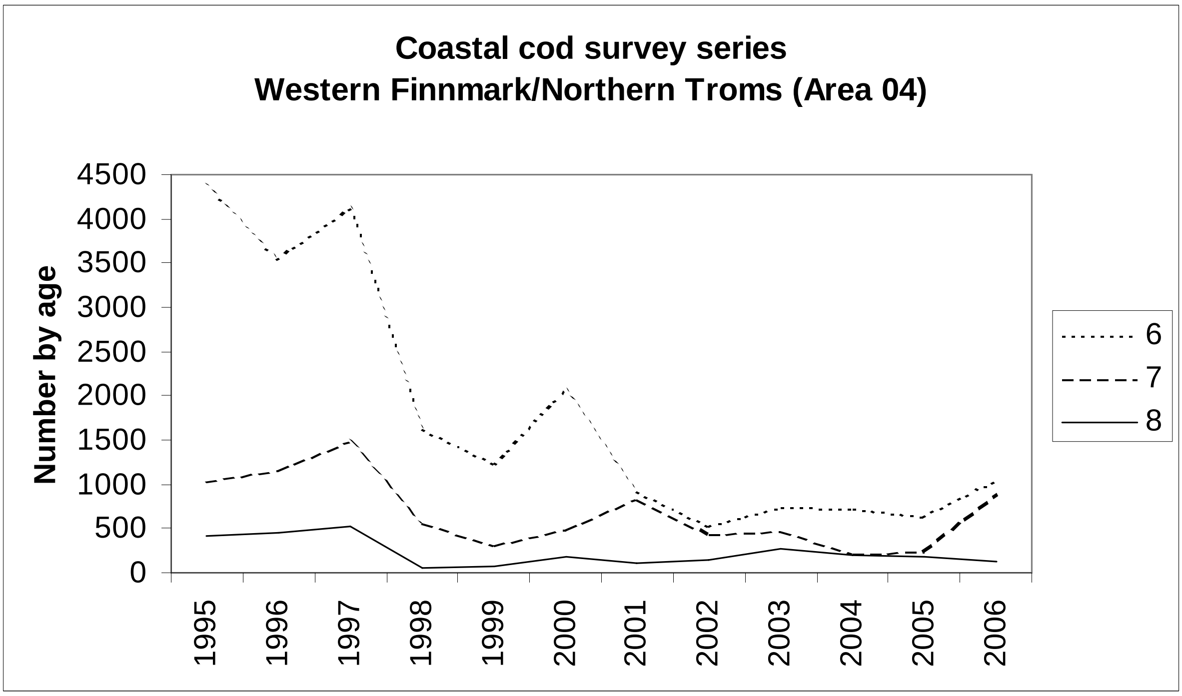
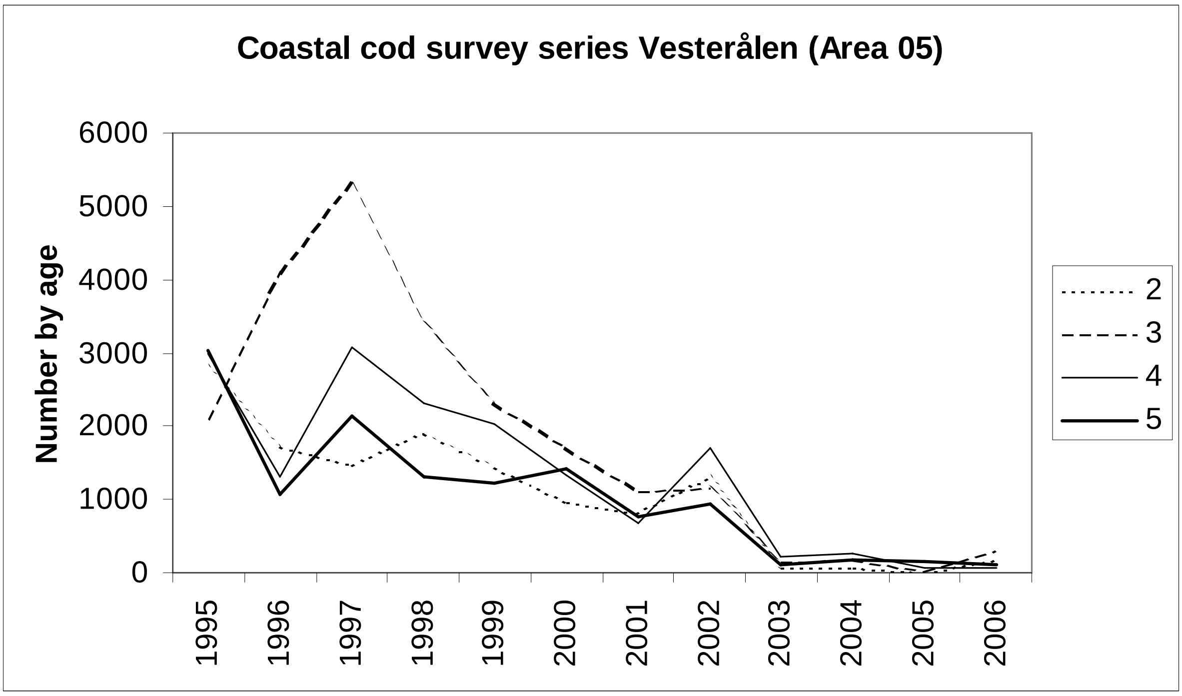


Figure 2.4 Coastal cod. Abundance at age in the survey, statistical area 04.

Upper: ages 2-5, Lower: ages 6-8.



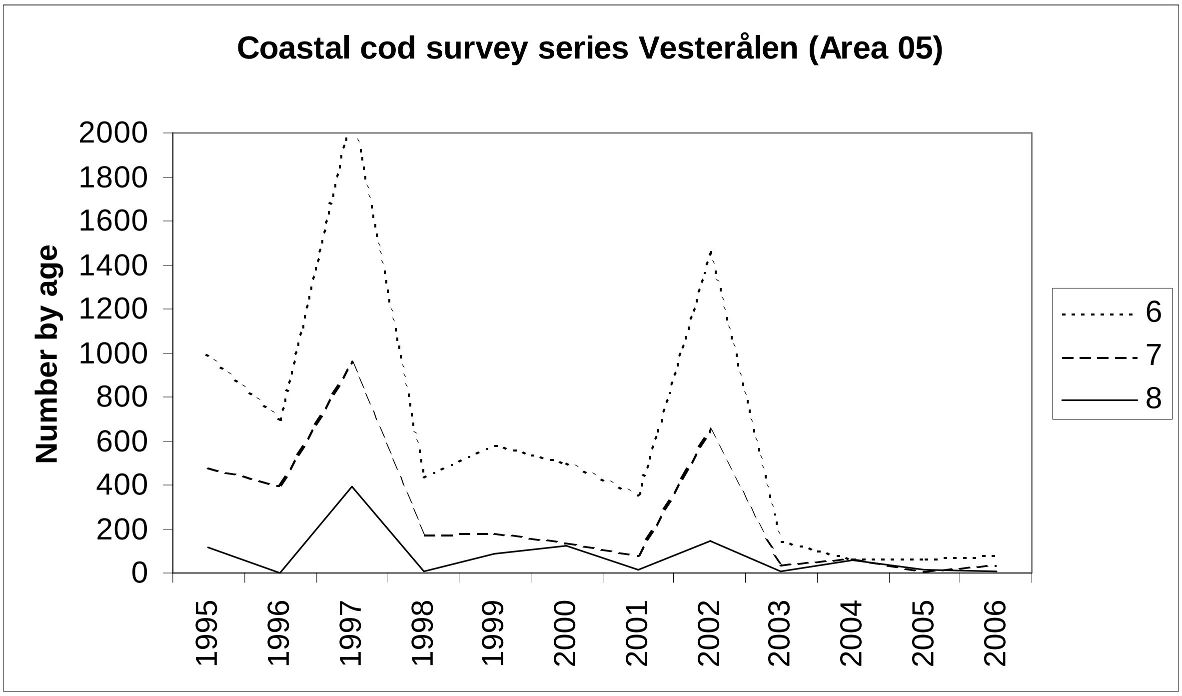
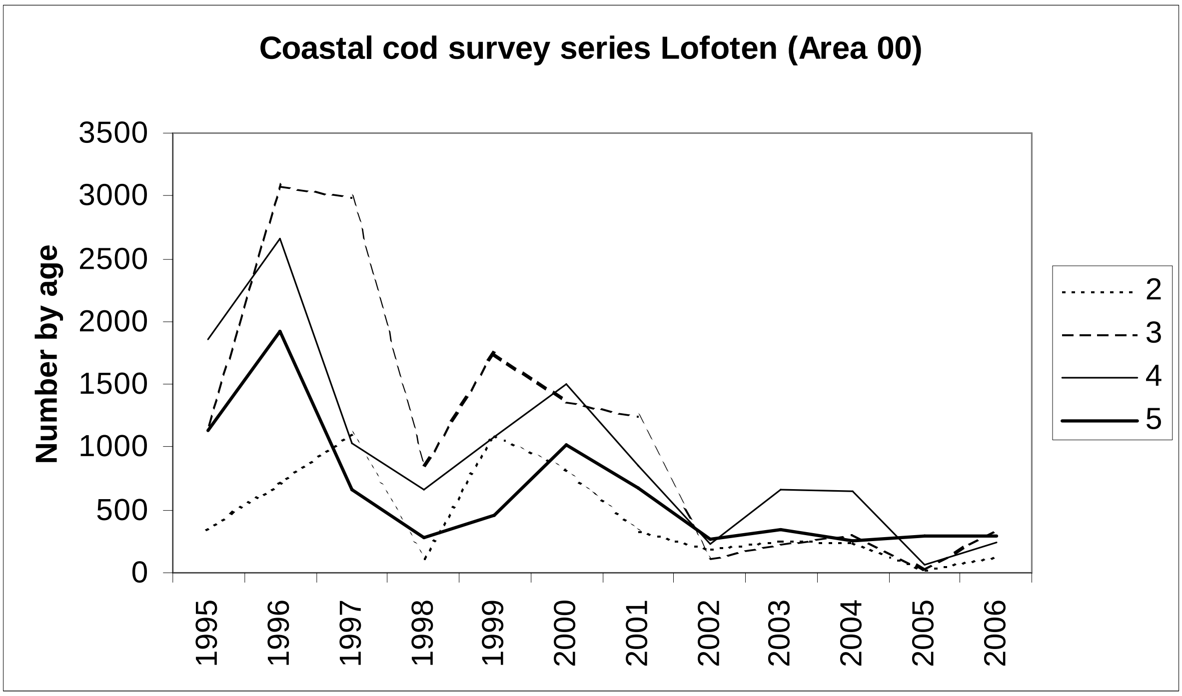


Figure 2.5 Coastal cod. Abundance at age in the survey, statistical area 05.

Upper: ages 2-5, Lower: ages 6-8.



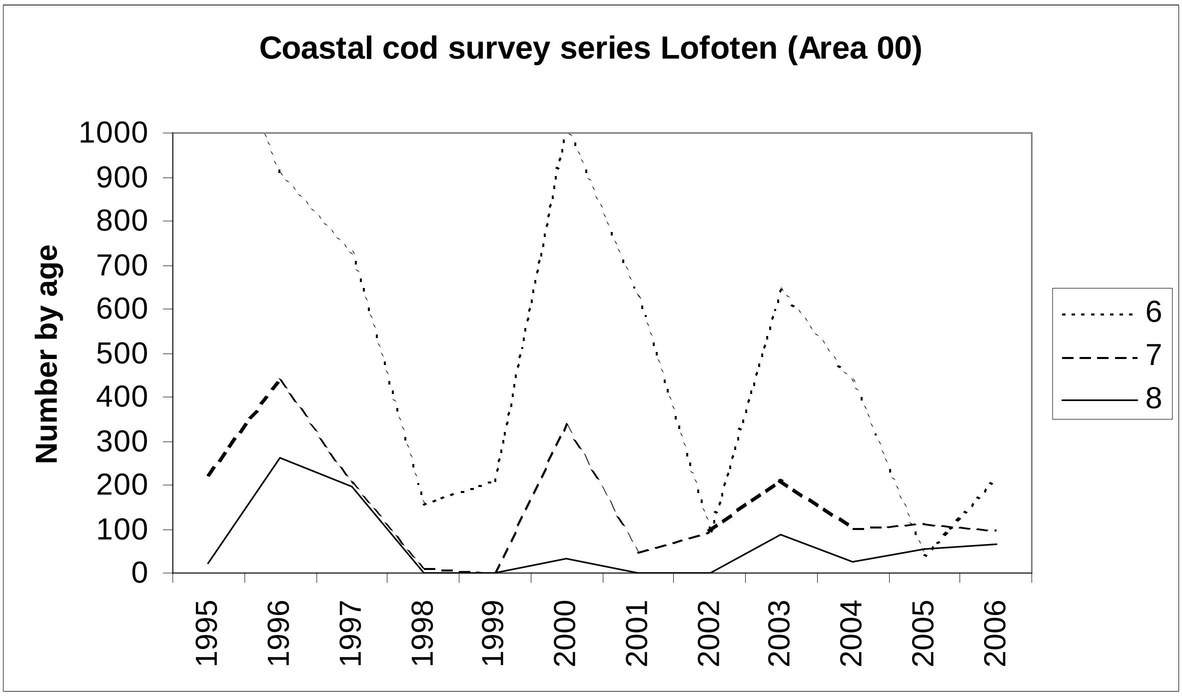
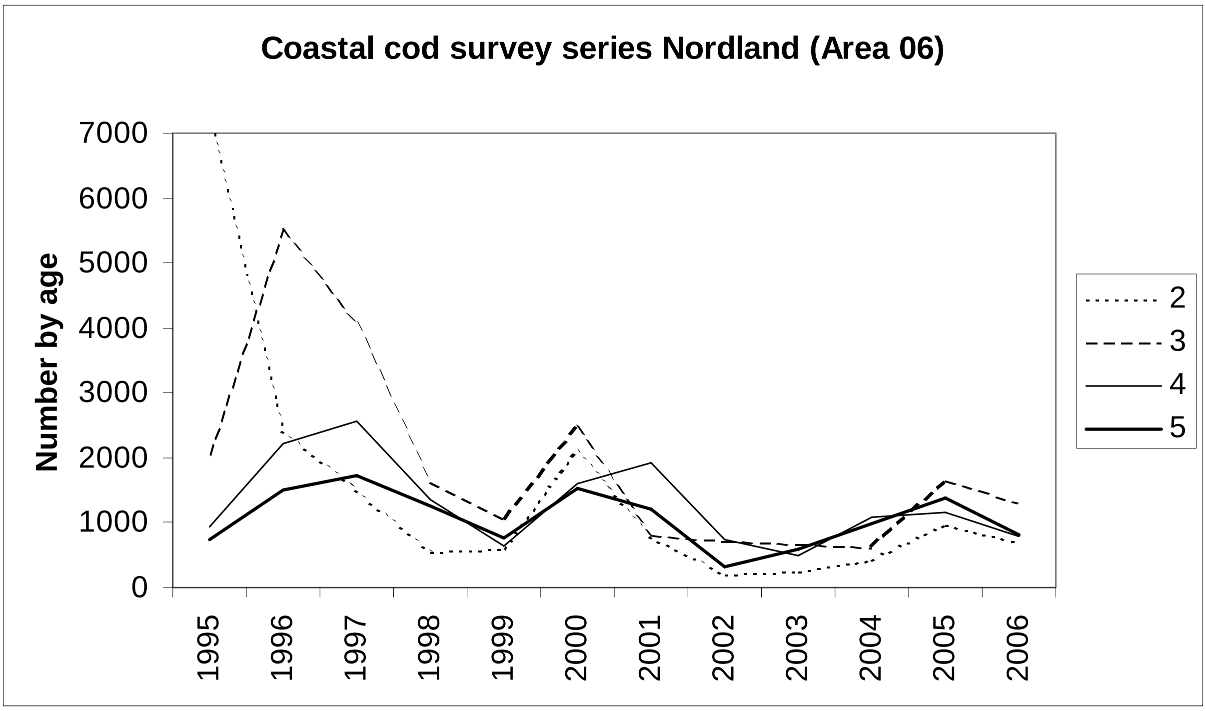


Figure 2.6 Coastal cod. Abundance at age in the survey, statistical rectangle 00.

Upper: ages 2-5, Lower: ages 6-8.



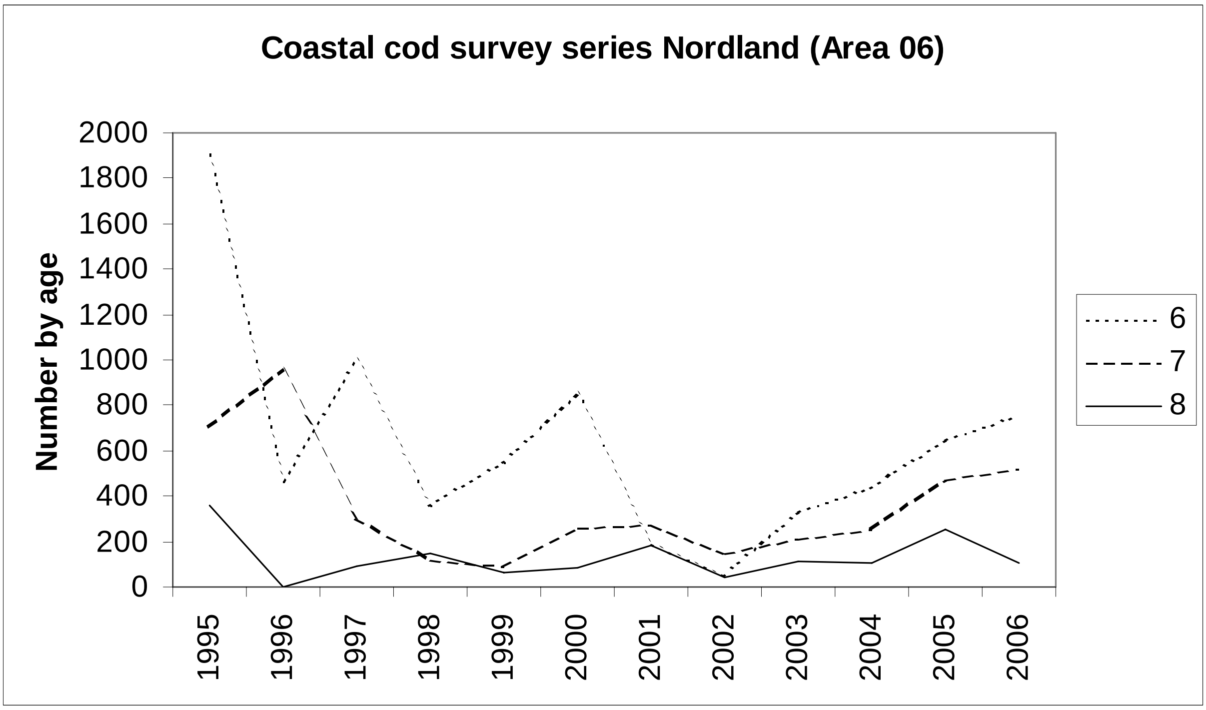
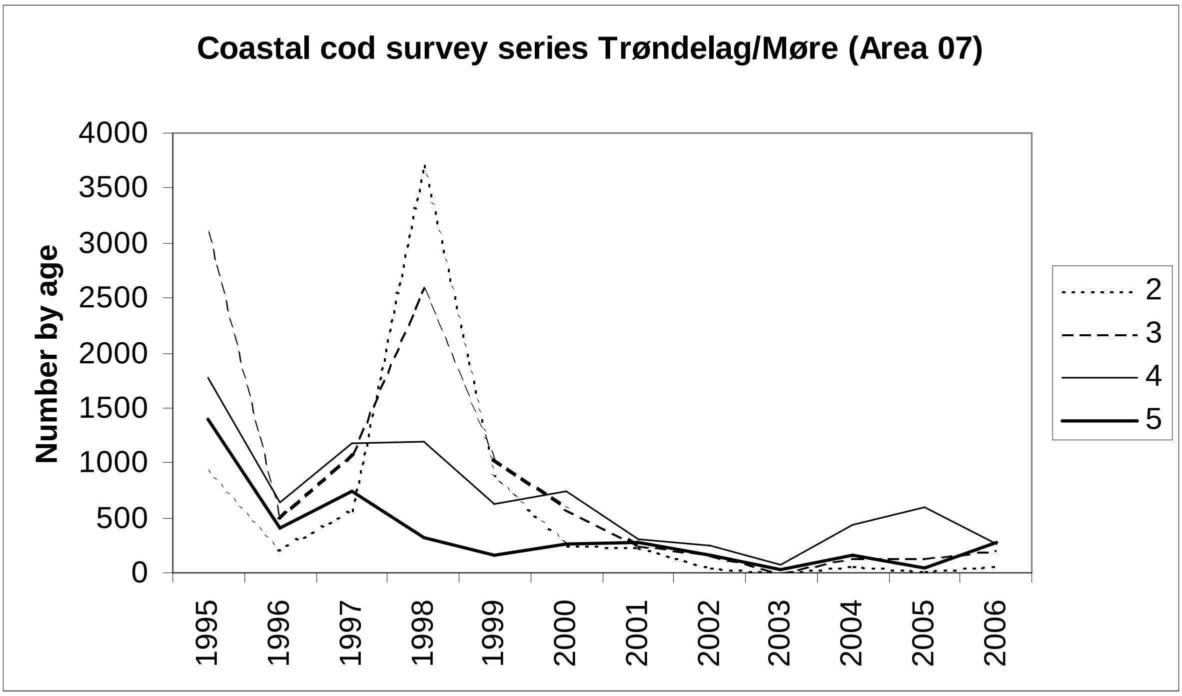


Figure 2.7 Coastal cod. Abundance at age in the survey, statistical area 06.

Upper: ages 2-5, Lower: ages 6-8.



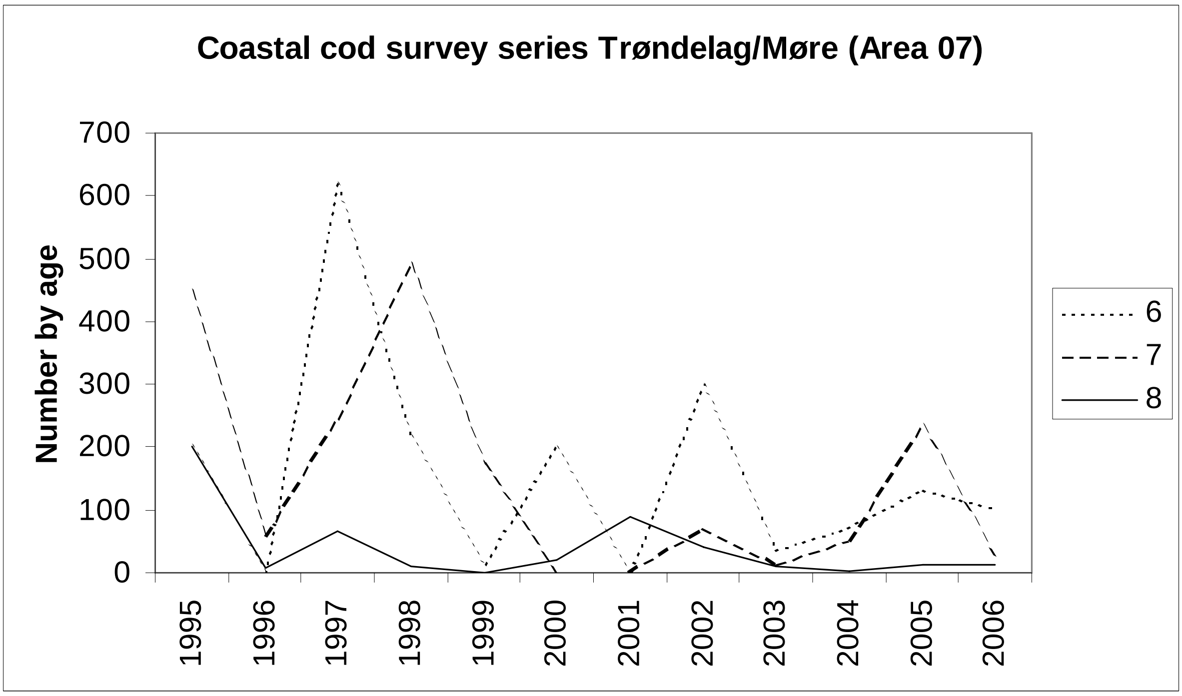
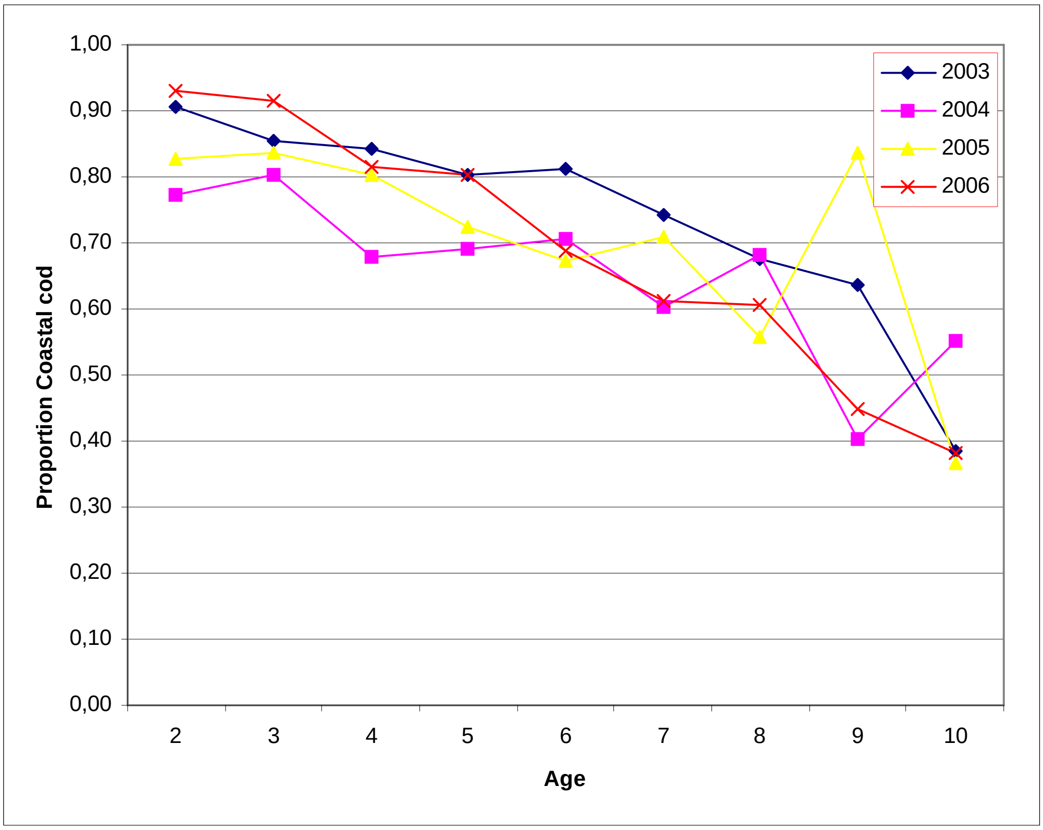


Figure 2.8 Coastal cod. Abundance at age in the survey, statistical area 07.

Upper: ages 2-5, Lower: ages 6-8.



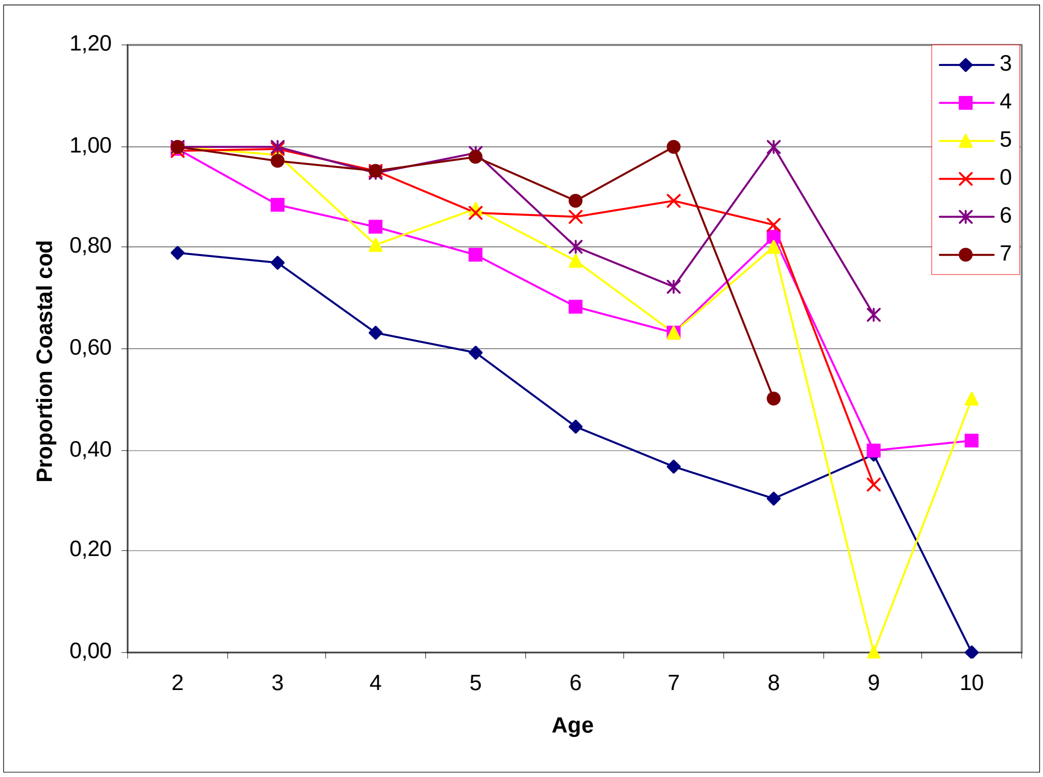
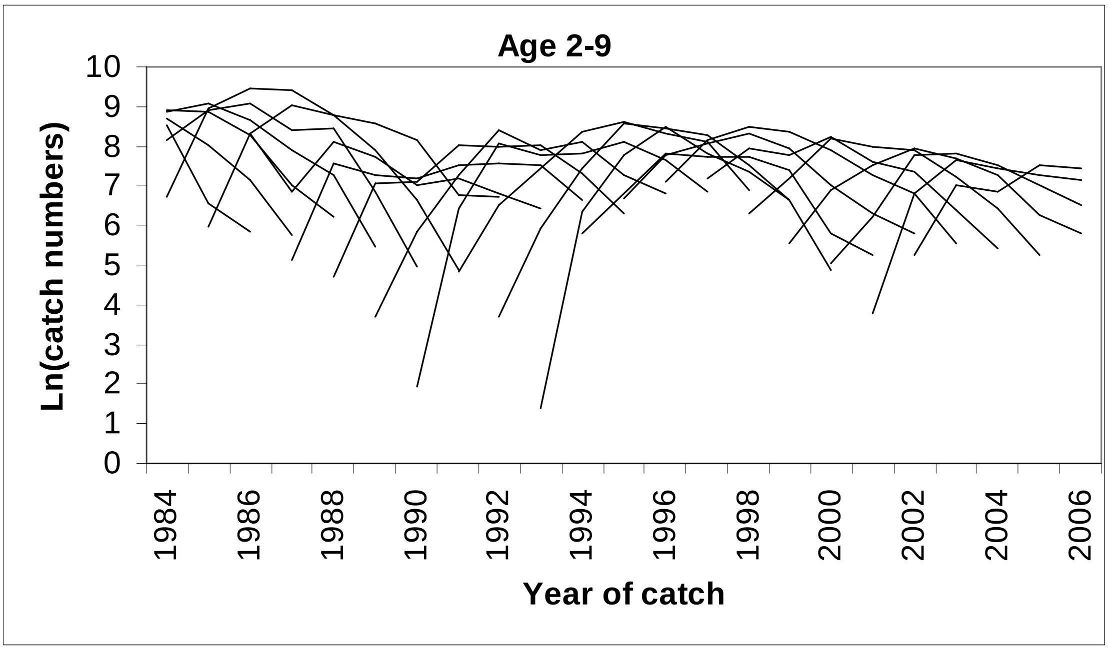


Figure 2.9. Proportion Coastal cod by age in the Norwegian coastal survey 2003-2006 (upper figure). Proportion Coastal cod by age and area in the Norwegian coastal survey 2006 (lower figure).



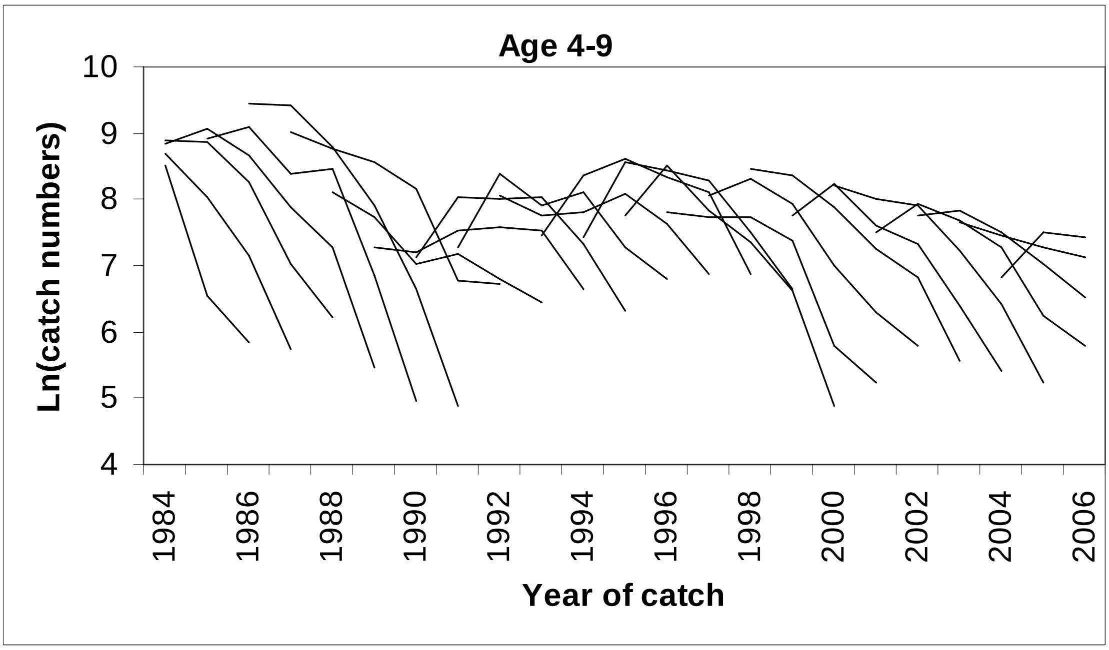


Figure 2.10. Log catch number at age by cohort and catch year. The plot starts with the 1977 year-classes in 1984 and ends with the 2000 yea-rclass in 2006.

Upper: ages 2-9, Lower: ages 4-9.

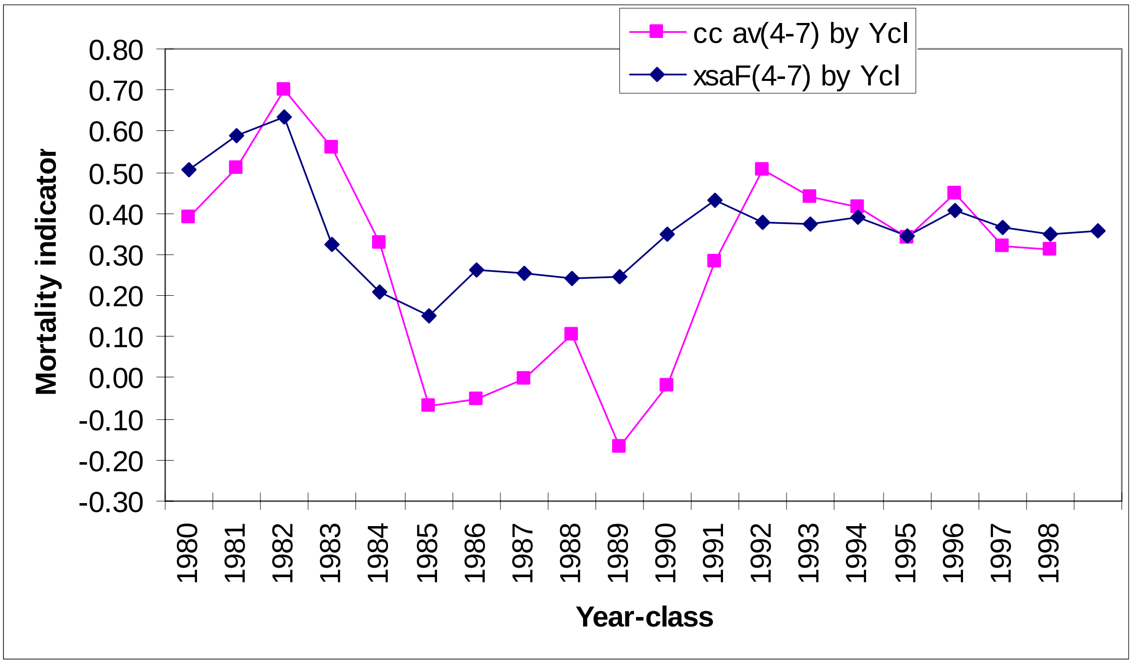


Figure 2.11. Log catch ratios averaged for ages 4-7 along cohorts (cc av(4-7)), and F values averaged for ages 4-7 along cohorts (xsaF(4-7)) from exploratory xsa.

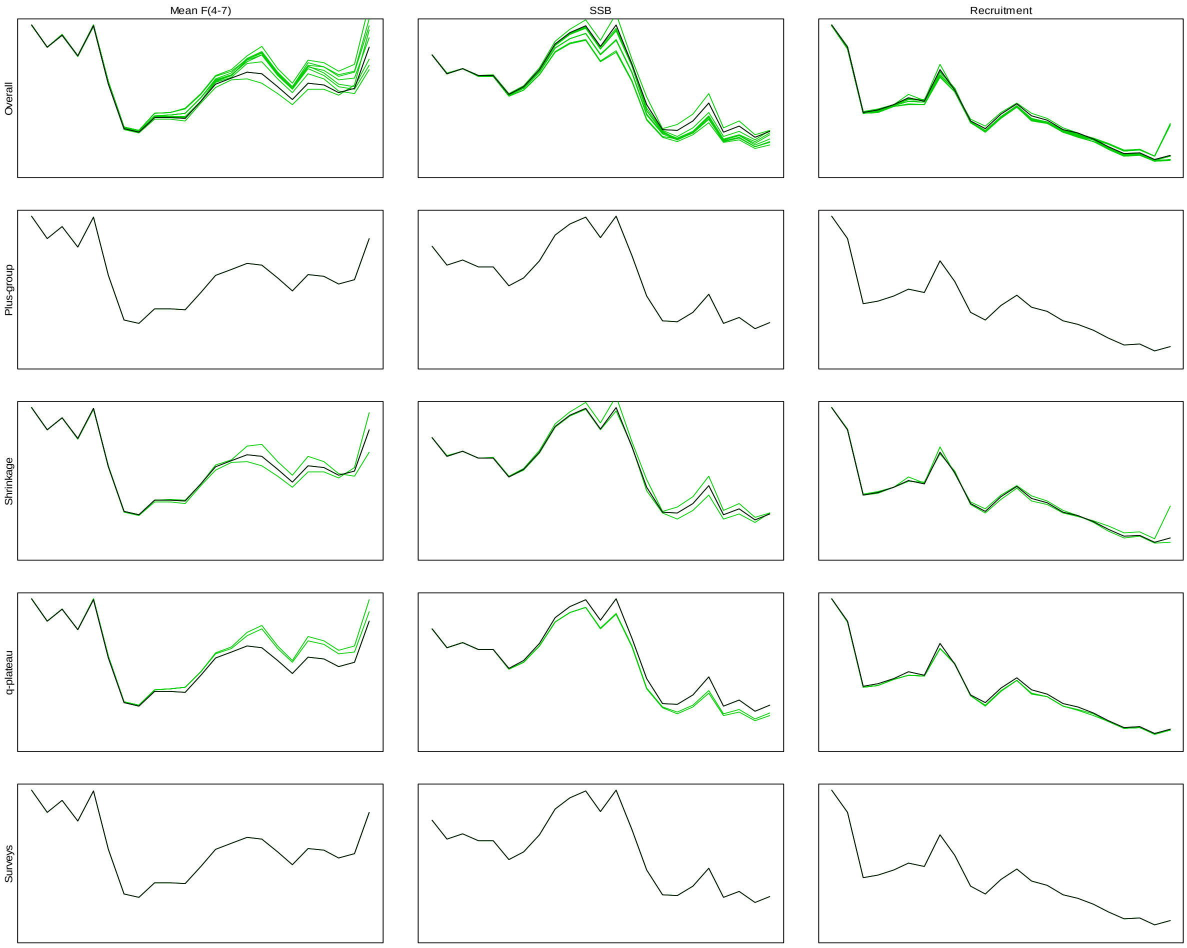


Figure 2.12. Effects on F (left panels), SSB (middle) and recruitment (right panels) by changing catchability plaeau from 8 to 7 and 6, and by changing shrinkage from 1.0 to 0.5 and 2.0. Upper panels show the whole range of outcomes from combined changes.

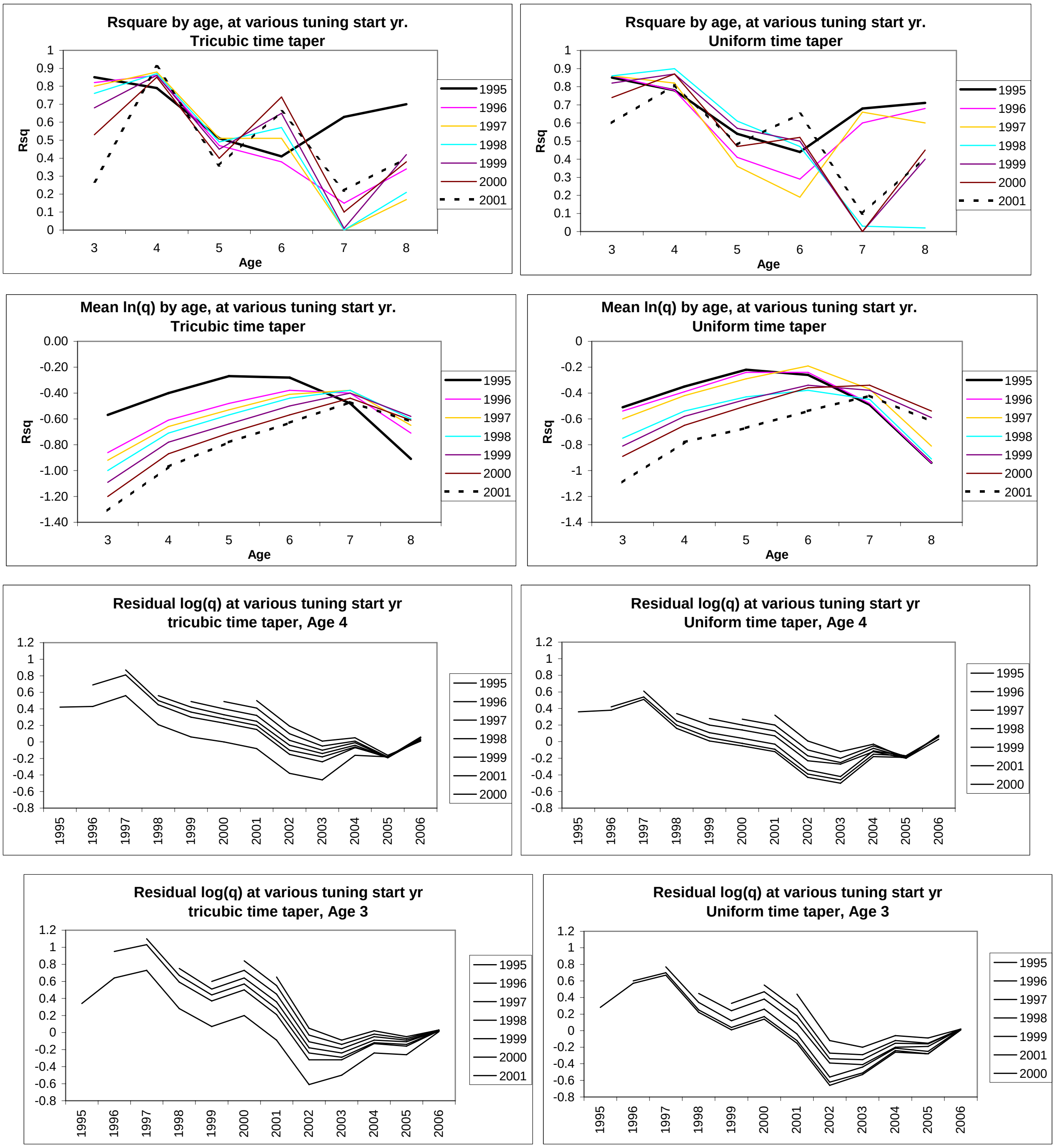


Figure 2.13 Effects of reducing survey series in the tuning one by one year from starting year 1995 to starting year 2001. Left panels: Tricubic time taper, Right hand: Unifor time taper.

Upper row: Rsquare for the survey/vpa relationship by age.

2. row: Log catchability at age

3. and 4. row: Residual log catchability by year for age 3 and 4.

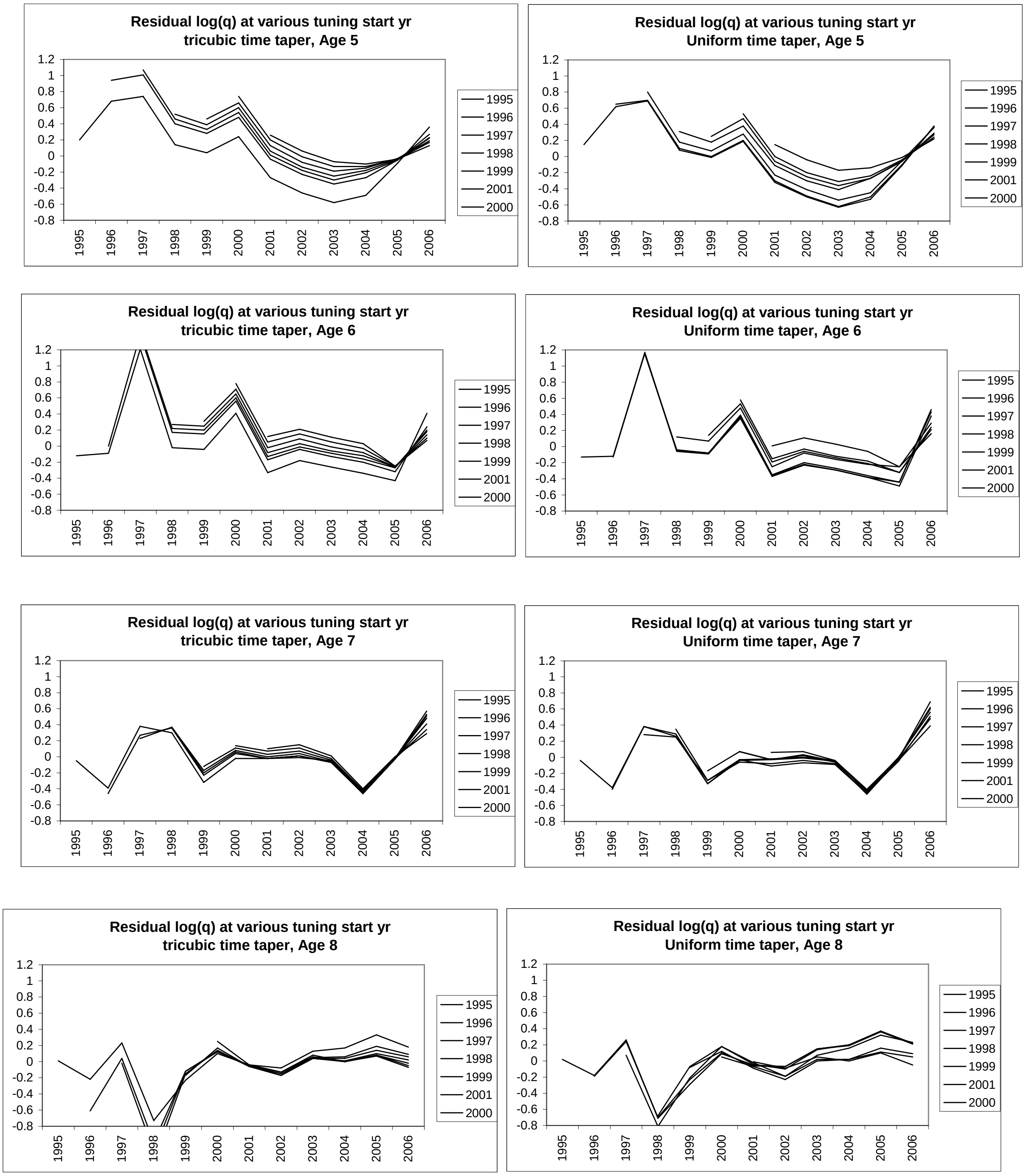


Figure 2.14 Effects of reducing survey series in the tuning one by one year from starting year 1995 to starting year 2001. Left panels: Tricubic time taper, Right hand: Unifor time taper.

Rows: Residual log catchability by year for age 5 and 8.

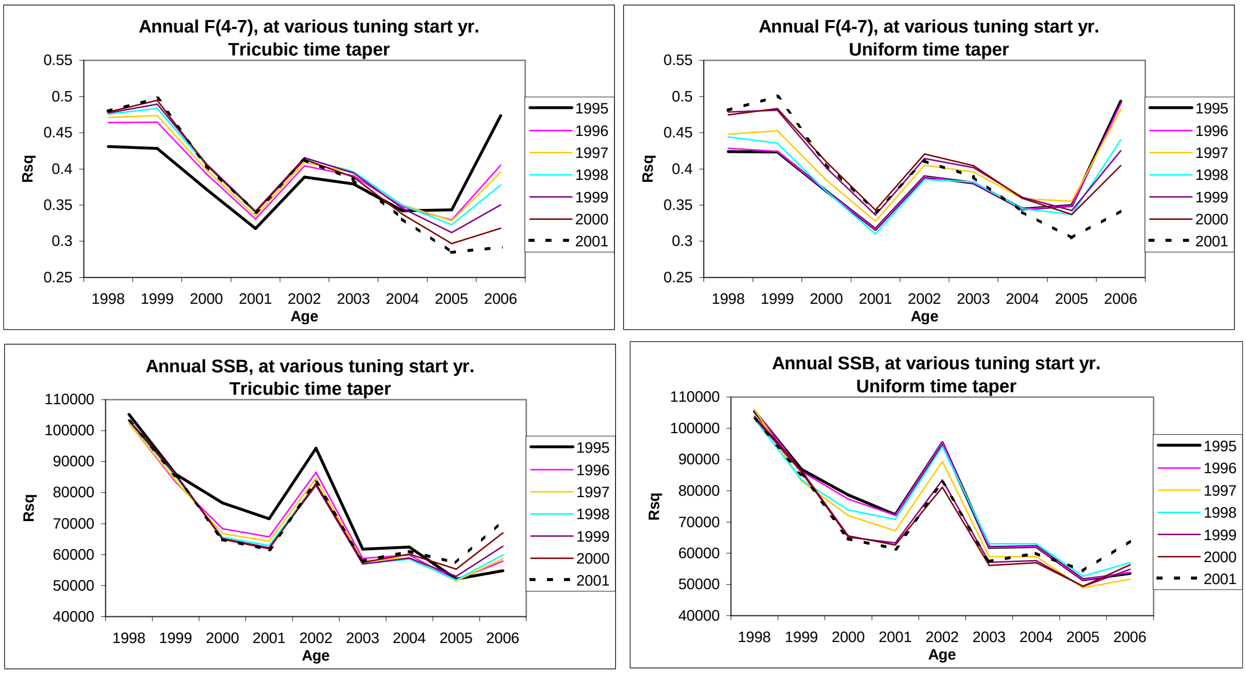


Figure 2.14 Effects of reducing survey series in the tuning one by one year from starting year 1995 to starting year 2001. Left panels: Tricubic time taper, Right hand: Unifor time taper.

Upper row: Estimated fishing mortality F(4-7) for the years 1998-2006.

Lower row: Estimated SSB for the years 1998-2006.

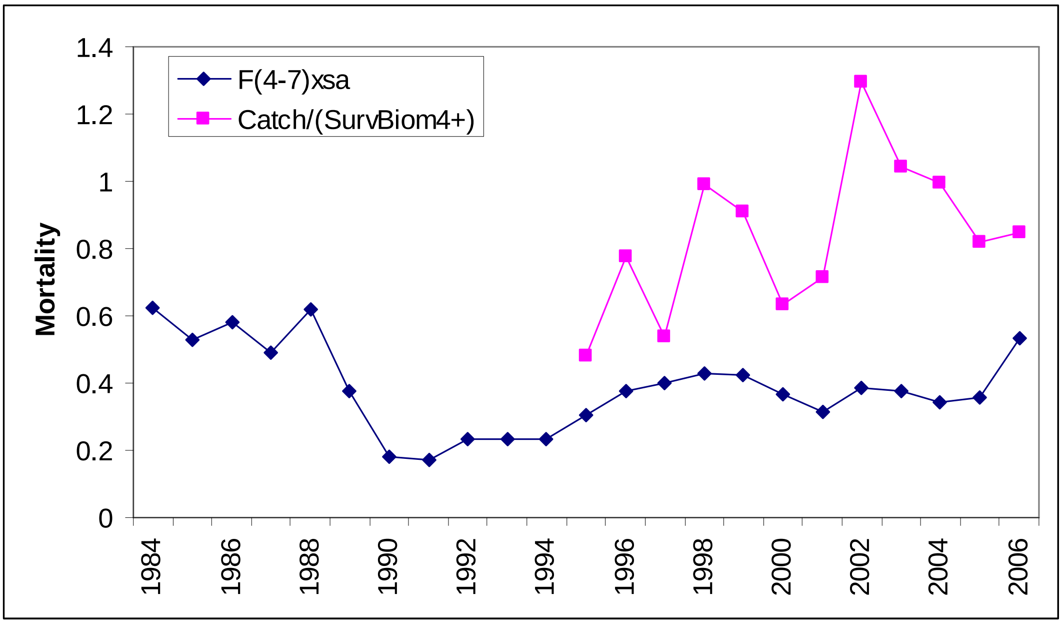


Figure 2.15 Harvest rates expressed as catch relative to survey biomass for age 4 and older, compared to fishing mortality from the updated xsa.

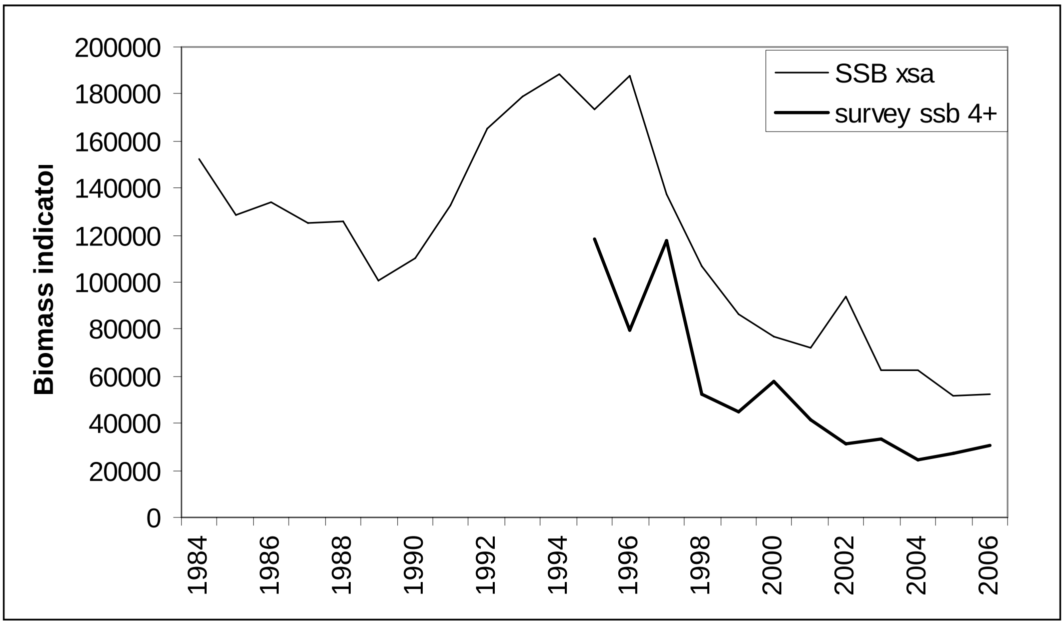


Figure 2.16. Biomass indicators from survey and xsa.

3 North-East Arctic Cod (Subareas I AND II)

The assessment of this stock is on the observation list, this year an update assessment was carried out.

3.1 Status of the fisheries

3.1.1 Historical development of the fisheries (Table 3.1a)

From a level of about 900,000 t in the mid-1970s, landings declined steadily to around 300,000 t in 1983-1985 (Table 3.1a). 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. After 2000, the reported catches have been between 400,000 and 500,000 t, in addition there have been unreported catches (see below). 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 Reported landings prior to 2007 (Tables 3.1–3.3, Figure 3.1)

Reported landings of cod in sub-area I and Divisions IIa and IIb:

Final official landings for 2005 amount to 488,462 t. The provisional official landings for 2006 are 485,177 t.

Reported landings figures used for the assessment of North-East Arctic cod:

The historical practise (considering catches between 62ºN and 67ºN for the whole year and catches between 67ºN and 69ºN for the second half of the year to be Norwegian coastal cod) leads to official landings of North-East Arctic cod of 475,276 t in 2005 and 469,197 t in 2006 (Table 3.1a). The coastal cod catches calculated this way in 2005 and 2006 were 13,366 t and 15,980 t, respectively. The catches of coastal cod calculated this way for the period 1960-2006 are given in Table 3.1b together with the coastal cod catches calculated based on otolith types as described in Section 2.

The landings by area, split into trawl and other gears, are given in Table 3.2 and the nominal landings by country are given in Table 3.3. Compared to 2005, the landings in 2006 decreased in Division IIb, but increased slightly in Division IIa (Table 3.1a).

3.1.3 Unreported catches of Northeast Arctic cod in 2002–2006

In recent years certain quantities of unreported catches (IUU catches) have been added to the reported landings. There were two estimates of potential unreported landings presented at the 2007 AFWG meeting by Russian and Norwegian delegates. More details on this issue are given in Section 0.5.

AFWG decided to make two separate runs of stock assessment based on two time series (2002-2006) of IUU estimates, incorporated in the catch data, and two sets of calculations to recommend TAC for 2008. All of these catches were assumed to be Northeast Arctic cod. The amount of unreported catches for 2002-2006, calculated using the two methods, are given in Table 3.1a.

The two runs are described as the NOR-IUU-run and RUS-IUU-run, respectively, The two sets of input and output data were labeled in the Section 3 text tables and figures by additional letter N (in case of Norwegian estimates) or R (in case of Russian estimates). Tables with identical input data for two sets of assessment were not labeled. Headings of the tables illustrated the stock assessment, based on Russian estimates, were shaded for distinction of two sets of assessment and for the convenience of readers.

3.1.4 Catch advice for 2006 and 2007

The Joint Norwegian-Russian Fisheries Commission (JNRFC) agreed on a TAC of 492,000 t for 2006, including 21,000 t Norwegian coastal cod. The total reported catch of 485,177 t in 2006 was 6,823 t below the agreed TAC.

The advice given and quota set for 2007 – summary:

Assessment by AFWG 2006, based on estimated total catch of 641 000 tonnes in 2005 and assuming F_{sq} (=F_{2005}) for 2006: TAC=**366,000 tonnes**, corresponding to using the agreed HCR. The 10% constraint on year-to-year variations was suspended because the predicted SSB in 2007 is below B_{pa} (441,000 tonnes), also F=0.383 (0.40*441,000/460,000) was used in the HCR. It should also be noted that the F_{sq} catch in 2006 (551,000 tonnes) was less than the 2006 TAC+ the level of unreported catches estimated for 2005 (471,000+166,000 = 637,000 tonnes). This fact was noted by AFWG, who also gave alternative predictions based on catch levels in 2006 above the F_{sq} catch.

ACFM Spring 2006: “ICES has evaluated these decision rules for cod and a management plan based upon them is in accordance with the precautionary approach when the SSB is above $\mathbf{B}_{lim}$. The agreed management plan was not evaluated with an implementation error as large as the one currently occurring in the fishery. The agreed management plan has been evaluated to be consistent with the precautionary approach when the SSB is above $\mathbf{B}_{lim}$ and there is a low level of implementation error. However, the management plan is not fully enforced, resulting in non-reported landings and exploitation above what was intended in the management plan. Total catches in 2007 consistent with the Precautionary Approach reference points are below **309 000** t.” (F=0.40 in 2007 gives 309 000 tonnes). ACFM did not comment on whether it would be more appropriate to use a value above F_{sq} for F_{2006} in the predictions.

The JNRFC considered the estimate of unreported catches in 2005 made by the Norwegian Directorate of Fisheries (114 000 tonnes) to be the appropriate figure to use in the assessment. An assessment using this figure was also given in the AFWG report for 2006. A short-term prediction based on this assessment gave an SSB in 2007 (and later years) above B_{pa} (460 000 tonnes), and thus the 10% constraint on year-to-year variations in HCR was not suspended. The HCR then resulted in a TAC advice of 424 000 tonnes for 2007, a 10% reduction from the 2006 value of 471 000 tonnes. Accordingly, the JNRFC set the TAC for NEA cod for 2007 to **424 000** tonnes, and the total cod TAC was set to 445,000 t, including 21,000 t Norwegian coastal cod.

The Working Group has no information on the size of expected unreported landings in 2007.

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 (Table A1).

3.2.2 Survey results (Tables A2–A4, A9–A10, Figure 3.2–3.4)

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 2007 are given in Tables A2 and A3. More details on this survey are given in Aglen (WD 8). The Russian zone was not covered this year, while some areas north of the standard survey area in the Svalbard zone was covered. These additional areas have not been included in the survey estimates.

Before 2000 this survey was made without participation from Russian vessels, while in 2001-2005 Russian vessels have covered important parts of the Russian zone. In 2006-2007 the survey was again carried out only by Norwegian vessels. In 2007 the vessels were not allowed to cover the Russian EEZ.

Several methods for adjusting the 2007 indices were discussed. For cod and haddock a swept area time series for 1993-2006 corresponding to the 2007 coverage was calculated (WD 8). For cod it was decided to estimate the amount in Russian zone by using the 2004-2006 average ratio between the index in REZ and neighbouring areas (western part of main areas D and D’ in Figure 3.2). Figure 3.3 illustrates how such recent 3-year average ratios would have performed if applied in earlier years. The ratios based on swept area were also used for the acoustic estimates.

Regarding the older part of this time series it should be noted that the survey prior to 1993 covered a smaller area (Jakobsen *et al*. 1997), and the number of young cod (particularly 1- and 2-year old fish) was probably underestimated. Other changes in the survey methodology through the 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. This mainly affects the age 1 indices.

Lofoten acoustic survey on spawners

The estimated abundance indices from the Norwegian acoustic survey off Lofoten and Vesterålen (the main spawning area for this stock) in March/April are given in Table A4. A description of the survey, sampling effort and details of the estimation procedure can be found in Korsbrekke (1997). The indices and length/weight at age from the 2005 and 2006 surveys have been slightly revised.

Russian autumn survey

Abundance estimates from the Russian autumn survey (November-December) are given in Table A9 (acoustic estimates) and Table A10 (bottom trawl estimates). The entire bottom trawl time series has now been revised back to 1982 (Golovanov et al., WD3), using the same method as in the revision presented last year, which went back to 1994. The new swept area indices reflect Northeast Arctic cod stock dynamics more precisely compared to the previous one - catch per hour trawling. The Russian autumn survey in 2006 was carried out with reduced area coverage. Divisions IIa and IIb were adequately investigated in the survey in contrast to Sub-area I, where the survey covered approximately 40% of the long-term average area coverage. The Sub-area I survey indices were calculated based on actual swept area (40 541 sq. miles). The AFWG decided to use the final year-class indices without any correction because of satisfactory internal correspondence between year class abundances at age 2-9 years according to the 2006 survey and ones due to the previous surveys (Fig 3.4).

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 chapter 0.6).

3.2.4 Length and Weight at age (Tables A5–A9, A11–A12)

Length at age is shown in Table A5 for the Norwegian survey in the Barents Sea in winter, in Table A7 for the Lofoten survey and in Table A11 for the Russian survey in October-December. Weight 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.

Both the Norwegian winter survey in 2007 and the Russian autumn survey in 2006 show small changes in size-at-age compared to the previous year (Table A6 and A12).

3.2.5 Maturity at age (Table 3.5)

Historical (pre 1982) Norwegian and Russian time series on maturity ogives were reconstructed by the 2001 AFWG meeting (ICES CM 2001/ACFM:19). The Norwegian maturity ogives were constructed using the Gulland method for individual cohorts, based on information on age at first spawning from otoliths. For the time period 1946-1958 only the Norwegian data were available. The Russian proportions mature at age, based on visual examinations of gonads, were available from 1959.

Since 1982 Russian and Norwegian survey data have been used (Table 3.5). For the years 1985-2007, Norwegian maturity at age ogives have been obtained by combining the Barents Sea and Lofoten surveys. Russian maturity ogives from the autumn survey as well as from commercial fishery for November-February are available from 1984 until present. 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. The approach used is consistent with the approach used to estimate the weight at age in the stock (described in Section 3.3.2). The percent mature at age for the Russian and Norwegian surveys have been arithmetically averaged for all years, except 1982-1983 when only Norwegian observations were used and 1984 when only Russian observations were used.

The Norwegian maturity ogives for 1989 and later years were revised last year, due to a slight change of methodology. In the years 1985-1988 another maturity scale was in use and some further work is required to recalculate for those years.

3.2.6 Status of research on reproductive potential of NEA cod

Section 3.2.5 in WG 2004 lists a few maturity related topics for intersessional work. More details are discussed in a long maturity chapter in the 2003 WG report (3.2.5). A Russian-Norwegian project (“Optimal long-term harvest in the Barents Sea ecosystem”) includes some of these topics, in particular the occurrence of skipped spawners. Gonads have been sampled for histological studies in both the Russian autumn survey and the joint winter survey in 2005-2007. In addition monthly sampling of gonads is made during 2006.

Research is ongoing into developing alternative indices of reproductive potential for NEA cod (Marshall et al. 1998). This research is benefiting from the improved accessibility of both Norwegian and Russian databases.

Marshall et al. (2006) estimated female-only spawner biomass (FSB) and total egg production (TEP) for the Northeast Arctic cod stock over a 56-year time period. The proportion of females (FSB/SSB) varied between 24% and 68%, and the variation was systematic with length such that SSB became more female-biased as the mean length of spawners increased. Relative fecundity of the stock (TEP/SSB) varied between 115 and 355 eggs g^{-1} and was significantly, positively correlated with mean length of spawners. Both FSB and TEP gave a different interpretation of the recruitment response to reductions in stock size (overcompensatory) compared with that obtained using SSB (either compensatory or depensatory). There was no difference between SSB and FSB in the assessment of stock status; however, in recent years (1980–2001) TEP fell below the threshold level at which recruitment becomes impaired more frequently than did SSB. This suggests that using SSB as a measure of stock reproductive potential could lead to overly optimistic assessments of stock status.

3.3 Data used in the assessment

3.3.1 Catch at age (Tables 3.8, 3.9 and 3.10)

No revisions were made to the 2005 catches. For 2006, age compositions from all areas were available from Russia, Spain and Norway. Germany provided age compositions from Divisions IIa and IIb, while Poland provided age compositions from sub-area IIb. Unreported catches in 2006 were distributed using total international trawl catch age distribution in Division IIb on half the unreported catch and total international trawl catch age distribution in Sub-area I on the other half.

Table 3.8 show available catch at age data for all ages 1-15+, with catches for 2002-2006, calculated using the two methods.

The catch numbers shown in Table 3.10 together with cannibalism figures (Table 3.9) were used in the XSA tuning. Data, based on the NOR-IUU-run, are presented in Table 3.9N-3.10.N, and data, based on RUS-IUU-run are in Table 3.9R-3.10R.

3.3.2 Weight at age (Tables 3.4 and 3.11–3.12).

Catch weights

For 2006, the mean weight at age in the catch (Table 3.11) was calculated as a weighted average of the weight at age in the catch for Norway, Russia, Germany, Spain and Poland. The weight at age in the catch for these countries is given in Table 3.4.

Stock weights

Since ages 12 and 13+ are scarce in the survey samples, fixed values for ages 12 to 15+ has formerly been used (set equal to typical weights for these ages observed in catches). Since the 2000 working group the assessment has applied 13 as plus group. For the years 1946-1984 the 13+ weights are calculated year by year as a weighted mean of the former fixed values for older ages. For later years they are calculated from the average observed weight for age 11 in the years 1995-2006 increased by 1.58 kg for age 12 and 2x1.58 kg for age 13+.

For ages 1-11 stock weights at age a at the start of year y ($W_{a,y}$) for 1983-2007 (Table 3.12) were calculated as follows:

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

where

$W_{rus,a-1,y-1}$: Weight at age a-1 in the Russian survey in year y-1 (Table A12)

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

$W_{nbar,a,y}$: Weight at age a in the Norwegian Barents Sea acoustic survey in year y (Table A6)

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

$W_{lof,a,y}$: Weight at age a in the Lofoten survey in year y (Table A8)

3.3.3 Natural mortality

A natural mortality of 0.2 was used. In addition, cannibalism was taken into account as described in Section 3.4.2. The proportion of F and M before spawning was set to zero.

3.3.4 Maturity at age (Tables 3.5 and 3.13)

As noted in Section 3.2.5, annual arithmetic averages of the Russian and Norwegian maturity at age values were used for 1985-2007.

3.3.5 Tuning data (Table 3.14)

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

	Name	Place	Season	Age	Years
Fleet 18	Russian bottom trawl surv.	Total area	Oct-Dec	3-9	1994-2006
Fleet 09	Russian trawl CPUE	Total area	All year	9-11	1985-2006
Fleet 15	Joint bottom trawl survey	Barents Sea	Feb-Mar	3-8	1981-2007
Fleet 16	Joint acoustic survey	Barents Sea + Lofoten	Feb-Mar	3-9	1985-2007 (Table A13)

The output tables from the tuning include ages 1 and 2, just to show the year-class abundance at age 1 and 2 created by the cannibalism numbers used in the tuning.

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 2007 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. The tuning fleet file is shown in Table 3.14.

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

1) Tapered time weighting power 3 over 10 years
2) Catchability dependent of stock size for ages less than 6
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

These settings are identical to those used by last years Working Group. The reasoning for keeping the same settings and tuning data are given in section 3.4.1.

3.3.6 Recruitment indices (Tables 3.6 and 3.7)

The survey data on ages 0, 1 and 2 in the autumn survey and ages 1, 2 and 3 in the joint winter survey are not used in the XSA, and are instead used to estimate the year-class strength at age 3 by making regressions with VPA estimates of recruitment at age 3 (the RCT3-program in the ICES software). The input based on the NOR-IUU-run is shown in Table 3.6N, the input based on RUS-IUU-run is in Table 3.6R, the outputs are shown in Table 3.7N and 3.7R respectively.

3.3.7 Cannibalism

The method used for calculation of the consumption is described by Bogstad and Mehl (1997). It should be noted that the temperature is used in these calculations. 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). On average about 9,000 cod stomachs from the Barents Sea have been analysed annually in the period 1984-2006. The stomachs are sampled throughout the year, although sampling is less frequent in the second quarter of the year. The consumption calculations have been updated by data for 2006 as well as additional data for 2004 and 2005. In addition, the age-length keys used for the second half of 2005 were revised (based on the ecosystem survey). 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. Thus, consumption by cod in the spawning period was omitted from the calculations. Cod generally consumes less food during the spawning period than at other times of the year, and the main food item in the period 1996-2006 was adult herring (Michalsen et al., in prep.). The geographical distribution of the cod stock by season is based on Norwegian survey data. The total numbers of cod ages 0–6 (million) consumed, based on the NOR-IUU-run, are given in Table 3.9N and those based on RUS-IUU-run are in Table 3.9R.

Work on extending the cannibalism time series back to 1947 is ongoing (Yaragina et al. in prep.).

3.3.8 Prediction data (Tables 3.23 and 3.28, Figure 3.5a-b and 3.13)

The input data to the short-term prediction with management option table (2007-2009) are given in Table 3.28. For 2007 stock weights and maturity were taken from surveys as described in Sections 3.3.2 and 3.3.4.

Catch weights in 2007 onwards and stock weights in 2008 onwards are predicted by the method described by Brander (2002), where the latest observation of weights by cohort are used together with average annual increments to predict the weight of the cohort the following year.

W(a+1,y+1)=W(a,y) + Incr(a), where Incr(a) is a “medium term” average of Incr(a,y)=
W(a+1,y+1)-W(a,y)

This method was introduced in the cod prediction in the 2003 working group. Then it was decided that for Catch Weights average annual increments by age were calculated for the period 1994-2001, and for Stock Weights average annual increments by age were calculated for the period 1995-2002. At the 2004 working group it was decided to follow the same procedure, except that for stock weights the period (2001-2003) was chosen for calculating average annual increment. The reason was that those years indicate a declining trend that could be associated with declining capelin stock. The same argument was considered valid at the 2005 and later working groups and only the 3 most recent values of annual increments were used for predicting stock weights. For catch weights, we use a 10-year period (1996-2005) for averaging the increments. Figures 3.5a and 3.5b show how these predictions perform back in history. Evidently the fit is best over the period which is the basis for calculated Incr(a). The latest observations of stock weights are very close to those predicted, while the observed catch weights in 2006 is somewhat below the predicted ones for ages 8 and older.

The maturity ogive for the years 2008 and 2009 was predicted by using the 2005-2007 average. The exploitation pattern in 2007 and later years was set equal to the 2004-2006 average.

At the 2006 WG meeting the $F_{status\ quo}$ was set equal to the F in the last year because that assessment showed an increasing F since 2003. This year, there is no clear trend in the F over the last three years, and thus a 3-year average F was used for $F_{status\ quo.}$ Runs a and c in medium term predictions was based on F_{sq} equal to the recent 3 year. For comparison,, it was decided also to make a forecast based on $F_{status\ quo}$ equal F_{2006} (runs b and d).

The stock number at age in 2007 was taken from the final VPA (Table 3.23 with data, based on the NOR-IUU-run, presented in Table 3.23N, and those based on RUS-IUU-run in Table 3.23R.) for ages 4 and older. The recruitment at age 3 in year 2007 and later was estimated from surveys (section 3.3.6). Fig. 3.13 shows the development in natural mortality due to cannibalism for cod (prey) age groups 1-3 together with the abundance of capelin in the period 1984-2006. The recent 3 years average M was considered realistic as input for the years 2007-2009 in the prediction.

It is seen from Figure 3.13 that the level of cannibalism, particularly on age 1 cod, may be inversely related to the capelin abundance. Models for predicting cannibalism were presented in WD 10 (2004).

3.4 Methods used in the assessment.

The XSA was also this year used as the main assessment method. Additional assessment methods are presented in Section 3.10.

3.4.1 VPA, tuning and sensitivity analysis

Figure 3.6 shows the residuals of various tuning series. Figure 3.7 compares the estimated survivors (by end of 2006) and Fs before shrinkage in single fleet tunings. For the ages 3-8 there is a fair agreement between the single fleets, and the combined fleet (ALL, after shrinkage) are located in-between the individual fleet estimates. For age 9 the estimated survivors from the cpue series (fleet 9) is less than half compared to the estimates from the two surveys. For age 10 the fleet 9 is the only observation, but the combined value is somewhat increased by the extrapolated observations of the same cohort one year earlier. The internal consistency within surveys is illustrated in the plots from the “surba” program (Needle, 2003 and Needle, 2004) in Figure 3.8.

Since the assessments in August 2000, few changes in model settings and data choices have been made. ACFM technical minutes have several times commented on the rather unconventional use of “stock size dependant catchability” (ssdq). For NEA cod, this is assumed for age groups 3-5. It is true that this choice involves more parameters to be estimated and a likely less precise parameter fit, in particular when the tuning is restricted to the latest 10 years. It is also observed that the influence of shrinkage is considerably higher for the age groups estimated by this q-assumption (table 3.15b). The 2005 WG argued for keeping this setting on the basis of compared retrospective patterns, and the ACFM reviewers agreed that without ssdq some problems might occur again as soon as some high survey values occur. The retrospective runs in last years report shows that the sensitivity to this choice was highest in the mid-1990s, a period with high survey estimates. The comparisons showed in Table 3.15b confirms that in the current situation with low or moderate survey estimates the assessment result is much less sensitive to these choices.

It is not clear whether this apparent stock size dependence in the surveys are real or caused by underreporting of catches. Underreporting would mean that the documented catches have been too small to confirm the abundance measured in the surveys. On the other hand, fish behaviour studies and comparative fishing have indicated that there might be a real tendency for higher escapement rate when fishing at low concentrations compared to high (Aglen *et al.* 1997).

The diagnostics (Table 3.16N), at least for some of the fleets, show that the t-values for the log-log regression slopes are significantly different from 1 for some of the younger ages. Figure 3.9 shows xsa values vs. survey values for ages 3-6, for the 10 last years. Points indicating a line through the origin fulfils the assumption of stock size independent q. Cases indicating a large intercept or an asymptotic pattern would be better described by a stock size dependent q. Even in this short series there are several cases where the dependent version would be preferable. The problem is of course the parameter estimation with a short tuning series. Probably it is better to estimate relevant parameters at low precision than less relevant parameters with higher precision. For the above mentioned reasons the former setting with stock size dependant q for ages 3-5 was kept.

The effects of using various levels of unreported catches in the period 2002-2006 on the assessment for those years are shown in Table 3.15a.

3.4.2 Including cannibalism in the VPA (Tables 3.16–3.22)

For the cod assessment data from annual sampling of cod stomachs has been used for estimating cannibalism, since the 1995 assessment. The argument has been raised that the uncertainty in such calculations are so large that they introduce too much noise in the assessment. A rather comprehensive analysis of the usefulness of this was presented in Appendix 1 in the 2004 AFWG report. The conclusion was that it improves the assessment.

The following procedure was followed: As a starting point the number of cod consumed by cod was 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 new estimates of consumption. This procedure was repeated until the consumed numbers for the latest year (2006) differed less than 1% from the previous iteration.

The tuning diagnostics from XSA with cannibalism are given in Table 3.16 and the total fishing mortalities (true fishing mortality plus mortality from cannibalism) and population numbers in Tables 3.17 and 3.18. Data, based on the NOR-IUU-run, are presented in Table 3.16N-3.18N, and those based on RUS-IUU-run in Table 3.16R-3.18R.

In order to build a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA analyses was split into the mortality caused by the fishing fleet (true F) and the mortality caused by cod cannibalism (M2 in MSVPA terminology) by using the number caught by fishing and by cannibalism. The new natural mortality matrix was prepared by adding 0.2 (M1) to the M2. This new M matrix (Table 3.19) was used together with the new true Fs (Table 3.21) to run the final VPA on ages 3-13+. M2 and F values for ages 1-6 in 1984-2006 are given in Tables 3.20 and 3.22, with those based on the NOR-IUU-run presented in Table 3.20N and 3.22,N, and those based on RUS-IUU-run in Table 3.20R and 3.22R.

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 3.27).

3.5 Results of the assessment

3.5.1 Fishing mortalities and VPA (Tables 3.21–3.26, Figure 3.1)

The estimated F_{5-10} in 2006 is lower than the assumed F_{sq} in last year's prediction (0.69 vs. 0.74), while the spawning stock biomass in 2006 is estimated to be 590,000 t, which is somewhat above last year's assessment (517,000 t), due to data based on the NOR-IUU-run to be consistent with the 2006 assessment.

The fishing mortalities and stock numbers are given in Tables 3.21 -3.23, while the stock biomass at age and the spawning stock biomass at age are given in Tables 3.24-3.25. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1946 is given in Table 3.26 and Figure 3.1. All these tables and figures are doubled and show results, based on the NOR-IUU-run, in tables labeled N, and results based on RUS-IUU-run in tables labeled R.

Figure 3.12 shows the results of a retrospective analysis when cannibalism is taken into account. The number of cod consumed by cod was not recalculated year by year in the retrospective analysis, however.

3.5.2 Recruitment (Table 3.6– 3.7)

From the RCT3 calculations the estimated number (millions) of recruits at age 3 were (Figures from the Nor-IUU run, with figures from the Rus-IUU run in brackets): 565(501) millions for the 2004 year-class, 535(476) millions for the 2005 year-class and 461(406) millions for the 2006 year-class. A comparison of these results with the results of other recruitment models is given in Table 1.18.

3.6 Reference points

New reference points for Northeast Arctic cod were proposed by SGBRP in January 2003 (ICES CM 2003/ACFM:11) and adopted by ACFM at the May 2003 meeting.

3.6.1 Biomass reference points (Figure 3.1)

The values adopted by ACFM in 2003 are $\mathbf{B}_{lim}$ = 220,000 t, $\mathbf{B}_{pa}$ = 460,000 t. (ICES CM 2003/ACFM:11).

3.6.2 Fishing mortality reference points

The values adopted by ACFM in 2003 are $\mathbf{F}_{lim}$ = 0.74 and $\mathbf{F}_{pa}$ = 0.40. (ICES CM 2003/ACFM:11).

Calculations of yield per recruit gave the following values: $F_{0.1}$ =0.15 and F_{max} =0.28.

3.6.3 Target reference points

The Russian-Norwegian Fishery Commission has requested an evaluation of the maximum sustainable yield (MSY) from the Barents Sea, taking into account species interactions and the influence from the environment. The work shall start with cod and gradually incorporate other species. A first step towards this is to study the MSY of cod in a single-species context (Kovalev and Bogstad, 2005). They studied the long-term yield of cod using the same biological model as used in the evaluation of the harvest control rule. Thus, mean weight at age in the stock was modelled as a function of total stock size, and mean weight at age in the catch and maturity at age was modelled as a function of mean weight at age in the stock. Cannibalism was included, and a stochastic segmented regression SSB-recruitment relationship was used. The results indicated that the long-term yield is fairly stable for a range of fishing mortalities between 0.25 and 0.6. It should be noted that there are few observations of biological parameters for low fishing mortalities and high stock sizes, so that the results for low Fs are more uncertain than those for higher Fs.

3.7 Short term forecast (Table 3.28–3.30)

Table 3.28 *a* and *c* (N, R respectively) shows input data for runs with F_{sq} equal to the recent 3 year average F. Table 3.28 *b* and *d* (N, R respectively) shows input data for runs with F_{sq} equal to the last year F. Table 3.29 *a* and *c* (N, R respectively), 3.29 *b* and *d* (N, R respectively) shows the short-term consequences over a range of F-values in 2007 for the before-mentioned runs. The detailed outputs corresponding to F_{sq} in 2007 and F_{pa} in 2008 is given in Tables 3.30 *a, b, a, d* (N, R respectively).

3.8 Three year forecasts and management scenarios

3.8.1 Adopted harvesting strategy

At the 31st session of The Joint Norwegian-Russian Fishery Commission in autumn 2002, the Parties agreed on a new harvest control rule. This rule was applied for the first time when setting quotas for 2004. The rule was somewhat amended at the 33rd session of The Joint Norwegian-Russian Fishery Commission in autumn 2004. The amended rule was evaluated by ICES in 2005 and found to be precautionary.

"The Parties agreed that the management strategies for cod and haddock should take into account the following:

- *conditions for high long-term yield from the stocks*
- *achievement of year-to-year stability in TACs*
- *full utilization of all available information on stock development*

On this basis, the Parties determined the following decision rules for setting the annual fishing quota (TAC) for Northeast Arctic cod (NEA cod):

- *estimate the average TAC level for the coming 3 years based on F_{pa}. TAC for the next year will be set to this level as a starting value for the 3-year period.*
- *the year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development, however the TAC should not be changed by more than +/- 10% compared with the previous year's TAC.*
- *if the spawning stock falls below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at B_{pa}, to F= 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year, a year before and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC.*

The Parties agreed on similar decision rules for haddock, based on F_{pa} and B_{pa} for haddock, and with a fluctuation in TAC from year to year of no more than +/-25% (due to larger stock fluctuations).

The working group notes that the current implementation of the rules corresponds to substituting the definition of operational years "current year, a year before and 3 years of prediction" by "current(intermediate in ICES terminology) year, quota year and 2 years of prediction", and asks for a clarification from the JRNFC whether such an implementation of the rule is acceptable.

3.8.2 Results

Tables 3.30a, 3.30c (N, R respectively) shows output of the predictions for the time period (2007-2010) relevant for applying the agreed harvest control rule (HCR). Table 3.30a (N, R respectively) is based on F_{sq} (=$F_{2004\text{-}2006}$=0.69) in 2007 and F=0.4 in the following years. Table 3.30c (N, R respectively) is based on 3 year average TAC applied to the first prediction year due to HCR.

Tables 3.30b, 3.30d (N, R respectively) shows output of the predictions for the time period (2007-2010) relevant for applying the agreed harvest control rule (HCR). Table 3.30b (N, R respectively) is based on F_{sq} equal to the last year F. (=$F_{2004\text{-}2006}$=0.66) and F=0.4 in the following years. Table 3.30d (N, R respectively) is based on 3 year average TAC applied to the first prediction year due to HCR, with F_{sq} equal to the last year's F.

The TAC in 2008 according to this rule is thus estimated to (NOR-IUU) 409,000 tonnes, corresponding to F=0.51 in 2008. For RUS-IUU the HCR gives 2008 TAC of 382 000 tonnes. These catch forecasts covers all catches. It is then implied that all types of catches are to be counted against this TAC. It also means that if any overfishing is expected to take place, the above calculated TAC should be reduced by the expected amount of overfishing.

The text table below shows the TAC for 2008 derived from the HCR, as well as the F_{sq} catch in 2007 and the SSB in 2008, for the two assumptions about IUU fishing and about $F_{status\ quo}$.

IUU figures	$F_{status\ quo}$	C2007 (1000 tonnes)	TAC2008 (1000 tonnes)	SSB 2008 (1000 tonnes)	Comments regarding HCR in 2008
Norwegian	2004-2006 average	530	409	531	
Norwegian	2006	510	415	548	
Russian	2004-2006 average	463	382	509	TAC 2008 would be 363 000 tonnes without 10% constraint on annual change of TAC
Russian	2006	438	382	530	TAC 2008 would be 371 000 tonnes without 10% constraint on annual change of TAC

It should be noted that the TAC for 2007 is 424,000 t. The difference between this TAC and the catches corresponding to the F_{sq} scenario is close to the estimated overfishing for 2006 (127 000 and 28000 tonnes, respectively).

3.8.3 Evaluation of HCR for different levels of implementation error.

The HCR evaluation performed in 2005 found the HCR to be in agreement with the precautionary approach, provided that the assessment uncertainty, assessment error and implementation error are not greater than those calculated from historic data and used in the evaluation. It should be noted that an implementation error of 12% with a CV of 0.18 was used for all age groups in the testing of the HCR. In 2002-2006, the implementation error has been in the 20-35% range. Thus, the assumptions made in the evaluation may be violated.

The HCR evaluation from 2005 was re-run (AFWG 2005 Table 3.35). Runs were made with 10%, 20%, 30%, 40% and 50% implementation error. The only setting which was changed was the CV of the implementation error which was set to 0. As in 2005, two sets of runs were made: With 'low' M on age 3 and 4 fish (M=0.2 for those age groups – Run 1 in AFWG 2005), and with 'high' M on age 3 and 4 fish (M=0.7 and 0.4, respectively – Run 2 in AFWG

2005). The high M levels are close to the highest M values calculated for these age groups in the period 1984-2006.

The results of the runs are given in the text table below. Catch and Biomasses in 1000 t.

Run No.	M	Error	Real. F	Catch	TSB	SSB	Recruits Age 3	% years SSB < Blim	% years SSB< Bpa	Average year-to-year % change in TAC
1	Low	10%	0.63	914	3140	749	690	0.001	4.0	11
2	Low	20%	0.73	916	2968	650	691	0.005	12.7	15
3	Low	30%	0.81	917	2821	573	690	0.05	24.2	21
4	Low	40%	0.86	919	2698	515	687	0.18	35.0	27
5	Low	50%	0.90	925	2606	476	686	0.48	43.3	34
6	High	10%	0.57	486	1894	451	687	0.11	48.7	17
7	High	20%	0.64	482	1794	395	682	0.69	62.9	23
8	High	30%	0.69	476	1709	355	674	2.4	71.0	29
9	High	40%	0.74	468	1633	325	660	5.7	75.2	34
10	High	50%	0.77	455	1556	300	640	10.6	77.5	37

A tentative conclusion is that the current levels of implementation error/IUU (according to Norwegian estimates) of around 30% are close to the level for which the agreed HCR no longer is precautionary, for a worst case scenario in terms of high mortality for age 3 and 4 cod. In the future, it would be useful to use models of cod cannibalism in the population model (see e. g. Kovalev and Bogstad 2005) when evaluating the HCR with respect to various levels of implementation error.

3.9 Comparison of this year's XSA assessment with last year's assessment.

The text table below compares this year's estimates (Nor-IUU-run) with last year's estimate for the year 2006 for number at age (millions), total biomass, spawning biomass (thousand tonnes) and reference F-values, as well as reference F for the year 2005.

		2006										
Assessment yr (specification)	F(2005)	age3	age4	age5	age6	age7	age8	age9	age10	TSB	SSB	F(2006)
2006 WG	0.74	431*	354	188	149	54.7	33.4	14.4	5.1	1319	517	0.74**
2007 WG	0.73	409	376	181	189	70.1	36.7	15.5	3.6	1461	590	0.66
Ratio 2007 WG/ 2006 WG	0.99	0.95	1.06	0.96	1.27	1.28	1.10	1.08	0.71	1.11	1.14	0.89

*estimated by rct3 **assuming F_{sq}

The final assessment values for ages 3-5 and 8-9 are fairly close to the 2006 assessment, while ages 6 and 7 seem to have been underestimated in last year's assessment. The F in 2005 is only 0.01 below last year's estimate. The SSB in 2006 is revised up by 14% and the estimated F for 2006 is 11% lower than the F_{sq} applied by last year's WG. The new estimate of SSB in 2007 (572,000 tonnes) is 30% above the prediction from last year (441,000 tonnes).

Retrospective plots of F, SSB and recruitment are shown in Figure 3.12.

3.10 Additional assessment methods

3.10.1 Survey calibration method

A “calibrated” prediction method of stock numbers from the Joint bottom trawl survey against VPA numbers, using data from the period 1981-1995 to scale the survey series to absolute numbers, was carried out. The method is described in Pennington and Nakken (WD13, 2006). The regression is done for ages 4-6 and 7+ separately. The results, using a regression method with intercept, are shown in Fig 3.10-3.11 and in the text table in Section 3.12. The figures show that the survey calibration method gives comparable trends with the VPA both for ages 4-6 and 7+.

3.10.2 Gadget

The biological Gadget model used for Northeast Arctic cod is described in Bogstad et al. (2004). The same model as last year was run, updated with an additional year of data. Model runs are now performed using Gadget version 2.1.03. Figure 3.15 shows the total stock biomass, spawning stock biomass and recruitment (age 3) from this year’s Gadget run compared to last year’s run. It is seen that the additional year of data gave small changes in the perception of current stock size, as was the case both with XSA and the survey calibration method. Also the stock size in 2007 seems to be about the same as in 2006.

Using Gadget to estimate missing catches

Earlier results (WD 24, 2006) presented showed that in principle, Gadget is capable of modeling missing catches for a stock characterized by constant recruitment. Work in progress builds on earlier results, and seeks to address the following issues:

1) Determination of the major source of information used in Gadget to determine missing catches, in the absence of accurate catch statistics

2) Investigate whether Gadget can also perform satisfactorily in detecting missing catches when confronted with stocks characterized by variable recruitment

In addressing (1), the work in progress includes monitoring the performance of Gadget under several scenarios when different noise levels are added to the age/length keys (for the catch and survey data), as well as errors in the age readings. The performance of Gadget under variable stock recruitment scenarios is also being investigated.

3.10.3 GIS technology method

Bulatov et al. (WD7) presented new data for assessment of fishable stock in 2000, 2002-2006. For 2006 the assessment estimated the fishable stock at 2 650 000 t.

Some problems with the method were identified:

- First, the use of catch rates from commercial fishing vessels to obtain swept area estimates representative for larger areas violates the condition that such measures of density have to be based on random samples. Obviously, fishing vessels do not fish at random, but use former experience and various fish-finding tools to seek up the densest concentrations before setting the trawls. Consequently, the catch rates obtained are only representative for the area covered by the trawl during the haul.
- Second, the method uses a constant trawl catchability factor for all length groups, trawl types, seasons etc., which is highly questionable.
- Third, a width of trawling equal to the wingspread of the trawl is used, not taking into consideration the herding effect of trawl wires, trawl doors, and sweeps.

Some members of the working group consider the first point to be a fundamental problem, which does not allow for this method to be used for absolute abundance estimation. The problems mentioned under the two last points can be corrected in the future. Consequently, these members felt that this method have potential for use as an index of relative abundance that can be used as an additional tuning series for a VPA, but cannot be used as absolute abundance estimates.

Some other members of the working group consider the merits of the method in that, in circumstances, when the area coverage by research surveys is not complete, it allows the use of more complete fisheries information on distribution of cod densities, including in areas not covered by the surveys. Despite the requirement for random sampling not met by this method, in fisheries statistics this weakness can be resolved by comparing the results by GIS-based method to data from standard research trawl surveys. A comparison of stock estimates by GIS-based method to estimates by research trawl surveys was undertaken for Alaska pollock in the Bering Sea and the Sea of Okhotsk (Bulatov & Moiseenko, 2004; 2007). According to GIS-based method estimates of this stock's fishable biomass were higher than by the bottom trawl surveys. The approach presented at AFWG is an extension of positive experience from the Far East. Application of GIS-based method for cod stock in the Barents Sea is possible in respect of both estimating the fishable stock and using the results in the conventional assessment done by the AFWG. To this end, some improvements are required, in particular:

- To standardize CPUE data to the long-term CPUE series
- To apply catchability coefficients adjusted for size group
- To take into consideration the herding effect of trawl wires and trawl doors

3.11 Comments to the assessment

In 2006-2007, there was incomplete coverage of the NEA cod distribution area by research surveys (see section 3.2). This increases the uncertainty in the assessment of this stock. The obstacles preventing complete spatial coverage should be removed, by allowing research vessels unlimited access to the entire Barents Sea. New approaches utilizing commercial CPUE data should also be explored. Also, the unreported catches increase the uncertainty in the assessment (section 0.5)

3.12 Precision in input data

Estimates of sampling error are to a large degree lacking or are incomplete for the input data used in the assessment. However, the uncertainty has been estimated for some parts of the input data:

For the Norwegian estimates of catch at age methods for estimating the precision have been developed, and the work is still in progress (Aanes and Pennington 2003, Hirst et al. 2004, Hirst et al. 2005). The methods are general and can in principle be used for the total catch, including all countries' catches, and provide estimates both at age and at length groups. Typical error coefficients of variation are in the range 5-40% depending on age and year. It is evident that the estimates of the oldest fish are the most imprecise due to the low numbers in the catches and resulting small number of samples on these age groups. 2006 was the first year when the catch at age in the assessment was calculated using the method described by Hirst et al. (2005).

For the Barents Sea winter survey, the sampling error is estimated per length group, but not per age group (Aglen, WD8). Since the ages are sampled stratified per length groups in this survey, it is not straightforward to estimate the sampling error per age group. However, this is possible by for example using similar methods as for the catch data (see Hirst et al. 2004).

Aging error is another source of uncertainty, which causes increased uncertainty in addition to bias in the estimates: An estimated age distribution to appear smoother than it would have been in absence of aging error. Some data have been analysed to estimate the precision in aging (Aanes 2002). If the aging error is known, this can currently be taken into account for the estimation of catch at age described above.

Work on quantifying uncertainties also for other input data sets should be encouraged.

3.13 New data sources

This section describes some data sources, which could be included in the assessment in the future.

3.13.1 Catch data

Discard and bycatch data series should be updated and then included in the catch at age matrix (Table 3.31, 3.31a, Sokolov WD 9, 2003). Also the time series described by Hylen (2002), extending the VPA back to 1932, should be reviewed. Consistency between the catch data used for NEA cod and coastal cod should also be ensured. At present, the catch figures used in the coastal cod assessment are not equal to the difference between the total cod catch and the catch used in the NEA cod assessment (Table 3.1b).

3.13.2 Survey data

The bottom trawl estimates from the joint ecosystem survey in August-September, starting in 2004, could in the future (when the time series becomes at least 5 years long) be considered for use as a tuning series. This survey covers the entire distribution area of cod.

3.13.3 New CPUE series

A new approach introduced in WD7, based on vessels' daily reports, may in the future be used for standardization of Russian CPUE series.

3.14 Answering 2006 ACFM comments:

The minutes of the review of the 2006 AFWG report contained a number of comments to the NEA cod assessment. Below, we answer these comments and describe how they have been taken into account (*in italics*):

This chapter highlights very well the current problem in providing advice on NEA cod, in that there is growing evidence for underreporting of catch which may be increasing in magnitude to beyond that included in the evaluation of the HCR as implementation error. It is difficult to predict the development of the stock in the short term as the scale and trend in catch misreporting is unknown for 2006, and this lack of information will erode the quality of the advice. This is particularly pertinent as the estimated spawning biomass close to the trigger biomass of the HCR. The catch statistics in the tables and model outputs agree. Comments by the previous reviewers were addressed. Sampling levels were not presented or evaluated.

Sampling table has not been added

The chapter is strengthened by the use of a range of stock assessment models. All models used show similar dynamics in the stock, although all models use catches as exact or quasi-exact entities. XSA assumes that catches are exact and considering the issues highlighted above this assumption does not hold for NEA cod. The survey based method (using 1 survey only) did show a slightly different perception of the state of the stock with an apparent rescaling in recent years, but the trends were similar. The reviewers were concerned about the comparisons as autocorrelation between XSA and the survey-based method would exist in the most recent 3-4 years.

Does not require any action from the WG

The reviewers agreed with the WG analysis of catchability dependent on stock size, but perhaps as mentioned by the WG, the increase in catchability with stock size might be the results of increased discard instead of a real increase (i.e. density mechanisms) of the catchability of the stock. Although the WG pointed to studies in the field that suggest that catchabilities do change dependent on stock size.

Does not require any action from the WG

The reviewers however felt that the criticism from last year's review about the clarity of the iterative process to determine the effect of cannibalism was still justified. In chapter 3 it is unclear which results come from the preparatory XSA runs and which from the final SVPA, that incorporates the cannibalism into estimates of natural mortality. Also, the matrix of M for the final SVPA was missing, but added during the review. The reviewers noted that the description of incorporating cod predation into the haddock assessment was more clear.

This has been improved by changing the text and the table headings

The WG should state clearly how the use of two separation methods (to distinguish between NEA and coastal cod) impacts on the catch estimates of both stocks. This is well tabulated (Table 3.1), but not that well described. Also the fact that some cod will be counted twice, once within each stock may impact on the quality of the advice. The reviewers would like to see a sensitivity analysis to this phenomenon.

This issue will be addressed when the catch at age series is revised (see Section 3.13.1)

Move most of chapter 3.2.5 into the stock annex.

This chapter has been shortened, but not moved

Figure and table labels have been improved to make them more clear.

Table 3.1a 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	137,197	204,167	73,506		414,870
2001	142,628	185,890	97,953		426,471
2002 [2]	184,789	189,013	71,242	90000/21716	535045/466760
2003 [2]	163,109	222,052	51,829	115000/27748	551990/464738
2004 [2]	177,888	219,261	92,296	117000/30000	606445/519445
2005 [2]	159,573	194,644	121,059	166000/41000	641276/516276
2006 [1,2]	159,851	204,603	104,743	127000/28000	596197/497197

[1] Provisional figures.

[2] two alternative estimates (see Chapter 0.5 for further details)

Table 3.1b Landings of Norwegian Coastal Cod in Sub-areas I and II

Year	Landings in '000 t: As calculated from samples and reported to AFWG	Landings in '000 t: 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
2001	30	14
2002	41	20
2003	35	19
2004	33	14
2005	31	13
2006	26	16
Average 1984-2006	47	26

*) No data

Table 3.2 Northeast Arctic Cod. Total nominal catch ('000t) 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	111.7	25.5	105.4	98.8	72.2	1.3
2001	119.1	23.5	83.1	102.8	95.4	2.5
2002	147.4	37.4	83.4	105.6	69.9	1.3
2003	146.0	17.1	107.8	114.2	50.1	1.8
2004	154.4	23.5	100.3	118.9	88.8	3.5
2005	132.4	27.2	87.0	107.7	115.4	5.6
2006 [1]	141.8	18.1	91.2	113.4	100.1	4.6

[1] Provisional figures.

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

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	United Kingdom	Russia[2]		Others	Total all countries
1961	3,934	13,755	3,921	8,129	268,377	-	158,113	325,780		1,212	783,221
1962	3,109	20,482	1,532	6,503	225,615	-	175,020	476,760		245	909,266
1963	-	18,318	129	4,223	205,056	108	129,779	417,964		-	775,577
1964	-	8,634	297	3,202	149,878	-	94,549	180,550		585	437,695
1965	-	526	91	3,670	197,085	-	89,962	152,780		816	444,930
1966	-	2,967	228	4,284	203,792	-	103,012	169,300		121	483,704
1967	-	664	45	3,632	218,910	-	87,008	262,340		6	572,605
1968	-	-	225	1,073	255,611	-	140,387	676,758		-	1,074,084
1969	29,374	-	5,907	5,543	305,241	7,856	231,066	612,215		133	1,197,226
1970	26,265	44,245	12,413	9,451	377,606	5,153	181,481	276,632		-	933,246
1971	5,877	34,772	4,998	9,726	407,044	1,512	80,102	144,802		215	689,048
1972	1,393	8,915	1,300	3,405	394,181	892	58,382	96,653		166	565,287
1973	1,916	17,028	4,684	16,751	285,184	843	78,808	387,196		276	792,686
1974	5,717	46,028	4,860	78,507	287,276	9,898	90,894	540,801		38,453	1,102,434
1975	11,309	28,734	9,981	30,037	277,099	7,435	101,843	343,580		19,368	829,377
1976	11,511	20,941	8,946	24,369	344,502	6,986	89,061	343,057		18,090	867,463
1977	9,167	15,414	3,463	12,763	388,982	1,084	86,781	369,876		17,771	905,301
1978	9,092	9,394	3,029	5,434	363,088	566	35,449	267,138		5,525	698,715
1979	6,320	3,046	547	2,513	294,821	15	17,991	105,846		9,439	440,538
1980	9,981	1,705	233	1,921	232,242	3	10,366	115,194		8,789	380,434
						Spain					
1981	12,825	3,106	298	2,228	277,818	14,500	5,262	83,000		-	399,037
1982	11,998	761	302	1,717	287,525	14,515	6,601	40,311		-	363,730
1983	11,106	126	473	1,243	234,000	14,229	5,840	22,975		-	289,992
1984	10,674	11	686	1,010	230,743	8,608	3,663	22,256		-	277,651
1985	13,418	23	1,019	4,395	211,065	7,846	3,335	62,489		4,330	307,920
1986	18,667	591	1,543	10,092	232,096	5,497	7,581	150,541		3,505	430,113
1987	15,036	1	986	7,035	268,004	16,223	10,957	202,314		2,515	523,071
1988	15,329	2,551	605	2,803	223,412	10,905	8,107	169,365		1,862	434,939
1989	15,625	3,231	326	3,291	158,684	7,802	7,056	134,593		1,273	332,481
1990	9,584	592	169	1,437	88,737	7,950	3,412	74,609		510	187,000
1991	8,981	975	**Greenland**	2,613	126,226	3,677	3,981	119,427[3]		3,278	269,158
1992	11,663	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	13,350	2,621	5,787	3,513	192,860	8,695	9,165	166,202	7,562	5,115	414,870
2001	12,500	2,681	5,727	4,524	188,431	9,196	8,698	183,572	5,917	5,225	426,471
2002	15,693	2,934	6,419	4,517	202,559	8,414	8,977	184,072	5,975	5,484	445,045
2003	19,427	2,921	7,026	4,732	191,977	7,924	8,711	182,160	5,963	6,149	436,990
2004	19,226	3,621	8,196	6,187	212,117	11,285	14,004	201,525	7,201	6,082	489,445
2005	16,273	3,491	8,135	5,848	207,825	9,349	10,744	200,077	5,874	7,660	475,276
2006[1]	16,480	3,834	8,164	3,769	201,185	9,219	10,594	203,775	5,915	6,261	469,197

[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	0.31	0.65	1.23	1.80	2.54	3.58	4.49	5.71	7.54	7.86	12.71	14.71	15.40	20.26
2001	0.30	0.77	1.18	1.83	2.75	3.64	4.88	5.93	7.43	8.90	10.22	11.11	13.03	18.85
2002	0.31	0.90	1.40	1.90	2.60	3.55	4.60	5.80	7.40	9.56	8.71	12.92	8.42	17.61
2003	0.55	0.88	1.39	2.01	2.63	3.59	4.83	5.57	7.26	9.36	9.52	9.52	10.68	21.66
2004	0.54	1.08	1.41	1.95	2.69	3.46	4.77	6.72	7.90	8.66	12.21	14.02	16.50	11.37
2005	0.58	0.92	1.38	1.86	2.61	3.54	4.57	6.41	8.24	9.89	11.04	14.08	11.81	20.08
2006	0.51	0.97	1.45	2.06	2.71	3.56	4.57	5.53	6.61	7.53	8.55	8.44	9.82	12.31

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			
2001	0.12	0.31	0.62	1.00	1.53	2.30	3.31	4.57	6.55	8.11	9.52	11.99		
2002	0.20	0.60	1.05	1.46	2.14	3.27	4.47	6.23	8.37	10.06	12.37			
2003	0.23	0.63	1.06	1.78	2.40	3.41	4.86	6.28	7.55	11.10	13.41	12.12	14.51	
2004	0.30	0.57	1.09	1.55	2.37	3.20	4.73	6.92	8.41	9.77	11.08			
2005	0.33	0.65	0.98	1.50	2.10	3.08	4.31	5.81	8.42	10.37	13.56	14.13		
2006	0.27	0.68	1.05	1.49	2.25	3.16	4.54	5.90	8.59	10.31	12.31			

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	
2001	0.38	0.80	1.21	1.90	2.74	3.90	4.99	5.69	7.15	7.32	11.72	9.11	6.60	
2002	0.35	1.00	1.31	1.80	2.53	3.64	4.38	5.07	6.82	9.21	7.59	13.18	19.17	19.20
2003	0.22	0.44	1.04	1.71	2.31	3.27	4.93	6.17	7.77	9.61	9.99	12.29	13.59	
2004 [2]	0.22	0.73	1.01	1.75	2.58	3.33	4.73	6.32	7.20	8.45	9.20	11.99	10.14	13.11
2005 [3]	0.57	0.77	1.13	1.66	2.33	3.36	4.38	5.92	6.65	7.26	10.01	11.14		
2006 [2]	0.71	0.91	1.39	1.88	2.56	3.77	5.33	6.68	9.14	10.89	11.51	16.83	18.77	

[1] Division IIa only
[2] IIa and IIb combined
[3] I, 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		
2001	0.23	0.64	1.25	1.95	2.86	3.55	4.95	6.46	8.50	11.07	13.09			
2002	0.16	0.55	1.00	1.48	2.17	3.29	4.47	5.35	8.29	12.23	9.01	12.16	15.2	
2003		0.58	1.05	1.70	2.33	3.33	4.92	6.24	9.98	13.07	14.74	14.17		
2004 [1]	0.31	0.56	0.80	1.28	1.96	2.59	3.72	5.36	5.28	7.41		11.43		
2005 [1]		0.63	1.14	1.85	2.48	3.43	4.25	5.38	8.41	11.19	15.04	16.93		
2006	0.30	0.61	0.99	1.46	2.04	2.55	3.39	3.50	4.70	6.36				

[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

Poland (Division IIb)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
2006	0.18	0.51	0.89	1.55	2.23	3.6	5.28	6.95	8.48	11	10.8	15.6	18.9	

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
2002		2	11	34	68	83	98	100
2003	0	0	11	29	66	90	95	100
2004	0	1	8	34	63	83	96	96
2005	0	1	5	24	62	85	95	98
2006	0	0	6	30	60	89	96	100
2007	0	0	6	21	60	84	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	2	1	4	31	70	82	100	100
1990	2	1	4	22	58	81	100	100
1991	0	3	14	38	76	90	95	100
1992	0	2	21	53	87	97	100	100
1993	0	3	10	53	85	97	99	100
1994	1	0	16	37	63	88	98	100
1995	0	1	8	52	64	81	98	99
1996	0	0	3	30	70	82	100	100
1997	0	0	2	18	73	93	99	100
1998	0	1	3	15	47	76	94	100
1999	0	0	2	28	71	95	99	100
2000	0	0	8	30	77	82	100	100
2001	1	1	9	44	63	74	94	100
2002	0	1	6	43	68	85	93	100
2003	0	0	7	36	69	88	96	100
2004	0	1	10	55	82	91	99	99
2005	0	0	9	55	82	94	98	100
2006	0	0	6	44	70	90	97	100
2007	0	0	9	48	84	92	99	100

Table 3.6N. Recruitment indices for NEA cod. Input for the RCT3-analysis. VPA numbers from runs with Norwegian figures for IUU.

```
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
9,22,2             (No. of surveys, No. of years, VPA Column No.),,
1985,   205,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1986,   173,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1987,   243,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1988,   412,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1989,   721,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1990,   896,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1991,   810,    -11,  -11, -11,    -11,     -11,     -11    -11, 296.5, 349.8
1992,   657,    -11,  -11, 699,    -11,     -11,   535.8, 577.2, 274.6, 166.2
1993,   437,    -11, 8332, 369, 1035.9,   858.3,   541.5, 292.9, 170.0,  92.9
1994,   723,  16066, 4719,1285, 5253.1,  2619.2,   707.6, 339.8, 238.0, 188.3
1995,   852,  57035, 3965,1353, 5768.5,  2396.0,  1045.1, 430.5, 396.0, 427.7
1996,   553,  26603, 3539, 896, 4815.5,  1623.5,   643.7, 632.9, 211.8, 150.0
1997,   618,  13714, 2768,1184, 2418.5,  3401.3,   340.1, 304.3, 235.2, 245.1
1998,   537,   3048,  401,1036,  484.6,   358.3,   248.3, 221.4, 191.1, 138.2
1999,   446,   2669,  377, 773,  128.8,   154.1,    76.6,  63.9,  88.3,  69.3
2000,   646,  14365, 2338,1356,  657.9,   629.9,   443.9, 215.1, 377.0, 303.4
2001,   324,   3216,  267, 268,   35.3,    18.2,    79.1,  61.5,  76.6,  33.6
2002,   558,  17979, 5175, 875, 2991.7,  1693.9,   235.4, 105.2, 246.9, 123.9
2003,   409,   4895, 1584, 617,  328.5,   157.6,   224.6, 119.6, 118.1,  79.8
2004,   -11,  17704, 3239, 895,  824.3,   465.3,   288.4, 216.6, 367.7,  80.3
2005,   -11,  22980,  858, -11,  862.7,   544.6,   393.9,  61.7,   -11,   -11
2006,   -11,   6838,  -11, -11,  485.9,   125.0,     -11,   -11,   -11,   -11
R-0      Russian Swept area trawl survey, area I+IIb,   age 0
R-1      Russian Swept area  trawl survey, area I+IIb,   age 1
R-2      Russian Swept area  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 3.6R. Recruitment indices for NEA cod. Input for the RCT3-analysis. VPA numbers from runs with Russian figures for IUU.

```
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
9,22,2            (No. of surveys, No. of years, VPA Column No.),,
1985,   205,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1986,   173,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1987,   243,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1988,   412,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1989,   721,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1990,   896,    -11,  -11, -11,    -11,     -11,     -11,  -11,   -11,  -11
1991,   810,    -11,  -11, -11,    -11,     -11,     -11    -11, 296.5, 349.8
1992,   657,    -11,  -11, 699,    -11,     -11,   535.8, 577.2, 274.6, 166.2
1993,   437,    -11, 8332, 369, 1035.9,   858.3,   541.5, 292.9, 170.0,  92.9
1994,   718,  16066, 4719,1285, 5253.1,  2619.2,   707.6, 339.8, 238.0, 188.3
1995,   831,  57035, 3965,1353, 5768.5,  2396.0,  1045.1, 430.5, 396.0, 427.7
1996,   510,  26603, 3539, 896, 4815.5,  1623.5,   643.7, 632.9, 211.8, 150.0
1997,   539,  13714, 2768,1184, 2418.5,  3401.3,   340.1, 304.3, 235.2, 245.1
1998,   455,   3048,  401,1036,  484.6,   358.3,   248.3, 221.4, 191.1, 138.2
1999,   375,   2669,  377, 773,  128.8,   154.1,    76.6,  63.9,  88.3,  69.3
2000,   539,  14365, 2338,1356,  657.9,   629.9,   443.9, 215.1, 377.0, 303.4
2001,   288,   3216,  267, 268,   35.3,    18.2,    79.1,  61.5,  76.6,  33.6
2002,   483,  17979, 5175, 875, 2991.7,  1693.9,   235.4, 105.2, 246.9, 123.9
2003,   353,   4895, 1584, 617,  328.5,   157.6,   224.6, 119.6, 118.1,  79.8
2004,   -11,  17704, 3239, 895,  824.3,   465.3,   288.4, 216.6, 367.7,  80.3
2005,   -11,  22980,  858, -11,  862.7,   544.6,   393.9,  61.7,   -11,   -11
2006,   -11,   6838,  -11, -11,  485.9,   125.0,     -11,   -11,   -11,   -11
R-0      Russian Swept area trawl survey, area I+IIb,   age 0
R-1      Russian Swept area  trawl survey, area I+IIb,   age 1
R-2      Russian Swept area  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 3.7N. Recruitment predictions based on survey indices shrunk towards the VPA mean. Based on VPA numbers from runs with Norwegian figures for IUU.

```
Analysis by RCT3 ver3.1 of data from file :
rec2007

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

Data for    9 surveys over   22 years :  1985 - 2006
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 =   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-0        .23   4.24    .18   .672     6   9.57    6.46     .240     .145
R-1        .56   2.10    .70   .127     7   7.76    6.42     .893     .010
R-2        .74   1.32    .23   .542     8   7.21    6.69     .301     .092
N-BST1     .22   4.75    .23   .584     7   6.49    6.18     .294     .096
N-BSA1     .29   4.35    .25   .523     7   6.45    6.21     .329     .077
N-BST2     .41   3.89    .27   .462     8   6.10    6.41     .333     .075
N-BSA2     .57   3.16    .37   .318     8   5.38    6.20     .458     .040
N-BST3     .64   2.94    .14   .764     9   5.93    6.77     .189     .209
N-BSA3     .44   4.15    .10   .878     9   5.72    6.65     .122     .209

                                       VPA Mean =    6.32     .421     .047

Yearclass =   2001

         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        .23   4.24    .16   .674     7   8.08    6.11     .226     .206
R-1        .54   2.20    .62   .134     8   5.59    5.25     .925     .012
R-2        .71   1.49    .22   .540     9   5.59    5.49     .377     .074
N-BST1     .24   4.67    .25   .486     8   3.59    5.52     .433     .056
N-BSA1     .31   4.26    .27   .455     8   2.95    5.17     .548     .035
N-BST2     .41   3.91    .25   .465     9   4.38    5.71     .374     .075
N-BSA2     .60   3.02    .37   .282     9   4.14    5.48     .566     .033
N-BST3     .61   3.08    .16   .691    10   4.35    5.75     .246     .174
N-BSA3     .43   4.19    .11   .836    10   3.54    5.70     .175     .262

                                       VPA Mean =    6.35     .379     .073

Yearclass =   2002

         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        .33   3.29    .24   .643     8   9.80    6.53     .304     .072
R-1        .38   3.52    .41   .374     9   8.55    6.74     .514     .025
R-2        .58   2.43    .17   .756    10   6.78    6.36     .205     .158
N-BST1     .19   4.99    .20   .711     9   8.00    6.54     .249     .107
N-BSA1     .20   5.00    .20   .718     9   7.44    6.51     .243     .112
N-BST2     .39   4.06    .22   .655    10   5.47    6.18     .263     .095
N-BSA2     .48   3.70    .29   .530    10   4.67    5.93     .357     .052
N-BST3     .59   3.19    .15   .814    11   5.51    6.46     .174     .166
N-BSA3     .40   4.33    .10   .911    11   4.83    6.26     .113     .166

                                       VPA Mean =    6.32     .373     .048
```

Table 3.7.N (Contd)

Yearclass = 2003

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	.33	3.26	.24	.617	9	8.50	6.07	.294	.073
R-1	.36	3.57	.39	.362	10	7.37	6.26	.464	.029
R-2	.58	2.44	.16	.761	11	6.43	6.15	.191	.157
N-BST1	.19	4.99	.20	.685	10	5.80	6.10	.242	.107
N-BSA1	.20	5.00	.19	.702	10	5.07	6.02	.237	.112
N-BST2	.38	4.10	.21	.651	11	5.42	6.18	.248	.102
N-BSA2	.48	3.76	.30	.482	11	4.79	6.04	.357	.049
N-BST3	.59	3.20	.15	.801	12	4.78	6.02	.178	.157
N-BSA3	.40	4.35	.09	.909	12	4.39	6.09	.111	.157
					VPA Mean =		6.33	.335	.056

Yearclass = 2004

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	.34	3.17	.23	.635	10	9.78	6.50	.275	.077
R-1	.39	3.34	.40	.348	11	8.08	6.52	.477	.026
R-2	.60	2.25	.16	.761	12	6.80	6.35	.188	.147
N-BST1	.20	4.95	.19	.695	11	6.72	6.27	.228	.113
N-BSA1	.20	5.02	.18	.731	11	6.14	6.24	.209	.135
N-BST2	.41	3.95	.22	.642	12	5.67	6.26	.250	.094
N-BSA2	.48	3.75	.28	.513	12	5.38	6.32	.326	.055
N-BST3	.58	3.24	.14	.823	13	5.91	6.68	.168	.147
N-BSA3	.41	4.30	.09	.910	13	4.40	6.08	.110	.147
					VPA Mean =		6.31	.313	.060

Yearclass = 2005

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	.34	3.15	.23	.633	10	10.04	6.59	.285	.131
R-1	.38	3.41	.39	.362	11	6.76	6.01	.470	.048
R-2									
N-BST1	.20	4.96	.19	.697	11	6.76	6.28	.229	.203
N-BSA1	.20	5.03	.17	.739	11	6.30	6.27	.207	.249
N-BST2	.41	3.97	.21	.648	12	5.98	6.39	.252	.168
N-BSA2	.48	3.77	.28	.519	12	4.14	5.74	.359	.082
N-BST3									
N-BSA3									
					VPA Mean =		6.31	.298	.119

Yearclass = 2006

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	.34	3.13	.23	.631	10	8.83	6.17	.281	.195
R-1									
R-2									
N-BST1	.19	4.97	.19	.700	11	6.19	6.17	.232	.285
N-BSA1	.19	5.05	.17	.747	11	4.84	5.99	.214	.336
N-BST2									
N-BSA2									
N-BST3									
N-BSA3									
					VPA Mean =		6.30	.290	.183

Table 3.7.N (Contd)

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
2000	677	6.52	.09	.07	.61	647	6.47
2001	325	5.79	.10	.09	.83	325	5.78
2002	588	6.38	.08	.06	.46	558	6.33
2003	448	6.10	.08	.03	.12	409	6.02
2004	565	6.34	.08	.06	.60		
2005	535	6.28	.10	.08	.67		
2006	461	6.13	.12	.06	.27		

Table 3.7R. Recruitment predictions based on survey indices shrunk towards the VPA mean. Based on VPA numbers from runs with Russian figures for IUU.

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

 rec2007
 NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,

 Data for    9 surveys over   22 years :  1985 - 2006

 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 =   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-0        .29   3.63    .21   .712      6   9.57    6.37     .278     .111
 R-1        .42   3.05    .48   .296      7   7.76    6.32     .608     .023
 R-2       1.16  -1.57    .44   .312      8   7.21    6.78     .574     .026
 N-BST1     .23   4.58    .20   .706      7   6.49    6.08     .261     .126
 N-BSA1     .31   4.11    .25   .608      7   6.45    6.12     .321     .083
 N-BST2     .41   3.81    .22   .638      8   6.10    6.34     .274     .113
 N-BSA2     .57   3.05    .34   .434      8   5.38    6.12     .421     .048
 N-BST3     .75   2.31    .15   .803      9   5.93    6.76     .201     .211
 N-BSA3     .55   3.53    .15   .802      9   5.72    6.65     .194     .213

                                        VPA Mean =    6.27     .430     .046

 Yearclass =   2001

          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        .29   3.62    .19   .706      7   8.08    5.93     .264     .199
 R-1        .41   3.11    .43   .305      8   5.59    5.42     .630     .035
 R-2       1.18  -1.77    .45   .272      9   5.59    4.82     .780     .023
 N-BST1     .23   4.61    .20   .665      8   3.59    5.44     .342     .119
 N-BSA1     .31   4.14    .24   .586      8   2.95    5.06     .482     .060
 N-BST2     .41   3.83    .20   .641      9   4.38    5.63     .305     .150
 N-BSA2     .56   3.11    .31   .429      9   4.14    5.44     .478     .061
 N-BST3     .77   2.16    .22   .624     10   4.35    5.50     .339     .121
 N-BSA3     .56   3.42    .19   .688     10   3.54    5.40     .316     .139

                                        VPA Mean =    6.29     .390     .092

 Yearclass =   2002

          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        .35   2.97    .23   .711      8   9.80    6.43     .291     .080
 R-1        .35   3.61    .33   .512      9   8.55    6.61     .424     .038
 R-2        .75   1.21    .30   .560     10   6.78    6.27     .354     .054
 N-BST1     .20   4.85    .17   .807      9   8.00    6.45     .209     .157
 N-BSA1     .22   4.81    .19   .760      9   7.44    6.42     .238     .120
 N-BST2     .40   3.91    .18   .770     10   5.47    6.08     .221     .140
 N-BSA2     .49   3.55    .26   .628     10   4.67    5.83     .324     .065
 N-BST3     .69   2.58    .19   .764     11   5.51    6.39     .228     .131
 N-BSA3     .48   3.85    .17   .814     11   4.83    6.16     .196     .170

                                        VPA Mean =    6.25     .393     .044
```

Table 3.7R (Contd)

Yearclass = 2003

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	.36	2.91	.23	.673	9	8.50	5.94	.291	.080
R-1	.35	3.57	.34	.467	10	7.37	6.15	.408	.041
R-2	.74	1.22	.28	.565	11	6.43	6.00	.332	.062
N-BST1	.20	4.83	.18	.755	10	5.80	5.98	.222	.138
N-BSA1	.22	4.79	.20	.723	10	5.07	5.89	.245	.113
N-BST2	.39	3.95	.17	.771	11	5.42	6.08	.205	.162
N-BSA2	.48	3.65	.26	.591	11	4.79	5.94	.318	.067
N-BST3	.69	2.56	.20	.737	12	4.78	5.86	.241	.117
N-BSA3	.47	3.88	.16	.816	12	4.39	5.95	.188	.169
					VPA Mean =		6.25	.359	.053

Yearclass = 2004

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	.36	2.83	.22	.688	10	9.78	6.39	.272	.086
R-1	.38	3.29	.36	.436	11	8.08	6.40	.433	.034
R-2	.77	1.05	.27	.581	12	6.80	6.26	.316	.064
N-BST1	.21	4.77	.18	.756	11	6.72	6.15	.213	.140
N-BSA1	.21	4.80	.19	.749	11	6.14	6.12	.218	.134
N-BST2	.42	3.77	.19	.745	12	5.67	6.16	.217	.134
N-BSA2	.49	3.60	.25	.612	12	5.38	6.22	.296	.072
N-BST3	.68	2.62	.19	.764	13	5.91	6.63	.227	.123
N-BSA3	.48	3.83	.15	.825	13	4.40	5.94	.181	.159
					VPA Mean =		6.21	.345	.054

Yearclass = 2005

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	.36	2.83	.22	.687	10	10.04	6.48	.280	.128
R-1	.38	3.34	.36	.445	11	6.76	5.90	.431	.054
R-2									
N-BST1	.20	4.78	.18	.756	11	6.76	6.16	.215	.216
N-BSA1	.21	4.82	.18	.753	11	6.30	6.15	.217	.212
N-BST2	.42	3.79	.19	.748	12	5.98	6.29	.219	.207
N-BSA2	.48	3.62	.25	.615	12	4.14	5.62	.327	.093
N-BST3									
N-BSA3									
					VPA Mean =		6.21	.333	.090

Yearclass = 2006

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	.36	2.84	.22	.686	10	8.83	6.04	.273	.212
R-1									
R-2									
N-BST1	.20	4.79	.18	.756	11	6.19	6.05	.219	.329
N-BSA1	.21	4.84	.18	.758	11	4.84	5.85	.225	.310
N-BST2									
N-BSA2									
N-BST3									
N-BSA3									
					VPA Mean =		6.19	.324	.150

Table 3.7R (Contd)

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
2000	627	6.44	.09	.09	.87	540	6.29
2001	272	5.61	.12	.11	.87	288	5.67
2002	535	6.28	.08	.06	.58	484	6.18
2003	396	5.98	.08	.03	.15	354	5.87
2004	501	6.22	.08	.07	.70		
2005	476	6.17	.10	.09	.80		
2006	406	6.01	.13	.07	.29		

Table 3.8

NE Arctic cod. International catch (thousands) at age for ages 1-15+

					A	G	E								
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	215	4701	33094	93044	47210	12671	6677	4787	1647	321	71	11	1	14
2001	23	237	5044	35019	62139	62456	22794	5266	1773	1163	343	84	6	7	22
2002 [1]	47	130	2348	31033	76175	67656	42122	11527	1801	529	223	120	21	9	5
2003 [1]	6	187	7263	20885	64447	71109	36706	14002	2887	492	142	97	21	43	1
2004 [1]	8	183	2090	38226	50826	68350	50838	18118	6239	1746	295	127	39	16	8
2005 [1]	11	453	5815	19768	113144	61665	44777	20553	6285	2348	562	100	21	24	7
2006 [1]	123	1224	9940	56958	39462	86270	34656	17323	7509	1710	581	153	147	19	107
2002 [2]	39	110	2013	26321	64374	57834	37152	10409	1644	493	206	114	20	9	5
2003 [2]	5	164	5855	16819	52029	58461	31230	12406	2622	440	128	90	20	40	1
2004 [2]	6	152	1738	31356	41892	57012	43436	16141	5722	1597	268	118	36	15	8
2005 [2]	8	343	4450	15182	86226	47652	36044	17356	5612	2138	506	92	19	21	7
2006 [2]	98	963	7885	45347	31781	70004	28747	15072	6741	1599	523	145	120	20	99

[1 & 2] two alternative estimates (see Chapter 0.5 for further details)

Table 3.9N. Total number (million) of cod consumed by cod, by year and prey age group.

Year	Age						
	0	1	2	3	4	5	6
1984	0	417	21	0	0	0	0
1985	1497	376	67	0	0	0	0
1986	53	966	392	99	0	0	0
1987	681	182	281	14	0	0	0
1988	29	411	22	2	0	0	0
1989	916	144	0	0	0	0	0
1990	0	126	28	0	0	0	0
1991	123	151	214	2	0	0	0
1992	4305	1027	155	4	0	0	0
1993	3833	20262	513	52	1	0	0
1994	8344	6947	647	134	54	8	0
1995	8315	15380	758	251	87	4	0
1996	9905	21734	1502	143	56	20	1
1997	2947	16000	1871	175	17	1	0
1998	79	4847	536	211	25	2	1
1999	591	1828	294	52	4	0	0
2000	1679	2235	170	37	14	4	0
2001	89	2274	112	23	11	2	1
2002	7344	477	394	42	6	1	0
2003	5523	4290	108	23	0	0	0
2004	2710	2191	460	18	12	1	0
2005	1943	2565	205	81	3	5	1
2006	1782	2117	104	6	2	0	0

Table 3.9R. Total number (million) of cod consumed by cod, by year and prey age group.

Year	Age						
	0	1	2	3	4	5	6
1984	0	417	21	0	0	0	0
1985	1497	376	67	0	0	0	0
1986	53	966	392	99	0	0	0
1987	681	182	281	14	0	0	0
1988	29	411	22	2	0	0	0
1989	916	144	0	0	0	0	0
1990	0	126	28	0	0	0	0
1991	123	151	214	2	0	0	0
1992	4305	1027	155	4	0	0	0
1993	3833	20262	513	52	1	0	0
1994	8344	6947	647	134	54	8	0
1995	8315	15380	758	251	87	4	0
1996	9905	21734	1502	143	56	20	1
1997	2941	15855	1866	175	17	1	0
1998	78	4757	531	210	25	2	1
1999	581	1773	290	52	4	0	0
2000	1511	2010	162	36	14	4	0
2001	77	1976	103	22	11	2	1
2002	6185	410	342	37	6	1	0
2003	4779	3764	92	20	0	0	0
2004	2320	1894	394	16	11	1	0
2005	1697	2256	180	73	3	5	0
2006	1604	1917	97	6	2	0	0

Table 3.10 . Catch numbers at age

1

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

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

YEAR	1946
AGE	
3	4008
4	10387
5	18906
6	16596
7	13843
8	15370
9	59845
10	22618
11	10093
12	9573
+gp	8137
0 TOTALNUM	189376
TONSLAND	706000
SOPCOF %	103

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

YEAR	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE										
3	710	140	991	1281	24687	24099	47413	11473	3902	10614
4	13192	3872	6808	10954	77924	120704	107659	155171	37652	24172
5	43890	31054	35214	29045	64013	113203	112040	146395	201834	129803
6	52017	55983	100497	45233	46867	73827	55500	100751	161336	250472
7	45501	77375	83283	62579	37535	49389	22742	40635	84031	86784
8	13075	21482	29727	30037	33673	20562	16863	10713	30451	51091
9	19718	15237	13207	19481	23510	24367	10559	11791	13713	14987
10	47678	9815	5606	9172	10589	15651	10553	8557	9481	7465
11	31392	30041	8617	6019	4221	8327	5637	6751	4140	3952
12	9348	7945	13154	4133	1288	3565	1752	2370	2406	1655
+gp	18055	12595	7719	9862	4935	2158	797	1287	1350	1906
0 TOTALNUM	294576	265539	304823	227796	329242	455852	391515	495894	550296	582901
TONSLAND	882017	774295	800122	731982	827180	876795	695546	826021	1147841	1343068
SOPCOF %	91	89	99	109	115	93	105	93	106	105

1

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	17321	31219	32308	37882	45478	42416	13196	5298	15725	55937
4	33931	133576	77942	97865	132655	170566	106984	45912	25999	55644
5	27182	71051	148285	64222	123458	167241	205549	97950	78299	34676
6	70702	40737	53480	67425	51167	89460	95498	58575	68511	42539
7	87033	38380	18498	23117	38740	28297	35518	19642	25444	37169
8	39213	35786	17735	8429	17376	21996	16221	9162	8438	18500
9	17747	13338	23118	7240	5791	7956	11894	6196	3569	5077
10	6219	10475	9483	11675	6778	2728	3884	3553	1467	1495
11	3232	3289	3748	4504	5560	2603	1021	783	1161	380
12	1220	1070	997	1843	1682	1647	1025	172	131	403
+gp	819	433	513	682	1298	775	784	782	337	156
0 TOTALNUM	304619	379354	386107	324884	429983	535685	491574	248025	229081	251976
TONSLAND	792557	769313	744607	622042	783221	909266	776337	437695	444930	483711
SOPCOF %	100	112	93	104	110	124	102	103	129	123

Table 3.10 (continued)

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

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	34467	3709	2307	7164	7754	35536	294262	91855	45282	85337
	4	160048	174585	24545	10792	13739	45431	131493	437377	59798	114341
	5	69235	267961	238511	25813	11831	26832	61000	203772	226646	79993
	6	22061	107051	181239	137829	9527	12089	20569	47006	118567	118236
	7	26295	26701	79363	96420	59290	7918	7248	12630	29522	47872
	8	25139	16399	26989	31920	52003	34885	8328	4370	9353	13962
	9	11323	11597	13463	8933	12093	22315	19130	2523	2617	4051
	10	2329	3657	5092	3249	2434	4572	4499	5607	1555	936
	11	687	657	1913	1232	762	1215	677	2127	1928	558
	12	316	122	414	260	418	353	195	322	575	442
+gp		279	240	190	180	216	476	195	296	283	218
0 TOTALNUM		352179	612679	574026	323792	170067	191622	547596	807885	496126	465946
TONSLAND		572605	1074084	1197226	933246	689048	565254	792685	1102433	829377	867463
SOPCOF %		109	108	105	112	124	118	130	137	115	127

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

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	39594	78822	8600	3911	3407	8948	3108	6942	24634	28968
	4	168609	45400	77484	17086	9466	20933	19594	14240	45769	70993
	5	136335	88495	43677	81986	20803	19345	20473	18807	27806	78672
	6	52925	56823	31943	40061	63433	28084	17656	20086	19418	25215
	7	61821	25407	16815	17664	21788	42496	17004	15145	11369	11711
	8	23338	31821	8274	7442	9933	8395	18329	8287	3747	4063
	9	5659	9408	10974	3508	4267	2878	2545	5988	1557	976
	10	1521	1227	1785	3196	1311	708	646	783	768	726
	11	610	913	427	678	882	271	229	232	137	557
	12	271	446	103	79	109	260	74	153	36	136
+gp		268	847	142	58	41	37	83	69	71	76
0 TOTALNUM		490951	339609	200224	175669	135440	132355	99741	90732	135312	222093
TONSLAND		905301	698715	440538	380434	399038	363730	289992	277651	307920	430113
SOPCOF %		107	109	121	127	118	125	90	95	102	102

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

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	13648	9828	5085	1911	4963	21835	10094	6531	4879	7655
	4	137106	22774	17313	7551	10933	36015	46182	59444	42587	28782
	5	98210	135347	32165	12999	16467	27494	63578	102548	115329	80711
	6	61407	54379	81756	17827	20342	23392	33623	59766	98485	100509
	7	13707	21015	27854	30007	19479	18351	14866	32504	32036	54590
	8	3866	3304	5501	6810	25193	13541	9449	10019	7334	10545
	9	910	1236	827	828	3888	18321	6571	6163	3014	2023
	10	455	519	290	179	428	2529	12593	3671	1725	930
	11	187	106	41	59	48	264	1749	7528	1174	462
	12	227	69	13	15	12	82	377	995	1920	230
+gp		100	62	28	13	4	13	86	144	264	894
0 TOTALNUM		329823	248639	170873	78199	101757	161837	199168	289313	308747	287331
TONSLAND		523071	434939	332481	212000	319158	513234	581611	771086	739999	732228
SOPCOF %		102	100	99	101	95	103	101	101	100	101

Table 3.10 N (continued)

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	12827	31887	7501	4701	5044	2348	7263	2090	5815	9940
4	36491	88874	77714	33094	35019	31033	20885	38226	19768	56958
5	69633	48972	92816	93044	62139	76175	64447	50826	113144	39462
6	83017	40493	31139	47210	62456	67656	71109	68350	61665	86270
7	65768	34513	15778	12671	22794	42122	36706	50838	44777	34656
8	28392	26354	15851	6677	5266	11527	14002	18118	20553	17323
9	4651	6583	8828	4787	1773	1801	2887	6239	6285	7509
10	1151	965	1837	1647	1163	529	492	1746	2348	1710
11	373	197	195	321	343	223	142	295	562	581
12	213	69	40	71	85	120	97	127	100	153
+gp	383	117	72	26	35	36	65	63	52	275
0 TOTALNUM	302899	279024	251771	204249	196117	233570	218095	236918	275069	254837
TONSLAND	762403	592624	484910	414868	426471	535045	551990	606445	641276	596197
SOPCOF %	100	101	100	100	100	100	100	100	100	100

1

Table 3.10 R. Catch numbers at age

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	12827	31887	7501	4701	5044	2013	5855	1738	4450	7885
4	36491	88874	77714	33094	35019	26321	16819	31356	15182	45347
5	69633	48972	92816	93044	62139	64374	52029	41892	86226	31781
6	83017	40493	31139	47210	62456	57834	58461	57012	47652	70004
7	65768	34513	15778	12671	22794	37152	31230	43436	36044	28747
8	28392	26354	15851	6677	5266	10409	12406	16141	17356	15072
9	4651	6583	8828	4787	1773	1644	2622	5722	5612	6741
10	1151	965	1837	1647	1163	494	440	1597	2138	1599
11	373	197	195	321	343	206	128	268	506	523
12	213	69	40	71	85	114	90	118	92	145
+gp	383	117	72	26	35	34	60	59	47	238
0 TOTALNUM	302899	279024	251771	204249	196117	200595	180140	199339	215305	208082
TONSLAND	762403	592624	484910	414868	426471	466761	464738	519445	516276	497197
SOPCOF %	100	101	100	100	100	101	101	101	101	100

1

Table 3.11 Catch weights at age

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Table 2 Catch weights at age (kg)

YEAR		1946
AGE		
	3	0.35
	4	0.59
	5	1.11
	6	1.69
	7	2.37
	8	3.17
	9	3.98
	10	5.05
	11	5.92
	12	7.2
+gp		8.146
0 SOPCOFAC		1.03

Table 2 Catch weights at age (kg)

YEAR		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE											
	3	0.32	0.34	0.37	0.39	0.4	0.44	0.4	0.44	0.32	0.33
	4	0.56	0.53	0.67	0.64	0.83	0.8	0.76	0.77	0.57	0.58
	5	0.95	1.26	1.11	1.29	1.39	1.33	1.28	1.26	1.13	1.07
	6	1.5	1.93	1.66	1.7	1.88	1.92	1.93	1.97	1.73	1.83
	7	2.14	2.46	2.5	2.36	2.54	2.64	2.81	3.03	2.75	2.89
	8	2.92	3.36	3.23	3.48	3.46	3.71	3.72	4.33	3.94	4.25
	9	3.65	4.22	4.07	4.52	4.88	5.06	5.06	5.4	4.9	5.55
	10	4.56	5.31	5.27	5.62	5.2	6.05	6.34	6.75	7.04	7.28
	11	5.84	5.92	5.99	6.4	7.14	7.42	7.4	7.79	7.2	8
	12	7.42	7.09	7.08	7.96	8.22	8.43	8.67	10.67	8.78	8.35
+gp		8.848	8.43	8.218	8.891	9.389	10.185	10.238	9.68	10.077	9.944
0 SOPCOFAC		0.9143	0.8915	0.992	1.088	1.1483	0.9348	1.0485	0.9294	1.0634	1.0455
	1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Table 2 Catch weights at age (kg)

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.33	0.34	0.35	0.34	0.31	0.32	0.32	0.33	0.38	0.44
	4	0.59	0.52	0.72	0.51	0.55	0.55	0.61	0.55	0.68	0.74
	5	1.02	0.95	1.47	1.09	1.05	0.93	0.96	0.95	1.03	1.18
	6	1.82	1.92	2.68	2.13	2.2	1.7	1.73	1.86	1.49	1.78
	7	2.89	2.94	3.59	3.38	3.23	3.03	3.04	3.25	2.41	2.46
	8	4.28	4.21	4.32	4.87	5.11	5.03	4.96	4.97	3.52	3.82
	9	5.49	5.61	5.45	6.12	6.15	6.55	6.44	6.41	5.73	5.36
	10	7.51	7.35	6.44	8.49	8.15	7.7	7.91	8.07	7.54	7.27
	11	8.24	8.67	7.17	7.79	8.68	9.27	9.62	9.34	8.47	8.63
	12	9.25	9.58	8.63	8.3	9.6	10.56	11.31	10.16	11.17	10.66
+gp		10.605	11.631	11.621	11.422	11.952	12.717	12.737	12.886	13.722	14.148
0 SOPCOFAC		1.0004	1.1232	0.9305	1.0416	1.097	1.2356	1.0226	1.0277	1.2903	1.2327

Table 3.11 (continued)

Table 2 Catch weights at age (kg)

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	0.29	0.33	0.44	0.37	0.45	0.38	0.38	0.32	0.41	0.35
	4	0.81	0.7	0.79	0.91	0.88	0.77	0.91	0.66	0.64	0.73
	5	1.35	1.48	1.23	1.34	1.38	1.43	1.54	1.17	1.11	1.19
	6	2.04	2.12	2.03	2	2.16	2.12	2.26	2.22	1.9	2.01
	7	2.81	3.14	2.9	3	3.07	3.23	3.29	3.21	2.95	2.76
	8	3.48	4.21	3.81	4.15	4.22	4.38	4.61	4.39	4.37	4.22
	9	4.89	5.27	5.02	5.59	5.81	5.83	6.57	5.52	5.74	5.88
	10	7.11	6.65	6.43	7.6	7.13	7.62	8.37	7.86	8.77	9.3
	11	9.03	9.01	8.33	8.97	8.62	9.52	10.54	9.82	9.92	10.28
	12	10.59	9.66	10.71	10.99	10.83	12.09	11.62	11.41	11.81	11.86
	+gp	13.829	14.848	14.211	14.074	12.945	13.673	13.904	13.242	13.107	13.544
0	SOPCOFAC	1.0911	1.0785	1.052	1.117	1.2405	1.1822	1.3003	1.366	1.152	1.2688

Table 2 Catch weights at age (kg)

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0.49	0.49	0.35	0.27	0.49	0.37	0.84	1.42	0.94	0.64
	4	0.9	0.81	0.7	0.56	0.98	0.66	1.37	1.93	1.37	1.27
	5	1.43	1.45	1.24	1.02	1.44	1.35	2.09	2.49	2.02	1.88
	6	2.05	2.15	2.14	1.72	2.09	1.99	2.86	3.14	3.22	2.79
	7	3.3	3.04	3.15	3.02	2.98	2.93	3.99	3.91	4.63	4.49
	8	4.56	4.46	4.29	4.2	4.85	4.24	5.58	4.91	6.04	5.84
	9	6.46	6.54	6.58	5.84	6.57	6.46	7.77	6.02	7.66	6.83
	10	8.63	7.98	8.61	7.26	9.16	8.51	9.29	7.4	9.81	7.69
	11	9.93	10.15	9.22	8.84	10.82	12.24	11.55	8.13	11.8	9.81
	12	10.9	10.85	10.89	9.28	10.77	10.78	16.2	8.57	14.16	10.71
	+gp	13.668	13.177	14.344	14.448	13.932	14.041	17.034	8.609	14.008	12.051
0	SOPCOFAC	1.0683	1.089	1.2139	1.2723	1.1809	1.2521	0.8953	0.9483	1.0182	1.016

Table 2 Catch weights at age (kg)

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0.49	0.54	0.74	0.81	1.05	1.16	0.81	0.82	0.77	0.79
	4	0.88	0.85	0.96	1.22	1.45	1.57	1.52	1.3	1.2	1.11
	5	1.55	1.32	1.31	1.64	2.15	2.21	2.16	2.06	1.78	1.61
	6	2.33	2.24	1.92	2.22	2.89	3.1	2.79	2.89	2.59	2.46
	7	3.44	3.52	2.93	3.24	3.75	4.27	4.07	3.21	3.81	3.82
	8	5.92	5.35	4.64	4.68	4.71	5.19	5.53	5.2	4.99	5.72
	9	8.6	8.06	7.52	7.3	6.08	6.14	6.47	6.8	6.23	6.74
	10	9.6	9.51	9.12	9.84	8.82	7.77	7.19	7.57	8.05	8.04
	11	12.17	11.36	11.08	13.25	11.8	10.12	7.98	8.01	8.74	9.28
	12	13.72	14.09	11.47	16.88	16.58	11.54	10.11	9.48	9.22	10.4
	+gp	13.38	16.706	16.484	11.617	16.69	14.332	14.183	11.978	12.319	10.966
0	SOPCOFAC	1.0224	1.0001	0.9879	1.0108	0.9521	1.027	1.0127	1.009	1.003	1.0147

Table 3.11 (continued)

Table 2 Catch weights at age (kg)

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	0.67	0.68	0.63	0.572	0.66	0.723	0.672	0.72	0.693	0.723
	4	1.04	1.05	1.01	1.036	1.05	1.133	1.119	1.13	1.081	1.157
	5	1.53	1.62	1.54	1.609	1.62	1.56	1.827	1.607	1.566	1.605
	6	2.22	2.3	2.34	2.344	2.51	2.306	2.499	2.429	2.205	2.381
	7	3.42	3.3	3.21	3.341	3.51	3.52	3.575	3.274	3.263	3.288
	8	5.2	4.86	4.29	4.476	4.78	4.784	5.039	4.725	4.443	4.527
	9	7.19	6.87	6	5.724	6.04	6.2	6.355	6.712	6.228	5.578
	10	7.73	9.3	6.73	7.523	7.54	7.659	8.196	7.984	8.187	7.021
	11	8.61	10.3	10.08	8.021	9	9.14	10.711	9.192	9.724	8.459
	12	11.07	15.05	13.88	12.478	10.48	8.197	11.958	12.024	11.496	9.501
	+gp	11.117	14.524	14.036	17.241	16.18	10.325	10.657	14.245	14.417	8.447
0	SOPCOFAC	1.0004	1.0072	0.9967	1.0039	0.9994	1.0025	1.0014	1.0017	0.9993	0.999
	1										

Table 3.12. Stock weights at age

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 17:06

Table 3 Stock weights at age (kg)

YEAR		1946
AGE		
	3	0.35
	4	0.59
	5	1.11
	6	1.69
	7	2.37
	8	3.17
	9	3.98
	10	5.05
	11	5.92
	12	7.2
+gp		8.146

Table 3 Stock weights at age (kg)

YEAR		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE											
	3	0.32	0.34	0.37	0.39	0.4	0.44	0.4	0.44	0.32	0.33
	4	0.56	0.53	0.67	0.64	0.83	0.8	0.76	0.77	0.57	0.58
	5	0.95	1.26	1.11	1.29	1.39	1.33	1.28	1.26	1.13	1.07
	6	1.5	1.93	1.66	1.7	1.88	1.92	1.93	1.97	1.73	1.83
	7	2.14	2.46	2.5	2.36	2.54	2.64	2.81	3.03	2.75	2.89
	8	2.92	3.36	3.23	3.48	3.46	3.71	3.72	4.33	3.94	4.25
	9	3.65	4.22	4.07	4.52	4.88	5.06	5.06	5.4	4.9	5.55
	10	4.56	5.31	5.27	5.62	5.2	6.05	6.34	6.75	7.04	7.28
	11	5.84	5.92	5.99	6.4	7.14	7.42	7.4	7.79	7.2	8
	12	7.42	7.09	7.08	7.96	8.22	8.43	8.67	10.67	8.78	8.35
+gp		8.848	8.43	8.218	8.891	9.389	10.185	10.238	9.68	10.077	9.944
	1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 17:06

Table 3 Stock weights at age (kg)

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.33	0.34	0.35	0.34	0.31	0.32	0.32	0.33	0.38	0.44
	4	0.59	0.52	0.72	0.51	0.55	0.55	0.61	0.55	0.68	0.74
	5	1.02	0.95	1.47	1.09	1.05	0.93	0.96	0.95	1.03	1.18
	6	1.82	1.92	2.68	2.13	2.2	1.7	1.73	1.86	1.49	1.78
	7	2.89	2.94	3.59	3.38	3.23	3.03	3.04	3.25	2.41	2.46
	8	4.28	4.21	4.32	4.87	5.11	5.03	4.96	4.97	3.52	3.82
	9	5.49	5.61	5.45	6.12	6.15	6.55	6.44	6.41	5.73	5.36
	10	7.51	7.35	6.44	8.49	8.15	7.7	7.91	8.07	7.54	7.27
	11	8.24	8.67	7.17	7.79	8.68	9.27	9.62	9.34	8.47	8.63
	12	9.25	9.58	8.63	8.3	9.6	10.56	11.31	10.16	11.17	10.66
+gp		10.605	11.631	11.621	11.422	11.952	12.717	12.737	12.886	13.722	14.148

Table 3.12 (continued)

Table 3 Stock weights at age (kg)

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.29	0.33	0.44	0.37	0.45	0.38	0.38	0.32	0.41	0.35
4	0.81	0.7	0.79	0.91	0.88	0.77	0.91	0.66	0.64	0.73
5	1.35	1.48	1.23	1.34	1.38	1.43	1.54	1.17	1.11	1.19
6	2.04	2.12	2.03	2	2.16	2.12	2.26	2.22	1.9	2.01
7	2.81	3.14	2.9	3	3.07	3.23	3.29	3.21	2.95	2.76
8	3.48	4.21	3.81	4.15	4.22	4.38	4.61	4.39	4.37	4.22
9	4.89	5.27	5.02	5.59	5.81	5.83	6.57	5.52	5.74	5.88
10	7.11	6.65	6.43	7.6	7.13	7.62	8.37	7.86	8.77	9.3
11	9.03	9.01	8.33	8.97	8.62	9.52	10.54	9.82	9.92	10.28
12	10.59	9.66	10.71	10.99	10.83	12.09	11.62	11.41	11.81	11.86
+gp	13.829	14.848	14.211	14.074	12.945	13.673	13.904	13.242	13.107	13.544

Table 3 Stock weights at age (kg)

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.49	0.49	0.35	0.27	0.49	0.37	0.37	0.42	0.413	0.311
4	0.9	0.81	0.7	0.56	0.98	0.66	0.92	1.16	0.875	0.88
5	1.43	1.45	1.24	1.02	1.44	1.35	1.6	1.81	1.603	1.47
6	2.05	2.15	2.14	1.72	2.09	1.99	2.44	2.79	2.81	2.467
7	3.3	3.04	3.15	3.02	2.98	2.93	3.82	3.78	4.059	3.915
8	4.56	4.46	4.29	4.2	4.85	4.24	4.76	4.57	5.833	5.81
9	6.46	6.54	6.58	5.84	6.57	6.46	6.17	6.17	7.685	6.58
10	8.63	7.98	8.61	7.26	9.16	8.51	7.7	7.7	10.117	6.833
11	9.93	10.15	9.22	8.84	10.82	12.24	9.25	9.25	14.29	11.004
12	10.9	10.85	10.89	9.28	10.77	10.78	10.85	10.85	12.731	12.731
+gp	13.668	13.177	14.344	14.448	13.932	14.041	12.988	13.033	14.311	14.311

Table 3 Stock weights at age (kg)

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.211	0.212	0.299	0.398	0.518	0.44	0.344	0.235	0.201	0.195
4	0.498	0.404	0.52	0.705	1.136	0.931	1.172	0.753	0.485	0.487
5	1.254	0.79	0.868	1.182	1.743	1.812	1.82	1.42	1.14	0.971
6	2.047	1.903	1.477	1.719	2.428	2.716	2.823	2.413	2.118	2.054
7	3.431	2.977	2.686	2.458	3.214	3.895	4.031	3.825	3.47	3.527
8	5.137	4.392	4.628	3.565	4.538	5.176	5.497	5.416	4.938	5.503
9	6.523	7.812	7.048	4.71	6.88	6.774	6.765	6.631	7.16	7.767
10	9.3	12.112	9.98	7.801	10.719	9.598	8.571	7.63	9.119	10.159
11	13.15	13.107	9.25	8.956	9.445	12.427	10.847	8.112	10.101	10.669
12	12.731	12.731	12.731	12.731	12.731	12.731	12.731	12.731	12.731	12.731
+gp	14.311	14.311	14.311	14.311	14.311	14.311	14.311	14.311	14.311	14.311

Table 3.12 (continued)

Table 3 Stock weights at age (kg)

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0.202	0.217	0.203	0.194	0.285	0.251	0.23	0.25	0.231	0.256
	4	0.521	0.533	0.52	0.465	0.522	0.605	0.537	0.546	0.624	0.602
	5	1.079	1.161	1.174	1.208	1.196	1.189	1.31	1.087	1.118	1.201
	6	1.878	1.939	2.031	1.972	2.239	2.138	2.009	2.035	1.932	2.009
	7	3.369	2.945	3.034	3.048	3.313	3.333	3.241	2.921	3.046	3.114
	8	5.263	4.574	4.464	4.096	5.118	4.766	4.971	4.384	3.955	4.427
	9	8.927	7.423	6.482	5.724	6.376	6.859	6.739	6.254	5.811	6.03
	10	12.154	10.367	10.269	7.457	9.241	9.333	8.706	8.543	8.289	8.037
	11	11.204	11.738	10.882	9.582	11.322	10.186	15.026	9.735	13.44	9.928
	12	12.731	12.731	12.731	12.731	12.731	12.731	12.731	12.731	12.731	15.784
+gp		14.311	14.311	14.311	14.311	14.311	14.311	14.311	14.311	14.311	17.533
	1										

Table 3.13 Northeast Arctic cod . Proportion mature at age

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 17:06

Table 5 Proportion mature at age

YEAR		1946
AGE		
	3	0
	4	0
	5	0.01
	6	0.03
	7	0.06
	8	0.11
	9	0.18
	10	0.44
	11	0.65
	12	0.86
+gp		0.96

Table 5 Proportion mature at age

YEAR		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	7	0.06	0.07	0.09	0.09	0.1	0.08	0.07	0.08	0.07	0.06
	8	0.13	0.13	0.17	0.23	0.24	0.22	0.19	0.16	0.13	0.12
	9	0.16	0.25	0.29	0.35	0.4	0.41	0.4	0.37	0.26	0.14
	10	0.42	0.47	0.54	0.52	0.58	0.63	0.64	0.68	0.53	0.41
	11	0.75	0.73	0.79	0.79	0.72	0.82	0.84	0.87	0.83	0.67
	12	0.91	0.91	0.88	0.95	0.85	0.92	0.94	0.93	0.92	0.91
+gp		0.95	0.97	0.97	0.97	0.96	0.97	0.97	0.96	0.97	0.96
	1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 17:06

Table 5 Proportion mature at age

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0.01	0	0	0.01	0	0	0
	5	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0	0	0.01
	6	0.03	0.03	0.04	0.06	0.06	0.05	0.03	0.03	0.01	0.02
	7	0.06	0.06	0.12	0.1	0.12	0.15	0.07	0.13	0.06	0.06
	8	0.09	0.1	0.34	0.19	0.31	0.34	0.28	0.37	0.2	0.22
	9	0.12	0.1	0.49	0.45	0.65	0.61	0.42	0.66	0.55	0.35
	10	0.22	0.3	0.67	0.69	0.91	0.81	0.81	0.89	0.73	0.74
	11	0.6	0.5	0.84	0.77	0.98	0.92	0.98	0.95	0.99	0.94
	12	0.82	0.82	0.87	0.85	0.98	0.97	0.98	0.99	0.98	0.94
+gp		0.97	0.97	1	0.99	1	1	1	1	1	1

Table 3.13 (continued)

Table 5 Proportion mature at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0	0	0	0	0	0.01	0	0	0	0
4	0	0	0	0.01	0	0.02	0	0	0	0
5	0	0.03	0	0	0.01	0.02	0	0	0.01	0
6	0.03	0.05	0.02	0.01	0.05	0.01	0.02	0.01	0.02	0.05
7	0.07	0.09	0.04	0.07	0.11	0.1	0.16	0.03	0.09	0.12
8	0.14	0.19	0.12	0.23	0.3	0.34	0.53	0.21	0.21	0.29
9	0.38	0.39	0.34	0.58	0.59	0.64	0.81	0.5	0.56	0.45
10	0.64	0.58	0.55	0.81	0.79	0.81	0.92	0.96	0.78	0.84
11	0.89	0.82	0.74	0.89	0.86	0.94	0.95	1	0.79	0.83
12	0.9	1	0.95	0.91	0.88	1	0.98	0.96	0.95	1
+gp	1	1	1	1	1	1	1	1	1	0.9

Table 5 Proportion mature at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0	0	0	0	0	0	0.01	0	0	0
4	0	0	0	0	0	0.05	0.08	0.05	0.01	0.05
5	0.02	0	0	0	0.02	0.1	0.1	0.18	0.09	0.08
6	0.08	0.02	0.03	0.02	0.07	0.34	0.3	0.31	0.36	0.19
7	0.26	0.13	0.13	0.13	0.2	0.65	0.73	0.56	0.55	0.53
8	0.54	0.44	0.39	0.35	0.54	0.82	0.88	0.9	0.85	0.71
9	0.76	0.71	0.77	0.65	0.8	0.92	0.97	0.99	0.96	0.62
10	0.87	0.77	0.89	0.82	0.97	1	1	1	0.9	0.9
11	0.93	0.81	0.83	1	1	1	1	1	1	1
12	0.94	0.89	0.78	0.9	1	1	1	1	1	1
+gp	0.9	0.8	0.9	0.9	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0	0	0.008	0.008	0.001	0.001	0	0.003	0	0
4	0.01	0.02	0.003	0.013	0.032	0.014	0.028	0.007	0.003	0
5	0.07	0.05	0.029	0.051	0.075	0.145	0.087	0.119	0.061	0.019
6	0.18	0.33	0.228	0.21	0.305	0.419	0.368	0.335	0.372	0.258
7	0.22	0.53	0.547	0.522	0.708	0.8	0.704	0.589	0.624	0.631
8	0.46	0.62	0.705	0.715	0.861	0.943	0.931	0.862	0.781	0.82
9	0.5	1	0.915	0.905	0.957	0.974	0.972	0.963	0.96	0.975
10	0.75	1	1	0.975	1	1	0.994	0.99	0.979	1
11	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1

Table 3.13 (continued)

Table 5 Proportion mature at age

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0	0.001	0.002	0	0.003	0.002	0.001	0.001	0	0
	4	0	0.003	0.002	0.001	0.003	0.013	0.001	0.01	0.004	0.001
	5	0.012	0.026	0.014	0.071	0.065	0.084	0.088	0.091	0.068	0.06
	6	0.14	0.152	0.187	0.247	0.359	0.388	0.326	0.442	0.397	0.369
	7	0.607	0.472	0.544	0.643	0.624	0.683	0.672	0.726	0.716	0.647
	8	0.83	0.814	0.847	0.83	0.819	0.841	0.888	0.872	0.892	0.897
	9	0.946	0.957	0.965	0.978	0.952	0.951	0.957	0.976	0.967	0.965
	10	1	0.98	1	1	1	1	1	0.977	0.991	1
	11	1	1	1	1	1	1	1	1	1	1
	12	1	1	1	1	1	1	1	1	1	1
+gp		1	1	1	1	1	1	1	1	1	1
	1										

Table 3.14

North-East Arctic cod (Sub-areas I and II) (run name: XSAASA01)
104
FLT09: Russian trawl catch and effort ages 9 - 11 (Catch: Thousa
(Catch: Unknown) (Effort: Unknown)
1985 2006
1 1 0.00 1.00
9 11

0.70	291	77	30
1.52	87	59	22
2.10	127	95	37
2.75	442	215	53
2.12	140	47	11
1.11	204	49	14
1.56	791	71	16
2.50	3852	689	62
2.64	2019	1778	68
2.96	1237	595	167
3.88	684	345	146
3.73	364	164	34
4.92	488	99	34
6.77	559	88	34
6.39	882	171	0
4.25	742	185	25
3.50	235	95	35
3.15	336	61	18
2.34	319	83	19
3.47	710	262	56
3.54	588	203	57
3.64	1182	183	102

FLT15: NorBarTrSur rev99 (Catch: Unknown) (Effort: Unknown)
1980 2006
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
1	1350	1096	425	151	24	3
1	1297	911	673	183	49	10
1	1725	569	447	273	76	17
1	621	981	247	155	45	11
1	1115	287	437	102	49	14
1	850	629	148	179	48	18

Table 3.14 (continued)

```
FLT16: NorBarLofAcSur rev99 (Catch: Unknown) (Effort: Unknown)
1984 2006
1 1 0.99 1.00
3 9
   1    1416     204     154     157      33      13      10
   1    1343     684     116      77      31       3       0
   1    2049     502     174      14      30       7       0
   1     355     578     109      40       3       0       1
   1     344     214     670     166      32       5       2
   1     206     262     269     668      73       6       3
   1     346     293     339     367     500      37       2
   1     658     215     184     284     254     824      43
   1    1911    1131     354     255     252     277     442
   1    4045    2175     895     225     119      94      39
   1    1598    2166    1040     290      44      43      30
   1     705     872     891     446      65      11       4
   1     517     497     422     499     205      22       5
   1    1826     424     338     340     247      49       7
   1     964     454     122     112     187      92      10
   1    1589    1457     493     129      69      52      12
   1    1716     816     573     198      24       8       6
   1    1122    1043     661     345      95      12       5
   1    1144    1315    1445     643     212      38       5
   1     928     327     451     468     222      88      22
   1     337     661     299     432      172     75      18
   1     591     157     381     169     155      88      24
   1     371     318     130     426     137      75      35
FLT18:  RusSweptArea  rev05  (ages  3-9)  (Catch:  Unknown)  (  (Catch:
Unknown) (Effort: Unknown)
1994 2006
1 1 0.90 1.00
3 9
1      1363   1309   1019   354    128    49     21
1      589    1065   1395   849    251    83     19
1      733    784    1035   773    348    132    19
1      1342   835    613    602    348    116    32
1      2028   1363   788    470    259    130    48
1      1587   2072   980    301    123    94     42
1      1839   1286   1786   773    114    52     23
1      1224   1557   1290  1061   304    50     14
1      980    1473   1473   896    600    182    29
1      1246   1057   1166  1203   535    241    40
1      329    1576   880    1111  776    279    93
1      1408   631    1832   744    605    244    88
1     877     1380   557    1182   482    301    101
```

Table 3.15a. NEAcod. Compared diagnostics and results for xsa with or without unreported catches added in 2002-2006.

		official catch	unrep. catch added var 1 norw.	unrep. catch added var 2 rus.
TSB	2002	1364853	1660357	1435257
	2003	1415011	1738668	1491931
	2004	1376327	1685469	1450556
	2005	1346058	1647739	1417648
	2006	1331892	1562359	1386807
SSB	2002	427750	502513	445951
	2003	466165	554453	487863
	2004	560699	669832	587913
	2005	518556	623216	543693
	2006	521289	595694	538250
F(5-10)	2002	0.667	0.678	0.670
	2003	0.509	0.535	0.516
	2004	0.673	0.691	0.679
	2005	0.669	0.735	0.688
	2006	0.597	0.658	0.610
N2006	age3	33471	40945	35270
N*10^-4	age4	30789	37767	32529
	age5	15623	18174	16384
	age6	15923	19174	16649
	age7	6133	7114	6367
	age8	3323	3735	3414
	age9	1428	1574	1460
	age10	339	361	344
F2006	age3	0.045	0.045	0.041
	age4	0.173	0.190	0.176
	age5	0.236	0.275	0.242
	age6	0.605	0.688	0.625
	age7	0.669	0.773	0.691
	age8	0.653	0.722	0.669
	age9	0.703	0.749	0.714
	age10	0.716	0.740	0.720
N2007	age3	38265	46435	40307
N*10^-4	age4	26211	32054	27721
	age5	21213	25560	22340
	age6	10105	11307	10531
	age7	7119	7892	7297
	age8	2572	2689	2611
	age9	1416	1486	1431
	age10	579	610	586
Catch	age3	1319	1623	1277
2006	age4	4415	5925	4744
N*10^-4	age5	2969	3949	3186
	age6	6540	8627	7000
	age7	2708	3466	2875
	age8	1442	1737	1507
	age9	652	751	674
	age10	157	171	160

Table 3.15b. NEAcod. Compared diagnostics and results for xsa tuned by single fleets and combination of fleets. Cannibalism included in catch

		FLT 09 Rus trawl CPUE	FLT 15 Joint BT survey	FLT 16 Joint+Lof Ac survey	FLT 18 Rus BT survey	Final run ALL Fleets
Min. SE for shrinkage		1.0	1.0	1.0	1.0	1.0
SS-ind.Q for age>		6	6	6	6	6
ages with fleet data		9 to 11	3 to 8	3 to 9	3 to 9	3 to 11
# of iterations to converg		29	26	>30	>30	30
age3	PshrinkW	**0.96**	**0.64**	**0.65**	**0.61**	**0.33**
	FshrinkW	0.04	0.03	0.03	0.03	0.02
age4	PshrinkW	**0.95**	**0.50**	**0.52**	**0.46**	0.21
	FshrinkW	0.05	0.03	0.03	0.03	0.02
age5	PshrinkW	**0.91**	**0.32**	**0.32**	**0.31**	0.15
	FshrinkW	0.09	0.03	0.03	0.03	0.01
age6	FshrinkW	**1.00**	0.06	0.08	0.06	0.02
age7	FshrinkW	**1.00**	0.07	0.08	0.07	0.03
age8	FshrinkW	**1.00**	0.08	0.10	0.07	0.03
age9	FshrinkW	0.16	0.21	0.09	0.09	0.03
age10	FshrinkW	0.15	**0.41**	0.17	0.16	0.06
age11	FshrinkW	0.10	**0.59**	**0.41**	**0.32**	0.07
age12	FshrinkW	0.25	**0.81**	**0.51**	**0.53**	0.15
N2006	age3	49981	45356	42759	48168	40945
N*10^-4	age4	43406	40080	37859	43086	37767
	age5	24187	20676	20575	20218	18174
	age6	23024	20030	18004	20731	19174
	age7	7249	7346	7028	7411	7114
	age8	3372	3627	3636	3853	3735
	age9	1568	1345	1702	1543	1574
	age10	300	335	469	459	361
F2006	age 4	0.164	0.178	0.190	0.165	0.190
	age5	0.199	0.237	0.238	0.243	0.275
	age6	0.535	0.646	0.754	0.616	0.688
	age7	0.752	0.737	0.788	0.727	0.773
	age8	0.843	0.754	0.751	0.690	0.722
	age9	0.753	0.960	0.669	0.772	0.749
	age10	0.995	0.829	0.515	0.530	0.740
2006	F(5-10)	0.679	0.694	0.619	0.596	0.658
	F(4-8)	0.498	0.510	0.544	0.488	0.529
TSB2006	incl Age1-2	1754498	1620918	1585401	1694946	1562359
SSB2006	('000 T)	608298	585673	600932	627600	595694
N2007	age3					46435
N*10^-4	age4	39452	35665	33539	37967	32054
	age5	30177	27453	25635	29914	25560
	age6	16230	13355	13273	12980	11307
	age7	11045	8593	6934	9167	7892
	age8	2799	2879	2618	2932	2689
	age9	1189	1398	1405	1583	1486
	age10	605	422	714	584	610
Survivors	age3		322810	273701	381694	
end of 06	age4		257769	223906	304780	
direct	age5		121628	121027	116218	
predic.	age6		84548	66526	90500	
by the	age7		28834	25924	29327	
survey	age8		14217	14239	16151	
N*10^-3	age9	6242	4009	7320	5862	
	age10	874	1261	2635	2483	
F2006	age3		0.044	0.052	0.038	
	age4		0.189	0.215	0.162	
direct	age5		0.258	0.259	0.268	
predic.	age6		0.654	0.776	0.622	
by the	age7		0.736	0.793	0.727	
survey	age8		0.745	0.744	0.680	
	age9	0.736	0.991	0.657	0.770	
	age10	1.019	0.801	0.462	0.484	

Table 3.16 N. Diagnostics for final XSA.

Lowestoft VPA Version 3.1

23/04/2007 13:27

Extended Survivors Analysis

Arctic Cod (run: XSAASA01/X01)

CPUE data from file fleet

Catch data for 23 years. 1984 to 2006. Ages 1 to 13.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT09: Russian trawl	1997	2006	9	11	0	1
FLT15: NorBarTrSur r	1997	2006	3	8	0.99	1
FLT16: NorBarLofAcSu	1997	2006	3	9	0.99	1
FLT18: RusSweptArea	1997	2006	3	9	0.9	1

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 30 iterations

1

Regression weights

0.02	0.116	0.284	0.482	0.67	0.82	0.921	0.976	0.997	1

Table 3.16 N (continued)

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	2.518	1.622	1.084	1.391	0.986	0.609	1.45	1.315	1.48	1.203
2	1.094	0.63	0.359	0.253	0.206	0.439	0.263	0.558	0.374	0.187
3	0.338	0.377	0.126	0.077	0.06	0.116	0.053	0.07	0.19	0.045
4	0.299	0.353	0.21	0.14	0.116	0.105	0.074	0.117	0.108	0.19
5	0.569	0.521	0.548	0.412	0.286	0.287	0.266	0.264	0.444	0.275
6	0.724	0.78	0.721	0.605	0.522	0.558	0.469	0.501	0.583	0.688
7	0.843	0.773	0.81	0.745	0.674	0.814	0.683	0.74	0.735	0.773
8	1.235	1.043	1.063	1.036	0.824	0.901	0.714	0.893	0.78	0.722
9	1.337	1.173	1.394	1.2	0.892	0.765	0.592	0.837	0.945	0.749
10	1.51	1.244	1.432	1.175	1.166	0.743	0.483	0.909	0.92	0.74
11	1.442	1.335	0.941	1.14	0.842	0.728	0.449	0.606	0.873	0.609
12	1.495	1.307	1.187	1.187	1.139	0.83	0.842	0.965	0.423	0.622

1

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1997	1.92E+07	3.11E+06	7.23E+05	2.27E+05	1.81E+05	1.79E+05	1.28E+05	4.42E+04	6.97E+03	1.63E+03
1998	6.68E+06	1.27E+06	8.52E+05	4.22E+05	1.38E+05	8.37E+04	7.08E+04	4.50E+04	1.05E+04	1.50E+03
1999	3.05E+06	1.08E+06	5.53E+05	4.78E+05	2.43E+05	6.70E+04	3.14E+04	2.68E+04	1.30E+04	2.67E+03
2000	3.29E+06	8.45E+05	6.18E+05	3.99E+05	3.17E+05	1.15E+05	2.67E+04	1.14E+04	7.57E+03	2.63E+03
2001	4.01E+06	6.70E+05	5.37E+05	4.68E+05	2.84E+05	1.72E+05	5.14E+04	1.04E+04	3.32E+03	1.87E+03
2002	1.16E+06	1.22E+06	4.46E+05	4.14E+05	3.41E+05	1.75E+05	8.36E+04	2.15E+04	3.72E+03	1.11E+03
2003	6.19E+06	5.15E+05	6.46E+05	3.25E+05	3.05E+05	2.10E+05	8.20E+04	3.03E+04	7.14E+03	1.42E+03
2004	3.31E+06	1.19E+06	3.24E+05	5.01E+05	2.47E+05	1.92E+05	1.07E+05	3.39E+04	1.22E+04	3.23E+03
2005	3.67E+06	7.27E+05	5.58E+05	2.47E+05	3.65E+05	1.56E+05	9.51E+04	4.19E+04	1.14E+04	4.31E+03
2006	3.34E+06	6.84E+05	4.09E+05	3.78E+05	1.82E+05	1.92E+05	7.11E+04	3.74E+04	1.57E+04	3.61E+03

Estimated population abundance at 1st Jan 2007

0.00E+00	8.22E+05	4.64E+05	3.21E+05	2.56E+05	1.13E+05	7.89E+04	2.69E+04	1.49E+04	6.10E+03

Taper weighted geometric mean of the VPA populations:

3.33E+06	8.19E+05	4.90E+05	3.80E+05	2.75E+05	1.66E+05	7.16E+04	2.66E+04	8.33E+03	2.41E+03

Standard error of the weighted Log(VPA populations) :

0.5193	0.3428	0.2638	0.2533	0.27	0.2924	0.4394	0.5162	0.5881	0.5168

YEAR \ AGE	11	12
1997	5.40E+02	3.03E+02
1998	2.95E+02	1.05E+02
1999	3.53E+02	6.36E+01
2000	5.22E+02	1.13E+02
2001	6.66E+02	1.37E+02
2002	4.77E+02	2.35E+02
2003	4.34E+02	1.88E+02
2004	7.17E+02	2.27E+02
2005	1.07E+03	3.20E+02
2006	1.41E+03	3.65E+02

Estimated population abundance at 1st Jan 2007

1.41E+03	6.27E+02

Taper weighted geometric mean of the VPA populations:

6.90E+02	2.11E+02

Table 3.16 N (continued)

Standard error of the weighted Log(VPA populations) :

	0.4883	0.4927
1		

Log catchability residuals.

Fleet : FLT09: Russian trawl

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.08	-0.74	-0.35	0.35	0.09	0.39	-0.09	-0.12	-0.21	0.05
10	-0.06	-0.51	-0.29	0.11	-0.02	-0.01	0.24	0.35	-0.21	-0.24
11	-0.04	0.2	99.99	-0.28	-0.12	-0.39	-0.07	0.19	-0.1	0.06

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
Mean Log q	-3.4958	-3.6039	-3.6039
S.E(Log q)	0.2587	0.2505	0.2149

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
9	1.33	-1.415	1.67	0.81	10	0.32	-3.5
10	1.16	-0.616	2.93	0.77	10	0.31	-3.6
11	0.85	0.886	4.1	0.9	9	0.17	-3.68
1							

Fleet : FLT15: NorBarTrSur r

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	0.1	-0.07	0	0.08	0	0.2	-0.02	-0.03	-0.08	-0.06
4	0.27	-0.07	0.06	0.06	0.04	0.05	0.03	-0.09	-0.04	-0.01
5	0.41	0.3	0.12	-0.03	0.07	0.13	0.01	-0.09	-0.08	-0.05
6	0.27	0.08	-0.17	-0.1	-0.06	0.16	0.29	-0.16	-0.29	0.17
7	0.27	0.26	0.18	-0.32	-0.27	0.1	0.42	-0.31	-0.11	0.2
8	-0.16	-0.19	0.35	0.07	-0.33	0.23	0.23	-0.14	-0.23	0.08
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									

Table 3.16 N (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	-6.2639	-6.5298	-6.8027
S.E(Log q)	0.2168	0.2878	0.2302

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	0.7	1.728	7.97	0.89	10	0.11	-5.77
4	0.53	4.103	9.2	0.95	10	0.07	-5.99
5	0.53	2.574	9.14	0.88	10	0.11	-6.18

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	0.76	0.978	7.65	0.79	10	0.17	-6.26
7	0.92	0.264	6.89	0.74	10	0.29	-6.53
8	0.97	0.136	6.9	0.84	10	0.25	-6.8
1							

Fleet : FLT16: NorBarLofAcSu

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	0.28	-0.23	0.35	0.25	0.14	0.37	-0.16	-0.04	-0.19	-0.23
4	0.51	-0.06	0.2	0.13	0.06	0.26	-0.03	-0.18	-0.02	-0.15
5	0.44	0.24	0.3	0.04	0.16	0.32	-0.09	-0.06	-0.26	-0.11
6	0.09	-0.21	0.1	-0.13	-0.06	0.58	-0.01	0.03	-0.61	0.21
7	0.12	0.37	0.22	-0.74	-0.09	0.37	0.3	-0.17	-0.16	0.05
8	-0.12	0.31	0.27	-0.77	-0.48	0.02	0.33	0.24	0.07	-0.03
9	-0.05	-0.27	-0.08	-0.43	-0.09	-0.33	0.33	-0.16	0.3	0.16
10	No data for this fleet at this age									
11	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
Mean Log q	-5.4327	-5.3342	-5.2612	-5.3205
S.E(Log q)	0.3677	0.3211	0.3467	0.2863

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	0.57	0.965	9.17	0.54	10	0.27	-6.23
4	0.38	2.025	10.39	0.71	10	0.18	-6.29
5	0.44	1.489	9.64	0.62	10	0.23	-5.99

Table 3.16 N (continued)

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	0.8	0.412	6.73	0.51	10	0.32	-5.43
7	0.78	0.892	6.65	0.79	10	0.25	-5.33
8	0.65	2.684	6.97	0.93	10	0.15	-5.26
9	0.83	0.927	5.94	0.88	10	0.24	-5.32
1							

Fleet : FLT18: RusSweptArea

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	-0.13	-0.07	0.12	0.06	-0.01	0.1	-0.19	-0.14	0.08	0.09
4	0.35	0.11	0.19	-0.02	-0.05	0.02	0	-0.11	-0.07	0.12
5	0.18	0.58	0.17	0.2	0.03	-0.07	-0.12	-0.09	0.09	-0.07
6	-0.36	0.2	-0.08	0.21	0.05	-0.1	-0.07	-0.03	-0.15	0.21
7	-0.73	-0.5	-0.4	-0.37	-0.12	0.21	-0.01	0.15	0.02	0.12
8	-0.54	-0.63	-0.41	-0.18	-0.32	0.31	0.07	0.28	-0.18	0.09
9	0.19	0.03	-0.1	-0.35	-0.31	0.18	-0.31	0.23	0.35	-0.03
10	No data for this fleet at this age									
11	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
Mean Log q	-4.4513	-4.1857	-4.0381	-4.119
S.E(Log q)	0.1453	0.2095	0.2703	0.2806

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	0.49	2.254	9.59	0.82	10	0.14	-5.92
4	0.71	1.552	7.54	0.87	10	0.11	-5.41
5	0.64	1.432	7.73	0.78	10	0.16	-4.99

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	1.04	-0.173	4.12	0.79	10	0.17	-4.45
7	0.73	2.525	6.07	0.95	10	0.11	-4.19
8	0.87	0.592	4.81	0.84	10	0.25	-4.04
9	0.86	0.747	4.8	0.87	10	0.25	-4.12
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2005

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	1	0	0	0	0	0	0
FLT16: NorBarLofAcSu	1	0	0	0	0	0	0
FLT18: RusSweptArea	1	0	0	0	0	0	0

Table 3.16 N (continued)

P shrinkage mean	819461	0.34					0.895	1.205
F shrinkage mean	847191	1					0.105	1.182

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
822333	0.32	13.62	2	41.999	1.203

1
Age 2 Catchability dependent on age and year class strength

Year class = 2004

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	1	0	0	0	0	0	0
FLT16: NorBarLofAcSu	1	0	0	0	0	0	0
FLT18: RusSweptArea	1	0	0	0	0	0	0
P shrinkage mean	490256	0.26				0.935	0.178
F shrinkage mean	212855	1				0.065	0.371

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
464350	0.26	13.05	2	51.158	0.187

Age 3 Catchability dependent on age and year class strength

Year class = 2003

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	300673	0.3	0	0	1	0.225	0.048
FLT16: NorBarLofAcSu	254817	0.319	0	0	1	0.199	0.056
FLT18: RusSweptArea	352448	0.3	0	0	1	0.225	0.041
P shrinkage mean	379698	0.25				0.33	0.038
F shrinkage mean	142383	1				0.021	0.098

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
320537	0.14	0.1	5	0.701	0.045

1
Age 4 Catchability dependent on age and year class strength

Year class = 2002

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	245577	0.213	0.038	0.18	2	0.258	0.197
FLT16: NorBarLofAcSu	216477	0.213	0.021	0.1	2	0.258	0.221
FLT18: RusSweptArea	284382	0.213	0.02	0.09	2	0.258	0.173
P shrinkage mean	275311	0.27				0.211	0.178
F shrinkage mean	488093	1				0.015	0.104

Weighted prediction :

Table 3.16 N (continued)

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
255598	0.11	0.05	8	0.474	0.19

Age 5 Catchability dependent on age and year class strength

Year class = 2001

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	108265	0.174	0.006	0.03	3	0.285	0.285
FLT16: NorBarLofAcSu	106473	0.179	0.03	0.17	3	0.272	0.289
FLT18: RusSweptArea	103513	0.174	0.023	0.13	3	0.285	0.297
P shrinkage mean	165759	0.29				0.146	0.195
F shrinkage mean	97924	1				0.012	0.311

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
113068	0.1	0.05	11	0.571	0.275

1

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

Year class = 2000

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	80623	0.157	0.068	0.43	4	0.344	0.677
FLT16: NorBarLofAcSu	71330	0.166	0.106	0.64	4	0.29	0.739
FLT18: RusSweptArea	82220	0.157	0.092	0.58	4	0.344	0.668
F shrinkage mean	111442	1				0.023	0.531

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
78923	0.09	0.05	13	0.533	0.688

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

Year class = 1999

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	27441	0.151	0.097	0.64	5	0.341	0.762
FLT16: NorBarLofAcSu	25784	0.163	0.136	0.84	5	0.284	0.796
FLT18: RusSweptArea	27133	0.15	0.055	0.36	5	0.349	0.768
F shrinkage mean	28825	1				0.026	0.736

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26887	0.09	0.05	16	0.561	0.773

1

Table 3.16 N (continued)

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

Year class = 1998

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	14851	0.159	0.042	0.27	6	0.352	0.722
FLT16: NorBarLofAcSu	14609	0.177	0.054	0.31	6	0.263	0.73
FLT18: RusSweptArea	15314	0.158	0.03	0.19	6	0.356	0.706
F shrinkage mean	12138	1				0.029	0.831

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
14862	0.1	0.02	19	0.247	0.722

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

Year class = 1997

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	6420	0.3	0	0	1	0.173	0.722
FLT15: NorBarTrSur r	5420	0.166	0.093	0.56	6	0.168	0.812
FLT16: NorBarLofAcSu	6795	0.194	0.045	0.23	7	0.286	0.693
FLT18: RusSweptArea	5809	0.172	0.038	0.22	7	0.34	0.775
F shrinkage mean	5403	1				0.033	0.814

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6096	0.11	0.03	22	0.302	0.749

1

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

Year class = 1996

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1122	0.232	0.012	0.05	2	0.438	0.867
FLT15: NorBarTrSur r	1486	0.178	0.102	0.57	6	0.097	0.714
FLT16: NorBarLofAcSu	1888	0.207	0.029	0.14	7	0.186	0.599
FLT18: RusSweptArea	1809	0.185	0.061	0.33	7	0.219	0.618
F shrinkage mean	1149	1				0.06	0.853

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1412	0.13	0.05	23	0.417	0.74

Table 3.16 N (continued)

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

Year class = 1995

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	612	0.209	0.085	0.41	3	0.647	0.62
FLT15: NorBarTrSur r	725	0.204	0.047	0.23	6	0.055	0.545
FLT16: NorBarLofAcSu	625	0.215	0.093	0.43	7	0.105	0.611
FLT18: RusSweptArea	747	0.191	0.031	0.16	7	0.125	0.533
F shrinkage mean	512	1				0.068	0.706

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
627	0.16	0.03	24	0.21	0.609

1

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

Year class = 1994

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	162	0.206	0.137	0.67	3	0.586	0.617
FLT15: NorBarTrSur r	172	0.228	0.096	0.42	6	0.044	0.591
FLT16: NorBarLofAcSu	201	0.239	0.066	0.28	7	0.102	0.524
FLT18: RusSweptArea	142	0.214	0.109	0.51	7	0.12	0.681
F shrinkage mean	142	1				0.147	0.681

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
160	0.19	0.04	24	0.229	0.622

1

Table 3.16 R. Diagnostics for final XSA.

Lowestoft VPA Version 3.1

23/04/2007 15:54

Extended Survivors Analysis

Arctic Cod (run: XSAASA01/X01)

CPUE data from file fleet

Catch data for 23 years. 1984 to 2006. Ages 1 to 13.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT09: Russian trawl	1997	2006	9	11	0	1
FLT15: NorBarTrSur r	1997	2006	3	8	0.99	1
FLT16: NorBarLofAcSu	1997	2006	3	9	0.99	1
FLT18: RusSweptArea	1997	2006	3	9	0.9	1

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 had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00031

Final year F values

Age	1	2	3	4	5	6	7	8	9	10
Iteration 29	1.2285	0.1987	0.0408	0.1757	0.2419	0.6249	0.6912	0.6694	0.7136	0.7201
Iteration 30	1.2285	0.1987	0.0408	0.1757	0.2419	0.6249	0.6912	0.6694	0.7136	0.7201

Age	11	12
Iteration 29	0.5691	0.5785
Iteration 30	0.5691	0.5784

Table 3.16 R (continued)

Regression weights

0.02	0.116	0.284	0.482	0.67	0.82	0.921	0.976	0.997	1

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	2.553	1.685	1.157	1.43	1.003	0.598	1.463	1.313	1.481	1.229
2	1.11	0.665	0.397	0.281	0.223	0.453	0.254	0.553	0.381	0.199
3	0.341	0.388	0.137	0.086	0.068	0.122	0.055	0.07	0.195	0.041
4	0.3	0.357	0.219	0.153	0.134	0.107	0.071	0.118	0.095	0.176
5	0.57	0.524	0.559	0.435	0.323	0.286	0.254	0.26	0.402	0.242
6	0.725	0.782	0.729	0.627	0.57	0.547	0.449	0.49	0.521	0.625
7	0.843	0.774	0.816	0.763	0.721	0.801	0.655	0.724	0.671	0.691
8	1.236	1.044	1.067	1.054	0.87	0.891	0.694	0.877	0.73	0.669
9	1.338	1.175	1.4	1.214	0.932	0.752	0.584	0.832	0.906	0.714
10	1.51	1.246	1.438	1.192	1.213	0.742	0.457	0.891	0.897	0.72
11	1.443	1.338	0.946	1.156	0.875	0.716	0.428	0.563	0.813	0.569
12	1.496	1.31	1.196	1.205	1.191	0.839	0.818	0.921	0.381	0.578

1

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1997	1.90E+07	3.08E+06	7.18E+05	2.26E+05	1.80E+05	1.78E+05	1.28E+05	4.42E+04	6.97E+03	1.63E+03
1998	6.45E+06	1.21E+06	8.31E+05	4.18E+05	1.37E+05	8.35E+04	7.08E+04	4.49E+04	1.05E+04	1.50E+03
1999	2.86E+06	9.80E+05	5.10E+05	4.62E+05	2.39E+05	6.65E+04	3.13E+04	2.67E+04	1.29E+04	2.66E+03
2000	2.92E+06	7.36E+05	5.39E+05	3.64E+05	3.04E+05	1.12E+05	2.62E+04	1.13E+04	7.52E+03	2.61E+03
2001	3.45E+06	5.73E+05	4.55E+05	4.05E+05	2.56E+05	1.61E+05	4.90E+04	1.00E+04	3.23E+03	1.83E+03
2002	1.01E+06	1.04E+06	3.75E+05	3.48E+05	2.90E+05	1.52E+05	7.45E+04	1.95E+04	3.44E+03	1.04E+03
2003	5.41E+06	4.54E+05	5.39E+05	2.72E+05	2.56E+05	1.78E+05	7.18E+04	2.74E+04	6.55E+03	1.33E+03
2004	2.86E+06	1.03E+06	2.88E+05	4.18E+05	2.07E+05	1.63E+05	9.32E+04	3.06E+04	1.12E+04	2.99E+03
2005	3.23E+06	6.31E+05	4.83E+05	2.20E+05	3.04E+05	1.31E+05	8.15E+04	3.70E+04	1.04E+04	3.99E+03
2006	3.00E+06	6.01E+05	3.53E+05	3.25E+05	1.64E+05	1.66E+05	6.37E+04	3.41E+04	1.46E+04	3.44E+03

Estimated population abundance at 1st Jan 2007

0.00E+00	7.18E+05	4.03E+05	2.77E+05	2.23E+05	1.05E+05	7.30E+04	2.61E+04	1.43E+04	5.86E+03

Taper weighted geometric mean of the VPA populations:

2.94E+06	7.13E+05	4.24E+05	3.29E+05	2.40E+05	1.46E+05	6.45E+04	2.45E+04	7.80E+03	2.28E+03

Standard error of the weighted Log(VPA populations) :

0.524	0.3406	0.2614	0.2496	0.2473	0.2504	0.3925	0.4874	0.5814	0.5143

YEAR \ AGE	11	12
1997	5.40E+02	3.03E+02
1998	2.95E+02	1.04E+02
1999	3.52E+02	6.34E+01
2000	5.18E+02	1.12E+02
2001	6.50E+02	1.33E+02
2002	4.45E+02	2.22E+02
2003	4.06E+02	1.78E+02
2004	6.88E+02	2.17E+02
2005	1.00E+03	3.21E+02
2006	1.33E+03	3.65E+02

Estimated population abundance at 1st Jan 2007

1.37E+03	6.17E+02

Taper weighted geometric mean of the VPA populations:

6.59E+02	2.06E+02

Table 3.16 R (continued)

Standard error of the weighted Log(VPA populations) :

	0.4827	0.4969
1		

Log catchability residuals.

Fleet : FLT09: Russian trawl

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.15	-0.8	-0.41	0.3	0.07	0.4	-0.07	-0.1	-0.2	0.05
10	-0.11	-0.56	-0.34	0.07	-0.03	0	0.24	0.37	-0.19	-0.25
11	-0.09	0.15	99.99	-0.32	-0.13	-0.38	-0.06	0.16	-0.12	0.05

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
Mean Log q	-3.4347	-3.5533	-3.5533
S.E(Log q)	0.2599	0.2599	0.2125

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	1.34	-1.423	1.56	0.8	10	0.32	-3.43
10	1.18	-0.643	2.82	0.76	10	0.32	-3.55
11	0.86	0.884	4.04	0.91	9	0.17	-3.64
1							

Fleet : FLT15: NorBarTrSur r

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	-0.04	-0.18	-0.06	0.08	0.02	0.23	0.02	-0.07	-0.08	-0.07
4	0.14	-0.21	-0.05	0.02	0.04	0.08	0.07	-0.06	-0.07	-0.01
5	0.28	0.22	0.01	-0.12	0.05	0.13	0.04	-0.03	-0.07	-0.05
6	0.17	-0.03	-0.26	-0.16	-0.05	0.18	0.32	-0.11	-0.28	0.14
7	0.19	0.18	0.11	-0.37	-0.26	0.12	0.45	-0.27	-0.1	0.15
8	-0.23	-0.25	0.29	0.04	-0.31	0.25	0.24	-0.12	-0.22	0.05
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									

Table 3.16 R (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	-6.155	-6.4495	-6.7368
S.E(Log q)	0.2249	0.2805	0.2246

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	0.7	1.442	7.79	0.85	10	0.12	-5.62
4	0.52	3.66	9.14	0.93	10	0.08	-5.85
5	0.48	3.137	9.36	0.89	10	0.09	-6.05

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	0.65	1.574	8.18	0.82	10	0.13	-6.16
7	0.87	0.462	7.07	0.73	10	0.26	-6.45
8	0.97	0.148	6.84	0.83	10	0.24	-6.74
1							

Fleet : FLT16: NorBarLofAcSu

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	0.14	-0.35	0.28	0.24	0.16	0.4	-0.12	-0.06	-0.19	-0.23
4	0.37	-0.2	0.07	0.08	0.05	0.28	0.01	-0.15	-0.03	-0.14
5	0.31	0.18	0.16	-0.06	0.12	0.28	-0.05	0.01	-0.23	-0.08
6	-0.02	-0.31	0	-0.19	-0.06	0.6	0.03	0.08	-0.61	0.18
7	0.04	0.29	0.15	-0.79	-0.08	0.39	0.33	-0.12	-0.15	0
8	-0.18	0.24	0.21	-0.81	-0.47	0.04	0.34	0.26	0.08	-0.06
9	-0.11	-0.33	-0.13	-0.46	-0.08	-0.32	0.35	-0.14	0.29	0.14
10	No data for this fleet at this age									
11	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
Mean Log q	-5.3239	-5.2539	-5.1953	-5.2649
S.E(Log q)	0.3744	0.3292	0.3561	0.2903

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	0.57	0.949	9.04	0.53	10	0.27	-6.08
4	0.36	2.208	10.35	0.73	10	0.17	-6.15
5	0.38	1.884	9.91	0.68	10	0.19	-5.86

Table 3.16 R (continued)

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	0.67	0.715	7.48	0.53	10	0.26	-5.32
7	0.71	1.132	6.92	0.78	10	0.23	-5.25
8	0.64	2.428	6.95	0.92	10	0.16	-5.2
9	0.85	0.762	5.81	0.86	10	0.26	-5.26
1							

Fleet : FLT18: RusSweptArea

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	-0.27	-0.2	0.06	0.05	0.01	0.12	-0.15	-0.16	0.08	0.1
4	0.22	-0.03	0.07	-0.06	-0.05	0.05	0.05	-0.08	-0.08	0.12
5	0.08	0.47	0.05	0.08	0.01	-0.06	-0.08	-0.02	0.07	-0.04
6	-0.47	0.09	-0.17	0.15	0.05	-0.08	-0.04	0.01	-0.14	0.18
7	-0.81	-0.58	-0.47	-0.42	-0.1	0.23	0.02	0.19	0.03	0.07
8	-0.61	-0.69	-0.48	-0.22	-0.31	0.33	0.09	0.3	-0.17	0.07
9	0.14	-0.02	-0.15	-0.38	-0.3	0.19	-0.29	0.25	0.34	-0.04
10	No data for this fleet at this age									
11	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
Mean Log q	-4.3416	-4.1043	-3.9714	-4.063
S.E(Log q)	0.1273	0.2356	0.2863	0.2845

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	0.48	2.204	9.47	0.81	10	0.14	-5.77
4	0.68	2.008	7.64	0.9	10	0.09	-5.27
5	0.55	2.496	8.28	0.88	10	0.1	-4.87

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	0.88	0.571	5.24	0.84	10	0.12	-4.34
7	0.68	2.637	6.34	0.94	10	0.11	-4.1
8	0.88	0.479	4.69	0.8	10	0.27	-3.97
9	0.88	0.594	4.65	0.85	10	0.27	-4.06
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2005

Fleet	Estima Survivo	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	1	0	0	0	0	0	0
FLT16: NorBarLofAcSu	1	0	0	0	0	0	0
FLT18: RusSweptArea	1	0	0	0	0	0	0

Table 3.16 R (continued)

P shrinkage mean	713025	0.34				0.896	1.234
F shrinkage mean	762985	1				0.104	1.186

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
718062	0.32	13.48	2	41.827	1.229

1

Age 2 Catchability dependent on age and year class strength

Year class = 2004

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	1	0	0	0	0	0	0
FLT16: NorBarLofAcSu	1	0	0	0	0	0	0
FLT18: RusSweptArea	1	0	0	0	0	0	0
P shrinkage mean	423630	0.26				0.936	0.19
F shrinkage mean	194573	1				0.064	0.375

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
403070	0.25	12.91	2	51.048	0.199

Age 3 Catchability dependent on age and year class strength

Year class = 2003

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	259200	0.3	0	0	1	0.224	0.044
FLT16: NorBarLofAcSu	220606	0.324	0	0	1	0.193	0.051
FLT18: RusSweptArea	304947	0.3	0	0	1	0.224	0.037
P shrinkage mean	328822	0.25				0.338	0.035
F shrinkage mean	107306	1				0.021	0.102

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
277213	0.14	0.11	5	0.744	0.041

1

Age 4 Catchability dependent on age and year class strength

Year class = 2002

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	214439	0.213	0.038	0.18	2	0.249	0.182
FLT16: NorBarLofAcSu	189879	0.213	0.025	0.12	2	0.249	0.204
FLT18: RusSweptArea	247001	0.213	0.017	0.08	2	0.249	0.16
P shrinkage mean	240430	0.25				0.24	0.164
F shrinkage mean	386518	1				0.015	0.105

Weighted prediction :

Table 3.16 R (continued)

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
223402	0.11	0.05	8	0.446	0.176

Age 5 Catchability dependent on age and year class strength

Year class = 2001

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	99280	0.174	0.006	0.04	3	0.273	0.255
FLT16: NorBarLofAcSu	99249	0.179	0.015	0.08	3	0.259	0.255
FLT18: RusSweptArea	96094	0.174	0.035	0.2	3	0.273	0.262
P shrinkage mean	145958	0.25				0.183	0.18
F shrinkage mean	80333	1				0.011	0.307

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
105313	0.09	0.05	11	0.582	0.242

1

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

Year class = 2000

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	74778	0.157	0.053	0.34	4	0.345	0.614
FLT16: NorBarLofAcSu	66754	0.165	0.089	0.54	4	0.289	0.667
FLT18: RusSweptArea	75614	0.157	0.076	0.48	4	0.345	0.609
F shrinkage mean	92908	1				0.021	0.52

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
72972	0.09	0.04	13	0.44	0.625

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

Year class = 1999

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	26672	0.149	0.089	0.6	5	0.349	0.681
FLT16: NorBarLofAcSu	25211	0.163	0.138	0.85	5	0.278	0.709
FLT18: RusSweptArea	26397	0.148	0.045	0.3	5	0.35	0.686
F shrinkage mean	24614	1				0.023	0.721

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26114	0.09	0.05	16	0.546	0.691

1

Table 3.16 R (continued)

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

Year class = 1998

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1	0	0	0	0	0	0
FLT15: NorBarTrSur r	14281	0.155	0.034	0.22	6	0.361	0.67
FLT16: NorBarLofAcSu	14170	0.176	0.058	0.33	6	0.259	0.674
FLT18: RusSweptArea	14769	0.156	0.019	0.12	6	0.354	0.654
F shrinkage mean	10719	1				0.027	0.821

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
14311	0.09	0.02	19	0.247	0.669

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

Year class = 1997

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	6163	0.3	0	0	1	0.171	0.688
FLT15: NorBarTrSur r	5305	0.164	0.092	0.56	6	0.178	0.765
FLT16: NorBarLofAcSu	6502	0.194	0.037	0.19	7	0.281	0.662
FLT18: RusSweptArea	5609	0.171	0.041	0.24	7	0.338	0.736
F shrinkage mean	4893	1				0.031	0.809

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5858	0.1	0.03	22	0.3	0.714

1

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

Year class = 1996

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	1085	0.231	0.022	0.09	2	0.434	0.847
FLT15: NorBarTrSur r	1476	0.176	0.104	0.59	6	0.103	0.683
FLT16: NorBarLofAcSu	1833	0.21	0.033	0.16	7	0.185	0.582
FLT18: RusSweptArea	1757	0.185	0.06	0.33	7	0.22	0.601
F shrinkage mean	1082	1				0.057	0.849

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1372	0.13	0.06	23	0.431	0.72

Table 3.16 R (continued)

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

Year class = 1995

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	601	0.208	0.075	0.36	3	0.649	0.581
FLT15: NorBarTrSur r	720	0.203	0.054	0.27	6	0.058	0.505
FLT16: NorBarLofAcSu	624	0.219	0.092	0.42	7	0.104	0.564
FLT18: RusSweptArea	747	0.194	0.034	0.17	7	0.124	0.491
F shrinkage mean	481	1				0.065	0.685

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
617	0.15	0.03	24	0.214	0.569

1

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

Year class = 1994

Fleet	Estima Surviv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT09: Russian trawl	169	0.205	0.147	0.72	3	0.597	0.574
FLT15: NorBarTrSur r	180	0.229	0.101	0.44	6	0.046	0.547
FLT16: NorBarLofAcSu	214	0.244	0.069	0.28	7	0.102	0.479
FLT18: RusSweptArea	150	0.218	0.106	0.49	7	0.12	0.629
F shrinkage mean	143	1				0.134	0.65

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
168	0.19	0.05	24	0.253	0.578

Table 3.17 N
Fishing mortality for XSA run down to age 1. Number of cod eaten by cod included in catch matrix

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1984	1985	1986
AGE			
1	0.2457	0.3591	0.9368
2	0.0373	0.0577	0.8027
3	0.0199	0.0533	0.1451
4	0.1235	0.1701	0.2122
5	0.3075	0.3763	0.4933
6	0.6274	0.6051	0.7052
7	1.1361	0.9248	0.948
8	1.2111	1.0189	1.0909
9	1.2623	0.7786	0.8281
10	0.9579	0.5057	1.112
11	1.0876	0.4205	0.8745
12	1.0345	0.4665	1.0045
+gp	1.0345	0.4665	1.0045
0 FBAR 5	0.9171	0.7016	0.8629

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	0.5267	0.8044	0.2145	0.0961	0.1038	0.4685	2.5645	1.7158	1.8683	1.9896
2	0.8028	0.1102	0.002	0.0594	0.2381	0.1461	0.4488	0.6315	0.9354	1.0555
3	0.1137	0.0629	0.0327	0.0086	0.0185	0.0405	0.0788	0.2097	0.5518	0.469
4	0.2285	0.127	0.1284	0.0622	0.0624	0.1266	0.096	0.2011	0.3038	0.3521
5	0.5097	0.3704	0.266	0.1342	0.1875	0.2205	0.3464	0.339	0.3381	0.4117
6	0.9363	0.5971	0.4016	0.231	0.321	0.4428	0.4597	0.6456	0.5772	0.5427
7	1.1398	1.0446	0.7156	0.2504	0.4259	0.5396	0.5663	1.1681	0.8909	0.7497
8	1.0143	0.9834	0.8892	0.3742	0.3451	0.5993	0.5976	0.9863	0.9434	0.8624
9	0.7784	1.1591	0.7166	0.3058	0.3805	0.4558	0.6665	1.0542	0.9618	0.7519
10	1.3241	1.718	0.9855	0.3242	0.256	0.4586	0.6631	1.0399	1.0193	0.9394
11	1.027	1.5371	0.5821	0.54	0.134	0.2482	0.6763	1.1611	1.2531	0.8661
12	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.1499	0.9126
+gp	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.1499	0.9126
0 FBAR 5	0.9504	0.9788	0.6624	0.27	0.3193	0.4528	0.5499	0.8722	0.7885	0.7097
1										

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR
AGE											
1	2.518	1.6216	1.0844	1.3912	0.9861	0.6086	1.4497	1.3153	1.4803	1.2029	1.3328
2	1.0944	0.6304	0.3586	0.2526	0.2058	0.4393	0.263	0.5581	0.3743	0.187	0.3731
3	0.3379	0.3775	0.1264	0.0769	0.0604	0.1162	0.0534	0.0698	0.1895	0.0448	0.1014
4	0.299	0.3527	0.2104	0.1397	0.1161	0.1047	0.0736	0.1168	0.1082	0.1904	0.1385
5	0.5693	0.5205	0.5483	0.412	0.2856	0.287	0.2655	0.2637	0.4444	0.2746	0.3276
6	0.7243	0.7799	0.721	0.6053	0.522	0.5579	0.4694	0.5011	0.5828	0.6877	0.5905
7	0.843	0.7732	0.8102	0.7447	0.6735	0.8138	0.683	0.7404	0.7346	0.773	0.7493
8	1.2352	1.0431	1.0628	1.0365	0.8239	0.9005	0.7137	0.8932	0.7799	0.7216	0.7982
9	1.3374	1.1735	1.3944	1.1998	0.8917	0.7645	0.5922	0.8366	0.9452	0.7489	0.8435
10	1.5097	1.2443	1.432	1.1746	1.1658	0.7434	0.4829	0.9085	0.9199	0.7399	0.8561
11	1.4416	1.3354	0.9409	1.1401	0.8416	0.7282	0.4489	0.6064	0.8725	0.6089	0.696
12	1.4952	1.3066	1.1867	1.1869	1.1391	0.8302	0.842	0.9646	0.4234	0.6221	0.67
+gp	1.4952	1.3066	1.1867	1.1869	1.1391	0.8302	0.842	0.9646	0.4234	0.6221	
0 FBAR 5	1.0365	0.9224	0.9948	0.8621	0.7271	0.6779	0.5345	0.6906	0.7345	0.6576	
1											

Table 3.17 R

Fishing mortality for XSA run down to age 1. Number of cod eaten by cod included in catch matrix

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 15:55

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1984	1985	1986
AGE			
1	0.2457	0.3591	0.9368
2	0.0373	0.0577	0.8027
3	0.0199	0.0533	0.1451
4	0.1235	0.1701	0.2122
5	0.3075	0.3763	0.4933
6	0.6274	0.6051	0.7052
7	1.1361	0.9248	0.948
8	1.2111	1.0189	1.0909
9	1.2623	0.7786	0.8281
10	0.9579	0.5057	1.112
11	1.0876	0.4205	0.8745
12	1.0345	0.4665	1.0045
+gp	1.0345	0.4665	1.0045
0 FBAR 5-10	0.9171	0.7016	0.8629

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	0.5267	0.8044	0.2145	0.0961	0.1038	0.4685	2.5647	1.7165	1.8705	1.9981
2	0.8028	0.1102	0.002	0.0594	0.2381	0.1461	0.4489	0.6318	0.9367	1.0605
3	0.1137	0.0629	0.0327	0.0086	0.0185	0.0405	0.0788	0.2097	0.5522	0.4703
4	0.2285	0.127	0.1284	0.0622	0.0624	0.1266	0.096	0.2011	0.3039	0.3525
5	0.5097	0.3704	0.266	0.1342	0.1875	0.2205	0.3464	0.339	0.3381	0.4119
6	0.9363	0.5971	0.4016	0.231	0.321	0.4428	0.4597	0.6457	0.5773	0.5428
7	1.1398	1.0446	0.7156	0.2504	0.4259	0.5396	0.5663	1.1682	0.891	0.7498
8	1.0143	0.9834	0.8892	0.3742	0.3451	0.5993	0.5976	0.9863	0.9435	0.8626
9	0.7784	1.1591	0.7166	0.3058	0.3805	0.4558	0.6665	1.0542	0.9618	0.752
10	1.3241	1.718	0.9855	0.3242	0.256	0.4586	0.6631	1.0399	1.0194	0.9396
11	1.027	1.5371	0.5821	0.54	0.134	0.2482	0.6763	1.1612	1.2532	0.8663
12	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.15	0.9127
+gp	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.15	0.9127
0 FBAR 5-10	0.9504	0.9788	0.6624	0.27	0.3193	0.4528	0.5499	0.8722	0.7885	0.7098
1										

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 15:55

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
1	2.5525	1.6854	1.157	1.4295	1.0026	0.5981	1.4635	1.3131	1.4813	1.2285	1.341
2	1.1097	0.665	0.397	0.2806	0.2229	0.453	0.2539	0.5532	0.3809	0.1987	0.3776
3	0.3408	0.388	0.1372	0.0863	0.0675	0.1224	0.0551	0.0696	0.1951	0.0408	0.1018
4	0.3002	0.357	0.2188	0.1533	0.1337	0.107	0.0708	0.1182	0.0951	0.1757	0.1297
5	0.5701	0.5237	0.5592	0.435	0.3225	0.2856	0.2542	0.2595	0.4024	0.2419	0.3013
6	0.7248	0.7821	0.7294	0.6272	0.5701	0.5474	0.4495	0.4905	0.5212	0.6249	0.5455
7	0.8433	0.7744	0.8155	0.7629	0.7214	0.8009	0.6549	0.7235	0.6706	0.6912	0.6951
8	1.2356	1.0443	1.0668	1.0541	0.8697	0.8909	0.6944	0.8769	0.7301	0.6694	0.7588
9	1.338	1.1747	1.4001	1.2144	0.9321	0.752	0.5838	0.8319	0.9062	0.7136	0.8172
10	1.5105	1.2465	1.4377	1.1916	1.2131	0.7423	0.4565	0.8912	0.8971	0.7201	0.8361
11	1.4425	1.3383	0.9458	1.1561	0.8749	0.7162	0.4283	0.5629	0.8131	0.5691	0.6483
12	1.496	1.3097	1.1958	1.2051	1.1907	0.8389	0.8177	0.9212	0.3811	0.5784	0.6269
+gp	1.496	1.3097	1.1958	1.2051	1.1907	0.8389	0.8177	0.9212	0.3811	0.5784	
0 FBAR 5-10	1.0371	0.9243	1.0014	0.8808	0.7715	0.6699	0.5156	0.6789	0.6879	0.6102	
1											

Table 3.18 N. Stock number at age
XSA run down to age 1 with number of cod eaten by cod included in catch matrix

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1984	1985	1986
AGE			
1	211678	137713	175527
2	67035	135548	78736
3	40282	52874	104751
4	13543	32331	41043
5	7852	9800	22329
6	4763	4727	5507
7	2465	2082	2113
8	1304	648	676
9	923	318	192
10	140	214	120
11	39	44	106
12	26	11	24
+gp	12	21	13
0 TOTAL	350063	376330	431137

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	49253	82174	81731	151984	173648	306303	2424806	936061	2008418	2777455
2	56317	23815	30098	53997	113033	128154	156977	152785	137810	253865
3	28886	20660	17463	24593	41660	72938	90660	82045	66519	44277
4	74177	21109	15883	13838	19962	33482	57346	68603	54468	31364
5	27180	48326	15222	11438	10646	15355	24154	42654	45935	32912
6	11163	13366	27319	9552	8188	7226	10083	13986	24880	26820
7	2227	3583	6023	14969	6207	4863	3800	5213	6004	11437
8	670	583	1032	2411	9541	3320	2321	1766	1327	2017
9	186	199	179	347	1358	5532	1493	1045	539	423
10	69	70	51	71	209	760	2871	628	298	169
11	32	15	10	16	42	133	393	1211	182	88
12	36	9	3	5	7	30	85	164	311	42
+gp	16	8	6	4	2	5	19	23	42	162
0 TOTAL	250213	213918	195019	283224	384505	578100	2775009	1306183	2346734	3181030
1										

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 84-**	AMST 84-**
AGE													
1	1923298	667592	305275	328780	400843	115548	619415	330919	366973	334424	0	346215	676591
2	310961	126948	107994	84509	66965	122425	51473	118996	72716	68375	82233	95031	113259
3	72334	85224	55332	61776	53744	44631	64596	32397	55754	40945	46435	49599	55126
4	22679	42241	47837	39921	46833	41423	32531	50137	24735	37767	32054	34169	38131
5	18057	13769	24305	31736	28425	34141	30542	24744	36525	18174	25560	21897	24739
6	17852	8366	6699	11500	17209	17491	20979	19174	15563	19174	11307	11883	13660
7	12761	7083	3140	2667	5140	8360	8197	10742	9511	7114	7892	5158	6147
8	4424	4497	2677	1144	1037	2146	3033	3390	4194	3735	2689	1814	2379
9	697	1053	1297	757	332	372	714	1216	1136	1574	1486	606	913
10	163	150	267	263	187	111	142	323	431	361	610	197	346
11	54	30	35	52	67	48	43	72	107	141	141	59	129
12	30	10	6	11	14	24	19	23	32	37	63	21	42
+gp	53	17	11	4	6	7	12	11	17	65	45		
0 TOTAL	2383364	956982	554876	563121	620801	386727	831696	592143	587694	531886	210513		
1													

Table 3.18 R. Stock number at age

XSA run down to age 1 with number of cod eaten by cod included in catch matrix

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 15:55

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1984	1985	1986
AGE			
1	211678	137713	175527
2	67035	135548	78736
3	40282	52874	104751
4	13543	32331	41043
5	7852	9800	22329
6	4763	4727	5507
7	2465	2082	2113
8	1304	648	676
9	923	318	192
10	140	214	120
11	39	44	106
12	26	11	24
+gp	12	21	13
0 TOTAL	350063	376330	431136

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	49253	82174	81730	151981	173636	306280	2424762	935917	2007604	2773748
2	56317	23815	30097	53996	113031	128144	156959	152748	137693	253198
3	28886	20660	17463	24593	41659	72936	90652	82030	66489	44180
4	74177	21109	15883	13838	19962	33482	57344	68596	54456	31340
5	27180	48325	15222	11437	10646	15354	24154	42652	45930	32901
6	11163	13366	27319	9552	8188	7226	10083	13985	24879	26815
7	2227	3583	6023	14969	6207	4863	3800	5213	6004	11436
8	670	583	1032	2411	9541	3320	2321	1766	1327	2017
9	186	199	179	347	1358	5532	1493	1045	539	423
10	69	70	51	71	209	760	2871	628	298	169
11	32	15	10	16	42	133	393	1211	182	88
12	36	9	3	5	7	30	85	164	311	42
+gp	16	8	6	4	2	5	19	23	42	162
0 TOTAL	250213	213917	195018	283220	384490	578064	2774936	1305979	2345753	3176520
1										

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 15:55

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 84-**	AMST 84-**
AGE													
1	1900240	645421	285773	292208	345011	100777	541272	286317	322637	299618	0	333300	662334
2	307925	121173	97953	73567	57279	103650	45369	102561	63052	60052	71806	91069	109371
3	71788	83112	51018	53917	45495	37528	53949	28816	48290	35270	40307	47541	53004
4	22600	41803	46161	36415	40493	34817	27185	41803	22007	32529	27721	32856	36590
5	18037	13705	23949	30367	25575	29004	25613	20735	30410	16384	22340	21193	23846
6	17843	8350	6646	11209	16093	15167	17847	16262	13096	16649	10531	11564	13190
7	12758	7076	3127	2624	4902	7451	7183	9322	8153	6367	7297	5047	5973
8	4424	4494	2671	1133	1002	1951	2739	3055	3702	3414	2611	1784	2337
9	697	1053	1295	752	323	344	655	1120	1041	1460	1431	598	903
10	163	150	266	261	183	104	133	299	399	344	586	194	344
11	54	30	35	52	65	45	41	69	100	133	137	59	129
12	30	10	6	11	13	22	18	22	32	36	62	20	42
+gp	53	17	11	4	5	7	12	11	16	59	44		
0 TOTAL	2356614	926393	518913	502521	536440	330864	722014	510392	512935	472315	184874		
1													

Table 3.19

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Table 4 Natural Mortality (M) at age

YEAF	1984	1985	1986
AGE			
1	0.2	0.2	0.2
2	0.2	0.2	0.2
3	0.2	0.2	0.2
4	0.2	0.2	0.2
5	0.2	0.2	0.2
6	0.2	0.2	0.2
7	0.2	0.2	0.2
8	0.2	0.2	0.2
9	0.2	0.2	0.2
10	0.2	0.2	0.2
11	0.2	0.2	0.2
12	0.2	0.2	0.2
+gp	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAF	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1										

Run title : Arctic Cod (run: XSAASA01/X01)

At 23/04/2007 16:00

Table 3.20N Natural mortality of cod (M2) due to cannibalism.

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	0.3583	0.0555	0.0004	0.0000	0.0000	0.0000
1986	0.5068	0.7908	0.1108	0.0000	0.0000	0.0000
1987	0.5205	0.7947	0.0580	0.0000	0.0000	0.0000
1988	0.7998	0.1087	0.0087	0.0000	0.0000	0.0000
1989	0.2148	0.0011	0.0000	0.0000	0.0000	0.0000
1990	0.0480	0.0587	0.0000	0.0000	0.0000	0.0000
1991	0.1023	0.2356	0.0049	0.0000	0.0000	0.0000
1992	0.4640	0.1412	0.0066	0.0000	0.0000	0.0000
1993	2.5640	0.4471	0.0660	0.0028	0.0024	0.0000
1994	1.7148	0.6291	0.1996	0.0955	0.0258	0.0046
1995	1.8701	0.9372	0.5449	0.2045	0.0111	0.0014
1996	1.9892	1.0537	0.4442	0.2321	0.0812	0.0060
1997	2.5179	1.0937	0.3148	0.0933	0.0103	0.0020
1998	1.6216	0.6286	0.3278	0.0768	0.0163	0.0095
1999	1.0843	0.3582	0.1105	0.0113	0.0000	0.0000
2000	1.3911	0.2523	0.0682	0.0415	0.0167	0.0006
2001	0.9860	0.2053	0.0497	0.0286	0.0078	0.0071
2002	0.6086	0.4392	0.1101	0.0175	0.0033	0.0002
2003	1.4497	0.2625	0.0406	0.0000	0.0000	0.0000
2004	1.3153	0.5579	0.0625	0.0275	0.0054	0.0002
2005	1.4798	0.3735	0.1769	0.0150	0.0204	0.0050
2006	1.2028	0.1848	0.0174	0.0072	0.0006	0.0000

Table 3.20R Natural mortality of cod (M2) due to cannibalism.

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	0.3583	0.0555	0.0004	0.0000	0.0000	0.0000
1986	0.5068	0.7908	0.1108	0.0000	0.0000	0.0000
1987	0.5205	0.7947	0.0580	0.0000	0.0000	0.0000
1988	0.7998	0.1087	0.0087	0.0000	0.0000	0.0000
1989	0.2148	0.0011	0.0000	0.0000	0.0000	0.0000
1990	0.0480	0.0587	0.0000	0.0000	0.0000	0.0000
1991	0.1023	0.2356	0.0049	0.0000	0.0000	0.0000
1992	0.4640	0.1412	0.0066	0.0000	0.0000	0.0000
1993	2.5640	0.4471	0.0660	0.0028	0.0024	0.0000
1994	1.7148	0.6291	0.1996	0.0955	0.0258	0.0046
1995	1.8701	0.9372	0.5449	0.2045	0.0111	0.0014
1996	1.9985	1.0611	0.4474	0.2328	0.0813	0.0060
1997	2.5520	1.1090	0.3176	0.0937	0.0104	0.0020
1998	1.6853	0.6635	0.3372	0.0776	0.0164	0.0096
1999	1.1579	0.3971	0.1200	0.0116	0.0000	0.0000
2000	1.4313	0.2806	0.0765	0.0451	0.0174	0.0006
2001	1.0024	0.2232	0.0551	0.0317	0.0084	0.0074
2002	0.5977	0.4546	0.1174	0.0190	0.0036	0.0002
2003	1.4692	0.2553	0.0435	0.0000	0.0000	0.0000
2004	1.3101	0.5532	0.0643	0.0306	0.0060	0.0003
2005	1.4296	0.3759	0.1912	0.0153	0.0218	0.0052
2006	1.1671	0.1911	0.0191	0.0078	0.0006	0.0000

Table 3.21 N. Northeast Arctic cod. Final VPA

Table 8 Fishing mortality (F) at age

YEAR	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE										
3	0.0018	0.0003	0.0023	0.002	0.0254	0.0225	0.0334	0.0199	0.0159	0.027
4	0.0249	0.0124	0.0209	0.0321	0.1612	0.1667	0.1325	0.1457	0.084	0.1291
5	0.1101	0.0751	0.1484	0.1167	0.2637	0.37	0.2299	0.2676	0.2859	0.4568
6	0.2024	0.1997	0.3662	0.2882	0.2787	0.5501	0.3125	0.3333	0.5297	0.69
7	0.416	0.5201	0.5101	0.4096	0.4122	0.5311	0.3243	0.3969	0.5139	0.6129
8	0.2545	0.3536	0.3869	0.348	0.4046	0.4175	0.3469	0.2494	0.588	0.688
9	0.4047	0.5286	0.3832	0.4741	0.5057	0.579	0.3932	0.4364	0.5805	0.6551
10	0.4405	0.3617	0.3766	0.5031	0.5149	0.7613	0.5364	0.6441	0.7645	0.738
11	0.7827	0.5536	0.6259	0.9031	0.4585	1.026	0.698	0.8035	0.7621	0.8756
12	0.6182	0.4604	0.5039	0.7111	0.4879	0.9056	0.6217	0.7304	0.7704	0.8152
+gp	0.6182	0.4604	0.5039	0.7111	0.4879	0.9056	0.6217	0.7304	0.7704	0.8152
0 FBAR 5-10	0.3047	0.3398	0.3619	0.3566	0.3966	0.5348	0.3572	0.3879	0.5437	0.6401

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Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0.024	0.0718	0.0535	0.0543	0.0562	0.0663	0.0313	0.0174	0.0226	0.0398
4	0.1128	0.2589	0.2564	0.2266	0.2717	0.3063	0.2366	0.1449	0.111	0.1037
5	0.2094	0.3626	0.5093	0.3477	0.4944	0.6498	0.742	0.3537	0.3909	0.2119
6	0.4862	0.5517	0.5121	0.4607	0.5168	0.8279	1.0069	0.4854	0.4494	0.3818
7	0.5494	0.5357	0.5251	0.4363	0.5279	0.6094	0.9764	0.5787	0.4033	0.4713
8	0.6287	0.4593	0.5111	0.4855	0.6931	0.6564	0.8798	0.7409	0.5303	0.5797
9	0.5463	0.4535	0.6141	0.4053	0.7389	0.8167	0.9416	1.0674	0.7389	0.7183
10	0.6333	0.7388	0.686	0.7381	0.8379	0.9855	1.3731	0.8476	0.8074	0.8182
11	0.8584	0.8415	0.6511	0.8449	1.0011	0.9522	1.4366	1.2968	0.7617	0.5024
12	0.7529	0.799	0.6734	0.7981	0.9284	0.9756	1.4264	1.0883	0.7927	0.6634
+gp	0.7529	0.799	0.6734	0.7981	0.9284	0.9756	1.4264	1.0883	0.7927	0.6634
0 FBAR 5-10	0.5089	0.5169	0.5596	0.4789	0.6348	0.7576	0.9866	0.6789	0.5533	0.5302

Table 8 Fishing mortality (F) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.0298	0.0251	0.023	0.0409	0.0214	0.0394	0.1959	0.2141	0.0837	0.166
4	0.1525	0.2064	0.2292	0.1422	0.1028	0.1673	0.1996	0.4959	0.2106	0.3121
5	0.1814	0.4087	0.4792	0.4004	0.2285	0.2976	0.3536	0.5375	0.5211	0.48
6	0.2026	0.4683	0.5382	0.568	0.2517	0.3849	0.3917	0.5078	0.7021	0.5715
7	0.432	0.4019	0.7725	0.6211	0.5144	0.3427	0.421	0.4451	0.705	0.6973
8	0.6844	0.5291	0.9302	0.8479	0.833	0.6583	0.7375	0.4863	0.7032	0.8908
9	0.8781	0.8041	1.1783	0.9682	0.9584	1.1338	0.9698	0.5192	0.6109	0.7746
10	0.885	0.8105	1.0769	1.09	0.7876	1.3393	0.7386	0.8842	0.7149	0.46
11	1.2253	0.6772	1.5554	0.8533	0.8388	1.2904	0.7222	0.9905	0.9079	0.6132
12	1.0696	0.7458	1.3377	0.9829	0.8179	1.3377	0.7358	0.9492	0.8218	0.5389
+gp	1.0696	0.7458	1.3377	0.9829	0.8179	1.3377	0.7358	0.9492	0.8218	0.5389
0 FBAR 5-10	0.5439	0.5704	0.8292	0.7493	0.5956	0.6928	0.602	0.5633	0.6595	0.6457

Table 8 Fishing mortality (F) at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.1338	0.146	0.0489	0.0318	0.0252	0.0672	0.0208	0.0194	0.0533	0.033
4	0.5671	0.2234	0.209	0.1296	0.1003	0.2121	0.205	0.1247	0.1716	0.2133
5	0.7544	0.6703	0.3475	0.3562	0.23	0.3045	0.3308	0.3096	0.3788	0.496
6	0.6857	0.8497	0.5478	0.6225	0.5163	0.5518	0.5033	0.6301	0.6078	0.7078
7	0.6763	0.8581	0.6643	0.6766	0.8475	0.7996	0.7821	1.135	0.9264	0.9487
8	0.9121	0.9296	0.7789	0.7123	1.0788	0.9846	1.0295	1.2083	1.0191	1.091
9	1.2298	1.3057	1.0352	0.939	1.2764	1.1588	0.9701	1.2572	0.7818	0.8325
10	0.7689	1.0301	0.9848	1.038	1.2299	0.7507	0.9203	0.9564	0.5088	1.1134
11	0.6231	1.8042	1.4314	1.4798	0.9557	0.9516	0.5853	1.081	0.4237	0.8774
12	0.6958	1.4375	1.2219	1.2775	1.1082	0.8607	0.759	1.0345	0.4665	1.0045
+gp	0.6958	1.4375	1.2219	1.2775	1.1082	0.8607	0.759	1.0345	0.4665	1.0045
0 FBAR 5-10	0.8379	0.9406	0.7264	0.7241	0.8632	0.7583	0.756	0.9161	0.7038	0.8649

Table 3.21N (Cont'd)

Table 8 Fishing mortality (F) at age

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.0555	0.0546	0.033	0.0087	0.0134	0.0341	0.0129	0.0098	0.0105	0.024
4	0.2293	0.1277	0.1292	0.0627	0.0631	0.1276	0.0942	0.1065	0.1008	0.121
5	0.5104	0.371	0.2671	0.1352	0.1888	0.2226	0.3464	0.3153	0.3291	0.3325
6	0.9362	0.5974	0.4024	0.2324	0.3228	0.4449	0.4635	0.6434	0.5786	0.5395
7	1.1362	1.0411	0.7142	0.2518	0.4277	0.5417	0.5693	1.1663	0.8923	0.7537
8	1.0143	0.9788	0.8851	0.3755	0.347	0.6013	0.6009	0.9867	0.9447	0.8663
9	0.7841	1.1546	0.7134	0.3067	0.3823	0.4585	0.6697	1.0542	0.9633	0.7577
10	1.3245	1.7027	0.9791	0.3242	0.2572	0.4612	0.6668	1.041	1.0204	0.9438
11	1.0329	1.5282	0.581	0.5377	0.1345	0.2497	0.6797	1.161	1.2494	0.8717
12	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.1499	0.9126
+gp	1.1899	1.6497	0.7917	0.4352	0.1959	0.3556	0.6759	1.1136	1.1499	0.9126
0 FBAR 5-10	0.951	0.9743	0.6602	0.271	0.321	0.455	0.5528	0.8678	0.7881	0.6989

Table 8 Fishing mortality (F) at age, N

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
3	0.0232	0.0498	0.0161	0.0088	0.0108	0.0062	0.0129	0.0074	0.0127	0.0274	0.0158
4	0.2068	0.277	0.2002	0.0989	0.0881	0.0879	0.0742	0.09	0.0933	0.1832	0.1222
5	0.5607	0.5056	0.5492	0.3968	0.2793	0.2851	0.2672	0.2598	0.4254	0.274	0.3198
6	0.724	0.7712	0.7212	0.6058	0.5166	0.5593	0.4711	0.5029	0.5792	0.6877	0.5899
7	0.8456	0.7759	0.8116	0.7446	0.6748	0.8134	0.6845	0.7406	0.736	0.773	0.7499
8	1.2349	1.0457	1.0636	1.0345	0.8222	0.899	0.7145	0.893	0.7796	0.7216	0.7981
9	1.3356	1.1748	1.3907	1.1982	0.8905	0.7622	0.5941	0.8362	0.9432	0.7489	0.8428
10	1.5072	1.242	1.4258	1.171	1.1617	0.7437	0.4831	0.9072	0.9169	0.7399	0.8547
11	1.4401	1.3337	0.9433	1.1322	0.8414	0.7291	0.4519	0.605	0.8702	0.6089	0.6947
12	1.4952	1.3066	1.1867	1.1869	1.1391	0.8302	0.842	0.9646	0.4234	0.6221	0.67
+gp	1.4952	1.3066	1.1867	1.1869	1.1391	0.8302	0.842	0.9646	0.4234	0.6221	
0 FBAR 5-10	1.0347	0.9192	0.9937	0.8585	0.7242	0.6771	0.5357	0.6899	0.7301	0.6575	
1											

Table 3.21 R Fishing mortality (F) at age, R

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
3	0.0234	0.0513	0.0175	0.0101	0.0128	0.0063	0.0124	0.0069	0.0112	0.0255	0.0145
4	0.2076	0.2805	0.2083	0.109	0.1028	0.0887	0.0714	0.0885	0.0801	0.1684	0.1123
5	0.5616	0.5087	0.5602	0.419	0.3157	0.2833	0.2555	0.2549	0.3819	0.2414	0.2927
6	0.7245	0.7735	0.7296	0.6276	0.5641	0.5487	0.4511	0.4913	0.5171	0.6252	0.5446
7	0.846	0.7772	0.817	0.7628	0.7222	0.8004	0.6565	0.7235	0.6706	0.6912	0.6951
8	1.2354	1.047	1.0679	1.052	0.8673	0.8893	0.6953	0.8764	0.73	0.6694	0.7586
9	1.3363	1.1761	1.3965	1.2129	0.9303	0.7495	0.5855	0.8313	0.9045	0.7136	0.8164
10	1.5081	1.2443	1.4317	1.188	1.2082	0.7423	0.4566	0.8895	0.894	0.7201	0.8345
11	1.441	1.3367	0.9482	1.1485	0.8746	0.7171	0.431	0.5616	0.811	0.5691	0.6472
12	1.496	1.3097	1.1958	1.2051	1.1907	0.8389	0.8177	0.9212	0.3811	0.5784	0.6269
+gp	1.496	1.3097	1.1958	1.2051	1.1907	0.8389	0.8177	0.9212	0.3811	0.5784	
0 FBAR 5-10	1.0353	0.9211	1.0005	0.8771	0.768	0.6689	0.5167	0.6778	0.683	0.6102	
1											

Table 3.22N. Fishing mortality of age 1-6 cod.

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	0.1235	0.3075	0.6275
1985	0.0001	0.0015	0.0529	0.1702	0.3763	0.6052
1986	0.0000	0.0017	0.0324	0.2123	0.4934	0.7056
1987	0.0000	0.0011	0.0548	0.2287	0.5100	0.9365
1988	0.0000	0.0009	0.0542	0.1270	0.3709	0.5977
1989	0.0000	0.0009	0.0327	0.1284	0.2661	0.4025
1990	0.0000	0.0004	0.0086	0.0622	0.1343	0.2311
1991	0.0000	0.0007	0.0134	0.0623	0.1872	0.3210
1992	0.0004	0.0011	0.0331	0.1265	0.2205	0.4427
1993	0.0000	0.0006	0.0128	0.0934	0.3443	0.4597
1994	0.0000	0.0003	0.0097	0.1057	0.3133	0.6412
1995	0.0000	0.0003	0.0106	0.1003	0.3269	0.5759
1996	0.0000	0.0006	0.0238	0.1200	0.3305	0.5367
1997	0.0000	0.0007	0.0231	0.2057	0.5590	0.7224
1998	0.0000	0.0019	0.0496	0.2759	0.5042	0.7704
1999	0.0000	0.0004	0.0159	0.1991	0.5483	0.7210
2000	0.0000	0.0003	0.0087	0.0981	0.3953	0.6047
2001	0.0000	0.0004	0.0107	0.0875	0.2778	0.5148
2002	0.0001	0.0001	0.0062	0.0872	0.2836	0.5578
2003	0.0000	0.0005	0.0128	0.0736	0.2655	0.4694
2004	0.0000	0.0002	0.0074	0.0893	0.2583	0.5009
2005	0.0000	0.0008	0.0127	0.0932	0.4241	0.5778
2006	0.0001	0.0022	0.0274	0.1832	0.2740	0.6877

Table 3.22R. Fishing mortality of age 1-6 cod.

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	0.1235	0.3075	0.6275
1985	0.0001	0.0015	0.0529	0.1702	0.3763	0.6052
1986	0.0000	0.0017	0.0324	0.2123	0.4934	0.7056
1987	0.0000	0.0011	0.0548	0.2287	0.5100	0.9365
1988	0.0000	0.0009	0.0542	0.1270	0.3709	0.5977
1989	0.0000	0.0009	0.0327	0.1284	0.2661	0.4025
1990	0.0000	0.0004	0.0086	0.0622	0.1343	0.2311
1991	0.0000	0.0007	0.0134	0.0623	0.1872	0.3210
1992	0.0004	0.0011	0.0331	0.1265	0.2205	0.4427
1993	0.0000	0.0006	0.0128	0.0934	0.3443	0.4597
1994	0.0000	0.0003	0.0097	0.1057	0.3133	0.6412
1995	0.0000	0.0003	0.0106	0.1003	0.3269	0.5759
1996	0.0000	0.0006	0.0239	0.1204	0.3309	0.5369
1997	0.0000	0.0007	0.0233	0.2066	0.5599	0.7229
1998	0.0000	0.0020	0.0512	0.2794	0.5074	0.7726
1999	0.0000	0.0004	0.0174	0.2072	0.5592	0.7293
2000	0.0000	0.0004	0.0100932	0.1084413	0.4175951	0.6265065
2001	0.0000	0.0005	0.0127406	0.1023789	0.314219	0.5628019
2002	0.0001	0.0001	0.0063695	0.088455	0.2820855	0.5472425
2003	0.0000	0.0005	0.0125324	0.0707875	0.2542074	0.4494582
2004	0.0000	0.0002	0.0070782	0.0887307	0.2538808	0.4902394
2005	0.0000	0.0007	0.0116534	0.0806678	0.3817386	0.5164117
2006	0.0001	0.0019	0.0255492	0.1684477	0.24143	0.6251949

Table 3.23. Stock number at age. Final VPA

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

	YEAF	1946
	AGE	
	3	728139
	4	577860
	5	402060
	6	197212
	7	93323
	8	96213
	9	244722
	10	101777
	11	38117
	12	39205
	+gp	33324
0	TOT/	2551952

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

	YEAF	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
	AGE										
	3	425311	442592	468348	704908	1083753	1193111	1590377	641584	272778	439602
	4	592530	347574	362238	382556	575973	865011	955076	1259285	514924	219807
	5	463732	473210	281072	290427	303320	401364	599477	684912	891184	387619
	6	312115	340097	359415	198391	211595	190765	226975	389987	429102	548181
	7	146496	208708	228044	204032	121764	131099	90099	135956	228785	206850
	8	63939	79121	101579	112107	110900	66016	63110	53333	74845	112048
	9	64933	40588	45487	56484	64808	60583	35603	36525	34028	34036
	10	146581	35470	19586	25387	28785	32000	27799	19673	19329	15591
	11	62991	77255	20227	11003	12568	14083	12237	13311	8459	7368
	12	22142	23578	36361	8856	3651	6506	4133	4985	4880	3232
	+gp	42765	37377	21337	21133	13989	3938	1880	2707	2738	3722
0	TOT/	2343535	2105569	1943694	2015284	2531108	2964476	3606766	3242259	2481052	1978057
	1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

	YEAF	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	804781	496824	683690	789653	916842	728338	472064	338678	776941	1582560
	4	350332	643259	378598	530599	612324	709603	558039	374580	272501	621906
	5	158175	256234	406511	239862	346346	382037	427678	360621	265306	199663
	6	200984	105033	145989	199996	138702	172949	163321	166726	207288	146941
	7	225110	101196	49529	71623	103298	67732	61876	48854	84015	108284
	8	91748	106395	48488	23986	37908	49883	30149	19083	22424	45954
	9	46105	40060	55027	23813	12084	15518	21185	10240	7448	10803
	10	14474	21860	20840	24380	13000	4726	5614	6764	2883	2913
	11	6103	6291	8550	8592	9541	4605	1444	1164	2373	1053
	12	2513	2118	2220	3650	3022	2871	1455	281	261	907
	+gp	1687	857	1142	1351	2332	1351	1113	1278	670	351
0	TOT/	1902013	1780129	1800584	1917505	2195401	2139612	1743938	1328269	1642109	2721334

	Table 10	Stock number at age (start of year)				Numbers*10**-3					
	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	1295416	164955	112039	197105	404774	1015319	1818949	523916	621616	613942
	4	1245195	1029477	131705	89647	154909	324399	799193	1224278	346265	468089
	5	458995	875269	685697	85743	63671	114439	224670	535936	610486	229669
	6	132256	313440	476187	347649	47037	41482	69576	129164	256342	296843
	7	82121	88421	160667	227600	161288	29940	23112	38504	63643	104000
	8	55340	43651	48433	60756	100131	78947	17401	12421	20199	25746
	9	21072	22854	21054	15642	21306	35642	33463	6815	6253	8186
	10	4313	7170	8373	5306	4863	6690	9391	10388	3320	2779
	11	1052	1457	2610	2335	1461	1811	1435	3673	3513	1330
	12	522	253	606	451	815	517	408	571	1117	1160
	+gp	461	498	278	312	421	697	408	525	550	572
0	TOTAL	3296742	2547445	1647648	1032545	960676	1649883	2998007	2486189	1933304	1752317

	Table 10	Stock number at age (start of year)				Numbers*10**-3					
	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	348054	638490	198490	137735	150868	151830	166831	397831	523674	1037294
	4	425778	249276	451722	154747	109237	120444	116234	133783	319254	406348
	5	280485	197708	163230	300088	111295	80899	79769	77525	96695	220157
	6	116349	108004	82807	94414	172067	72401	48848	46916	46570	54207
	7	137232	47987	37806	39202	41481	84063	34138	24176	20455	20763
	8	42398	57130	16658	15929	16316	14551	30937	12785	6362	6632
	9	8650	13943	18463	6259	6397	4542	4451	9048	3127	1880
	10	3089	2070	3093	5368	2004	1461	1167	1381	2107	1171
	11	1436	1172	605	946	1557	480	565	381	435	1037
	12	590	631	158	118	176	490	152	258	106	233
	+gp	583	1198	218	87	66	70	170	116	209	130
0	TOTAL	1364643	1317608	973250	754893	611465	531231	483261	704200	1018993	1749851

	Table 10	Stock number at age (start of year)				Numbers*10**-3					
	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	286233	204644	172781	242749	411727	720977	896132	810730	659269	437438
	4	735513	209193	157267	136870	197020	330975	566757	678022	538355	309726
	5	268787	478806	150744	113154	105246	151440	238515	421133	453597	324814
	6	109763	132093	270500	94492	80926	71340	99244	137783	245145	264285
	7	21867	35238	59509	148105	61322	47979	37432	51114	59011	112378
	8	6583	5747	10186	23854	94265	32734	22853	17344	13036	19794
	9	1824	1954	1768	3442	13417	54551	14689	10259	5294	4150
	10	669	682	504	709	2074	7495	28238	6156	2927	1654
	11	315	146	102	155	420	1313	3869	11868	1780	864
	12	353	92	26	47	74	301	837	1605	3043	418
	+gp	156	82	56	40	25	48	191	232	418	1624
0	TOTAL	1432062	1068678	823443	763616	966515	1419152	1908758	2146247	1981875	1477144

	Table 10	Stock number at age (start of year) , N					Numbers*10**-3							
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 46-**	AMST 46-**
	AGE													
	3	715534	843569	547506	611503	531705	441520	638975	322496	554414	408987	0	495940	603313
	4	224246	417820	473466	394972	463552	409777	321797	495912	246213	375534	320180	378911	458742
	5	178146	135999	240142	313738	281030	337707	301941	244622	361020	180892	254156	260346	312759
	6	175840	82398	66075	113526	169878	172663	207216	189249	153619	189258	112539	149908	181131
	7	125400	69659	30904	26300	50683	82384	80789	105918	93689	70127	77899	73308	91343
	8	43302	44076	26250	11238	10226	21133	29904	33359	41351	36744	26504	32141	43353
	9	6815	10312	12682	7419	3270	3679	7042	11983	11183	15525	14620	13436	23791
	10	1593	1467	2608	2584	1833	1099	1406	3183	4252	3565	6011	5207	12573
	11	527	289	347	513	656	470	428	710	1052	1392	1393	1947	6464
	12	296	102	62	111	135	232	185	223	317	361	620	712	3293
	+gp	532	173	112	41	56	69	124	111	165	648	444		
0	TOTAL	1472230	1605865	1400155	1481944	1513025	1470733	1589807	1407765	1467274	1283033	814365		
	1													

	Table 3.23 R	Stock number at age (start of year), R					Numbers*10**-3							
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 46-**	AMST 46-**
	AGE													
	3	710092	822860	505075	534046	450749	371986	534499	287054	483163	348573	0	488589	595905
	4	223454	413396	456834	360398	400958	344831	269111	413813	218866	323102	272939	373684	453334
	5	177957	135349	236577	300184	252918	286977	253504	205154	300759	162885	221798	257343	309626
	6	175748	82234	65545	110621	158860	149755	176347	160752	129400	164453	104694	148464	179486
	7	125361	69585	30768	25871	48322	73442	70819	91964	80498	62839	72054	72741	90735
	8	43294	44044	26190	11128	9878	19215	27007	30074	36521	33704	25774	31952	43206
	9	6813	10305	12656	7371	3182	3397	6465	11032	10250	14410	14129	13371	23758
	10	1592	1466	2603	2564	1794	1028	1314	2948	3934	3397	5779	5185	12565
	11	527	289	346	509	640	439	400	682	992	1317	1353	1940	6462
	12	296	102	62	110	132	218	175	213	318	361	610	710	3293
	+gp	532	173	112	40	54	65	117	107	163	592	438		
0	TOTAL	1465665	1579804	1336769	1352842	1327488	1251354	1339760	1203792	1264862	1115632	719569		
	1													

Table 3.24. Stock biomass at age. Final VPA

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

YEAR	1946
AGE	
3	254849
4	340937
5	446286
6	333289
7	221176
8	304996
9	973994
10	513974
11	225651
12	282275
+gp	271456
0 TOTAL	4168882

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

YEAR	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
AGE										
3	136099	150481	173289	274914	433501	524969	636151	282297	87289	145069
4	331817	184214	242699	244836	478058	692009	725857	969649	293507	127488
5	440545	596245	311990	374651	421615	533814	767331	862989	1007038	414753
6	468173	656387	596629	337265	397799	366270	438062	768275	742347	1003170
7	313502	513421	570111	481515	309280	346101	253178	411947	629160	597796
8	186702	265846	328099	390132	383714	244919	234769	230934	294890	476204
9	237005	171279	185131	255308	316264	306548	180151	197233	166739	188902
10	668411	188345	103218	142673	149682	193600	176245	132792	136079	113501
11	367868	457348	121160	70420	89737	104495	90555	103693	60902	58944
12	164292	167165	257435	70497	30013	54844	35831	53190	42844	26988
+gp	378386	315087	175349	187892	131347	40110	19247	26204	27591	37015
0 TOTAL	3692801	3665819	3065111	2830103	3141009	3407679	3557376	4039204	3488383	3189831
1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	265578	168920	239291	268482	284221	233068	151061	111764	295238	696327
4	206696	334495	272591	270606	336778	390282	340404	206019	185301	460210
5	161338	243423	597571	261449	363663	355294	410571	342590	273265	235602
6	365792	201664	391251	425991	305145	294013	282545	310111	308859	261555
7	650567	297518	177809	242086	333654	205229	188104	158775	202475	266378
8	392683	447924	209470	116810	193710	250910	149537	94841	78931	175545
9	253117	224738	299899	145737	74320	101645	136428	65640	42675	57905
10	108698	160673	134210	206985	105953	36390	44408	54588	21740	21174
11	50286	54540	61300	66934	82819	42684	13894	10875	20098	9087
12	23247	20287	19159	30297	29013	30314	16454	2856	2911	9669
+gp	17892	9967	13275	15429	27875	17178	14173	16470	9201	4967
0 TOTAL	2495895	2164149	2415826	2050805	2137149	1957006	1747579	1374529	1440693	2198418

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

YEAF	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	375671	54435	49297	72929	182148	385821	691201	167653	254863	214880
4	1008608	720634	104047	81578	136320	249787	727266	808024	221610	341705
5	619644	1295399	843407	114895	87866	163647	345992	627045	677639	273307
6	269803	664492	966659	695298	101599	87943	157241	286743	487049	596655
7	230760	277642	465934	682799	495154	96707	76038	123596	187748	287041
8	192584	183771	184531	252138	422555	345787	80219	54527	88269	108649
9	103040	120443	105690	87437	123791	207793	219854	37616	35894	48132
10	30662	47678	53839	40323	34676	50977	78601	81651	29113	25849
11	9500	13129	21742	20948	12590	17245	15127	36074	34848	13669
12	5524	2444	6492	4958	8822	6248	4742	6512	13192	13760
+gp	6369	7389	3953	4396	5449	9529	5674	6947	7206	7750
0 TOTAL	2852164	3387455	2805591	2057698	1610969	1621485	2401955	2236387	2037430	1931396

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

YEAF	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	170547	312860	69471	37188	73926	56177	61727	167089	216277	322598
4	383200	201913	316206	86659	107052	79493	106936	155188	279347	357586
5	401093	286676	202406	306090	160265	109213	127630	140320	155003	323630
6	238515	232208	177208	162392	359620	144077	119188	130896	130862	133728
7	452865	145879	119088	118389	123613	246304	130406	91385	83027	81286
8	193334	254800	71461	66900	79133	61698	147262	58429	37111	38530
9	55876	91184	121484	36552	42028	29340	27463	55823	24029	12370
10	26656	16521	26635	38975	18354	12436	8986	10636	21316	8004
11	14264	11898	5579	8362	16843	5870	5224	3521	6210	11412
12	6427	6843	1720	1099	1899	5283	1645	2794	1346	2965
+gp	7970	15783	3124	1256	924	979	2209	1514	2984	1863
0 TOTAL	1950748	1576565	1114381	863862	983658	750871	738675	817596	957513	1293972

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

YEAF	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	60395	43384	51662	96614	213275	317230	308269	190522	132513	85300
4	366286	84514	81779	96494	223815	308138	664240	510551	261102	150836
5	337058	378257	130846	133748	183444	274410	434098	598009	517100	315394
6	224685	251374	399529	162431	196489	193758	280167	332471	519218	542842
7	75026	104902	159840	364042	197088	186880	150890	195511	204767	396357
8	33816	25242	47139	85040	427775	169432	125623	93934	64373	108928
9	11896	15268	12462	16210	92306	369527	99373	68028	37904	32230
10	6226	8256	5034	5534	22227	71933	242024	46970	26690	16804
11	4142	1910	941	1389	3966	16313	41966	96270	17976	9216
12	4496	1169	330	593	944	3826	10659	20437	38739	5318
+gp	2226	1181	798	578	354	682	2733	3325	5988	23235
0 TOTAL	1126251	915458	890358	962672	1561682	1912130	2360042	2156027	1826370	1686462

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

YEAF	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	144538	183054	111144	118632	151536	110822	146964	80624	128070	104701
4	116832	222698	246202	183662	241974	247915	172805	270768	153637	226071
5	192220	157895	281927	378996	336112	401533	395543	265904	403620	217251
6	330227	159770	134198	223872	380357	369153	416297	385122	296792	380220
7	422472	205147	93764	80163	167914	274584	261837	309386	285376	218375
8	227897	201605	117182	46031	52337	100721	148654	146244	163542	162666
9	60835	76543	82205	42466	20851	25236	47454	74942	64982	93617
10	19356	15212	26780	19272	16937	10257	12237	27191	35243	28651
11	5905	3391	3775	4917	7428	4784	6427	6911	14138	13815
12	3766	1301	793	1408	1724	2948	2361	2838	4041	5694
+gp	7611	2481	1605	580	798	994	1779	1582	2362	11368
0 TOTAL	1531660	1229095	1099574	1099999	1377969	1548947	1612359	1571512	1551802	1462430
1										

	Table 3.24 R	Stock biomass at age (start of year), R			Tonnes					
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	143439	178561	102530	103605	128463	93369	122935	71764	111611	89235
	4	116419	220340	237554	167585	209300	208623	144512	225942	136572	194507
	5	192015	157140	277741	362622	302490	341215	332091	223003	336249	195624
	6	330056	159452	133122	218145	355688	320176	354281	327129	250001	330386
	7	422340	204929	93351	78853	160091	244783	229523	268627	245195	195682
	8	227855	201460	116914	45580	50553	91581	134251	131844	144440	149207
	9	60820	76495	82039	42190	20287	23301	43570	68996	59560	86891
	10	19351	15197	26727	19121	16582	9590	11444	25182	32605	27298
	11	5903	3387	3763	4878	7245	4470	6017	6637	13327	13078
	12	3765	1300	790	1397	1683	2782	2233	2712	4052	5695
	+gp	7610	2478	1599	575	779	933	1674	1524	2327	10383
0	TOTALBIO	1529572	1220738	1076131	1044552	1253161	1340822	1382531	1353359	1335940	1297985

Table 3.25. Northeast Arctic cod. Spawning stock biomass at age

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

	YEAF	1946
	AGE	
	3	0
	4	0
	5	4463
	6	9999
	7	13271
	8	33550
	9	175319
	10	226148
	11	146673
	12	242756
	+gp	260598
0	TOTSF	1112776

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

	YEAF	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	4405	5962	3120	3747	4216	5338	7673	8630	10070	4148
	6	14045	19692	17899	10118	11934	10988	13142	23048	22270	30095
	7	18810	35939	51310	43336	30928	27688	17722	32956	44041	35868
	8	24271	34560	55777	89730	92091	53882	44606	36949	38336	57144
	9	37921	42820	53688	89358	126506	125685	72060	72976	43352	26446
	10	280733	88522	55738	74190	86815	121968	112796	90299	72122	46535
	11	275901	333864	95716	55632	64611	85686	76066	90213	50549	39492
	12	149506	152120	226543	66972	25511	50457	33681	49467	39416	24559
	+gp	359467	305634	170088	182256	126093	38907	18670	25156	26763	35534
0	TOTSF	1165059	1019114	729879	615339	568705	520599	396417	429694	346919	299823
	1										

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Traditional vpa using file input for terminal F

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

	YEAF	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	2706	0	0	3404	0	0	0
	5	1613	2434	5976	7843	3637	3553	4106	0	0	2356
	6	10974	6050	15650	25559	18309	14701	8476	9303	3089	5231
	7	39034	17851	21337	24209	40038	30784	13167	20641	12149	15983
	8	35341	44792	71220	22194	60050	85309	41870	35091	15786	38620
	9	30374	22474	146950	65582	48308	62004	57300	43323	23471	20267
	10	23914	48202	89921	142819	96417	29476	35970	48583	15870	15669
	11	30172	27270	51492	51539	81163	39269	13616	10332	19897	8542
	12	19063	16635	16668	25753	28433	29404	16125	2828	2853	9089
	+gp	17356	9668	13275	15274	27875	17178	14173	16470	9201	4967
0	TOTSF	207840	195377	432489	383479	404228	311678	208207	186570	102315	120722

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

	YEAF	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	0	0	0	0	0	3858	0	0	0	0
	4	0	0	0	816	0	4996	0	0	0	0
	5	0	38862	0	0	879	3273	0	0	6776	0
	6	8094	33225	19333	6953	5080	879	3145	2867	9741	29833
	7	16153	24988	18637	47796	54467	9671	12166	3708	16897	34445
	8	26962	34917	22144	57992	126766	117567	42516	11451	18536	31508
	9	39155	46973	35935	50714	73036	132988	178082	18808	20100	21659
	10	19624	27653	29611	32662	27394	41292	72313	78385	22708	21713
	11	8455	10766	16089	18644	10827	16210	14370	36074	27530	11345
	12	4972	2444	6167	4512	7763	6248	4647	6251	12532	13760
	+gp	6369	7389	3953	4396	5449	9529	5674	6947	7206	6975
0	TOTSF	129784	227215	151870	224482	311662	346511	332913	164491	142028	171238

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

	YEAF	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0	0	0	0	0	0	617	0	0	0
	4	0	0	0	0	0	3975	8555	7759	2793	17879
	5	8022	0	0	0	3205	10921	12763	25258	13950	25890
	6	19081	4644	5316	3248	25173	48986	35756	40578	47110	25408
	7	117745	18964	15481	15391	24723	160097	95196	51176	45665	43081
	8	104400	112112	27870	23415	42732	50592	129590	52586	31544	27356
	9	42466	64741	93543	23759	33622	26992	26639	55265	23068	7669
	10	23191	12721	23705	31960	17804	12436	8986	10636	19184	7204
	11	13266	9637	4630	8362	16843	5870	5224	3521	6210	11412
	12	6041	6090	1342	989	1899	5283	1645	2794	1346	2965
	+gp	7173	12626	2812	1130	924	979	2209	1514	2984	1863
0	TOTSF	341385	241536	174699	108253	166926	326133	327181	251087	193856	170729

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

	YEAF	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0	0	413	773	213	317	0	572	0	0
	4	3663	1690	245	1254	7162	4314	18599	3574	783	0
	5	23594	18913	3795	6821	13758	39789	37766	71163	31543	5992
	6	40443	82953	91093	34111	59929	81185	103102	111378	193149	140053
	7	16506	55598	87433	190030	139538	149504	106226	115156	127774	250101
	8	15555	15650	33233	60804	368314	159775	116955	80971	50275	89321
	9	5948	15268	11403	14670	88337	359919	96591	65511	36388	31424
	10	4670	8256	5034	5395	22227	71933	240572	46500	26130	16804
	11	4142	1910	941	1389	3966	16313	41966	96270	17976	9216
	12	4496	1169	330	593	944	3826	10659	20437	38739	5318
	+gp	2226	1181	798	578	354	682	2733	3325	5988	23235
0	TOTSF	121243	202589	234716	316417	704743	887558	775169	614856	528745	571465

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

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
YEAR											
	AGE										
	3	0	183	222	0	455	222	147	81	0	0
	4	0	668	492	184	726	3223	173	2708	615	226
	5	2307	4105	3947	26909	21847	33729	34808	24197	27446	13035
	6	46232	24285	25095	55297	136548	143231	135713	170224	117826	140301
	7	256441	96829	51008	51545	104778	187541	175955	224615	204329	141289
	8	189154	164106	99253	38206	42864	84706	132005	127525	145879	145911
	9	57550	73251	79327	41532	19850	23999	45414	73143	62838	90340
	10	19356	14908	26780	19272	16937	10257	12237	26566	34925	28651
	11	5905	3391	3775	4917	7428	4784	6427	6911	14138	13815
	12	3766	1301	793	1408	1724	2948	2361	2838	4041	5694
	+gp	7611	2481	1605	580	798	994	1779	1582	2362	11368
0	TOTSPBIO	588322	385508	292298	239848	353956	495634	547018	660389	614399	590631
	1										

Table 3.25 R Spawning stock biomass at age (spawning time), R

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
YEAR											
	AGE										
	3	0	179	205	0	385	187	123	72	0	0
	4	0	661	475	168	628	2712	145	2259	546	195
	5	2304	4086	3888	25746	19662	28662	29224	20293	22865	11737
	6	46208	24237	24894	53882	127692	124228	115496	144591	99250	121912
	7	256360	96726	50783	50703	99897	167187	154240	195023	175560	126606
	8	189119	163988	99026	37832	41403	77020	119215	114968	128841	133839
	9	57535	73206	79168	41262	19313	22159	41697	67340	57594	83849
	10	19351	14893	26727	19121	16582	9590	11444	24603	32312	27298
	11	5903	3387	3763	4878	7245	4470	6017	6637	13327	13078
	12	3765	1300	790	1397	1683	2782	2233	2712	4052	5695
	+gp	7610	2478	1599	575	779	933	1674	1524	2327	10383
0	TOTSPBIO	588156	385140	291319	235563	335268	439929	481506	580022	536675	534592
	1										

Table 3.26. Northeast Arctic cod. Summary Table, N .

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 15:43

Table 16 Summary (without SOP correction)

Traditional vpa using file input for terminal F

	RE Age 3	TOTALE	TOTSPE	LANDIN	YIELD/S	FBAR 5-10
1946	728139	4168882	1112776	706000	0.6344	0.1857
1947	425311	3692801	1165059	882017	0.7571	0.3047
1948	442592	3665819	1019114	774295	0.7598	0.3398
1949	468348	3065111	729879	800122	1.0962	0.3619
1950	704908	2830103	615339	731982	1.1896	0.3566
1951	1083753	3141009	568705	827180	1.4545	0.3966
1952	1193111	3407679	520599	876795	1.6842	0.5348
1953	1590377	3557376	396417	695546	1.7546	0.3572
1954	641584	4039204	429694	826021	1.9223	0.3879
1955	272778	3488383	346919	1147841	3.3087	0.5437
1956	439602	3189831	299823	1343068	4.4795	0.6401
1957	804781	2495895	207840	792557	3.8133	0.5089
1958	496824	2164149	195377	769313	3.9376	0.5169
1959	683690	2415826	432489	744607	1.7217	0.5596
1960	789653	2050805	383479	622042	1.6221	0.4789
1961	916842	2137149	404228	783221	1.9376	0.6348
1962	728338	1957006	311678	909266	2.9173	0.7576
1963	472064	1747579	208207	776337	3.7287	0.9866
1964	338678	1374529	186570	437695	2.346	0.6789
1965	776941	1440693	102315	444930	4.3486	0.5533
1966	1582560	2198418	120722	483711	4.0068	0.5302
1967	1295416	2852164	129784	572605	4.412	0.5439
1968	164955	3387455	227215	1074084	4.7272	0.5704
1969	112039	2805591	151870	1197226	7.8832	0.8292
1970	197105	2057698	224482	933246	4.1573	0.7493
1971	404774	1610969	311662	689048	2.2109	0.5956
1972	1015319	1621485	346511	565254	1.6313	0.6928
1973	1818949	2401955	332913	792685	2.3811	0.602
1974	523916	2236387	164491	1102433	6.7021	0.5633
1975	621616	2037430	142028	829377	5.8395	0.6595
1976	613942	1931396	171238	867463	5.0658	0.6457
1977	348054	1950748	341385	905301	2.6518	0.8379
1978	638490	1576565	241536	698715	2.8928	0.9406
1979	198490	1114381	174699	440538	2.5217	0.7264
1980	137735	863862	108253	380434	3.5143	0.7241
1981	150868	983658	166926	399038	2.3905	0.8632
1982	151830	750871	326133	363730	1.1153	0.7583
1983	166831	738675	327181	289992	0.8863	0.756
1984	397831	817596	251087	277651	1.1058	0.9161
1985	523674	957513	193856	307920	1.5884	0.7038
1986	1037294	1293972	170729	430113	2.5193	0.8649
1987	286233	1126251	121243	523071	4.3142	0.951
1988	204644	915458	202589	434939	2.1469	0.9743
1989	172781	890358	234716	332481	1.4165	0.6602
1990	242749	962672	316417	212000	0.67	0.271
1991	411727	1561682	704743	319158	0.4529	0.321
1992	720977	1912130	887558	513234	0.5783	0.455
1993	896132	2360042	775169	581611	0.7503	0.5528
1994	810730	2156027	614856	771086	1.2541	0.8678
1995	659269	1826370	528745	739999	1.3995	0.7881
1996	437438	1686462	571465	732228	1.2813	0.6989
1997	715534	1531660	588322	762403	1.2959	1.0347
1998	843569	1229095	385508	592624	1.5373	0.9192
1999	547506	1099574	292298	484910	1.659	0.9937
2000	611503	1099999	239848	414868	1.7297	0.8585
2001	531705	1377969	353956	426471	1.2049	0.7242
2002	441520	1548947	495634	535045	1.0795	0.6771
2003	638975	1612359	547018	551990	1.0091	0.5357
2004	322496	1571512	660389	606445	0.9183	0.6899
2005	554414	1551802	614399	641276	1.0437	0.7301
2006	408987	1462430	590631	596197	1.0094	0.6575
Arith. Mean	599326	1995105	393225	660056	2.3339	0.6478
0 Units 1	(Thousar	(Tonnes	(Tonnes	(Tonnes)		

Table 3.26. Northeast Arctic cod. Summary Table, R .

Run title : Arctic Cod (run: SVPASA15/V15)

At 23/04/2007 17:06

Table 16 Summary (without SOP correction)

Traditional vpa using file input for terminal F

	RE(Age 3	TOTALE	TOTSPE	LANDIN	YIELD/S:	FBAR 5-10
1946	728139	4168882	1112776	706000	0.6344	0.1857
1947	425311	3692801	1165059	882017	0.7571	0.3047
1948	442592	3665819	1019114	774295	0.7598	0.3398
1949	468348	3065111	729879	800122	1.0962	0.3619
1950	704908	2830103	615339	731982	1.1896	0.3566
1951	1083753	3141009	568705	827180	1.4545	0.3966
1952	1193111	3407679	520599	876795	1.6842	0.5348
1953	1590377	3557376	396417	695546	1.7546	0.3572
1954	641584	4039204	429694	826021	1.9223	0.3879
1955	272778	3488383	346919	1147841	3.3087	0.5437
1956	439602	3189831	299823	1343068	4.4795	0.6401
1957	804781	2495895	207840	792557	3.8133	0.5089
1958	496824	2164149	195377	769313	3.9376	0.5169
1959	683690	2415826	432489	744607	1.7217	0.5596
1960	789653	2050805	383479	622042	1.6221	0.4789
1961	916842	2137149	404228	783221	1.9376	0.6348
1962	728338	1957006	311678	909266	2.9173	0.7576
1963	472064	1747579	208207	776337	3.7287	0.9866
1964	338678	1374529	186570	437695	2.346	0.6789
1965	776941	1440693	102315	444930	4.3486	0.5533
1966	1582560	2198418	120722	483711	4.0068	0.5302
1967	1295416	2852164	129784	572605	4.412	0.5439
1968	164955	3387455	227215	1074084	4.7272	0.5704
1969	112039	2805591	151870	1197226	7.8832	0.8292
1970	197105	2057698	224482	933246	4.1573	0.7493
1971	404774	1610969	311662	689048	2.2109	0.5956
1972	1015319	1621485	346511	565254	1.6313	0.6928
1973	1818949	2401955	332913	792685	2.3811	0.602
1974	523916	2236387	164491	1102433	6.7021	0.5633
1975	621616	2037430	142028	829377	5.8395	0.6595
1976	613942	1931396	171238	867463	5.0658	0.6457
1977	348054	1950748	341385	905301	2.6518	0.8379
1978	638490	1576565	241536	698715	2.8928	0.9406
1979	198490	1114381	174699	440538	2.5217	0.7264
1980	137735	863862	108253	380434	3.5143	0.7241
1981	150868	983658	166926	399038	2.3905	0.8632
1982	151830	750871	326133	363730	1.1153	0.7583
1983	166831	738675	327181	289992	0.8863	0.756
1984	397831	817596	251087	277651	1.1058	0.9161
1985	523674	957513	193856	307920	1.5884	0.7038
1986	1037293	1293972	170729	430113	2.5193	0.8649
1987	286232	1126251	121243	523071	4.3142	0.951
1988	204643	915457	202589	434939	2.1469	0.9743
1989	172780	890357	234716	332481	1.4165	0.6602
1990	242747	962669	316417	212000	0.67	0.271
1991	411721	1561674	704742	319158	0.4529	0.321
1992	720954	1912109	887554	513234	0.5783	0.455
1993	896026	2359969	775163	581611	0.7503	0.5528
1994	810520	2155880	614844	771086	1.2541	0.8678
1995	659082	1826152	528718	739999	1.3996	0.7881
1996	437308	1686147	571397	732228	1.2815	0.699
1997	710092	1529572	588156	762403	1.2963	1.0353
1998	822860	1220738	385140	592624	1.5387	0.9211
1999	505075	1076131	291319	484910	1.6645	1.0005
2000	534046	1044552	235563	414868	1.7612	0.8771
2001	450749	1253161	335268	426471	1.272	0.768
2002	371986	1340822	439929	466761	1.061	0.6689
2003	534499	1382531	481506	464738	0.9652	0.5167
2004	287054	1353359	580022	519445	0.8956	0.6778
2005	483163	1335940	536675	516276	0.962	0.683
2006	348573	1297985	534592	497197	0.93	0.6102
Arith. Mean	590002	1974591	387324	652408	2.3316	0.6468
0 Units	(Thousar	(Tonnes	(Tonnes	(Tonnes)		

1

Table 3.27. Summary, no cannibalism included. NOR-IUU-run

Run title : Arctic Cod (run: SVPASA15/V15)

At 26/04/2007 15:02

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	0.6344	0.1857	0.1084
1947	425311	3692801	1165059	882017	0.7571	0.3047	0.2016
1948	442592	3665819	1019114	774295	0.7598	0.3398	0.2322
1949	468348	3065111	729879	800122	1.0962	0.3619	0.2865
1950	704908	2830103	615339	731982	1.1896	0.3566	0.2389
1951	1083753	3141009	568705	827180	1.4545	0.3966	0.3041
1952	1193111	3407679	520599	876795	1.6842	0.5348	0.4071
1953	1590377	3557376	396417	695546	1.7546	0.3572	0.2692
1954	641584	4039204	429694	826021	1.9223	0.3879	0.2786
1955	272778	3488383	346919	1147841	3.3087	0.5437	0.4003
1956	439602	3189831	299823	1343068	4.4795	0.6401	0.5154
1957	804781	2495895	207840	792557	3.8133	0.5089	0.3973
1958	496824	2164149	195377	769313	3.9376	0.5169	0.4337
1959	683690	2415826	432489	744607	1.7217	0.5596	0.4628
1960	789653	2050805	383479	622042	1.6221	0.4789	0.3914
1961	916842	2137149	404228	783221	1.9376	0.6348	0.5008
1962	728338	1957006	311678	909266	2.9173	0.7576	0.61
1963	472064	1747579	208207	776337	3.7287	0.9866	0.7683
1964	338678	1374529	186570	437695	2.346	0.6789	0.4607
1965	776941	1440693	102315	444930	4.3486	0.5533	0.377
1966	1582560	2198418	120722	483711	4.0068	0.5302	0.3497
1967	1295416	2852164	129784	572605	4.412	0.5439	0.3306
1968	164955	3387455	227215	1074084	4.7272	0.5704	0.4029
1969	112039	2805591	151870	1197226	7.8832	0.8292	0.5899
1970	197105	2057698	224482	933246	4.1573	0.7493	0.5159
1971	404774	1610969	311662	689048	2.2109	0.5956	0.3861
1972	1015319	1621485	346511	565254	1.6313	0.6928	0.3702
1973	1818949	2401955	332913	792685	2.3811	0.602	0.4207
1974	523916	2236387	164491	1102433	6.7021	0.5633	0.4945
1975	621616	2037430	142028	829377	5.8395	0.6595	0.5684
1976	613942	1931396	171238	867463	5.0658	0.6457	0.5904
1977	348054	1950748	341385	905301	2.6518	0.8379	0.7191
1978	638490	1576565	241536	698715	2.8928	0.9406	0.7062
1979	198490	1114381	174699	440538	2.5217	0.7264	0.5095
1980	137735	863862	108253	380434	3.5143	0.7241	0.4994
1981	150868	983658	166926	399038	2.3905	0.8632	0.5546
1982	151830	750871	326133	363730	1.1153	0.7583	0.5705
1983	166831	738675	327181	289992	0.8863	0.756	0.5701
1984	397595	817497	251087	277651	1.1058	0.9161	0.6815
1985	523470	957429	193856	307920	1.5884	0.7038	0.6207
1986	930300	1260697	170729	430113	2.5193	0.8649	0.6914
1987	270553	1122943	121243	523071	4.3142	0.951	0.7653
1988	202920	915093	202589	434939	2.1469	0.9743	0.6232
1989	172781	890358	234716	332481	1.4165	0.6602	0.4796
1990	242749	962672	316417	212000	0.67	0.271	0.2115
1991	408166	1559837	704742	319158	0.4529	0.321	0.2699
1992	700324	1901851	887532	513234	0.5783	0.455	0.3877
1993	759224	2295695	774574	581611	0.7509	0.553	0.4156
1994	516519	2022956	612327	771086	1.2593	0.8687	0.646
1995	306785	1689575	527966	739999	1.4016	0.7886	0.5735
1996	257765	1597100	570420	732228	1.2837	0.7013	0.5288
1997	491500	1473247	588230	762403	1.2961	1.0357	0.718
1998	599490	1158705	385201	592624	1.5385	0.9203	0.6784
1999	469164	1077659	292253	484910	1.6592	0.9937	0.6701
2000	554669	1074140	239351	414868	1.7333	0.8593	0.5777
2001	497712	1356746	353006	426471	1.2081	0.7246	0.477
2002	392855	1531391	495438	535045	1.0799	0.6772	0.5292
2003	589210	1599644	547001	551990	1.0091	0.5358	0.4424
2004	298688	1552519	660062	606445	0.9188	0.6902	0.4981
2005	463550	1520871	613498	641276	1.0453	0.7309	0.5239
2006	405583	1460738	590627	596197	1.0094	0.6575	0.5279
Arith. Mean	567095	1982769	393089	660056	2.3342	0.648	0.4808
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

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Table 3.28 a and c N

MFDP version 1a
Run: run a N
Time and date: 23:41 25.04.2007
Fbar age range: 5-10

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	565000	0.2856	0	0	0	0.262	0.0158	0.754
4	320180	0.2072	0.004	0	0	0.699	0.1222	1.142
5	254156	0.2006	0.072	0	0	1.341	0.3197	1.657
6	112539	0.2	0.343	0	0	2.121	0.5899	2.383
7	77899	0.2	0.723	0	0	3.167	0.7499	3.282
8	26504	0.2	0.876	0	0	4.64	0.7981	4.664
9	14620	0.2	0.976	0	0	6.495	0.8428	6.467
10	6011	0.2	1	0	0	9.123	0.8547	7.861
11	1393	0.2	1	0	0	11.78	0.6947	9.343
12	620	0.2	1	0	0	17.255	0.67	10.812
13	444	0.2	1	0	0	14.311	0.67	12.133

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	535000	0.2856	0	0	0	0.266	0.0158	0.754
4	.	0.2072	0.003	0	0	0.658	0.1222	1.153
5	.	0.2006	0.067	0	0	1.328	0.3197	1.674
6	.	0.2	0.37	0	0	2.226	0.5899	2.402
7	.	0.2	0.696	0	0	3.238	0.7499	3.392
8	.	0.2	0.888	0	0	4.481	0.7981	4.571
9	.	0.2	0.969	0	0	6.497	0.8428	6.122
10	.	0.2	0.997	0	0	8.946	0.8547	7.925
11	.	0.2	1	0	0	12.55	0.6947	9.319
12	.	0.2	1	0	0	14.358	0.67	10.801
13	.	0.2	1	0	0	19.833	0.67	12.27

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	461000	0.2856	0	0	0	0.262	0.0158	0.754
4	.	0.2072	0.003	0	0	0.662	0.1222	1.153
5	.	0.2006	0.067	0	0	1.287	0.3197	1.686
6	.	0.2	0.37	0	0	2.214	0.5899	2.419
7	.	0.2	0.696	0	0	3.343	0.7499	3.41
8	.	0.2	0.888	0	0	4.552	0.7981	4.681
9	.	0.2	0.969	0	0	6.338	0.8428	6.029
10	.	0.2	0.997	0	0	8.948	0.8547	7.58
11	.	0.2	1	0	0	12.373	0.6947	9.383
12	.	0.2	1	0	0	15.128	0.67	10.777
13	.	0.2	1	0	0	16.936	0.67	12.259

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	599000	0.2856	0	0	0	0.262	0.0158	0.754
4	.	0.2072	0.003	0	0	0.662	0.1222	1.153
5	.	0.2006	0.067	0	0	1.287	0.3197	1.686
6	.	0.2	0.37	0	0	2.214	0.5899	2.419
7	.	0.2	0.696	0	0	3.343	0.7499	3.41
8	.	0.2	0.888	0	0	4.552	0.7981	4.681
9	.	0.2	0.969	0	0	6.338	0.8428	6.029
10	.	0.2	0.997	0	0	8.948	0.8547	7.58
11	.	0.2	1	0	0	12.373	0.6947	9.383
12	.	0.2	1	0	0	15.128	0.67	10.777
13	.	0.2	1	0	0	16.936	0.67	12.259

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	599000	0.2856	0	0	0	0.262	0.0158	0.754
4	.	0.2072	0.003	0	0	0.662	0.1222	1.153
5	.	0.2006	0.067	0	0	1.287	0.3197	1.686
6	.	0.2	0.37	0	0	2.214	0.5899	2.419
7	.	0.2	0.696	0	0	3.343	0.7499	3.41
8	.	0.2	0.888	0	0	4.552	0.7981	4.681
9	.	0.2	0.969	0	0	6.338	0.8428	6.029
10	.	0.2	0.997	0	0	8.948	0.8547	7.58
11	.	0.2	1	0	0	12.373	0.6947	9.383
12	.	0.2	1	0	0	15.128	0.67	10.777
13	.	0.2	1	0	0	16.936	0.67	12.259

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	599000	0.2856	0	0	0	0.262	0.0158	0.754
4	.	0.2072	0.003	0	0	0.662	0.1222	1.153
5	.	0.2006	0.067	0	0	1.287	0.3197	1.686
6	.	0.2	0.37	0	0	2.214	0.5899	2.419
7	.	0.2	0.696	0	0	3.343	0.7499	3.41
8	.	0.2	0.888	0	0	4.552	0.7981	4.681
9	.	0.2	0.969	0	0	6.338	0.8428	6.029
10	.	0.2	0.997	0	0	8.948	0.8547	7.58
11	.	0.2	1	0	0	12.373	0.6947	9.383
12	.	0.2	1	0	0	15.128	0.67	10.777
13	.	0.2	1	0	0	16.936	0.67	12.259

Input units are thousands and kg - output in tonnes

Table 3.28 b and d N

MFDP version 1a
Run: run b N
Time and date: 02:09 27.04.2007
Fbar age range: 5-10

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	565000	0.2856	0	0	0	0.262	0.015	0.754
4	320180	0.2072	0.004	0	0	0.699	0.116	1.142
5	254156	0.2006	0.072	0	0	1.341	0.3036	1.657
6	112539	0.2	0.343	0	0	2.121	0.5601	2.383
7	77899	0.2	0.723	0	0	3.167	0.712	3.282
8	26504	0.2	0.876	0	0	4.64	0.7577	4.664
9	14620	0.2	0.976	0	0	6.495	0.8002	6.467
10	6011	0.2	1	0	0	9.123	0.8115	7.861
11	1393	0.2	1	0	0	11.78	0.6596	9.343
12	620	0.2	1	0	0	17.255	0.6361	10.812
13	444	0.2	1	0	0	14.311	0.6361	12.133

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	535000	0.2856	0	0	0	0.266	0.015	0.754
4	.	0.2072	0.003	0	0	0.658	0.116	1.153
5	.	0.2006	0.067	0	0	1.328	0.3036	1.674
6	.	0.2	0.37	0	0	2.226	0.5601	2.402
7	.	0.2	0.696	0	0	3.238	0.712	3.392
8	.	0.2	0.888	0	0	4.481	0.7577	4.571
9	.	0.2	0.969	0	0	6.497	0.8002	6.122
10	.	0.2	0.997	0	0	8.946	0.8115	7.925
11	.	0.2	1	0	0	12.55	0.6596	9.319
12	.	0.2	1	0	0	14.358	0.6361	10.801
13	.	0.2	1	0	0	19.833	0.6361	12.27

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	461000	0.2856	0	0	0	0.262	0.015	0.754
4	.	0.2072	0.003	0	0	0.662	0.116	1.153
5	.	0.2006	0.067	0	0	1.287	0.3036	1.686
6	.	0.2	0.37	0	0	2.214	0.5601	2.419
7	.	0.2	0.696	0	0	3.343	0.712	3.41
8	.	0.2	0.888	0	0	4.552	0.7577	4.681
9	.	0.2	0.969	0	0	6.338	0.8002	6.029
10	.	0.2	0.997	0	0	8.948	0.8115	7.58
11	.	0.2	1	0	0	12.373	0.6596	9.383
12	.	0.2	1	0	0	15.128	0.6361	10.777
13	.	0.2	1	0	0	16.936	0.6361	12.259

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	599000	0.2856	0	0	0	0.262	0.015	0.754
4	.	0.2072	0.003	0	0	0.662	0.116	1.153
5	.	0.2006	0.067	0	0	1.287	0.3036	1.686
6	.	0.2	0.37	0	0	2.214	0.5601	2.419
7	.	0.2	0.696	0	0	3.343	0.712	3.41
8	.	0.2	0.888	0	0	4.552	0.7577	4.681
9	.	0.2	0.969	0	0	6.338	0.8002	6.029
10	.	0.2	0.997	0	0	8.948	0.8115	7.58
11	.	0.2	1	0	0	12.373	0.6596	9.383
12	.	0.2	1	0	0	15.128	0.6361	10.777
13	.	0.2	1	0	0	16.936	0.6361	12.259

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	599000	0.2856	0	0	0	0.262	0.015	0.754
4	.	0.2072	0.003	0	0	0.662	0.116	1.153
5	.	0.2006	0.067	0	0	1.287	0.3036	1.686
6	.	0.2	0.37	0	0	2.214	0.5601	2.419
7	.	0.2	0.696	0	0	3.343	0.712	3.41
8	.	0.2	0.888	0	0	4.552	0.7577	4.681
9	.	0.2	0.969	0	0	6.338	0.8002	6.029
10	.	0.2	0.997	0	0	8.948	0.8115	7.58
11	.	0.2	1	0	0	12.373	0.6596	9.383
12	.	0.2	1	0	0	15.128	0.6361	10.777
13	.	0.2	1	0	0	16.936	0.6361	12.259

Table 3.28 a and c R

MFDP version 1a
Run: run a R
Time and date: 19:40 25.04.2007
Fbar age range: 5-10

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	501000	0.2915	0	0	0	0.262	0.0145	0.754
4	272939	0.2179	0.004	0	0	0.699	0.1123	1.142
5	221798	0.2095	0.072	0	0	1.341	0.2927	1.657
6	104694	0.2018	0.343	0	0	2.121	0.5446	2.383
7	72054	0.2	0.723	0	0	3.167	0.6951	3.282
8	25774	0.2	0.876	0	0	4.64	0.7586	4.664
9	14129	0.2	0.976	0	0	6.495	0.8164	6.467
10	5779	0.2	1	0	0	9.123	0.8345	7.861
11	1353	0.2	1	0	0	11.78	0.6472	9.343
12	610	0.2	1	0	0	17.255	0.6269	10.812
13	438	0.2	1	0	0	14.311	0.6269	12.133

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	476000	0.2915	0	0	0	0.266	0.0145	0.754
4	.	0.2179	0.003	0	0	0.658	0.1123	1.153
5	.	0.2095	0.067	0	0	1.328	0.2927	1.674
6	.	0.2018	0.37	0	0	2.226	0.5446	2.402
7	.	0.2	0.696	0	0	3.238	0.6951	3.392
8	.	0.2	0.888	0	0	4.481	0.7586	4.571
9	.	0.2	0.969	0	0	6.497	0.8164	6.122
10	.	0.2	0.997	0	0	8.946	0.8345	7.925
11	.	0.2	1	0	0	12.55	0.6472	9.319
12	.	0.2	1	0	0	14.358	0.6269	10.801
13	.	0.2	1	0	0	19.833	0.6269	12.27

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	406000	0.2915	0	0	0	0.262	0.0145	0.754
4	.	0.2179	0.003	0	0	0.662	0.1123	1.153
5	.	0.2095	0.067	0	0	1.287	0.2927	1.686
6	.	0.2018	0.37	0	0	2.214	0.5446	2.419
7	.	0.2	0.696	0	0	3.343	0.6951	3.41
8	.	0.2	0.888	0	0	4.552	0.7586	4.681
9	.	0.2	0.969	0	0	6.338	0.8164	6.029
10	.	0.2	0.997	0	0	8.948	0.8345	7.58
11	.	0.2	1	0	0	12.373	0.6472	9.383
12	.	0.2	1	0	0	15.128	0.6269	10.777
13	.	0.2	1	0	0	16.936	0.6269	12.259

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	590000	0.2915	0	0	0	0.262	0.0145	0.754
4	.	0.2179	0.003	0	0	0.662	0.1123	1.153
5	.	0.2095	0.067	0	0	1.287	0.2927	1.686
6	.	0.2018	0.37	0	0	2.214	0.5446	2.419
7	.	0.2	0.696	0	0	3.343	0.6951	3.41
8	.	0.2	0.888	0	0	4.552	0.7586	4.681
9	.	0.2	0.969	0	0	6.338	0.8164	6.029
10	.	0.2	0.997	0	0	8.948	0.8345	7.58
11	.	0.2	1	0	0	12.373	0.6472	9.383
12	.	0.2	1	0	0	15.128	0.6269	10.777
13	.	0.2	1	0	0	16.936	0.6269	12.259

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	590000	0.2915	0	0	0	0.262	0.0145	0.754
4	.	0.2179	0.003	0	0	0.662	0.1123	1.153
5	.	0.2095	0.067	0	0	1.287	0.2927	1.686
6	.	0.2018	0.37	0	0	2.214	0.5446	2.419
7	.	0.2	0.696	0	0	3.343	0.6951	3.41
8	.	0.2	0.888	0	0	4.552	0.7586	4.681
9	.	0.2	0.969	0	0	6.338	0.8164	6.029
10	.	0.2	0.997	0	0	8.948	0.8345	7.58
11	.	0.2	1	0	0	12.373	0.6472	9.383
12	.	0.2	1	0	0	15.128	0.6269	10.777
13	.	0.2	1	0	0	16.936	0.6269	12.259

2012

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	590000	0.2915	0	0	0	0.262	0.0145	0.754
4	.	0.2179	0.003	0	0	0.662	0.1123	1.153
5	.	0.2095	0.067	0	0	1.287	0.2927	1.686
6	.	0.2018	0.37	0	0	2.214	0.5446	2.419
7	.	0.2	0.696	0	0	3.343	0.6951	3.41
8	.	0.2	0.888	0	0	4.552	0.7586	4.681
9	.	0.2	0.969	0	0	6.338	0.8164	6.029
10	.	0.2	0.997	0	0	8.948	0.8345	7.58
11	.	0.2	1	0	0	12.373	0.6472	9.383
12	.	0.2	1	0	0	15.128	0.6269	10.777
13	.	0.2	1	0	0	16.936	0.6269	12.259

Input units are thousands and kg - output in tonnes

Table 3.28 b and d R

MFDP version 1a
Run: run b R
Time and date: 02:34 27.04.2007
Fbar age range: 5-10

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	501000	0.2915	0	0	0	0.262	0.0135	0.754
4	272939	0.2179	0.004	0	0	0.699	0.1043	1.142
5	221798	0.2095	0.072	0	0	1.341	0.2719	1.657
6	104694	0.2018	0.343	0	0	2.121	0.5058	2.383
7	72054	0.2	0.723	0	0	3.167	0.6456	3.282
8	25774	0.2	0.876	0	0	4.64	0.7046	4.664
9	14129	0.2	0.976	0	0	6.495	0.7583	6.467
10	5779	0.2	1	0	0	9.123	0.7751	7.861
11	1353	0.2	1	0	0	11.78	0.6011	9.343
12	610	0.2	1	0	0	17.255	0.5823	10.812
13	438	0.2	1	0	0	14.311	0.5823	12.133

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	476000	0.2915	0	0	0	0.266	0.0135	0.754
4	.	0.2179	0.003	0	0	0.658	0.1043	1.153
5	.	0.2095	0.067	0	0	1.328	0.2719	1.674
6	.	0.2018	0.37	0	0	2.226	0.5058	2.402
7	.	0.2	0.696	0	0	3.238	0.6456	3.392
8	.	0.2	0.888	0	0	4.481	0.7046	4.571
9	.	0.2	0.969	0	0	6.497	0.7583	6.122
10	.	0.2	0.997	0	0	8.946	0.7751	7.925
11	.	0.2	1	0	0	12.55	0.6011	9.319
12	.	0.2	1	0	0	14.358	0.5823	10.801
13	.	0.2	1	0	0	19.833	0.5823	12.27

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	406000	0.2915	0	0	0	0.262	0.0135	0.754
4	.	0.2179	0.003	0	0	0.662	0.1043	1.153
5	.	0.2095	0.067	0	0	1.287	0.2719	1.686
6	.	0.2018	0.37	0	0	2.214	0.5058	2.419
7	.	0.2	0.696	0	0	3.343	0.6456	3.41
8	.	0.2	0.888	0	0	4.552	0.7046	4.681
9	.	0.2	0.969	0	0	6.338	0.7583	6.029
10	.	0.2	0.997	0	0	8.948	0.7751	7.58
11	.	0.2	1	0	0	12.373	0.6011	9.383
12	.	0.2	1	0	0	15.128	0.5823	10.777
13	.	0.2	1	0	0	16.936	0.5823	12.259

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	590000	0.2915	0	0	0	0.262	0.0135	0.754
4	.	0.2179	0.003	0	0	0.662	0.1043	1.153
5	.	0.2095	0.067	0	0	1.287	0.2719	1.686
6	.	0.2018	0.37	0	0	2.214	0.5058	2.419
7	.	0.2	0.696	0	0	3.343	0.6456	3.41
8	.	0.2	0.888	0	0	4.552	0.7046	4.681
9	.	0.2	0.969	0	0	6.338	0.7583	6.029
10	.	0.2	0.997	0	0	8.948	0.7751	7.58
11	.	0.2	1	0	0	12.373	0.6011	9.383
12	.	0.2	1	0	0	15.128	0.5823	10.777
13	.	0.2	1	0	0	16.936	0.5823	12.259

2011

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	590000	0.2915	0	0	0	0.262	0.0135	0.754
4	.	0.2179	0.003	0	0	0.662	0.1043	1.153
5	.	0.2095	0.067	0	0	1.287	0.2719	1.686
6	.	0.2018	0.37	0	0	2.214	0.5058	2.419
7	.	0.2	0.696	0	0	3.343	0.6456	3.41
8	.	0.2	0.888	0	0	4.552	0.7046	4.681
9	.	0.2	0.969	0	0	6.338	0.7583	6.029
10	.	0.2	0.997	0	0	8.948	0.7751	7.58
11	.	0.2	1	0	0	12.373	0.6011	9.383
12	.	0.2	1	0	0	15.128	0.5823	10.777
13	.	0.2	1	0	0	16.936	0.5823	12.259

Table 3.29 a and c N

MFDP version 1a
Run: runa N
preMFDP Index file 25.04.2005
Time and date: 23:38 25.04.2007
Fbar age range: 5-10

2007				
Biomass	SSB	FMult	FBar	Landings
1504296	574383	1	0.6925	530228

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1512725	531490	0	0	0	2165410	956341
.	531490	0.1	0.0693	65939	2084407	898112
.	531490	0.2	0.1385	128229	2008146	843751
.	531490	0.3	0.2078	187104	1936316	792988
.	531490	0.4	0.277	242782	1868625	745574
.	531490	0.5	0.3463	295467	1804805	701277
.	531490	0.6	0.4155	345349	1744602	659880
.	531490	0.7	0.4848	392603	1687783	621185
.	531490	0.8	0.554	437395	1634130	585005
.	531490	0.9	0.6233	479879	1583439	551168
.	531490	1	0.6925	520196	1535521	519513
.	531490	1.1	0.7618	558482	1490200	489892
.	531490	1.2	0.831	594860	1447312	462165
.	531490	1.3	0.9003	629448	1406702	436204
.	531490	1.4	0.9695	662353	1368229	411889
.	531490	1.5	1.0388	693678	1331759	389110
.	531490	1.6	1.108	723517	1297167	367762
.	531490	1.7	1.1773	751958	1264338	347749
.	531490	1.8	1.2465	779084	1233163	328983
.	531490	1.9	1.3158	804973	1203542	311379
.	531490	2	1.385	829697	1175381	294861

Input units are thousands and kg - output in tonnes

Table 3.29 b and d N

MFDP version 1a
Run: run b N
preMFDP Index file 25.04.2005
Time and date: 02:05 27.04.2007
Fbar age range: 5-10

2007				
Biomass	SSB	FMult	FBar	Landings
1504296	574383	1	0.6575	509987

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1536903	548043	0	0	0	2193725	979814
.	548043	0.1	0.0658	64106	2114908	922864
.	548043	0.2	0.1315	124821	2040499	869521
.	548043	0.3	0.1973	182353	1970223	819545
.	548043	0.4	0.263	236895	1903821	772715
.	548043	0.5	0.3288	288630	1841052	728821
.	548043	0.6	0.3945	337727	1781690	687672
.	548043	0.7	0.4603	384344	1725524	649085
.	548043	0.8	0.526	428631	1672358	612894
.	548043	0.9	0.5918	470726	1622008	578940
.	548043	1	0.6575	510759	1574302	547079
.	548043	1.1	0.7233	548851	1529079	517174
.	548043	1.2	0.789	585118	1486188	489097
.	548043	1.3	0.8548	619665	1445490	462730
.	548043	1.4	0.9205	652593	1406852	437963
.	548043	1.5	0.9863	683994	1370151	414692
.	548043	1.6	1.052	713957	1335273	392821
.	548043	1.7	1.1178	742564	1302110	372259
.	548043	1.8	1.1835	769891	1270560	352925
.	548043	1.9	1.2493	796012	1240529	334738
.	548043	2	1.315	820993	1211929	317626

Input units are thousands and kg - output in tonnes

Table 3.29 a and c R

MFDP version 1a
Run: run c R
preMFDP Index file 25.04.2005
Time and date: 23:33 25.04.2007
Fbar age range: 5-10

2007				
Biomass	SSB	FMult	FBar	Landings
1366542	543110	1	0.657	463153

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1374471	508750	0	0	0	1944406	887968
.	508750	0.1	0.0657	56933	1874329	836274
.	508750	0.2	0.1314	110834	1808203	787868
.	508750	0.3	0.1971	161889	1745777	742531
.	508750	0.4	0.2628	210274	1686819	700058
.	508750	0.5	0.3285	256152	1631111	660259
.	508750	0.6	0.3942	299676	1578448	622957
.	508750	0.7	0.4599	340988	1528642	587986
.	508750	0.8	0.5256	380222	1481515	555193
.	508750	0.9	0.5913	417503	1436901	524435
.	508750	1	0.657	452947	1394645	495577
.	508750	1.1	0.7227	486664	1354604	468495
.	508750	1.2	0.7884	518756	1316642	443073
.	508750	1.3	0.8541	549318	1280632	419204
.	508750	1.4	0.9198	578439	1246457	396786
.	508750	1.5	0.9855	606205	1214006	375725
.	508750	1.6	1.0512	632692	1183176	355933
.	508750	1.7	1.1169	657975	1153871	337329
.	508750	1.8	1.1826	682123	1126000	319837
.	508750	1.9	1.2483	705199	1099479	303384
.	508750	2	1.314	727265	1074228	287905

Input units are thousands and kg - output in tonnes

Table 3.29 b and d R

MFDP version 1a
Run: run b R
preMFDP Index file 25.04.2005
Time and date: 02:31 27.04.2007
Fbar age range: 5-10

2007				
Biomass	SSB	FMult	FBar	Landings
1366542	543110	1	0.6102	437827

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1404823	530150	0	0	0	1979737	917745
.	530150	0.1	0.061	54631	1912417	867758
.	530150	0.2	0.122	106534	1848651	820741
.	530150	0.3	0.1831	155868	1788231	776509
.	530150	0.4	0.2441	202780	1730959	734889
.	530150	0.5	0.3051	247408	1676649	695720
.	530150	0.6	0.3661	289883	1625129	658849
.	530150	0.7	0.4272	330327	1576236	624134
.	530150	0.8	0.4882	368855	1529817	591442
.	530150	0.9	0.5492	405574	1485729	560650
.	530150	1	0.6102	440586	1443837	531640
.	530150	1.1	0.6712	473986	1404015	504303
.	530150	1.2	0.7323	505864	1366145	478537
.	530150	1.3	0.7933	536304	1330115	454246
.	530150	1.4	0.8543	565384	1295821	431340
.	530150	1.5	0.9153	593179	1263165	409736
.	530150	1.6	0.9763	619759	1232055	389355
.	530150	1.7	1.0374	645190	1202404	370123
.	530150	1.8	1.0984	669533	1174132	351970
.	530150	1.9	1.1594	692847	1147160	334833
.	530150	2	1.2204	715187	1121418	318649

Input units are thousands and kg - output in tonnes

Table 3.30 a N

MFDP version 1a
Run: runa N
Time and date: 23:41 25.04.2007
Fbar age range: 5-10

Year:		2007	F multiplie	1	Fbar:	0.6925				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0158	7707	5811	565000	148030	0	0	0	0
	4	0.1222	33335	38068	320180	223806	1281	895	1281	895
	5	0.3197	63350	104972	254156	340823	18299	24539	18299	24539
	6	0.5899	45898	109374	112539	238695	38601	81872	38601	81872
	7	0.7499	37712	123769	77899	246706	56321	178369	56321	178369
	8	0.7981	13382	62413	26504	122979	23218	107729	23218	107729
	9	0.8428	7651	49481	14620	94957	14269	92678	14269	92678
	10	0.8547	3175	24955	6011	54838	6011	54838	6011	54838
	11	0.6947	640	5975	1393	16410	1393	16410	1393	16410
	12	0.67	277	3000	620	10698	620	10698	620	10698
	13	0.67	199	2411	444	6354	444	6354	444	6354
Total			213325	530228	1379366	1504296	160456	574383	160456	574383

Year:		2008	F multiplie	0.5776	Fbar:	0.4				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0091	4229	3188	535000	142310	0	0	0	0
	4	0.0706	25759	29700	417977	275029	1254	825	1254	825
	5	0.1847	35297	59086	230323	305869	15432	20493	15432	20493
	6	0.3407	39756	95494	151056	336250	55891	124412	55891	124412
	7	0.4331	16392	55601	51080	165398	35552	115117	35552	115117
	8	0.461	10163	46456	30130	135011	26755	119890	26755	119890
	9	0.4868	3440	21060	9769	63468	9466	61501	9466	61501
	10	0.4937	1835	14539	5153	46099	5138	45961	5138	45961
	11	0.4013	631	5884	2094	26275	2094	26275	2094	26275
	12	0.387	167	1800	569	8175	569	8175	569	8175
	13	0.387	130	1601	446	8841	446	8841	446	8841
Total			137798	334410	1433596	1512725	152596	531490	152596	531490

Year:		2009	F multiplie	0.5776	Fbar:	0.4				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0091	3644	2747	461000	120782	0	0	0	0
	4	0.0706	24554	28311	398434	263763	1195	791	1195	791
	5	0.1847	48518	81802	316601	407466	21212	27300	21212	27300
	6	0.3407	41237	99753	156683	346896	57973	128352	57973	128352
	7	0.4331	28228	96257	87964	294062	61223	204667	61223	204667
	8	0.461	9148	42821	27120	123449	24082	109622	24082	109622
	9	0.4868	5478	33029	15557	98602	15075	95546	15075	95546
	10	0.4937	1750	13265	4916	43984	4901	43852	4901	43852
	11	0.4013	777	7287	2575	31863	2575	31863	2575	31863
	12	0.387	336	3620	1148	17360	1148	17360	1148	17360
	13	0.387	165	2025	564	9559	564	9559	564	9559
Total			163836	410918	1472561	1757785	189948	668912	189948	668912

Year:		2010	F multiplie	0.5776	Fbar:	0.4				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0091	4735	3570	599000	156938	0	0	0	0
	4	0.0706	21158	24395	343323	227280	1030	682	1030	682
	5	0.1847	46250	77977	301798	388414	20220	26024	20220	26024
	6	0.3407	56684	137119	215376	476842	79689	176432	79689	176432
	7	0.4331	29279	99843	91240	305017	63503	212292	63503	212292
	8	0.461	15753	73740	46702	212586	41471	188776	41471	188776
	9	0.4868	4931	29729	14003	88751	13569	86000	13569	86000
	10	0.4937	2787	21126	7828	70047	7805	69836	7805	69836
	11	0.4013	741	6951	2456	30394	2456	30394	2456	30394
	12	0.387	413	4453	1412	21353	1412	21353	1412	21353
	13	0.387	279	3416	952	16120	952	16120	952	16120
Total			183010	482319	1624090	1993742	232107	827909	232107	827909

Year:		2011	F multiplie	1	Fbar:	0.6925				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0158	8171	6161	599000	156938	0	0	0	0
	4	0.1222	46444	53550	446097	295316	1338	886	1338	886
	5	0.3197	64820	109287	260054	334689	17424	22424	17424	22424
	6	0.5899	83731	202546	205306	454546	75963	168182	75963	168182
	7	0.7499	60716	207042	125419	419275	87291	291815	87291	291815
	8	0.7981	24458	114488	48441	220506	43016	195809	43016	195809
	9	0.8428	12620	76086	24114	152835	23367	148097	23367	148097
	10	0.8547	3721	28207	7046	63048	7025	62859	7025	62859
	11	0.6947	1796	16852	3912	48403	3912	48403	3912	48403
	12	0.67	602	6493	1346	20369	1346	20369	1346	20369
	13	0.67	588	7208	1314	22254	1314	22254	1314	22254
Total			307669	827919	1722049	2188180	261996	981100	261996	981100

Year:		2012	F multiplie	1	Fbar:	0.6925				
Age		F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
	3	0.0158	8171	6161	599000	156938	0	0	0	0
	4	0.1222	46135	53194	443129	293352	1329	880	1329	880
	5	0.3197	79987	134859	320902	413001	21500	27671	21500	27671
	6	0.5899	63036	152483	154561	342198	57188	126613	57188	126613
	7	0.7499	45112	153832	93186	311521	64858	216819	64858	216819
	8	0.7981	24492	114648	48509	220815	43076	196084	43076	196084
	9	0.8428	9344	56335	17855	113162	17301	109654	17301	109654
	10	0.8547	4489	34025	8499	76053	8474	75825	8474	75825
	11	0.6947	1127	10572	2454	30365	2454	30365	2454	30365
	12	0.67	715	7711	1599	24189	1599	24189	1599	24189
	13	0.67	499	6114	1115	18877	1115	18877	1115	18877
Total			283108	729934	1690809	2000470	218894	826976	218894	826976

Input units are thousands and kg - output in tonnes

Table 3.30 b N

MFDP version 1a									
Run: run b N									
Time and date: 02:09 27.04.2007									
Fbar age range: 5-10									
Year:	2007	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7320	5519	565000	148030	0	0	0	0
4	0.116	31736	36243	320180	223806	1281	895	1281	895
5	0.3036	60605	100422	254156	340823	18299	24539	18299	24539
6	0.5601	44149	105207	112539	238695	38601	81872	38601	81872
7	0.712	36385	119415	77899	246706	56321	178369	56321	178369
8	0.7577	12922	60267	26504	122979	23218	107729	23218	107729
9	0.8002	7395	47820	14620	94957	14269	92678	14269	92678
10	0.8115	3069	24123	6011	54838	6011	54838	6011	54838
11	0.6596	616	5759	1393	16410	1393	16410	1393	16410
12	0.6361	267	2890	620	10698	620	10698	620	10698
13	0.6361	191	2322	444	6354	444	6354	444	6354
Total		204655	509987	1379366	1504296	160456	574383	160456	574383
Year:	2008	F multiplie	0.6084	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0091	4229	3188	535000	142310	0	0	0	0
4	0.0706	25777	29720	418311	275249	1255	826	1255	826
5	0.1847	35525	59469	231756	307771	15528	20621	15528	20621
6	0.3408	40405	97053	153507	341707	56798	126432	56798	126432
7	0.4332	16889	57287	52625	170401	36627	118599	36627	118599
8	0.461	10556	48250	31294	140227	27789	124521	27789	124521
9	0.4868	3582	21929	10172	66085	9856	64036	9856	64036
10	0.4937	1915	15173	5377	48106	5361	47961	5361	47961
11	0.4013	659	6144	2186	27435	2186	27435	2186	27435
12	0.387	173	1864	590	8467	590	8467	590	8467
13	0.387	135	1656	461	9146	461	9146	461	9146
Total		139844	341736	1441279	1536903	156451	548043	156451	548043
Year:	2009	F multiplie	0.6084	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0091	3644	2747	461000	120782	0	0	0	0
4	0.0706	24552	28308	398434	263763	1195	791	1195	791
5	0.1847	48570	81889	316857	407795	21229	27322	21229	27322
6	0.3408	41495	100377	157649	349036	58330	129143	58330	129143
7	0.4332	28687	97823	89388	298823	62214	207981	62214	207981
8	0.461	9424	44114	27939	127178	24810	112934	24810	112934
9	0.4868	5690	34307	16158	102411	15657	99236	15657	99236
10	0.4937	1822	13813	5118	45795	5103	45658	5103	45658
11	0.4013	810	7604	2687	33248	2687	33248	2687	33248
12	0.387	351	3780	1198	18126	1198	18126	1198	18126
13	0.387	171	2097	584	9895	584	9895	584	9895
Total		165217	416859	1477012	1776852	193008	684334	193008	684334
Year:	2010	F multiplie	0.6084	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0091	4735	3570	599000	156938	0	0	0	0
4	0.0706	21156	24393	343323	227280	1030	682	1030	682
5	0.1847	46262	77998	301801	388417	20221	26024	20221	26024
6	0.3408	56733	137236	215539	477203	79749	176565	79749	176565
7	0.4332	29461	100462	91800	306886	63893	213593	63893	213593
8	0.461	16008	74931	47456	216020	42141	191825	42141	191825
9	0.4868	5080	30629	14426	91432	13979	88598	13979	88598
10	0.4937	2895	21942	8130	72749	8106	72531	8106	72531
11	0.4013	771	7237	2558	31644	2558	31644	2558	31644
12	0.387	431	4646	1473	22281	1473	22281	1473	22281
13	0.387	290	3556	991	16784	991	16784	991	16784
Total		183821	486602	1626496	2007634	234139	840526	234139	840526
Year:	2011	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7760	5851	599000	156938	0	0	0	0
4	0.116	44217	50983	446097	295316	1338	886	1338	886
5	0.3036	62012	104552	260056	334692	17424	22424	17424	22424
6	0.5601	80538	194820	205297	454527	75960	168175	75960	168175
7	0.712	58622	199903	125509	419576	87354	292025	87354	292025
8	0.7577	23761	111224	48736	221848	43278	197001	43278	197001
9	0.8002	12393	74720	24504	155303	23744	150489	23744	150489
10	0.8115	3706	28088	7259	64950	7237	64755	7237	64755
11	0.6596	1798	16869	4063	50269	4063	50269	4063	50269
12	0.6361	604	6512	1402	21206	1402	21206	1402	21206
13	0.6361	591	7239	1370	23200	1370	23200	1370	23200
Total		296002	800761	1723291	2197826	263169	990431	263169	990431
Year:	2012	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7760	5851	599000	156938	0	0	0	0
4	0.116	43958	50684	443484	293586	1330	881	1330	881
5	0.3036	76997	129816	322898	415569	21634	27843	21634	27843
6	0.5601	61619	149056	157071	347755	58116	128669	58116	128669
7	0.712	44840	152904	96001	320931	66817	223368	66817	223368
8	0.7577	24581	115065	50419	229509	44772	203804	44772	203804
9	0.8002	9460	57034	18704	118545	18124	114870	18124	114870
10	0.8115	4601	34875	9013	80644	8986	80402	8986	80402
11	0.6596	1168	10960	2640	32662	2640	32662	2640	32662
12	0.6361	741	7990	1720	26019	1720	26019	1720	26019
13	0.6361	518	6348	1201	20344	1201	20344	1201	20344
Total		276244	720584	1702150	2042502	225340	858862	225340	858862
Input units are thousands and kg - output in tonnes									

Table 3.30 c N

MFDP version 1a
Run: runc N
Time and date: 23:50 25.04.2007
Fbar age range: 5-10

Year:	2007	F multiplie	1	Fbar:	0.6925				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0158	7707	5811	565000	148030	0	0	0	0
4	0.1222	33335	38068	320180	223806	1281	895	1281	895
5	0.3197	63350	104972	254156	340823	18299	24539	18299	24539
6	0.5899	45898	109374	112539	238695	38601	81872	38601	81872
7	0.7499	37712	123769	77899	246706	56321	178369	56321	178369
8	0.7981	13382	62413	26504	122979	23218	107729	23218	107729
9	0.8428	7651	49481	14620	94957	14269	92678	14269	92678
10	0.8547	3175	24955	6011	54838	6011	54838	6011	54838
11	0.6947	640	5975	1393	16410	1393	16410	1393	16410
12	0.67	277	3000	620	10698	620	10698	620	10698
13	0.67	199	2411	444	6354	444	6354	444	6354
Total		213325	530228	1379366	1504296	160456	574383	160456	574383

Year:	2008	F multiplie	0.7358	Fbar:	0.5096				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0116	5381	4057	535000	142310	0	0	0	0
4	0.0899	32513	37488	417977	275029	1254	825	1254	825
5	0.2352	43917	73517	230323	305869	15432	20493	15432	20493
6	0.434	48556	116632	151056	336250	55891	124412	55891	124412
7	0.5518	19813	67206	51080	165398	35552	115117	35552	115117
8	0.5872	12247	55980	30130	135011	26755	119890	26755	119890
9	0.6201	4134	25307	9769	63468	9466	61501	9466	61501
10	0.6289	2203	17459	5153	46099	5138	45961	5138	45961
11	0.5112	766	7137	2094	26275	2094	26275	2094	26275
12	0.493	202	2187	569	8175	569	8175	569	8175
13	0.493	159	1945	446	8841	446	8841	446	8841
Total		169890	408914	1433596	1512725	152596	531490	152596	531490

Year:	2009	F multiplie	0.7358	Fbar:	0.5096				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0116	4636	3496	461000	120782	0	0	0	0
4	0.0899	30916	35646	397439	263105	1192	789	1192	789
5	0.2352	59212	99832	310539	399664	20806	26778	20806	26778
6	0.434	47881	115824	148956	329788	55114	122021	55114	122021
7	0.5518	31079	105980	80126	267861	55768	186431	55768	186431
8	0.5872	9790	45828	24086	109639	21388	97359	21388	97359
9	0.6201	5802	34982	13712	86907	13287	84213	13287	84213
10	0.6289	1839	13940	4302	38494	4289	38378	4289	38378
11	0.5112	823	7721	2249	27833	2249	27833	2249	27833
12	0.493	366	3941	1028	15553	1028	15553	1028	15553
13	0.493	181	2213	508	8597	508	8597	508	8597
Total		192525	469402	1443945	1668222	175629	607953	175629	607953

Year:	2010	F multiplie	0.7358	Fbar:	0.5096				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0116	60242	45422	5990000	1569380	0	0	0	0
4	0.0899	26640	30715	342466	226712	1027	680	1027	680
5	0.2352	56303	94926	295281	380026	19784	25462	19784	25462
6	0.434	64557	156163	200833	444645	74308	164519	74308	164519
7	0.5518	30647	104507	79012	264137	54992	183839	54992	183839
8	0.5872	15357	71886	37782	171982	33550	152720	33550	152720
9	0.6201	4638	27965	10961	69473	10622	67320	10622	67320
10	0.6289	2581	19568	6038	54032	6020	53869	6020	53869
11	0.5112	687	6446	1878	23236	1878	23236	1878	23236
12	0.493	393	4234	1105	16711	1105	16711	1105	16711
13	0.493	273	3348	768	13007	768	13007	768	13007
Total		262318	565180	6966124	3233342	204055	701363	204055	701363

Year:	2011	F multiplie	1	Fbar:	0.6925				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0158	81711	61610	5990000	1569380	0	0	0	0
4	0.1222	463285	534167	4449829	2945787	13349	8837	13349	8837
5	0.3197	63421	106927	254438	327462	17047	21940	17047	21940
6	0.5899	77883	188398	190965	422797	70657	156435	70657	156435
7	0.7499	51572	175861	106530	356130	74145	247866	74145	247866
8	0.7981	18811	88052	37256	169591	33084	150597	33084	150597
9	0.8428	8999	54252	17194	108978	16661	105600	16661	105600
10	0.8547	2549	19324	4827	43193	4813	43063	4813	43063
11	0.6947	1210	11355	2636	32615	2636	32615	2636	32615
12	0.67	413	4447	922	13951	922	13951	922	13951
13	0.67	419	5137	936	15860	936	15860	936	15860
Total		770271	1249531	11055535	6005744	234251	796765	234251	796765

Year:	2012	F multiplie	1	Fbar:	0.6925				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0158	81711	61610	5990000	1569380	0	0	0	0
4	0.1222	461355	531942	4431293	2933516	13294	8801	13294	8801
5	0.3197	797876	1345219	3201008	4119697	214468	276020	214468	276020
6	0.5899	61674	149190	151223	334808	55953	123879	55953	123879
7	0.7499	41961	143087	86677	289762	60327	201674	60327	201674
8	0.7981	20804	97382	41204	187559	36589	166552	36589	166552
9	0.8428	7186	43327	13732	87033	13306	84335	13306	84335
10	0.8547	3201	24261	6060	54229	6042	54066	6042	54066
11	0.6947	772	7242	1681	20802	1681	20802	1681	20802
12	0.67	482	5196	1077	16299	1077	16299	1077	16299
13	0.67	348	4272	779	13188	779	13188	779	13188
Total		1477370	2412728	13924735	9626274	403516	965617	403516	965617

Input units are thousands and kg - output in tonnes

Table 3.30 d N

MFDP version 1a									
Run: run d N									
Time and date: 02:26 27.04.2007									
Fbar age range: 5-10									
Year:	2007	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7320	5519	565000	148030	0	0	0	0
4	0.116	31736	36243	320180	223806	1281	895	1281	895
5	0.3036	60605	100422	254156	340823	18299	24539	18299	24539
6	0.5601	44149	105207	112539	238695	38601	81872	38601	81872
7	0.712	36385	119415	77899	246706	56321	178369	56321	178369
8	0.7577	12922	60267	26504	122979	23218	107729	23218	107729
9	0.8002	7395	47820	14620	94957	14269	92678	14269	92678
10	0.8115	3069	24123	6011	54838	6011	54838	6011	54838
11	0.6596	616	5759	1393	16410	1393	16410	1393	16410
12	0.6361	267	2890	620	10698	620	10698	620	10698
13	0.6361	191	2322	444	6354	444	6354	444	6354
Total		204655	509987	1379366	1504296	160456	574383	160456	574383
Year:	2008	F multiplie	0.7696	Fbar:	0.506				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0115	5343	4029	535000	142310	0	0	0	0
4	0.0893	32317	37262	418311	275249	1255	826	1255	826
5	0.2337	43925	73530	231756	307771	15528	20621	15528	20621
6	0.4311	49069	117865	153507	341707	56798	126432	56798	126432
7	0.548	20305	68874	52625	170401	36627	118599	36627	118599
8	0.5831	12653	57838	31294	140227	27789	124521	27789	124521
9	0.6158	4282	26216	10172	66085	9856	64036	9856	64036
10	0.6245	2287	18126	5377	48106	5361	47961	5361	47961
11	0.5076	795	7412	2186	27435	2186	27435	2186	27435
12	0.4895	209	2253	590	8467	590	8467	590	8467
13	0.4895	163	2001	461	9146	461	9146	461	9146
Total		171349	415406	1441279	1536903	156451	548043	156451	548043
Year:	2009	F multiplie	0.7696	Fbar:	0.506				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0115	4604	3471	461000	120782	0	0	0	0
4	0.0893	30707	35405	397471	263126	1192	789	1192	789
5	0.2337	58941	99375	310987	400241	20836	26816	20836	26816
6	0.4311	47987	116079	150120	332365	55544	122975	55544	122975
7	0.548	31512	107455	81671	273025	56843	190026	56843	190026
8	0.5831	10072	47147	24909	113388	22120	100688	22120	100688
9	0.6158	6021	36298	14300	90636	13857	87826	13857	87826
10	0.6245	1913	14504	4499	40253	4485	40133	4485	40133
11	0.5076	858	8049	2358	29171	2358	29171	2358	29171
12	0.4895	381	4106	1077	16297	1077	16297	1077	16297
13	0.4895	187	2286	527	8931	527	8931	527	8931
Total		193182	474176	1448920	1688215	178840	623652	178840	623652
Year:	2010	F multiplie	0.7696	Fbar:	0.506				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0115	5982	4511	599000	156938	0	0	0	0
4	0.0893	26460	30508	342494	226731	1027	680	1027	680
5	0.2337	56005	94424	295494	380301	19798	25480	19798	25480
6	0.4311	64392	155764	201442	445993	74534	165017	74534	165017
7	0.548	30816	105083	79868	267000	55588	185832	55588	185832
8	0.5831	15631	73168	38657	175969	34328	156260	34328	156260
9	0.6158	4792	28893	11383	72145	11030	69909	11030	69909
10	0.6245	2690	20391	6325	56593	6306	56423	6306	56423
11	0.5076	718	6733	1972	24404	1972	24404	1972	24404
12	0.4895	411	4429	1162	17577	1162	17577	1162	17577
13	0.4895	285	3491	805	13637	805	13637	805	13637
Total		208182	527396	1578603	1837287	206551	715220	206551	715220
Year:	2011	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7760	5851	599000	156938	0	0	0	0
4	0.116	44111	50860	445019	294603	1335	884	1335	884
5	0.3036	60716	102367	254622	327699	17060	21956	17060	21956
6	0.5601	75088	181639	191406	423774	70820	156796	70820	156796
7	0.712	50058	170699	107173	358281	74593	249363	74593	249363
8	0.7577	18431	86276	37804	172085	33570	152812	33570	152812
9	0.8002	8935	53868	17666	111964	17118	108493	17118	108493
10	0.8115	2570	19481	5034	45047	5019	44912	5019	44912
11	0.6596	1227	11513	2773	34310	2773	34310	2773	34310
12	0.6361	419	4516	972	14704	972	14704	972	14704
13	0.6361	426	5216	987	16717	987	16717	987	16717
Total		269741	692286	1662457	1956123	224247	800949	224247	800949
Year:	2012	F multiplie	1	Fbar:	0.6575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.015	7760	5851	599000	156938	0	0	0	0
4	0.116	43958	50684	443484	293586	1330	881	1330	881
5	0.3036	76811	129503	322118	414566	21582	27776	21582	27776
6	0.5601	60331	145941	153789	340488	56902	125981	56902	125981
7	0.712	41806	142558	89505	299216	62296	208255	62296	208255
8	0.7577	20990	98255	43054	195981	38232	174031	38232	174031
9	0.8002	7338	44241	14508	91954	14059	89103	14059	89103
10	0.8115	3317	25143	6497	58139	6478	57965	6478	57965
11	0.6596	810	7602	1831	22653	1831	22653	1831	22653
12	0.6361	506	5453	1174	17759	1174	17759	1174	17759
13	0.6361	366	4487	849	14380	849	14380	849	14380
Total		263994	659719	1675809	1905661	204732	738783	204732	738783
Input units are thousands and kg - output in tonnes									

Table 3.30 a R

Fbar age range: 5-10

Year: 2007 F multiplier 1 Fbar: 0.657

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0145	6258	4719	501000	131262	0	0	0	0
4	0.1123	26104	29811	272939	190784	1092	763	1092	763
5	0.2927	51037	84568	221798	297431	15969	21415	15969	21415
6	0.5446	40175	95737	104694	222056	35910	76165	35910	76165
7	0.6951	33093	108612	72054	228195	52095	164985	52095	164985
8	0.7586	12576	58654	25774	119591	22578	104762	22578	104762
9	0.8164	7242	46832	14129	91768	13790	89565	13790	89565
10	0.8345	3005	23622	5779	52722	5779	52722	5779	52722
11	0.6472	591	5518	1353	15938	1353	15938	1353	15938
12	0.6269	260	2813	610	10526	610	10526	610	10526
13	0.6269	187	2267	438	6268	438	6268	438	6268
Total		180528	463153	1220568	1366542	149614	543110	149614	543110

Year: 2008 F multiplier 0.6088 Fbar: 0.4

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0088	3630	2737	476000	126616	0	0	0	0
4	0.0684	21934	25290	368930	242756	1107	728	1107	728
5	0.1782	28979	48511	196183	260531	13144	17456	13144	17456
6	0.3316	34493	82851	134232	298800	49666	110556	49666	110556
7	0.4232	15630	53018	49632	160709	34544	111854	34544	111854
8	0.4618	9945	45457	29439	131916	26142	117141	26142	117141
9	0.497	3537	21654	9883	64207	9576	62216	9576	62216
10	0.508	1862	14753	5113	45743	5098	45606	5098	45606
11	0.394	610	5686	2054	25776	2054	25776	2054	25776
12	0.3817	168	1813	580	8326	580	8326	580	8326
13	0.3817	133	1628	458	9091	458	9091	458	9091
Total		120920	303398	1272504	1374471	142369	508750	142369	508750

Year: 2009 F multiplier 0.6088 Fbar: 0.4

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0088	3096	2334	406000	106372	0	0	0	0
4	0.0684	20958	24165	352514	233364	1058	700	1058	700
5	0.1782	40930	69009	277089	356613	18565	23893	18565	23893
6	0.3316	34210	82755	133134	294758	49259	109060	49259	109060
7	0.4232	24799	84563	78745	263244	54807	183218	54807	183218
8	0.4618	8991	42085	26615	121150	23634	107581	23634	107581
9	0.497	5436	32773	15188	96259	14717	93275	14717	93275
10	0.508	1792	13583	4922	44043	4907	43911	4907	43911
11	0.394	748	7021	2519	31165	2519	31165	2519	31165
12	0.3817	328	3536	1134	17155	1134	17155	1134	17155
13	0.3817	168	2059	580	9829	580	9829	580	9829
Total		141456	363884	1298439	1573953	171180	619788	171180	619788

Year: 2010 F multiplier 0.6088 Fbar: 0.4

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0088	4499	3392	590000	154580	0	0	0	0
4	0.0684	17876	20611	300674	199046	902	597	902	597
5	0.1782	39109	65938	264760	340746	17739	22830	17739	22830
6	0.3316	48319	116883	188038	416315	69574	154037	69574	154037
7	0.4232	24596	83872	78101	261091	54358	181719	54358	181719
8	0.4618	14264	66771	42226	192213	37497	170685	37497	170685
9	0.497	4914	29629	13731	87025	13305	84327	13305	84327
10	0.508	2754	20875	7564	67686	7542	67483	7542	67483
11	0.394	720	6759	2425	30001	2425	30001	2425	30001
12	0.3817	402	4337	1391	21038	1391	21038	1391	21038
13	0.3817	277	3400	958	16229	958	16229	958	16229
Total		157731	422467	1489866	1785970	205690	748946	205690	748946

Year: 2011 F multiplier 1 Fbar: 0.657

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0145	7370	5557	590000	154580	0	0	0	0
4	0.1123	41790	48184	436940	289254	1311	868	1311	868
5	0.2927	51963	87610	225824	290636	15130	19473	15130	19473
6	0.5446	68946	166781	179671	397791	66478	147183	66478	147183
7	0.6951	50663	172762	110309	368764	76775	256660	76775	256660
8	0.7586	20435	95656	41881	190641	37190	169289	37190	169289
9	0.8164	11166	67317	21785	138071	21109	133790	21109	133790
10	0.8345	3556	26954	6839	61193	6818	61010	6818	61010
11	0.6472	1627	15262	3726	46105	3726	46105	3726	46105
12	0.6269	571	6153	1339	20252	1339	20252	1339	20252
13	0.6269	560	6865	1313	22237	1313	22237	1313	22237
Total		258647	699101	1619626	1979523	231190	876865	231190	876865

Year: 2012 F multiplier 1 Fbar: 0.657

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0145	7370	5557	590000	154580	0	0	0	0
4	0.1123	41553	47911	434468	287618	1303	863	1303	863
5	0.2927	72267	121843	314063	404200	21042	27081	21042	27081
6	0.5446	52445	126864	136668	302584	50567	111956	50567	111956
7	0.6951	39120	133400	85177	284745	59283	198183	59283	198183
8	0.7586	21990	102937	45069	205153	40021	182176	40021	182176
9	0.8164	8231	49622	16058	101777	15560	98622	15560	98622
10	0.8345	4099	31073	7884	70544	7860	70332	7860	70332
11	0.6472	1061	9955	2431	30073	2431	30073	2431	30073
12	0.6269	681	7341	1597	24161	1597	24161	1597	24161
13	0.6269	495	6065	1160	19643	1160	19643	1160	19643
Total		249313	642568	1634575	1885078	200825	763090	200825	763090

Input units are thousands and kg - output in tonnes

Table 3.30 b R

MFDP version 1a									
Run: run b R									
Time and date: 02:34 27.04.2007									
Fbar age range: 5-10									
Year:	2007	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	5829	4395	501000	131262	0	0	0	0
4	0.1043	24337	27793	272939	190784	1092	763	1092	763
5	0.2719	47865	79312	221798	297431	15969	21415	15969	21415
6	0.5058	37955	90447	104694	222056	35910	76165	35910	76165
7	0.6456	31395	103039	72054	228195	52095	164985	52095	164985
8	0.7046	11951	55739	25774	119591	22578	104762	22578	104762
9	0.7583	6892	44571	14129	91768	13790	89565	13790	89565
10	0.7751	2861	22492	5779	52722	5779	52722	5779	52722
11	0.6011	560	5228	1353	15938	1353	15938	1353	15938
12	0.5823	246	2664	610	10526	610	10526	610	10526
13	0.5823	177	2147	438	6268	438	6268	438	6268
Total		170069	437827	1220568	1366542	149614	543110	149614	543110
Year:	2008	F multiplie	0.6555	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0088	3639	2743	476000	126616	0	0	0	0
4	0.0684	21956	25315	369299	242999	1108	729	1108	729
5	0.1782	29217	48910	197759	262624	13250	17596	13250	17596
6	0.3316	35218	84593	137053	305080	50710	112880	50710	112880
7	0.4232	16249	55117	51596	167067	35911	116279	35911	116279
8	0.4619	10450	47766	30933	138610	27468	123085	27468	123085
9	0.4971	3734	22857	10431	67769	10107	65668	10107	65668
10	0.5081	1973	15636	5419	48479	5403	48334	5403	48334
11	0.394	648	6034	2180	27354	2180	27354	2180	27354
12	0.3817	176	1898	607	8719	607	8719	607	8719
13	0.3817	139	1702	479	9506	479	9506	479	9506
Total		123397	312573	1281755	1404823	147223	530150	147223	530150
Year:	2009	F multiplie	0.6555	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0088	3103	2340	406000	106372	0	0	0	0
4	0.0684	20958	24164	352506	233359	1058	700	1058	700
5	0.1782	40979	69090	277366	356970	18584	23917	18584	23917
6	0.3316	34484	83417	134198	297115	49653	109932	49653	109932
7	0.4232	25321	86343	80400	268777	55958	187069	55958	187069
8	0.4619	9347	43752	27667	125942	24569	111836	24569	111836
9	0.4971	5712	34437	15958	101141	15463	98005	15463	98005
10	0.5081	1891	14337	5195	46485	5179	46346	5179	46346
11	0.394	793	7441	2669	33028	2669	33028	2669	33028
12	0.3817	348	3753	1203	18204	1203	18204	1203	18204
13	0.3817	176	2155	607	10286	607	10286	607	10286
Total		143111	371229	1303771	1597679	174944	639324	174944	639324
Year:	2010	F multiplie	0.6555	Fbar:	0.4				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0088	4510	3400	590000	154580	0	0	0	0
4	0.0684	17876	20611	300667	199042	902	597	902	597
5	0.1782	39115	65948	264754	340738	17738	22829	17738	22829
6	0.3316	48365	116996	188219	416717	69641	154185	69641	154185
7	0.4232	24793	84545	78725	263179	54793	183173	54793	183173
8	0.4619	14565	68177	43113	196250	38284	174270	38284	174270
9	0.4971	5109	30802	14273	90464	13831	87659	13831	87659
10	0.5081	2894	21934	7948	71116	7924	70903	7924	70903
11	0.394	760	7134	2559	31663	2559	31663	2559	31663
12	0.3817	427	4597	1474	22295	1474	22295	1474	22295
13	0.3817	293	3591	1012	17141	1012	17141	1012	17141
Total		158706	427734	1492744	1803185	208158	764716	208158	764716
Year:	2011	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	6865	5176	590000	154580	0	0	0	0
4	0.1043	38959	44920	436930	289248	1311	868	1311	868
5	0.2719	48733	82163	225819	290629	15130	19472	15130	19472
6	0.5058	65133	157557	179661	397769	66474	147174	66474	147174
7	0.6456	48110	164056	110416	369121	76850	256908	76850	256908
8	0.7046	19574	91627	42215	192163	37487	170640	37487	170640
9	0.7583	10849	65411	22241	140967	21552	136597	21552	136597
10	0.7751	3519	26678	7109	63609	7087	63418	7087	63418
11	0.6011	1619	15192	3915	48440	3915	48440	3915	48440
12	0.5823	571	6150	1413	21373	1413	21373	1413	21373
13	0.5823	561	6880	1389	23532	1389	23532	1389	23532
Total		244494	665810	1621109	1991430	232608	888422	232608	888422
Year:	2012	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	6865	5176	590000	154580	0	0	0	0
4	0.1043	38778	44711	434903	287906	1305	864	1305	864
5	0.2719	68319	115186	316579	407437	21211	27298	21211	27298
6	0.5058	50587	122370	139538	308937	51629	114307	51629	114307
7	0.6456	38579	131555	88541	295994	61625	206012	61625	206012
8	0.7046	21979	102885	47402	215772	42093	191605	42093	191605
9	0.7583	8334	50245	17085	108282	16555	104925	16555	104925
10	0.7751	4223	32014	8531	76332	8505	76103	8505	76103
11	0.6011	1109	10404	2681	33173	2681	33173	2681	33173
12	0.5823	710	7649	1757	26583	1757	26583	1757	26583
13	0.5823	518	6346	1282	21706	1282	21706	1282	21706
Total		240001	628541	1648298	1936700	208642	802575	208642	802575
Input units are thousands and kg - output in tonnes									

Table 3.30 c R

MFDP version 1a
Run: run c R
Time and date: 23:31 25.04.2007
Fbar age range: 5-10

Year:	2007	F multiplie	1	Fbar:	0.657				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0145	6258	4719	501000	131262	0	0	0	0
4	0.1123	26104	29811	272939	190784	1092	763	1092	763
5	0.2927	51037	84568	221798	297431	15969	21415	15969	21415
6	0.5446	40175	95737	104694	222056	35910	76165	35910	76165
7	0.6951	33093	108612	72054	228195	52095	164985	52095	164985
8	0.7586	12576	58654	25774	119591	22578	104762	22578	104762
9	0.8164	7242	46832	14129	91768	13790	89565	13790	89565
10	0.8345	3005	23622	5779	52722	5779	52722	5779	52722
11	0.6472	591	5518	1353	15938	1353	15938	1353	15938
12	0.6269	260	2813	610	10526	610	10526	610	10526
13	0.6269	187	2267	438	6268	438	6268	438	6268
Total		180528	463153	1220568	1366542	149614	543110	149614	543110

Year:	2008	F multiplie	0.7565	Fbar:	0.497				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.011	4506	3397	476000	126616	0	0	0	0
4	0.085	27041	31179	368930	242756	1107	728	1107	728
5	0.2214	35292	59078	196183	260531	13144	17456	13144	17456
6	0.412	41329	99272	134232	298800	49666	110556	49666	110556
7	0.5258	18557	62944	49632	160709	34544	111854	34544	111854
8	0.5739	11762	53764	29439	131916	26142	117141	26142	117141
9	0.6176	4169	25525	9883	64207	9576	62216	9576	62216
10	0.6313	2192	17372	5113	45743	5098	45606	5098	45606
11	0.4896	727	6770	2054	25776	2054	25776	2054	25776
12	0.4742	200	2161	580	8326	580	8326	580	8326
13	0.4742	158	1940	458	9091	458	9091	458	9091
Total		145932	363403	1272504	1374471	142369	508750	142369	508750

Year:	2009	F multiplie	0.7565	Fbar:	0.497				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.011	3843	2898	406000	106372	0	0	0	0
4	0.085	25783	29728	351760	232865	1055	699	1055	699
5	0.2214	49026	82658	272531	350747	18260	23500	18260	23500
6	0.412	39257	94962	127501	282286	47175	104446	47175	104446
7	0.5258	27166	92635	72659	242899	50571	169058	50571	169058
8	0.5739	9596	44919	24018	109329	21328	97085	21328	97085
9	0.6176	5728	34536	13578	86056	13157	83388	13157	83388
10	0.6313	1870	14178	4363	39040	4350	38923	4350	38923
11	0.4896	788	7391	2227	27551	2227	27551	2227	27551
12	0.4742	356	3832	1031	15591	1031	15591	1031	15591
13	0.4742	183	2237	529	8960	529	8960	529	8960
Total		163595	409973	1276195	1501697	159682	569200	159682	569200

Year:	2010	F multiplie	0.7565	Fbar:	0.497				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.011	5585	4211	590000	154580	0	0	0	0
4	0.085	21991	25356	300030	198620	900	596	900	596
5	0.2214	46744	78811	259847	334423	17410	22406	17410	22406
6	0.412	54534	131917	177119	392142	65534	145093	65534	145093
7	0.5258	25804	87990	69015	230719	48035	160580	48035	160580
8	0.5739	14048	65759	35161	160052	31223	142126	31223	142126
9	0.6176	4674	28177	11078	70209	10734	68033	10734	68033
10	0.6313	2570	19479	5994	53638	5976	53477	5976	53477
11	0.4896	672	6306	1900	23509	1900	23509	1900	23509
12	0.4742	385	4154	1117	16903	1117	16903	1117	16903
13	0.4742	274	3361	795	13459	795	13459	795	13459
Total		177281	455522	1452057	1648255	183624	646182	183624	646182

Year:	2011	F multiplie	1	Fbar:	0.657				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0145	7370	5557	590000	154580	0	0	0	0
4	0.1123	41700	48081	436005	288635	1308	866	1308	866
5	0.2927	50999	85985	221634	285243	14850	19111	14850	19111
6	0.5446	64804	156761	168876	373892	62484	138340	62484	138340
7	0.6951	44033	150154	95874	320506	66728	223072	66728	223072
8	0.7586	16296	76281	33398	152026	29657	134999	29657	134999
9	0.8164	8312	50112	16217	102783	15714	99596	15714	99596
10	0.8345	2543	19276	4891	43761	4876	43630	4876	43630
11	0.6472	1139	10692	2610	32299	2610	32299	2610	32299
12	0.6269	407	4382	953	14423	953	14423	953	14423
13	0.6269	416	5094	974	16500	974	16500	974	16500
Total		238019	612373	1571433	1784649	200155	722837	200155	722837

Year:	2012	F multiplie	1	Fbar:	0.657				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0145	7370	5557	590000	154580	0	0	0	0
4	0.1123	41553	47911	434468	287618	1303	863	1303	863
5	0.2927	72113	121582	313392	403335	20997	27023	20997	27023
6	0.5446	51472	124510	134133	296970	49629	109879	49629	109879
7	0.6951	36770	125385	80059	267638	55721	186276	55721	186276
8	0.7586	19113	89466	39171	178306	34784	158336	34784	158336
9	0.8164	6563	39571	12806	81162	12409	78646	12409	78646
10	0.8345	3052	23131	5869	52514	5851	52357	5851	52357
11	0.6472	759	7119	1738	21506	1738	21506	1738	21506
12	0.6269	477	5143	1119	16926	1119	16926	1119	16926
13	0.6269	360	4409	843	14280	843	14280	843	14280
Total		239601	593785	1613597	1774834	184395	666091	184395	666091

Input units are thousands and kg - output in tonnes

Table 3.30 d R

MFDP version 1a									
Run: run d R									
Time and date: 02:42 27.04.2007									
Fbar age range: 5-10									
Year:	2007	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	5829	4395	501000	131262	0	0	0	0
4	0.1043	24337	27793	272939	190784	1092	763	1092	763
5	0.2719	47865	79312	221798	297431	15969	21415	15969	21415
6	0.5058	37955	90447	104694	222056	35910	76165	35910	76165
7	0.6456	31395	103039	72054	228195	52095	164985	52095	164985
8	0.7046	11951	55739	25774	119591	22578	104762	22578	104762
9	0.7583	6892	44571	14129	91768	13790	89565	13790	89565
10	0.7751	2861	22492	5779	52722	5779	52722	5779	52722
11	0.6011	560	5228	1353	15938	1353	15938	1353	15938
12	0.5823	246	2664	610	10526	610	10526	610	10526
13	0.5823	177	2147	438	6268	438	6268	438	6268
Total		170069	437827	1220568	1366542	149614	543110	149614	543110
Year:	2008	F multiplie	0.8079	Fbar:	0.493				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0109	4480	3378	476000	126616	0	0	0	0
4	0.0843	26857	30966	369299	242999	1108	729	1108	729
5	0.2197	35321	59128	197759	262624	13250	17596	13250	17596
6	0.4086	41917	100685	137053	305080	50710	112880	50710	112880
7	0.5216	19170	65026	51596	167067	35911	116279	35911	116279
8	0.5692	12284	56150	30933	138610	27468	123085	27468	123085
9	0.6126	4375	26782	10431	67769	10107	65668	10107	65668
10	0.6262	2309	18303	5419	48479	5403	48334	5403	48334
11	0.4856	766	7139	2180	27354	2180	27354	2180	27354
12	0.4704	208	2248	607	8719	607	8719	607	8719
13	0.4704	164	2016	479	9506	479	9506	479	9506
Total		147852	371820	1281755	1404823	147223	530150	147223	530150
Year:	2009	F multiplie	0.8079	Fbar:	0.493				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0109	3821	2881	406000	106372	0	0	0	0
4	0.0843	25583	29497	351782	232880	1055	699	1055	699
5	0.2197	48759	82207	272992	351341	18290	23540	18290	23540
6	0.4086	39378	95256	128751	285055	47638	105470	47638	105470
7	0.5216	27656	94308	74435	248837	51807	173191	51807	173191
8	0.5692	9958	46611	25075	114140	22266	101357	22266	101357
9	0.6126	6011	36242	14333	90843	13889	88027	13889	88027
10	0.6262	1972	14951	4628	41412	4614	41288	4614	41288
11	0.4856	834	7823	2372	29349	2372	29349	2372	29349
12	0.4704	376	4056	1098	16611	1098	16611	1098	16611
13	0.4704	191	2335	556	9412	556	9412	556	9412
Total		164539	416167	1282022	1526251	163586	588942	163586	588942
Year:	2010	F multiplie	0.8079	Fbar:	0.493				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0109	5553	4187	590000	154580	0	0	0	0
4	0.0843	21821	25159	300049	198633	900	596	900	596
5	0.2197	46446	78308	260043	334675	17423	22423	17423	22423
6	0.4086	54359	131494	177732	393498	65761	145594	65761	145594
7	0.5216	25981	88595	69926	233764	48669	162700	48669	162700
8	0.5692	14365	67244	36174	164666	32123	146223	32123	146223
9	0.6126	4873	29378	11619	73639	11259	71356	11259	71356
10	0.6262	2710	20544	6359	56904	6340	56733	6340	56733
11	0.4856	712	6681	2026	25064	2026	25064	2026	25064
12	0.4704	410	4414	1195	18077	1195	18077	1195	18077
13	0.4704	290	3555	846	14326	846	14326	846	14326
Total		177519	459559	1455969	1667826	186541	663094	186541	663094
Year:	2011	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	6865	5176	590000	154580	0	0	0	0
4	0.1043	38879	44827	436032	288653	1308	866	1308	866
5	0.2719	47866	80702	221801	285458	14861	19126	14861	19126
6	0.5058	61377	148472	169301	374833	62641	138688	62641	138688
7	0.6456	42059	143422	96528	322695	67184	224596	67184	224596
8	0.7046	15757	73760	33983	154691	30177	137366	30177	137366
9	0.7583	8176	49296	16762	106237	16242	102943	16242	102943
10	0.7751	2552	19346	5155	46128	5140	45989	5140	45989
11	0.6011	1151	10802	2784	34441	2784	34441	2784	34441
12	0.5823	412	4442	1021	15438	1021	15438	1021	15438
13	0.5823	422	5169	1044	17679	1044	17679	1044	17679
Total		225517	585414	1574411	1800833	202401	737132	202401	737132
Year:	2012	F multiplie	1	Fbar:	0.6102				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0135	6865	5176	590000	154580	0	0	0	0
4	0.1043	38778	44711	434903	287906	1305	864	1305	864
5	0.2719	68179	114949	315928	406600	21167	27242	21167	27242
6	0.5058	49687	120193	137055	303440	50710	112273	50710	112273
7	0.6456	36355	123969	83436	278926	58071	194133	58071	194133
8	0.7046	19215	89944	41440	188633	36798	167506	36798	167506
9	0.7583	6709	40447	13753	87167	13327	84465	13327	84465
10	0.7751	3183	24127	6429	57526	6410	57353	6410	57353
11	0.6011	804	7545	1944	24056	1944	24056	1944	24056
12	0.5823	505	5438	1249	18900	1249	18900	1249	18900
13	0.5823	381	4675	944	15990	944	15990	944	15990
Total		230660	581175	1627082	1823725	191926	702783	191926	702783
Input units are thousands and kg - output in tonnes									

Table 3.31. North East arctic cod. Stock numbers at age (in thousands) estimated by VPA including discard estimates, and % increase in stock numbers relative to a VPA without discards. From Dingsør (2001). The discard numbers applied correspond to method II (1946-1982) and IIIb (1983-1998) mentioned in Dingsør (2001).

	Estimated stock numbers (thousands)			Percent increase		
Year	Age 3	Age 4	Age 5	Age 3	Age 4	Age 5
1946	875 346	602 579	407 163	20 %	4 %	1 %
1947	531 993	676 806	465 099	27 %	14 %	0 %
1948	570 356	392 309	497 476	29 %	14 %	5 %
1949	589 367	416 668	285 459	26 %	16 %	3 %
1950	799 732	414 016	291 200	13 %	9 %	1 %
1951	1 235 322	586 054	302 346	14 %	2 %	0 %
1952	1 388 731	889 509	401 768	17 %	3 %	0 %
1953	1 801 114	975 004	600 908	13 %	2 %	0 %
1954	830 653	1 321 053	684 303	29 %	5 %	0 %
1955	381 489	615 696	907 875	40 %	19 %	2 %
1956	567 555	274 235	399 344	29 %	25 %	3 %
1957	914 850	387 496	161 710	14 %	10 %	2 %
1958	552 600	672 221	262 135	11 %	4 %	2 %
1959	757 567	391 906	406 694	11 %	3 %	0 %
1960	855 470	534 350	240 047	8 %	1 %	0 %
1961	1 041 570	620 707	347 043	13 %	1 %	0 %
1962	894 728	739 196	382 556	23 %	4 %	0 %
1963	551 938	614 025	429 068	17 %	10 %	0 %
1964	389 151	396 165	361 790	15 %	5 %	0 %
1965	845 469	293 844	266 134	9 %	8 %	0 %
1966	1 618 188	647 435	203 168	2 %	4 %	2 %
1967	1 404 569	1 249 506	465 035	9 %	0 %	1 %
1968	210 875	1 088 071	876 095	24 %	6 %	0 %
1969	143 791	155 947	699 033	28 %	15 %	2 %
1970	222 635	104 415	92 541	13 %	17 %	4 %
1971	462 474	164 397	65 112	14 %	6 %	2 %
1972	1 221 559	358 357	115 892	20 %	10 %	1 %
1973	1 858 123	947 409	249 400	2 %	19 %	11 %
1974	598 555	1 246 499	583 612	14 %	2 %	9 %
1975	654 442	382 692	627 793	5 %	10 %	3 %
1976	622 230	477 390	233 608	1 %	2 %	1 %
1977	397 826	426 386	280 645	14 %	0 %	0 %
1978	653 256	277 410	198 204	2 %	11 %	0 %
1979	225 935	460 104	164 243	14 %	2 %	1 %
1980	152 937	171 954	300 312	11 %	11 %	0 %
1981	161 752	116 964	116 337	7 %	7 %	4 %
1982	151 642	125 307	81 780	0 %	4 %	1 %
1983	166 310	115 423	82 423	0 %	-1 %	3 %
1984	408 525	133 333	77 728	3 %	0 %	0 %
1985	543 828	324 072	96 327	4 %	2 %	0 %
1986	1 114 252	412 683	219 993	7 %	2 %	0 %
1987	307 425	767 656	268 642	7 %	4 %	0 %
1988	222 819	215 720	490 161	9 %	3 %	2 %
1989	180 066	166 955	151 576	4 %	6 %	0 %
1990	249 968	139 922	114 006	3 %	2 %	1 %
1991	418 955	200 700	105 559	2 %	2 %	0 %
1992	748 962	333 517	151 973	4 %	1 %	0 %
1993	1 002 933	576 112	238 980	10 %	2 %	0 %
1994	896 184	744 062	420 039	9 %	8 %	0 %
1995	733 664	584 808	476 048	10 %	6 %	3 %
1996	467 093	341 918	344 124	3 %	7 %	3 %
1997	765 234	238 202	193 102	3 %	0 %	4 %
1998	836 301	429 147	144 629	2 %	1 %	-1 %

Table 3.31a. Numbers ('000) of NEA cod by length groups and total weight (tonnes) taken as bycatch in the Norwegian Barents Sea shrimp fishery during 1983-2005.

Fish length	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4	0	0	0	0	0	0	0	0	0	1	0	0
5	0	0	1	0	0	0	0	63	0	52	0	4
6	0	0	17	0	0	2	19	316	0	184	149	32
7	0	1	457	7	7	0	42	626	0	1066	101	187
8	863	2	744	36	6	8	111	546	4	644	134	201
9	20	2	1298	61	4	56	49	264	23	1687	934	375
10	293	45	1593	264	8	67	202	306	201	2401	1074	327
11	317	150	1260	161	15	74	2	142	438	2483	2148	278
12	598	191	1311	200	36	88	27	339	866	1762	1074	239
13	250	350	1984	235	80	76	17	421	859	1191	889	182
14	287	382	1776	178	99	92	11	405	903	886	472	148
15	709	460	3193	291	398	94	10	523	597	416	534	182
16	674	493	3476	453	619	54	66	184	707	403	335	265
17	1008	617	3670	441	451	39	95	253	1059	456	308	201
18	1196	596	4548	414	448	110	49	224	636	451	289	214
19	974	699	4044	437	195	188	36	294	689	333	338	158
20	673	754	3960	544	432	251	80	302	1163	248	555	99
21	555	598	4421	635	416	365	44	312	1067	140	450	54
22	384	577	3535	679	466	444	34	234	600	81	469	29
23	376	659	4163	910	935	610	48	152	641	106	504	34
24	88	479	6667	979	923	260	96	72	576	30	252	50
25	259	314	8678	1215	1415	468	82	38	698	28	307	24
>25	3589	4621	53581	9327	9627	9307	6014	2264	1547	0	0	0
Total	13112	11991	114376	17469	16577	12653	7135	8280	13276	15050	11314	3281
Tonnes	5335	4036	49261	8375	7607	10164	11592	5382	2197	287	405	92

Table 3.31a. (continued)

Fish length	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
4	0	7	0	0	0	0	0	0	0	0	0
5	0	33	0	0	0	0	0	0	0	0	0
6	29	25	0	0	0	1	4	0	295	0	0
7	69	209	58	42	54	1	25	21	2697	598	0
8	26	225	209	404	24	4	129	61	1088	105	1
9	194	84	412	4224	115	21	346	182	117	31	5
10	531	62	651	11713	436	116	398	180	214	155	52
11	760	478	5711	13854	292	108	757	115	741	229	130
12	855	1238	4730	7008	332	222	1156	121	1523	234	198
13	709	2084	4443	5908	1243	1423	1302	108	2006	175	265
14	625	2374	2864	3906	1165	892	1289	168	1946	123	194
15	313	1687	2202	1827	1779	820	1117	146	1260	84	177
16	173	1162	982	1574	1372	741	889	139	647	67	139
17	94	934	460	1740	1148	249	851	180	333	62	82
18	88	690	190	915	634	219	672	176	131	68	39
19	19	450	247	1345	408	172	360	126	81	56	20
20	22	263	318	423	258	125	329	105	32	42	9
21	11	24	173	93	152	82	181	65	20	20	4
22	3	10	61	28	48	41	43	22	35	7	0
23	0	4	0	1	0	8	50	13	7	1	0
24	0	4	0	0	0	7	0	5	3	1	0
25	0	0	0	0	0	1	0	3	3	1	0
>25	0	0	0	0	0	0	0	0	0	0	0
Total	4521	12045	23711	55005	9461	5252	9898	1936	13180	2061	1317
Tonnes	86	343	497	980	309	159	294	63	233	37	33

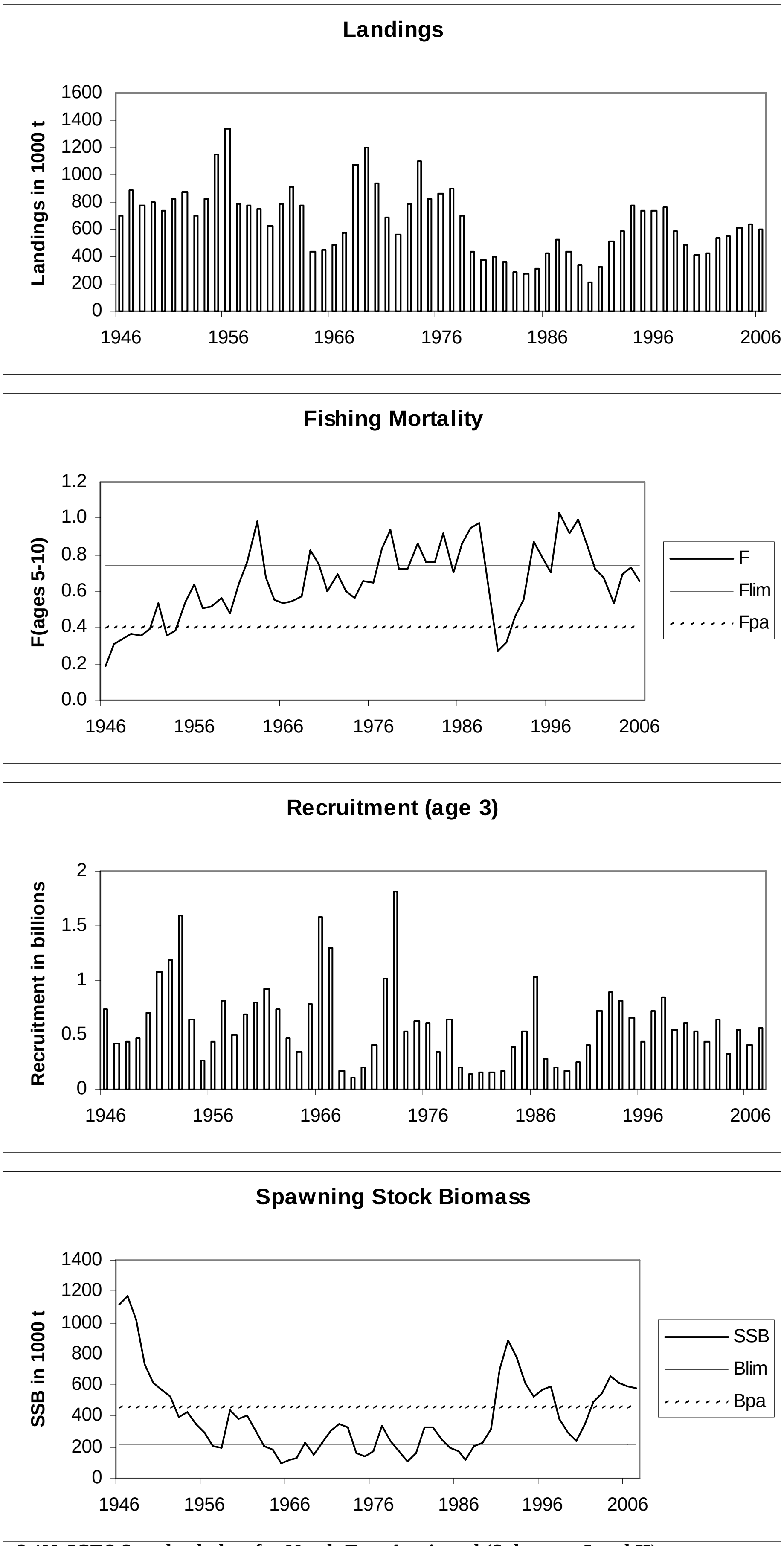


Figure 3.1N. ICES Standard plots for North-East Arctic cod (Sub-areas I and II)

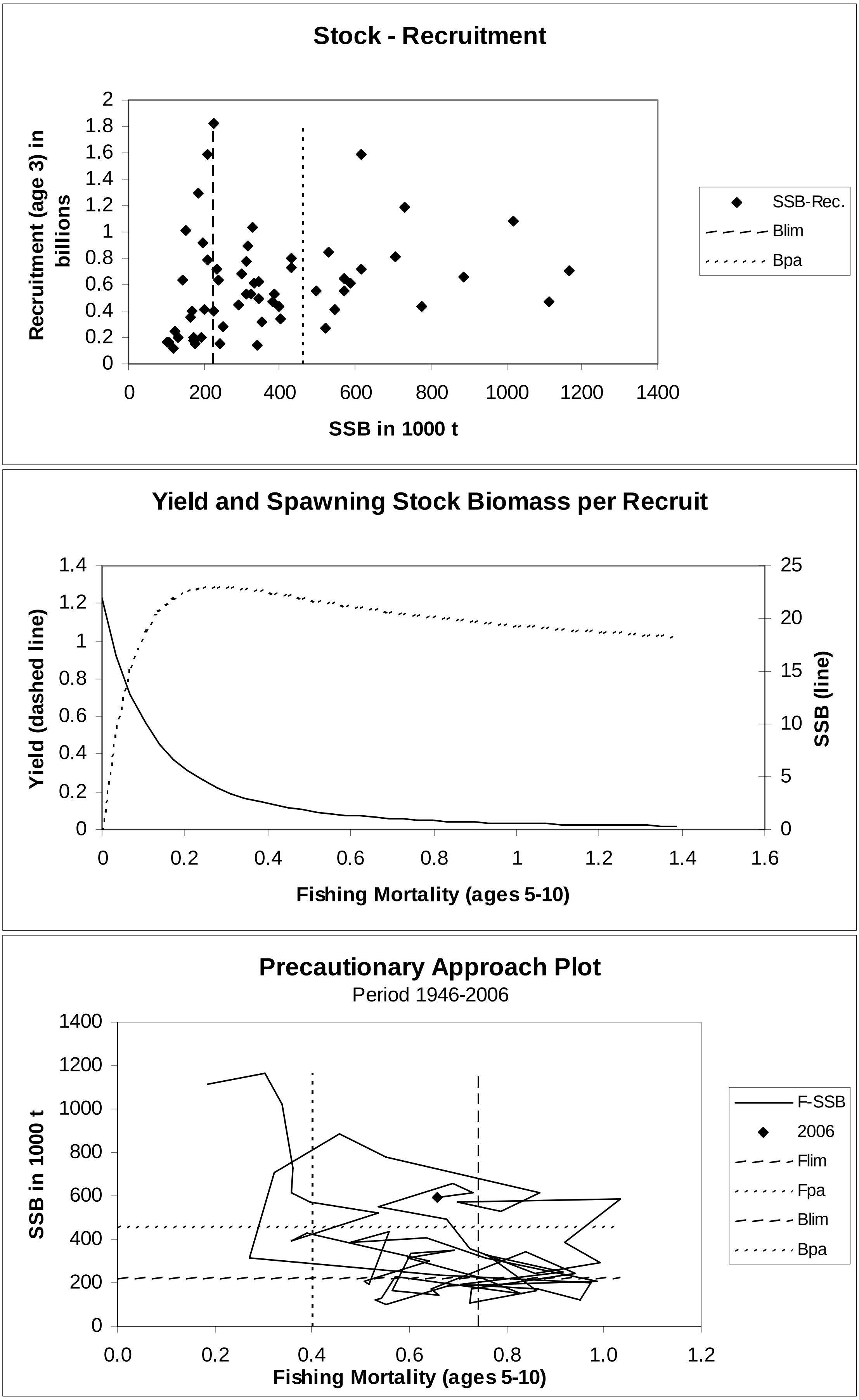


Figure 3.1N. Continued. ICES Standard plots for North-East Arctic cod (Sub-areas I and II)

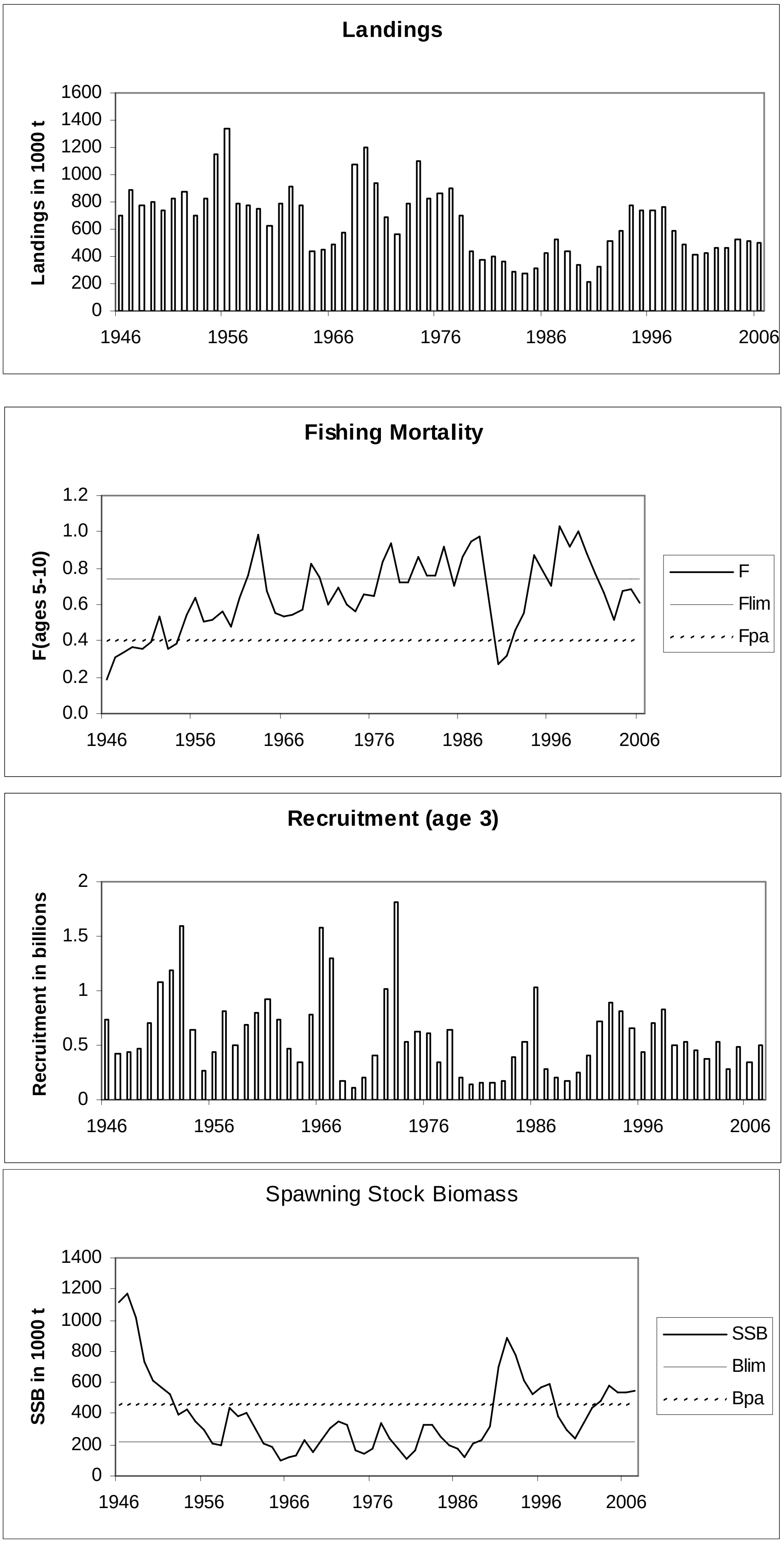
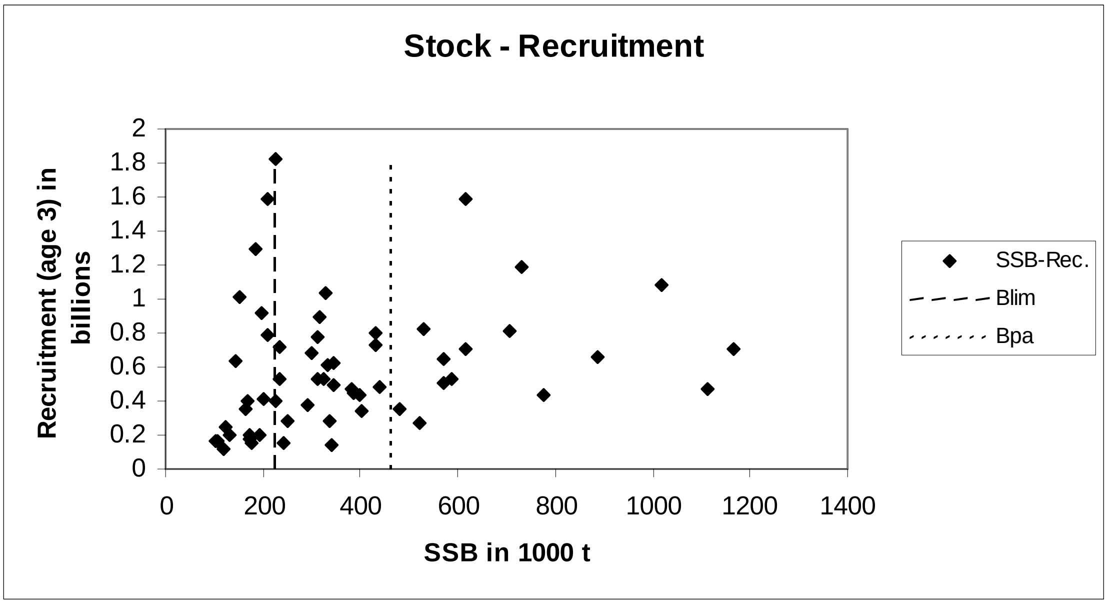
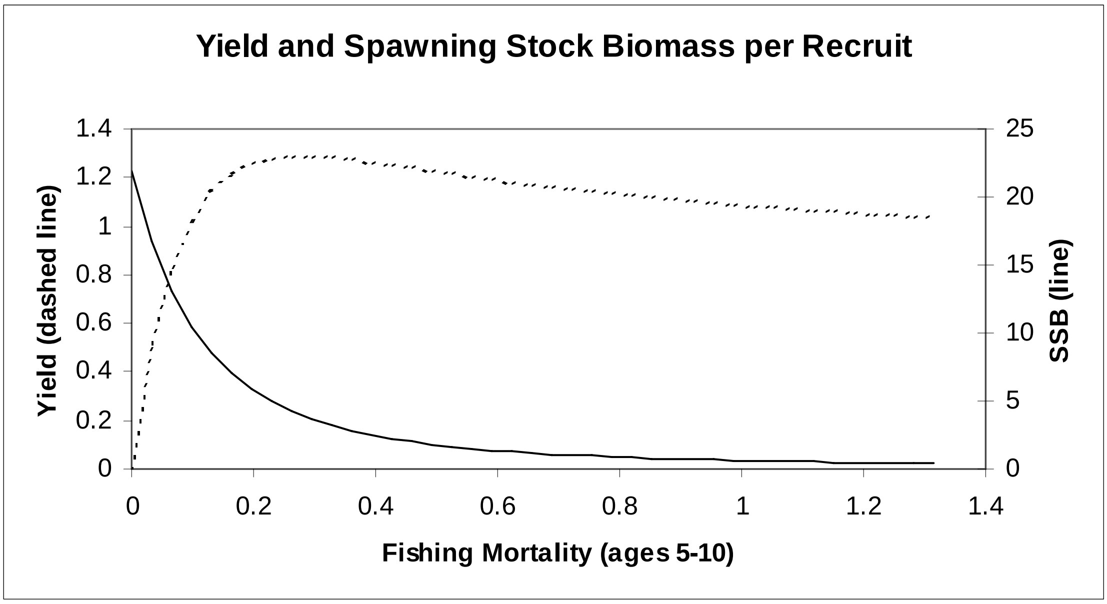


Figure 3.1R. ICES Standard plots for North-East Arctic cod (Sub-areas I and II)





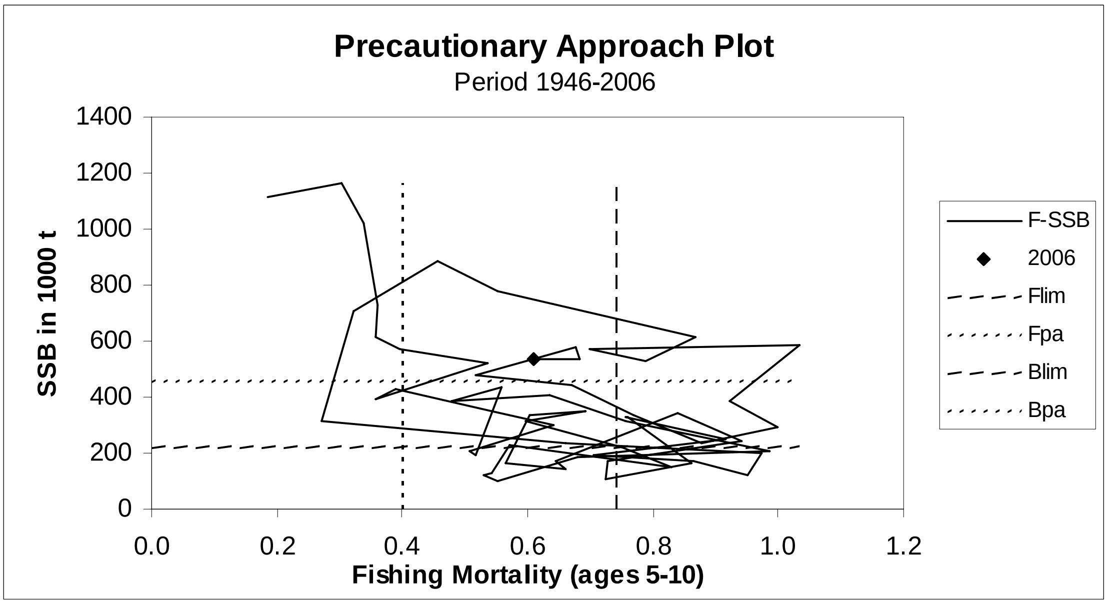


Figure 3.1R. Continued. ICES Standard plots for North-East Arctic cod (Sub-areas I and II)

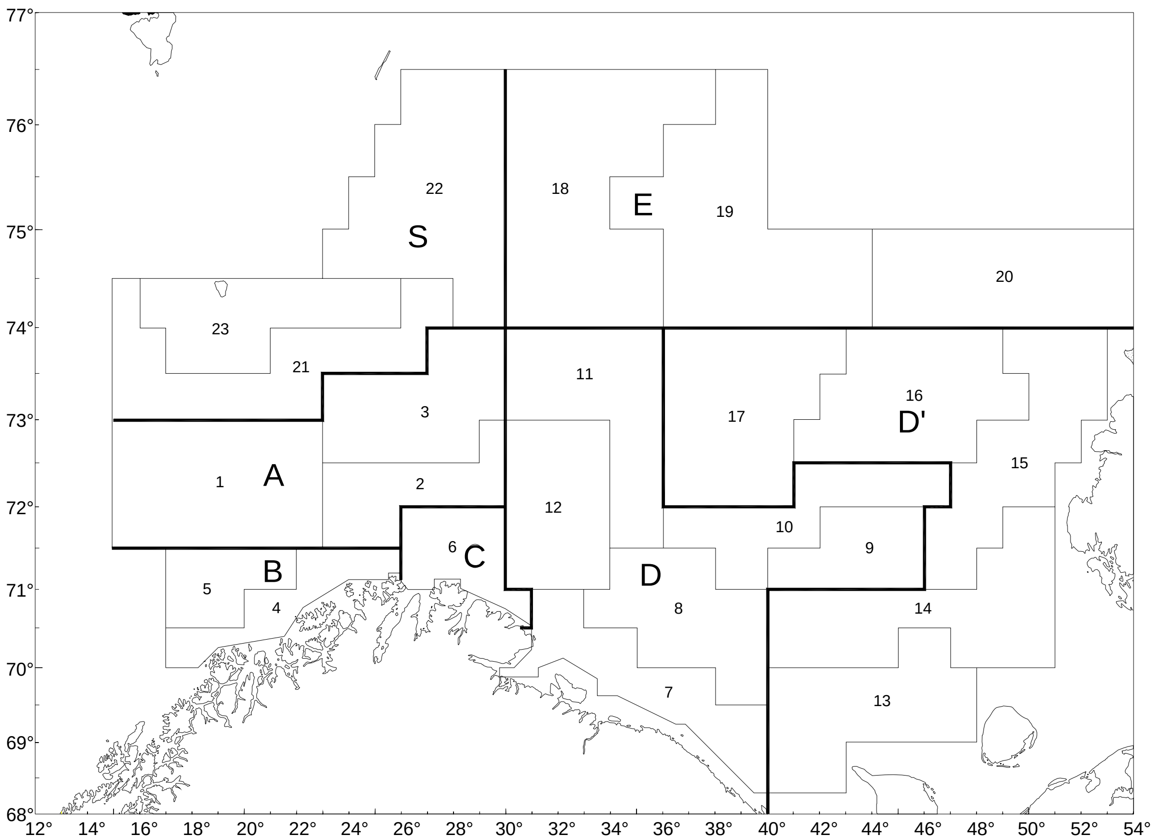


Figure 3.2. Norwegian winter survey Strata (1-23) and Main Areas (A,B,C,D,D',E and S) used for swept area estimations. The Main Areas are also used for acoustic estimation.

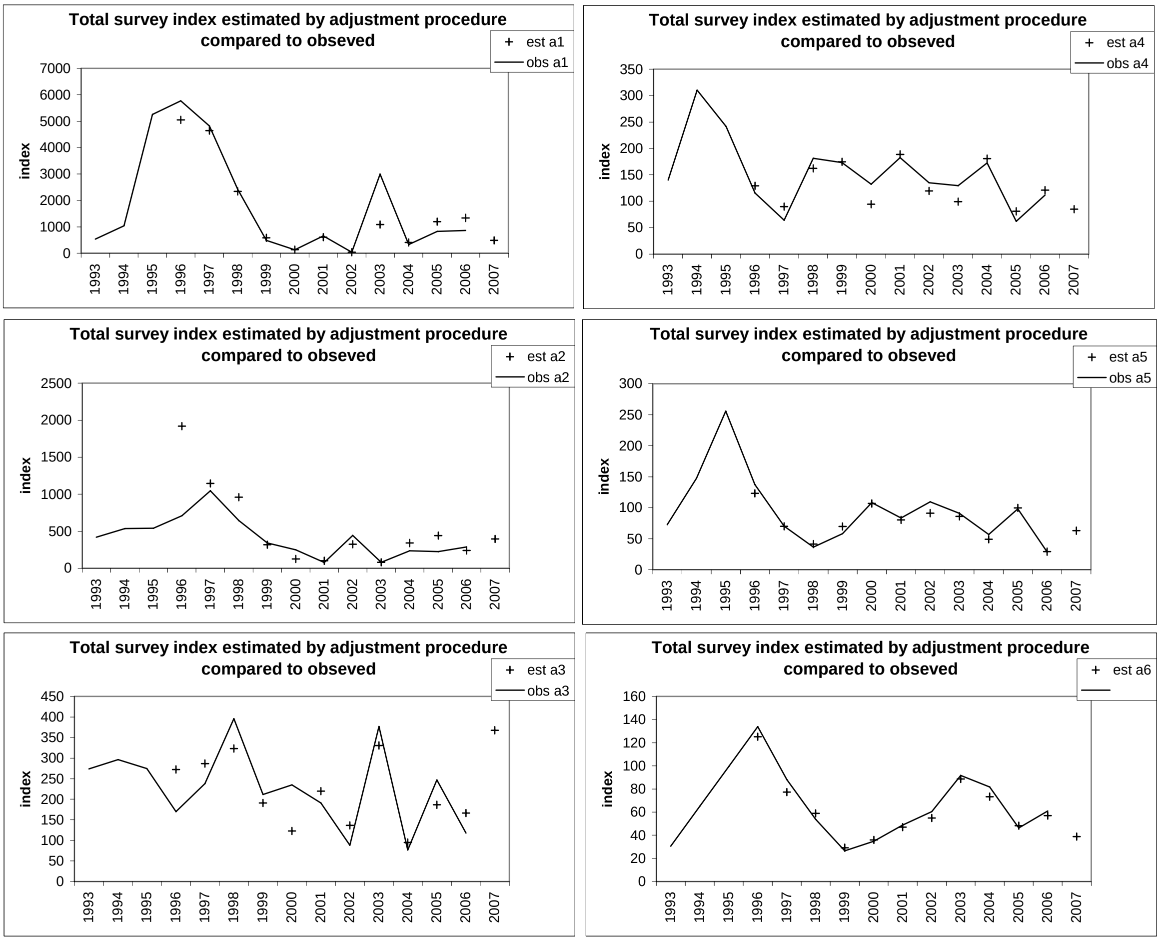


Figure 3.3. Northeast arctic cod. Estimated Norwegian survey indices (+) by described area adjustments and observed indices (line).

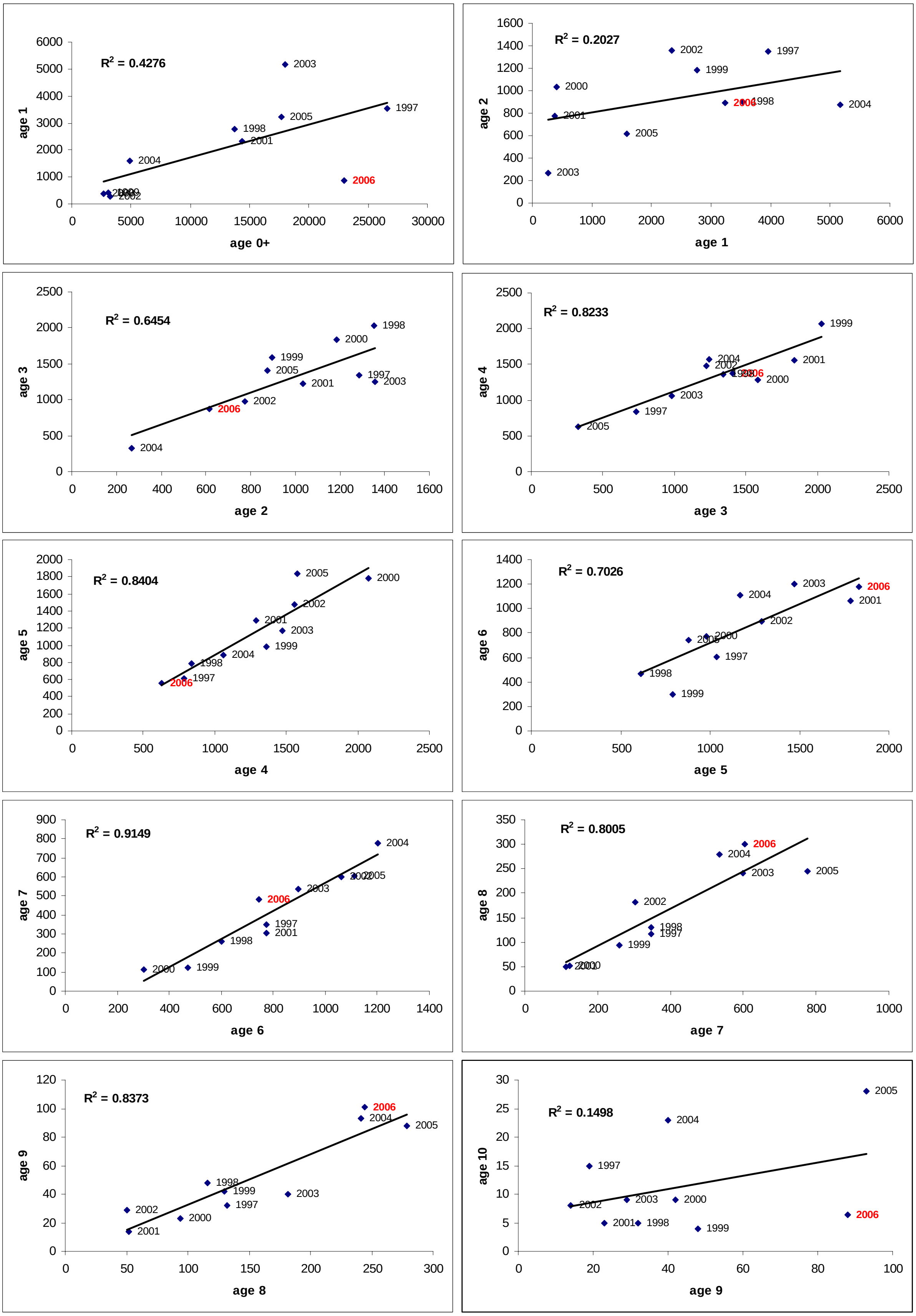


Figure 3. 4. Northeast Arctic cod. Relationships between abundance indices of adjacent age groups for 1996-2006 in the Russian autumn survey.

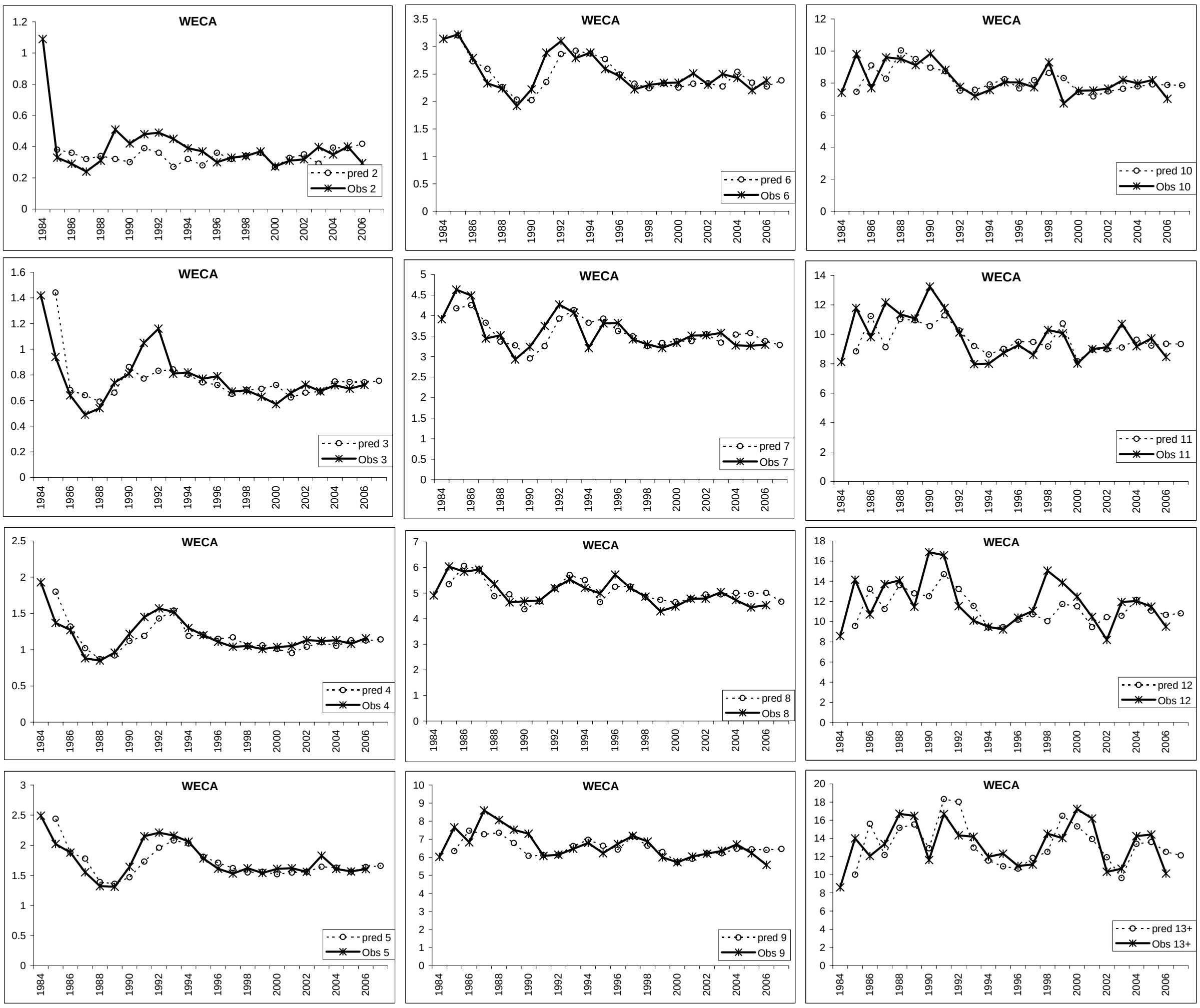


Figure. 3.5a . North-east Arctic cod. Weight in catch predictions.

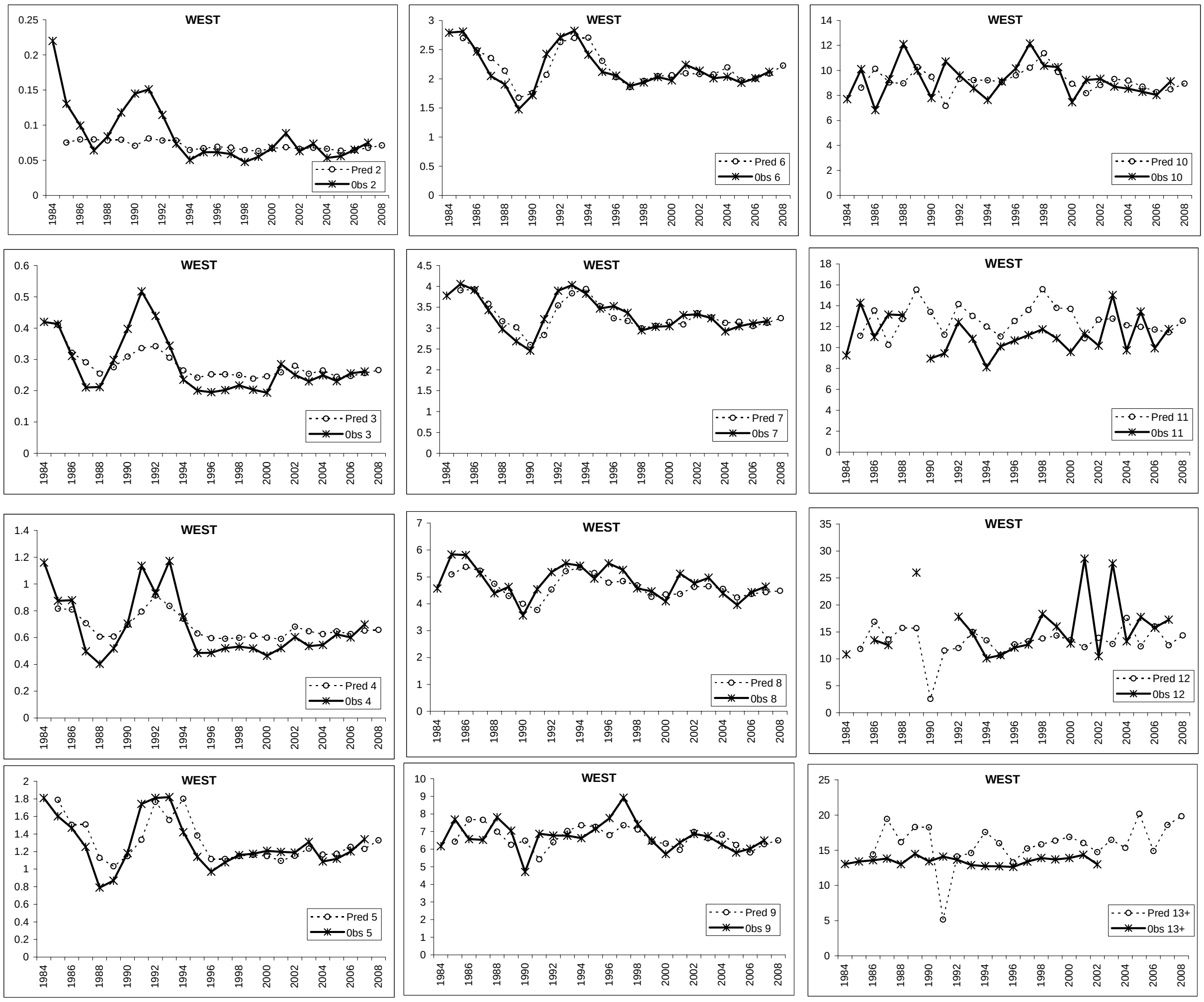


Figure. 3.5b. North-east Arctic cod. Weight in stock predictions.

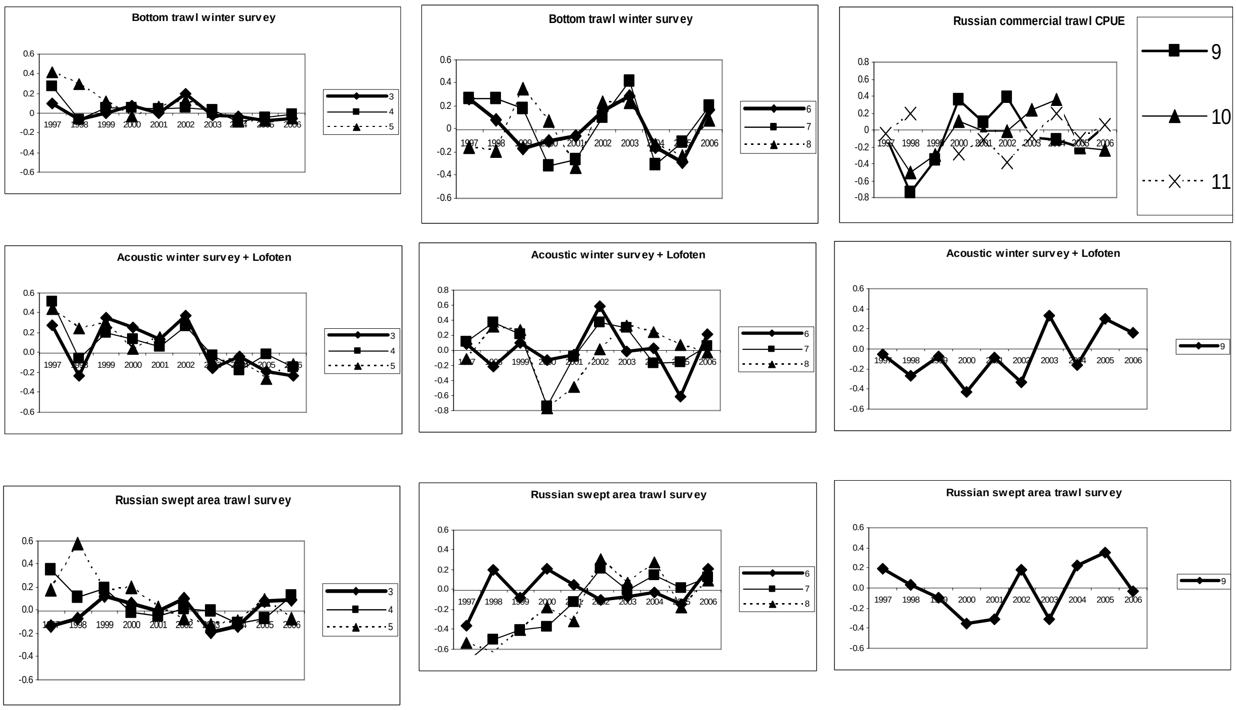


Figure 3.6. Residual log catchability by fleets and ages from the final XSA output in the 2007 assessment (run NOR-IUU).

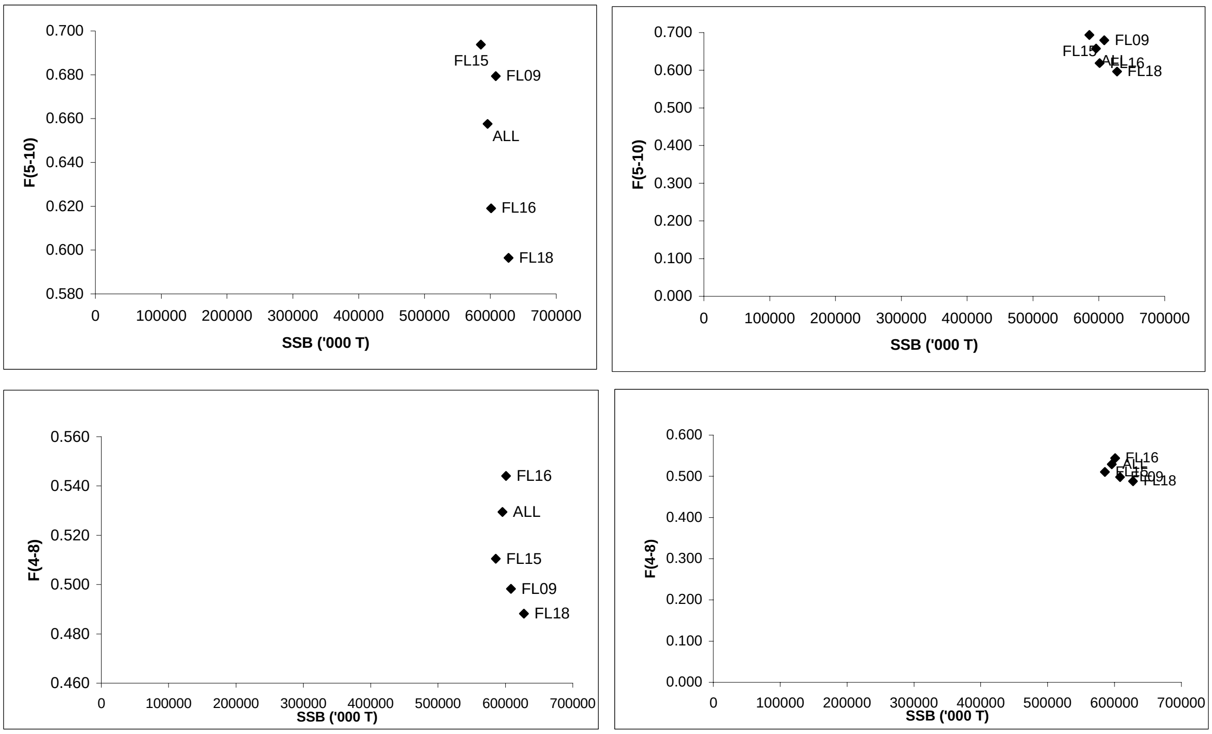


Figure 3.7. Single fleet tuning results before shrinkage by ages plotted against the final run (ALL) (run NOR-IUU) for 2006

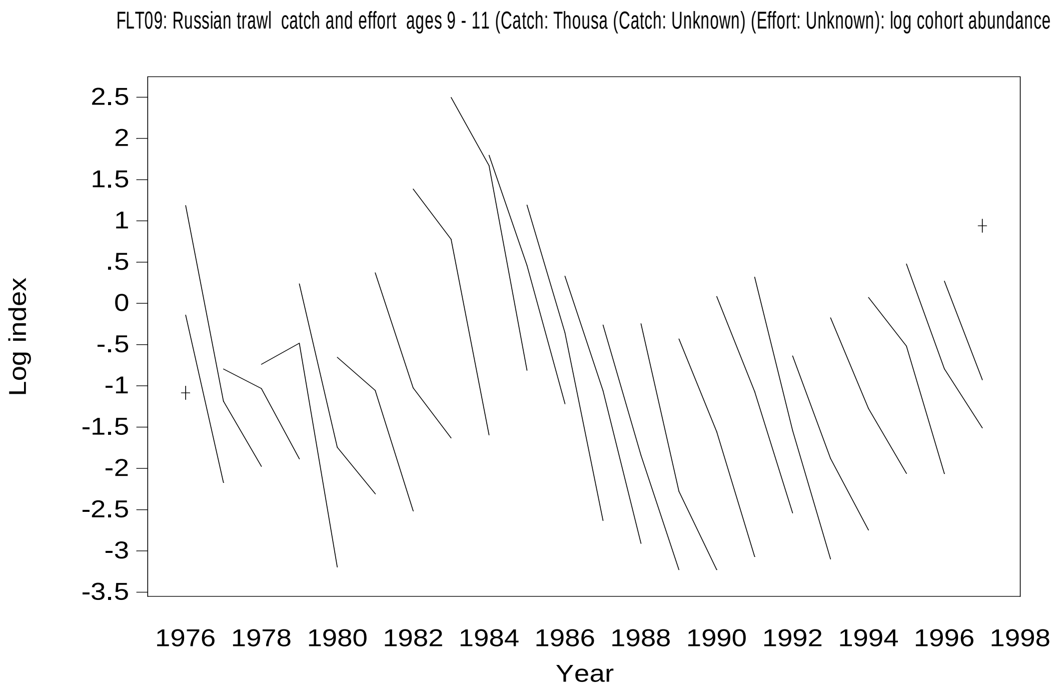


Figure 3.8. Northeast Arctic cod. Standard SURBA plot for fleet 09.

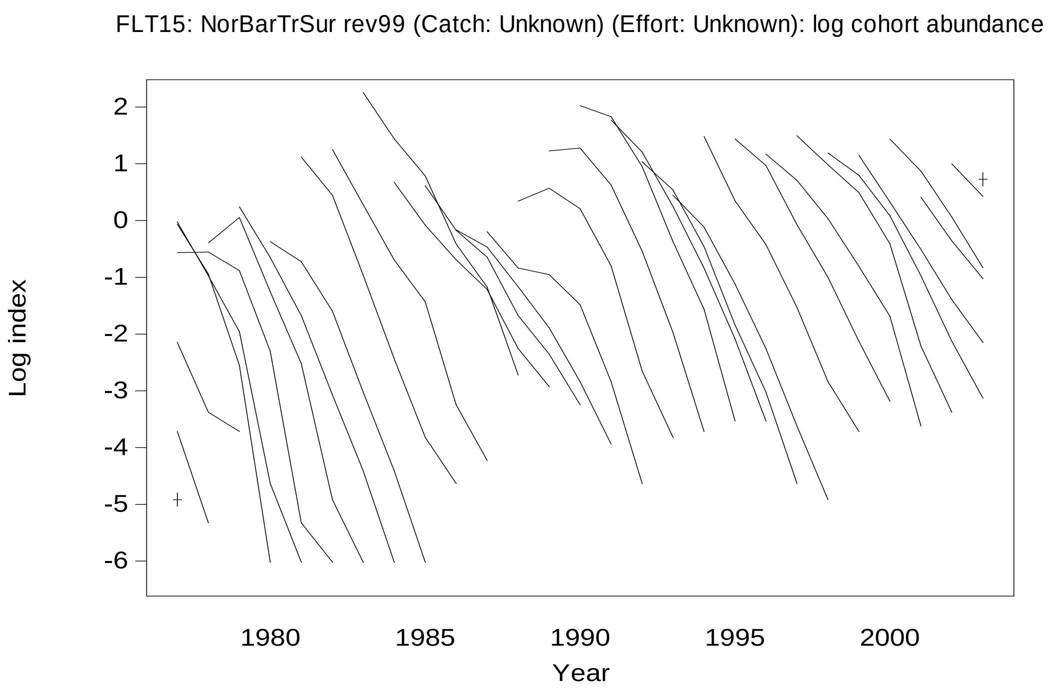


Figure 3.8 (continued). Standard SURBA plot for fleet 15.

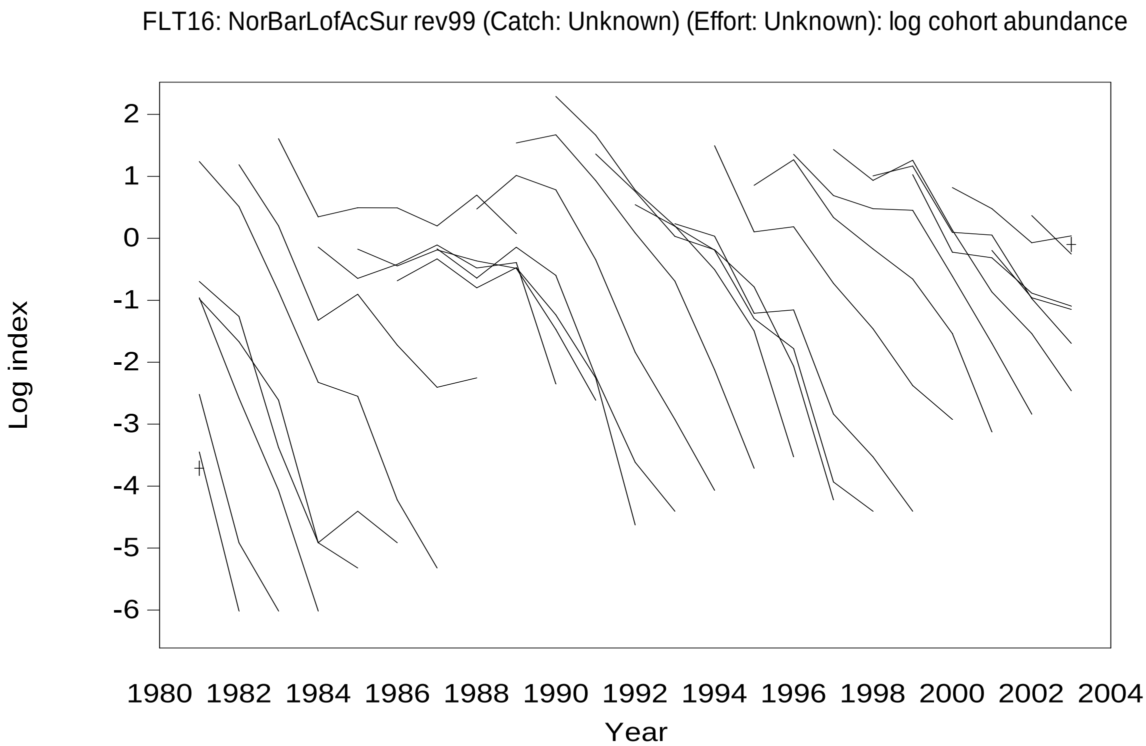


Figure 3.8 (continued). Standard SURBA plot for fleet 16.

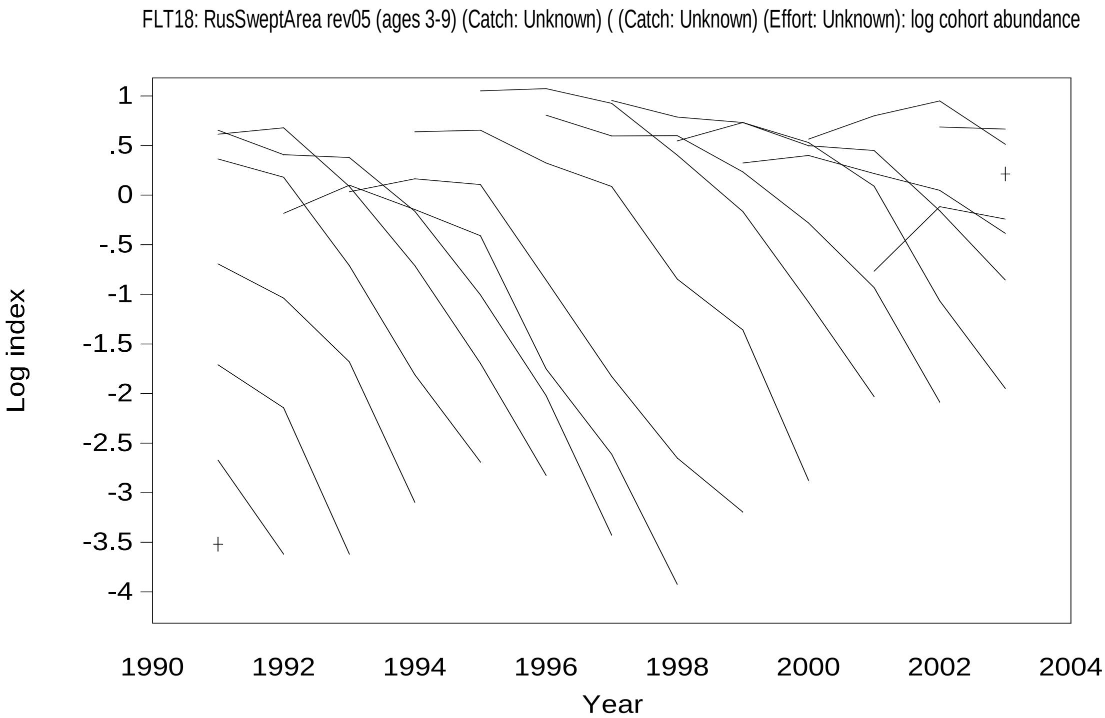


Figure 3.8 (continued). Standard SURBA plot for fleet 18.

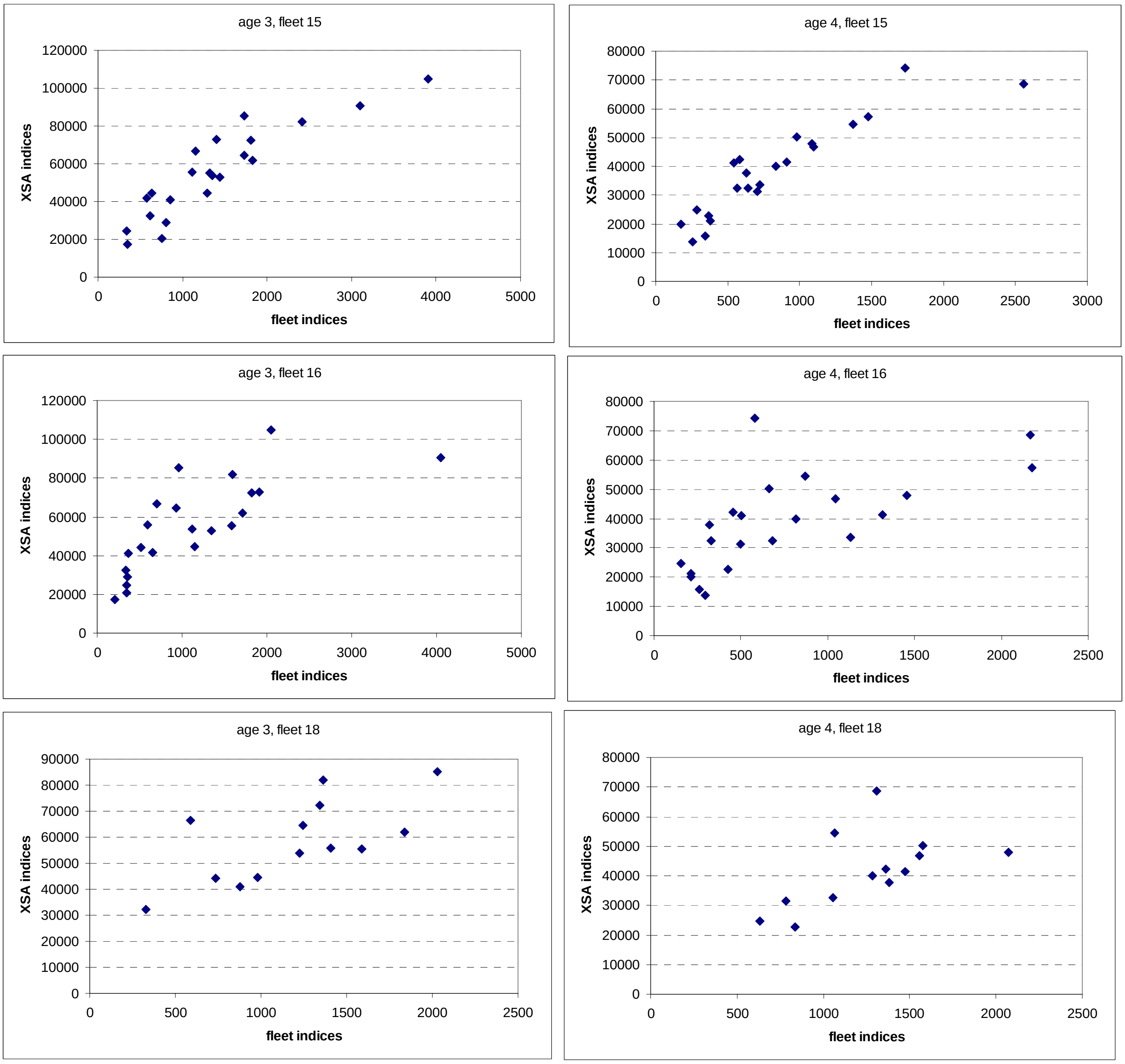


Figure 3.9. Fleet indices for ages 3 and 4 plotted against XSA indices in the 2007 assessment (run NOR-IUU).

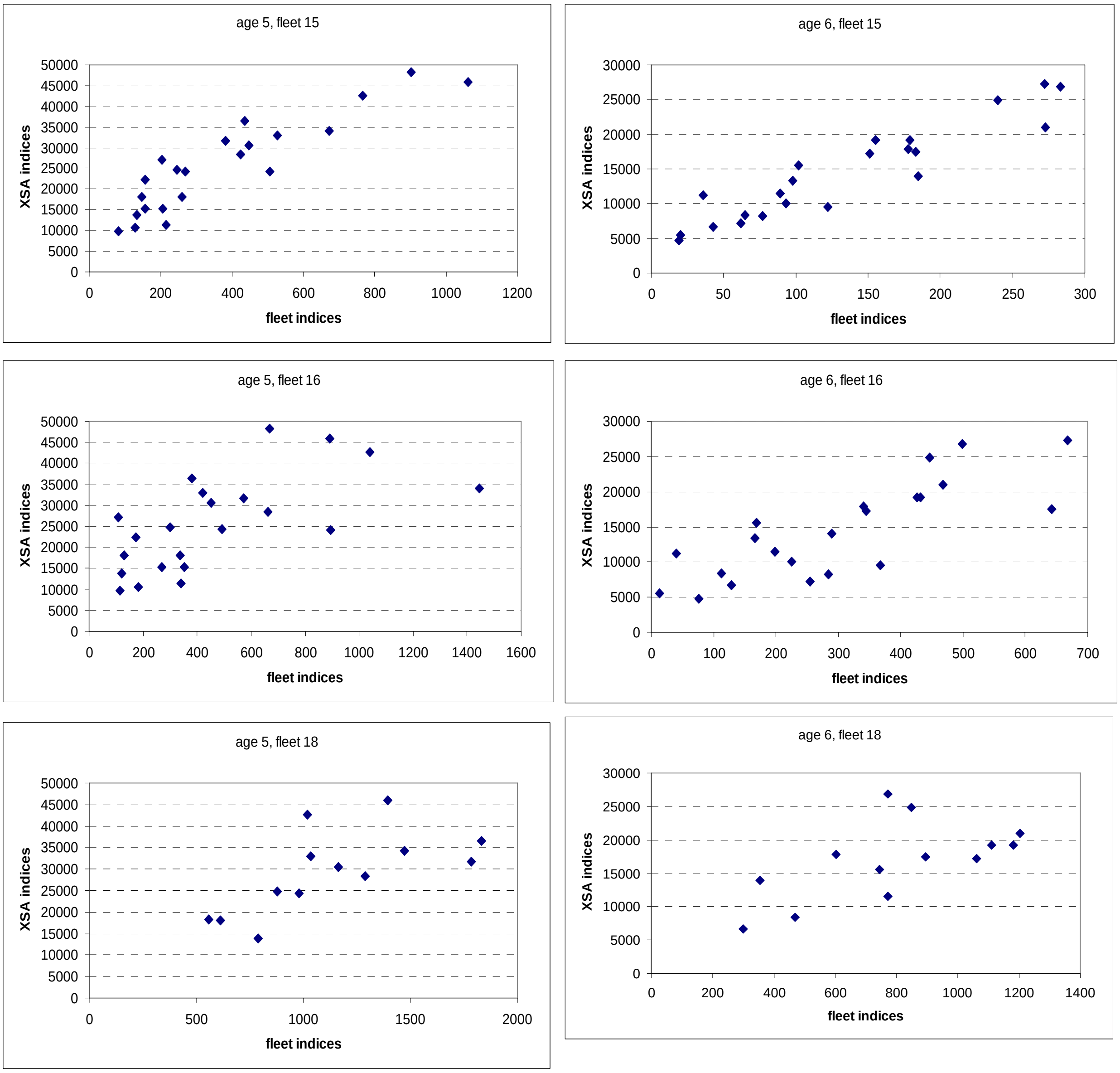


Figure 3.9 (continued). Fleet indices for ages 5 and 6 plotted against XSA indices in the 2007 assessment (run NOR-IUU).

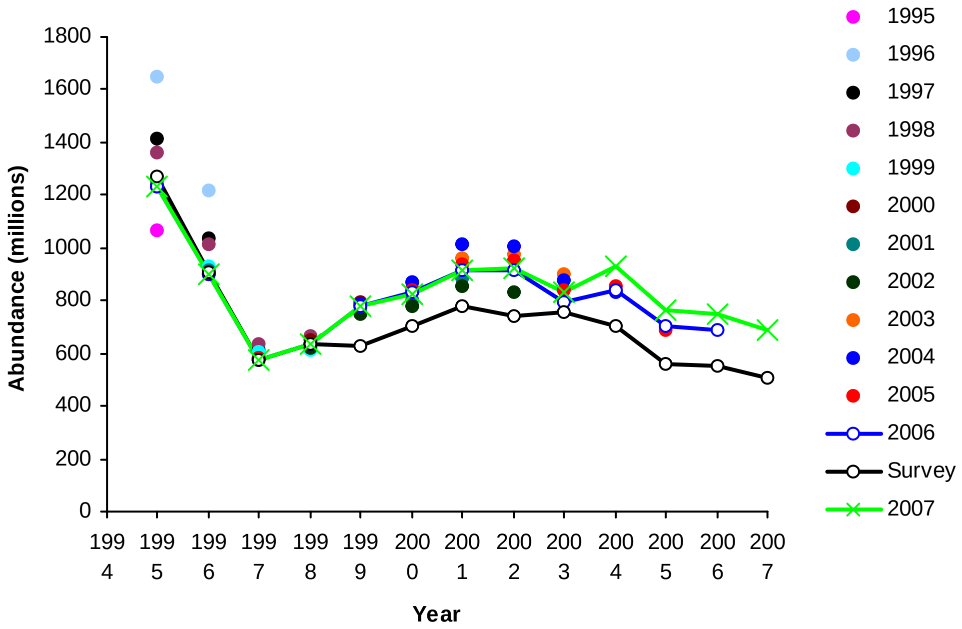


Figure 3.10. Calibrated survey estimates (method described by Pennington and Nakken, WD13, 2006) compared to annual VPA estimates. Number of age 4-6 fish.

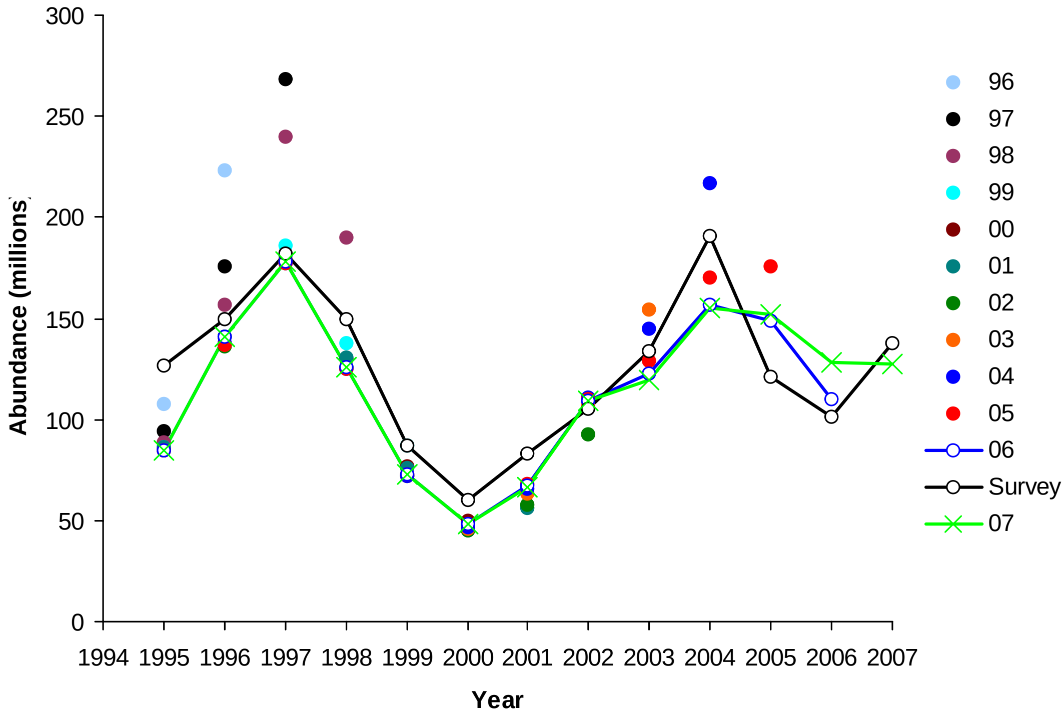


Figure 3.11. Calibrated survey estimates (method described by Pennington and Nakken, WD13, 2006) compared to annual VPA estimates. Number of age 7+ fish.

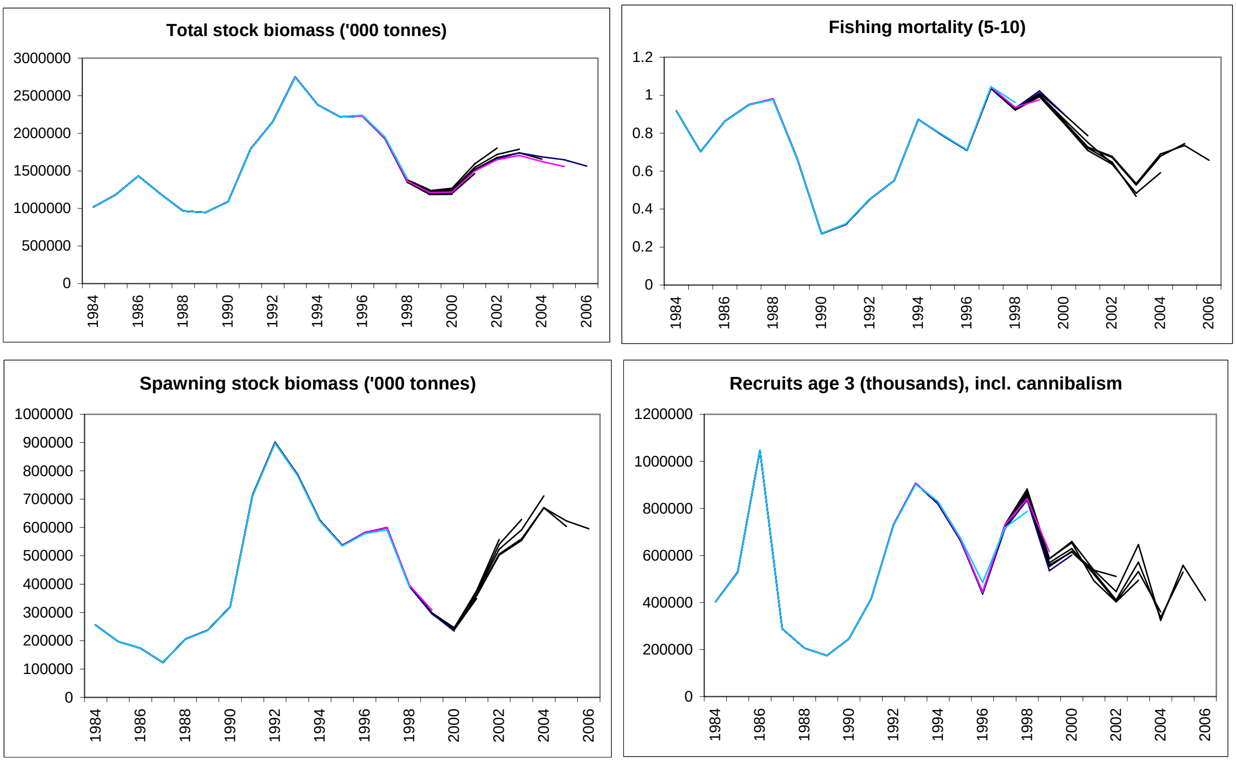


Figure 3.12. Northeast Arctic cod. Retrospective plots with catchability dependent on stock size for ages < 6.

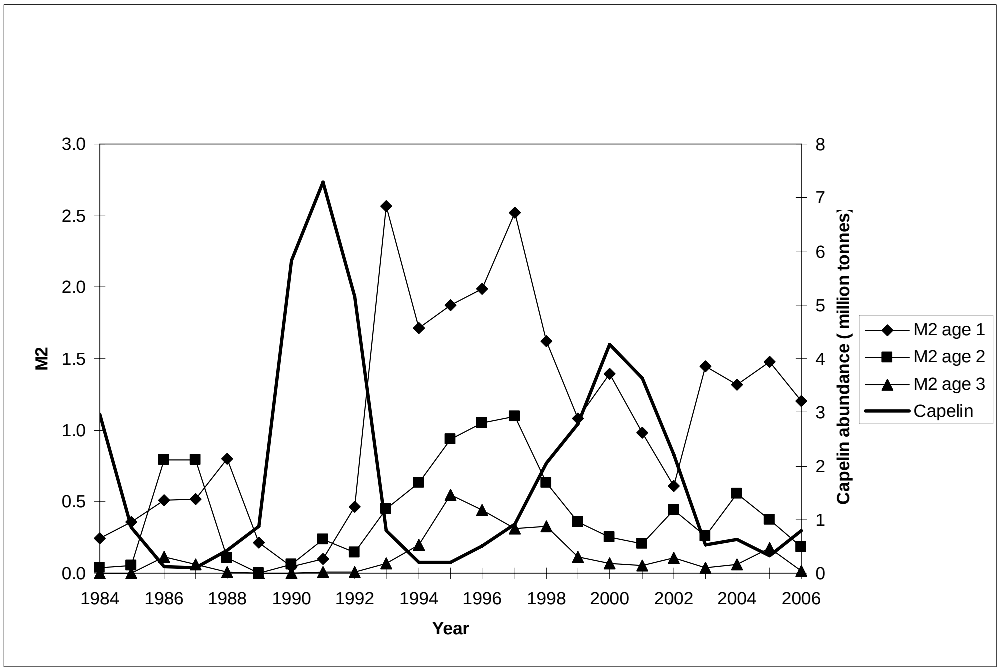
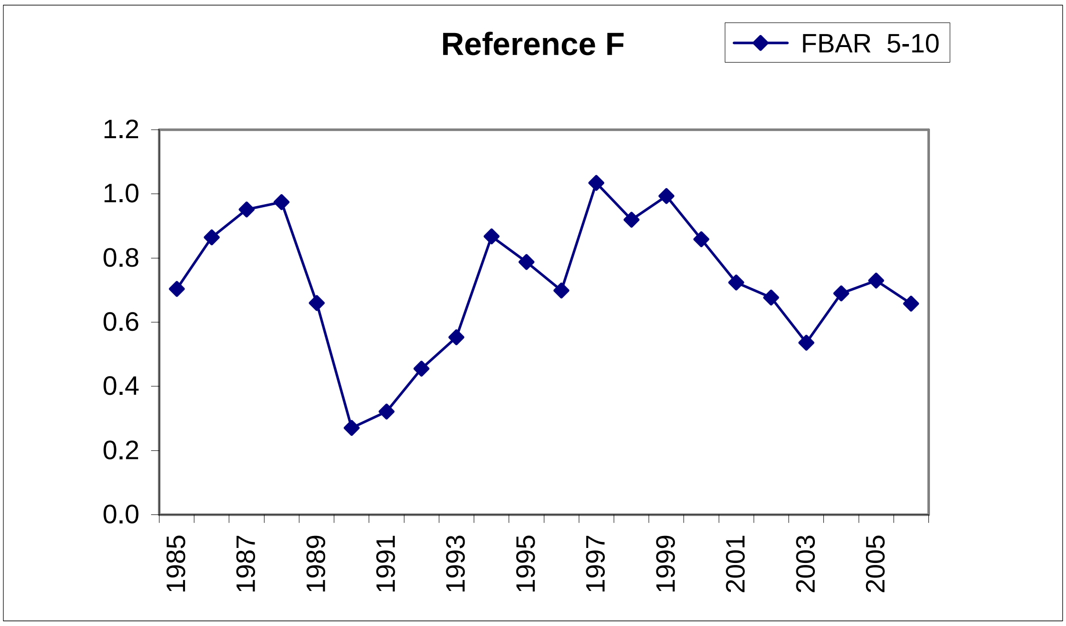


Figure 3.13. Northeast Arctic cod. Temporal trends of cod M2 (cannibalism mortality) for ages 1-3 vs. capelin stock size.



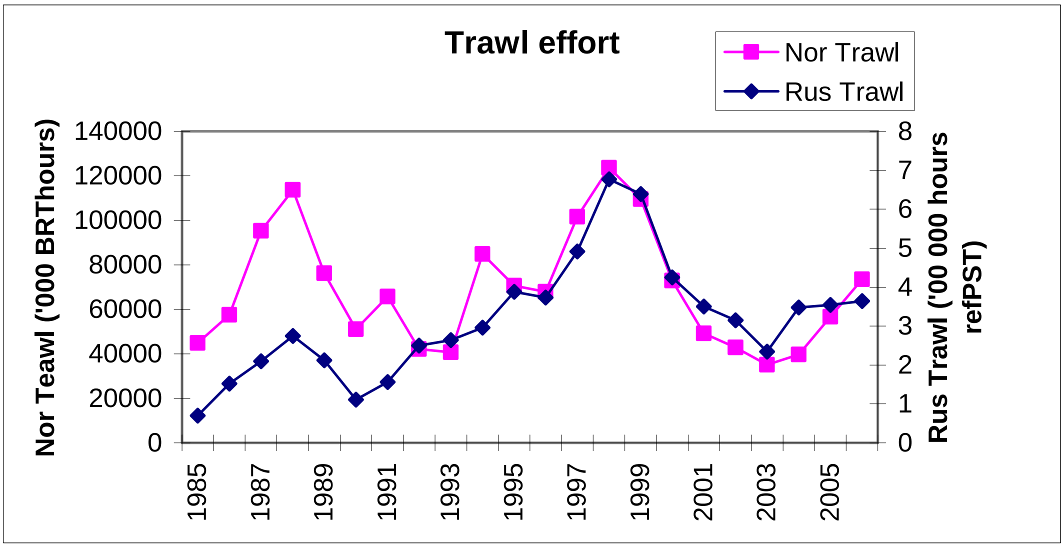


Figure 3.14. Northeast Arctic cod. Fishing mortality ($F_{5\text{-}10}$) (top panel) and trawl efforts in 1985-2006 (bottom panel).

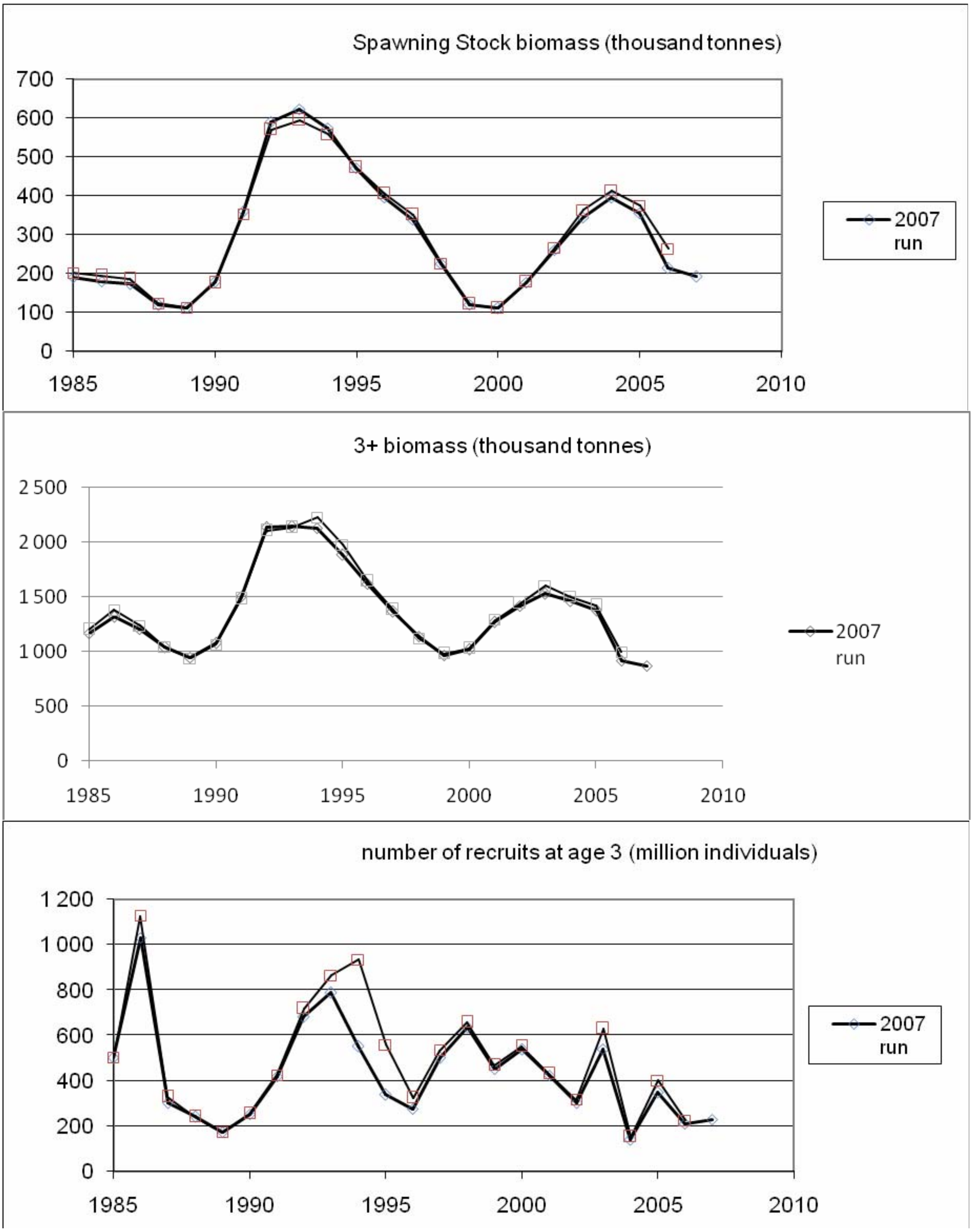


Fig 3.15. Spawning stock biomass, stock biomass (3+) and recruitment from the 2007 Gadget run for Northeast Arctic Cod.

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

	Sub-area I			Division IIb			Division IIa		Total
Year	Norway[2]	UK[3]	Russia[4]	Norway[2]	UK[3]	Russia[4]	Norway[2]	UK[3]	Norway
1960	-	0.075	0.42	-	0.105	0.31	-	0.067	
1961	-	0.079	0.38	-	0.129	0.44	-	0.058	
1962	-	0.092	0.59	-	0.133	0.74	-	0.066	
1963	-	0.085	0.60	-	0.098	0.55	-	0.066	
1964	-	0.056	0.37	-	0.092	0.39	-	0.070	
1965	-	0.066	0.39	-	0.109	0.49	-	0.066	
1966	-	0.074	0.42	-	0.078	0.19	-	0.067	
1967	-	0.081	0.53	-	0.106	0.87	-	0.052	
1968	-	0.110	1.09	-	0.173	1.21	-	0.056	
1969	-	0.113	1.00	-	0.135	1.17	-	0.094	
1970	-	0.100	0.80	-	0.100	0.80	-	0.066	
1971	-	0.056	0.43	-	0.071	0.16	-	0.062	
1972	0.90	0.047	0.34	0.59	0.051	0.18	1.08	0.055	
1973	1.05	0.057	0.56	0.43	0.054	0.57	0.71	0.043	
1974	1.75	0.079	0.86	1.94	0.106	0.77	0.19	0.028	
1975	1.82	0.077	0.94	1.67	0.100	0.43	1.36	0.033	
1976	1.69	0.060	0.84	1.20	0.081	0.30	1.69	0.035	
1977	1.54	0.052	0.63	0.91	0.056	0.25	1.16	0.044	1.17
1978	1.37	0.062	0.52	0.56	0.044	0.08	1.12	0.037	0.94
1979	0.85	0.046	0.43	0.62	-	0.06	1.06	0.042	0.85
1980	1.47	-	0.49	0.41	-	0.16	1.27	-	1.23
					Spain[5]			**Russia**[4]	
1981	1.42	-	0.41	(0.96)	-	0.07	1.02	0.35	1.21
1982	1.30	-	0.35	-	0.86	0.26	1.01	0.34	1.09
1983	1.58	-	0.31	(1.31)	0.92	0.36	1.05	0.38	1.11
1984	1.40	-	0.45	1.20	0.78	0.35	0.73	0.27	0.96
1985	1.86	-	1.04	1.51	1.37	0.50	0.90	0.39	1.29
1986	1.97	-	1.00	2.39	1.73	0.84	1.36	1.14	1.70
1987	1.77	-	0.97	2.00	1.82	1.05	1.73	0.67	1.77
1988	1.58	-	0.66	1.61	(1.36)	0.54	0.97	0.55	1.03
1989	1.49	-	0.71	0.41	2.70	0.45	0.78	0.43	0.76
1990	1.35	-	0.70	0.39	2.69	0.80	0.38	0.60	0.49
1991	1.38	-	0.67	0.29	4.96	0.76	0.50	0.90	0.44
1992	2.19	-	0.79	3.06	2.47	0.23	0.98	0.65	1.29
1993	2.33	-	0.85	2.98	3.38	1.00	1.74	1.03	1.87
1994	2.50	-	1.01	2.82	1.44	1.14	1.27	0.86	1.59
1995	1.57	-	0.59	2.73	1.65	1.10	1.00	1.01	1.92
1996			0.74		1.11	0.85		0.99	1.81
1997			0.61			0.57		0.74	1.36
1998			0.37			0.29		0.40	0.83
1999			0.29			0.34		0.39	0.74
2000			0.34			0.37		0.53	0.92
2001			0.46			0.46		0.69	1.21
2002			0.58			0.66		0.57	1.35
2003			0.70			1.22		0.73	1.67
2004			0.48			0.78		0.84	1.67
2005			0.45			0.62		0.81	1.23
2006[1]			0.49			0.54		0.84	0.88

[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]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	245.2	158.9	142.1	45.4	9.6	4.7	3.0	1.1	985.5
2001	629.9	63.9	138.2	171.6	77.3	39.7	11.8	1.4	0.5	0.2	1134.5
2002	18.2	215.5	69.3	112.2	102.0	47.0	18.0	3.0	0.4	0.3	585.9
2003	1693.9	61.5	303.4	114.4	129.0	114.9	34.3	7.7	1.9	0.5	2461.5
2004	157.6	105.2	33.6	92.8	30.7	27.6	17.0	5.9	1.2	0.2	471.8
2005	465.3	119.6	123.9	33.7	62.8	16.9	14.5	4.2	1.0	0.4	842.4
2006	544.6	216.6	79.8	59.1	15.5	25.6	8.8	4.5	1.4	0.5	956.5
2007 [2]	125.0	61.7	80.3	37.1	30.4	9.1	14.1	5.0	2.1	0.7	365.6

[1] Survey covered a larger area

[2] Adjusted indices

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

	Age										
Year	1	2	3	4	5	6	7	8	9	10+	Total
1981	4.6	34.3	16.4	23.3	40	38.4	4.8	1	0.3	0	163.1
1982	0.8	2.9	28.3	27.7	23.6	15.5	16	1.4	0.2	0	116.4
1983	152.9	13.4	25.0	52.3	43.3	17.0	5.8	3.2	1.0	0.1	313.9
1984	2755.0	379.1	97.5	28.3	21.4	11.7	4.1	0.4	0.1	0.1	3297.7
1985	49.5	660.0	166.8	126.0	19.9	7.7	3.3	0.2	0.1	0.1	1033.6
1986	665.8	399.6	805.0	143.9	64.1	8.3	1.9	0.3	0.0	0.0	2089.1
1987	30.7	445.0	240.4	391.1	54.3	15.7	2.0	0.5	0.0	0.0	1179.8
1988	3.2	72.8	148.0	80.5	173.3	20.5	3.6	0.5	0.0	0.0	502.5
1989	8.2	15.6	46.4	75.9	37.8	90.2	9.8	0.9	0.1	0.1	285.0
1990	207.2	56.7	28.4	34.9	34.6	20.6	27.2	1.6	0.4	0.0	411.5
1991	460.5	220.1	45.9	33.7	25.7	21.5	12.2	12.7	0.6	0.0	832.7
1992	126.6	570.9	158.3	57.7	17.8	12.8	7.7	4.3	2.7	0.2	959.0
1993 [1]	534.5	420.4	273.9	140.1	72.5	15.8	6.2	3.9	2.2	2.4	1471.9
1994 [1]	1035.9	535.8	296.5	310.2	147.4	50.6	9.3	2.4	1.6	1.3	2391.0
1995 [1]	5253.1	541.5	274.6	241.4	255.9	76.7	18.5	2.4	0.8	1.1	6666.2
1996 [1]	5768.5	707.6	170.0	115.4	137.2	106.1	24.0	2.9	0.4	0.5	7032.5
1997 [1,2]	4815.5	1045.1	238.0	64.0	70.4	52.7	28.3	5.7	0.9	0.5	6321.1
1998 [1,2]	2418.5	643.7	396.0	181.3	36.5	25.9	17.8	8.6	1.0	0.5	3729.8
1999 [1]	484.6	340.1	211.8	173.2	58.1	13.4	6.5	5.1	1.2	0.4	1294.4
2000	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
2002	35.3	443.9	88.3	135.0	109.6	42.5	15.1	2.4	0.3	0.2	872.6
2003	2991.7	79.1	377.0	129.7	91.1	67.3	18.3	4.9	1.0	0.2	3760.3
2004	328.5	235.4	76.6	172.5	56.9	44.7	27.3	7.6	1.7	0.4	951.6
2005	824.3	224.6	246.9	62.1	98.1	24.7	15.5	4.5	1.1	0.4	1502.3
2006	862.7	288.4	118.1	111.5	28.7	43.7	10.2	4.9	1.4	0.6	1470.4
2007	485.9	393.9	367.7	85.0	62.9	14.8	17.9	4.8	1.8	0.7	1435.4

[1] Survey covered a larger area

[2] Adjusted indices

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

Year	5	6	7	8	9	10	11	12+	Sum
1985	0.68	7.45	12.36	3.11	1.15	1.01	0.45		26.21
1986	2.49	3.30	5.54	2.71	0.16		0.40	0.08	14.68
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	4.33	17.61	8.03	0.96	0.33	0.36	0.26	0.09	31.97
2002	2.30	19.11	16.50	6.49	0.83	0.31	0.47	0.01	46.02
2003	2.49	29.56	30.01	13.46	1.90	0.11	0.04	0.02	77.59
2004	1.96	17.52	29.82	16.34	7.67	2.04	0.15	0.68	76.18
2005	3.33	12.93	28.75	13.06	6.51	1.55	0.06	0.16	66.35
2006	0.20	12.50	8.11	10.98	7.42	2.12	0.16	0.66	42.14
2007	1.46	3.88	28.52	8.69	5.35	2.8	0.68	0.36	51.72

Table A5. 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
2002	12.2	19.9	30.1	43.6	52.2	61.7	71.6	79.1
2003	12.0	21.2	29.1	39.2	53.3	61.6	70.3	80.7
2004	11.0	18.9	32.0	40.9	52.0	61.8	69.0	79.0
2005	11.5	18.6	29.3	43.0	51.1	60.3	71.1	78.4
2006	12.2	19.9	31.3	42.1	53.5	60.8	68.9	77.7
2007	13.4	21.3	30.7	42.2	52.8	62.3	70.5	77.9

[1] Adjusted lengths

Table A6. 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	103	338	664	1257	2188	3145	4463
2002	15	68	256	747	1234	2024	3190	4511
2003	14	82	228	569	1302	1980	2975	4666
2004	11	58	294	600	1167	1934	2657	4025
2005	13	57	230	705	1135	1817	2948	4081
2006	15	71	288	682	1366	1991	2959	4354
2007	19	78	253	691	1302	2128	3032	4327

[1] Adjusted weights
[2] Estimated weights

Table A7. 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	59.3	66.9	73.2	87.1	88.7	102.8	98.5	128.2
2002	58.6	66.0	73.2	80.8	88.2	101.8	91.0	101.4
2003	62.3	65.0	73.2	80.9	88.9	86.4	120.0	122.0
2004	58.8	64.7	71.2	80.1	85.6	97.0	102.6	115.8
2005	56.3	65.4	72.3	76.0	85.3	95.5	110.5	117.8
2006	56.2	63.7	72.6	77.5	82.9	88.3	89.2	116.3
2007	63.0	66.4	72.4	82.5	88.2	99.8	103.7	115.0

Table A8. 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	1.90	2.72	3.49	6.23	6.82	10.95	10.29	28.58
2002	1.87	2.57	3.52	4.71	6.18	10.56	8.70	10.48
2003	2.30	2.34	3.48	4.59	5.89	8.07	24.50	27.70
2004	1.74	2.30	3.02	4.50	5.77	7.81	9.95	13.25
2005	1.56	2.40	3.20	3.71	5.79	8.52	16.27	18.63
2006	1.54	2.35	3.44	4.19	5.43	6.57	6.19	18.15
2007	2.34	2.67	3.53	5.30	6.70	9.95	11.24	16.62

Table A9 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, rev]	24	82	191	159	127	48	6	3	1	1	642
2001 [1]	38	59	148	204	120	70	14	2	1		656
2002 [1,5,6]	83	2	106	85	140	151	67	30	7	1	672
2003	69	36	25	218	142	167	163	60	23	4	908
2004	375	35	170	85	345	194	229	167	49	19	1669
2005	112	48	65	154	70	214	68	47	17	8	803
2006 [7]	12	20	39	49	78	32	64	23	13	8	341

[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
[6] Area IIa not covered
[7] Area I not fully covered

Table A10. North-East Arctic COD. Abundance indices (millions) from the Russian bottom trawl survey in the Barents Sea

Year	Age											
	0	1	2	3	4	5	6	7	8	9	10+	Total
			Total (Sub-area I and Division IIa and IIb)									
1982	8493	19053	332	1413	1525	721	198	551	174	37	19	32516
1983	18722	20034	732	520	642	506	358	179	252	94	0	42039
1984	3633	1805	1044	1189	700	489	357	154	69	61	17	9518
1985	2846	156	1290	1188	1592	1068	365	165	37	8	16	8731
1986	3299	76	317	1622	1532	1493	481	189	42	2	6	9059
1987	77	13	469	557	3076	900	701	184	60	25	4	6066
1988	925	29	313	993	938	2879	583	260	47	24	1	6992
1989	3558	30	147	490	978	1062	1454	1167	299	112	47	9344
1990	12484	311	510	167	487	627	972	1538	673	153	49	17971
1991	9740	640	911	1077	484	532	583	685	747	98	14	15511
1992	12048	1577	1511	675	308	239	273	218	175	25	4	17053
1993	4848	380	1586	1604	1135	681	416	354	87	3	7	11101
1994	16066	8332	699	1363	1309	1019	354	128	49	21	11	29351
1995	57035	4719	369	589	1065	1395	849	251	83	19	18	66392
1996	26603	3965	1285	733	784	1035	773	348	132	19	5	35682
1997	13714	3539	1353	1342	835	613	602	348	116	32	15	22509
1998	3048	2768	896	2028	1363	788	470	259	130	48	5	11803
1999	2669	401	1184	1587	2072	980	301	123	94	42	4	9457
2000	14365	377	1036	1839	1286	1786	773	114	52	23	9	21660
2001	3216	2338	773	1224	1557	1290	1061	304	50	14	5	11832
2002	17979	267	1356	980	1473	1473	896	600	182	29	8	25243
2003	4895	5175	268	1246	1057	1166	1203	535	241	40	9	15835
2004	17704	1584	875	329	1576	880	1111	776	279	93	23	25230
2005	22980	3239	617	1408	631	1832	744	605	244	88	28	32416
2006	6838	858	895	877	1380	557	1182	482	301	101	6	13477

Table A11 North-East Arctic COD. Length at age (cm) from Russian surveys in November–December.

Year	Age									
	0	1	2	3	4	5	6	7	8	9
1984	15.7	22.3	30.7	44.3	51.7	63.6	73.4	82.5	88.4	97.0
1985	15.0	21.1	30.6	43.2	53.7	61.2	72.8	83.0	92.8	101.3
1986	15.2	19.7	28.3	39.0	51.8	62.2	70.9	83.0	91.3	104.0
1987	-	19.2	27.9	33.4	41.4	59.1	69.2	80.1	95.7	102.6
1988	11.3	21.3	28.7	36.2	43.9	53.3	65.3	79.5	85.0	-
1989	-	20.8	28.8	34.8	46.0	53.9	61.8	69.8	78.7	88.6
1990	16.0	24.0	30.4	46.5	54.9	62.5	69.7	77.6	87.8	102.0
1991	11.5	22.4	30.6	43.0	55.9	64.6	72.8	78.5	87.9	101.8
1992	11.3	21.3	31.9	50.1	59.8	69.1	78.6	84.0	90.8	97.5
1993	12.1	17.4	29.1	43.4	52.7	64.3	73.9	81.2	89.1	91.8
1994	12.2	20.3	26.3	33.7	47.4	58.7	70.6	80.8	90.1	96.1
1995	11.6	19.8	27.6	33.8	45.2	60.5	71.1	83.5	92.9	99.1
1996	10.2	20.0	28.1	36.7	48.7	58.9	70.5	80.0	93.6	102.7
1997	9.6	18.5	28.8	38.2	50.8	62.0	70.5	80.1	88.9	103.5
1998	11.4	19.0	28.0	36.4	50.5	61.0	70.7	80.3	91.1	102.5
1999	11.7	19.7	27.9	35.3	51.6	60.6	70.6	78.9	86.8	94.3
2000	10.7	20.8	30.1	34.7	49.8	61.1	71.6	82.0	88.3	85.7
2001	10.6	19.4	29.8	37.3	50.4	61.9	71.9	81.4	91.0	98.7
2002	10.7	19.2	29.9	38.2	52.5	60.4	70.6	82.2	91.3	97.2
2003	9.8	18.9	28.3	34.9	49.2	62.2	71.0	81.5	92.3	100.9
2004	9.8	19.6	29.3	38.4	49.1	60.0	70.5	80.0	91.0	98.0
2005	11.2	19.4	29.7	38.5	48.7	59.3	69.3	79.2	87.7	96.1
2006	13.0	21.9	31.6	42.7	53.2	60.1	70.2	79.1	88.3	95.2

Table A12 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	379	1,101	2,128	3,341	5,054	6,560	8,497	12,353
2001	9	58	221	459	1,125	2,078	3,329	4,950	7,270	9,541	11,672
2002	8	65	232	505	1,299	1,964	3,271	5,325	7,249	9,195	11,389
2003	6	49	205	492	972	1,993	2,953	4,393	6,638	9,319	11,085
2004	6	55	231	543	1,079	1,798	2,977	4,110	5,822	8,061	12,442
2005	10	59	223	521	1,034	1,910	3,036	4,619	6,580	9,106	12,006
2006	13	72	270	707	1,332	1,953	2,969	4,340	6,410	8,622	12,436

Table A13. Sum of acoustic abundance estimates (millions) in the Joint winter Barents Sea survey (Table A2) and the Norwegian Lofoten acoustic survey (Table A4)

	Age											
Year	1	2	3	4	5	6	7	8	9	10	11	12+
1985	69.1	446.3	153.0	141.6	20.4	15.1	15.7	3.3	1.3	1.0	0.5	0.0
1986	353.6	243.9	499.6	134.3	68.4	11.6	7.7	3.1	0.3	0.0	0.4	0.1
1987	1.6	34.1	62.8	204.9	50.2	17.4	1.4	3.0	0.7	0.0	0.0	0.0
1988	2.0	26.3	50.4	35.5	57.8	10.9	4.0	0.3	0.0	0.1	0.0	0.0
1989	7.5	8.0	17.0	34.4	21.4	67.0	16.6	3.2	0.5	0.2	0.0	0.1
1990	81.1	24.9	14.8	20.6	26.2	26.9	66.8	7.3	0.6	0.3	0.0	0.0
1991	181.0	219.5	50.2	34.6	29.3	33.9	36.7	50.0	3.7	0.2	0.2	0.0
1992	241.4	562.1	176.5	65.8	21.5	18.4	28.4	25.4	82.4	4.3	1.7	0.2
1993	1074.0	494.7	357.2	191.1	113.1	35.4	25.5	25.2	27.7	44.2	4.9	0.8
1994	858.3	577.2	349.8	404.5	217.5	89.5	22.5	11.9	9.4	3.9	18.0	2.7
1995	2619.2	292.9	166.2	159.8	216.6	104.0	29.0	4.4	4.3	3.0	2.6	8.1
1996	2396.0	339.8	92.9	70.5	87.2	89.1	44.6	6.5	1.1	0.4	0.9	1.4
1997	1623.5	430.5	188.3	51.7	49.7	42.2	49.9	20.5	2.2	0.5	0.0	0.8
1998	3401.3	632.9	427.7	182.6	42.4	33.8	34.0	24.7	4.9	0.7	0.2	0.1
1999	358.3	304.3	150.0	96.4	45.4	12.2	11.2	18.7	9.2	1.0	0.2	0.2
2000	154.1	221.4	245.2	158.9	145.7	49.3	12.9	6.9	5.2	1.2	0.6	0.2
2001	629.9	63.9	138.2	171.6	81.6	57.3	19.8	2.4	0.8	0.6	0.3	0.1
2002	18.2	215.5	69.3	112.2	104.3	66.1	34.5	9.5	1.2	0.5	0.6	0.0
2003	1693.9	61.5	303.4	114.4	131.5	144.5	64.3	21.2	3.8	0.5	0.1	0.1
2004	157.7	105.2	33.6	92.8	32.7	45.1	46.8	22.2	8.8	2.2	0.2	0.7
2005	465.3	119.6	123.9	33.7	66.1	29.9	43.2	17.2	7.5	1.8	0.1	0.2
2006	544.6	216.6	79.8	59.1	15.7	38.1	16.9	15.5	8.8	2.4	0.3	0.8
2007	125.0	61.7	80.3	37.1	31.8	13.0	42.7	13.8	7.5	3.3	0.8	0.4

4 Northeast Arctic Haddock (Subareas I and II)

4.1 Status of the Fisheries

4.1.1 Historical development of the fisheries

Haddock is mainly fished by trawl as by-catch in the fishery for cod. Also a directed trawl fishery for haddock is conducted and the proportion of total catches taken by this fishery varies between years. On average approximately 33% of the catch is with conventional gears, mostly longline, which in the past was used almost exclusively by Norway. Some of the longline catch are from a directed fishery, which is restricted by national quotas. In the Norwegian management 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/catches of juveniles and other seasonal and area restrictions.

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 caught as 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.

4.1.2 Landings prior to 2007 (Tables 4.1–4.3, Figure 4.1A)

The official landings for 2005 amount to 118,015 t, and the provisional official landings for 2006 are 131,857 t.

In the last two years, estimates of unreported catches (IUU catches) of haddock have been added to reported landings for the years 2002 and onwards. In 2006 the Working Group decided to base the IUU estimates of haddock on the IUU estimates of cod by applying the haddock-cod ratio from reported catches in ICES Sub-area I and Division IIb. This year, two estimates of IUU catches of cod (Norwegian and Russian estimates of IUU estimates) are presented to the working group based on different data and methods (see Chapter 0.5 for further details). Consequently, there are also two estimates of IUU catches of haddock. For the Norwegian estimates of IUU, the ratio between cod and haddock in the international reported landings from Sub-area I and Division IIb in 2002-2006 is used to estimate the proportion of cod and haddock in the unreported landings. Finally, the unreported landings of haddock these years are estimated by multiplying the proportion of haddock with the total unreported landings of cod during the same time period (see AFWG 2006 for further details). The Russian estimates of IUU haddock is obtained by assuming the ratio Russian estimated IUU haddock to Norwegian estimated IUU haddock equals the ratio Russian estimated IUU cod to Norwegian estimated IUU cod. In both cases the amounts have increased since 2002, and the Norwegian IUU estimate for 2006 is about the same as in 2005 (slightly more than 40,000 t), while the Russian IUU estimates have decreased from 9,950 t in 2005 to 8,889 t in 2006 (Table 4.1).

Also, in 2006 it was decided to include reported Norwegian landings of haddock from the Norwegian statistical areas 06 and 07 (i.e., between 62N and Lofoten) not previously included in the total landings of NEA haddock used as input for this stock assessment (Tables 4.1 – 4.3).

4.1.3 Catch advice and landings for 2006 and 2007

ACFM recommended to set a TAC lower than 112 000 t for 2006, while the agreed TAC for 2006 was 125 000 t by applying the agreed harvest control rule. The provisional reported catch is 131,857 t. The assessment of haddock in 2006 was rejected by ACFM, and the advice was to set a TAC lower than 130,000 t for 2007 based on historical catches and trends in the surveys. The mixed Norwegian-Russian Fisheries Commission agreed on a TAC of 150,000 t which corresponds to agreed 3-year harvest control rule. The reported catch in 2007 is expected to be close to agreed TAC.

4.2 Status of Research

4.2.1 Fishing effort and CPUE (Table 4.2)

After a period of reduced trawl fishery for haddock, it has increased in recent years (Table 4.2). The CPUE series of Norwegian trawl fisheries has previously been updated for tuning of the older ages in the VPA. The basis was 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. The CPUE series was not used for tuning the XSA in the three previous assessments and the series has not been updated with values for the last years.

4.2.2 Survey results (Tables B1-B4, 4.9-4.11, Figures B1-B2)

The overall picture seen in the surveys is summarized as follows: the yearclass 1997 seems to be poor while the 1998, 1999 and the 2001 year classes appear above average. The 2000 and 2003 year classes appear closer to the average, while the 2002, 2004, 2005 and 2006 year classes seem to be well above average. The numbers of 8+ appear at low levels.

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 2007 are given in Aglen (WD 8). The Russian zone was not covered this year, while some areas north of the standard survey area in the Svalbard zone were covered. These additional areas have not been included in the survey estimates.

Before 2000 this survey was made without participation from Russian vessels, while in 2001-2005 Russian vessels covered important parts of the Russian zone. In 2006-2007 only Norwegian vessels carried out the survey again and permit to cover the Russian EEZ was not given in 2007.

Several methods for adjusting the 2007 indices were discussed. For cod and haddock a swept area time series for 1993-2006 corresponding to the 2007 coverage was calculated (WD 8). The time series of ratios between the bottom trawl index in the 1993-2006 coverage and the reduced area (2007 coverage) are significantly auto-correlated for ages 1-4, whereas for ages above 4 the ratios were varying around a constant mean (not shown). Based on these observation two sets of ratios for correction was calculated, one based on the average of ratios for 2004-2006, and one as the 1-step prediction given by fitting the ratios to an AR model (Figure B1). To evaluate the potential correction factors we examined the survey for internal consistency; i.e. examined the relationship between the index at age a in year t with the index at age $a+1$ in year $t+1$ for the years 1981-2006 (Figure B2). If the total mortality is constant over time, the relationships are linear in absence of sampling variability, and deviation from the average is caused by variation in total mortality and sampling variability In particular for the youngest age groups the unadjusted indices misses large parts of the population (Figure B2). Applying the same correction factors for both the bottom trawl index and the acoustic index we find that the adjusted indices are more consistent with the historical indices in the survey, but that they produce higher abundances than ever observed for the bottom-trawl index for age 2 and 3, and for the acoustic index age 2, the average ratio for 2004-2006 more so than the time-series prediction. The working group decided to adjust both the bottom trawl index and the acoustic index by the latter approach, but restrict the indices to the maximum values observed in the time series 1981-2006 (bottom-trawl ages 2 and 3, and acoustic index age 2). The adjusted indices are given in Tables B1 and B3 and shown in Figure B2.

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. For age group 2, the 2004 year class appears equally strong as the 1990 year class. The 2005 year class has the same potential. The year classes 1998 to 2001 have been observed as stronger than the 1992-1997 year classes, while the 2003 year class does not seem to be that strong. The 2006 yearclass appears stronger than average although it is lower than the two preceeding year classes

Russian bottom trawl and acoustic survey

Russia provided indices from the 2006 Barents Sea trawl and acoustic survey (Tables B2, B4a, and B4b, 4.11), which was carried out in October-December. The Russian surveys show 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 is therefore presented in 2 tables (Table B4a and B4b) for old and new method of calculating indices.

Also in the Russian bottom trawl and acoustic survey the coverage of REZ was reduced compared to previous years. The Working group decided to adjust these indices with a similar approach as for the Joint Barents Sea winter survey indices, but instead of using the ratio abundance in total area to abundance in reduced area, it was decided to use the average ratio for the years 2003-2005 of abundance in reduced area to the abundance in the area not covered in 2006 for each age group to adjust the 2006 indices.

International 0-group survey

Estimates of the abundance of 0-group haddock from the International 0-group survey are presented in Tables 1.1 -1.4. There are two new versions of the area based indices, one which is corrected for catching efficiency (Table 1.3) and one without (Table 1.4). The four tables show slightly different pictures, but all tables indicate that the 2002-2006 year classes are very strong. While the 2004 and 2005 logarithmic index is not calculated, the area based indices show even higher values for 2005 and the one corrected for catching efficiency is twice as high as the former record value.

4.2.3 Weight-at-age (Tables B5, B6)

Length and weight-at-age from the surveys are given in Tables B5 and B6, respectively. Weights-at-age are on average about the same as last year.

4.3 Data Used in the Assessment

4.3.1 Estimates of unreported catches (Tables 4.1-4.3)

It have been made two estimates of unreported NEA Haddock catches in 2002-2006 based on two methods of estimating IUU catches (see Chapter 0.5 and 4.1.2). The Working Group therefore decided to make two corresponding assessments of NEA Haddock. They are described in Report as the NOR-IUU-run and RUS-IUU-run, respectively, and the tables are duplicated and labelled N and R, respectively.

4.3.2 Catch-at-age (Table 4.4)

Age and length compositions of the landings for 2005 were available from Norway and Russia in Subarea I and IIb, from Norway, Russia, and Germany in Division IIa. The unreported landings were distributed by ages using catch-at-age matrix for international trawl fleet from Sub-area I and Division IIb for both estimates of unreported catches. The combined catch data were estimated by the SALLOC program (Patterson, 1998). The SOP check gave no deviation from the nominal catch of 2006.

The age distributions and weight at age were for the Norwegian catches were estimated using the software based on the method of Hirst et al. (2005). In this method, the three different types of available samples (age and weight samples, age and weight stratified by length groups and length samples) are modeled simultaneously using a previously developed Bayesian hierarchical model (Hirst et al. 2004).

4.3.3 Weight-at-age (Tables 4.5-4.6, Table B.6)

The mean weight-at-age in the catches were calculated by the SALLOC program (Patterson, 1998) and based on weights in the catches of Russia, Norway and Germany (Table 4.5). The weights-at-age in the catch in 2006 are showing an increasing tendency for most ages.

Stock weights (Table 4.6) used from 1985 to 2006 are averages of values derived from Russian surveys in autumn (mostly October-December) and Norwegian surveys in January-March the following year (Table B6). These averages are assumed to give representative values for the beginning of the year. In 2006 the Working group decided to model the stock weight at age data in order to remove some of the sampling variability in the estimates. The weight at age is modelled as follows: Mean length at age is modeled using a von Bertalanffy model with L_∞ and T_0 parameters estimated over the whole time series and a separate K parameter for each year-class. Weight at age is estimated from a length weight relationship using the smoothed (modeled) length at age. Estimates were produced separately for the Russian autumn survey and the joint winter survey and was later combined as plain average.

4.3.4 Natural mortality (Table 4.7)

Natural mortality (Table 4.7) was set to 0.2+mortality from predation by cod (see Section 4.4.1). The proportion of F and M before spawning was set to zero. For the period from 1984 to 2006 actual data from predation for cod have been used while for the previous years (1950-1983) the average natural mortality for 1984-2006 was used (age groups 1-6).

4.3.5 Maturity-at-age (Table 4.8)

In 2006 the Working group revised the estimates of maturity at age. Previous assessments used relative frequencies per age groups observed during the Russian autumn survey from 1980 and onwards and as constant from 1950-1979.

For the years 1980 and onwards the current series consists of predicted values using a logistic link function with age and length as explanatory variables from the joint winter survey combined with predicted proportions from the Russian autumn survey using:

$$Mat = \frac{1}{1 + e^{(-a*(age-age50\%)}}$$

The new series is based on the data from the Russian autumn survey and the joint winter survey. For the period 1950-1979 an average from both data series is used.

The estimates of maturity-at-age are shown in Table 4.8. The proportions mature at age are lower than historic averages.

4.3.6 Changes in data from last year (Table 4.12)

The new estimates of the unreported catches are presented in Tables 4.1-4.3:

Different values of total catches, catch matrix, weights in the catch and natural mortality in two runs were used while maturity at age and weights in the stock were the same.

Weights in the catch in 2002-2006 have been changed slightly in both runs. As stock weights are modelled (See Chapter 4.3.6) the values of this parameter have been changed slightly both in 1950-1984 for which average values are used and in 1985-2006. The same approach have been used in consumption of NEA haddock by NEA cod estimates and in maturity at age. Data in both runs similar to other parameters showed slight deviation from the data used in 2006. The retrospective performance of the XSA is illustrated in Figure 4.6

4.3.7 Data for tuning (Table 4.9, Figure 4.7)

The following surveys series (Table 4.9) are included in the data for tuning:

Name	Place	Season	Age	Year	prior weight
Russian bottom trawl	Barents Sea	Autumn	1–7	1983–2006	1
Norwegian bottom trawl	Barents Sea	Winter	1–8	1982–2007	1
Norwegian acoustic	Barents Sea	Winter	1–7	1980–2007	1

The indices for the Russian BT survey in the 1990 and indices for 1996-year class were not used for tuning the XSA. Since the 2004 WG meeting the survey data before 1990 have not been used in the XSA run. This decision is based on the analysis of survey residuals and changes in some surveys methodology (See Figures 4.6-4.8, Section 4.4.1 in the 2002 and the 2004 reports). Log catchability residuals plot presented in Figure 4.7

4.3.8 Recruitment indices (Table 4.10)

The table with recruitment indices (Table 4.10) covers the year classes 1980 and later. Similar to XSA turning points from the 1990 Russian BT survey and indices of the 1996-year class were removed from recruitment estimation.

4.3.9 Prediction data (Table 4.11, Table 4.22)

Weights at age and proportions mature at age shows strong cyclic patterns related to periods of good recruitment. The working group believes that the estimated recruitment in the latest years is so high that it will affect growth and maturation processes. The working group therefore decided to use similar trends in weight at age, maturity and natural mortality as has been observed in previous periods following good recruitment. The input data for making the prediction are presented in Table 4.22:

- The estimated recruitment from RCT for 2007-2009 and average for 2010 given in Table 4.22 (different for two runs).
- The average fishing pattern observed in the 3 last years (different for two runs).
- Smoothed observed maturity for 2007, smoothed average maturity for the 1982-1985, 1990-1993 and 2000-2005 yearclasses for 2008-2010.
- Smoothedobserved weights at age in the stock for 2007, smoothed average weights for the 1982-1985, 1990-1993 and 2000-2005 yearclasses for 2008-2010 (the same for two runs).

- The average weights in the catch for the 1982-1985, 1990-1993 and 2000-2005 yearclasses for 2007-2010 (different for two runs).
- Natural mortality – average for the 3 last years (2004-2006) (different for two runs).
- And stock numbers and fishing mortalities from the standard VPA (different for two runs).

4.4 Methods Used in the Assessment

4.4.1 VPA and tuning (Table 4.9)

The Extended Survivors Analysis (XSA) was used to tune the VPA to the available index series (Table 4.9). The settings used by the AFWG in 2006 were not changed:

- The tuning window is set to (1990-2006).
- The F shrinkage was giving a weight corresponding to SE=0.5

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 (1984–2006). The consumption of NEA haddock by NEA cod is given below for two runs corresponding to two assessments of NEA cod (with different level of IUU catches) named as N and R, respectively:

N	Consumption of Haddock by NEA Cod (millions)					
	1	2	3	4	5	6
1984	980.0	14.7	0.1	0.0	0.0	0.0
1985	1203.5	5.2	0.0	0.0	0.0	0.0
1986	563.9	244.9	168.0	0.0	0.0	0.0
1987	766.7	0.0	0.0	0.0	0.0	0.0
1988	17.1	0.5	9.1	0.0	0.2	0.0
1989	230.2	0.0	0.0	0.0	0.0	0.0
1990	143.8	37.8	3.7	0.0	0.0	0.0
1991	457.6	14.2	0.0	0.0	0.0	0.0
1992	2111.1	150.6	1.1	0.0	0.0	0.0
1993	1379.6	165.7	36.8	3.4	2.9	0.0
1994	1412.6	80.6	24.9	7.7	0.9	0.0
1995	2899.8	163.6	12.0	29.7	29.9	0.3
1996	1592.2	161.3	40.2	5.5	2.6	3.4
1997	905.2	35.5	25.5	1.7	0.8	0.5
1998	1533.0	28.2	2.0	2.9	0.5	0.0
1999	907.2	23.6	0.3	0.0	0.0	0.0
2000	1216.5	64.9	2.1	1.1	0.2	0.1
2001	554.0	52.5	4.9	0.1	0.0	0.0
2002	2396.3	229.6	38.3	2.5	0.4	0.2
2003	3622.2	221.3	38.7	12.3	1.2	0.0
2004	2407.0	200.6	21.3	5.7	1.4	0.0
2005	5648.8	263.8	71.6	12.2	3.5	1.1
2006	7135.8	313.4	3.5	4.6	1.2	0.5

R	CONSUMPTION OF HADDOCK BY NEA COD (MILLIONS)					
	1	2	3	4	5	6
1984	980.0	14.7	0.1	0.0	0.0	0.0
1985	1203.5	5.2	0.0	0.0	0.0	0.0
1986	563.9	244.9	168.0	0.0	0.0	0.0
1987	766.7	0.0	0.0	0.0	0.0	0.0
1988	17.1	0.5	9.1	0.0	0.2	0.0
1989	230.2	0.0	0.0	0.0	0.0	0.0
1990	143.8	37.8	3.7	0.0	0.0	0.0
1991	457.6	14.2	0.0	0.0	0.0	0.0
1992	2111.1	150.6	1.1	0.0	0.0	0.0
1993	1379.6	165.7	36.8	3.4	2.9	0.0
1994	1412.6	80.6	24.9	7.7	0.9	0.0
1995	2899.8	163.6	12.0	29.7	29.9	0.3
1996	1592.2	161.3	40.2	5.5	2.6	3.4
1997	901.5	35.4	25.5	1.7	0.8	0.5
1998	1512.9	28.1	2.0	2.9	0.5	0.0
1999	880.3	23.2	0.3	0.0	0.0	0.0
2000	1105.5	62.0	2.0	1.1	0.2	0.1
2001	488.1	47.9	4.6	0.1	0.0	0.0
2002	2054.4	199.9	33.3	2.3	0.4	0.2
2003	3078.8	193.4	34.3	10.9	1.0	0.0
2004	2084.6	174.4	18.9	5.2	1.3	0.0
2005	4894.2	230.9	64.6	11.0	3.2	1.1
2006	6322.6	281.2	3.2	4.3	1.1	0.4

The fishing mortality estimated by these XSA were split into the mortality caused by the fishing fleet (F) and the mortality caused by the cod's predation (M2) according to the ratio of fleet catch and predation "catch". The new natural mortality data set were then prepared by adding 0.2 (M1) to the predation mortality. This new M matrixes (Table 4.7) were used in the final XSA.

4.4.2 Recruitment (Tables 4.10-4.11)

The recruiting year classes 2004-2006 were estimated using RCT3 (input given in Tables 4.10 and output given in Table 4.11) for two runs. The indices for the 1996-year class were removed, as were the indices from the Russian 1990 BT survey. The tuning window was used for the period from 1990 to 2006.

4.5 Results of the Assessments

4.5.1 Comparison of assessments (Fig.4.5)

Both runs show the same trends and similar absolute values, except that the Norwegian estimates of IUU catches yields a larger increase in fishing mortality from 2004 to 2006 than the Russian estimates of IUU catches. Estimates of total biomass and spawning biomass in 2006 are high, and well above average but with a declining tendency. At the same time conflicting trends for the survey based indices of SSB and the XSA estimate of SSB is still observed (for details see Chapter 4.7.2 in AFWG Report in 2006, and 4.6.1 this report) and caused some concern in the working group.

4.5.2 Fishing mortality and VPA (Tables 4.12–4.21 and Figures 4.1A–D)

The tuning diagnostics of the final XSA (predation included) is given in Table 4.12.

Proportion of M and F before spawning was set to 0 and given in Tables 4.13 and 4.14. Fishing mortality and relative fishing morality are given in Tables 4.15 and 4.16 respectively, while the stock numbers and spawning stock numbers, stock biomass at age and the spawning biomass at age of the final VPA are given in Tables 4.17, 4.18, 4.19 and 4.20. A summary of landings, fishing mortality, spawning stock biomass, and recruitment since 1950 are given in Table 4.21 and Figures 4.1A, 4.1B, 4.1C and 4.1D.

Assessments based on higher values of IUU NEA Haddock catches labelled as N demonstrates an increasing trend of fishing mortality for the last three years while the run labelled as R Fbar was very stable. Estimates of fishing mortality were not critically higher than Fpa in the first run (0.39) while in the second run it was lower than Fpa (0.31).

Fishing mortality is currently estimated much lower than the long term mean, but in run N it is increasing, which is typical for years following periods of strong yearclasses.

The largest contribution to the total and spawning stock in 2006 was made by 2001 and 2002 yearclasses.

4.5.3 Recruitment (Tables 4.11, Figure 4.1C)

The strength of the recruiting yearclasses is given in the table below (numbers in millions at age 3) for two runs. The numbers marked with * are XSA estimates, and the rest is RCT results (Table 4.11). The recruitment time series are shown in Figure 4.1C.

N	Year of assessment		
Year Class	2005	2006	2007
2000	197*	237*	236*
2001	176*	219*	224*
2002	295	313*	339*
2003	156	183	135*
2004	462	755	672
2005		521	731
2006			463
R	Year of assessment		
Year Class	2005	2006	2007
2000	-	-	212*
2001	-	-	203*
2002	-	-	310*
2003	-	-	125*
2004	-	-	611
2005		-	658
2006			427

4.5.4 Catch options for 2008–2009 (Tables 4.22 - 4.24)

Input to the predictions are given in Table 4.22. The estimated catch in 2006 correspond to F=0.39 and F=0.31 and the corresponding estimated spawning stock biomass are 221 000 and 238 000 t in the beginning of 2007 in runs labelled N and R, respectively. In each of the two runs, the average corresponding F for last three years was used for 2007.

The deterministic projection shows a slight increase in SSB for both runs in the beginning of 2008 (table 4.23)

Fishing at $\mathbf{F}_{pa}$ in 2008 corresponds to total landings of 178 000 t in both runs, keeping the SSB in the beginning of 2009 on high level in the range 256 000–261 000 tons (table 4.24).

Fishing in period 2008-2010 with F corresponding to agreed harvest control rule is equal to total mean landings of 222 000 and 215 000 t in 2008 correspondingly in runs N and R. But the 25 % limitation restricting the TAC leads to decrease in its level for both runs to 187 500 t (+25 % to agreed TAC in 2007 equal 150 000 t).

4.6 Comments to the assessment and forecasts

This table reflects mainly uncertainties in assessment and forecasts.

Source of uncertainty	Description	Comments
Incomplete survey coverage (1)	Since 1997 has all of the surveys used for tuning been affected by an incomplete coverage for some of the years. (Due to Norwegian vessels not been given access to REZ, Russian vessels not been given access to NEZ).	All indices affected have been corrected using a factor based on geographical distributions observed before and after the incomplete coverage. This procedure is likely to introduce increased uncertainty to the indices (see WD 8 and 4.2.2).
Incomplete survey coverage (2)	None of the surveys have a complete coverage of the stock. The proportion of a year class being outside the coverage varies between year classes (see also the WG report from 2002). The most recent "extreme" case is the 1996 year class (deleted from tuning).	May appear as yearclass dependent changes in survey catchability. This year catches of haddock in Norwegian statistical areas 06 and were added to the NEA haddock. These include haddock of older ages compared to the landings of NEA haddock. Since the surveys don't cover the coastal regions this indicates that the older ages are covered more poorly.
Correlated error structures	Year effects in a survey are quite common. The year effect introduces correlated errors between the age groups, but in this case also between survey series.	
Discards	The level of discarding is not known.	Discarding is known to be a (varying) problem in the longline fisheries related to the abundance of haddock close to, but below the minimum landing size.
Unreported catches	This year, estimates for unreported catches were provided for 2002-2006.	The estimates are considered quite uncertain.
Predation on young yearclasses	The survival due to predation (to a large extent by cod) varies substantially from year to year.	The predictions of young yearclasses are very uncertain, escpecially for the 3-years HCR.
Sampling error	Estimation of catch at age is based on sampling catches. The uncertainty in the estimates caused by sampling can be considerable for some age groups in some years even if the total catch is known. The estimation of the abundance indices from surveys will also be affected by sampling error.	The effect of not taking sampling error into account when fitting models to data may introduce bias in the resulting estimates. This bias is likely to increase with sampling error.

4.6.1 Uncertainty in the assessment

To elaborate on the uncertainty in the present assessment of haddock we have undertaken 3 analysis: 1) compared the XSA-results to survey indices 2) sensitivity analyses of settings in XSA and 3) consistency in survey series and estimates of catch at age.

There is a conflict in the temporal trend between the survey-based indices of SSB and the XSA estimates of SSB (Figure 4.11), i.e. the XSA estimates relatively higher SSB in the recent years than survey-based indices of SSB. All surveys show a similar trend although there seem to be some noise in the age composition. It is difficult to detect this conflict when inspecting the log residual plots (Figure 4.7).

The XSA run uses density dependent (2 parameter) catchability for ages up to and including age 6. An exploratory run (not shown in the report) using density dependent catchability only for the 2 youngest age groups increased the XSA SSB-estimate in the most recent period thus being even more in conflict with the signals in the surveys.

Furthermore, we examined the sensitivity to varying the XSA-settings using the FLR implementation of XSA (http://www.flr-project.org/doku.php) to screen over various XSA-settings. The results are summarized in Figure 4.8 and our overall impression is that the “conflict” is not caused by any of these XSA settings.

Log transformed indices and log transformed catch at age are shown in Figure 4.9. A trained eye is able to interpret the log indices plot where lines connect both cohorts and agegroups as a 3-dimensional “landscape”. This kind of interpretation suggest that the indices from the Norwegian acoustic and Russian bottom trawl surveys are slightly more “noisy” than the indices from the Norwegian bottom trawl. There is nothing to suggest that the consistency of the survey series are causing the problems. The plot of log catch at age numbers is more difficult to interpret, but the reduced slopes over cohorts (particularly ages 4 to 6) for the last few years correspond of course with the reduced fishing mortality estimated in the XSA.

Conclusion

The assessment should be treated with caution.

4.7 Biomass and fishing mortality reference points

In 2006 the data used in the assessment were revised for the entire time series, and some additional catches previously not included into statistic (Norwegian statistical regions 06 and 07) have been added (see AFWG 2006 for a detailed description). The reference points have not been updated accordingly. However, the biomass reference points previously adopted and currently used by ACFM for this stock are $\mathbf{B}_{\text{lim}}$=50,000 t and $\mathbf{B}_{\text{pa}}$ =80,000 t. The fishing mortality reference points are $\mathbf{F}_{\text{lim}}$=0.49 and $\mathbf{F}_{\text{pa}}$ =0.35 (Figure 4.4). Due to time constrain there was no work done during the AFWG meeting on revising the reference points of NEA haddock. The WG will therefore recommend that this work should be done intersessionally. A plot of SSB versus recruitment is shown in Figure 4.2. Yield and SSB per recruit (YPR and SPR) are presented in Table 4.25 and Figure 4.3.

4.8 Evaluation of HCR

During its meeting in 2006 AFWG evaluated the harvest control rule for haddock suggested by the Norwegian-Russian Fishery Commission (ICES CM 2006/ACFM:25). However, the group reviewing the AFWG report before the spring meeting in ACFM considered the evaluation insufficient. The evaluation was found by the review group to be lacking in particular with respect to the influence of the recruitment pattern. It was argued that the recruitment pattern is rather abnormal and that the standard model that was used did not fully include the special features that pertain to haddock. It was also noted that various levels of implementation error should be explored. Consequently, ACFM during its spring meeting in 2006 asked an ad hoc group, consisting of Sondre Aanes, Bjarte Bogstad, Harald Gjøsæter and Knut Korsbrekke, to do further work along those lines before the end of June 2006. This ad hoc group delivered a report (appendix 3) ultimo June 2006 and ICES gave advice to Norway and Russia according to that report. Some main results are summarized in this chapter.

The main difference between the AFWG 2006 and the ad hoc group's way of dealing with the HCR evaluation was, first, that a new recruitment model was implemented and second, that runs were made for various levels of implementation error (i.e. unreported catches), not only for the level estimated during recent years.

Various recruitment models were developed for "poor", "good" and "outstanding" recruitment, and a cycle for these situations was made from observed recruitment in the 1980's and early 1990's. A "reality check" was made based on the new model, which showed reasonably good correspondence with the assessments done by the AFWG. In addition to the three-year-rule that ICES was asked to evaluate, the group also evaluated a one-year-rule with similar trigger point and f-levels as those for the three-year-rule.

The results of the HCR evaluation are summarized in table below.

Run no	Rule	TAC constr.	Trigger point	Impl. error	Intended F	Realised F	Catch (tonnes)	SSB (tonnes)	Prob. SSB<50kt	Prob. SSB<80kt	Prob. SSB<100 kt	Prob. F>Flim	Prob upper constr.	Prob lower constr.
1	3-year	25 %	80	no	0.35	0.36	170583	285771	0.000	0.000	0.000	0.053	0.083	0.035
2	3-year	25 %	80	10 %	0.38	0.43	166415	225059	0.000	0.000	0.003	0.231	0.105	0.050
3	3-year	25 %	80	20 %	0.41	0.53	146807	166376	0.000	0.034	0.106	0.491	0.139	0.090
4	3-year	25 %	80	30 %	0.43	0.64	132582	129565	0.020	0.197	0.339	0.630	0.098	0.148
5	3-year	25 %	80	40 %	0.44	0.72	122663	108073	0.081	0.351	0.496	0.724	0.046	0.180
6	1-year	25 %	80	no	0.35	0.35	170185	289197	0.000	0.000	0.000	0.010	0.165	0.086
7	1-year	25 %	80	10 %	0.35	0.39	169244	249254	0.000	0.000	0.001	0.078	0.190	0.105
8	1-year	25 %	80	20 %	0.35	0.44	158765	207645	0.000	0.006	0.024	0.264	0.228	0.144
9	1-year	25 %	80	30 %	0.35	0.50	143088	166750	0.006	0.061	0.156	0.482	0.230	0.192
10	1-year	25 %	80	40 %	0.36	0.57	125689	125637	0.026	0.219	0.402	0.633	0.141	0.200

Summary of results

3-year rule vs 1-year rule:

The 3-year-rule is performing well under the assumption of no implementation error. There was zero probability of producing SSB's below Blim, but a probability of 5.3% to fish above Flim. The 3-year rule is not very robust to implementation errors (runs 2, 3, 4 and 5). The 1-year rule is more robust to implementation error (run 6 – 10), even with an implementation error of 40% the probability of F being above Flim is less than 5% .

TAC constraint vs no constraint:

The 1-year rule with a TAC constraint was compared to a 1-year rule without a TAC. The performance was quite similar, but with the rule without a TAC constraint performing slightly better relative to the probabilities of SSB falling below the different B-levels tested or F being above Flim.

Conclusion:

The suggested 3-year-rule behaves well for a trigger level (Bpa) of 80 kt with respect to risk of falling below various SSB-levels from 50 – 100kt, but the risk of fishing at a level above Flim is considerable, especially if there is implementation error. The 3-year-rule dos not correspond to the precautionary approach as the level of risk to fish above Flim is higher than 5%.

A 1-year-rule behaves better than a 3-year-rule in all situations, but also this rule implies risk towards fishing above Flim when even with the implementation error 10%. For 1 year rule the realized F is lower, and the catches and the SSB is higher than for a 3-year-rule with similar settings. One year rule is in correspondence with the precautionary approach if there no implementation error in stock management.

4.9 Assessment of NEA haddock stock by model ISVPA

ISVPA vs. XSA

Unlike XSA, ISVPA (Vasilyev, 2005) is a separable cohort model. Unknown parameters of XSA model are estimated by iterative procedure; convergence of this procedure is considered completed, if terminal fishing mortality coefficient estimates after two successive iterations are sufficiently close to each other. Such convergence of the calculations does not prove that the solution found is the only one and that it has a clear statistical meaning. Furthermore, convergence within XSA is usually not achievable after 30 iterations, and even after a considerably larger number of iterations.

ISVPA estimates the unknown parameters by means of minimisation of a loss function with distinct statistical meaning.

For XSA tuning it is possible to use several age-disaggregated indices, such as CPUE series or survey results. The requirement for these indices to be used is the availability of data for the terminal year. If any of the series is not complete this index can not be used.

ISVPA can use auxiliary information in form of age-structured time series or integral time series. The procedure used to estimate parameters permits time gaps in auxiliary data, even for the terminal year. Furthermore, the procedure can estimate parameters from catch-at-age data alone.

Other advantages of this model include an option to use principles of robust statistics to reduce the effect of data noise on results and the possibility to get unbiased estimates of the stock parameters. This model was used for NEA cod stock assessment (Bulgakova and Vasilyev, WD# 9 for AFWG-2006). It was applied to NEA haddock stock assessment too but for years 1980-2005 (WD#10).

4.9.1 Input data

The input data for ISVPA runs for haddock were mainly taken the same as used in the *SVPA* run undertaken on *25/04/2007*. For years 2002-2006 catch-at age were taken with account for unreported catch estimates, provided by the Norwegian national delegate and by the Russian national delegate to ICES. IUU-N or IUU-R, correspondingly, are used in the figures as symbols for the two separate runs. Natural mortality coefficients as function of age were taken as averaged values for 5 last years calculated by XSA run including cod predation, separately for each run. The age interval taken was from 3 to 11+.

4.9.2 ISVPA run for NEA Haddock (Tables B4B)

The first stage of ISVPA analysis is to identify the most appropriate model settings. The user can divide the time-series into two sub-periods, and estimate constant selectivity pattern for each sub-period. For haddock, a preliminary analysis indicated that the sub-periods 1980-1990 and 1991-2006 were most appropriate.

The tuning was carried out with 3 or 4 survey indices for 1980-2006 and for age interval 1-7 or 1-8. Three indices are the same as used on XSA tuning. The fourth index (Russian acoustic survey) was denoted as Ac-new and derived by applying a new method of acoustic index calculation (Table B4B). The symbols and year intervals used for each index in ISVPA are shown in Table given below. Survey data for Aged 2 and Aged 3 were shifted to the end of the previous year (such procedure was carried out for XSA too).

Data series chosen for ISVPA tuning

Data index in XSA	Data index in ISVPA	Name	Year interval in ISVPA	Age interval	Season
FLT 01	Aged1	Russian bottom trawl survey	1983-2006	3-7	Nov-Dec 0.95
FLT 02	Aged2	Norway acoustic survey	1980-2006	3-7	Jan-Mar 0.99, shifted
FLT 04	Aged3	Norway bottom trawl survey	1982-2006	3-8	Jan-Mar 0.99 shifted
-	Ac-new	Russian acoustic survey, new method	1995-2006	3-8	Oct-Dec 0.95

Three ISVPA runs were analysed at this meeting of AFWG (see Table given below). A series of preliminary calculations was carried out to determinate suitable model options and suitable form of the loss function component for each index. Loss functions with a pronounced minimum in the loss profile were selected (See Table given below and Figures 4.12 and 4.13). Loss function component for each survey was set as median of distribution of squared logarithmic residuals (MDN). The abundance at age from survey was used for the model tuning as absolute number (noted as N^N). (Vasilyev, 2005; Bulgakova, WD#10).

List of ISVPA model versions chosen for different runs.

For all runs year interval is taken as 1980-2006 and Ly =1990

Notation in Figures	IUU	C(a,y)	Aged1,Aged2, Aged3	Ac-new
IUU-R 4ind	Russian estimate	MDN,catch-controlled	MDN, N^N	MDN, N^N
IUU-R 3ind	Russian estimate	MDN,catch-controlled	MDN, N^N	no
IUU-N	Norwegian estimate	MDN, mixed	MDN, N^N	no

4.9.3 Results

Final LF profiles of these components are presented in Figures 4.12 (run IUU-R, 4 indices) and 4.13 (run IUU-N 3indices).

a) Comparison of the two ISVPA runs after tuning with three and four indices.

Figure 4.14 shows the haddock stock dynamics obtained with ISVPA runs after tuning with 3 and 4 indices for case of IUU-R. Incorporation of the fourth index results in some decline of the stock biomass estimate.

b) Comparison of ISVPA and XSA results after tuning with three stock indices

ISVPA results were presented in Tables given below for cases IUU-R and IUU-N. The haddock stock dynamics according to two models, XSA and ISVPA, was compared (Figure 4.15a and 4.15b).

The comparison was made for the runs tuned with 3 survey indices and for two estimates of unreported catch for 2002-2006, IUU-N and IUU-R. The highest divergence between runs was observed in the last period. ISVPA run with IUU-R gave lower values of TSB and SSB, than run of the same model with IUU-N, but SSB estimates for terminal year are coincident. The both XSA runs (IUU-N and IUU-R) showed lower TSB and SSB values for the last period in comparison with ISVPA. At the same time XSA run IUU-N gave higher TSB and SSB estimates than IUU-R run, but SSB estimates are coincident in the terminal year.

Results of ISVPA for NEA haddock obtained in run including IUU-R

Year	TSB	SSB	LANDINGS	R(3)	Fbar(4-7)
1980	341145	152067	87889	37307	0.338
1981	262675	130762	77153	17335	0.297
1982	218051	136260	46955	19349	0.209
1983	167778	121001	24600	12703	0.208
1984	141832	114556	20945	15303	0.194
1985	259436	115857	45052	356016	0.234
1986	393685	118170	100563	436933	0.365
1987	394994	98892	154916	177896	0.519
1988	315834	101912	95255	66361	0.460
1989	265845	115511	58518	36533	0.312
1990	226566	128187	27182	42593	0.123
1991	259678	152637	36216	126445	0.160
1992	328763	168194	59922	252447	0.241
1993	515424	176409	82379	744217	0.318
1994	613917	205044	135186	302631	0.399
1995	578442	200805	142448	104801	0.358
1996	533714	250368	178128	85231	0.384
1997	431707	237330	154359	134876	0.405
1998	332803	185912	100630	91953	0.322
1999	359045	160904	83195	304052	0.291
2000	358431	165526	68944	118825	0.186
2001	478744	196674	89640	499256	0.192
2002	581509	224530	100582	421840	0.211
2003	641001	273442	113722	232926	0.287
2004	681764	310980	133054	319666	0.223
2005	835024	367000	127965	660397	0.211
2006	857025	376436	140746	254637	0.183

Results of ISVPA for NEA haddock obtained in run including IUU-N

Year	TSB	SSB	LANDING	R(3)	Fbar(4-7)
1980	208272	58655	87889	31900	0.499
1981	164342	65700	77153	15115	0.486
1982	125749	68762	46955	14446	0.338
1983	96364	62866	24600	13688	0.314
1984	78945	54944	20945	21421	0.283
1985	162520	52695	45052	260475	0.319
1986	274894	54639	100563	371259	0.516
1987	309213	57736	154916	188103	0.795
1988	260242	66075	95255	69106	0.724
1989	220260	83166	58518	34123	0.381
1990	198609	107566	27182	37700	0.140
1991	224802	131900	36216	103568	0.175
1992	281715	140973	59922	227616	0.269
1993	476268	141662	82379	784643	0.367
1994	583798	163466	135186	336348	0.474
1995	568235	177845	142448	111033	0.432
1996	526834	230814	178128	113060	0.408
1997	411274	212266	154359	134999	0.431
1998	320432	167085	100630	99473	0.318
1999	329283	148214	83195	241770	0.291
2000	324742	150851	68944	118498	0.188
2001	444235	179039	89640	484715	0.211
2002	571866	204650	114794	488752	0.259
2003	652906	254205	138945	277667	0.357
2004	716251	291591	157854	403170	0.263
2005	921872	354911	158299	830526	0.262
2006	964187	377069	172173	314088	0.203

4.9.4 Diagnostics

The quality of tuning of ISVPA model was assessed by comparing the dynamics of the main age groups abundance by ISVPA to survey indices for the same ages. Figure 4.16 showed good consistency between such trends for each index. This consistency was also confirmed by high correlation coefficients presented in Table given below.

Correlation coefficients for three survey indices and stock abundance by ISVPA for ages 3-7

Age	aged1	aged2	aged3
3	0.725	0.785	0.861
4	0.781	0.810	0.807
5	0.832	0.909	0.836
6	0.864	0.885	0.863
7	0.616	0.786	0.811

4.9.5 Predictions

Determinate predictions have been carried out on the basis of the ISVPA run IUU-R (3 indices) and is presented in table below. The recruitment for each year after 2006 was taken as equal to average R(3) for the whole interval 1980-2006 (378 x 10^6). Natural mortality M(a) was the same as in retrospective run, weight at age and maturity ogives were taken as averaged values for 2002-2006. Catch for 2006 was equal to real catch including IUU-R, catch for 2007 was equal to conventional TAC (150 000 t). Results of predictions presented in Table given below showed higher stock biomass and TAC estimates for 2008-2010 than obtained by XSA.

Predicted values of haddock stock parameters, C (catch) and stock biomass –in tons, recruitment R(3) – in 1000'.

	2006	2007	2008	2009	2010
C or TAC	140746	150000	278485	240636	217379
TSB	860520	933646	988756	916434	845252
SSB	377600	472089	552835	509319	441805
Fbar	0.20	0.19	0.35	0.35	0.35
R(3)	254637	378000	378000	378000	378000

4.9.6 Conclusions

The analysis of applying the ISVPA for assessment of haddock stock has shown:

- quality of the model tuning was satisfactory, however, the stock trend in the last years seemed to have shown larger increase compared to the trend shown by indices; this may, probably, be due to the matrix used C (a,y);
- since ISVPA gives a better justified solution statistically, than XSA, work with this model should further be continued for the same stock and its diagnostics assessed;
- the stock of haddock is in a good shape and allows some increase of the TAC.

4.10 Comments to Technical Minutes from ACFM

General comments

The chapter was well written. The data and what was done with them was well described and the methods were generally transparent.

The assessment of NEA Haddock was supposed to be an update assessment, - but substantial changes and revisions of much of the data and time series had been carried out. When such huge changes are made in the input data, a somewhat more thorough investigation of the assessment should be made. The reviewers were not clear whether to review this stock assessment as benchmark or update. Considering the extensive revision of the data, the reviewers suggest that this stock should be a candidate for a bench mark assessment next year.

The changes in the time series that definitely impacted the assessment were the reworking of mean weights, the new maturity ogive and the addition of unreported catches and the addition of catches from areas which has not been in the assessment earlier (Statistical areas 06 and 07). These added catches represent some 25 % of the total catches in 2005.

Even though this was only an update assessment, a simple exploratory analysis of log catch ratios to look for consistency in the new catch matrix would have been appropriate. An investigation of cohort consistency by using regressions between age groups and years, within the catch at age matrix, and between this matrix and the numbers at age in the abundance indices should also be made next year.

No follow up from the WG (not lack of good will, but we continue to struggle in our compilation of input data including different estimates of unreported catches).

We acknowledge the revision of the data, and this revision will probably lead to better assessments of haddock in the future, but at this point some sensitivity analyses, saying something about how the various parts of the added or changed data affect the assessment *should be made. A SPALY run was carried out by WKHAD and it should have been shown again in this chapter.*

The “base run” presented is a SPALY run.

The assessment

Due to the patchy and partial incorporation of cod predation into natural mortality Table 4.7 shows some strange phenomena in accuracy. There was some very accurate numbers of natural mortality (up to 4 decimal places) while most of the estimates were to just 1 decimal place (0.2). The accurate numbers and the 0,2 values should not be mixed in the same table.

This is not a concern shared by the WG. Predation from cod is estimated with many decimal places (high uncertainty) and added to the highly uncertain traditional M=0.2 (most likely to be biased). These are “noisy” numbers and should not be rounded off before being used. The WG agrees that when the natural mortality table is presented the numbers can be somewhat rounded off, but we should explain that cells with 0.2 corresponds to not finding any haddock of that age that year in the cod stomachs.

The maturity ogive on older fish should be replaced by 1, as the empirical data suggest 100% mature for fish aged 8 and older, whereas smoothing has created an asymptote effect slightly below 1.

The WG checked and found immature females at ages 8 and 9 in the raw data used for the Norwegian surveys. These surveys take place just before the spawning season. The total number of 8 and 9 year old in the samples can be quite low in some years.

The signals of the abundance indices used in the assessment are quite consistent showing the same overall trend. Figure 4.9 does suggest a problem however, as comparison of the survey based SSBs and XSA SSBs shows that this trend is not similarly matched in the most recent years, and indicates that perhaps the catchabilities have changed across the whole series. If this was true, it should be reflected in the residuals of survey estimate to XSA numbers. However this does not appear to be the case (Table 4.12). This needs further investigation and must be addressed next year.

The WG struggled quite a lot with this problem this year: Replacing the current “density dependent catcahability” for ages 1 to 6 to the traditional catchability assumption worsened the situation.

The log catchability residuals of the various fleets are not very high, but there seems to be some year effects. However, the retrospective runs show strong patterns of overestimations of SSB when the stock is decreasing, and underestimating the stock when it is increasing. This indicates that a big problem with this stock is the difficulty of tracing the changes and it may be explained by the spasmodic recruitment pattern for haddock.

The WG agrees that the “spasmodic” variation in yearclass strength may be a central issue, but it is not clear for us how this “explanation” can be used in the assessment model. Ideas discussed includeded handling strong yearclasses in separate models, but since there seems to be some “spillover” due to age readings (increasing with age) this is rather complicated.

In the assessment, there is high weight on shrinkage. There are also indications of high bias, which is mentioned throughout the chapter by the WG. This has been investigated by the WG in the past, but in the next benchmark assessment, the WG should look again into the problem of bias introduced by this high shrinkage. The only rational that appears to be given for this use of high shrinkage appears to be “it is the same as it was done in the past”.

The WG is using very high F-shrinkage (corresponding to an s.e of 0.5) and last years "sensitivity" run using FLR suggested that this was a candidate for explaining the bias. Similar analysis this year suggest that the level of shrinkage can NOT cause the observed bias.

Metrics for retrospective bias must be included in the analysis.

Any references for such analysis? Or good examples?

An analysis of the model uncertainty was done (FLR analysis). The analysis is well described in the report and Figures 4.6 and 4.7 are very useful. As described and showed in the report only a limited group of settings were tested. However, it is demonstrated that the assessment is sensitive to the abundance index fleets and the combination of these, the number of age groups in the plus group and the shrinkage level. We note that the choice of plus group has a large effect on the SSB and this may well be caused by the effect of strong cohorts still dominating the plus group. At the next benchmark assessment, the reviewers recommend that this plus group effect is investigated. Although the choice of settings for the XSA sensitivity analysis was arbitrary and "man-made" it is clear that the final deterministic estimates of F and recruitment were close to the central tendency of the settings in XSA, the SSB is to the extreme (see Figure 4.7). In the future, the analysis should be done also on the uncertainty in growth and recruitment (as the WG also suggests in the report).

The fact that the unreported catches represent some 25 % of the total catch and that the catch statistics is very uncertain, lead the reviewers to think about other methods than XSA, not assuming the catches to be true and reliable. The reviewers would also like to see other assessment methods investigated on this stock (although the strong cohort effects may make separable models inappropriate) and recommend this for the next benchmark. The WG also state that exploration with different models is required.

The WG share the scepticism towards separable models due to the very strong cohort effects. A lot more intersessional work must be done both on the quality of the input data as well as choosing an appropriate assessment model explaining the strange structures in the catchability fluctuations which we of course interpret as: The surveys and the catch at age matrix does not tell the "same story".

The under reporting of catches is a problem, and there is an increasing trend as for the NEA Cod. The problem seems to be as great for haddock as for cod, in terms of proportion of the total catch (about 25%). There is probably also a discarding problem in the demersal fishery in the Barents Sea, and the WG should look into this problem in the future, as requested by last year's reviewers.

The members of the WG share the view of the review group on this point. The possibility of estimating discards are relatively limited due to the discard ban.

Summary

Much of the exploratory work was carried out by WKHAD, and that report was not fully available to the reviewers. The estimates of F and recruitment appear fairly robust to changes in most of the model settings, but the SSB estimate in recent years appears very sensitive to model assumptions.

The reviewers were concerned about the apparent contradiction between the survey signals in Fig 4.9 and the residuals in the XSA run. These differences could not be explained.

The WG have tried to resolve this issue this year as well as last, but are still struggling. The assessment has the same serious conflict between the tuning series and the XSA.

As a basis for advice, the reviewers note that the perception of the stock as being moderately exploited is clear from both the old data and the new data (Figure 4.5). The trend in the *survey indices agree with the assessment that the SSB is relatively high for the time series, but the reviewers were not convinced that the absolute values of SSB in the most recent years were well estimated.*

The WG believes that the description above holds very well this year as well, but would like to add that very high recruitment is expected to make its influence on the fishery in 2008 with large practical problems of conducting a fishery without a high proportion of haddock below the minimum landing size in the catches.

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	2 unreported	3 unreported	2 Total	3 Total	4 Norwegian statistical areas 06 and 07
1960	125 026	27 781	1 844	-	-	154651	154651	6000
1961	165 156	25 641	2 427	-	-	193224	193224	4000
1962	160 561	25 125	1 723	-	-	187409	187409	3000
1963	124 332	20 956	936	-	-	146224	146224	4000
1964	79 262	18 784	1 112	-	-	99158	99158	6000
1965	98 921	18 719	943	-	-	118583	118583	6000
1966	125 009	35 143	1 626	-	-	161778	161778	5000
1967	107 996	27 962	440	-	-	136398	136398	3000
1968	140 970	40 031	725	-	-	181726	181726	3000
1969	89 948	40 306	566	-	-	130820	130820	2000
1970	60 631	27 120	507	-	-	88258	88258	-
1971	56 989	21 453	463	-	-	78905	78905	-
1972	221 880	42 111	2 162	-	-	266153	266153	-
1973	285 644	23 506	13 077	-	-	322227	322227	-
1974	159 051	47 037	15 069	-	-	221157	221157	10000
1975	121 692	44 337	9 729	-	-	175758	175758	6000
1976	94 054	37 562	5 648	-	-	137264	137264	2000
1977	72 159	28 452	9 547	-	-	110158	110158	2000
1978	63 965	30 478	979	-	-	95422	95422	2000
1979	63 841	39 167	615	-	-	103623	103623	6000
1980	54 205	33 616	68	-	-	87889	87889	5098
1981	36 834	39 864	455	-	-	77153	77153	4767
1982	17 948	29 005	2	-	-	46955	46955	3335
1983	5 837	16 859	1 904	-	-	24600	24600	3112
1984	2 934	16 683	1 328	-	-	20945	20945	3803
1985	27 982	14 340	2 730	-	-	45052	45052	3583
1986	61 729	29 771	9 063	-	-	100563	100563	4021
1987	97 091	41 084	16 741	-	-	154916	154916	3194
1988	45 060	49 564	631	-	-	95255	95255	3756
1989	29 723	28 478	317	-	-	58518	58518	4701
1990	13 306	13 275	601	-	-	27182	27182	2912
1991	17 985	17801	430	-	-	36216	36216	3045
1992	30 884	28 064	974	-	-	59922	59922	5634
1993	46 918	32 433	3 028	-	-	82379	82379	5559
1994	76 748	50 388	8 050	-	-	135186	135186	6311
1995	75 860	53 460	13 128	-	-	142448	142448	5444
1996	112 749	61 722	3 657	-	-	178128	178128	5126
1997	78 128	73 475	2 756	-	-	154359	154359	5987
1998	45 640	53 936	1 054	-	-	100630	100630	6338
1999	38 291	40 819	4 085	-	-	83195	83195	5743
2000 .	25 931	39 169	3 844	-	-	68944	68944	4536
2001	35 072	47 245	7 323	-	-	89640	89640	4542
2002	40721	42774	12567	18732	4520	114794	100582	6898
2003	53653	43564	8483	33245	8022	138945	113722	4279
2004	64873	47483	12146	33352	8552	157854	133054	3743
2005 [1]	53518	48081	16416	40284	9950	158299	127965	5538
2006 [1]	50767	47939	33151	40316	8889	172173	140746	5356

1 Provisional figures, Norwegian catches on Russian quotas are included

2 Figures based on Norwegian IUU estimates

3 Figures based on Russian IUU estimates

4 Included in total landings in region IIa

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		[2] unreported	[3] unreported
Year	Trawl	Others	Trawl	Others	Trawl	Others		
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	3.6	2.2	8.7	8.2	0.2	1.7	-	-
1984	1.6	1.3	7.6	9.1	0.1	1.2	-	-
1985	24.4	3.5	6.2	8.1	0.1	2.6	-	-
1986	51.7	10.1	14.0	15.8	0.8	8.3	-	-
1987	79.0	18.1	23.0	18.1	3.0	13.8	-	-
1988	28.7	16.4	34.3	15.3	0.6	0.0	-	-
1989	20.0	9.7	13.5	15.0	0.3	0.0	-	-
1990	4.4	8.9	5.1	8.2	0.6	0.0	-	-
1991	9.0	8.9	8.9	8.9	0.2	0.2	-	-
1992	21.3	9.6	11.9	16.1	1.0	0.0	-	-
1993	35.3	11.6	14.5	17.9	3.0	0.0	-	-
1994	58.6	18.2	26.1	24.3	7.9	0.2	-	-
1995	63.9	12.0	29.6	23.8	12.1	1.0	-	-
1996	98.3	14.4	36.5	25.2	3.4	0.3	-	-
1997	57.4	20.7	44.9	28.6	2.5	0.3	-	-
1998	26.0	19.6	27.1	26.9	0.7	0.3	-	-
1999	29.4	8.9	19.1	21.8	4.0	0.1	-	-
2000	20.1	5.9	18.8	20.4	3.7	0.1	-	-
2001	28.4	6.7	23.4	23.8	7.0	0.3	-	-
2002	30.5	10.2	19.5	23.3	12.5	0.1	18.7	4.5
2003	42.7	10.9	21.9	21.7	8.1	0.4	33.2	8
2004	52.4	12.5	27.0	20.5	11.5	0.6	33.4	8.6
2005	[1] 38.5	15.0	24.9	20.9	13.0	1.6	40.3	10
2006	[1] 39.8	11.0	22.7	35.3	30.0	3.2	40.3	8.9

1 Provisional

2 Figures based on Norwegian IUU estimates

3 Figures based on Russian IUU estimates

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).

1 Provisional figures, Norwegian catches on Russian quotas are included.

Year	Faroe Islands	France	German Dem.Re.	Fed. Re. Germ.	Norway[5]	Poland	United Kingdom	Russia[2]	Others	[3]Illegal catches	[4]Illegal catches	[3] Total	[4] Total
1960	172	-	-	5 597	46 263	-	45 469	57 025	125	-	-	154 651	154 479
1961	285	220	-	6 304	60 862	-	39 650	85 345	558	-	-	193 224	192 939
1962	83	409	-	2 895	54 567	-	37 486	91 910	58	-	-	187 408	187 325
1963	17	363	-	2 554	59 955	-	19 809	63 526	-	-	-	146224	146224
1964	-	208	-	1 482	38 695	-	14 653	43 870	250	-	-	99158	99158
1965	-	226	-	1 568	60 447	-	14 345	41 750	242	-	-	118578	118578
1966	-	1 072	11	2 098	82 090	-	27 723	48 710	74	-	-	161778	161778
1967	-	1 208	3	1 705	51 954	-	24 158	57 346	23	-	-	136397	136397
1968	-	-	-	1 867	64 076	-	40 129	75 654	-	-	-	181726	181726
1969	2	-	309	1 490	67 549	-	37 234	24 211	25	-	-	130820	130820
1970	541	-	656	2 119	37 716	-	20 423	26 802	-	-	-	88257	88257
1971	81	-	16	896	45 715	43	16 373	15 778	3	-	-	78905	78905
1972	137	-	829	1 433	46 700	1 433	17 166	196 224	2 231	-	-	266153	266153
1973	1 212	3 214	22	9 534	86 767	34	32 408	186 534	2 501	-	-	322226	322226
1974	925	3 601	454	23 409	66 164	3 045	37 663	78 548	7 348	-	-	221157	221157
1975	299	5 191	437	15 930	55 966	1 080	28 677	65 015	3 163	-	-	175758	175758
1976	536	4 459	348	16 660	49 492	986	16 940	42 485	5 358	-	-	137264	137264
1977	213	1 510	144	4 798	40 118	-	10 878	52 210	287	-	-	110158	110158
1978	466	1 411	369	1 521	39 955	1	5 766	45 895	38	-	-	95422	95422
1979	343	1 198	10	1 948	66 849	2	6 454	26 365	454	-	-	103623	103623
1980	497	226	15	1 365	66 501	-	2 948	20 706	246	-	-	92504	92504
1981	381	414	22	2 402	63 435	**Spain**	1 682	13 400	-	-	-	81736	81736
1982	496	53	-	1 258	43 702	-	827	2 900	-	-	-	49236	49236
1983	428	-	1	729	22 364	139	259	680	-	-	-	24600	24600
1984	297	15	4	400	18 813	37	276	1 103	-	-	-	20945	20945
1985	424	21	20	395	21 272	77	153	22 690	-	-	-	45052	45052
1986	893	12	75	1 079	52 313	22	431	45 738	-	-	-	100563	100563
1987	464	7	83	3 105	72 419	59	563	78 211	5	-	-	154916	154916
1988	1 113	116	78	1 323	60 823	72	435	31 293	2	-	-	95255	95255
1989	1 217	-	26	171	36 451	1	590	20 062	-	-	-	58518	58518
1990	705	-	5	167	20 621	-	494	5 190	-	-	-	27182	27182
1991	1 117	-	**Greenld**	213	22 178	-	514	12 177	17	-	-	36216	36216
1992	1 093	151	1 719	387	36 238	38	596	19 699	1	-	-	59922	59922
1993	546	1215	880	1 165	40 978	76	1 802	35 071	646	-	-	82379	82379
1994	2 761	678	770	2 412	71 171	22	4 673	51 822	877	-	-	135186	135186
1995	2 833	598	1 097	2 675	76 886	14	3 111	54 516	718	-	-	142448	142448
1996	3 743	6	1 510	942	94 527	669	2 275	74 239	217	-	-	178128	178128
1997	3 327	540	1 877	972	103 407	364	2 340	41 228	304	-	-	154359	154359
1998	1 903	241	854	385	75 108	257	1 229	20 559	94	-	-	100630	100630
1999	1 913	64	437	641	48 182	652	694	30 520	92	-	-	83195	83195
2000	631	178	432	880	42 009	502	747	22 738	827	-	-	68944	68944
2001	1 210	324	553	554	49 067	1 497	1 068	34 307	1060	-	-	89640	89640
2002	1 564	297	858	627	52 247	1 505	1 125	37 157	682	18732	4520	114794	100582
2003	1 959	382	1 363	918	56 485	1 330	1 018	41 142	1103	33245	8022	138945	113722
2004[1]	2484	103	1680	823	62192	54	1250	54347	1569	33352	8552	157854	133054
2005[1]	2138	333	15	996	60850	963	1899	50012	1262	40284	9950	158299	127965
2006[1]	2189	815	1830	989	69179	703	1591	53313	1250	40316	8889	172173	140746

2 USSR prior to 1991.
3 Figures based on Norwegian IUU estimates
4 Figures based on Russian IUU estimates
5 Included landings in Norwegian statistical areas 06 and 07 (from 1983)

Table 4.4. N. Catch numbers at age (numbers, thousands spec.)

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

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

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	3189	65643	6012	64528	6563	1154	16437
4	37949	9178	151996	13013	154696	10689	5922
5	35344	18014	13634	70781	5885	176678	14713
6	18849	13551	9850	5431	27590	4993	127879
7	28868	6808	4693	2867	3233	28273	3182
8	9199	6850	3237	1080	1302	1445	8003
9	1979	3322	2434	424	712	271	450
10	1093	1182	606	315	319	100	200
+gp	2977	1348	880	1005	543	100	185
0 TOTALNUM	139447	125896	193342	159444	200843	223703	176971
TONSLAND	132125	120077	127660	123920	156788	202286	213924
SOPCOF %	61	80	56	68	66	64	77

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	2074	1727	20318	39910	15429	39503	28466	22363	5936	26345
4	24704	5914	7826	70912	56855	30868	72736	49290	46356	22631
5	7942	31438	7243	13647	63351	48903	18969	30672	40201	63176
6	12535	5820	14040	7101	8706	33836	13579	5815	12631	29048
7	46619	12748	3154	6236	3578	3201	9257	3527	1679	5752
8	1087	17565	2237	1579	4407	1341	1239	2716	974	582
9	1971	822	5918	2340	788	1773	559	833	897	438
10	356	1072	285	2005	527	242	409	104	123	189
+gp	176	601	500	606	1434	756	375	633	802	242
0 TOTALNUM	97464	77707	61521	144336	155075	160423	145589	115953	109599	148403
TONSLAND	123583	112672	88211	154651	193224	187408	146224	99158	118578	161778
SOPCOF %	78	87	104	94	98	93	85	72	85	84

1

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	15907	657	1524	23444	1978	230942	70679	9685	10037	13994
4	41346	67632	1968	2454	24358	22315	260520	41706	14088	13454
5	13496	41267	44634	1906	1257	42981	24180	88120	33871	6810
6	25719	7748	19002	22417	918	3206	6919	5829	49711	20796
7	8872	15599	3620	8100	9279	1611	422	4138	2135	40057
8	1616	5292	4937	2012	3056	6758	426	382	1236	1247
9	218	655	1628	2016	826	2638	1692	618	92	1350
10	175	182	316	740	1043	900	529	2043	131	193
+gp	271	286	109	293	534	1652	584	1870	934	1604
0 TOTALNUM	107620	139318	77738	63382	43249	313003	365951	154391	112235	99505
TONSLAND	136397	181726	130820	88257	78905	266153	322226	221157	175758	137264
SOPCOF %	98	98	111	100	128	90	84	109	109	87

Table 4.4. N (cont.). Catch numbers at age (numbers, thousands spec.)

	Table 1 Catch numbers at age			Numbers*10**-3							
	YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE											
		3	55967	47311	17540	627	486	883	1173	1271	29624	23113
		4	22043	18812	35290	22878	2561	900	2636	1019	1695	68429
		5	7368	4076	10645	21794	22124	3372	1360	1899	564	1565
		6	2586	1389	1429	2971	10685	12203	2394	657	1009	783
		7	7781	1626	812	250	1034	2625	2506	950	943	896
		8	11043	2596	546	504	162	344	1799	2619	886	393
		9	311	6215	1466	230	162	75	267	352	1763	702
		10	388	162	2310	842	72	80	37	87	588	1144
	+gp		379	400	323	1460	963	649	292	77	281	987
0	TOTALNUM		107866	82587	70361	51556	38249	21131	12464	8931	37353	98012
	TONSLAND		110158	95422	103623	87889	77153	46955	24600	20945	45052	100563
	SOPCOF %		90	106	127	129	136	135	95	95	102	95

	Table 1 Catch numbers at age			Numbers*10**-3							
	YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
		3	5031	1439	2157	1015	4421	11571	13487	3374	2003	1662
		4	87170	12478	4986	2580	3564	11567	19457	47821	16109	6818
		5	64556	47890	16071	2142	2416	4099	13704	36333	72644	36473
		6	960	20429	25313	4046	3299	2642	4103	13264	19145	73579
		7	597	397	3198	6221	4633	2894	1747	2057	6417	13426
		8	376	178	147	840	3953	3327	1886	903	746	2944
		9	212	74	1	134	461	3498	2105	1453	361	573
		10	230	88	28	42	83	486	1965	2769	770	365
	+gp		738	446	177	71	54	84	323	2110	1576	1897
0	TOTALNUM		159870	83419	52078	17091	22884	40168	58777	110084	119771	137737
	TONSLAND		154916	95255	58518	27182	36216	59922	82379	135186	142448	178128
	SOPCOF %		101	100	102	98	96	102	100	99	98	98

	Table 1 Catch numbers at age			Numbers*10**-3							
	YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE											
		3	2280	1701	16839	1520	12971	7131	6496	7958	10941	5458
		4	5633	11304	8039	29986	5230	46333	27043	21023	19547	44477
		5	12603	9258	15365	6496	32049	11083	51599	41150	22409	30828
		6	32832	8633	6073	5149	5279	21984	12927	41145	36778	17385
		7	49478	13801	4466	2406	2941	2602	14900	4935	26238	19160
		8	5636	19469	6355	1657	1137	1602	2156	4913	2461	8463
		9	778	2113	6204	1570	1161	482	1662	598	3093	1272
		10	245	330	647	1744	1169	448	1231	1251	1149	1184
	+gp		748	490	446	437	1204	1029	1219	900	1645	553
0	TOTALNUM		110233	67099	64434	50965	63141	92694	119233	123873	124261	128780
	TONSLAND		154359	100630	83195	68944	89640	114794	138945	157854	158299	172173
	SOPCOF %		95	99	98	97	101	99	103	98	100	100
		1										

Table 4.4. R. Catch numbers at age (numbers, thousands spec.)

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

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

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	3189	65643	6012	64528	6563	1154	16437
4	37949	9178	151996	13013	154696	10689	5922
5	35344	18014	13634	70781	5885	176678	14713
6	18849	13551	9850	5431	27590	4993	127879
7	28868	6808	4693	2867	3233	28273	3182
8	9199	6850	3237	1080	1302	1445	8003
9	1979	3322	2434	424	712	271	450
10	1093	1182	606	315	319	100	200
+gp	2977	1348	880	1005	543	100	185
0 TOTALNUM	139447	125896	193342	159444	200843	223703	176971
TONSLAND	132125	120077	127660	123920	156788	202286	213924
SOPCOF %	61	80	56	68	66	64	77

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	2074	1727	20318	39910	15429	39503	28466	22363	5936	26345
4	24704	5914	7826	70912	56855	30868	72736	49290	46356	22631
5	7942	31438	7243	13647	63351	48903	18969	30672	40201	63176
6	12535	5820	14040	7101	8706	33836	13579	5815	12631	29048
7	46619	12748	3154	6236	3578	3201	9257	3527	1679	5752
8	1087	17565	2237	1579	4407	1341	1239	2716	974	582
9	1971	822	5918	2340	788	1773	559	833	897	438
10	356	1072	285	2005	527	242	409	104	123	189
+gp	176	601	500	606	1434	756	375	633	802	242
0 TOTALNUM	97464	77707	61521	144336	155075	160423	145589	115953	109599	148403
TONSLAND	123583	112672	88211	154651	193224	187408	146224	99158	118578	161778
SOPCOF %	78	87	104	94	98	93	85	72	85	84
1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	15907	657	1524	23444	1978	230942	70679	9685	10037	13994
4	41346	67632	1968	2454	24358	22315	260520	41706	14088	13454
5	13496	41267	44634	1906	1257	42981	24180	88120	33871	6810
6	25719	7748	19002	22417	918	3206	6919	5829	49711	20796
7	8872	15599	3620	8100	9279	1611	422	4138	2135	40057
8	1616	5292	4937	2012	3056	6758	426	382	1236	1247
9	218	655	1628	2016	826	2638	1692	618	92	1350
10	175	182	316	740	1043	900	529	2043	131	193
+gp	271	286	109	293	534	1652	584	1870	934	1604
0 TOTALNUM	107620	139318	77738	63382	43249	313003	365951	154391	112235	99505
TONSLAND	136397	181726	130820	88257	78905	266153	322226	221157	175758	137264
SOPCOF %	98	98	111	100	128	90	84	109	109	87

Table 4.4. R (cont.). Catch numbers at age (numbers, thousands spec.)

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	55967	47311	17540	627	486	883	1173	1271	29624	23113
4	22043	18812	35290	22878	2561	900	2636	1019	1695	68429
5	7368	4076	10645	21794	22124	3372	1360	1899	564	1565
6	2586	1389	1429	2971	10685	12203	2394	657	1009	783
7	7781	1626	812	250	1034	2625	2506	950	943	896
8	11043	2596	546	504	162	344	1799	2619	886	393
9	311	6215	1466	230	162	75	267	352	1763	702
10	388	162	2310	842	72	80	37	87	588	1144
+gp	379	400	323	1460	963	649	292	77	281	987
0 TOTALNUM	107866	82587	70361	51556	38249	21131	12464	8931	37353	98012
TONSLAND	110158	95422	103623	87889	77153	46955	24600	20945	45052	100563
SOPCOF %	90	106	127	129	136	135	95	95	102	95

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	5031	1439	2157	1015	4421	11571	13487	3374	2003	1662
4	87170	12478	4986	2580	3564	11567	19457	47821	16109	6818
5	64556	47890	16071	2142	2416	4099	13704	36333	72644	36473
6	960	20429	25313	4046	3299	2642	4103	13264	19145	73579
7	597	397	3198	6221	4633	2894	1747	2057	6417	13426
8	376	178	147	840	3953	3327	1886	903	746	2944
9	212	74	1	134	461	3498	2105	1453	361	573
10	230	88	28	42	83	486	1965	2769	770	365
+gp	738	446	177	71	54	84	323	2110	1576	1897
0 TOTALNUM	159870	83419	52078	17091	22884	40168	58777	110084	119771	137737
TONSLAND	154916	95255	58518	27182	36216	59922	82379	135186	142448	178128
SOPCOF %	101	100	102	98	96	102	100	99	98	98

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	2280	1701	16839	1520	12971	5887	5241	5931	9011	3912
4	5633	11304	8039	29986	5230	38178	22953	15626	14447	34016
5	12603	9258	15365	6496	32049	9723	47136	31773	17093	24232
6	32832	8633	6073	5149	5279	20416	10687	36435	27842	14020
7	49478	13801	4466	2406	2941	2350	13867	4661	21474	15803
8	5636	19469	6355	1657	1137	1468	1549	4804	2190	7349
9	778	2113	6204	1570	1161	452	2140	577	2852	1194
10	245	330	647	1744	1169	418	836	1224	952	1139
+gp	748	490	446	437	1204	944	1157	868	1554	518
0 TOTALNUM	110233	67099	64434	50965	63141	79836	105566	101899	97415	102183
TONSLAND	154359	100630	83195	68944	89640	100582	113722	133054	127965	140746
SOPCOF %	95	99	98	97	101	99	98	98	100	101
1										

Table 4.5. N. Catch weights at age (kg)

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 2 Catch weights at age (kg)

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752
+gp		3.177	3.177	3.177	3.177	3.177	3.177	3.177
0 SOPCOFAC		0.6148	0.796	0.5603	0.6839	0.6614	0.6354	0.7714

Table 2 Catch weights at age (kg)

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752
+gp		3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177
0 SOPCOFAC		0.7831	0.8697	1.038	0.9368	0.9807	0.927	0.8514	0.7191	0.8484	0.8391
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 2 Catch weights at age (kg)

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752
+gp		3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177
0 SOPCOFAC		0.9761	0.9781	1.1066	0.9988	1.2771	0.8971	0.8366	1.0914	1.0879	0.8715

Table 4.5. N (cont.). Catch weights at age (kg)

Table 2 Catch weights at age (kg)

	YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE											
		3	0.768	0.768	0.768	0.768	0.768	0.768	1.033	1.218	0.835	0.612
		4	1.065	1.065	1.065	1.065	1.065	1.065	1.408	1.632	1.29	1.064
		5	1.353	1.353	1.353	1.353	1.353	1.353	1.71	2.038	1.816	1.539
		6	1.663	1.663	1.663	1.663	1.663	1.663	2.149	2.852	2.174	1.944
		7	1.921	1.921	1.921	1.921	1.921	1.921	2.469	2.845	2.301	2.362
		8	2.183	2.183	2.183	2.183	2.183	2.183	2.748	3.218	2.835	2.794
		9	2.463	2.463	2.463	2.463	2.463	2.463	3.069	3.605	3.253	3.25
		10	2.752	2.752	2.752	2.752	2.752	2.752	3.687	4.065	3.721	3.643
	+gp		3.177	3.177	3.177	3.177	3.177	3.177	4.516	4.667	4.416	5.283
0	SOPCOFAC		0.8969	1.0601	1.2702	1.2854	1.3583	1.3511	0.9535	0.9491	1.0242	0.9508

Table 2 Catch weights at age (kg)

	YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
		3	0.497	0.55	0.684	0.793	0.941	0.906	0.94	0.614	0.739	0.683
		4	0.765	0.908	0.84	1.172	1.281	1.263	1.204	0.906	0.808	0.868
		5	1.179	1.097	0.998	1.397	1.556	1.535	1.487	1.287	1.107	1.045
		6	1.724	1.357	1.176	1.624	1.797	1.747	1.748	1.602	1.556	1.363
		7	2.135	1.537	1.546	1.885	2.044	2.043	1.994	1.968	1.838	1.71
		8	2.551	1.704	1.713	2.112	2.079	2.2	2.237	2.059	2.234	1.886
		9	3.009	2.403	1.949	2.653	2.311	2.298	2.417	2.39	2.416	2.214
		10	3.414	2.403	2.14	3.102	2.788	2.494	2.654	2.545	2.602	2.37
	+gp		4.213	2.571	2.685	3.338	3.219	2.652	3.026	2.893	3.13	2.675
0	SOPCOFAC		1.0078	1.0045	1.023	0.9843	0.9639	1.0207	0.9969	0.9945	0.9759	0.9832

Table 2 Catch weights at age (kg)

	YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE											
		3	0.682	0.748	0.826	0.853	0.751	0.687	0.594	0.637	0.724	0.735
		4	1.028	0.974	1.079	1.186	1.104	1.001	0.875	0.886	0.882	1.033
		5	1.151	1.262	1.261	1.395	1.459	1.363	1.113	1.183	1.097	1.256
		6	1.369	1.433	1.485	1.588	1.709	1.64	1.364	1.509	1.319	1.467
		7	1.637	1.641	1.634	1.808	1.921	1.975	1.361	1.821	1.595	1.707
		8	1.856	1.863	1.798	1.989	2.182	2.086	1.972	2.075	2.003	2
		9	2.073	2.069	2.032	2.264	2.331	2.294	1.634	2.339	2.163	2.309
		10	2.5	2.335	2.237	2.415	2.609	2.488	1.877	2.58	2.435	2.646
	+gp		2.554	2.81	2.712	2.892	2.981	2.778	2.409	3.318	2.745	3.241
0	SOPCOFAC		0.9505	0.9888	0.9792	0.9741	1.0098	0.9896	1.0286	0.9789	0.9954	1.0029

Table 4.5. R. Catch weights at age (kg)

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 2 Catch weights at age (kg)

	YEAR	1950	1951	1952	1953	1954	1955	1956
	AGE							
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752
	+gp	3.177	3.177	3.177	3.177	3.177	3.177	3.177
0	SOPCOFAC	0.6148	0.796	0.5603	0.6839	0.6614	0.6354	0.7714

Table 2 Catch weights at age (kg)

	YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752
	+gp	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177
0	SOPCOFAC	0.7831	0.8697	1.038	0.9368	0.9807	0.927	0.8514	0.7191	0.8484	0.8391
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 2 Catch weights at age (kg)

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353	1.353
	6	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663	1.663
	7	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921	1.921
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183	2.183
	9	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463	2.463
	10	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752	2.752
	+gp	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177	3.177
0	SOPCOFAC	0.9761	0.9781	1.1066	0.9988	1.2771	0.8971	0.8366	1.0914	1.0879	0.8715

Table 4.5. R (cont.). Catch weights at age (kg)

Table 2 Catch weights at age (kg)

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0.768	0.768	0.768	0.768	0.768	0.768	1.033	1.218	0.835	0.612
	4	1.065	1.065	1.065	1.065	1.065	1.065	1.408	1.632	1.29	1.064
	5	1.353	1.353	1.353	1.353	1.353	1.353	1.71	2.038	1.816	1.539
	6	1.663	1.663	1.663	1.663	1.663	1.663	2.149	2.852	2.174	1.944
	7	1.921	1.921	1.921	1.921	1.921	1.921	2.469	2.845	2.301	2.362
	8	2.183	2.183	2.183	2.183	2.183	2.183	2.748	3.218	2.835	2.794
	9	2.463	2.463	2.463	2.463	2.463	2.463	3.069	3.605	3.253	3.25
	10	2.752	2.752	2.752	2.752	2.752	2.752	3.687	4.065	3.721	3.643
	+gp	3.177	3.177	3.177	3.177	3.177	3.177	4.516	4.667	4.416	5.283
0	SOPCOFAC	0.8969	1.0601	1.2702	1.2854	1.3583	1.3511	0.9535	0.9491	1.0242	0.9508

Table 2 Catch weights at age (kg)

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0.497	0.55	0.684	0.793	0.941	0.906	0.94	0.614	0.739	0.683
	4	0.765	0.908	0.84	1.172	1.281	1.263	1.204	0.906	0.808	0.868
	5	1.179	1.097	0.998	1.397	1.556	1.535	1.487	1.287	1.107	1.045
	6	1.724	1.357	1.176	1.624	1.797	1.747	1.748	1.602	1.556	1.363
	7	2.135	1.537	1.546	1.885	2.044	2.043	1.994	1.968	1.838	1.71
	8	2.551	1.704	1.713	2.112	2.079	2.2	2.237	2.059	2.234	1.886
	9	3.009	2.403	1.949	2.653	2.311	2.298	2.417	2.39	2.416	2.214
	10	3.414	2.403	2.14	3.102	2.788	2.494	2.654	2.545	2.602	2.37
	+gp	4.213	2.571	2.685	3.338	3.219	2.652	3.026	2.893	3.13	2.675
0	SOPCOFAC	1.0078	1.0045	1.023	0.9843	0.9639	1.0207	0.9969	0.9945	0.9759	0.9832

Table 2 Catch weights at age (kg)

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	0.682	0.748	0.826	0.853	0.751	0.706	0.59	0.648	0.756	0.744
	4	1.028	0.974	1.079	1.186	1.104	1.01	0.856	0.893	0.913	1.044
	5	1.151	1.262	1.261	1.395	1.459	1.363	1.068	1.188	1.132	1.274
	6	1.369	1.433	1.485	1.588	1.709	1.633	1.324	1.507	1.344	1.487
	7	1.637	1.641	1.634	1.808	1.921	1.955	1.318	1.808	1.604	1.736
	8	1.856	1.863	1.798	1.989	2.182	2.077	1.925	2.054	1.979	2.008
	9	2.073	2.069	2.032	2.264	2.331	2.263	1.603	2.304	2.123	2.302
	10	2.5	2.335	2.237	2.415	2.609	2.432	1.84	2.561	2.306	2.615
	+gp	2.554	2.81	2.712	2.892	2.981	2.748	2.404	2.962	2.962	3.199
0	SOPCOFAC	0.9505	0.9888	0.9792	0.9741	1.0098	0.9901	0.9783	0.9799	0.9966	1.0074
	1										

Table 4.6. N. Stock weights at age (kg)

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 3 Stock weights at age (kg)

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.363	0.363	0.363	0.363	0.363	0.363	0.363
	4	0.667	0.667	0.667	0.667	0.667	0.667	0.667
	5	1.035	1.035	1.035	1.035	1.035	1.035	1.035
	6	1.455	1.455	1.455	1.455	1.455	1.455	1.455
	7	1.907	1.907	1.907	1.907	1.907	1.907	1.907
	8	2.383	2.383	2.383	2.383	2.383	2.383	2.383
	9	2.844	2.844	2.844	2.844	2.844	2.844	2.844
	10	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp		3.682	3.682	3.682	3.682	3.682	3.682	3.682

Table 3 Stock weights at age (kg)

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363
	4	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
	5	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035
	6	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455
	7	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907
	8	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383
	9	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844
	10	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp		3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682

1

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 3 Stock weights at age (kg)

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363
	4	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
	5	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035
	6	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455
	7	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907
	8	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383
	9	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844
	10	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp		3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682

Table 4.6. N (cont.). Stock weights at age (kg)

Table 3 Stock weights at age (kg)

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	0.363	0.363	0.363	0.446	0.597	0.623	0.517	0.386	0.373	0.306
	4	0.667	0.667	0.667	0.864	0.794	1.042	1.088	0.916	0.693	0.675
	5	1.035	1.035	1.035	1.163	1.299	1.204	1.552	1.621	1.383	1.06
	6	1.455	1.455	1.455	1.682	1.591	1.765	1.651	2.091	2.187	1.888
	7	1.907	1.907	1.907	2.302	2.132	2.032	2.241	2.112	2.631	2.757
	8	2.383	2.383	2.383	3.143	2.748	2.575	2.472	2.708	2.568	3.153
	9	2.844	2.844	2.844	3.334	3.533	3.171	3.002	2.899	3.155	3.008
	10	3.273	3.273	3.273	3.579	3.716	3.891	3.566	3.406	3.305	3.575
+gp		3.682	3.682	3.682	4.076	3.944	4.067	4.217	3.932	3.784	3.687

Table 3 Stock weights at age (kg)

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	0.327	0.379	0.44	0.408	0.397	0.335	0.275	0.259	0.278	0.296
	4	0.563	0.597	0.682	0.781	0.729	0.712	0.609	0.506	0.48	0.515
	5	1.038	0.879	0.929	1.047	1.184	1.11	1.091	0.943	0.793	0.754
	6	1.465	1.443	1.24	1.305	1.451	1.622	1.527	1.508	1.318	1.121
	7	2.405	1.888	1.87	1.628	1.708	1.875	2.075	1.962	1.944	1.716
	8	3.311	2.914	2.313	2.304	2.03	2.123	2.306	2.526	2.397	2.384
	9	3.643	3.835	3.402	2.73	2.733	2.436	2.541	2.732	2.963	2.822
	10	3.424	4.094	4.322	3.86	3.129	3.149	2.836	2.951	3.143	3.38
+gp		3.963	3.811	4.504	4.768	4.283	3.506	3.546	3.223	3.348	3.536

Table 3 Stock weights at age (kg)

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0.326	0.344	0.34	0.297	0.299	0.29	0.287	0.303	0.306	0.308
	4	0.544	0.594	0.625	0.618	0.544	0.548	0.532	0.528	0.557	0.56
	5	0.81	0.851	0.921	0.968	0.956	0.85	0.854	0.832	0.829	0.87
	6	1.07	1.148	1.201	1.289	1.352	1.335	1.197	1.2	1.173	1.172
	7	1.474	1.413	1.516	1.578	1.683	1.762	1.737	1.57	1.572	1.541
	8	2.122	1.842	1.772	1.901	1.969	2.087	2.182	2.148	1.956	1.955
	9	2.815	2.525	2.214	2.137	2.292	2.363	2.49	2.6	2.557	2.345
	10	3.228	3.228	2.917	2.581	2.499	2.68	2.753	2.885	3.008	2.954
+gp		3.77	3.611	3.619	3.291	2.938	2.854	3.059	3.13	3.266	3.4

1

Table 4.6. R. Stock weights at age (kg)

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 3 Stock weights at age (kg)

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	0.363	0.363	0.363	0.363	0.363	0.363	0.363
4	0.667	0.667	0.667	0.667	0.667	0.667	0.667
5	1.035	1.035	1.035	1.035	1.035	1.035	1.035
6	1.455	1.455	1.455	1.455	1.455	1.455	1.455
7	1.907	1.907	1.907	1.907	1.907	1.907	1.907
8	2.383	2.383	2.383	2.383	2.383	2.383	2.383
9	2.844	2.844	2.844	2.844	2.844	2.844	2.844
10	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp	3.682	3.682	3.682	3.682	3.682	3.682	3.682

Table 3 Stock weights at age (kg)

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363
4	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
5	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035
6	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455
7	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907
8	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383
9	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844
10	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682

1

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 3 Stock weights at age (kg)

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363	0.363
4	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
5	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035	1.035
6	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.455
7	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907	1.907
8	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383	2.383
9	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844	2.844
10	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273	3.273
+gp	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682	3.682

Table 4.6. R (cont.). Stock weights at age (kg)

Table 3 Stock weights at age (kg)

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	0.363	0.363	0.363	0.446	0.597	0.623	0.517	0.386	0.373	0.306
	4	0.667	0.667	0.667	0.864	0.794	1.042	1.088	0.916	0.693	0.675
	5	1.035	1.035	1.035	1.163	1.299	1.204	1.552	1.621	1.383	1.06
	6	1.455	1.455	1.455	1.682	1.591	1.765	1.651	2.091	2.187	1.888
	7	1.907	1.907	1.907	2.302	2.132	2.032	2.241	2.112	2.631	2.757
	8	2.383	2.383	2.383	3.143	2.748	2.575	2.472	2.708	2.568	3.153
	9	2.844	2.844	2.844	3.334	3.533	3.171	3.002	2.899	3.155	3.008
	10	3.273	3.273	3.273	3.579	3.716	3.891	3.566	3.406	3.305	3.575
+gp		3.682	3.682	3.682	4.076	3.944	4.067	4.217	3.932	3.784	3.687

Table 3 Stock weights at age (kg)

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	0.327	0.379	0.44	0.408	0.397	0.335	0.275	0.259	0.278	0.296
	4	0.563	0.597	0.682	0.781	0.729	0.712	0.609	0.506	0.48	0.515
	5	1.038	0.879	0.929	1.047	1.184	1.11	1.091	0.943	0.793	0.754
	6	1.465	1.443	1.24	1.305	1.451	1.622	1.527	1.508	1.318	1.121
	7	2.405	1.888	1.87	1.628	1.708	1.875	2.075	1.962	1.944	1.716
	8	3.311	2.914	2.313	2.304	2.03	2.123	2.306	2.526	2.397	2.384
	9	3.643	3.835	3.402	2.73	2.733	2.436	2.541	2.732	2.963	2.822
	10	3.424	4.094	4.322	3.86	3.129	3.149	2.836	2.951	3.143	3.38
+gp		3.963	3.811	4.504	4.768	4.283	3.506	3.546	3.223	3.348	3.536

Table 3 Stock weights at age (kg)

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0.326	0.344	0.34	0.297	0.299	0.29	0.287	0.303	0.306	0.308
	4	0.544	0.594	0.625	0.618	0.544	0.548	0.532	0.528	0.557	0.56
	5	0.81	0.851	0.921	0.968	0.956	0.85	0.854	0.832	0.829	0.87
	6	1.07	1.148	1.201	1.289	1.352	1.335	1.197	1.2	1.173	1.172
	7	1.474	1.413	1.516	1.578	1.683	1.762	1.737	1.57	1.572	1.541
	8	2.122	1.842	1.772	1.901	1.969	2.087	2.182	2.148	1.956	1.955
	9	2.815	2.525	2.214	2.137	2.292	2.363	2.49	2.6	2.557	2.345
	10	3.228	3.228	2.917	2.581	2.499	2.68	2.753	2.885	3.008	2.954
+gp		3.77	3.611	3.619	3.291	2.938	2.854	3.059	3.13	3.266	3.4
	1										

Table 4.7. N. Natural mortality (M) at age

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 4 Natural Mortality (M) at age

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179
4	0.228	0.228	0.228	0.228	0.228	0.228	0.228
5	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151
6	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179
4	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228
5	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151
6	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 4 Natural Mortality (M) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179
4	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.228
5	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151
6	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4.7. N (cont.). Natural mortality (M) at age

Table 4 Natural Mortality (M) at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.3179	0.2074	0.2	0.646
4	0.228	0.228	0.228	0.228	0.228	0.228	0.228	0.2	0.2	0.2
5	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2151	0.2	0.2	0.2
6	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2033	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.2	0.4044	0.2	0.3191	0.2	0.2058	0.2613	0.2943	0.3436	0.734
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2253	0.2173	0.364	0.297
5	0.2	0.2023	0.2	0.2	0.2	0.2	0.2679	0.2113	0.3042	0.224
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2005	0.208	0.2225
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	0.4761	0.2354	0.2016	0.2242	0.2142	0.3238	0.4078	0.3127	0.4722	0.2288
4	0.2409	0.2505	0.2	0.2078	0.2012	0.2097	0.2574	0.2471	0.2961	0.2294
5	0.223	0.2191	0.2	0.2072	0.2	0.2088	0.2072	0.2101	0.2469	0.2159
6	0.2094	0.2	0.2	0.2042	0.2	0.2038	0.2	0.2	0.2151	0.2113
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1										

Table 4.7. R. Natural mortality (M) at age

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 4 Natural Mortality (M) at age

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192
	4	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283
	5	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152
	6	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192
	4	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283
	5	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152
	6	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 4 Natural Mortality (M) at age

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192
	4	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283
	5	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152
	6	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4.7. R (cont.). Natural mortality (M) at age

Table 4 Natural Mortality (M) at age

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.3192	0.2074	0.2	0.6463
	4	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2283	0.2	0.2	0.2
	5	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2152	0.2	0.2	0.2
	6	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2032	0.2	0.2	0.2
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	0.2	0.4048	0.2	0.3193	0.2	0.2058	0.2617	0.2953	0.3448	0.7568
	4	0.2	0.2	0.2	0.2	0.2	0.2	0.2254	0.2174	0.3662	0.298
	5	0.2	0.2023	0.2	0.2	0.2	0.2	0.268	0.2114	0.3052	0.2245
	6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2005	0.2081	0.2228
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0.4746	0.237	0.2016	0.2254	0.2148	0.324	0.4097	0.3116	0.4728	0.2286
	4	0.2434	0.2501	0.2	0.2079	0.2012	0.2099	0.2581	0.248	0.2958	0.2294
	5	0.2233	0.2206	0.2	0.2075	0.2	0.2089	0.207	0.2103	0.2462	0.2152
	6	0.2096	0.2	0.2	0.2041	0.2	0.2036	0.2	0.2	0.215	0.2104
	7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	1										

Table 4.8. N. Proportion mature at age

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 5 Proportion mature at age

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	4	0.104	0.104	0.104	0.104	0.104	0.104	0.104
	5	0.322	0.322	0.322	0.322	0.322	0.322	0.322
	6	0.635	0.635	0.635	0.635	0.635	0.635	0.635
	7	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	8	0.948	0.948	0.948	0.948	0.948	0.948	0.948
	9	0.984	0.984	0.984	0.984	0.984	0.984	0.984
	10	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp		1	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	4	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
	5	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
	6	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
	7	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	8	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948
	9	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
	10	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp		1	1	1	1	1	1	1	1	1	1
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 5 Proportion mature at age

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	4	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
	5	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
	6	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
	7	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	8	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948
	9	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
	10	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp		1	1	1	1	1	1	1	1	1	1

Table 4.8. N (cont.). Proportion mature at age

Table 5 Proportion mature at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.028	0.028	0.028	0.023	0.051	0.049	0.054	0.04	0.024	0.019
4	0.104	0.104	0.104	0.07	0.097	0.153	0.175	0.192	0.142	0.096
5	0.322	0.322	0.322	0.233	0.293	0.323	0.465	0.505	0.522	0.449
6	0.635	0.635	0.635	0.65	0.539	0.569	0.662	0.802	0.799	0.765
7	0.85	0.85	0.85	0.864	0.862	0.764	0.797	0.864	0.931	0.932
8	0.948	0.948	0.948	0.953	0.952	0.95	0.905	0.922	0.955	0.979
9	0.984	0.984	0.984	0.986	0.986	0.985	0.985	0.967	0.974	0.985
10	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.99	0.992
+gp	1	1	1	1	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.019	0.022	0.029	0.042	0.038	0.028	0.016	0.015	0.014	0.018
4	0.071	0.07	0.085	0.121	0.157	0.14	0.107	0.068	0.055	0.065
5	0.286	0.234	0.244	0.299	0.353	0.446	0.391	0.323	0.221	0.207
6	0.717	0.575	0.534	0.579	0.625	0.706	0.745	0.706	0.635	0.496
7	0.924	0.903	0.826	0.803	0.826	0.861	0.884	0.908	0.891	0.86
8	0.979	0.978	0.969	0.94	0.93	0.94	0.954	0.963	0.972	0.967
9	0.994	0.994	0.994	0.991	0.982	0.978	0.981	0.986	0.989	0.992
10	0.994	0.998	0.998	0.997	0.998	0.995	0.993	0.994	0.995	0.997
+gp	1	1	1	1	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	0.023	0.029	0.04	0.026	0.028	0.021	0.022	0.02	0.02	0.022
4	0.069	0.088	0.111	0.14	0.096	0.106	0.091	0.081	0.075	0.077
5	0.198	0.251	0.3	0.343	0.389	0.309	0.322	0.262	0.263	0.25
6	0.494	0.5	0.583	0.622	0.667	0.712	0.639	0.635	0.582	0.595
7	0.765	0.753	0.764	0.802	0.86	0.886	0.9	0.848	0.858	0.827
8	0.952	0.912	0.903	0.905	0.931	0.952	0.962	0.969	0.955	0.956
9	0.99	0.986	0.972	0.969	0.97	0.98	0.986	0.989	0.991	0.986
10	0.998	0.997	0.996	0.991	0.99	0.99	0.993	0.996	0.997	0.997
+gp	1	1	1	1	1	1	1	1	1	1
1										

Table 4.8. R. Proportion mature at age

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 5 Proportion mature at age

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	0.028	0.028	0.028	0.028	0.028	0.028	0.028
4	0.104	0.104	0.104	0.104	0.104	0.104	0.104
5	0.322	0.322	0.322	0.322	0.322	0.322	0.322
6	0.635	0.635	0.635	0.635	0.635	0.635	0.635
7	0.85	0.85	0.85	0.85	0.85	0.85	0.85
8	0.948	0.948	0.948	0.948	0.948	0.948	0.948
9	0.984	0.984	0.984	0.984	0.984	0.984	0.984
10	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp	1	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
4	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
5	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
6	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
7	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
8	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948
9	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
10	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp	1	1	1	1	1	1	1	1	1	1
1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 5 Proportion mature at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
4	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
5	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322
6	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
7	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
8	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.948
9	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
10	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
+gp	1	1	1	1	1	1	1	1	1	1

Table 4.8. R (cont.). Proportion mature at age

Table 5	Proportion mature at age									
YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	0.028	0.028	0.028	0.023	0.051	0.049	0.054	0.04	0.024	0.019
	4	0.104	0.104	0.104	0.07	0.097	0.153	0.175	0.192	0.142	0.096
	5	0.322	0.322	0.322	0.233	0.293	0.323	0.465	0.505	0.522	0.449
	6	0.635	0.635	0.635	0.65	0.539	0.569	0.662	0.802	0.799	0.765
	7	0.85	0.85	0.85	0.864	0.862	0.764	0.797	0.864	0.931	0.932
	8	0.948	0.948	0.948	0.953	0.952	0.95	0.905	0.922	0.955	0.979
	9	0.984	0.984	0.984	0.986	0.986	0.985	0.985	0.967	0.974	0.985
	10	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.99	0.992
+gp		1	1	1	1	1	1	1	1	1	1

Table 5	Proportion mature at age									
YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	0.019	0.022	0.029	0.042	0.038	0.028	0.016	0.015	0.014	0.018
	4	0.071	0.07	0.085	0.121	0.157	0.14	0.107	0.068	0.055	0.065
	5	0.286	0.234	0.244	0.299	0.353	0.446	0.391	0.323	0.221	0.207
	6	0.717	0.575	0.534	0.579	0.625	0.706	0.745	0.706	0.635	0.496
	7	0.924	0.903	0.826	0.803	0.826	0.861	0.884	0.908	0.891	0.86
	8	0.979	0.978	0.969	0.94	0.93	0.94	0.954	0.963	0.972	0.967
	9	0.994	0.994	0.994	0.991	0.982	0.978	0.981	0.986	0.989	0.992
	10	0.994	0.998	0.998	0.997	0.998	0.995	0.993	0.994	0.995	0.997
+gp		1	1	1	1	1	1	1	1	1	1

Table 5	Proportion mature at age									
YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0.023	0.029	0.04	0.026	0.028	0.021	0.022	0.02	0.02	0.022
	4	0.069	0.088	0.111	0.14	0.096	0.106	0.091	0.081	0.075	0.077
	5	0.198	0.251	0.3	0.343	0.389	0.309	0.322	0.262	0.263	0.25
	6	0.494	0.5	0.583	0.622	0.667	0.712	0.639	0.635	0.582	0.595
	7	0.765	0.753	0.764	0.802	0.86	0.886	0.9	0.848	0.858	0.827
	8	0.952	0.912	0.903	0.905	0.931	0.952	0.962	0.969	0.955	0.956
	9	0.99	0.986	0.972	0.969	0.97	0.98	0.986	0.989	0.991	0.986
	10	0.998	0.997	0.996	0.991	0.99	0.99	0.993	0.996	0.997	0.997
+gp		1	1	1	1	1	1	1	1	1	1
	1										

Table 4.9 Survey indices used in tuning XSA

North-East Arctic haddock
103
FLT01: Russian BT survey, total area, Nov-Dec, age 1-7
1983 2006
1 1 0.90 1.00
1 7

1	592	95	5	4	0.1	0	0
1	586	584	15	2	1	0.1	0
1	144	1343	900	4	1	1	0
1	14	107	363	164	1	0.1	0.1
1	9	17	83	225	57	0.1	0.1
1	3	7	17	40	76	8	0.1
1	18	24	4	14	41	81	11
1	0	0	0	0	0	0	0
1	429	176	62	9	3	6	18
1	282	1286	346	50	4	6	9
1	48	357	1985	356	48	8	4
1	49	58	442	1014	116	15	1
1	72	42	31	123	370	40	5
1	23	57	28	49	362	334	29
1	0	19	32	32	10	27	10
1	29	0	38	46	8	5	15
1	289	61	0	39	37	8	3
1	207	262	60	0	26	11	2
1	149	261	334	40	0	11	4
1	193	189	399	450	47	0	4
1	328	251	221	299	231	34	0
1	110	206	113	94	107	87	5
1	792	136	240	86	48	57	24
1	792	1227	113	119	57	26	24

FLT02: Norwegian acoustic, age 1-7, shifted
1980 2006
1 1 0.99 1.00
1 7

1	140	50	210	600	180	10	0
1	20	30	40	40	100	60	0
1	50	20	30	10	10	40	20
1	1730	60	20	10	0	0	0
1	7760	2150	50	0	0	0	0
1	2660	4520	1890	0	0	0	0
1	170	490	1710	500	0	0	0
1	40	80	230	460	70	0	0
1	50	60	110	200	210	20	0
1	350	30	30	40	70	110	20
1	2520	450	80	30	30	30	60
1	8680	1340	230	20	0	0	10
1	6260	5630	1300	130	0	0	0
1	1930	2550	6310	1110	120	0	0
1	2850	360	1110	3870	420	20	0
1	2290	440	310	760	1510	80	0
1	240	510	170	120	430	430	20
1	0	200	280	120	50	130	160
1	455	0	131	140	36	14	19
1	5089	322	0	185	110	16	5
1	3156	2096	231	0	13	10	1
1	2820	2157	1495	135	0	10	0
1	2786	1452	1976	1688	172	0	2
1	4743	1267	759	760	659	66	0
1	2092	2189	1019	365	401	90	1
1	8036	542	862	302	116	90	22
1	8680	3790	537	878	218	61	52

Table 4.9 (cont.). Survey indices used in tuning XSA

FLT04: Norwegian BT survey, age 1-8, shifted
1982 2006
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	0	227	332	132	34	80	81	7
1	576	0	122	102	28	10	17	11
1	4522	272	0	84	40	8	3	7
1	4603	2960	293	0	17	9	1	1
1	5347	3147	1853	176	0	8	3	0
1	5131	3174	1820	736	55	0	2	1
1	7112	1881	1027	804	462	59	0	2
1	4204	3465	1333	668	522	123	6	0
1	13131	774	1405	482	196	152	31	2
1	15938	5077	660	860	233	75	37	14

Table 4.10 N. North-East Arctic HADDOCK. Input data for recruitment prediction (RCT3)

NORTHEAST ARCTIC HADDOCK: recruits as 3 year-olds
8 17 2

'Year-class'	'VPA'	'RT1'	'RT2'	'NT2'	'NT3'	'NT4'	'RT0'	'NT1'	'NA1'
1990	686.8	42.9	128.6	1375.5	507.7	436.6	-11.0	2006.0	1890.0
1991	306.9	28.2	35.7	599.0	339.5	171.1	16.7	1659.4	1135.0
1992	98.9	4.8	5.8	228.0	53.6	48.1	16.4	727.9	947.0
1993	105.7	4.9	4.2	179.3	52.5	28.0	3.5	603.2	562.0
1994	116.1	7.2	5.7	263.6	86.1	33.2	9.1	1463.6	1379.0
1995	62.2	2.3	1.9	67.9	22.7	12.2	6.4	309.5	240.0
1996	235.7	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
1997	93.2	2.9	6.1	57.6	27.2	29.3	1.8	212.9	220.0
1998	396.0	28.9	26.2	452.2	296.0	185.3	10.7	1244.9	856.0
1999	369.7	20.7	26.1	460.3	314.7	182.0	11.7	847.2	1024.0
2000	235.7	14.9	18.9	534.7	317.4	102.7	15.1	1220.5	976.0
2001	224.3	19.3	25.1	513.1	188.1	133.3	20.8	1680.3	2062.0
2002	338.9	32.8	20.6	711.2	346.5	140.5	33.2	3332.1	2394.0
2003	134.6	11.0	13.6	420.4	77.4	66.0	19.8	715.9	752.0
2004	-11.0	79.2	122.7	1313.1	507.7	-11.0	50.0	4630.2	3364.0
2005	-11.0	79.2	-11.0	1593.8	-11.0	-11.0	62.0	5141.3	2767.0
2006	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	53.4	3874.5	3196.8

1990 RT was removed from XSA tuning
1996 yearclass removed from XSA tuning
RT1 Russian bottom trawl survey age 2
RT2 Russian bottom trawl survey age 3
NT2 Norwegian bottom trawl survey age 2
NT3 Norwegian bottom trawl survey age 3
NT4 Norwegian bottom trawl survey age 4
RT0 Russian bottom trawl survey age 1
NT1 Norwegian bottom trawl survey age 1
NA1 Norwegian acoustic survey age 1

Table 4.10 R. North-East Arctic HADDOCK. Input data for recruitment prediction (RCT3)

NORTHEAST ARCTIC HADDOCK: recruits as 3 year-olds
8 17 2

'Year-class'	'VPA'	'RT1'	'RT2'	'NT2'	'NT3'	'NT4'	'RT0'	'NT1'	'NA1'
1990	681.2	42.9	128.6	1375.5	507.7	436.6	-11.0	2006.0	1890.0
1991	302.6	28.2	35.7	599.0	339.5	171.1	16.7	1659.4	1135.0
1992	98.0	4.8	5.8	228.0	53.6	48.1	16.4	727.9	947.0
1993	102.5	4.9	4.2	179.3	52.5	28.0	3.5	603.2	562.0
1994	116.3	7.2	5.7	263.6	86.1	33.2	9.1	1463.6	1379.0
1995	59.1	2.3	1.9	67.9	22.7	12.2	6.4	309.5	240.0
1996	231.1	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
1997	85.4	2.9	6.1	57.6	27.2	29.3	1.8	212.9	220.0
1998	357.1	28.9	26.2	452.2	296.0	185.3	10.7	1244.9	856.0
1999	327.2	20.7	26.1	460.3	314.7	182.0	11.7	847.2	1024.0
2000	211.9	14.9	18.9	534.7	317.4	102.7	15.1	1220.5	976.0
2001	203.3	19.3	25.1	513.1	188.1	133.3	20.8	1680.3	2062.0
2002	310.4	32.8	20.6	711.2	346.5	140.5	33.2	3332.1	2394.0
2003	125.4	11.0	13.6	420.4	77.4	66.0	19.8	715.9	752.0
2004	-11.0	79.2	122.7	1313.1	507.7	-11.0	50.0	4630.2	3364.0
2005	-11.0	79.2	-11.0	1593.8	-11.0	-11.0	62.0	5141.3	2767.0
2006	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	53.4	3874.5	3196.8

1990 RT was removed from XSA tuning
1996 yearclass removed from XSA tuning
RT1 Russian bottom trawl survey age 2
RT2 Russian bottom trawl survey age 3
NT2 Norwegian bottom trawl survey age 2
NT3 Norwegian bottom trawl survey age 3
NT4 Norwegian bottom trawl survey age 4
RT0 Russian bottom trawl survey age 1
NT1 Norwegian bottom trawl survey age 1
NA1 Norwegian acoustic survey age 1

Table 4.11. N. NEA Haddock. Analysis by RCT3 ver.1

Yearclass	=	2003							
Survey/	Slope	Inter-	Std	Rsquare	No.	Index	Predicted	Std	WAP
Series	cept	Error	Pts	Value	Value	Error	Weights		
RT1	0.82	3.18	0.19	0.941	12	2.48	5.21	0.22	0.247
RT2	0.76	3.24	0.23	0.914	12	2.68	5.28	0.269	0.165
NT2	0.86	0.36	0.38	0.798	12	6.04	5.54	0.444	0.061
NT3	0.68	1.92	0.23	0.914	12	4.36	4.9	0.274	0.16
NT4	0.73	2.1	0.16	0.956	12	4.2	5.16	0.188	0.299
RT0	1.41	1.75	0.85	0.404	11	3.03	6.03	1.041	0.011
NT1	1.19	-2.93	0.71	0.53	12	6.57	4.91	0.834	0.017
NA1	1.29	-3.51	0.78	0.48	12	6.62	5.05	0.917	0.014
VPA	Mean	=	5.3	0.677	0.026				

Yearclass	=	2004							
Survey/	Slope	Inter-	Std	Rsquare	No.	Index	Predicted	Std	WAP
Series	cept	Error	Pts	Value	Value	Error	Weights		
RT1	0.83	3.12	0.21	0.923	13	4.38	6.75	0.287	0.293
RT2	0.8	3.11	0.26	0.884	13	4.82	6.95	0.372	0.175
NT2	0.9	0.07	0.43	0.73	13	7.18	6.51	0.562	0.077
NT3	0.67	1.95	0.22	0.916	13	6.23	6.16	0.271	0.33
NT4									
RT0	1.53	1.35	0.96	0.327	12	3.93	7.35	1.319	0.014
NT1	1.17	-2.79	0.66	0.534	13	8.44	7.1	0.91	0.029
NA1	1.28	-3.46	0.74	0.48	13	8.12	6.96	0.981	0.025
VPA	Mean	=	5.27	0.647	0.058				

Yearclass	=	2005							
Survey/	Slope	Inter-	Std	Rsquare	No.	Index	Predicted	Std	WAP
Series	cept	Error	Pts	Value	Value	Error	Weights		
RT1	0.83	3.12	0.21	0.92	13	4.38	6.74	0.297	0.588
RT2									
NT2	0.9	0.07	0.44	0.718	13	7.37	6.69	0.602	0.143
NT3									
NT4									
RT0	1.52	1.36	0.96	0.327	12	4.14	7.66	1.402	0.026
NT1	1.15	-2.64	0.66	0.531	13	8.55	7.18	0.94	0.059
NA1	1.26	-3.28	0.73	0.479	13	7.93	6.68	0.955	0.057
VPA	Mean	=	5.27	0.638	0.127				

Yearclass	=	2006							
Survey/	Slope	Inter-	Std	Rsquare	No.	Index	Predicted	Std	WAP
Series	cept	Error	Pts	Value	Value	Error	Weights		
RT1									
RT2									
NT2									
NT3									
NT4									
RT0	1.51	1.37	0.97	0.325	12	4	7.41	1.395	0.097
NT1	1.12	-2.46	0.66	0.529	13	8.26	6.82	0.906	0.23
NA1	1.23	-3.08	0.73	0.48	13	8.07	6.82	0.988	0.193
VPA	Mean	=	5.28	0.627	0.48				

Year Class Prediction	Weighted Average Error	Log WAP Error	Int Std	Ext Std	Var Ratio	VPA VPA	Log
2002	339	5.83	0.11	0.11	0.95	339	5.83
2003	177	5.18	0.11	0.06	0.34	135	4.91
2004	672	6.51	0.16	0.17	1.22		
2005	731	6.59	0.23	0.24	1.11		
2006	463	6.14	0.43	0.49	1.25		

Table 4.11. R. NEA Haddock. Analysis by RCT3 ver.1

Yearclass = 2003

Survey/ Series	Slope cept	Inter- Error	Std Pts	Rsquare Value	No. Value	Index Error	Predicted Weights	Std	WAP
RT1	0.8	3.16	0.18	0.943	12	2.48	5.14	0.211	0.253
RT2	0.74	3.22	0.22	0.919	12	2.68	5.21	0.255	0.173
NT2	0.83	0.46	0.35	0.817	12	6.04	5.46	0.408	0.068
NT3	0.67	1.93	0.23	0.912	12	4.36	4.84	0.271	0.154
NT4	0.71	2.1	0.16	0.954	12	4.2	5.09	0.188	0.281
RT0	1.33	1.88	0.79	0.421	11	3.03	5.92	0.967	0.012
NT1	1.14	-2.65	0.66	0.552	12	6.57	4.85	0.779	0.019
NA1	1.24	-3.21	0.73	0.5	12	6.62	4.99	0.862	0.015
VPA	Mean	=	5.23	0.663	0.026				

Yearclass = 2004

Survey/ Series	Slope cept	Inter- Error	Std Pts	Rsquare Value	No. Value	Index Error	Predicted Weights	Std	WAP
RT1	0.81	3.1	0.2	0.924	13	4.38	6.65	0.277	0.294
RT2	0.78	3.09	0.25	0.886	13	4.82	6.84	0.359	0.175
NT2	0.87	0.18	0.41	0.746	13	7.18	6.4	0.526	0.082
NT3	0.66	1.96	0.21	0.914	13	6.23	6.07	0.266	0.32
NT4									
RT0	1.44	1.48	0.9	0.34	12	3.93	7.16	1.236	0.015
NT1	1.12	-2.51	0.62	0.557	13	8.44	6.95	0.849	0.031
NA1	1.23	-3.15	0.7	0.499	13	8.12	6.82	0.921	0.027
VPA	Mean	=	5.2	0.633	0.056				

Yearclass = 2005

Survey/ Series	Slope cept	Inter- Error	Std Pts	Rsquare Value	No. Value	Index Error	Predicted Weights	Std	WAP
RT1	0.8	3.11	0.2	0.923	13	4.38	6.63	0.284	0.583
RT2									
NT2	0.86	0.19	0.41	0.734	13	7.37	6.56	0.563	0.148
NT3									
NT4									
RT0	1.44	1.5	0.9	0.339	12	4.14	7.45	1.315	0.027
NT1	1.1	-2.34	0.62	0.554	13	8.55	7.02	0.874	0.061
NA1	1.2	-2.97	0.69	0.499	13	7.93	6.54	0.895	0.059
VPA	Mean	=	5.2	0.623	0.121				

Yearclass = 2006

Survey/ Series	Slope cept	Inter- Error	Std Pts	Rsquare Value	No. Value	Index Error	Predicted Weights	Std	WAP
RT1									
RT2									
NT2									
NT3									
NT4									
RT0	1.43	1.51	0.91	0.336	12	4	7.22	1.308	0.1
NT1	1.07	-2.16	0.61	0.553	13	8.26	6.67	0.839	0.242
NA1	1.17	-2.76	0.68	0.5	13	8.07	6.67	0.923	0.201
VPA	Mean	=	5.21	0.611	0.457				

Year Class Prediction	Weighted Average Error	Log WAP Error	Int Std	Ext Std	Var Ratio	VPA VPA	Log
2002	316	5.76	0.11	0.11	0.97	311	5.74
2003	167	5.12	0.11	0.06	0.35	126	4.84
2004	611	6.42	0.15	0.16	1.2		
2005	658	6.49	0.22	0.23	1.09		
2006	427	6.06	0.41	0.46	1.23		

Table 4.12. N. Extended Survivors Analysis

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

NEA Haddock (Final XSA AFWG07)

CPUE data from file fleet

Catch data for 57 years. 1950 to 2006. Ages 1 to 11.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
FLT01: Russian BT su	1990	2006	1	7	0.9	1
FLT02: Norwegian aco	1990	2006	1	7	0.99	1
FLT04: Norwegian BT	1990	2006	1	8	0.99	1

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 = .500

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00178

Final year F values

Age	1	2	3	4	5	6	7	8	9	10
Iteration 29	0.0001	0.0038	0.0464	0.28	0.4148	0.3975	0.4888	0.3887	0.2942	0.3936
Iteration 30	0.0001	0.0038	0.0464	0.2799	0.4147	0.3974	0.4885	0.3883	0.2938	0.3932

1

Regression weights										
	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Table 4.12. N (cont.).

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0	0.001	0	0	0	0	0	0	0	0
2	0.001	0.005	0.005	0.001	0.004	0.002	0.002	0.003	0.003	0.004
3	0.025	0.031	0.082	0.018	0.037	0.023	0.034	0.042	0.041	0.046
4	0.136	0.199	0.205	0.206	0.082	0.181	0.124	0.169	0.154	0.28
5	0.371	0.357	0.471	0.255	0.356	0.251	0.318	0.293	0.29	0.415
6	0.576	0.478	0.427	0.283	0.341	0.444	0.523	0.456	0.472	0.397
7	0.714	0.514	0.49	0.298	0.26	0.281	0.623	0.386	0.597	0.488
8	0.686	0.694	0.475	0.338	0.223	0.22	0.398	0.427	0.339	0.388
9	0.627	0.601	0.494	0.203	0.422	0.139	0.374	0.181	0.528	0.294
10	0.696	0.601	0.368	0.248	0.229	0.284	0.625	0.54	0.627	0.393

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XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1997	1.39E+06	1.15E+05	1.17E+05	5.01E+04	4.55E+04	8.32E+04	1.07E+05	1.25E+04	1.85E+03	5.40E+02
1998	1.81E+06	3.23E+05	6.26E+04	7.09E+04	3.44E+04	2.51E+04	3.79E+04	4.30E+04	5.17E+03	8.07E+02
1999	1.70E+06	1.40E+05	2.38E+05	4.80E+04	4.52E+04	1.93E+04	1.27E+04	1.86E+04	1.76E+04	2.32E+03
2000	2.00E+06	5.61E+05	9.39E+04	1.79E+05	3.20E+04	2.31E+04	1.03E+04	6.38E+03	9.45E+03	8.79E+03
2001	1.30E+06	5.16E+05	3.99E+05	7.37E+04	1.18E+05	2.02E+04	1.42E+04	6.28E+03	3.73E+03	6.32E+03
2002	3.29E+06	5.51E+05	3.73E+05	3.11E+05	5.55E+04	6.79E+04	1.17E+04	8.96E+03	4.11E+03	2.00E+03
2003	4.82E+06	5.22E+05	2.38E+05	2.64E+05	2.10E+05	3.51E+04	3.55E+04	7.25E+03	5.88E+03	2.93E+03
2004	3.16E+06	6.42E+05	2.26E+05	1.53E+05	1.80E+05	1.24E+05	1.70E+04	1.56E+04	3.99E+03	3.31E+03
2005	8.58E+06	4.52E+05	3.41E+05	1.59E+05	1.01E+05	1.09E+05	6.45E+04	9.46E+03	8.33E+03	2.72E+03
2006	8.71E+06	1.08E+06	1.35E+05	2.04E+05	1.01E+05	5.89E+04	5.48E+04	2.91E+04	5.52E+03	4.02E+03

Estimated population abundance at 1st Jan 2007

0.00E+00	9.67E+05	5.50E+05	1.02E+05	1.23E+05	5.39E+04	3.21E+04	2.75E+04	1.62E+04	3.37E+03

Taper weighted geometric mean of the VPA populations:

2.75E+06	4.04E+05	1.87E+05	1.29E+05	8.14E+04	4.51E+04	2.22E+04	1.01E+04	4.74E+03	2.49E+03

Standard error of the weighted Log(VPA populations) :

0.6989	0.6581	0.6755	0.7507	0.7934	0.8361	0.8541	0.7952	0.7853	0.9108

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Log catchability residuals.

Fleet : FLT01: Russian BT su

Age	1990	1991	1992	1993	1994	1995	1996
1	99.99	0.33	0.21	-0.13	-0.38	-0.39	-0.25
2	99.99	0.22	0.23	0.15	0.08	-0.31	-0.19
3	99.99	0.03	0.45	0.41	0.26	-0.28	-0.18
4	99.99	-0.21	-0.08	0.7	0.29	-0.37	0.11
5	99.99	-0.33	-0.32	0.31	0.29	-0.18	0.76
6	99.99	-0.41	0.4	0.59	0.1	0.15	0.57
7	99.99	0.49	0.68	0.87	-0.42	0.35	1.29
8	No data for this fleet at this age						

Table 4.12. N (cont.).

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	1	99.99	-0.21	0.45	0.22	0.14	-0.02	0.04	-0.28	0.07	0.13
	2	-0.09	99.99	0.32	-0.19	-0.12	-0.09	0.14	-0.31	0.13	0.31
	3	-0.34	0.25	99.99	0.13	-0.21	0.03	0.16	-0.28	-0.1	0.19
	4	0.08	0.06	0.3	99.99	-0.2	0.25	0.1	-0.2	-0.28	-0.25
	5	-0.55	-0.44	0.42	0.38	99.99	0.24	0.06	-0.34	-0.29	-0.12
	6	-0.43	-0.67	-0.07	-0.1	0.08	99.99	0.57	0.01	-0.17	-0.25
	7	-1.01	0.24	-0.3	-0.68	-0.34	-0.13	99.99	-0.17	0.26	0.32
	8	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 q	-7.4005
S.E(Log q)	0.5841

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	0.64	2.801	10.47	0.87	15	0.26	-8.02
2	0.62	3.323	9.37	0.9	15	0.23	-7.21
3	0.65	2.971	8.78	0.89	15	0.25	-6.93
4	0.75	2.154	8.05	0.89	15	0.28	-6.79
5	0.69	1.939	8.18	0.82	15	0.41	-6.82
6	0.8	1.363	7.65	0.84	15	0.39	-6.91

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
7	0.97	0.148	7.48	0.71	15	0.6	-7.4
1							

Fleet : FLT02: Norwegian aco

Age		1990	1991	1992	1993	1994	1995	1996
	1	0.64	0.37	0.49	0.42	0.41	0.09	-0.82
	2	0.12	0.27	0.09	0.27	-0.06	-0.07	-0.04
	3	0.16	-0.21	0.34	0.3	-0.12	0.14	-0.08
	4	0.08	-0.45	-0.3	0.52	0.19	-0.03	-0.15
	5	0.02	99.99	99.99	0.25	0.41	-0.05	0.11
	6	-0.22	99.99	99.99	99.99	0	0.27	0.2
	7	1.51	-0.12	99.99	99.99	99.99	99.99	0.91
	8	No data for this fleet at this age						

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	1	99.99	-0.45	0.42	0.07	-0.01	-0.14	0.07	-0.25	-0.02	0.13
	2	0.02	99.99	0.02	-0.06	0.04	0.06	0.01	0.05	-0.19	-0.04
	3	0.01	-0.08	99.99	-0.1	-0.2	0.14	-0.03	0.17	-0.25	0.17
	4	0.14	-0.05	0.51	99.99	-0.23	0.18	-0.22	-0.17	-0.31	0.22
	5	-0.07	-0.01	0.48	-0.66	99.99	0.42	-0.01	-0.19	-0.37	0.08
	6	0.35	-0.13	0.19	-0.43	-0.25	99.99	0.68	-0.41	-0.25	0.03
	7	1.76	0.47	0.2	-1.39	99.99	-0.84	99.99	-1.8	0.17	1.08
	8	No data for this fleet at this age									

Table 4.12. N (cont.).

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 q	-7.3576
S.E(Log q)	1.1841

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	0.83	1.032	6.79	0.8	16	0.36	-5.1
2	0.72	5.481	7.4	0.98	16	0.1	-5.29
3	0.72	3.455	7.28	0.94	16	0.18	-5.36
4	0.7	2.563	7.35	0.89	16	0.29	-5.46
5	0.63	2.43	7.8	0.84	14	0.36	-5.74
6	0.72	1.813	7.61	0.84	13	0.37	-6.38

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	0.47	3.092	8.86	0.85	11	0.38	-7.36
1							

Fleet : FLT04: Norwegian BT

Age	1990	1991	1992	1993	1994	1995	1996
1	0.57	0.42	0.1	0.24	-0.24	-0.13	-0.23
2	-0.19	0.16	-0.29	0.18	0.08	-0.12	0.13
3	-0.31	-0.32	0.05	-0.1	0.05	0.31	0.13
4	0.3	-0.43	-0.46	-0.05	0.11	0.45	0.18
5	0.27	0.11	-0.09	-0.29	0.29	0.07	0.14
6	-0.44	-0.2	0.25	-0.22	0.29	0.4	0.08
7	1.08	0.28	-0.51	-0.61	99.99	0.86	1.4
8	99.99	1.21	-0.38	-0.08	0.36	99.99	0.05

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	99.99	-0.49	0.04	0.07	0.24	0.02	0.02	-0.01	-0.05	0.17
2	0.04	99.99	-0.17	-0.07	0.04	0.31	0.03	0.08	-0.16	-0.16
3	-0.02	-0.29	99.99	-0.08	-0.19	-0.06	0.04	0.22	-0.04	0.17
4	0.2	-0.27	-0.05	99.99	-0.04	-0.4	-0.18	0.26	0.02	0.21
5	-0.06	0.11	0.07	-0.14	99.99	-0.08	-0.25	-0.05	0.04	0.17
6	-0.1	-0.16	-0.05	-0.25	-0.15	99.99	0.56	-0.32	-0.05	0.11
7	1.01	0.29	-0.38	-1.46	-0.72	-0.91	99.99	-0.08	0.44	0.67
8	0.97	0.2	0.37	-0.65	99.99	-1.1	-0.02	99.99	-0.35	0.53

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 q	-7.2852	-7.5792
S.E(Log q)	0.8566	0.6209

Table 4.12. N (cont.).

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	0.75	2.345	7.21	0.91	16	0.22	-4.7
2	0.64	4.491	7.84	0.94	16	0.17	-4.96
3	0.72	3.39	7.11	0.94	16	0.18	-5.16
4	0.7	2.715	7.32	0.9	16	0.27	-5.46
5	0.53	7.621	8.5	0.97	16	0.16	-6
6	0.58	4.063	8.26	0.91	16	0.29	-6.48

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	0.57	3.203	8.47	0.87	15	0.35	-7.29
8	0.77	1.083	7.99	0.74	13	0.47	-7.58

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Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	1102158	0.307	0	0	1	0.313	0
FLT02: Norwegian aco	1098447	0.413	0	0	1	0.173	0
FLT04: Norwegian BT	1146743	0.3	0	0	1	0.328	0
P shrinkage mean	404168	0.66				0.068	0
F shrinkage mean	583384	0.5				0.118	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
966738	0.17	0.17	5	1.013	0

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Age 2 Catchability dependent on age and year class strength

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	666121	0.213	0.12	0.56	2	0.325	0.003
FLT02: Norwegian aco	531485	0.241	0.008	0.03	2	0.255	0.004
FLT04: Norwegian BT	493259	0.212	0.056	0.26	2	0.328	0.004
P shrinkage mean	187456	0.68				0.032	0.011
F shrinkage mean	733274	0.5				0.059	0.003

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
549906	0.12	0.1	8	0.791	0.004

Table 4.12. N (cont.).

Age 3 Catchability dependent on age and year class strength

Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	103782	0.173	0.148	0.85	3	0.326	0.046
FLT02: Norwegian aco	95626	0.184	0.132	0.71	3	0.288	0.05
FLT04: Norwegian BT	102606	0.173	0.095	0.55	3	0.326	0.046
P shrinkage mean	129422	0.75				0.018	0.037
F shrinkage mean	134650	0.5				0.041	0.036

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
102486	0.1	0.06	11	0.604	0.046

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Age 4 Catchability dependent on age and year class strength

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	105155	0.15	0.078	0.52	4	0.326	0.32
FLT02: Norwegian aco	124752	0.159	0.104	0.65	4	0.291	0.276
FLT04: Norwegian BT	131564	0.15	0.055	0.37	4	0.326	0.263
P shrinkage mean	81446	0.79				0.016	0.397
F shrinkage mean	258546	0.5				0.04	0.143

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
122784	0.09	0.06	14	0.739	0.28

Age 5 Catchability dependent on age and year class strength

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	48133	0.142	0.083	0.58	5	0.304	0.454
FLT02: Norwegian aco	51789	0.146	0.089	0.61	5	0.293	0.428
FLT04: Norwegian BT	59161	0.135	0.043	0.32	5	0.344	0.384
P shrinkage mean	45140	0.84				0.016	0.478
F shrinkage mean	78112	0.5				0.044	0.303

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
53867	0.08	0.05	17	0.574	0.415

Table 4.12. N (cont.).

Age 6 Catchability dependent on age and year class strength

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	29827	0.137	0.079	0.57	6	0.29	0.422
FLT02: Norwegian aco	29601	0.14	0.065	0.46	6	0.284	0.424
FLT04: Norwegian BT	37520	0.126	0.047	0.38	6	0.363	0.348
P shrinkage mean	22243	0.85				0.016	0.533
F shrinkage mean	27469	0.5				0.047	0.451

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
32073	0.08	0.04	20	0.552	0.397

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

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	27933	0.139	0.079	0.57	7	0.301	0.483
FLT02: Norwegian aco	26417	0.141	0.099	0.7	7	0.273	0.505
FLT04: Norwegian BT	27212	0.127	0.066	0.52	7	0.351	0.493
F shrinkage mean	32035	0.5				0.076	0.433

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
27546	0.08	0.04	22	0.528	0.488

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

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	17479	0.145	0.097	0.67	7	0.265	0.363
FLT02: Norwegian aco	15455	0.146	0.102	0.7	7	0.241	0.402
FLT04: Norwegian BT	14642	0.141	0.114	0.81	8	0.372	0.421
F shrinkage mean	20045	0.5				0.122	0.324

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
16152	0.1	0.06	23	0.614	0.388

Table 4.12. N (cont.).

Age 9 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
FLT01: Russian BT su	3682	0.142	0.114	0.8	7	0.275	0.272
FLT02: Norwegian aco	3457	0.145	0.195	1.34	7	0.245	0.287
FLT04: Norwegian BT	3254	0.134	0.123	0.92	8	0.359	0.303
F shrinkage mean	2936	0.5				0.121	0.331

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3374	0.09	0.07	23	0.79	0.294

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Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	1	0	0	0	0	0	0
FLT02: Norwegian aco	1	0	0	0	0	0	0
FLT04: Norwegian BT	1	0	0	0	0	0	0
F shrinkage mean	2226	0.5				1	0.393

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2226	0.5	0	1	0	0.393

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Table 4.12. R. Extended Survivors Analysis

Lowestoft VPA Version 3.1

24/04/2007 13:00

Extended Survivors Analysis

NEA Haddock (Final XSA AFWG07)

CPUE data from file fleet

Catch data for 57 years. 1950 to 2006. Ages 1 to 11.

Fleet	Firs year	Last year	First age	Last age	Alpha	Beta
FLT01: Russian BT su	1990	2006	1	7	0.9	1
FLT02: Norwegian aco	1990	2006	1	7	0.99	1
FLT04: Norwegian BT	1990	2006	1	8	0.99	1

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 = .500

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00214

Final year F values

Age	1	2	3	4	5	6	7	8	9	10
Iteration 29	0.0001	0.0034	0.0355	0.2273	0.3328	0.3133	0.3696	0.3233	0.2647	0.3216
Iteration 30	0.0001	0.0034	0.0355	0.2273	0.3326	0.3131	0.3693	0.3229	0.2642	0.3211

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Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Table 4.12. R. (cont.).

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0	0.001	0	0	0	0	0	0	0	0
2	0.001	0.005	0.005	0.002	0.005	0.001	0.002	0.002	0.004	0.003
3	0.025	0.033	0.083	0.02	0.041	0.021	0.031	0.034	0.037	0.035
4	0.144	0.198	0.217	0.211	0.09	0.165	0.119	0.138	0.123	0.227
5	0.377	0.388	0.468	0.275	0.367	0.241	0.319	0.249	0.232	0.333
6	0.597	0.491	0.483	0.28	0.379	0.425	0.459	0.44	0.366	0.313
7	0.737	0.547	0.511	0.358	0.257	0.289	0.579	0.372	0.507	0.369
8	0.719	0.742	0.527	0.36	0.285	0.196	0.314	0.403	0.299	0.323
9	0.655	0.658	0.559	0.235	0.464	0.175	0.488	0.184	0.447	0.264
10	0.729	0.652	0.428	0.297	0.276	0.301	0.565	0.58	0.521	0.321

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XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9	10
1997	1.38E+06	1.11E+05	1.17E+05	4.74E+04	4.48E+04	8.11E+04	1.05E+05	1.21E+04	1.79E+03	5.23E+02
1998	1.76E+06	3.17E+05	5.96E+04	7.12E+04	3.22E+04	2.46E+04	3.62E+04	4.11E+04	4.84E+03	7.62E+02
1999	1.61E+06	1.30E+05	2.33E+05	4.55E+04	4.55E+04	1.75E+04	1.23E+04	1.71E+04	1.60E+04	2.05E+03
2000	1.82E+06	5.10E+05	8.60E+04	1.75E+05	3.00E+04	2.33E+04	8.84E+03	6.05E+03	8.28E+03	7.50E+03
2001	1.17E+06	4.59E+05	3.60E+05	6.73E+04	1.15E+05	1.85E+04	1.44E+04	5.06E+03	3.46E+03	5.36E+03
2002	2.89E+06	4.93E+05	3.30E+05	2.79E+05	5.03E+04	6.53E+04	1.04E+04	9.10E+03	3.12E+03	1.78E+03
2003	4.20E+06	4.69E+05	2.13E+05	2.33E+05	1.91E+05	3.21E+04	3.49E+04	6.35E+03	6.12E+03	2.14E+03
2004	2.80E+06	5.81E+05	2.05E+05	1.37E+05	1.60E+05	1.13E+05	1.66E+04	1.60E+04	3.80E+03	3.08E+03
2005	7.54E+06	4.09E+05	3.13E+05	1.45E+05	9.34E+04	1.01E+05	5.97E+04	9.36E+03	8.75E+03	2.59E+03
2006	7.75E+06	9.74E+05	1.26E+05	1.88E+05	9.54E+04	5.79E+04	5.66E+04	2.94E+04	5.68E+03	4.58E+03

Estimated population abundance at 1st Jan 2007

0.00E+00	8.66E+05	4.97E+05	9.67E+04	1.19E+05	5.52E+04	3.43E+04	3.20E+04	1.75E+04	3.58E+03

Taper weighted geometric mean of the VPA populations:

2.55E+06	3.77E+05	1.76E+05	1.22E+05	7.74E+04	4.32E+04	2.14E+04	9.69E+03	4.52E+03	2.30E+03

Standard error of the weighted Log(VPA populations) :

0.6676	0.6367	0.6598	0.736	0.7845	0.8332	0.8665	0.8099	0.7848	0.8962

1

Log catchability residuals.

Fleet : FLT01: Russian BT su

Age	1990	1991	1992	1993	1994	1995	1996
1	99.99	0.26	0.13	-0.2	-0.44	-0.47	-0.3
2	99.99	0.15	0.13	0.07	0.03	-0.35	-0.26
3	99.99	-0.02	0.38	0.31	0.19	-0.32	-0.18
4	99.99	-0.23	-0.13	0.64	0.21	-0.41	0.07
5	99.99	-0.35	-0.35	0.27	0.25	-0.22	0.73
6	99.99	-0.46	0.35	0.55	0.07	0.14	0.6
7	99.99	0.47	0.66	0.84	-0.44	0.33	1.29
8	No data for this fleet at this age						

Table 4.12. R. (cont.).

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	1	99.99	-0.23	0.45	0.25	0.18	0.01	0.07	-0.25	0.09	0.15
	2	-0.09	99.99	0.34	-0.17	-0.08	-0.05	0.16	-0.29	0.13	0.31
	3	-0.39	0.25	99.99	0.16	-0.18	0.07	0.19	-0.25	-0.1	0.19
	4	0.1	0.01	0.31	99.99	-0.15	0.27	0.15	-0.17	-0.27	-0.26
	5	-0.57	-0.38	0.36	0.42	99.99	0.29	0.1	-0.3	-0.3	-0.16
	6	-0.42	-0.69	0.02	-0.16	0.15	99.99	0.59	0.08	-0.2	-0.33
	7	-1	0.29	-0.28	-0.5	-0.38	-0.03	99.99	-0.2	0.22	0.14
	8	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 q	-7.3683
S.E(Log q)	0.5566

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	0.64	2.553	10.44	0.84	15	0.28	-7.93
2	0.61	3.335	9.38	0.89	15	0.23	-7.13
3	0.63	3.062	8.79	0.88	15	0.25	-6.87
4	0.74	2.251	8.05	0.89	15	0.27	-6.74
5	0.69	1.975	8.16	0.82	15	0.4	-6.78
6	0.82	1.199	7.56	0.83	15	0.41	-6.88

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	0.004	7.37	0.72	15	0.59	-7.37
1							

Fleet : FLT02: Norwegian aco

Age		1990	1991	1992	1993	1994	1995	1996
	1	0.59	0.3	0.41	0.34	0.34	0.01	-0.84
	2	0.07	0.21	0	0.19	-0.11	-0.11	-0.11
	3	0.14	-0.26	0.27	0.2	-0.18	0.1	-0.08
	4	0.05	-0.48	-0.35	0.45	0.12	-0.08	-0.18
	5	-0.01	99.99	99.99	0.21	0.37	-0.1	0.08
	6	-0.27	99.99	99.99	99.99	-0.04	0.26	0.23
	7	1.47	-0.15	99.99	99.99	99.99	99.99	0.9
	8	No data for this fleet at this age						

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	1	99.99	-0.44	0.43	0.1	0.04	-0.1	0.08	-0.22	-0.02	0.13
	2	0.03	99.99	0.06	-0.03	0.08	0.08	0.03	0.06	-0.19	-0.04
	3	-0.05	-0.07	99.99	-0.05	-0.17	0.17	0	0.18	-0.24	0.17
	4	0.16	-0.1	0.52	99.99	-0.18	0.2	-0.17	-0.14	-0.3	0.2
	5	-0.1	0.03	0.43	-0.62	99.99	0.47	0.03	-0.15	-0.38	0.04
	6	0.38	-0.16	0.27	-0.51	-0.21	99.99	0.7	-0.35	-0.28	-0.05
	7	1.76	0.51	0.21	-1.22	99.99	-0.75	99.99	-1.83	0.11	0.89
	8	No data for this fleet at this age									

Table 4.12. R. (cont.).

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 q	-7.3162
S.E(Log q)	1.1361

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	0.81	1.127	6.88	0.79	16	0.35	-5.02
2	0.71	5.713	7.47	0.98	16	0.1	-5.21
3	0.7	3.775	7.34	0.95	16	0.17	-5.29
4	0.69	2.687	7.36	0.89	16	0.28	-5.41
5	0.63	2.537	7.77	0.85	14	0.34	-5.7
6	0.74	1.621	7.49	0.83	13	0.39	-6.34

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	0.5	2.935	8.74	0.84	11	0.4	-7.32
1							

Fleet : FLT04: Norwegian BT

Age	1990	1991	1992	1993	1994	1995	1996
1	0.51	0.35	0.03	0.17	-0.3	-0.21	-0.27
2	-0.23	0.09	-0.37	0.11	0.02	-0.16	0.05
3	-0.33	-0.36	-0.02	-0.19	-0.02	0.26	0.12
4	0.27	-0.46	-0.5	-0.1	0.04	0.39	0.14
5	0.23	0.08	-0.12	-0.33	0.24	0.02	0.11
6	-0.48	-0.24	0.21	-0.27	0.26	0.39	0.08
7	1.05	0.25	-0.54	-0.63	99.99	0.84	1.4
8	99.99	1.19	-0.4	-0.1	0.35	99.99	0.06

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	99.99	-0.5	0.05	0.11	0.28	0.05	0.04	0.01	-0.04	0.19
2	0.04	99.99	-0.13	-0.05	0.09	0.33	0.05	0.09	-0.15	-0.15
3	-0.08	-0.27	99.99	-0.04	-0.16	-0.02	0.08	0.23	-0.04	0.17
4	0.22	-0.32	-0.03	99.99	0	-0.37	-0.13	0.28	0.02	0.19
5	-0.08	0.15	0.02	-0.1	99.99	-0.03	-0.21	0	0.03	0.14
6	-0.09	-0.18	0.03	-0.3	-0.08	99.99	0.58	-0.27	-0.07	0.05
7	1.02	0.33	-0.36	-1.28	-0.77	-0.81	99.99	-0.1	0.39	0.49
8	1.01	0.26	0.47	-0.6	99.99	-1.17	0	99.99	-0.4	0.42

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 q	-7.2527	-7.5527
S.E(Log q)	0.8069	0.6384

Table 4.12. R. (cont.).

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	0.74	2.206	7.22	0.89	16	0.24	-4.62
2	0.62	4.492	7.88	0.94	16	0.17	-4.89
3	0.7	3.575	7.15	0.94	16	0.18	-5.09
4	0.7	2.812	7.32	0.9	16	0.26	-5.41
5	0.52	8.518	8.47	0.97	16	0.14	-5.96
6	0.58	4.003	8.19	0.91	16	0.28	-6.44

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	0.58	3.338	8.4	0.88	15	0.33	-7.25
8	0.77	1.015	7.95	0.73	13	0.49	-7.55

1
Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2005

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Rι	1003397	0.331	0	0	1	0.278	0
FLT02: Nc	987682	0.402	0	0	1	0.188	0
FLT04: Nc	1043814	0.3	0	0	1	0.338	0
P shrinkε	376930	0.64				0.075	0
F shrinka	500692	0.5				0.122	0

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
865761	0.17	0.18	5	1.054	0

1
Age 2 Catchability dependent on age and year class strength
Year class = 2004

Fleet	I :	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Rι	611500	0.221	0.111	0.5	2	0.308	0.003
FLT02: Nc	482092	0.238	0.007	0.03	2	0.265	0.004
FLT04: Nc	451095	0.212	0.059	0.28	2	0.333	0.004
P shrinkε	176035	0.66				0.035	0.01
F shrinka	605407	0.5				0.06	0.003

Weighted prediction :

Survivors at end of y	Int s.e	Ext s.e	N	Var Ratio	F
496750	0.12	0.09	8	0.767	0.003

Table 4.12. R. (cont.).

Age 3 Catchability dependent on age and year class strength

Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	98943	0.173	0.138	0.8	3	0.325	0.035
FLT02: Norwegian aco	90804	0.183	0.125	0.68	3	0.291	0.038
FLT04: Norwegian BT	97801	0.173	0.092	0.53	3	0.325	0.035
P shrinkage mean	121895	0.74				0.019	0.028
F shrinkage mean	104088	0.5				0.041	0.033

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
96711	0.1	0.05	11	0.551	0.035

1

Age 4 Catchability dependent on age and year class strength

Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	102790	0.15	0.083	0.55	4	0.325	0.259
FLT02: Norwegian aco	121460	0.157	0.098	0.63	4	0.298	0.223
FLT04: Norwegian BT	127916	0.15	0.049	0.32	4	0.325	0.213
P shrinkage mean	77434	0.78				0.015	0.331
F shrinkage mean	223233	0.5				0.038	0.127

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
118908	0.09	0.06	14	0.678	0.227

Age 5 Catchability dependent on age and year class strength

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	50075	0.142	0.085	0.6	5	0.305	0.361
FLT02: Norwegian aco	53544	0.144	0.086	0.6	5	0.3	0.341
FLT04: Norwegian BT	61019	0.135	0.038	0.28	5	0.343	0.305
P shrinkage mean	43212	0.83				0.014	0.408
F shrinkage mean	66414	0.5				0.039	0.283

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
55160	0.08	0.04	17	0.527	0.333

Table 4.12. R. (cont.).

Age 6 Catchability dependent on age and year class strength

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	32422	0.137	0.09	0.66	6	0.29	0.329
FLT02: Norwegian aco	31848	0.138	0.068	0.49	6	0.289	0.334
FLT04: Norwegian BT	40308	0.125	0.056	0.45	6	0.366	0.272
P shrinkage mean	21431	0.87				0.014	0.463
F shrinkage mean	24400	0.5				0.041	0.417

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
34340	0.08	0.05	20	0.634	0.313

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

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	32853	0.137	0.072	0.53	7	0.304	0.361
FLT02: Norwegian aco	31545	0.139	0.089	0.64	7	0.281	0.374
FLT04: Norwegian BT	32319	0.126	0.051	0.4	7	0.356	0.366
F shrinkage mean	28780	0.5				0.059	0.403

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
32039	0.08	0.04	22	0.477	0.369

1

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

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	19344	0.144	0.092	0.64	7	0.272	0.295
FLT02: Norwegian aco	17413	0.144	0.096	0.67	7	0.25	0.323
FLT04: Norwegian BT	15912	0.137	0.093	0.68	8	0.373	0.349
F shrinkage mean	18909	0.5				0.104	0.301

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
17474	0.09	0.05	23	0.564	0.323

Table 4.12. R. (cont.).

Age 9 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
FLT01: Russian BT su	3966	0.142	0.115	0.81	7	0.278	0.241
FLT02: Norwegian aco	3750	0.143	0.195	1.36	7	0.254	0.253
FLT04: Norwegian BT	3542	0.132	0.127	0.96	8	0.362	0.266
F shrinkage mean	2546	0.5				0.106	0.354

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3580	0.09	0.08	23	0.888	0.264

1

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian BT su	1	0	0	0	0	0	0
FLT02: Norwegian aco	1	0	0	0	0	0	0
FLT04: Norwegian BT	1	0	0	0	0	0	0
F shrinkage mean	2726	0.5				1	0.321

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2726	0.5	0	1	0	0.321

1

Table 4.13 Proportion of M before spawning

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 6 Proportion of M before Spawning

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0

Table 6 Proportion of M before Spawning

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0	0	0
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 6 Proportion of M before Spawning

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0	0	0

Table 4.13 (cont.) Proportion of M before spawning

Table 6 Proportion of M before Spawning

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0	0	0

Table 6 Proportion of M before Spawning

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0	0	0

Table 6 Proportion of M before Spawning

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0	0	0
	1										

Table 4.14 Proportion of F before spawning

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 7 Proportion of F before Spawning

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0

Table 7 Proportion of F before Spawning

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0	0	0	0

1

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 7 Proportion of F before Spawning

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0	0	0	0

Table 4.14 (cont.) Proportion of F before spawning

Table 7 Proportion of F before Spawning

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0	0	0	0

Table 7 Proportion of F before Spawning

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0	0	0	0

Table 7 Proportion of F before Spawning

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
+gp	0	0	0	0	0	0	0	0	0	0
1										

Table 4.15. N. Fishing mortality at age

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	0.0498	0.1285	0.1063	0.0656	0.0561	0.023	0.1041
4	0.5812	0.2142	0.5365	0.3829	0.2399	0.1319	0.1707
5	0.8184	0.6291	0.5801	0.5328	0.3063	0.486	0.2766
6	0.8114	0.9123	0.8876	0.4892	0.414	0.4684	0.8115
7	1.157	0.8053	0.9961	0.7145	0.6139	1.0131	0.6249
8	1.0055	1.0036	1.2502	0.6589	0.8609	0.6211	0.9345
9	0.6504	1.4256	1.3695	0.5162	1.3582	0.43	0.3985
10	0.946	1.0901	1.2251	0.6331	0.9584	0.6948	0.6588
+gp	0.946	1.0901	1.2251	0.6331	0.9584	0.6948	0.6588
0 FBAR 4- 7	0.842	0.6402	0.7501	0.5298	0.3935	0.5249	0.4709

Table 8 Fishing mortality (F) at age

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	0.0412	0.026	0.0657	0.1851	0.1563	0.1839	0.1114	0.0739	0.0612	0.119
4	0.2441	0.1713	0.1706	0.3717	0.4779	0.5841	0.6648	0.3116	0.2343	0.3782
5	0.3718	0.5741	0.3353	0.5149	0.6921	1.0545	0.9299	0.6875	0.4642	0.5912
6	0.4066	0.5208	0.5575	0.6522	0.7506	1.0604	1.0252	0.8698	0.6976	0.7426
7	0.8167	0.9643	0.6025	0.5207	0.8335	0.7002	1.0012	0.8437	0.6762	0.8234
8	0.4513	0.8693	0.4321	0.7026	0.8825	0.904	0.6536	0.9605	0.5955	0.5278
9	0.6298	0.743	0.8446	1.1478	0.9636	1.1812	1.3586	1.3821	1.0492	0.5925
10	0.6371	0.8688	0.6304	0.7976	0.9015	0.9374	1.0158	1.0779	0.7832	0.6549
+gp	0.6371	0.8688	0.6304	0.7976	0.9015	0.9374	1.0158	1.0779	0.7832	0.6549
0 FBAR 4- 7	0.4598	0.5576	0.4165	0.5149	0.6885	0.8498	0.9053	0.6782	0.5181	0.6339
1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.0561	0.0381	0.0923	0.1564	0.0214	0.2634	0.311	0.2069	0.2363	0.3
4	0.3017	0.3877	0.1659	0.229	0.2631	0.3836	0.59	0.334	0.5761	0.6306
5	0.4186	0.5742	0.4937	0.2458	0.18	1.0616	0.9841	0.4166	0.5123	0.6347
6	0.5198	0.4587	0.5809	0.5032	0.1811	0.9483	0.4769	0.6947	0.4455	0.7034
7	0.5329	0.7021	0.4049	0.5297	0.4031	0.5512	0.2977	0.5912	0.5984	0.7989
8	0.5805	0.7159	0.5022	0.4138	0.3894	0.5804	0.2726	0.4815	0.3499	0.872
9	0.3839	0.4945	0.5015	0.3945	0.2977	0.6922	0.2768	0.7995	0.2019	0.8092
10	0.5027	0.6448	0.4733	0.4492	0.3649	0.6145	0.2825	0.6304	0.3844	0.8375
+gp	0.5027	0.6448	0.4733	0.4492	0.3649	0.6145	0.2825	0.6304	0.3844	0.8375
0 FBAR 4- 7	0.4433	0.5307	0.4114	0.3769	0.2568	0.7362	0.5872	0.5091	0.5331	0.6919

Table 4.15. N. (cont.) Fishing mortality at age

Table 8 Fishing mortality (F) at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.7035	0.3235	0.1344	0.0265	0.0462	0.0672	0.1651	0.1236	0.1195	0.0613
4	1.2541	0.6068	0.47	0.2831	0.1553	0.1223	0.3175	0.2264	0.2417	0.4406
5	0.9119	0.8737	0.8843	0.6192	0.5002	0.3221	0.2808	0.4055	0.1886	0.3678
6	0.5378	0.4295	0.9247	0.6757	0.729	0.5815	0.4038	0.2145	0.3925	0.4316
7	0.6309	0.7892	0.4836	0.3981	0.5312	0.3921	0.2224	0.2772	0.5399	0.7307
8	0.5337	0.4453	0.6805	0.6354	0.4886	0.3365	0.5127	0.3814	0.4507	0.4539
9	0.5553	0.6613	0.4888	0.6962	0.4303	0.4409	0.4754	0.1755	0.4798	0.794
10	0.5781	0.6381	0.5555	0.5826	0.4877	0.3924	0.4065	0.2784	0.4932	0.6666
+gp	0.5781	0.6381	0.5555	0.5826	0.4877	0.3924	0.4065	0.2784	0.4932	0.6666
0 FBAR 4- 7	0.8337	0.6748	0.6907	0.494	0.4789	0.3545	0.3061	0.2809	0.3407	0.4927

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.0492	0.0323	0.0939	0.0332	0.0479	0.0626	0.0226	0.0128	0.0242	0.0224
4	0.4587	0.1654	0.1674	0.1552	0.167	0.17	0.1445	0.1084	0.0887	0.1218
5	1.0005	0.4954	0.3314	0.1006	0.2129	0.2941	0.3228	0.4452	0.2539	0.3311
6	0.4047	1.0898	0.5348	0.1293	0.2216	0.3799	0.5384	0.6259	0.4533	0.4791
7	0.6942	0.291	0.4797	0.2399	0.2141	0.3085	0.4664	0.5736	0.7203	0.6765
8	0.801	0.4562	0.1661	0.2211	0.2362	0.2348	0.339	0.4703	0.4216	0.8907
9	0.4754	0.3528	0.004	0.2244	0.1815	0.339	0.2289	0.4761	0.3478	0.6733
10	0.6658	0.3698	0.2181	0.2295	0.2112	0.2954	0.3243	0.5296	0.5018	0.7147
+gp	0.6658	0.3698	0.2181	0.2295	0.2112	0.2954	0.3243	0.5296	0.5018	0.7147
0 FBAR 4- 7	0.6395	0.5104	0.3784	0.1562	0.2039	0.2881	0.368	0.4383	0.3791	0.4021

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
3	0.025	0.0312	0.0821	0.0184	0.037	0.0228	0.0341	0.0422	0.0413	0.0464	0.0433
4	0.1361	0.1997	0.2053	0.2064	0.0821	0.1818	0.1245	0.1696	0.1544	0.2799	0.2013
5	0.371	0.3574	0.4704	0.2555	0.3563	0.251	0.3186	0.2936	0.2899	0.4147	0.3327
6	0.5749	0.4779	0.4269	0.2838	0.342	0.4443	0.522	0.4558	0.4715	0.3974	0.4416
7	0.7119	0.5132	0.4894	0.2987	0.2608	0.282	0.6212	0.3861	0.5956	0.4885	0.49
8	0.6847	0.691	0.4738	0.338	0.2246	0.2211	0.399	0.4276	0.3386	0.3883	0.3848
9	0.6269	0.5993	0.4924	0.203	0.4211	0.1399	0.375	0.1824	0.527	0.2938	0.3344
10	0.6963	0.6012	0.3684	0.2476	0.2289	0.2842	0.6249	0.5399	0.6275	0.3932	0.5202
+gp	0.6963	0.6012	0.3684	0.2476	0.2289	0.2842	0.6249	0.5399	0.6275	0.3932	
0 FBAR 4- 7	0.4485	0.387	0.398	0.2611	0.2603	0.2898	0.3966	0.3263	0.3778	0.3951	
1											

Table 4.15. R. Fishing mortality at age

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.0497	0.1284	0.1062	0.0655	0.056	0.023	0.104
	4	0.5811	0.2141	0.5364	0.3828	0.2398	0.1319	0.1706
	5	0.8184	0.6291	0.58	0.5327	0.3063	0.486	0.2766
	6	0.8114	0.9123	0.8876	0.4892	0.414	0.4684	0.8115
	7	1.157	0.8053	0.9961	0.7145	0.6139	1.0131	0.6249
	8	1.0055	1.0036	1.2502	0.6589	0.8609	0.6211	0.9345
	9	0.6504	1.4256	1.3695	0.5162	1.3582	0.43	0.3985
	10	0.946	1.0901	1.2251	0.6331	0.9584	0.6948	0.6588
+gp		0.946	1.0901	1.2251	0.6331	0.9584	0.6948	0.6588
0 FBAR 4- 7		0.842	0.6402	0.7501	0.5298	0.3935	0.5248	0.4709

Table 8 Fishing mortality (F) at age

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.0411	0.026	0.0657	0.185	0.1561	0.1837	0.1113	0.0738	0.0611	0.1189
	4	0.2441	0.1713	0.1705	0.3716	0.4778	0.584	0.6647	0.3116	0.2342	0.3781
	5	0.3717	0.5741	0.3353	0.5149	0.6921	1.0544	0.9299	0.6874	0.4642	0.5912
	6	0.4066	0.5208	0.5575	0.6522	0.7506	1.0604	1.0252	0.8698	0.6976	0.7426
	7	0.8167	0.9643	0.6025	0.5207	0.8335	0.7002	1.0012	0.8437	0.6762	0.8234
	8	0.4513	0.8693	0.4321	0.7026	0.8825	0.904	0.6536	0.9605	0.5955	0.5278
	9	0.6298	0.743	0.8446	1.1478	0.9636	1.1812	1.3586	1.3821	1.0492	0.5925
	10	0.6371	0.8688	0.6304	0.7976	0.9015	0.9374	1.0158	1.0779	0.7832	0.6549
+gp		0.6371	0.8688	0.6304	0.7976	0.9015	0.9374	1.0158	1.0779	0.7832	0.6549
0 FBAR 4- 7		0.4598	0.5576	0.4165	0.5149	0.6885	0.8498	0.9052	0.6781	0.518	0.6338
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.0561	0.0381	0.0923	0.1562	0.0213	0.2632	0.3107	0.2068	0.2361	0.2998
	4	0.3017	0.3876	0.1659	0.229	0.2631	0.3836	0.5899	0.3339	0.576	0.6305
	5	0.4186	0.5742	0.4936	0.2458	0.18	1.0616	0.9841	0.4166	0.5122	0.6347
	6	0.5198	0.4587	0.5809	0.5032	0.1811	0.9484	0.4769	0.6947	0.4455	0.7034
	7	0.5329	0.7021	0.4049	0.5297	0.4031	0.5512	0.2977	0.5912	0.5984	0.7989
	8	0.5805	0.7159	0.5022	0.4138	0.3894	0.5804	0.2726	0.4815	0.3499	0.872
	9	0.3839	0.4945	0.5015	0.3945	0.2977	0.6922	0.2768	0.7995	0.2019	0.8092
	10	0.5027	0.6448	0.4733	0.4492	0.3649	0.6145	0.2825	0.6304	0.3844	0.8375
+gp		0.5027	0.6448	0.4733	0.4492	0.3649	0.6145	0.2825	0.6304	0.3844	0.8375
0 FBAR 4- 7		0.4432	0.5307	0.4113	0.3769	0.2568	0.7362	0.5871	0.5091	0.533	0.6919

Table 4.15. R. (cont.) Fishing mortality at age

Table 8	Fishing mortality (F) at age									
YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.703	0.3233	0.1343	0.0264	0.0462	0.0671	0.165	0.1237	0.1196	0.0613
4	1.2539	0.6067	0.47	0.283	0.1553	0.1223	0.3175	0.2265	0.242	0.4407
5	0.9119	0.8737	0.8843	0.6192	0.5002	0.3221	0.2809	0.4056	0.1887	0.3683
6	0.5378	0.4295	0.9247	0.6757	0.7291	0.5816	0.4039	0.2146	0.3926	0.432
7	0.6309	0.7892	0.4836	0.3982	0.5312	0.3922	0.2224	0.2773	0.5403	0.7311
8	0.5337	0.4453	0.6806	0.6354	0.4886	0.3365	0.5128	0.3815	0.4509	0.4545
9	0.5553	0.6613	0.4888	0.6962	0.4303	0.4409	0.4755	0.1756	0.48	0.7947
10	0.5781	0.6381	0.5555	0.5826	0.4878	0.3924	0.4066	0.2785	0.4935	0.6671
+gp	0.5781	0.6381	0.5555	0.5826	0.4878	0.3924	0.4066	0.2785	0.4935	0.6671
0 FBAR 4- 7	0.8336	0.6748	0.6906	0.494	0.4789	0.3546	0.3062	0.281	0.3409	0.493

Table 8	Fishing mortality (F) at age									
YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.0493	0.0323	0.0942	0.0333	0.048	0.063	0.0227	0.013	0.0244	0.0233
4	0.4592	0.1658	0.1679	0.1556	0.1674	0.1704	0.1454	0.1094	0.0902	0.1234
5	1.001	0.4963	0.3327	0.101	0.2137	0.295	0.3237	0.449	0.2569	0.3385
6	0.4055	1.0913	0.5363	0.1299	0.2225	0.3818	0.541	0.6288	0.4594	0.4878
7	0.6953	0.2918	0.4812	0.2409	0.2152	0.3101	0.4699	0.5784	0.7269	0.6927
8	0.8019	0.4575	0.1667	0.222	0.2375	0.2365	0.3414	0.4759	0.4273	0.909
9	0.4763	0.3535	0.004	0.2254	0.1824	0.3415	0.2309	0.4814	0.3541	0.6892
10	0.6669	0.3709	0.2187	0.2304	0.2123	0.2973	0.3276	0.5364	0.5109	0.7371
+gp	0.6669	0.3709	0.2187	0.2304	0.2123	0.2973	0.3276	0.5364	0.5109	0.7371
0 FBAR 4- 7	0.6402	0.5113	0.3795	0.1568	0.2047	0.2893	0.37	0.4414	0.3833	0.4106

Table 8	Fishing mortality (F) at age										
YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
3	0.0249	0.0328	0.0838	0.0201	0.0412	0.0213	0.0306	0.0345	0.0371	0.0355	0.0357
4	0.1446	0.1987	0.2179	0.2113	0.0902	0.1656	0.1189	0.138	0.1229	0.2273	0.1628
5	0.3772	0.3876	0.4672	0.2755	0.3677	0.2418	0.3192	0.2495	0.2318	0.3326	0.2713
6	0.5959	0.4903	0.483	0.281	0.3792	0.4247	0.4584	0.4395	0.3659	0.3131	0.3728
7	0.7358	0.5462	0.5104	0.3582	0.2574	0.2892	0.5776	0.3714	0.5057	0.3693	0.4155
8	0.7176	0.7392	0.5256	0.3603	0.2863	0.1974	0.3145	0.4031	0.299	0.3229	0.3417
9	0.6545	0.6561	0.5571	0.2353	0.4629	0.1758	0.4889	0.1846	0.4459	0.2642	0.2982
10	0.7294	0.6516	0.4278	0.2972	0.2759	0.3005	0.5647	0.5796	0.5212	0.3211	0.474
+gp	0.7294	0.6516	0.4278	0.2972	0.2759	0.3005	0.5647	0.5796	0.5212	0.3211	
0 FBAR 4- 7	0.4634	0.4057	0.4196	0.2815	0.2736	0.2803	0.3685	0.2996	0.3066	0.3106	

Table 4.16. N. Relative F at age

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

Table 9 Relative F at age

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	0.0591	0.2007	0.1417	0.1238	0.1425	0.0439	0.221
	4	0.6902	0.3345	0.7153	0.7227	0.6096	0.2513	0.3624
	5	0.972	0.9826	0.7733	1.0055	0.7784	0.926	0.5874
	6	0.9637	1.425	1.1834	0.9234	1.0521	0.8924	1.7232
	7	1.3741	1.2578	1.328	1.3484	1.5599	1.9303	1.327
	8	1.1942	1.5676	1.6668	1.2437	2.1877	1.1833	1.9845
	9	0.7725	2.2267	1.8258	0.9743	3.4516	0.8193	0.8462
	10	1.1235	1.7027	1.6333	1.1949	2.4355	1.3238	1.399
+gp		1.1235	1.7027	1.6333	1.1949	2.4355	1.3238	1.399
0 REFMEAN		0.842	0.6402	0.7501	0.5298	0.3935	0.5249	0.4709

Table 9 Relative F at age

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	0.0895	0.0466	0.1578	0.3596	0.2269	0.2164	0.123	0.109	0.1181	0.1878
	4	0.5309	0.3072	0.4095	0.722	0.6941	0.6874	0.7344	0.4595	0.4522	0.5966
	5	0.8085	1.0296	0.805	1	1.0052	1.2408	1.0272	1.0137	0.8961	0.9327
	6	0.8843	0.934	1.3387	1.2668	1.0901	1.2478	1.1325	1.2827	1.3465	1.1716
	7	1.7762	1.7293	1.4467	1.0113	1.2106	0.824	1.1059	1.2441	1.3052	1.2991
	8	0.9815	1.559	1.0375	1.3645	1.2818	1.0638	0.722	1.4164	1.1494	0.8327
	9	1.3698	1.3324	2.0281	2.2292	1.3996	1.3899	1.5007	2.038	2.0253	0.9347
	10	1.3856	1.558	1.5137	1.5491	1.3093	1.1031	1.1221	1.5895	1.5118	1.0332
+gp		1.3856	1.558	1.5137	1.5491	1.3093	1.1031	1.1221	1.5895	1.5118	1.0332
0 REFMEAN		0.4598	0.5576	0.4165	0.5149	0.6885	0.8498	0.9053	0.6782	0.5181	0.6339
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

Table 9 Relative F at age

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	0.1267	0.0718	0.2245	0.4149	0.0832	0.3578	0.5297	0.4064	0.4433	0.4336
	4	0.6807	0.7306	0.4033	0.6077	1.0245	0.5211	1.0049	0.656	1.0807	0.9114
	5	0.9444	1.0821	1.2001	0.6521	0.701	1.442	1.676	0.8183	0.961	0.9174
	6	1.1728	0.8643	1.4122	1.335	0.7051	1.2882	0.8122	1.3645	0.8357	1.0166
	7	1.2021	1.3231	0.9844	1.4053	1.5694	0.7487	0.5069	1.1612	1.1226	1.1546
	8	1.3096	1.349	1.2209	1.0978	1.5161	0.7884	0.4642	0.9458	0.6565	1.2602
	9	0.8661	0.9318	1.2192	1.0466	1.1591	0.9402	0.4714	1.5703	0.3787	1.1695
	10	1.1341	1.215	1.1506	1.1918	1.4207	0.8347	0.4811	1.2382	0.7211	1.2104
+gp		1.1341	1.215	1.1506	1.1918	1.4207	0.8347	0.4811	1.2382	0.7211	1.2104
0 REFMEAN		0.4433	0.5307	0.4114	0.3769	0.2568	0.7362	0.5872	0.5091	0.5331	0.6919

Table 4.16. N (cont.). Relative F at age

Table 9 Relative F at age

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0.8439	0.4795	0.1946	0.0536	0.0965	0.1896	0.5392	0.44	0.3509	0.1243
	4	1.5043	0.8992	0.6806	0.573	0.3242	0.3451	1.0371	0.806	0.7096	0.8944
	5	1.0939	1.2948	1.2804	1.2534	1.0444	0.9084	0.9172	1.4436	0.5536	0.7465
	6	0.6451	0.6365	1.3388	1.3677	1.5223	1.6404	1.3192	0.7636	1.152	0.8761
	7	0.7567	1.1695	0.7002	0.8059	1.1091	1.1061	0.7264	0.9868	1.5848	1.483
	8	0.6402	0.6599	0.9854	1.2862	1.0202	0.9491	1.6747	1.3576	1.323	0.9213
	9	0.666	0.98	0.7078	1.4092	0.8986	1.2435	1.5529	0.6247	1.4085	1.6117
	10	0.6934	0.9456	0.8043	1.1793	1.0183	1.1069	1.3279	0.9911	1.4478	1.353
	+gp	0.6934	0.9456	0.8043	1.1793	1.0183	1.1069	1.3279	0.9911	1.4478	1.353
0	REFMEAN	0.8337	0.6748	0.6907	0.494	0.4789	0.3545	0.3061	0.2809	0.3407	0.4927

Table 9 Relative F at age

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0.0769	0.0632	0.2483	0.2126	0.2347	0.2173	0.0613	0.0291	0.0638	0.0556
	4	0.7172	0.324	0.4425	0.9932	0.819	0.5901	0.3926	0.2472	0.2341	0.303
	5	1.5644	0.9706	0.876	0.6442	1.0443	1.0207	0.8771	1.0158	0.6698	0.8233
	6	0.6329	2.1352	1.4134	0.8273	1.0868	1.3186	1.463	1.4281	1.1958	1.1915
	7	1.0855	0.5701	1.268	1.5354	1.0498	1.0706	1.2674	1.3089	1.9003	1.6823
	8	1.2525	0.8939	0.4391	1.4152	1.1586	0.815	0.921	1.073	1.1123	2.2149
	9	0.7434	0.6913	0.0106	1.4365	0.8901	1.1766	0.6219	1.0864	0.9176	1.6744
	10	1.0411	0.7246	0.5764	1.4689	1.0358	1.0252	0.8812	1.2084	1.3238	1.7772
	+gp	1.0411	0.7246	0.5764	1.4689	1.0358	1.0252	0.8812	1.2084	1.3238	1.7772
0	REFMEAN	0.6395	0.5104	0.3784	0.1562	0.2039	0.2881	0.368	0.4383	0.3791	0.4021

Table 9 Relative F at age

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	MEAN **-**
	AGE											
	3	0.0557	0.0805	0.2062	0.0704	0.1423	0.0788	0.086	0.1292	0.1093	0.1174	0.1186
	4	0.3034	0.5159	0.5158	0.7905	0.3156	0.6274	0.3139	0.5199	0.4086	0.7084	0.5456
	5	0.8273	0.9235	1.1819	0.9786	1.3689	0.8663	0.8035	0.8998	0.7672	1.0495	0.9055
	6	1.2819	1.2347	1.0726	1.087	1.3137	1.5333	1.3162	1.397	1.248	1.0058	1.2169
	7	1.5874	1.3259	1.2297	1.144	1.0018	0.973	1.5665	1.1833	1.5762	1.2363	1.3319
	8	1.5267	1.7855	1.1906	1.2947	0.8628	0.7629	1.0061	1.3105	0.8961	0.9827	1.0631
	9	1.3979	1.5485	1.2372	0.7775	1.6179	0.4828	0.9456	0.5589	1.3947	0.7436	0.8991
	10	1.5527	1.5534	0.9257	0.9484	0.8794	0.9808	1.5758	1.6547	1.6608	0.9951	1.4369
	+gp	1.5527	1.5534	0.9257	0.9484	0.8794	0.9808	1.5758	1.6547	1.6608	0.9951	
0	REFMEAN	0.4485	0.387	0.398	0.2611	0.2603	0.2898	0.3966	0.3263	0.3778	0.3951	

Table 4.16. R. Relative F at age

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

Table 9 Relative F at age

	YEAR	1950	1951	1952	1953	1954	1955	1956
	AGE							
	3	0.059	0.2005	0.1416	0.1236	0.1424	0.0438	0.2208
	4	0.6901	0.3345	0.7152	0.7225	0.6095	0.2512	0.3623
	5	0.972	0.9826	0.7733	1.0055	0.7784	0.926	0.5874
	6	0.9637	1.4251	1.1834	0.9234	1.0521	0.8924	1.7232
	7	1.3742	1.2578	1.3281	1.3485	1.56	1.9303	1.327
	8	1.1942	1.5676	1.6669	1.2437	2.1878	1.1833	1.9845
	9	0.7725	2.2268	1.8259	0.9743	3.4517	0.8194	0.8462
	10	1.1236	1.7028	1.6334	1.195	2.4356	1.3238	1.399
	+gp	1.1236	1.7028	1.6334	1.195	2.4356	1.3238	1.399
0	REFMEAN	0.842	0.6402	0.7501	0.5298	0.3935	0.5248	0.4709

Table 9 Relative F at age

	YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	0.0894	0.0466	0.1576	0.3593	0.2268	0.2162	0.1229	0.1089	0.118	0.1876
	4	0.5308	0.3071	0.4095	0.7218	0.694	0.6873	0.7343	0.4594	0.4521	0.5965
	5	0.8085	1.0295	0.805	1	1.0052	1.2408	1.0272	1.0137	0.8961	0.9327
	6	0.8844	0.934	1.3388	1.2668	1.0902	1.2479	1.1325	1.2827	1.3466	1.1716
	7	1.7763	1.7293	1.4467	1.0113	1.2106	0.824	1.106	1.2441	1.3052	1.2991
	8	0.9816	1.559	1.0375	1.3646	1.2819	1.0639	0.722	1.4164	1.1494	0.8327
	9	1.3698	1.3325	2.0281	2.2293	1.3996	1.39	1.5008	2.0381	2.0253	0.9347
	10	1.3857	1.5581	1.5137	1.5492	1.3094	1.1031	1.1221	1.5895	1.5118	1.0332
	+gp	1.3857	1.5581	1.5137	1.5492	1.3094	1.1031	1.1221	1.5895	1.5118	1.0332
0	REFMEAN	0.4598	0.5576	0.4165	0.5149	0.6885	0.8498	0.9052	0.6781	0.518	0.6338
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

Table 9 Relative F at age

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	0.1266	0.0717	0.2243	0.4146	0.0831	0.3575	0.5292	0.4061	0.4429	0.4333
	4	0.6806	0.7305	0.4032	0.6076	1.0244	0.521	1.0047	0.6559	1.0806	0.9113
	5	0.9444	1.0821	1.2001	0.6521	0.701	1.442	1.6761	0.8183	0.961	0.9174
	6	1.1728	0.8643	1.4123	1.335	0.7052	1.2882	0.8122	1.3646	0.8357	1.0167
	7	1.2022	1.3231	0.9844	1.4053	1.5695	0.7487	0.507	1.1612	1.1227	1.1546
	8	1.3096	1.349	1.221	1.0979	1.5162	0.7884	0.4642	0.9458	0.6565	1.2603
	9	0.8662	0.9319	1.2192	1.0466	1.1591	0.9403	0.4715	1.5703	0.3787	1.1695
	10	1.1341	1.2151	1.1506	1.1919	1.4208	0.8347	0.4812	1.2382	0.7212	1.2105
	+gp	1.1341	1.2151	1.1506	1.1919	1.4208	0.8347	0.4812	1.2382	0.7212	1.2105
0	REFMEAN	0.4432	0.5307	0.4113	0.3769	0.2568	0.7362	0.5871	0.5091	0.533	0.6919

Table 4.16. R (cont.). Relative F at age

	Table 9 Relative F at age										
	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0.8433	0.4791	0.1944	0.0535	0.0964	0.1894	0.539	0.4402	0.3508	0.1243
	4	1.5042	0.8991	0.6805	0.5729	0.3242	0.3451	1.037	0.8062	0.7098	0.894
	5	1.0939	1.2948	1.2804	1.2534	1.0443	0.9084	0.9174	1.4434	0.5536	0.747
	6	0.6452	0.6365	1.3389	1.3678	1.5224	1.6404	1.3192	0.7637	1.1516	0.8762
	7	0.7568	1.1696	0.7002	0.806	1.1091	1.1062	0.7264	0.9867	1.5849	1.4828
	8	0.6402	0.66	0.9854	1.2862	1.0202	0.9491	1.6749	1.3575	1.3227	0.9218
	9	0.6661	0.98	0.7078	1.4093	0.8985	1.2436	1.553	0.6248	1.4081	1.6119
	10	0.6935	0.9457	0.8043	1.1793	1.0185	1.1067	1.328	0.9911	1.4477	1.3531
	+gp	0.6935	0.9457	0.8043	1.1793	1.0185	1.1067	1.328	0.9911	1.4477	1.3531
0	REFMEAN	0.8336	0.6748	0.6906	0.494	0.4789	0.3546	0.3062	0.281	0.3409	0.493

	Table 9 Relative F at age										
	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0.077	0.0632	0.2482	0.2122	0.2342	0.2176	0.0615	0.0293	0.0638	0.0569
	4	0.7172	0.3244	0.4425	0.9923	0.8178	0.5889	0.3929	0.2478	0.2353	0.3004
	5	1.5634	0.9706	0.8765	0.6439	1.0439	1.0196	0.8749	1.0172	0.6701	0.8245
	6	0.6334	2.1343	1.4132	0.8279	1.0869	1.3196	1.4621	1.4246	1.1983	1.188
	7	1.0859	0.5707	1.2678	1.536	1.0514	1.0719	1.2701	1.3103	1.8962	1.6871
	8	1.2526	0.8947	0.4392	1.4155	1.1603	0.8172	0.9228	1.0783	1.1147	2.2139
	9	0.744	0.6915	0.0106	1.4368	0.891	1.1803	0.624	1.0907	0.9238	1.6785
	10	1.0417	0.7254	0.5762	1.4689	1.037	1.0275	0.8854	1.2153	1.3328	1.7952
	+gp	1.0417	0.7254	0.5762	1.4689	1.037	1.0275	0.8854	1.2153	1.3328	1.7952
0	REFMEAN	0.6402	0.5113	0.3795	0.1568	0.2047	0.2893	0.37	0.4414	0.3833	0.4106

	Table 9 Relative F at age											
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	MEAN **-**
	AGE											
	3	0.0537	0.0809	0.1996	0.0713	0.1504	0.0759	0.0829	0.1152	0.1209	0.1143	0.1168
	4	0.3121	0.4898	0.5192	0.7507	0.3296	0.5909	0.3227	0.4607	0.401	0.7319	0.5312
	5	0.814	0.9554	1.1134	0.9788	1.3438	0.8626	0.8661	0.8326	0.756	1.0709	0.8865
	6	1.2859	1.2085	1.1511	0.9981	1.3859	1.515	1.2438	1.4671	1.1934	1.0081	1.2229
	7	1.588	1.3462	1.2163	1.2724	0.9406	1.0316	1.5674	1.2396	1.6496	1.1891	1.3594
	8	1.5487	1.8219	1.2527	1.2797	1.0461	0.7042	0.8534	1.3455	0.9751	1.0397	1.1201
	9	1.4124	1.6171	1.3277	0.8358	1.6916	0.6272	1.3267	0.616	1.4544	0.8507	0.9737
	10	1.5741	1.6061	1.0195	1.0557	1.0083	1.0719	1.5322	1.9346	1.7	1.0339	1.5562
	+gp	1.5741	1.6061	1.0195	1.0557	1.0083	1.0719	1.5322	1.9346	1.7	1.0339	
0	REFMEAN	0.4634	0.4057	0.4196	0.2815	0.2736	0.2803	0.3685	0.2996	0.3066	0.3106	

Table 4.17. N. Stock numbers at age (start of year). Numbers *10**-3

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

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

	YEAR		1950	1951	1952	1953	1954	1955	1956
	AGE								
		3	76587	633307	69415	1184843	140265	59170	193612
		4	95239	53023	405257	45417	807437	96498	42076
		5	69282	42403	34075	188671	24656	505720	67332
		6	36974	24648	18229	15385	89310	14638	250843
		7	45596	13404	8078	6123	7697	48176	7478
		8	15745	11738	4905	2442	2454	3411	14321
		9	4518	4716	3523	1150	1035	849	1501
		10	1941	1930	928	733	562	218	452
	+gp		5287	2201	1348	2339	957	218	418
0	TOTAL		351169	787370	545757	1447105	1074373	728897	578034

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

	YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE											
		3	59968	78470	372268	274309	123997	273225	314406	365687	116589	273231
		4	126959	41876	55633	253653	165866	77175	165420	204669	247134	79802
		5	28242	79182	28090	37346	139248	81885	34259	67740	119317	155662
		6	41177	15705	35964	16200	17997	56206	23006	10902	27470	60487
		7	90933	22377	7613	16806	6886	6934	15885	6735	3728	11159
		8	3277	32898	6985	3412	8175	2450	2818	4779	2372	1552
		9	4605	1709	11292	3712	1384	2769	812	1200	1497	1070
		10	825	2009	665	3973	964	432	696	171	247	429
	+gp		408	1126	1168	1201	2624	1350	638	1040	1609	550
0	TOTAL		356395	275351	519679	610613	467142	502427	557940	662923	519963	583943
		1										

Run title : NEA Haddock (SVPA AFWG07)

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

	YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE											
		3	339592	20490	20119	188253	109166	1156182	306169	60154	55330	62531
		4	176509	233613	14352	13348	117151	77756	646485	163237	35589	31788
		5	43528	103922	126211	9679	8452	71688	42179	285298	93059	15926
		6	69500	23096	47195	62127	6105	5693	19998	12714	151680	44964
		7	23489	33725	11915	21545	30655	4157	1800	10130	5180	79287
		8	4010	11287	13682	6507	10386	16772	1961	1094	4592	2331
		9	750	1837	4517	6779	3522	5761	7685	1223	553	2649
		10	485	418	917	2240	3741	2141	2361	4771	450	370
	+gp		750	657	316	887	1915	3930	2606	4367	3208	3078
0	TOTAL		658612	429046	239226	311365	291093	1344079	1031243	542986	349642	242925

Table 4.17. N (cont.). Stock numbers at age (start of year). Numbers *10-3**

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

			1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE											
		3	126984	198110	162269	28016	12551	15833	8961	12078	289498	526284
		4	33707	45724	104308	103229	19854	8721	10772	5528	8674	210314
		5	13470	7657	19844	51901	61924	13533	6143	6243	3609	5577
		6	6808	4364	2577	6609	22535	30284	7909	3741	3407	2447
		7	18159	3245	2318	834	2744	8871	13816	4310	2472	1884
		8	29201	7912	1207	1170	459	1321	4907	9056	2674	1180
		9	798	14020	4150	500	507	230	773	2406	5064	1395
		10	966	375	5925	2084	204	270	121	393	1653	2566
	+gp		943	926	829	3613	2731	2192	958	348	790	2214
0	TOTAL		231037	282333	303426	197957	123509	81255	54359	44104	317841	753860

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

			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
		3	115566	55068	26504	36262	104284	210705	686776	306899	98941	105861
		4	259464	90077	35585	19754	25496	81390	161103	517077	225766	68490
		5	110826	134284	62508	24643	13849	17664	56217	111309	373364	143558
		6	3161	33365	66835	36739	18244	9164	10777	31141	57730	213683
		7	1301	1727	9186	32055	26432	11968	5131	5150	13628	29798
		8	743	532	1057	4655	20647	17471	7198	2635	2376	5429
		9	613	273	276	733	3055	13347	11310	4199	1348	1276
		10	516	312	157	225	479	2086	7786	7366	2135	779
	+gp		1657	1582	993	381	312	361	1280	5613	4371	4051
0	TOTAL		493847	317218	203100	155447	212799	364155	947578	991388	779659	572926

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

	YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 50-**	AMST 50-**
	AGE														
		3	116059	62179	235659	93180	395966	369661	235748	224256	338882	134557	0	123508	214318
		4	49687	70315	47631	177455	73113	308007	261368	151545	157261	202788	102185	80378	139039
		5	45053	34081	44828	31760	117272	55075	208230	178406	99903	100224	121859	46811	81016
		6	82403	24876	19149	22930	19997	67234	34773	123079	107816	58405	53347	22599	39349
		7	105943	37614	12630	10231	14075	11630	35167	16892	63880	54262	31774	10380	17940
		8	12403	42565	18435	6338	6214	8879	7183	15470	9401	28831	27257	4765	7921
		9	1824	5121	17461	9397	3701	4064	5827	3946	8259	5486	16009	2193	3641
		10	533	798	2302	8737	6280	1989	2893	3279	2692	3992	3348	989	1787
	+gp		1627	1185	1587	2189	6468	4568	2865	2359	3854	1865	3236		
0	TOTAL		415533	278733	399683	362218	643086	831106	794054	719233	791947	590409	359015		
		1													

Table 4.17. R. Stock numbers at age (start of year). Numbers *10-3**

Run title : NEA Haddock (SVPA AFWG07)

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

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	76708	634233	69519	1186702	140490	59266	193908
	4	95265	53041	405370	45431	807706	96533	42090
	5	69287	42406	34078	188687	24658	505763	67338
	6	36974	24647	18229	15385	89309	14637	250840
	7	45596	13404	8078	6123	7697	48176	7478
	8	15745	11738	4905	2442	2454	3411	14321
	9	4518	4716	3523	1150	1035	849	1501
	10	1941	1930	928	733	562	218	452
+gp		5287	2201	1348	2339	957	218	418
0 TOTAL		351321	788317	545978	1448994	1074868	729072	578347

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

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	60064	78597	372842	274697	124174	273607	314882	366257	116770	273642
	4	127000	41891	55652	253730	165912	77195	165463	204735	247216	79827
	5	28245	79189	28093	37349	139259	81891	34261	67746	119327	155675
	6	41177	15704	35964	16200	17997	56206	23005	10901	27470	60486
	7	90933	22377	7613	16806	6886	6934	15885	6735	3728	11159
	8	3277	32898	6985	3412	8175	2450	2818	4779	2372	1552
	9	4605	1709	11292	3712	1384	2769	812	1200	1497	1070
	10	825	2009	665	3973	964	432	696	171	247	429
+gp		408	1126	1168	1201	2624	1350	638	1040	1609	550
0 TOTAL		356535	275499	520274	611081	467376	502834	558461	663564	520235	584391
	1										

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

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	340119	20523	20150	188529	109338	1157739	306579	60238	55405	62609
	4	176565	233684	14357	13353	117187	77779	646661	163288	35599	31797
	5	43531	103931	126222	9680	8452	71693	42182	285323	93067	15927
	6	69499	23096	47195	62126	6105	5693	19997	12714	151677	44964
	7	23489	33725	11915	21545	30655	4157	1800	10130	5180	79287
	8	4010	11287	13682	6507	10386	16772	1961	1094	4592	2331
	9	750	1837	4517	6779	3522	5761	7685	1223	553	2649
	10	485	418	917	2240	3741	2141	2361	4771	450	370
+gp		750	657	316	887	1915	3930	2606	4367	3208	3078
0 TOTAL		659198	429158	239272	311646	291302	1345665	1031833	543146	349732	243012

Table 4.17. R (cont.). Stock numbers at age (start of year). Numbers *10-3**

	Table 10	Stock number at age (start of year)			Numbers*10**-3						
	YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE											
		3	127117	198366	162505	28059	12568	15854	8968	12069	289449	526031
		4	33714	45736	104336	103258	19859	8721	10773	5525	8667	210274
		5	13471	7657	19845	51903	61925	13533	6142	6242	3607	5571
		6	6808	4364	2577	6609	22532	30281	7907	3740	3406	2445
		7	18159	3245	2318	834	2744	8869	13814	4309	2470	1883
		8	29201	7912	1207	1170	459	1321	4906	9054	2673	1178
		9	798	14020	4150	500	507	230	772	2405	5062	1394
		10	966	375	5925	2084	204	270	121	393	1652	2564
	+gp		943	926	829	3613	2730	2192	958	348	789	2213
0	TOTAL		231178	282601	303691	198030	123529	81271	54361	44085	317777	753554

	Table 10	Stock number at age (start of year)			Numbers*10**-3						
	YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
		3	115274	54942	26437	36191	104090	209583	681233	302685	97988	102527
		4	259238	89838	35486	19699	25438	81231	160185	512580	222390	67732
		5	110793	134099	62312	24562	13804	17617	56087	110562	369692	140897
		6	3156	33338	66685	36579	18178	9127	10739	31036	57122	210728
		7	1300	1722	9165	31933	26302	11914	5101	5119	13542	29303
		8	742	531	1053	4638	20547	17364	7153	2610	2350	5360
		9	612	273	275	730	3041	13266	11223	4162	1328	1255
		10	516	311	157	224	477	2075	7719	7294	2106	763
	+gp		1655	1578	991	379	310	359	1269	5558	4310	3965
0	TOTAL		493286	316633	202560	154935	212187	362534	940708	981607	770828	562531

	Table 10	Stock number at age (start of year)			Numbers*10**-3									
	YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 50-**	AMST 50-**
	AGE														
		3	116336	59131	231072	85441	357119	327179	211949	203311	310398	125387	0	122131	211656
		4	46994	70600	45145	173703	66844	276464	231651	136468	143828	186415	96287	79512	137216
		5	44442	31880	45069	29726	114223	49947	189906	158889	92767	94625	118073	46367	79958
		6	80240	24378	17353	23127	18338	64743	31825	112206	100327	57518	54714	22398	38868
		7	103542	35857	12224	8765	14238	10275	34538	16475	59192	56122	34074	10292	17772
		8	12000	40615	17002	6008	5015	9011	6300	15870	9304	29226	31761	4715	7811
		9	1768	4794	15879	8229	3431	3084	6056	3766	8683	5649	17325	2163	3557
		10	516	752	2036	7447	5325	1768	2118	3041	2564	4551	3551	970	1714
	+gp		1575	1117	1404	1866	5484	3993	2931	2156	4185	2070	3932		
0	TOTAL		407412	269124	387184	344312	590017	746465	717274	652182	731246	561563	359718		
		1													

Table 4.18. N. Spawning stock numbers at age (spawning time). Numbers *10-3**

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

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	2144	17733	1944	33176	3927	1657	5421
4	9905	5514	42147	4723	83973	10036	4376
5	22309	13654	10972	60752	7939	162842	21681
6	23479	15651	11575	9769	56712	9295	159285
7	38757	11393	6866	5205	6543	40949	6356
8	14926	11127	4650	2315	2326	3234	13577
9	4445	4641	3466	1132	1018	836	1477
10	1931	1920	923	730	559	217	450
+gp	5287	2201	1348	2339	957	218	418

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	1679	2197	10424	7681	3472	7650	8803	10239	3264	7650
4	13204	4355	5786	26380	17250	8026	17204	21286	25702	8299
5	9094	25497	9045	12025	44838	26367	11031	21812	38420	50123
6	26148	9972	22837	10287	11428	35691	14609	6922	17444	38409
7	77293	19020	6471	14285	5853	5894	13502	5725	3169	9485
8	3107	31187	6621	3235	7750	2322	2672	4530	2248	1471
9	4532	1681	11111	3653	1362	2725	799	1181	1473	1053
10	821	1999	662	3953	960	430	692	170	245	427
+gp	408	1126	1168	1201	2624	1350	638	1040	1609	550

1

Run title : NEA Haddock (SVPA AFWG07)

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	9509	574	563	5271	3057	32373	8573	1684	1549	1751
4	18357	24296	1493	1388	12184	8087	67234	16977	3701	3306
5	14016	33463	40640	3117	2721	23084	13582	91866	29965	5128
6	44132	14666	29969	39451	3877	3615	12699	8073	96317	28552
7	19966	28666	10127	18313	26056	3533	1530	8610	4403	67394
8	3802	10700	12971	6168	9846	15900	1859	1037	4353	2210
9	738	1808	4445	6671	3466	5669	7562	1203	545	2607
10	482	416	913	2228	3723	2130	2349	4747	448	368
+gp	750	657	316	887	1915	3930	2606	4367	3208	3078

Table 4.18. N (cont.). Spawning stock numbers at age (spawning time). Numbers *10-3**

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

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	3556	5547	4544	644	640	776	484	483	6948	9999
4	3506	4755	10848	7226	1926	1334	1885	1061	1232	20190
5	4337	2466	6390	12093	18144	4371	2857	3153	1884	2504
6	4323	2771	1637	4296	12146	17232	5236	3001	2722	1872
7	15435	2758	1970	721	2366	6777	11011	3724	2301	1756
8	27683	7500	1144	1115	437	1255	4441	8350	2554	1155
9	785	13796	4083	493	500	227	761	2327	4932	1374
10	961	373	5896	2075	203	269	121	392	1636	2545
+gp	943	926	829	3613	2731	2192	958	348	790	2214

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	2196	1211	769	1523	3963	5900	10988	4603	1385	1906
4	18422	6305	3025	2390	4003	11395	17238	35161	12417	4452
5	31696	31422	15252	7368	4889	7878	21981	35953	82514	29717
6	2266	19185	35690	21272	11403	6470	8029	21986	36659	105987
7	1202	1559	7588	25740	21833	10304	4536	4676	12142	25626
8	727	520	1024	4376	19202	16423	6866	2537	2309	5250
9	610	271	274	726	3000	13054	11095	4140	1333	1266
10	513	312	157	224	478	2076	7731	7322	2125	777
+gp	1657	1582	993	381	312	361	1280	5613	4371	4051

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	2669	1803	9426	2423	11087	7763	5186	4485	6778	2960
4	3428	6188	5287	24844	7019	32649	23785	12275	11795	15615
5	8921	8554	13448	10894	45619	17018	67050	46742	26274	25056
6	40707	12438	11164	14263	13338	47870	22220	78155	62749	34751
7	81047	28324	9649	8205	12105	10304	31650	14325	54809	44874
8	11808	38819	16646	5736	5785	8453	6910	14990	8978	27562
9	1806	5049	16972	9106	3590	3983	5746	3902	8185	5409
10	532	795	2293	8659	6217	1969	2873	3266	2684	3980
+gp	1627	1185	1587	2189	6468	4568	2865	2359	3854	1865

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Table 4.18. R. Spawning stock numbers at age (spawning time). Numbers *10-3**

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

YEAR	1950	1951	1952	1953	1954	1955	1956
AGE							
3	2148	17759	1947	33228	3934	1659	5429
4	9908	5516	42158	4725	84001	10039	4377
5	22311	13655	10973	60757	7940	162856	21683
6	23478	15651	11575	9769	56711	9295	159283
7	38757	11393	6866	5205	6543	40949	6356
8	14926	11127	4650	2315	2326	3234	13577
9	4445	4641	3466	1132	1018	836	1477
10	1931	1920	923	730	559	217	450
+gp	5287	2201	1348	2339	957	218	418

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

YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE										
3	1682	2201	10440	7692	3477	7661	8817	10255	3270	7662
4	13208	4357	5788	26388	17255	8028	17208	21292	25710	8302
5	9095	25499	9046	12026	44841	26369	11032	21814	38423	50127
6	26147	9972	22837	10287	11428	35691	14608	6922	17443	38409
7	77293	19020	6471	14285	5853	5894	13502	5725	3169	9485
8	3107	31187	6621	3235	7750	2322	2672	4530	2248	1471
9	4532	1681	11111	3653	1362	2725	799	1181	1473	1053
10	821	1999	662	3953	960	430	692	170	245	427
+gp	408	1126	1168	1201	2624	1350	638	1040	1609	550

1

Run title : NEA Haddock (SVPA AFWG07)

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	9523	575	564	5279	3061	32417	8584	1687	1551	1753
4	18363	24303	1493	1389	12187	8089	67253	16982	3702	3307
5	14017	33466	40644	3117	2722	23085	13583	91874	29968	5129
6	44132	14666	29969	39450	3877	3615	12698	8073	96315	28552
7	19966	28666	10127	18313	26056	3533	1530	8610	4403	67394
8	3802	10700	12971	6168	9846	15900	1859	1037	4353	2210
9	738	1808	4445	6671	3466	5669	7562	1203	545	2607
10	482	416	913	2228	3723	2130	2349	4747	448	368
+gp	750	657	316	887	1915	3930	2606	4367	3208	3078

Table 4.18. R (cont.). Spawning stock numbers at age (spawning time). Numbers *10-3**

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

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	3559	5554	4550	645	641	777	484	483	6947	9995
	4	3506	4757	10851	7228	1926	1334	1885	1061	1231	20186
	5	4338	2466	6390	12093	18144	4371	2856	3152	1883	2501
	6	4323	2771	1637	4296	12145	17230	5235	2999	2722	1871
	7	15435	2758	1970	721	2365	6776	11009	3723	2300	1755
	8	27683	7500	1144	1115	437	1255	4440	8348	2553	1154
	9	785	13796	4083	493	500	227	761	2326	4930	1373
	10	961	373	5896	2075	203	269	121	391	1635	2544
+gp		943	926	829	3613	2730	2192	958	348	789	2213

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

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	2190	1209	767	1520	3955	5868	10900	4540	1372	1845
	4	18406	6289	3016	2384	3994	11372	17140	34855	12231	4403
	5	31687	31379	15204	7344	4873	7857	21930	35712	81702	29166
	6	2263	19169	35610	21179	11361	6443	8000	21912	36272	104521
	7	1201	1555	7570	25642	21725	10258	4509	4648	12066	25200
	8	727	519	1021	4360	19109	16322	6824	2514	2284	5183
	9	609	271	273	723	2986	12974	11009	4104	1313	1245
	10	513	311	156	224	476	2064	7665	7250	2095	761
+gp		1655	1578	991	379	310	359	1269	5558	4310	3965

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

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	2676	1715	9243	2221	9999	6871	4663	4066	6208	2759
	4	3243	6213	5011	24318	6417	29305	21080	11054	10787	14354
	5	8799	8002	13521	10196	44433	15434	61150	41629	24398	23656
	6	39639	12189	10117	14385	12232	46097	20336	71251	58390	34223
	7	79209	27000	9339	7029	12244	9104	31084	13971	50787	46413
	8	11424	37041	15353	5437	4669	8579	6061	15378	8885	27940
	9	1750	4727	15434	7974	3328	3022	5971	3725	8604	5570
	10	515	750	2028	7380	5272	1750	2103	3029	2556	4538
+gp		1575	1117	1404	1866	5484	3993	2931	2156	4185	2070
	1										

Table 4.19. N. Stock biomass at age with SOP (start of year). Tonnes

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

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

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	17092	182998	14117	294164	33677	13648	54213
	4	39055	28153	151441	20719	356217	40899	21648
	5	44085	34935	19759	133557	16879	332596	53756
	6	33075	28547	14860	15310	85950	13533	281533
	7	53458	20348	8630	7987	9709	58377	11000
	8	23067	22266	6549	3981	3868	5165	26325
	9	7899	10677	5613	2238	1946	1535	3292
	10	3906	5029	1702	1641	1217	453	1142
+gp		11969	6452	2780	5891	2330	510	1188
0 TOTALBIO		233605	339404	225451	485488	511793	466716	454097

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

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	17046	24772	140274	93285	44141	91944	97165	95457	35904	83221
	4	66313	24291	38519	158500	108494	47719	93935	98168	139843	44662
	5	22890	71273	30180	36211	141336	78567	30187	50417	104767	135182
	6	46917	19872	54319	22083	25680	75813	28498	11406	33909	73845
	7	135795	37111	15071	30025	12879	12258	25790	9236	6031	17856
	8	6116	68179	17278	7618	19104	5412	5718	8189	4795	3104
	9	10257	4226	33336	9891	3859	7300	1967	2455	3613	2555
	10	2114	5717	2261	12182	3096	1311	1939	402	685	1179
+gp		1176	3606	4462	4142	9476	4609	2000	2754	5025	1698
0 TOTALBIO		308625	259049	335699	373935	368064	324934	287198	278484	334571	363302
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

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

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	120330	7275	8082	68255	50607	376505	92975	23831	21850	19783
	4	114922	152409	10594	8893	99791	46526	360732	118826	25824	18479
	5	43976	105205	144559	10006	11171	66562	36521	322260	104779	14366
	6	98709	32869	75992	90288	11344	7431	24341	20189	240084	57018
	7	43725	62906	25144	41037	74656	7111	2871	21082	10745	131775
	8	9328	26309	36082	15487	31608	35854	3910	2845	11904	4841
	9	2081	5111	14216	19258	12792	14698	18284	3795	1712	6567
	10	1548	1338	3323	7321	15638	6287	6463	17040	1602	1056
+gp		2697	2366	1289	3261	9007	12982	8027	17546	12852	9876
0 TOTALBIO		437318	395789	319281	263806	316615	573954	554125	547416	431352	263761

Table 4.19. N (cont.). Stock biomass at age with SOP (start of year). Tonnes

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

YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE											
	3	41343	76239	74820	16061	10178	13327	4417	4425	110600	153126
	4	20165	32332	88373	114641	21413	12278	11175	4806	6157	134983
	5	12504	8402	26088	77585	109262	22015	9091	9605	5112	5621
	6	8885	6732	4763	14289	48699	72219	12450	7425	7633	4393
	7	31060	6560	5615	2469	7947	24354	29523	8639	6661	4939
	8	62412	19987	3653	4727	1712	4596	11566	23277	7034	3536
	9	2035	42271	14990	2144	2435	987	2211	6620	16363	3990
	10	2835	1301	24633	9586	1031	1420	413	1271	5595	8722
+gp		3116	3614	3875	18930	14629	12044	3852	1299	3061	7761
0 TOTALBIO		184355	197437	246810	260431	217307	163240	84700	67367	168216	327072

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

YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
	3	38085	20965	11930	14563	39907	72049	188274	79047	26841	30808
	4	147217	54018	24826	15186	17916	59151	97806	260193	105751	34679
	5	115934	118566	59404	25396	15805	20013	61142	104383	288929	106423
	6	4667	48362	84779	47193	25517	15172	16405	46701	74251	235511
	7	3154	3274	17573	51367	43517	22905	10614	10048	25853	50274
	8	2479	1557	2500	10557	40401	37859	16546	6619	5557	12725
	9	2252	1052	961	1969	8049	33188	28650	11407	3898	3540
	10	1782	1284	695	855	1446	6706	22012	21616	6549	2590
+gp		6617	6057	4575	1786	1287	1290	4524	17990	14280	14082
0 TOTALBIO		322184	255134	207243	168872	193844	268334	445972	558005	551910	490633

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

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE											
	3	35964	21149	78456	26959	119551	106089	69597	66516	103217	41564
	4	25693	41298	29150	106831	40162	167036	143030	78327	87188	113891
	5	34688	28677	40427	29949	113208	46328	182921	145301	82435	87448
	6	83811	28236	22519	28793	27300	88826	42815	144577	125881	68649
	7	148437	52552	18748	15726	23920	20280	62834	25961	99954	83860
	8	25017	77523	31986	11738	12354	18338	16121	32528	18303	56528
	9	4881	12784	37854	19562	8566	9503	14926	10043	21020	12902
	10	1635	2546	6576	21967	15848	5274	8192	9260	8060	11827
+gp		5829	4230	5624	7019	19190	12901	9014	7228	12529	6358
0 TOTALBIO		365956	268994	271341	268544	380098	474575	549450	519741	558585	483027

Table 4.19. R. Stock biomass at age with SOP (start of year). Tonnes

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

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

	YEAR	1950	1951	1952	1953	1954	1955	1956
	AGE							
	3	17119	183266	14138	294625	33731	13670	54296
	4	39065	28162	151483	20725	356336	40913	21656
	5	44089	34938	19761	133568	16880	332625	53761
	6	33074	28547	14860	15310	85949	13533	281529
	7	53458	20348	8630	7987	9709	58377	11000
	8	23067	22266	6549	3981	3868	5165	26325
	9	7899	10677	5613	2238	1946	1535	3292
	10	3906	5029	1702	1641	1217	453	1142
	+gp	11969	6452	2780	5891	2330	510	1188
0	TOTALBIO	233646	339683	225516	485967	511966	466782	454189

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

	YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	17074	24812	140490	93417	44204	92072	97312	95606	35960	83346
	4	66335	24300	38532	158548	108524	47732	93959	98199	139889	44676
	5	22892	71279	30182	36215	141347	78573	30189	50421	104776	135193
	6	46916	19872	54318	22082	25679	75812	28497	11406	33908	73844
	7	135795	37111	15071	30025	12879	12258	25790	9236	6031	17856
	8	6116	68179	17278	7618	19104	5412	5718	8189	4795	3104
	9	10257	4226	33336	9891	3859	7300	1967	2455	3613	2555
	10	2114	5717	2261	12182	3096	1311	1939	402	685	1179
	+gp	1176	3606	4462	4142	9476	4609	2000	2754	5025	1698
0	TOTALBIO	308675	259103	335931	374118	368168	325080	287371	278668	334681	363451
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

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

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	120517	7287	8095	68355	50687	377012	93100	23864	21879	19808
	4	114959	152456	10597	8896	99822	46540	360831	118863	25831	18484
	5	43980	105214	144571	10007	11172	66567	36524	322288	104788	14367
	6	98708	32869	75991	90286	11344	7431	24341	20188	240081	57017
	7	43725	62906	25144	41037	74656	7111	2871	21082	10745	131775
	8	9328	26309	36082	15487	31608	35854	3910	2845	11904	4841
	9	2081	5111	14216	19258	12792	14698	18284	3795	1712	6567
	10	1548	1338	3323	7321	15638	6287	6463	17040	1602	1056
	+gp	2697	2366	1289	3261	9007	12982	8027	17546	12852	9876
0	TOTALBIO	437544	395855	319309	263909	316727	574480	554351	547514	431394	263791

Table 4.19. R (cont.). Stock biomass at age with SOP (start of year). Tonnes

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

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	41386	76337	74929	16085	10192	13345	4421	4422	110581	153053
	4	20169	32340	88396	114672	21418	12278	11177	4804	6152	134957
	5	12505	8402	26089	77588	109265	22014	9089	9603	5109	5615
	6	8884	6732	4763	14288	48695	72210	12448	7422	7631	4389
	7	31060	6560	5615	2469	7947	24350	29518	8637	6657	4937
	8	62412	19987	3652	4727	1712	4595	11563	23271	7032	3533
	9	2035	42271	14990	2144	2435	987	2211	6617	16358	3988
	10	2835	1301	24633	9586	1030	1420	413	1271	5592	8717
	+gp	3116	3614	3875	18930	14627	12044	3852	1298	3060	7757
0	TOTALBIO	184403	197544	246943	260489	217320	163245	84690	67345	168171	326947

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

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	37988	20917	11899	14534	39832	71666	186755	77962	26583	29838
	4	147089	53874	24757	15144	17875	59036	97248	257930	104170	34296
	5	115899	118404	59218	25313	15754	19960	61000	103683	286087	104450
	6	4659	48323	84589	46987	25424	15110	16347	46544	73469	232254
	7	3150	3267	17533	51171	43302	22801	10551	9987	25691	49438
	8	2477	1554	2492	10518	40205	37627	16444	6557	5498	12563
	9	2248	1050	957	1962	8012	32985	28428	11309	3839	3482
	10	1780	1281	693	852	1439	6669	21823	21406	6459	2535
	+gp	6609	6042	4564	1780	1281	1283	4485	17815	14082	13785
0	TOTALBIO	321900	254711	206703	168260	193124	267137	443081	553192	545877	482640

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

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	36050	20112	76929	24720	107822	93945	59512	60366	94658	38903
	4	24300	41465	27628	104572	36719	150007	120569	70608	79839	105161
	5	34217	26824	40644	28031	110265	42036	158667	129541	76641	82929
	6	81611	27671	20406	29039	25035	85579	37269	131943	117283	67907
	7	145072	50096	18145	13473	24196	17926	58694	25347	92733	87121
	8	24205	73972	29501	11125	9972	18621	13449	33404	18137	57558
	9	4731	11968	34423	17131	7940	7216	14753	9595	22126	13345
	10	1583	2401	5817	18724	13437	4692	5704	8597	7685	13544
	+gp	5643	3988	4975	5982	16270	11283	8772	6614	13621	7089
0	TOTALBIO	357413	258499	258469	252798	351656	431306	477390	476015	522723	473557
	1										

Table 4.20. N. Spawning stock biomass at age with SOP (spawning time). Tonnes

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

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

YEAR		1950	1951	1952	1953	1954	1955	1956
AGE								
	3	479	5124	395	8237	943	382	1518
	4	4062	2928	15750	2155	37047	4253	2251
	5	14195	11249	6362	43005	5435	107096	17309
	6	21002	18128	9436	9722	54578	8594	178773
	7	45439	17295	7336	6789	8253	49621	9350
	8	21868	21108	6208	3774	3667	4897	24956
	9	7773	10506	5523	2202	1915	1510	3240
	10	3887	5004	1693	1633	1211	451	1136
+gp		11969	6452	2780	5891	2330	510	1188
0 TOTSPBIO		130673	97793	55484	83408	115378	177313	239723

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

YEAR		1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
AGE											
	3	477	694	3928	2612	1236	2574	2721	2673	1005	2330
	4	6897	2526	4006	16484	11283	4963	9769	10209	14544	4645
	5	7371	22950	9718	11660	45510	25299	9720	16234	33735	43529
	6	29792	12619	34492	14022	16307	48141	18096	7243	21532	46892
	7	115426	31544	12810	25521	10947	10419	21921	7850	5126	15178
	8	5798	64634	16379	7222	18110	5131	5421	7763	4545	2942
	9	10093	4159	32803	9732	3798	7184	1935	2415	3555	2514
	10	2104	5689	2250	12121	3080	1305	1929	400	682	1173
+gp		1176	3606	4462	4142	9476	4609	2000	2754	5025	1698
0 TOTSPBIO		179133	148420	120848	103516	119747	109624	73512	57543	89749	120900
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Traditional vpa using file input for terminal F

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

YEAR		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE											
	3	3369	204	226	1911	1417	10542	2603	667	612	554
	4	11952	15851	1102	925	10378	4839	37516	12358	2686	1922
	5	14160	33876	46548	3222	3597	21433	11760	103768	33739	4626
	6	62680	20872	48255	57333	7203	4718	15457	12820	152454	36207
	7	37166	53470	21372	34882	63458	6045	2440	17920	9133	112009
	8	8843	24941	34206	14682	29965	33990	3706	2698	11285	4589
	9	2048	5029	13988	18950	12588	14462	17992	3734	1685	6462
	10	1541	1332	3306	7285	15560	6255	6431	16955	1594	1051
+gp		2697	2366	1289	3261	9007	12982	8027	17546	12852	9876
0 TOTSPBIO		144457	157940	170294	142449	153173	115266	105932	188466	226039	177295

Table 4.20. N (cont.). Spawning stock biomass at age with SOP (spawning time). Tonnes

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

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	1158	2135	2095	369	519	653	239	177	2654	2909
	4	2097	3363	9191	8025	2077	1878	1956	923	874	12958
	5	4026	2705	8400	18077	32014	7111	4228	4851	2669	2524
	6	5642	4275	3025	9288	26249	41093	8242	5955	6098	3360
	7	26401	5576	4773	2133	6851	18606	23530	7464	6201	4603
	8	59167	18948	3463	4505	1630	4366	10467	21461	6718	3462
	9	2003	41594	14750	2114	2401	972	2178	6402	15938	3930
	10	2821	1295	24510	9548	1026	1415	411	1266	5539	8652
	+gp	3116	3614	3875	18930	14629	12044	3852	1299	3061	7761
0	TOTSPBIO	106430	83503	74082	72988	87396	88139	55102	49797	49753	50161

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

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	724	461	346	612	1516	2017	3012	1186	376	555
	4	10452	3781	2110	1838	2813	8281	10465	17693	5816	2254
	5	33157	27745	14495	7593	5579	8926	23906	33716	63853	22029
	6	3346	27808	45272	27324	15948	10711	12222	32971	47150	116813
	7	2914	2957	14515	41247	35945	19721	9383	9124	23035	43235
	8	2427	1523	2423	9924	37573	35588	15785	6374	5402	12305
	9	2238	1045	955	1951	7904	32458	28105	11248	3855	3512
	10	1771	1281	693	853	1443	6672	21858	21486	6517	2582
	+gp	6617	6057	4575	1786	1287	1290	4524	17990	14280	14082
0	TOTSPBIO	63646	72658	85384	93128	110008	125665	129260	151787	170283	217369

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

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	827	613	3138	701	3347	2228	1531	1330	2064	914
	4	1773	3634	3236	14956	3856	17706	13016	6344	6539	8770
	5	6868	7198	12128	10272	44038	14315	58901	38069	21680	21862
	6	41403	14118	13129	17909	18209	63244	27359	91807	73263	40846
	7	113555	39571	14323	12613	20571	17968	56551	22015	85760	69352
	8	23816	70701	28883	10623	11502	17457	15508	31520	17479	54041
	9	4832	12605	36794	18956	8309	9313	14717	9932	20831	12722
	10	1632	2539	6550	21770	15689	5222	8135	9223	8036	11791
	+gp	5829	4230	5624	7019	19190	12901	9014	7228	12529	6358
0	TOTSPBIO	200535	155209	123806	114818	144710	160354	204731	217469	248181	226657
	1										

Table 4.20. R. Spawning stock biomass at age with SOP (spawning time). Tonnes

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

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

	YEAR	1950	1951	1952	1953	1954	1955	1956
	AGE							
	3	479	5131	396	8250	944	383	1520
	4	4063	2929	15754	2155	37059	4255	2252
	5	14197	11250	6363	43009	5435	107105	17311
	6	21002	18127	9436	9722	54577	8593	178771
	7	45439	17295	7336	6789	8253	49621	9350
	8	21868	21108	6208	3774	3667	4897	24956
	9	7773	10506	5523	2202	1915	1510	3240
	10	3887	5004	1693	1633	1211	451	1136
	+gp	11969	6452	2780	5891	2330	510	1188
0	TOTSPBIO	130675	97802	55490	83425	115391	177324	239725

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

	YEAR	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
	AGE										
	3	478	695	3934	2616	1238	2578	2725	2677	1007	2334
	4	6899	2527	4007	16489	11287	4964	9772	10213	14548	4646
	5	7371	22952	9719	11661	45514	25300	9721	16236	33738	43532
	6	29792	12619	34492	14022	16306	48141	18096	7243	21532	46891
	7	115426	31544	12810	25521	10947	10419	21921	7850	5126	15178
	8	5798	64634	16379	7222	18110	5131	5421	7763	4545	2942
	9	10093	4159	32803	9732	3798	7184	1935	2415	3555	2514
	10	2104	5689	2250	12121	3080	1305	1929	400	682	1173
	+gp	1176	3606	4462	4142	9476	4609	2000	2754	5025	1698
0	TOTSPBIO	179136	148424	120856	103526	119756	109630	73520	57552	89758	120908
	1										

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Traditional vpa using file input for terminal F

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

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	3374	204	227	1914	1419	10556	2607	668	613	555
	4	11956	15855	1102	925	10382	4840	37526	12362	2686	1922
	5	14161	33879	46552	3222	3598	21434	11761	103777	33742	4626
	6	62679	20872	48254	57332	7203	4718	15457	12820	152451	36206
	7	37166	53470	21372	34882	63458	6045	2440	17920	9133	112009
	8	8843	24941	34206	14682	29965	33990	3706	2698	11285	4589
	9	2048	5029	13988	18950	12588	14462	17992	3734	1685	6462
	10	1541	1332	3306	7285	15560	6255	6431	16955	1594	1051
	+gp	2697	2366	1289	3261	9007	12982	8027	17546	12852	9876
0	TOTSPBIO	144466	157948	170298	142452	153179	115283	105947	188480	226041	177296

Table 4.20. R (cont.). Spawning stock biomass at age with SOP (spawning time). Tonnes

	Table 15	Spawning stock biomass with SOP (spawning time)				Tonnes					
	YEAR		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE											
		3	1159	2137	2098	370	520	654	239	177	2654	2908
		4	2098	3363	9193	8027	2078	1879	1956	922	874	12956
		5	4027	2705	8401	18078	32015	7110	4226	4850	2667	2521
		6	5642	4275	3025	9287	26246	41088	8241	5952	6097	3358
		7	26401	5576	4773	2133	6850	18603	23526	7462	6198	4602
		8	59167	18948	3463	4505	1630	4365	10465	21456	6715	3459
		9	2003	41594	14750	2114	2401	972	2178	6399	15933	3928
		10	2821	1295	24510	9548	1026	1415	411	1266	5536	8648
	+gp		3116	3614	3875	18930	14627	12044	3852	1298	3060	7757
0	TOTSPBIO		106432	83507	74087	72991	87393	88131	55092	49783	49733	50136

	Table 15	Spawning stock biomass with SOP (spawning time)				Tonnes					
	YEAR		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
		3	722	460	345	610	1514	2007	2988	1169	372	537
		4	10443	3771	2104	1832	2806	8265	10406	17539	5729	2229
		5	33147	27706	14449	7568	5561	8902	23851	33490	63225	21621
		6	3341	27786	45170	27206	15890	10668	12178	32860	46653	115198
		7	2911	2950	14482	41090	35767	19632	9327	9068	22890	42516
		8	2425	1520	2415	9887	37391	35370	15687	6314	5344	12148
		9	2235	1044	952	1944	7867	32259	27888	11151	3797	3454
		10	1769	1278	691	850	1436	6635	21670	21277	6426	2528
	+gp		6609	6042	4564	1780	1281	1283	4485	17815	14082	13785
0	TOTSPBIO		63601	72557	85173	92767	109514	125021	128481	150683	168519	214017

	Table 15	Spawning stock biomass with SOP (spawning time)				Tonnes					
	YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE											
		3	829	583	3077	643	3019	1973	1309	1207	1893	856
		4	1677	3649	3067	14640	3525	15901	10972	5719	5988	8097
		5	6775	6733	12193	9615	42893	12989	51091	33940	20157	20732
		6	40316	13836	11897	18062	16699	60932	23815	83784	68258	40405
		7	110980	37722	13863	10805	20809	15883	52824	21494	79565	72049
		8	23043	67462	26639	10068	9284	17728	12938	32369	17321	55025
		9	4684	11800	33459	16600	7702	7071	14547	9489	21926	13158
		10	1580	2394	5793	18556	13303	4645	5664	8562	7662	13503
	+gp		5643	3988	4975	5982	16270	11283	8772	6614	13621	7089
0	TOTSPBIO		195527	148168	114964	104972	133503	148404	181933	203179	236392	230914
		1										

Table 4.21. N. Summary

Run title : NEA Haddock (SVPA AFWG07)

At 24/04/2007 21:48

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 4- 7
1950	76587	233605	130673	132125	1.0111	0.6148	0.842
1951	633307	339404	97793	120077	1.2279	0.796	0.6402
1952	69415	225451	55484	127660	2.3008	0.5603	0.7501
1953	1184843	485488	83408	123920	1.4857	0.6839	0.5298
1954	140265	511793	115378	156788	1.3589	0.6614	0.3935
1955	59170	466716	177313	202286	1.1408	0.6354	0.5249
1956	193612	454097	239723	213924	0.8924	0.7714	0.4709
1957	59968	308625	179133	123583	0.6899	0.7831	0.4598
1958	78470	259049	148420	112672	0.7591	0.8697	0.5576
1959	372268	335699	120848	88211	0.7299	1.038	0.4165
1960	274309	373935	103516	154651	1.494	0.9368	0.5149
1961	123997	368064	119747	193224	1.6136	0.9807	0.6885
1962	273225	324934	109624	187408	1.7095	0.927	0.8498
1963	314406	287198	73512	146224	1.9891	0.8514	0.9053
1964	365687	278484	57543	99158	1.7232	0.7191	0.6782
1965	116589	334571	89749	118578	1.3212	0.8484	0.5181
1966	273231	363302	120900	161778	1.3381	0.8391	0.6339
1967	339592	437318	144457	136397	0.9442	0.9761	0.4433
1968	20490	395789	157940	181726	1.1506	0.9781	0.5307
1969	20119	319281	170294	130820	0.7682	1.1066	0.4114
1970	188253	263806	142449	88257	0.6196	0.9988	0.3769
1971	109166	316615	153173	78905	0.5151	1.2771	0.2568
1972	1156182	573954	115266	266153	2.309	0.8971	0.7362
1973	306169	554125	105932	322226	3.0418	0.8366	0.5872
1974	60154	547416	188466	221157	1.1735	1.0914	0.5091
1975	55330	431352	226039	175758	0.7776	1.0879	0.5331
1976	62531	263761	177295	137264	0.7742	0.8715	0.6919
1977	126984	184355	106430	110158	1.035	0.8969	0.8337
1978	198110	197437	83503	95422	1.1427	1.0601	0.6748
1979	162269	246810	74082	103623	1.3988	1.2702	0.6907
1980	28016	260431	72988	87889	1.2042	1.2854	0.494
1981	12551	217307	87396	77153	0.8828	1.3583	0.4789
1982	15833	163240	88139	46955	0.5327	1.3511	0.3545
1983	8961	84700	55102	24600	0.4464	0.9535	0.3061
1984	12078	67367	49797	20945	0.4206	0.9491	0.2809
1985	289498	168216	49753	45052	0.9055	1.0242	0.3407
1986	526284	327072	50161	100563	2.0048	0.9508	0.4927
1987	115566	322184	63646	154916	2.434	1.0078	0.6395
1988	55068	255134	72658	95255	1.311	1.0045	0.5104
1989	26504	207243	85384	58518	0.6853	1.023	0.3784
1990	36262	168872	93128	27182	0.2919	0.9843	0.1562
1991	104284	193844	110008	36216	0.3292	0.9639	0.2039
1992	210705	268334	125665	59922	0.4768	1.0207	0.2881
1993	686776	445972	129260	82379	0.6373	0.9969	0.368
1994	306899	558005	151787	135186	0.8906	0.9945	0.4383
1995	98941	551910	170283	142448	0.8365	0.9759	0.3791
1996	105861	490633	217369	178128	0.8195	0.9832	0.4021
1997	116059	365956	200535	154359	0.7697	0.9505	0.4485
1998	62179	268994	155209	100630	0.6484	0.9888	0.387
1999	235659	271341	123806	83195	0.672	0.9792	0.398
2000	93180	268544	114818	68944	0.6005	0.9741	0.2611
2001	395966	380098	144710	89640	0.6194	1.0098	0.2603
2002	369661	474575	160354	114794	0.7159	0.9896	0.2898
2003	235748	549450	204731	138945	0.6787	1.0286	0.3966
2004	224256	519741	217469	157854	0.7259	0.9789	0.3263
2005	338882	558585	248181	158299	0.6378	0.9954	0.3778
2006	134557	483027	226657	172173	0.7596	1.0029	0.3951
Arith. Mean	215104	343390	128721	124952	1.0592		.4860
0 Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)			

1

Table 4.21. R. Summary

Run title : NEA Haddock (SVPA AFWG07)

At 25/04/2007 0:53

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 4- 7
1950	76708	233646	130675	132125	1.0111	0.6148	0.842
1951	634233	339683	97802	120077	1.2278	0.796	0.6402
1952	69519	225516	55490	127660	2.3006	0.5603	0.7501
1953	1186702	485967	83425	123920	1.4854	0.6839	0.5298
1954	140490	511966	115391	156788	1.3588	0.6614	0.3935
1955	59266	466782	177324	202286	1.1408	0.6354	0.5248
1956	193908	454189	239725	213924	0.8924	0.7714	0.4709
1957	60064	308675	179136	123583	0.6899	0.7831	0.4598
1958	78597	259103	148424	112672	0.7591	0.8697	0.5576
1959	372842	335931	120856	88211	0.7299	1.038	0.4165
1960	274697	374118	103526	154651	1.4938	0.9368	0.5149
1961	124174	368168	119756	193224	1.6135	0.9807	0.6885
1962	273607	325080	109630	187408	1.7095	0.927	0.8498
1963	314882	287371	73520	146224	1.9889	0.8514	0.9052
1964	366257	278668	57552	99158	1.7229	0.7191	0.6781
1965	116770	334681	89758	118578	1.3211	0.8484	0.518
1966	273642	363451	120908	161778	1.338	0.8391	0.6338
1967	340119	437544	144466	136397	0.9441	0.9761	0.4432
1968	20523	395855	157948	181726	1.1505	0.9781	0.5307
1969	20150	319309	170298	130820	0.7682	1.1066	0.4113
1970	188529	263909	142452	88257	0.6196	0.9988	0.3769
1971	109338	316727	153179	78905	0.5151	1.2771	0.2568
1972	1157739	574480	115283	266153	2.3087	0.8971	0.7362
1973	306579	554351	105947	322226	3.0414	0.8366	0.5871
1974	60238	547514	188480	221157	1.1734	1.0914	0.5091
1975	55405	431394	226041	175758	0.7775	1.0879	0.533
1976	62609	263791	177296	137264	0.7742	0.8715	0.6919
1977	127117	184403	106432	110158	1.035	0.8969	0.8336
1978	198366	197544	83507	95422	1.1427	1.0601	0.6748
1979	162505	246943	74087	103623	1.3987	1.2702	0.6906
1980	28059	260489	72991	87889	1.2041	1.2854	0.494
1981	12568	217320	87393	77153	0.8828	1.3583	0.4789
1982	15854	163245	88131	46955	0.5328	1.3511	0.3546
1983	8968	84690	55092	24600	0.4465	0.9535	0.3062
1984	12069	67345	49783	20945	0.4207	0.9491	0.281
1985	289449	168171	49733	45052	0.9059	1.0242	0.3409
1986	526031	326947	50136	100563	2.0058	0.9508	0.493
1987	115274	321900	63601	154916	2.4357	1.0078	0.6402
1988	54942	254711	72557	95255	1.3128	1.0045	0.5113
1989	26437	206703	85173	58518	0.687	1.023	0.3795
1990	36191	168260	92767	27182	0.293	0.9843	0.1568
1991	104090	193124	109514	36216	0.3307	0.9639	0.2047
1992	209583	267137	125021	59922	0.4793	1.0207	0.2893
1993	681233	443081	128481	82379	0.6412	0.9969	0.37
1994	302685	553192	150683	135186	0.8972	0.9945	0.4414
1995	97988	545877	168519	142448	0.8453	0.9759	0.3833
1996	102527	482640	214017	178128	0.8323	0.9832	0.4106
1997	116336	357413	195527	154359	0.7895	0.9505	0.4634
1998	59131	258499	148168	100630	0.6792	0.9888	0.4057
1999	231072	258469	114964	83195	0.7237	0.9792	0.4196
2000	85441	252798	104972	68944	0.6568	0.9741	0.2815
2001	357119	351656	133503	89640	0.6714	1.0098	0.2736
2002	327179	431306	148404	100582	0.6778	0.9901	0.2803
2003	211949	477390	181933	113722	0.6251	0.9783	0.3685
2004	203311	476015	203179	133054	0.6549	0.9799	0.2996
2005	310398	522723	236392	127965	0.5413	0.9966	0.3066
2006	125387	473557	230914	140746	0.6095	1.0074	0.3106
Arith. Mean	211875	338095	126840	122742	1.0564		.4841
0 Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)			

1

Table 4.22 N
Prediction with management option table : input data

MFDP version 1a
Run: res-f
Time and date: 14:52 26.04.2007
Fbar age range: 4-7

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	672000	0.3379	0.014	0	0	0.294	0.0433	0.681
4	102185	0.2575	0.08	0	0	0.564	0.2013	0.905
5	121859	0.2243	0.274	0	0	0.871	0.3327	1.161
6	53347	0.2088	0.566	0	0	1.226	0.4416	1.439
7	31774	0.2	0.844	0	0	1.543	0.4901	1.772
8	27257	0.2	0.944	0	0	1.921	0.3848	2.058
9	16009	0.2	0.986	0	0	2.339	0.3344	2.292
10	3348	0.2	0.996	0	0	2.727	0.5202	2.461
11	3236	0.2	0.999	0	0	3.334	0.5202	2.901

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	731000	0.3379	0.019	0	0	0.306	0.0433	0.681
4	.	0.2575	0.076	0	0	0.562	0.2013	0.905
5	.	0.2243	0.249	0	0	0.875	0.3327	1.161
6	.	0.2088	0.557	0	0	1.232	0.4416	1.439
7	.	0.2	0.807	0	0	1.615	0.4901	1.772
8	.	0.2	0.929	0	0	2.019	0.3848	2.058
9	.	0.2	0.977	0	0	2.431	0.3344	2.292
10	.	0.2	0.993	0	0	2.824	0.5202	2.461
11	.	0.2	0.999	0	0	3.204	0.5202	2.901

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	463000	0.3379	0.019	0	0	0.306	0.0433	0.681
4	.	0.2575	0.076	0	0	0.562	0.2013	0.905
5	.	0.2243	0.249	0	0	0.875	0.3327	1.161
6	.	0.2088	0.557	0	0	1.232	0.4416	1.439
7	.	0.2	0.807	0	0	1.615	0.4901	1.772
8	.	0.2	0.929	0	0	2.019	0.3848	2.058
9	.	0.2	0.977	0	0	2.431	0.3344	2.292
10	.	0.2	0.993	0	0	2.824	0.5202	2.461
11	.	0.2	0.999	0	0	3.204	0.5202	2.901

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	215000	0.3379	0.019	0	0	0.306	0.0433	0.681
4	.	0.2575	0.076	0	0	0.562	0.2013	0.905
5	.	0.2243	0.249	0	0	0.875	0.3327	1.161
6	.	0.2088	0.557	0	0	1.232	0.4416	1.439
7	.	0.2	0.807	0	0	1.615	0.4901	1.772
8	.	0.2	0.929	0	0	2.019	0.3848	2.058
9	.	0.2	0.977	0	0	2.431	0.3344	2.292
10	.	0.2	0.993	0	0	2.824	0.5202	2.461
11	.	0.2	0.999	0	0	3.204	0.5202	2.901

Table 4.22 R
Prediction with management option table : input data

MFDP version 1a
Run: res
Time and date: 14:12 26.04.2007
Fbar age range: 4-7

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	611000	0.3377	0.014	0	0	0.294	0.0357	0.686
4	96287	0.2577	0.08	0	0	0.564	0.1627	0.908
5	118073	0.2239	0.274	0	0	0.871	0.2713	1.166
6	54714	0.2085	0.566	0	0	1.226	0.3728	1.444
7	34074	0.2	0.844	0	0	1.543	0.4155	1.775
8	31761	0.2	0.944	0	0	1.921	0.3417	2.058
9	17325	0.2	0.986	0	0	2.339	0.2982	2.288
10	3551	0.2	0.996	0	0	2.727	0.474	2.449
11	3932	0.2	0.999	0	0	3.334	0.474	2.852

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	658000	0.3377	0.019	0	0	0.306	0.0357	0.686
4	.	0.2577	0.076	0	0	0.562	0.1627	0.908
5	.	0.2239	0.249	0	0	0.875	0.2713	1.166
6	.	0.2085	0.557	0	0	1.232	0.3728	1.444
7	.	0.2	0.807	0	0	1.615	0.4155	1.775
8	.	0.2	0.929	0	0	2.019	0.3417	2.058
9	.	0.2	0.977	0	0	2.431	0.2982	2.288
10	.	0.2	0.993	0	0	2.824	0.474	2.449
11	.	0.2	0.999	0	0	3.204	0.474	2.852

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	427000	0.3377	0.019	0	0	0.306	0.0357	0.686
4	.	0.2577	0.076	0	0	0.562	0.1627	0.908
5	.	0.2239	0.249	0	0	0.875	0.2713	1.166
6	.	0.2085	0.557	0	0	1.232	0.3728	1.444
7	.	0.2	0.807	0	0	1.615	0.4155	1.775
8	.	0.2	0.929	0	0	2.019	0.3417	2.058
9	.	0.2	0.977	0	0	2.431	0.2982	2.288
10	.	0.2	0.993	0	0	2.824	0.474	2.449
11	.	0.2	0.999	0	0	3.204	0.474	2.852

2010

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	211000	0.3377	0.019	0	0	0.306	0.0357	0.686
4	.	0.2577	0.076	0	0	0.562	0.1627	0.908
5	.	0.2239	0.249	0	0	0.875	0.2713	1.166
6	.	0.2085	0.557	0	0	1.232	0.3728	1.444
7	.	0.2	0.807	0	0	1.615	0.4155	1.775
8	.	0.2	0.929	0	0	2.019	0.3417	2.058
9	.	0.2	0.977	0	0	2.431	0.2982	2.288
10	.	0.2	0.993	0	0	2.824	0.474	2.449
11	.	0.2	0.999	0	0	3.204	0.474	2.852

Table 4.23 N
Prediction with management option table for 2007-2009

MFDP version 1a
Run: res1
preMFDP Index file 26.04.2007
Time and date: 14:49 26.04.2007
Fbar age range: 4-7

2007				
Biomass	SSB	FMult	FBar	Landings
585495	221077	1	0.3664	144735

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
774986	224644	0	0	0	1046108	353114
.	224644	0.1	0.0366	21036	1026395	341096
.	224644	0.2	0.0733	41447	1007322	329548
.	224644	0.3	0.1099	61256	988867	318452
.	224644	0.4	0.1466	80483	971004	307789
.	224644	0.5	0.1832	99151	953712	297541
.	224644	0.6	0.2199	117280	936970	287690
.	224644	0.7	0.2565	134888	920756	278220
.	224644	0.8	0.2931	151995	905051	269115
.	224644	0.9	0.3298	168618	889835	260360
.	224644	1	0.3664	184774	875092	251941
.	224644	1.1	0.4031	200480	860803	243844
.	224644	1.2	0.4397	215751	846951	236056
.	224644	1.3	0.4764	230603	833521	228563
.	224644	1.4	0.513	245051	820497	221354
.	224644	1.5	0.5496	259108	807864	214418
.	224644	1.6	0.5863	272788	795608	207743
.	224644	1.7	0.6229	286104	783715	201318
.	224644	1.8	0.6596	299068	772173	195134
.	224644	1.9	0.6962	311692	760969	189180
.	224644	2	0.7329	323988	750090	183447

Input units are thousands and kg - output in tonnes

Table 4.23 R
Prediction with management option table for 2007-2009

MFDP version 1a
Run: res1
preMFDP Index file 26.04.2007
Time and date: 15:00 26.04.2007
Fbar age range: 4-7

2007				
Biomass	SSB	FMult	FBar	Landings
580766	237672	1	0.3056	128080

2008					2009	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
755169	244971	0	0	0	1003088	366971
.	244971	0.1	0.0306	17829	986152	355941
.	244971	0.2	0.0611	35184	969707	345291
.	244971	0.3	0.0917	52083	953737	335009
.	244971	0.4	0.1222	68539	938225	325080
.	244971	0.5	0.1528	84567	923156	315492
.	244971	0.6	0.1833	100180	908515	306231
.	244971	0.7	0.2139	115392	894288	297287
.	244971	0.8	0.2445	130216	880460	288647
.	244971	0.9	0.275	144664	867019	280300
.	244971	1	0.3056	158747	853952	272235
.	244971	1.1	0.3361	172478	841246	264444
.	244971	1.2	0.3667	185867	828890	256914
.	244971	1.3	0.3972	198926	816871	249638
.	244971	1.4	0.4278	211664	805180	242605
.	244971	1.5	0.4584	224091	793804	235807
.	244971	1.6	0.4889	236217	782735	229236
.	244971	1.7	0.5195	248052	771962	222884
.	244971	1.8	0.55	259604	761475	216742
.	244971	1.9	0.5806	270882	751265	210803
.	244971	2	0.6112	281895	741323	205060

Input units are thousands and kg - output in tonnes

Table 4.24 N
Prediction single option table for period 2007-2010

MFDP version 1a
Run: res
Time and date: 14:07 26.04.2007
Fbar age range: 4-7

Year:	2007	F multiplie	1	Fbar:	0.3664				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0433	24194	16476	672000	197568	9408	2766	9408	2766
4	0.2013	16497	14930	102185	57632	8175	4611	8175	4611
5	0.3327	31086	36090	121859	106139	33389	29082	33389	29082
6	0.4416	17319	24923	53347	65403	30194	37018	30194	37018
7	0.4901	11248	19932	31774	49027	26817	41379	26817	41379
8	0.3848	7941	16343	27257	52361	25731	49428	25731	49428
9	0.3344	4147	9505	16009	37445	15785	36921	15785	36921
10	0.5202	1241	3055	3348	9130	3335	9093	3335	9093
11	0.5202	1200	3481	3236	10789	3233	10778	3233	10778
Total		114874	144735	1031015	585495	156067	221077	156067	221077

Year:	2008	F multiplie	0.9552	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0414	25162	17135	731000	223686	13889	4250	13889	4250
4	0.1923	71079	64326	459004	257960	34884	19605	34884	19605
5	0.3178	15844	18395	64585	56512	16082	14071	16082	14071
6	0.4218	21843	31432	69816	86013	38888	47909	38888	47909
7	0.4681	9506	16844	27838	44959	22466	36282	22466	36282
8	0.3676	4470	9198	15935	32174	14804	29889	14804	29889
9	0.3194	3784	8673	15188	36922	14839	36073	14839	36073
10	0.4969	3357	8262	9382	26494	9316	26308	9316	26308
11	0.4969	1147	3326	3204	10266	3201	10256	3201	10256
Total		156191	177592	1395953	774986	168368	224644	168368	224644

Year:	2009	F multiplie	0.9552	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0414	15937	10853	463000	141678	8797	2692	8797	2692
4	0.1923	77469	70110	500273	281153	38021	21368	38021	21368
5	0.3178	71815	83377	292738	256145	72892	63780	72892	63780
6	0.4218	11751	16909	37558	46272	20920	25773	20920	25773
7	0.4681	12689	22485	37161	60014	29989	48432	29989	48432
8	0.3676	4003	8238	14272	28814	13258	26769	13258	26769
9	0.3194	2251	5159	9034	21961	8826	21456	8826	21456
10	0.4969	3233	7957	9035	25514	8972	25336	8972	25336
11	0.4969	2243	6508	6269	20087	6263	20067	6263	20067
Total		201391	231596	1369339	881640	207937	255672	207937	255672

Year:	2010	F multiplie	0.9552	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0414	7401	5040	215000	65790	4085	1250	4085	1250
4	0.1923	49068	44406	316862	178077	24082	13534	24082	13534
5	0.3178	78272	90874	319058	279175	79445	69515	79445	69515
6	0.4218	53261	76643	170235	209730	94821	116820	94821	116820
7	0.4681	6826	12096	19991	32285	16133	26054	16133	26054
8	0.3676	5343	10997	19051	38463	17698	35732	17698	35732
9	0.3194	2016	4620	8091	19668	7905	19216	7905	19216
10	0.4969	1923	4733	5374	15176	5336	15070	5336	15070
11	0.4969	2728	7914	7623	24426	7616	24401	7616	24401
Total		206837	257321	1081285	862791	257120	321592	257120	321592

Table 4.24 R
Prediction single option table for period 2007-2010

MFDP version 1a
Run: res
Time and date: 14:12 26.04.2007
Fbar age range: 4-7

Year:	2007	F multiplie	1	Fbar:	0.3056				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0357	18203	12487	611000	179634	8554	2515	8554	2515
4	0.1627	12790	11613	96287	54306	7703	4344	7703	4344
5	0.2713	25264	29458	118073	102842	32352	28179	32352	28179
6	0.3728	15468	22336	54714	67079	30968	37967	30968	37967
7	0.4155	10572	18766	34074	52576	28758	44374	28758	44374
8	0.3417	8379	17245	31761	61013	29982	57596	29982	57596
9	0.2982	4069	9310	17325	40523	17082	39956	17082	39956
10	0.474	1225	2999	3551	9684	3537	9645	3537	9645
11	0.474	1356	3867	3932	13109	3928	13096	3928	13096
Total		97326	128080	970717	580766	162865	237672	162865	237672

Year:	2008	F multiplie	1.1454	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0409	22399	15366	658000	201348	12502	3826	12502	3826
4	0.1864	63293	57470	420606	236381	31966	17965	31966	17965
5	0.3107	15222	17748	63240	55335	15747	13778	15747	13778
6	0.427	22741	32838	71959	88654	40081	49380	40081	49380
7	0.4759	10584	18786	30594	49410	24690	39874	24690	39874
8	0.3914	5440	11196	18413	37175	17105	34536	17105	34536
9	0.3416	4873	11149	18477	44918	18052	43885	18052	43885
10	0.5429	4033	9878	10527	29728	10453	29520	10453	29520
11	0.5429	1461	4167	3814	12220	3810	12207	3810	12207
Total		150046	178598	1295631	755169	174407	244971	174407	244971

Year:	2009	F multiplie	1.1454	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0409	14536	9971	427000	130662	8113	2483	8113	2483
4	0.1864	67809	61571	450615	253246	34247	19247	34247	19247
5	0.3107	64937	75717	269789	236065	67177	58780	67177	58780
6	0.427	11709	16908	37051	45646	20637	25425	20637	25425
7	0.4759	13185	23404	38115	61555	30758	49675	30758	49675
8	0.3914	4598	9463	15563	31422	14458	29191	14458	29191
9	0.3416	2688	6150	10192	24778	9958	24208	9958	24208
10	0.5429	4119	10088	10751	30360	10676	30148	10676	30148
11	0.5429	2614	7455	6822	21859	6815	21837	6815	21837
Total		186195	220726	1265898	835594	202840	260993	202840	260993

Year:	2010	F multiplie	1.1454	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jar	SSB(Jan)	SSNos(ST	SSB(ST)
3	0.0409	7183	4927	211000	64566	4009	1227	4009	1227
4	0.1864	44004	39955	292421	164340	22224	12490	22224	12490
5	0.3107	69570	81119	289038	252908	71970	62974	71970	62974
6	0.427	49952	72130	158063	194734	88041	108467	88041	108467
7	0.4759	6789	12050	19625	31694	15837	25577	15837	25577
8	0.3914	5729	11789	19389	39146	18012	36366	18012	36366
9	0.3416	2272	5199	8615	20943	8417	20462	8417	20462
10	0.5429	2272	5565	5930	16747	5889	16630	5889	16630
11	0.5429	3203	9135	8360	26785	8352	26758	8352	26758
Total		190973	241869	1012440	811863	242751	310951	242751	310951

Table 4.25 N Yield per recruit. Input data and results

MFYPR version 2a
Run: res
NEA Haddock
Time and date: 10:54 27.04.2007
Fbar age range: 4-7

Age	M	Mat	PF	PM	SWt	Sel	CWt
3	0.3379	0.014	0	0	0.294	0.0433	0.681
4	0.2575	0.08	0	0	0.564	0.2013	0.905
5	0.2243	0.274	0	0	0.871	0.332733	1.161
6	0.2088	0.566	0	0	1.226	0.441567	1.439
7	0.2	0.844	0	0	1.543	0.490067	1.772
8	0.2	0.944	0	0	1.927	0.384833	2.058
9	0.2	0.986	0	0	2.339	0.3344	2.292
10	0.2	0.996	0	0	2.727	0.5202	2.461
11	0.2	0.999	0	0	3.334	0.5202	2.901

Weights in kilograms

MFYPR version 2a
Run: res
Time and date: 10:54 27.04.2007
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJ	SSBJan	SpwnNosS	SSBSpwn
0	0	0	0	4.6776	6.8829	2.3667	5.5093	2.3667	5.5093
0.1	0.0366	0.1091	0.2024	4.1419	5.375	1.863	4.0402	1.863	4.0402
0.2	0.0733	0.1842	0.3212	3.7762	4.4041	1.5274	3.105	1.5274	3.105
0.3	0.1099	0.2396	0.3959	3.5079	3.7325	1.2874	2.4663	1.2874	2.4663
0.4	0.1466	0.2827	0.4452	3.3012	3.2438	1.1074	2.0083	1.1074	2.0083
0.5	0.1832	0.3175	0.479	3.1361	2.8747	0.9676	1.6678	0.9676	1.6678
0.6	0.2199	0.3462	0.5028	3.0006	2.5875	0.8561	1.4074	0.8561	1.4074
0.7	0.2565	0.3706	0.5201	2.887	2.3588	0.7653	1.2037	0.7653	1.2037
0.8	0.2931	0.3915	0.5328	2.7902	2.1731	0.6902	1.0415	0.6902	1.0415
0.9	0.3298	0.4097	0.5424	2.7064	2.0197	0.6271	0.9103	0.6271	0.9103
1	0.3664	0.4259	0.5498	2.6331	1.8912	0.5736	0.8028	0.5736	0.8028
1.1	0.4031	0.4403	0.5554	2.5683	1.7822	0.5277	0.7136	0.5277	0.7136
1.2	0.4397	0.4532	0.5599	2.5106	1.6888	0.488	0.6388	0.488	0.6388
1.3	0.4763	0.4649	0.5634	2.4586	1.6078	0.4533	0.5756	0.4533	0.5756
1.4	0.513	0.4757	0.5663	2.4116	1.5371	0.4229	0.5217	0.4229	0.5217
1.5	0.5496	0.4855	0.5686	2.3688	1.4748	0.3961	0.4754	0.3961	0.4754
1.6	0.5863	0.4946	0.5705	2.3296	1.4195	0.3722	0.4353	0.3722	0.4353
1.7	0.6229	0.503	0.572	2.2936	1.3701	0.3509	0.4004	0.3509	0.4004
1.8	0.6596	0.5109	0.5733	2.2603	1.3257	0.3318	0.3699	0.3318	0.3699
1.9	0.6962	0.5182	0.5744	2.2293	1.2855	0.3145	0.343	0.3145	0.343
2	0.7328	0.5251	0.5754	2.2005	1.249	0.2989	0.3192	0.2989	0.3192

Reference	F multiplier	Absolute F
Fbar(4-7)	1	0.3664
FMax	>=1000000	
F0.1	0.5138	0.1883
F35%SPR	0.4211	0.1543

Weights in kilograms

Table 4.25 R Yield per recruit. Input data and results

MFYPR version 2a
Run: res
NEA Haddock
Time and date: 10:46 27.04.2007
Fbar age range: 4-7

Age	M	Mat	PF	PM	SWt	Sel	CWt
3	0.3377	0.014	0	0	0.294	0.0357	0.686
4	0.2577	0.08	0	0	0.564	0.162733	0.908
5	0.2239	0.274	0	0	0.871	0.2713	1.166
6	0.2085	0.566	0	0	1.226	0.372833	1.444
7	0.2	0.844	0	0	1.543	0.415467	1.775
8	0.2	0.944	0	0	1.921	0.341667	2.058
9	0.2	0.986	0	0	2.339	0.298233	2.228
10	0.2	0.996	0	0	2.727	0.473967	2.449
11	0.2	0.999	0	0	3.334	0.473967	2.852

Weights in kilograms

MFYPR version 2a
Run: res
Time and date: 10:46 27.04.2007
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJ	SSBJan	SpwnNosS	SSBSpwn
0	0	0	0	4.6793	6.8851	2.3682	5.5113	2.3682	5.5113
0.1	0.0306	0.0966	0.1823	4.2045	5.5351	1.9197	4.1935	1.9197	4.1935
0.2	0.0611	0.1651	0.2953	3.8699	4.631	1.6101	3.3193	1.6101	3.3193
0.3	0.0917	0.2168	0.3696	3.6187	3.9866	1.3827	2.7028	1.3827	2.7028
0.4	0.1222	0.2577	0.4206	3.4217	3.5061	1.2083	2.2486	1.2083	2.2486
0.5	0.1528	0.2911	0.4569	3.262	3.1355	1.0702	1.9027	1.0702	1.9027
0.6	0.1834	0.319	0.4834	3.1294	2.842	0.9583	1.6326	0.9583	1.6326
0.7	0.2139	0.3428	0.5032	3.017	2.6046	0.8657	1.4172	0.8657	1.4172
0.8	0.2445	0.3635	0.5183	2.9204	2.409	0.788	1.2426	0.788	1.2426
0.9	0.275	0.3816	0.53	2.8361	2.2455	0.722	1.099	0.722	1.099
1	0.3056	0.3977	0.5391	2.7618	2.1071	0.6652	0.9794	0.6652	0.9794
1.1	0.3361	0.4122	0.5464	2.6957	1.9885	0.6159	0.8788	0.6159	0.8788
1.2	0.3667	0.4252	0.5522	2.6365	1.8859	0.5728	0.7934	0.5728	0.7934
1.3	0.3973	0.4371	0.5569	2.5829	1.7964	0.5349	0.7202	0.5349	0.7202
1.4	0.4278	0.448	0.5608	2.5343	1.7176	0.5012	0.6571	0.5012	0.6571
1.5	0.4584	0.458	0.564	2.4898	1.6479	0.4713	0.6023	0.4713	0.6023
1.6	0.4889	0.4672	0.5667	2.4489	1.5857	0.4444	0.5544	0.4444	0.5544
1.7	0.5195	0.4759	0.5689	2.4112	1.5299	0.4203	0.5124	0.4203	0.5124
1.8	0.5501	0.4839	0.5708	2.3763	1.4795	0.3985	0.4752	0.3985	0.4752
1.9	0.5806	0.4914	0.5724	2.3438	1.4339	0.3787	0.4422	0.3787	0.4422
2	0.6112	0.4985	0.5738	2.3135	1.3923	0.3606	0.4128	0.3606	0.4128

Reference	F multiplie	Absolute F
Fbar(4-7)	1	0.3056
FMax	>=1000000	
F0.1	0.5892	0.1801
F35%SPR	0.4915	0.1502

Weights in kilograms

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

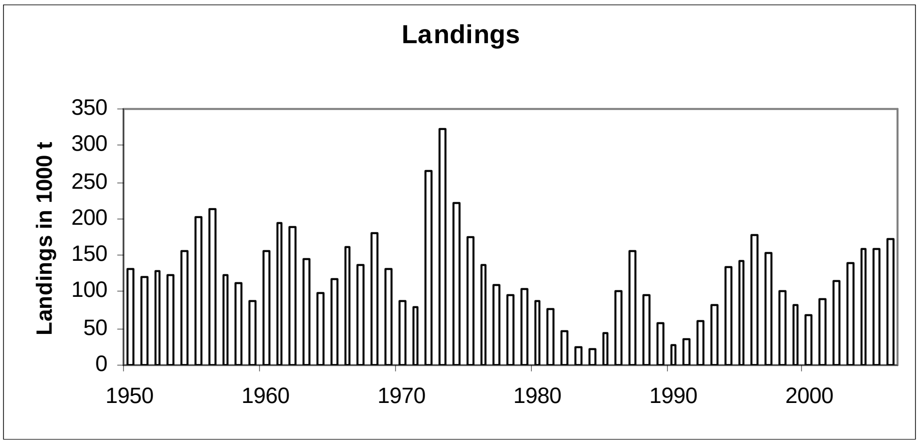


Figure 4.1 A Landings of Northeast Arctic Haddock

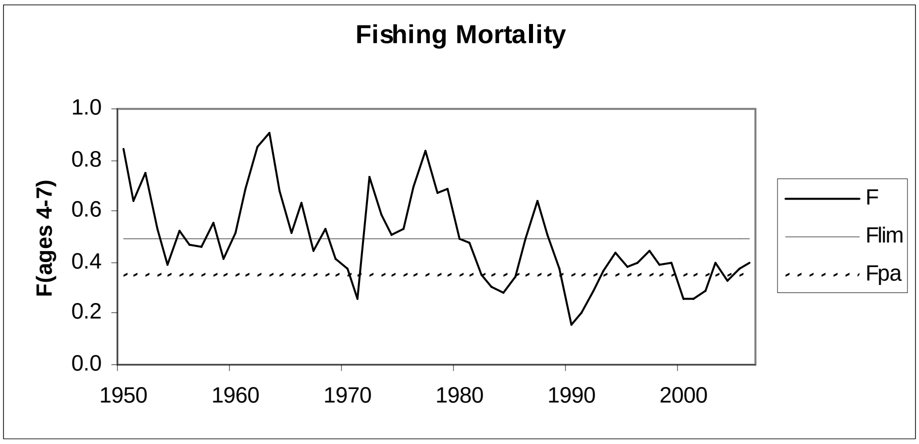


Figure 4.1 B Fishing mortality of Northeast Arctic Haddock

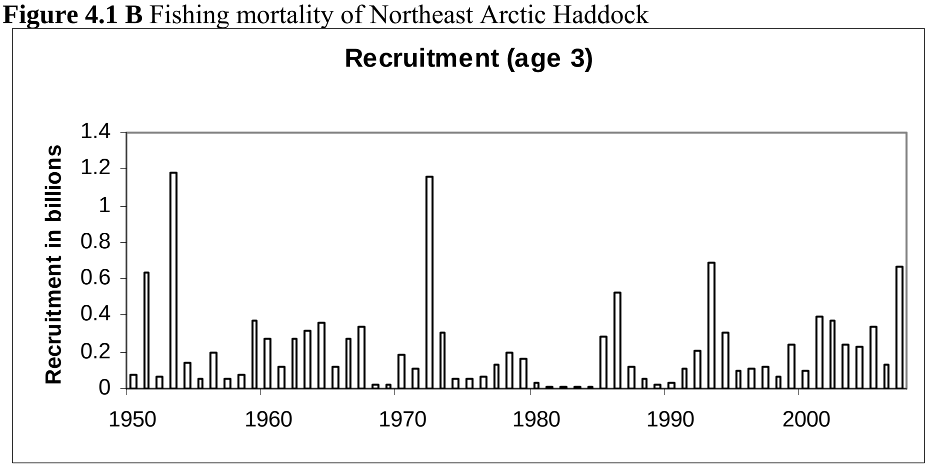


Figure 4.1C Recruitment of Northeast Arctic Haddock

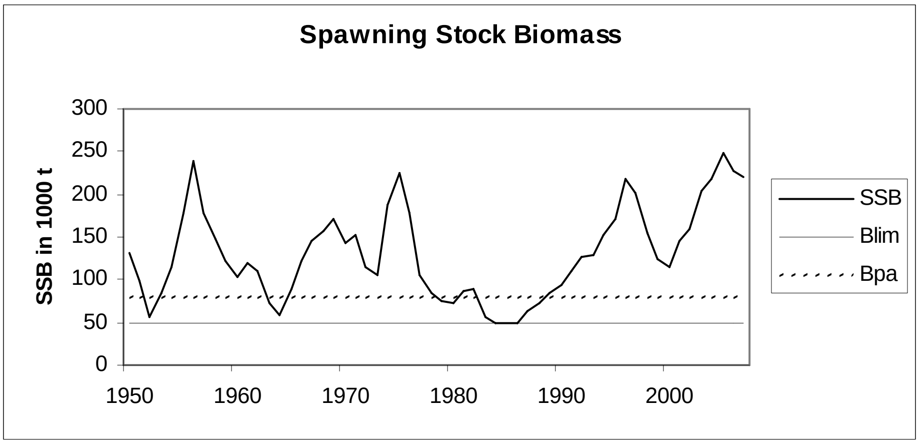


Figure 4.1D Spawning stock biomass of Northeast Arctic haddock

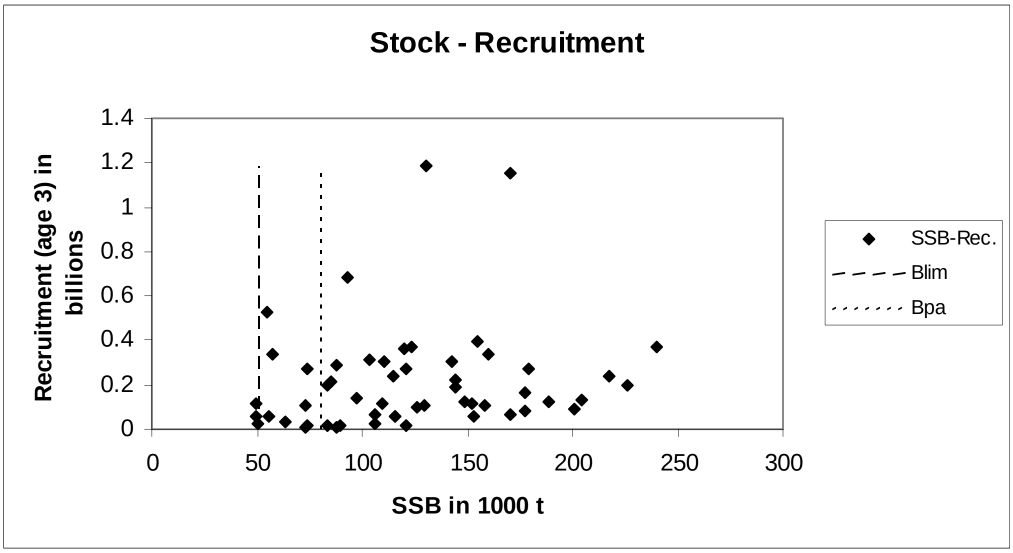


Figure 4.2 Northeast Arctic haddock

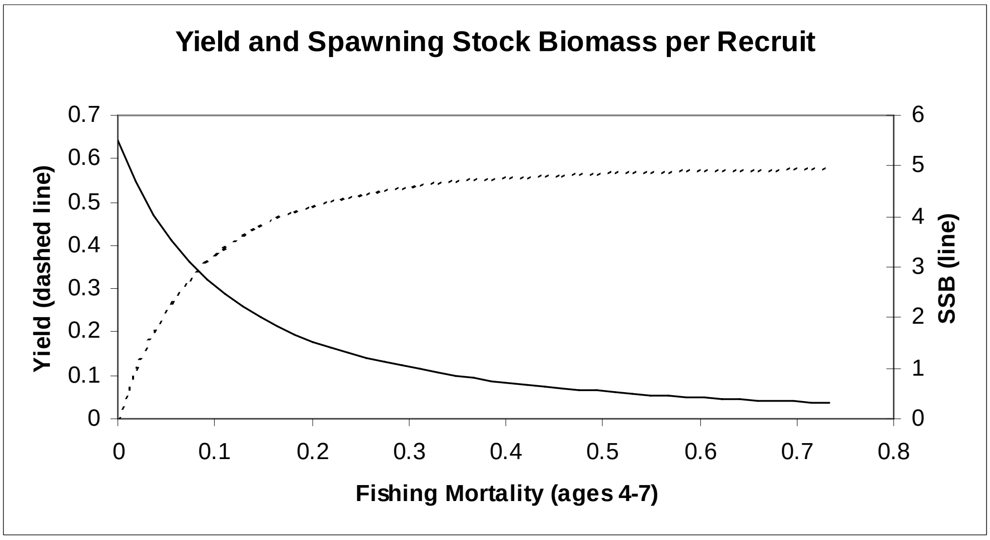


Figure 4.3 Northeast Arctic haddock

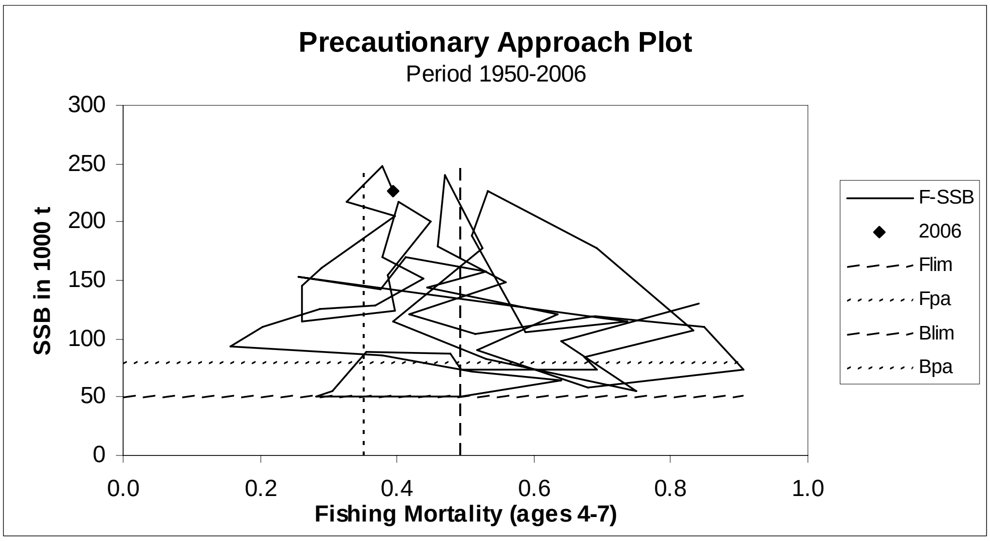


Figure 4.4 Northeast Arctic haddock

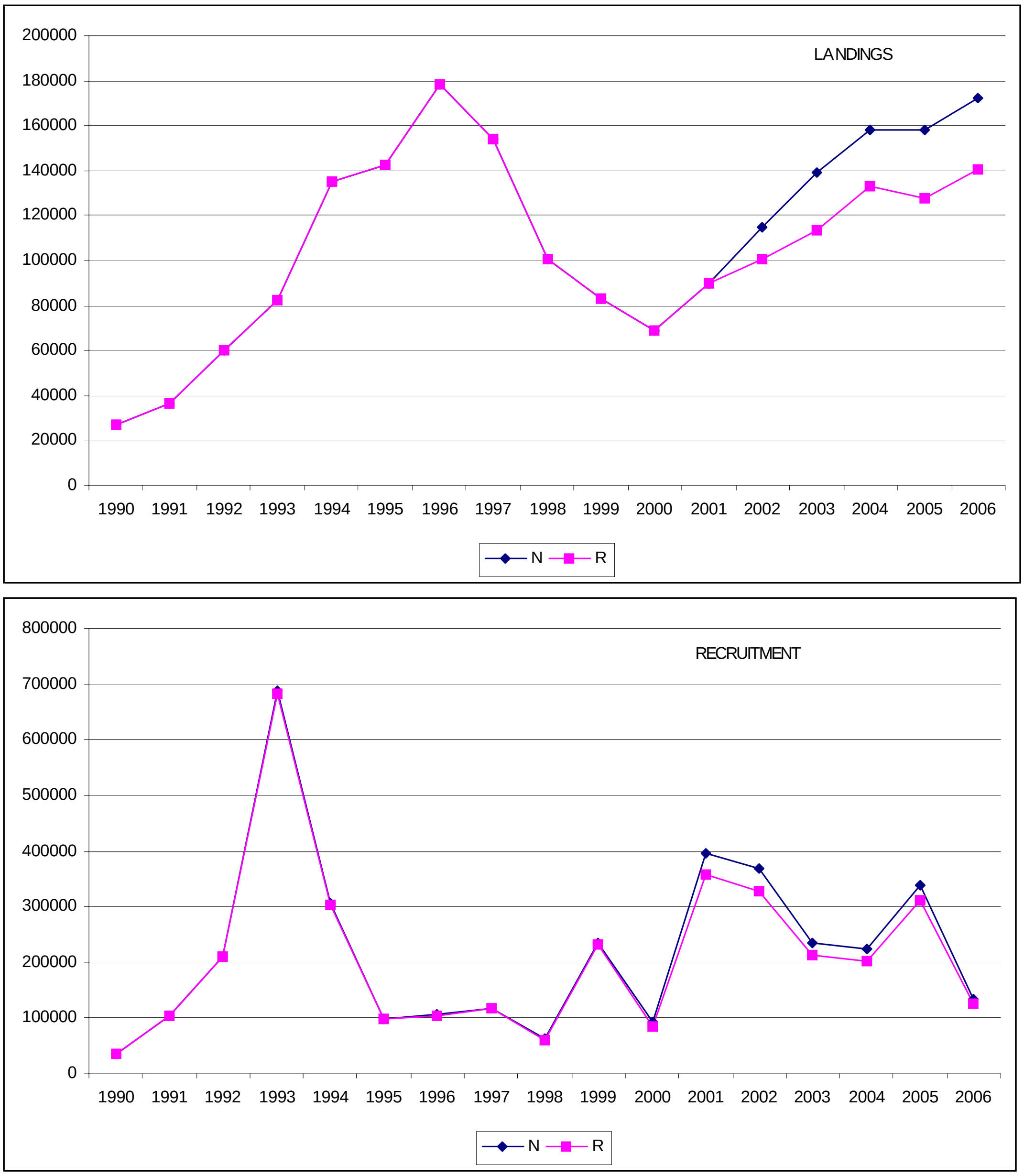


Figure 4.5A NEA haddock. Dynamics of landings and recruitment in two runs corresponding to different estimated levels of IUU catches of haddock and consumptions of haddock by cod (N - estimates of IUU catches of cod and haddock based on report from Norway, R - based on report from Russia).

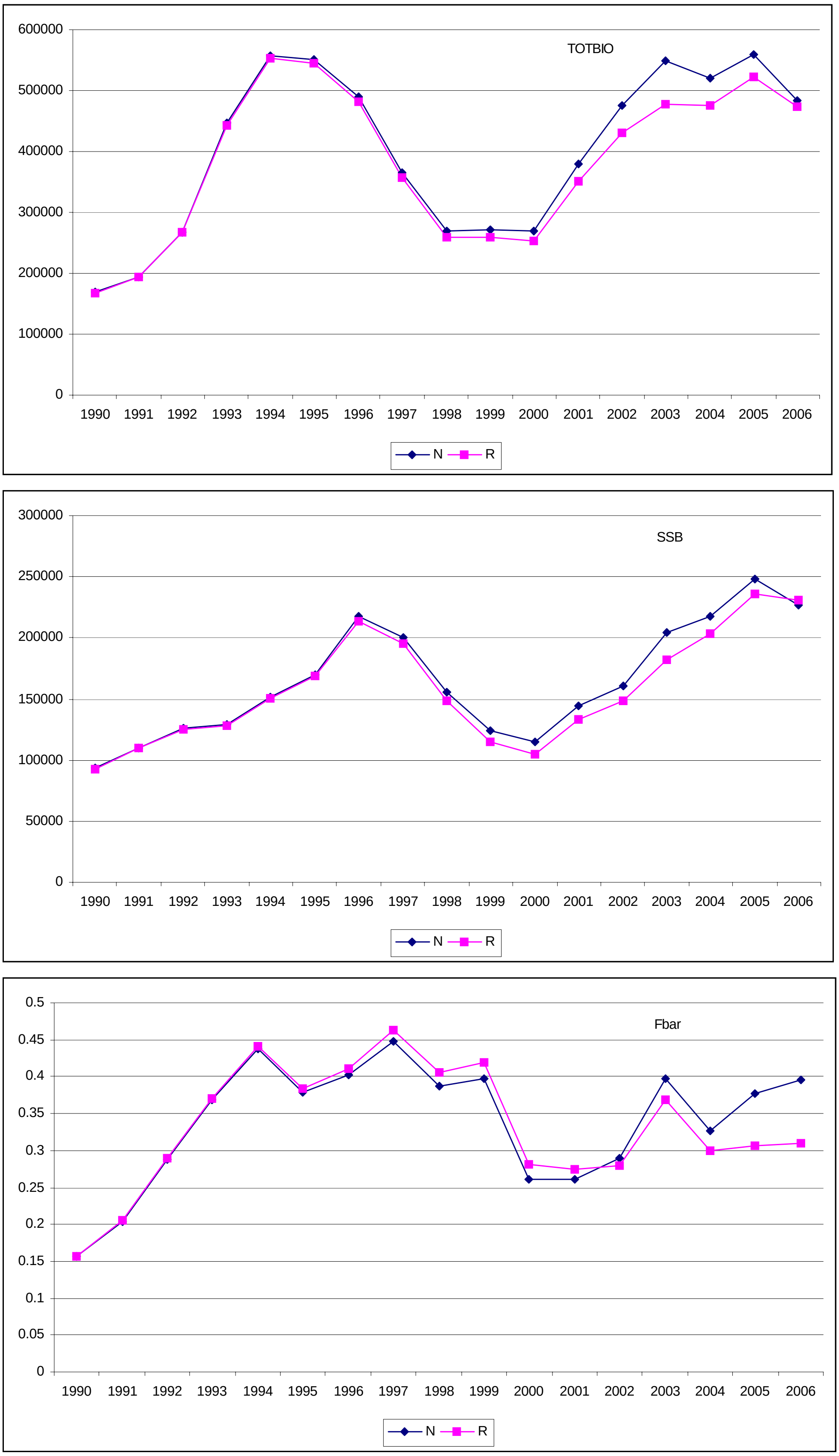


Figure 4.5B NEA haddock. Dynamics of total and spawning stock biomass and F_{bar} in two runs corresponding to different estimated levels of IUU catches of haddock and consumptions of haddock by cod (N - estimates of IUU catches of cod and haddock based on report from Norway, R - based on report from Russia).

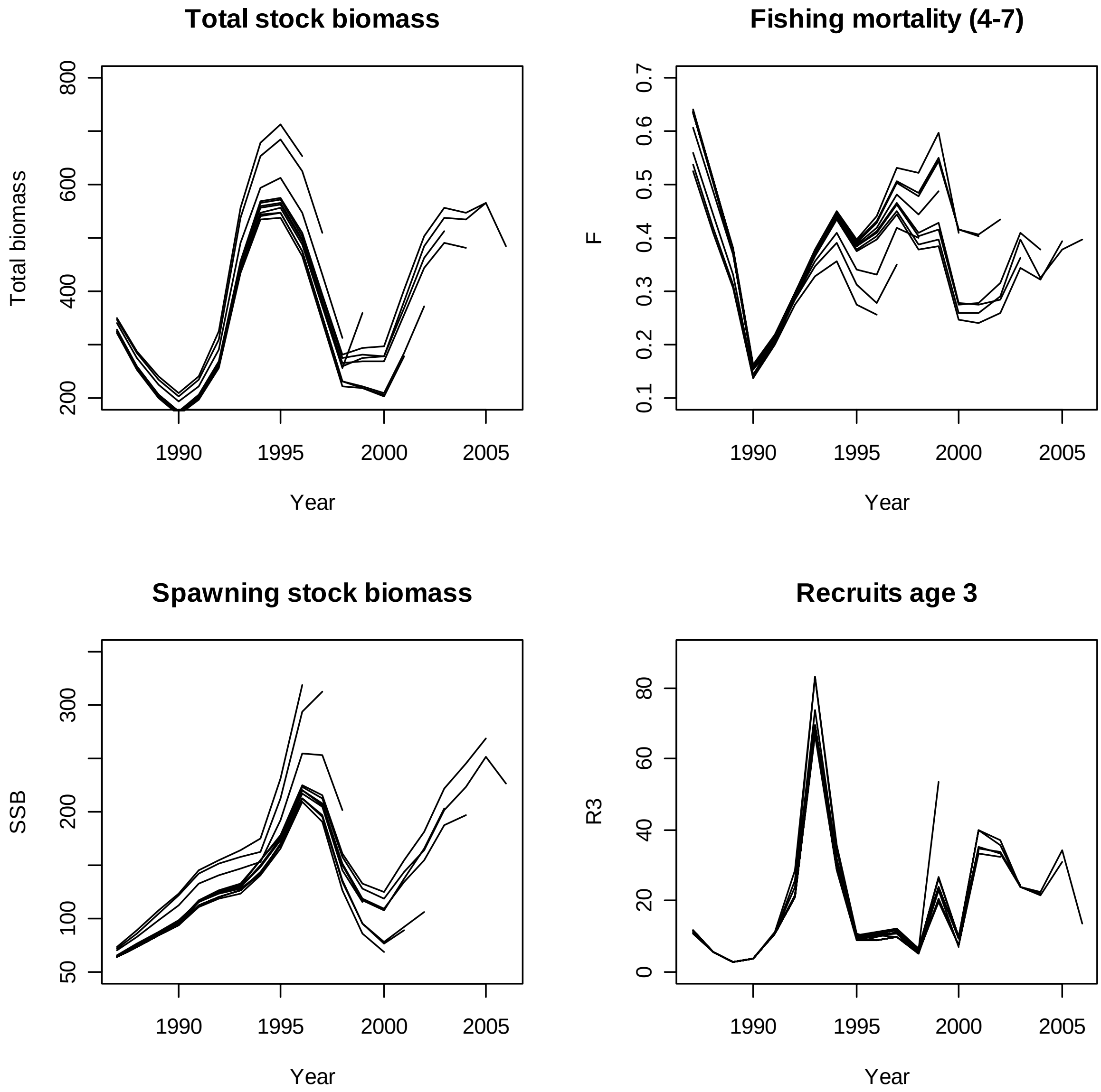


Figure 4.6N. Retrospective plots for assessment years 1997-2007 with the Norwegian IUU estimates using standard settings in the XSA runs and keeping weight, maturity and natural mortality as estimated in 2007 for all runs.

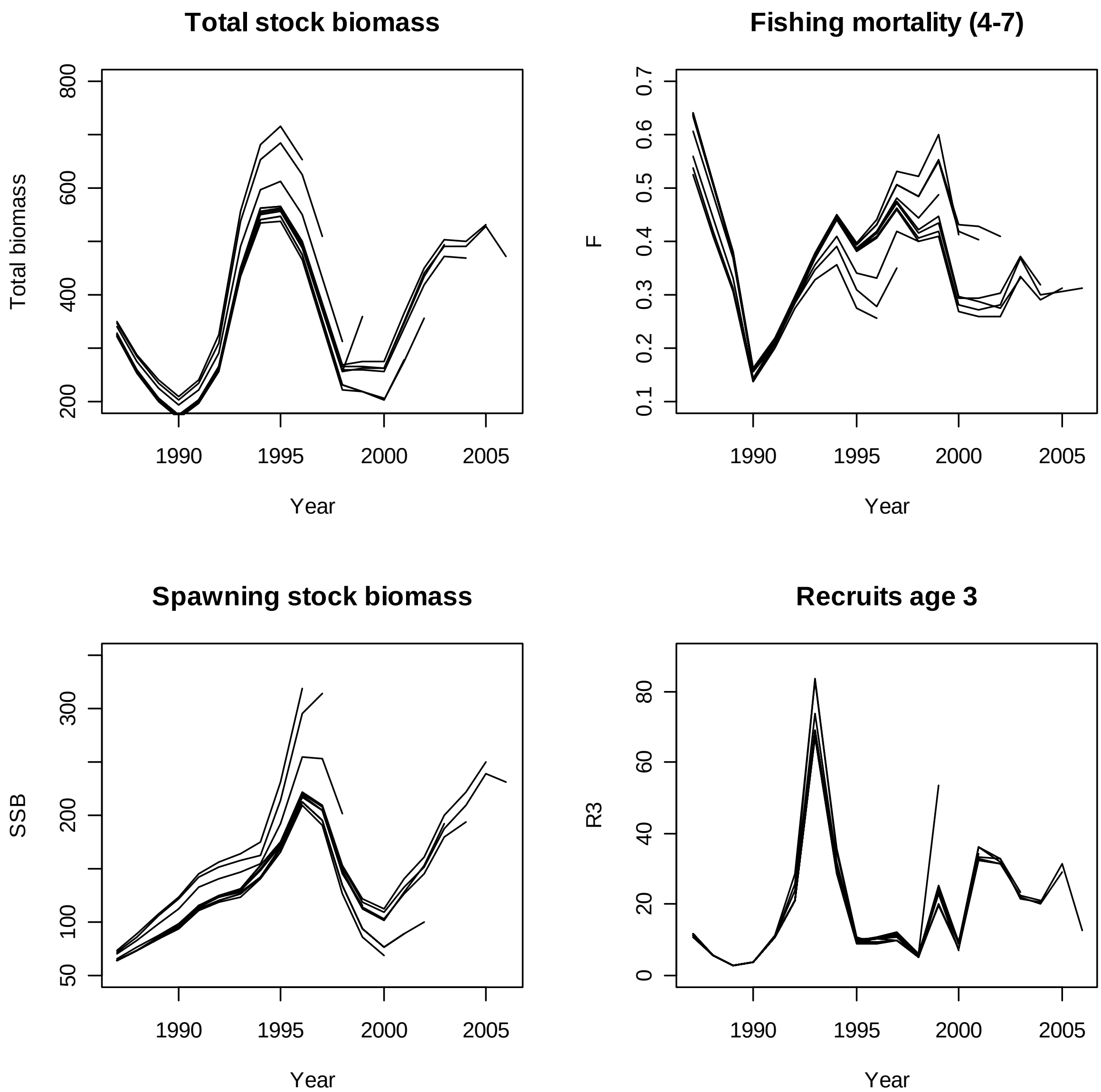


Figure 4.6R. Retrospective plots for assessment years 1997-2007 with the Russian IUU estimates using standard settings in the XSA runs and keeping weight, maturity and natural mortality as estimated in 2007 for all runs.

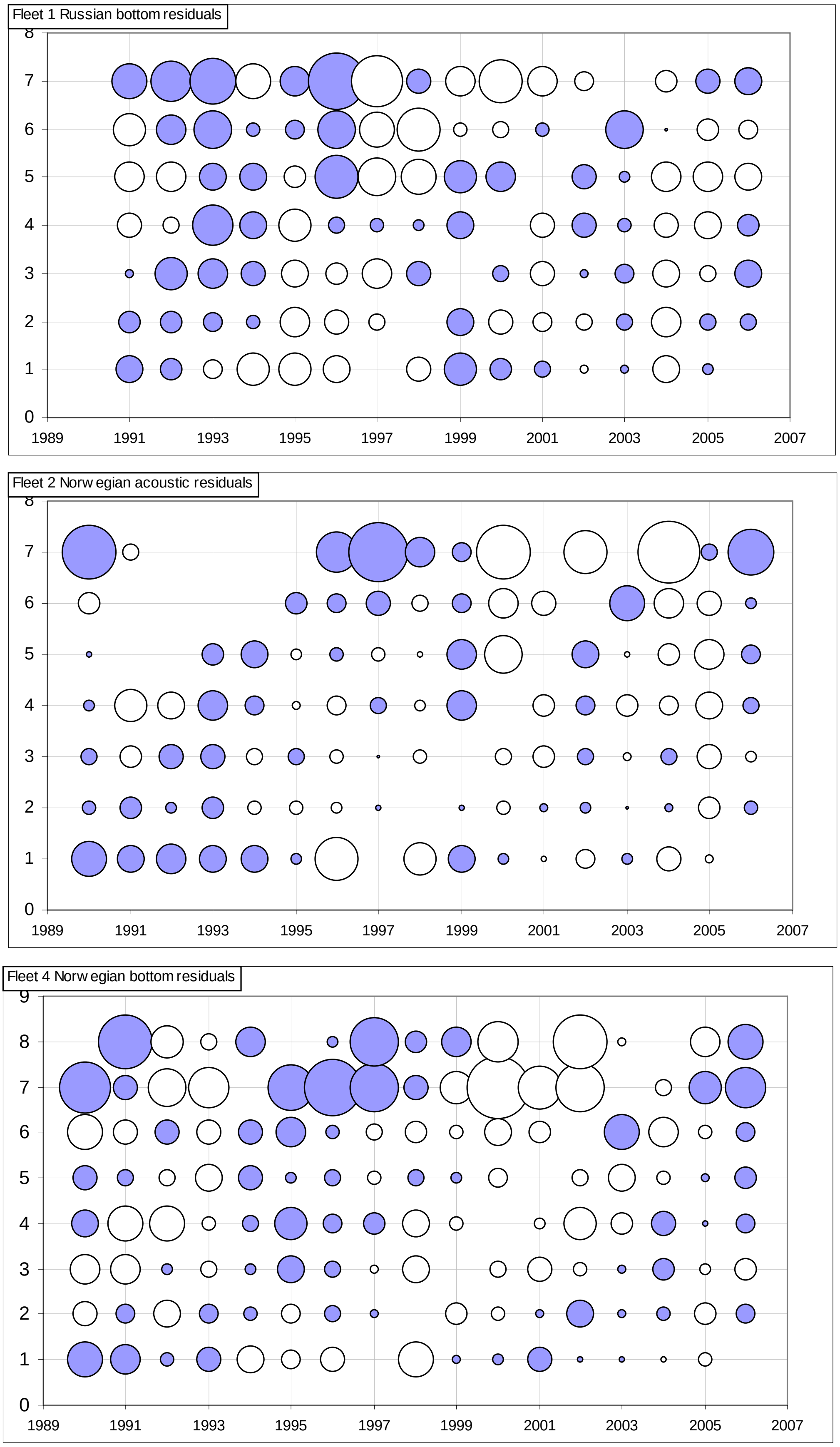


Figure 4.7N. NEA Haddock, Log catchability residuals plot, fleets combined, with shrinkage 0.5

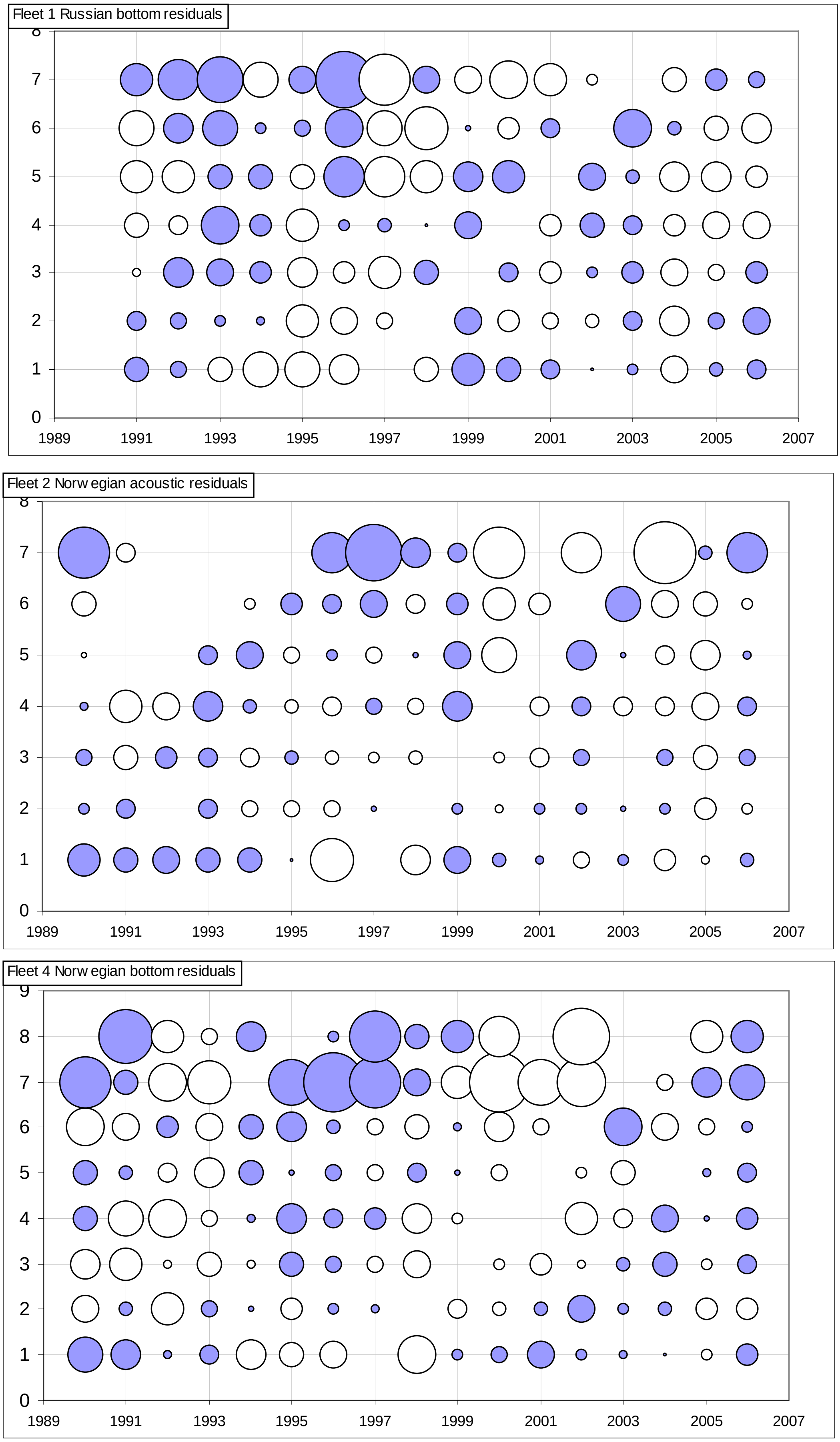


Figure 4.7R. NEA Haddock, Log catchability residuals plot, fleets combined, with shrinkage 0.5

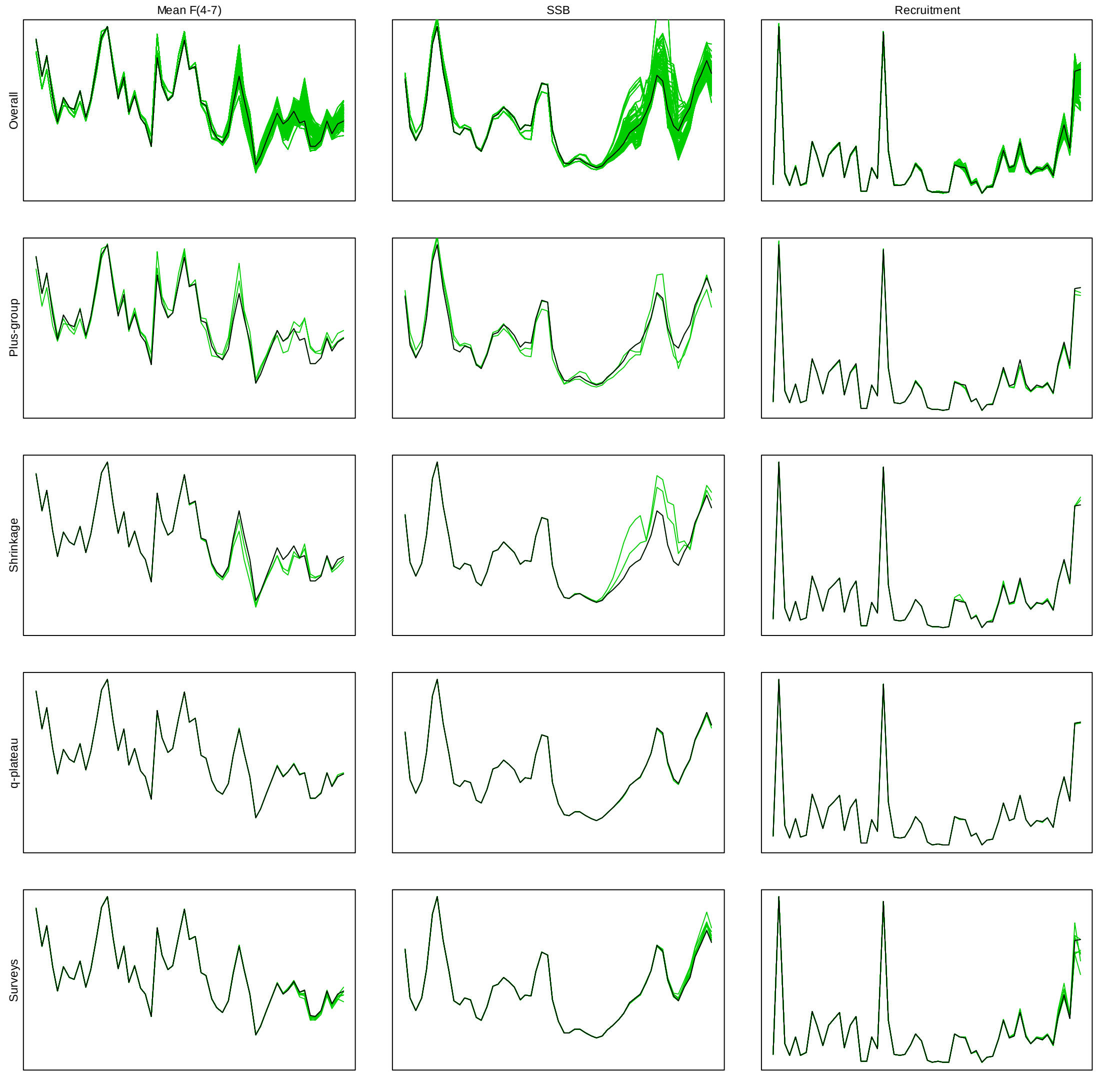
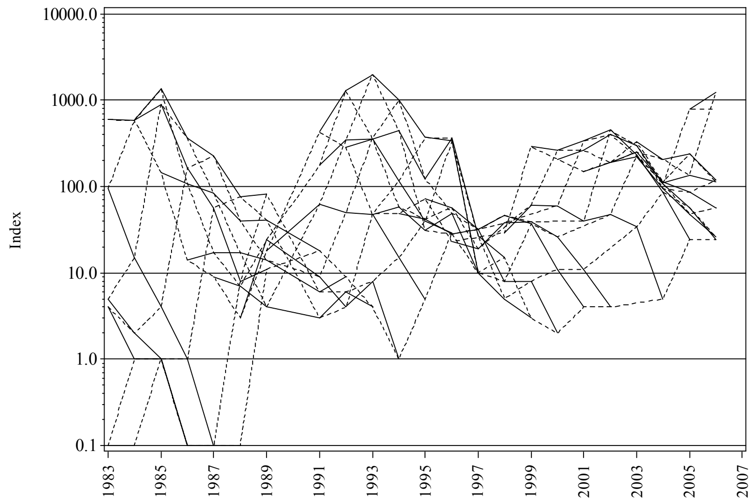
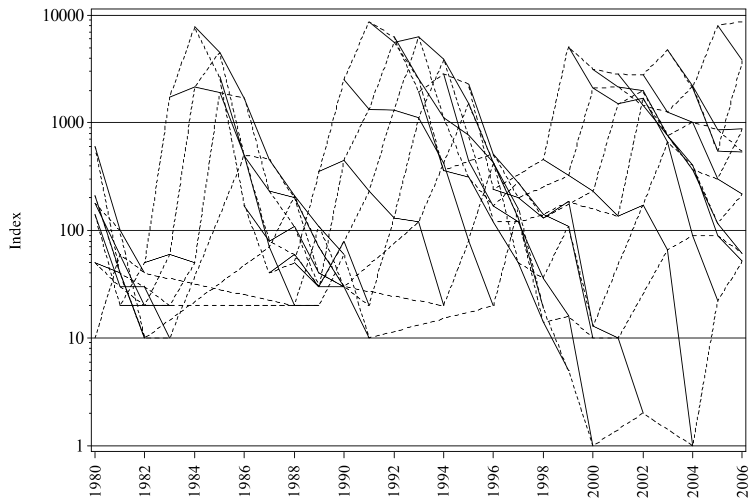


Figure 4.8. NEA haddock. Time-series plots showing the effect on the assessment of varying user-defined XSA run settings. The black line shows the baseline assessment from AFWG.

Tuning fleet: FLT01: Russian BT



Tuning fleet: FLT02: Norwegian acoustic



Tuning fleet: FLT04: Norwegian BT

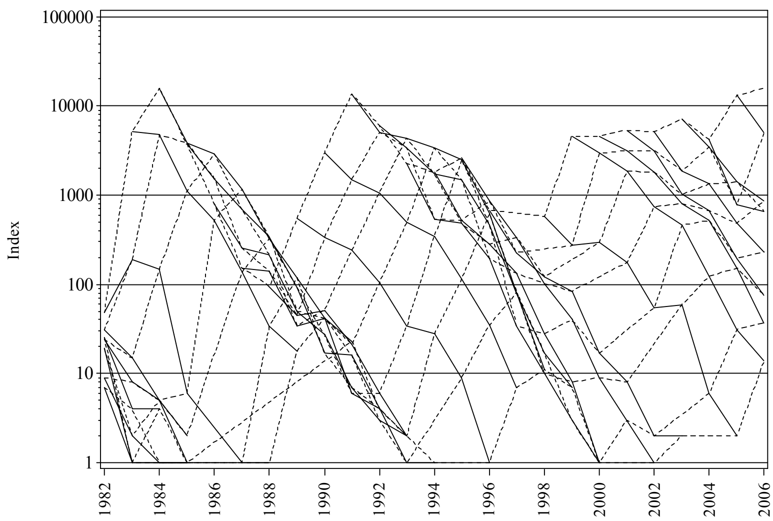


Figure 4.9 NEA haddock. Surface of survey indices for all observed ages used for tuning the XSA.

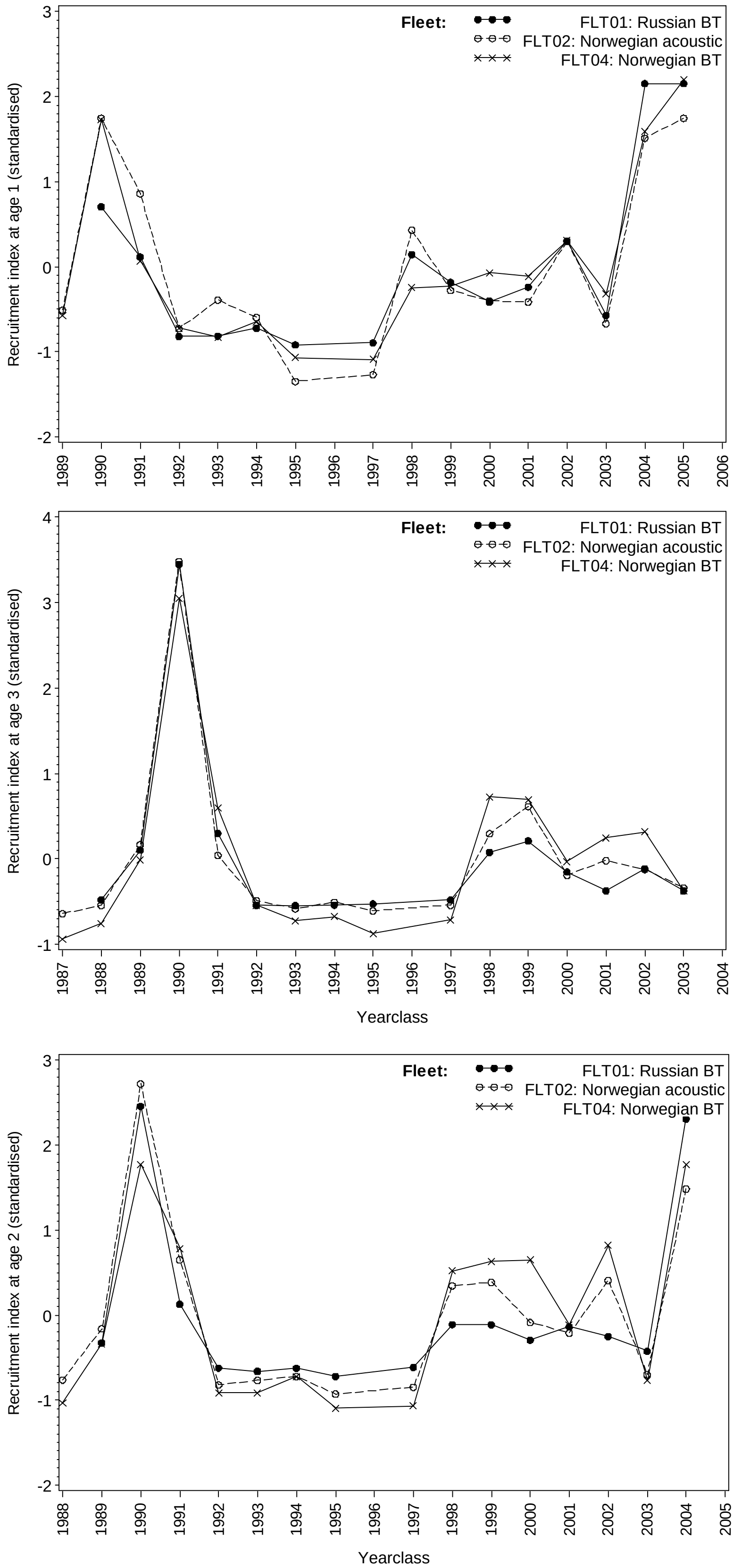


Figure 4.10 NEA haddock. Survey indices for age 1-3 used for tuning the XSA.

Tuning fleet: All fleets

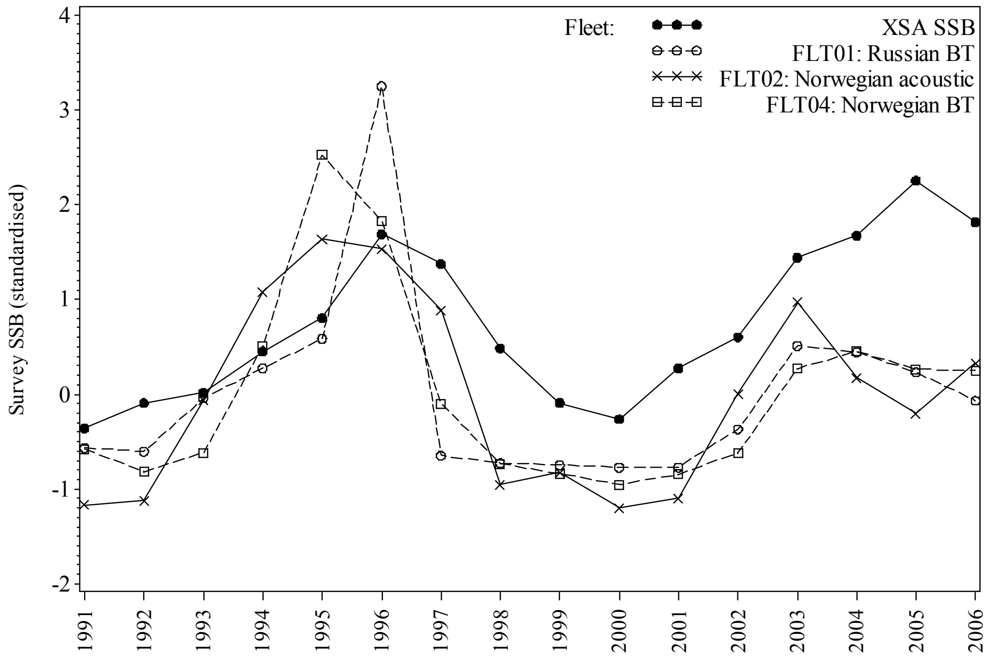


Figure 4.11 NEA haddock. Comparing survey SSB trends with SSB estimates from the XSA

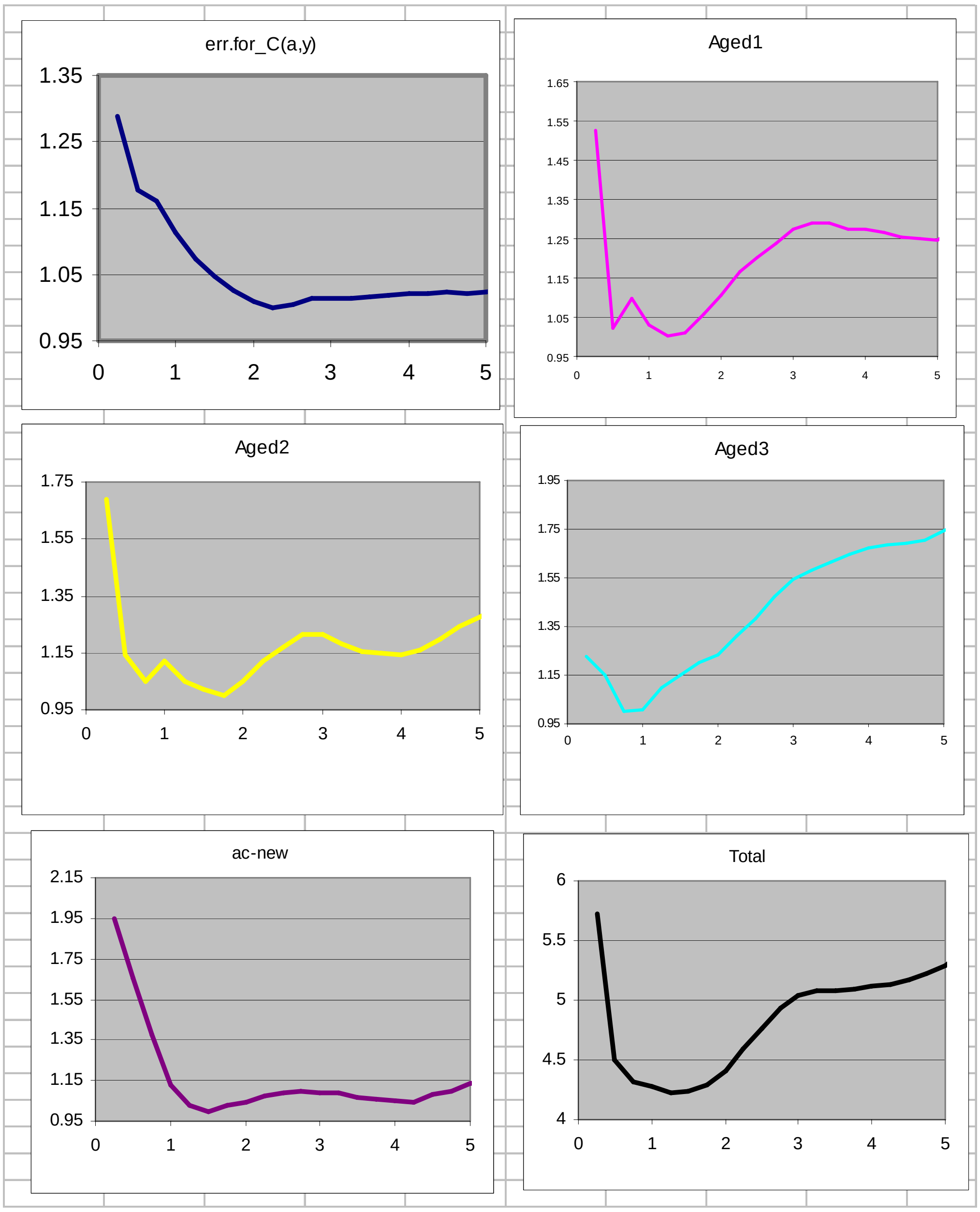


Figure 4.12. Profiles of loss function (LF) components for 4 indices, variant IUU-R. For each survey, LF component was set as median of distribution of squared logarithmic residuals (MDN)

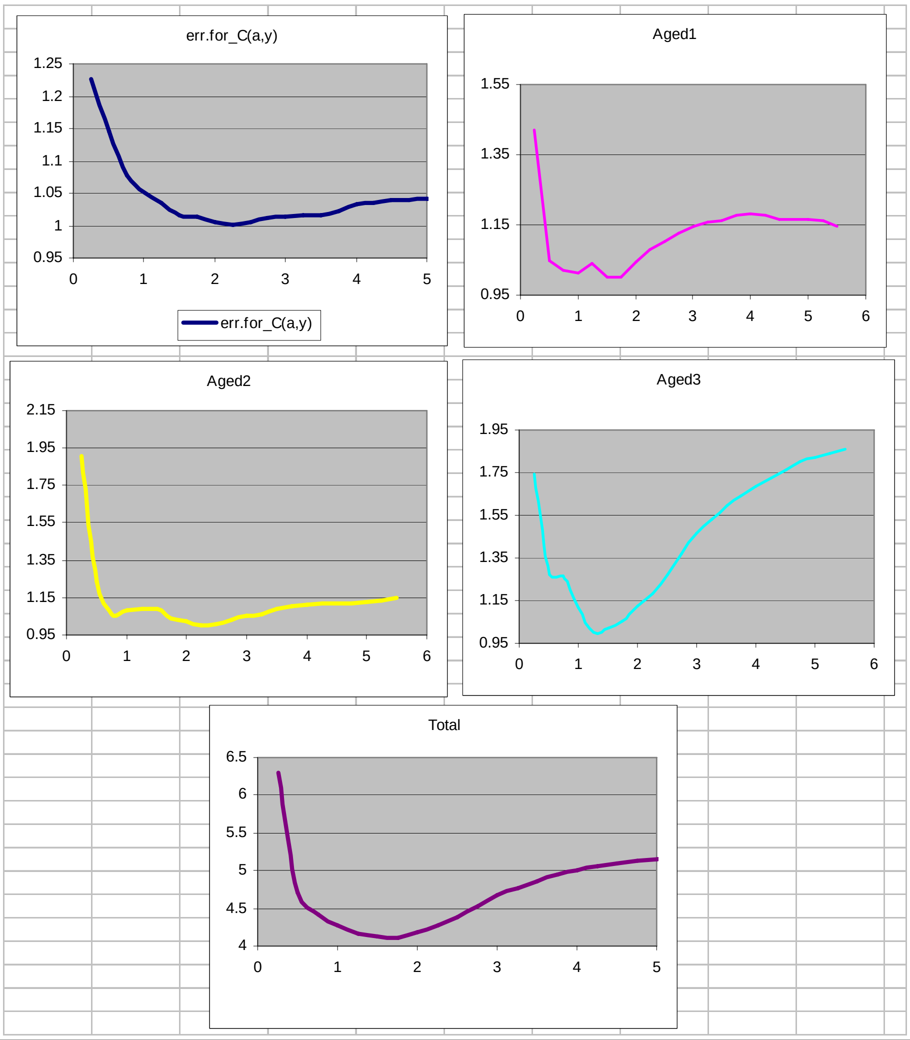


Figure 4.13. Profiles of LF components for 3 indices, run variant IUU-N. For each survey LF component was set as median of distribution of squared logarithmic residuals (MDN)

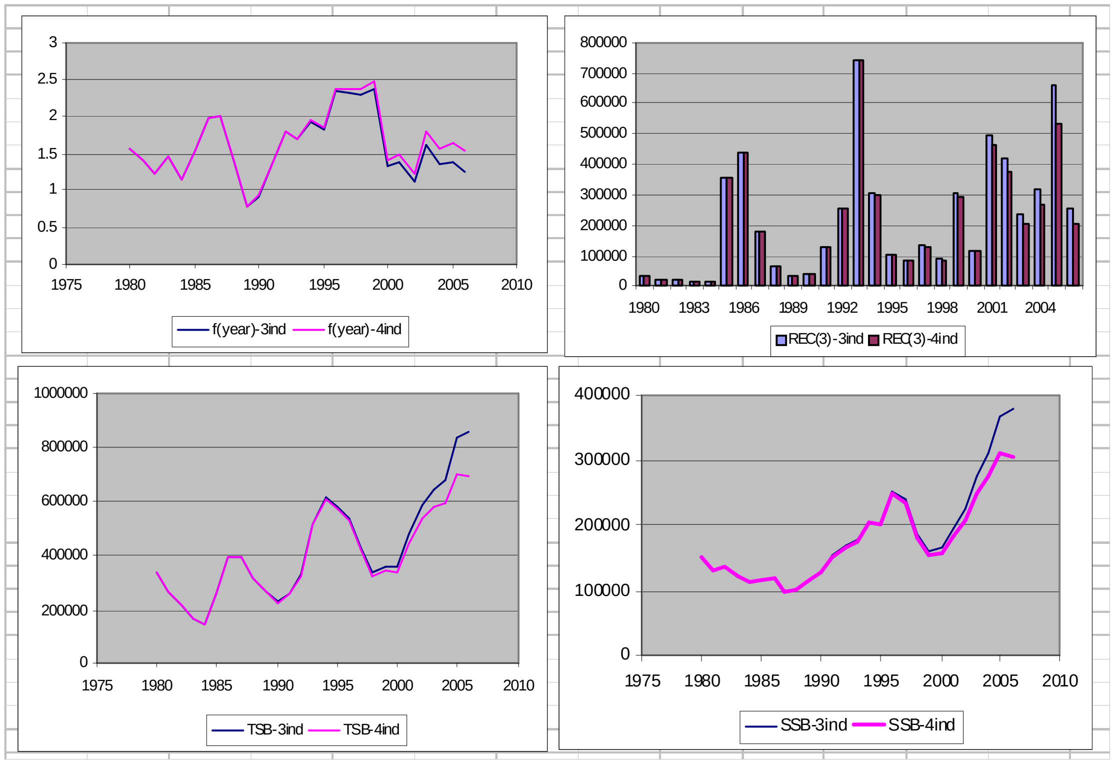
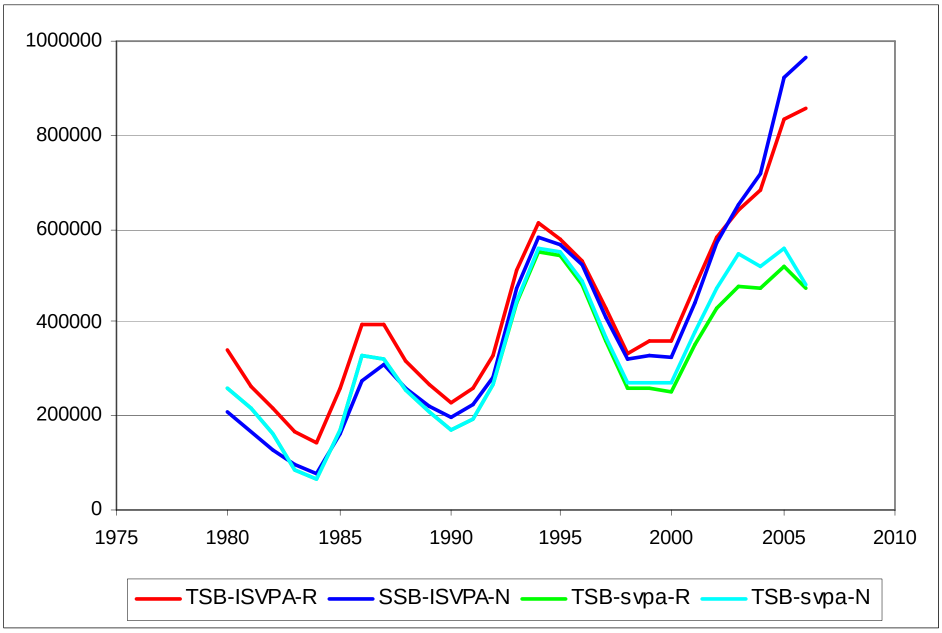


Figure 4.14. Comparison of results of two ISVPA runs with IUU-R: with 3 or 4 survey indices included in the model tuning.



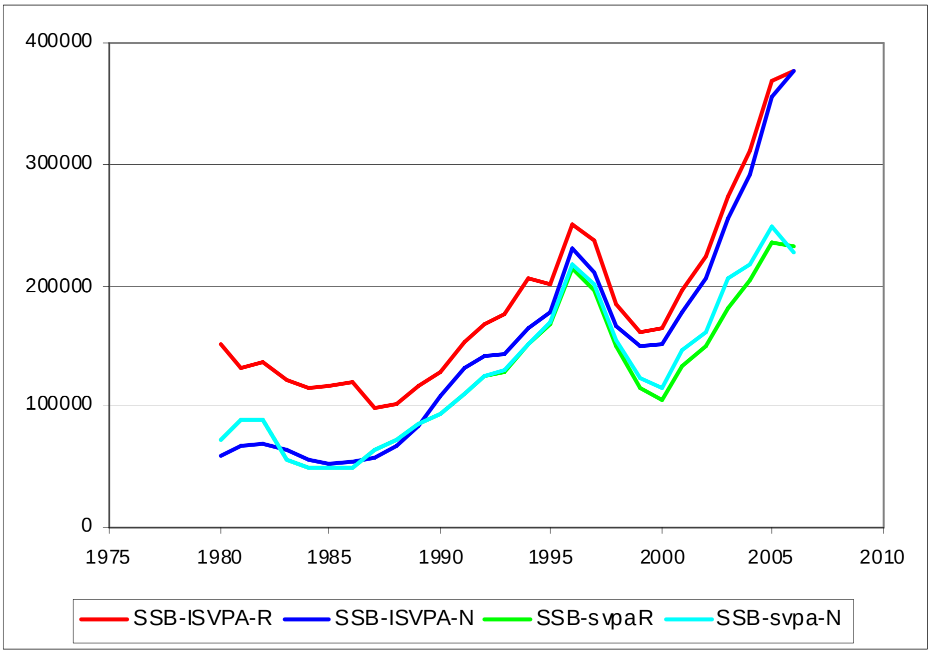
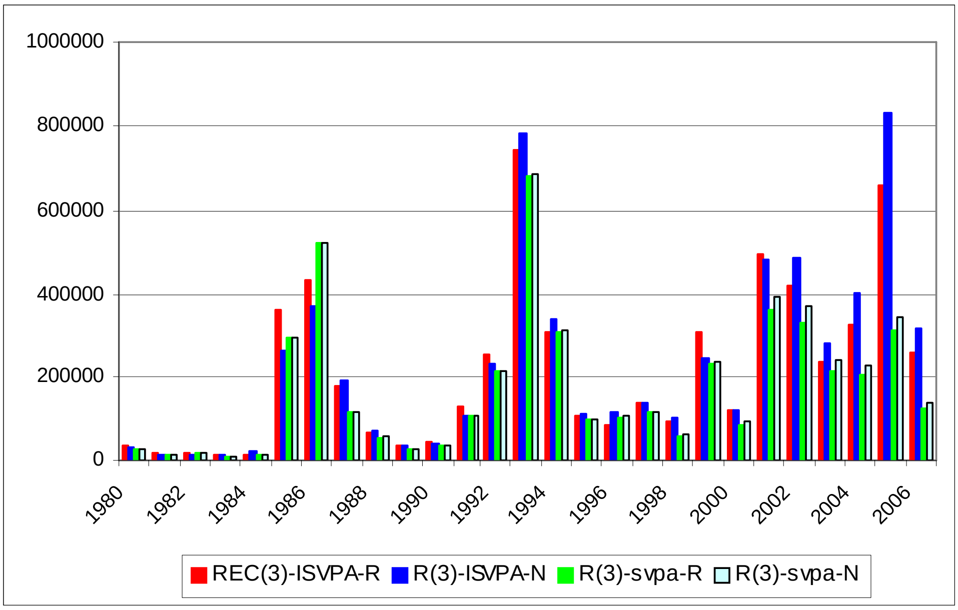


Figure 4.15a. Comparison of two models results (ISVPA and XSA(SVPA)) for haddock with two variants of estimation (IUU-R and IUU-N). Tuning was carried out on 3 stock indices.

Total stock biomass and spawning stock biomass dynamics.



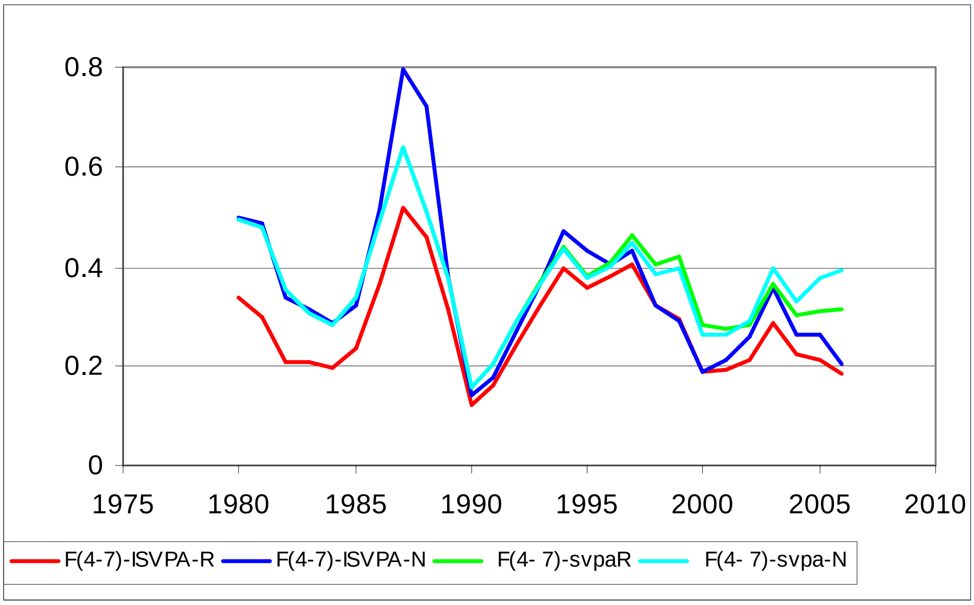


Figure 4.15b. Comparison of two models results (ISVPA and XSA(SVPA)) for haddock with two variants of IUU estimation. Tuning was carried out on 3 stock indices. Recruitment at age 3 dynamics and Fbar(4-7) by year

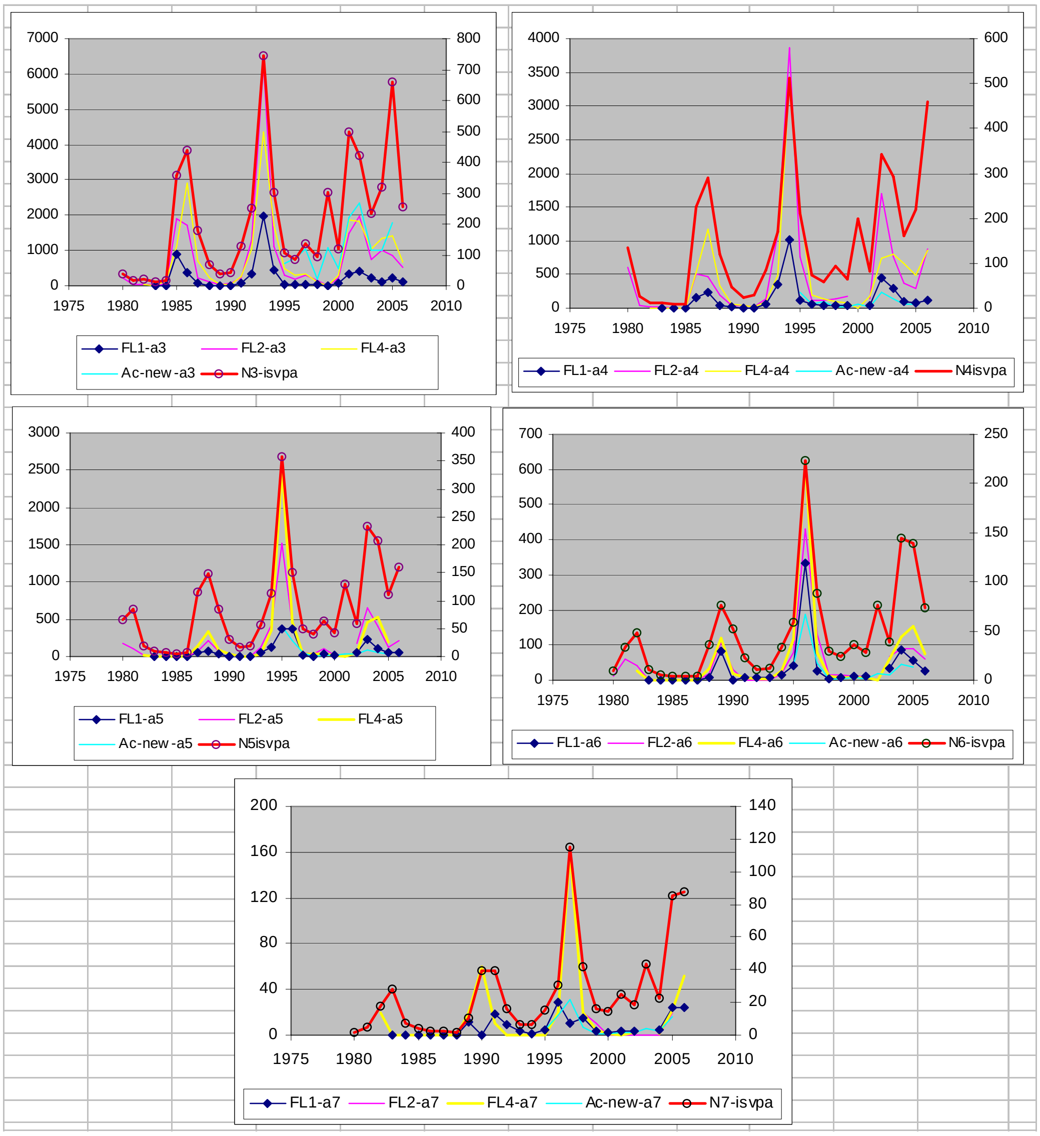


Figure 4.16. Diagnostics of ISVPA tuning on 4 indices for IUU-R variant. For each age Index dynamics was compared with abundance variations by year according the model

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	-	-	2935.6
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	0.0	-	-	-	0.3	741.5
1988	35.4	15.3	25.3	68.9	116.4	13.8	0.1	-	-	-	275.2
1989	81.2	9.5	14.1	21.6	34.0	32.7	3.4	0.1	-	-	196.6
1990	644.1	54.6	4.5	3.4	5.0	9.2	11.8	1.8	-	-	734.4
1991	2006.0	300.3	33.4	5.1	4.2	2.7	1.7	4.2	-	-	2357.6
1992	1659.4	1375.5	150.5	24.4	2.1	0.6	0.7	1.6	2.3	-	3217.1
1993	727.9	599.0	507.7	105.6	10.5	0.6	0.4	0.3	0.4	1.1	1953.5
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	-	0.1	-	2244.5
1996	309.5	263.6	52.5	48.1	148.6	252.8	11.6	0.9	-	0.1	1087.7
1997[1]	1268.0	67.9	86.1	28.0	19.4	46.7	62.2	3.5	0.1	-	1581.9
1998[1]	212.9	137.9	22.7	33.2	13.2	3.4	8.0	8.1	0.7	0.1	440.2
1999	1244.9	57.6	59.8	12.2	10.2	2.8	1.0	1.7	1.1	-	1391.3
2000	847.2	452.2	27.2	35.4	8.4	4.0	0.8	0.3	0.7	0.2	1376.4
2001	1220.5	460.3	296.0	29.3	25.1	1.7	0.9	0.1	0.1	0.3	2034.3
2002	1680.3	534.7	314.7	185.3	17.6	8.2	0.8	0.3	+	0.3	2742.2
2003	3332.1	513.1	317.4	182	73.6	5.5	2.3	0.2	0.1	0.2	4426.5
2004	715.9	711.2	188.1	102.7	80.4	46.2	5.9	1.1	0.2	0.1	1852
2005	4630.2	420.4	346.5	133.3	66.8	52.2	12.3	0.6	0.2	0	5662.4
2006	5141.3	1313.1	77.4	140.5	48.2	19.6	15.2	3.1	0.1	0.3	6758.8
2007[1]	3874.4	1593.8	507.7	66	86	23.3	7.5	3.7	1.4	0.2	6164

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

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

Year	Age											Total
	0	1	2	3	4	5	6	7	8	9	Older	
						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
2001	30.5	18.6	42.3	58.9	5.8	6.8	0.8	0.5	0.1	0.1		164.5
2002	39.7	29.2	29.4	69.2	74.7	6.7	3.2	0.6	0.1	0.2		252.7
2003	28.1	38.9	35.4	28.1	43	28	3.5	0.8	0.1	0.1		206.0
2004	47.9	12	27.9	18.6	12.8	16.1	12.4	0.8	0.3	0.1		148.9
2005	62.7	109.6	20.7	34.4	12.4	6.5	7.1	2.5	0.1	0.1		256.1
2006[3]	48.0	168.7	157.9	15.2	25.5	7.3	3.1	2.7	0.8	0.2		429.4
						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
2001	39.0	13.5	7.6	8.4	2.2	7.9	1.4	0.3	0.1	0.4		80.8
2002[2]	61.9	16.6	5.3	10.2	29.9	6.0	3.3	0.3	0.1	0.2		133.7
2003	20.6	30.8	9.8	8.3	10.4	16.1	2.4	2.1	0.2	+		100.7
2004	100.2	32.8	18.1	4.5	5.5	7.2	8.1	0.7	1.1	0.3		178.4
2005	61.6	23.9	4.6	10.9	2.1	2.7	5.3	2.9	0.5	0.2		114.6
2006	33.3	36.9	15.2	1.9	8.2	3.4	2.5	1.8	1.8	0.3		105.5

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
2001	2.7	13.1	15.9	11.4	0.8	4.7	1.2	0.4	0.1	0.6		51.0
2002	9.0	4.2	7.7	5.1	2.6	0.7	0.8	0.1	0.1	0.1		26.8
2003	3.6	21.5	10.4	15.5	11.3	15.9	3.6	3	0.4	0.3		85.7
2004	34.9	5.6	6.4	1.3	2.6	1.8	2.9	0.1	0.2	0.1		56
2005	60.9	43.5	4.1	10.3	4.1	2.7	3.6	2.2	0.1	0.3		131.7
2006	75.4	110.6	71.6	4.6	6.1	2.4	1.4	2	1.8	0.3		276.2
						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
2001	20.8	14.9	26.1	33.4	4.0	6.5	1.1	0.4	0.1	0.3		107.5
2002[2]	33.2	19.3	18.9	39.9	45	4.7	2.4	0.4	0.1	0.2		164.0
2003	19.8	32.8	25.1	22.1	29.9	23.1	3.4	1.6	0.2	0.1		158.3
2004	50.0	11.0	20.6	11.3	9.4	10.7	8.7	0.5	0.4	0.2		122.8
2005	62	79.2	13.6	24	8.6	4.8	5.7	2.4	0.1	0.2		200.7
2006[3]	53.4	79.2	122.7	11.3	11.9	5.7	2.6	2.4	1.1	0.2		290.5

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

2) Adjusted data based on 2001 distribution.

3) Adjusted data based on 2004-2006 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	0	5	2	3	1	1	4	2	+	+	18
1984	1 685	173	6	2	1	+	+	+	+	+	1 867
1985	1 530	776	215	5	+	+	+	+	+	+	2 526
1986	556	266	452	189	+	+	+	+	+	+	1 463
1987	85	17	49	171	50	+	+	+	-	+	372
1988	18	4	8	23	46	7	+	-	-	+	106
1989	52	5	6	11	20	21	2	-	-	-	117
1990	270	35	3	3	4	7	11	2	+	+	335
1991	1 890	252	45	8	3	3	3	6	+	-	2 210
1992	1 135	868	134	23	2	+	+	1	2	+	2 165
1993	947	626	563	130	13	+	+	+	+	3	2 282
1994	562	193	255	631	111	12	+	+	+	+	1 764
1995	1 379	285	36	111	387	42	2	+	+	+	2 242
1996	249	229	44	31	76	151	8	+	-	+	788
1997[1]	693	24	51	17	12	43	43	2	+	+	885
1998[1]	220	122	20	28	12	5	13	16	1	+	437
1999	856	46	57	13	14	4	1	2	2	+	994
2000	1 024	509	32	65	19	11	2	1	2	+	1 664
2001	976	316	210	23	22	1	1	+	+	1	1 549
2002	2 062	282	216	149	14	12	1	+	+	1	2 737
2003	2394	279	145	198	169	17	5	+	+	1	3208
2004	752	474	127	76	76	66	7	2	+	+	1580
2005	3364	209	219	102	36	40	9	+	+	0	3979
2006	2767	804	54	86	30	12	9	2	+	+	3764
2007[1]	3197	868	379	54	88	22	6	5	2	0	4621

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

Table B4a. North-East Arctic HADDOCK. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent waters in late autumn 1985-2001 (old method). Index of number of fish at age.

	Age										
Year	0	1	2	3	4	5	6	7	8	9+	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	5	1 595
1994[1]	118	51	39	252	591	76	9	+	1	4	1 141
1995[1]	38	40	18	18	77	225	23	3	1	1	443
1996[1,4]	281	44	148	93	69	280	242	19	3	2	1 181
1997[1,4]	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	4	949
2001[1]	256	122	200	229	24	45	7	3	1	2	888
2002[1,5,6]	868	811	581	447	237	329	49	20	12	10	3364
2003[6]	352	310	189	124	161	124	19	9	1	1	1290
2004	3164	472	421	176	143	154	151	10	21	5	4722
2005	7156	2521	271	476	172	114	154	79	5	7	10956
2006[7]	-	-	-	-	-	-	-	-	-	-	-

[1] October-December
[2] September-October
[3] November-January
[4] Adjusted data based on average 1985-1995 distribution
[5] Adjusted data based on 2001 distribution
[6] Adjusted data in 2004
[6] No data

Table B4b. North-East Arctic HADDOCK. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent waters in late autumn 1996-2006 (new method). Index of number of fish at age.

	Age											
Year	0	1	2	3	4	5	6	7	8	9	10+	Total
1995[5]	163	170	79	72	230	404	41	5	1	1	2	1 168
1996[1,3]	992	245	291	91	63	206	187	17	1	+	+	2 092
1997[1,3]	185	104	21	121	94	48	47	31	20	+	+	671
1998[2]	257	44	83	20	20	6	2	7	2	+	+	442
1999[1]	632	499	60	123	14	16	4	1	4	1	+	1 355
2000[1]	524	395	287	54	57	14	6	1	1	1	1	1 340
2001[1]	491	160	227	221	19	35	5	2	1	1	1	1 163
2002[1,4,5]	1045	209	139	268	239	27	17	2	1	+	1	1 947
2003	1168	473	217	116	134	94	14	6	1	+	+	2 223
2004	8529	1141	342	116	54	55	44	3	4	1	1	10289
2005	17782	2903	123	205	62	33	38	16	1	1	+	21165
2006[6]	9396	1286	308	30	31	10		5	5	4	1	11075

[1] October-December
[2] November-January
[3] Adjusted data based on average 1985-1995 distribution
[4] Adjusted data based on 2001 distribution
[5] Adjusted data 2004
[6] Not adjusted data to the whole area

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	16.1	27.7	27.7	35.4	39.7	47.5	50.1			
	1998	14.4	29.2	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	22.2	22.2	32.2	37.8	47.2	51.2	58.7			
	2002	21.1	21.1	29.6	40.2	44.2	50.9	58.4			
	2003	16.5	24.1	28	37.2	46.5	49.6	54.7			
	2004	14.2	22.3	30.6	36.3	43.4	49.8	51.4			
	2005	15.1	20.8	30.0	36.6	41.5	47.9	51.9			
	2006	14.7	22.6	31.3	37.8	43.2	48.0	50.8			
	2007 [1]	15.7	23.2	28.7	37.4	45.5	48.5	53.5			
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
	2001	15.1	22.4	29.8	37.8	48	55.3	58.8	62.1	63.6	65.4
	2002	14.6	23.8	30.1	35.6	48.2	55.1	60.2	60.5	63.3	66.8
	2003	14.0	22.9	28.9	35.3	44.8	52.2	57.5	63.1	66.3	69.6
	2004	14.4	23.1	30.4	37.7	44.2	49.4	56.4	61.6	66.4	69.1
	2005	14.9	23.5	30.0	36.9	44.8	49.9	54.7	59.2	65.9	66.6
	2006 [1]	15.3	24.1	32.6	39.8	46.7	51.8	54.9	59.0	62.4	65.3

[1] Limited area coverage, lengths are not adjusted to account for 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	24	91	273	542	934	-	-
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	35	88	200	429	625	1 063	1 286
1998	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	556	1 100	1 429	2 085
2002	30	84	144	623	848	1 341	2 032
2003	38	127	202	493	981	1189	1613
2004	23	98	266	459	780	1 167	1 328
2005	29	84	253	469	699	1 054	1 378
2006	26	107	303	540	821	1 111	1 332
2007 [1]	32	112	237	539	970	1 195	1 608

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	30	103	209	347	743	1 152	1 650	2 442	3 218	3 333	4 648
1997	22	115	227	447	911	1 216	1 583	1 966	3 155	2 815	3 423
1998	27	94	230	569	1 087	1 482	1 690	1 914	2 539	3 893	3 900
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	-
2001	26	102	244	533	1 097	1 695	2 065	2 469	2 704	2 867	3 141
2002	25	127	280	457	1166	1690	2293	2484	2784	2962	4655
2003	21	104	220	419	855	1 347	1 844	2 402	2 923	2 582	-
2004	24	87	253	518	846	1 130	1 571	1 959	2 633	3 366	-
2005	27	115	259	511	933	1 289	1 670	2 079	2 833	2 965	-
2006 [1]	26	105	269	444	867	1307	1604	1922	2274	2520	-

[1] Limited area coverage, weights are not adjusted to account for limited area coverage.

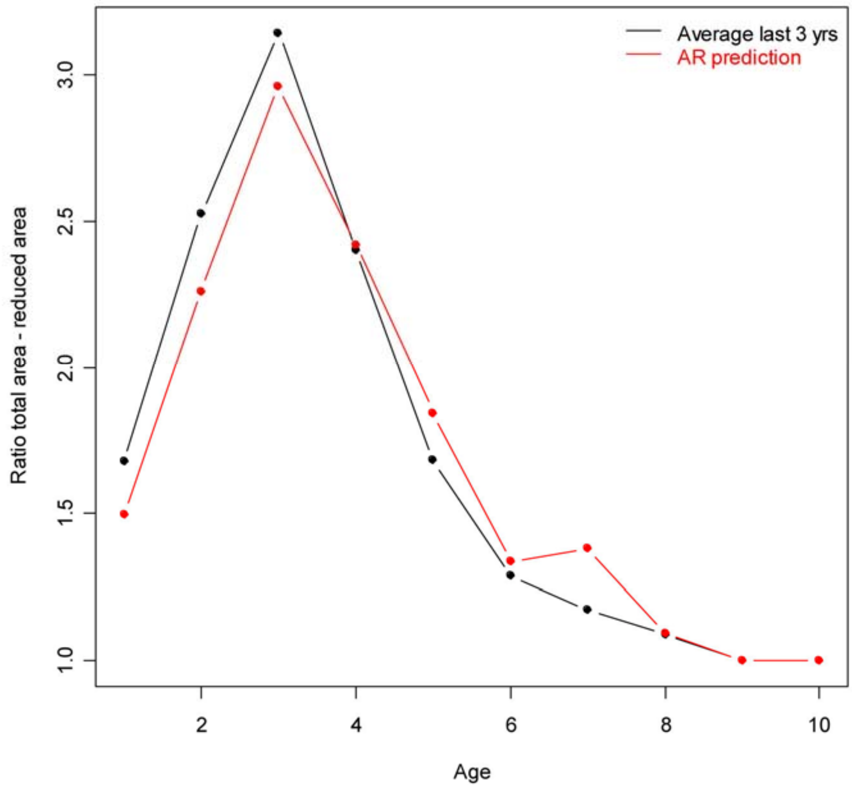


Figure B1. Ratio of abundance at age for haddock from the bottom trawl index from the Joint Barents Sea winter survey for the total area (including the Russian zone) versus the reduced area (excluding the Russian zone) by using the average for the last 3 years with full coverage (2004, 2005 and 2006) (black line), and the predicted ratio by fitting a autoregressive model to the time series of ratios for the period 1993-2006 (red line).

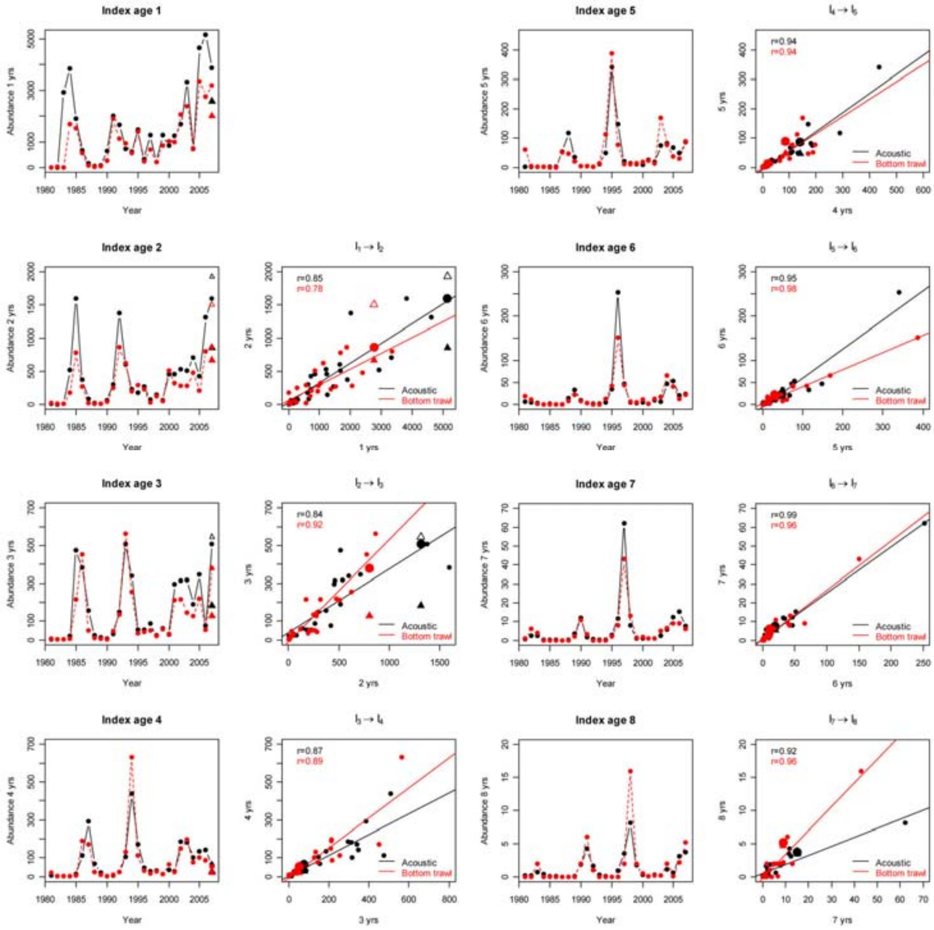


Figure B2. Time series of bottom trawl (black) and acoustic indices (red) from the Joint Barents Sea winter survey (left panels), and relationship between abundance at age *a* in year *t* and abundance at age *a+1* in year *t+1* for ages 1-8 and years 1981-2006. The unadjusted indices for 2007 are shown by solid triangles, the adjusted index by large filled circles, and the adjusted indices (restricted to the highest observed indices for bottom trawl ages 2 and 3, and acoustic age 2, see text for further details). The corresponding linear correlations are shown in the upper left corner.

5 Northeast Arctic Saithe (Sub-areas I and II)

An update assessment is presented for this stock. General information is located in the Quality Handbook.

5.1 The Fishery (Tables 5.1.1–5.1.2, Figure 5.1.1)

Currently the main fleets targeting saithe include trawl, purse seine, gillnet, hand line and Danish seine. Landings of saithe were highest in 1970-1976 with an average of 238,000 t and a maximum of 274,000 t in 1974. 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 70,000-122,000 t. An increasing trend was seen after 1990 to 171,000 t in 1996, followed by a new decline to 136,000 t in 2000. Since then the annual landings have increased gradually to about 212,000 t in 2006.

There is known to be a discarding problem in the saithe fishery. Undocumented observations and comparisons by people having taken scientific samples from commercial trawlers for many years indicate a substantial discarding in certain areas and seasons. There are also records of discard in the purse seine fishery. At the moment it is not possible to estimate the total level of discarding and use the information quantitatively in the assessment.

5.1.1 ICES advice applicable to 2006 and 2007

The advice from ICES for 2006 was as follows:

Exploitation boundaries in relation to precautionary limits: In order to harvest the stock within precautionary limits, fishing mortality should be kept below F_{pa}. This corresponds to landings of less than 202,000 t in 2006. Take account of *Sebastes marinus* by-catch.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects: The current estimated fishing mortality (0.21) is just above the lowest fishing mortality that would lead to high long-term yields ($F_{0.1}$=0.15).

The advice from ICES for 2007 was as follows:

Exploitation boundaries in relation to precautionary limits: In the absence of an agreed management plan, which has been evaluated to be in agreement with the Precautionary Approach, ICES proposes that in order to harvest the stock within precautionary limits, fishing mortality should be kept below Fpa. This corresponds to landings of less than 247,000 t in 2007.

Exploitation boundaries in relation to proposed management plan. The proposed management plan implies a TAC of 194,000 t in 2007.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects: The current estimated fishing mortality (0.19) is just above the lowest fishing mortality that would lead to high long-term yields ($F_{0.1}$=0.14).

5.1.2 Management applicable in 2006 and 2007

Management of Northeast Arctic saithe is by TAC and technical measures. Norwegian authorities set the TACs for 2006 and 2007 to 193,500 t and 222,525 t, respectively. The Institute of Marine Research, Bergen, Norway, advised a TAC for 2007 of 194,000 t, corresponding to the proposed management plan.

5.1.3 The fishery in 2006 and expected landings in 2007

396 Provisional figures show that the landings in 2006 were approximately 212,000 t, which is about 20,000 t. more than the TAC and what was expected by the WG last year (193,500 t).

Official landings in 2007 are expected to be around the TAC of 222,525 t, which is 15 % higher than the 2006 TAC and 5 % higher than the 2006 landings.

5.2 Commercial catch-effort data and research vessel surveys

5.2.1 Fishing Effort and Catch-per-unit-effort (Tables 5.2.1-5.2.3, Figure 5.2.1)

In the purse seine fishery, more than half of the vessels catch less than 100 tonnes per year, and the sum of these catches represents only about 5 – 10% of the total purse seine catch. Therefore the numbers of vessels catching more than 100 tonnes annually have been regarded as a more representative and stable measure of effort in the purse seine fishery. These numbers have been raised to the total purse seine catch (Table 5.2.1). There was an increase in purse seine effort in 2003, a decrease in 2004 and a new increase in 2005 and 2006 to the 2003 level. These variations may be explained both by better availability of schooling saithe in some years with strong recruiting year classes and by transfer of quota, allowing for a longer fishing season. The 2005 WG decided not to apply the series in the further analysis.

In the Norwegian trawl CPUE indices all days with 20% or more saithe in the catches from vessels larger than the median length were included. First all CPUE observations for each quarter were averaged, and then a yearly index was calculated by averaging over the year. Due to a large increase in quarter one CPUE since 2003 (Figure 5.2.1), this quarter has been left out in the averaging used for tuning since the 2006 WG (ICES 2006/ACFM:25). There was an increase in the total CPUE from 1998 to 2001 (Table 5.2.2, Figure 5.2.1), and since then it has been quite stable. The total CPUE index was finally divided on age groups applying yearly catch in numbers and weight at age data from the trawl fishery.

In 2005 German freezer trawler CPUE data was made available for the WG (Table 5.2.3). The data come from one trawler only fishing in the first quarter of the year. Analyses performed by the 2005 WG showed that the CPUE data did not track weak and strong year classes very well and showed some very strong year effects. There were strong age effects on selectivity for most age groups. In the combined tuning this fleet got the lowest scaled weights and the WG decided not to apply the series in the analysis.

5.2.2 Survey results (Table 5.2.4)

In autumn 2003 the saithe- and coastal cod surveys were combined (Berg *et al*., WD 11 2004). However, until new time series can be established, the estimation of abundance indices is done very much in the same way as before and the results should be comparable. The total index for 2006 (Aglen *et al*., WD 5) decreased by about 10 % compared to 2005, and was at the same level as in 2003. Age groups 2, 4 and 7+ were above average level, the others below.

5.2.3 Recruitment indices

Good recruitment indices are crucial for reliable predictions. Attempts at establishing year class strength at age 0 or 1 have so far failed. The accuracy of the survey recruitment indices varies from year to year according to the extent to which 2 - 4 year old saithe have migrated out from the near coast areas and become available to the acoustic saithe survey on the banks. An observer program for establishing a 0-group index series started in 2000 (Borge and Mehl, WD 21 2002. However, these observations do not seem to pick up the year class strength very well, and the program will be evaluated in connection with the next saithe benchmark assessment (Mehl, WD 6).

5.3 Data used in the Assessment

5.3.1 Catch numbers at age (Table 5.3.1)

The allocation of biological samples of catch numbers, mean length and mean weight at age from the Norwegian fishery in 2005 was updated, and the total landings by numbers were adjusted to the official total catch reported to ICES. This revision resulted in minor changes in catch numbers-at-age and weight-at-age. Age composition data for 2006 was available from Norway, Russia (Division I and IIA) and Germany (Division IIA). These countries accounted for 98% of the landings. Other areas and countries were assumed to have the same age composition as Norwegian trawlers.

5.3.2 Weight at age (Table 5.3.2)

Constant weights 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. Weight at age increased for all age groups in 2006 compared to the previous years.

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 5.3.4)

A constant maturity ogive was used until the 2005 WG, when these estimates were evaluated. In later years the maturity at age had decreased somewhat, and the WG decided to use a 3-year running average for the period from 1985 and onwards (2-year average for the first and last year). New analyses were only available back to 1985. Table 5.3.4 presents the 3-year running average maturity ogives. In the two last years the maturity of 5 year olds have increased somewhat. This is fish from the relatively weak 2000 and 2001-year classes, and could therefore be density dependent effects.

5.3.5 Tuning data (Table 5.3.5, Figure 5.3.5)

Until the 2005 WG the tuning was based on three data series: CPUE from Norwegian purse seine and Norwegian trawl and indices from a Norwegian acoustic survey. The 2005 WG found rather large and variable log q residuals and large S.E. log q for the purse seine fleet, strong year effects and in the combined tuning the fleet got low scaled weights. The WG decided not to include the purse seine tuning fleet in the final analysis and the following two fleets are used since 2005:

- Fleet 12: CPUE data from the Norwegian trawl fisheries (start 1994, age groups 4 to 8, only quarter 2-4 since 2006)
- Fleet 13: Indices from the Norwegian acoustic survey (start 1994, age groups 3 to 7).

Figure 5.3.5 presents the tuning data by fleet, year and age. The abundance indices are widely divergent.

5.4 Exploratory runs

The settings of the different runs are shown in Table 5.4.1.

5.4.1 XSA runs based on data until 2005 (Table 5.4.1, Figure 5.4.1)

398 Based on the update of Norwegian catch statistics and allocations of biological samples, a SPALY (Same Procedure As Last Year) XSA (run 1) was performed, giving similar results as in the 2005 assessment. $F_{4\text{-}7}$ in 2005 was almost the same as in last assessment (0.18 compared to 0.19), while SSB 1 Jan. 2005 increased a little from 690,000 t to 714,000 t (Figure 5.4.1).

5.4.2 XSA runs based on data with 2006 included (Table 5.4.1, Figure 5.4.1–5.4.2).

Singe fleet tuning runs

Two single fleet tuning runs were performed; one with the Norwegian trawl CPUE (run 2), and one with the Norwegian acoustic survey (run 3). Figure 5.4.1 compares estimates of SSB and $F_{4\text{-}7}$ in 2006 from the two single fleet XSA-runs as well as from the SPALY combined tuning run (run 4). SSB and $F_{4\text{-}7}$ in 2005 from the updated 2005-data run (run1) is also presented. The single fleet tuning runs based on the CPUE gives the lowest $F_{4\text{-}7}$ and highest SSB in the last assessment year (2006). The SPALY combined run results in a $F_{4\text{-}7}$ higher than both of the two single fleet tuning runs and a SSB lower than in the single fleet tuning runs.

Figure 5.4.2 present S.E. log q for the different age groups in the two fleets used in the single fleet tuning runs. The single fleet tuning run based on the survey has much lower S.E. log q for age 4, similar for age 5, much higher for age 6 and a little lower for age 7, compared to the run based on the CPUE. The high S.E. log q for age group 6 may be due to a large increase in availability and/or catchability of this age group in 1997-98.

5.5 Final assessment run (Tables 5.5.1–5.5.7, Figure 5.5.1–5.5.4)

Extended Survivors Analysis (XSA) was used for the final assessment with settings shown in Table 5.4.1 (run 4). The settings for this update assessment are the same as in the 2006 assessment since diagnostics of initial runs were similar to last year’s. Full tuning fleet diagnostics are given in Table 5.5.1. Figure 5.5.1 presents log q residuals for the two fleets, and there are some year and age effects in both fleets. Figure 5.5.2 shows scaled weights. The survey gets the highest weights for the youngest year classes, the CPUE for age group six and older. Figure 5.5.3a-b shows plots of the tuning indices versus stock numbers from the XSA. The correlation is poor for age three in the survey but somewhat better for the older ages, especially age four and five. For the CPUE the correlation is best for age groups five, seven and eight. Figure 5.5.4 presents results of a “sensitivity analyses” of the final assessment run. This run is compared to runs with different levels of F-shrinkage, catchability plateau and combinations of tuning fleets. The alternate runs represent moderate deviances from the final run, with the choice of different shrinkage levels contributing the most.

5.5.1 Fishing mortalities and VPA (Tables 5.5.2–5.5.7, Figure 5.5.5)

The fishing mortality ($F_{4\text{-}7}$) in 2005 was 0.20, which is slightly higher than the value of 0.19 from last year’s assessment. The fishing mortality ($F_{4\text{-}7}$) in 2006 was 0.22, i.e. a little above the corresponding figure for 2005 but well below the F_{pa} of 0.35. Fishing mortalities and stock size has in later years been over- and underestimated, respectively, in the assessment year as is illustrated by the retrospective plots in Figure 5.5.5. However, in the last assessment this trend has changed to a small under- and overestimation of fishing mortalities and stock size, respectively, in 2005.

The XSA-estimates of the 2003-2004 year classes are not considered to be valid and these estimates are therefore shaded (Tables 5.5.3 and 5.5.5). The summary table (Table 5.5.7) presents the recalculated recruitment figures and total biomass. The 1996-year class was well represented in the catches over several years, and also appear to be above average in the current assessment, while the 1997-year class is weak and the 1998-year class is of about average strength. The 1999-year class is well above average, while the 2000-year class is weak and the 2001-year class is below average strength. The 2002-year class has been the most numerous in the landings the two last years and is presently estimated to be of the same strength as the 1989 and 1992-year classes. No information is available on recent year classes.

The total biomass (ages 3+) has been at a high and increasing level above the long-term (1960-2006) mean since 1995. Likewise, the SSB has been above the long-term mean since 1996 and above B_{pa} since 1994 (Tables 5.5.5-5.5.7).

5.5.2 Recruitment (Table 5.3.1, Figure 5.1.1)

Estimates of the recruiting year classes up to the 2002-year class (4 year olds) from the XSA were accepted. Catches of age group 3 have to a large extent declined to low levels in recent years (Table 5.3.1). Until the 2005 WG RCT3-runs were conducted to estimate the corresponding year classes, with 2 and 3 year olds from the acoustic survey as input together with VPA numbers. These estimates were, however, strongly weighted towards the mean value of the input XSA-numbers, which due to the short survey time series also contained year classes that are still not converged. It has therefore been stated several times in the ACFM Technical Minutes that it would be more transparent to use the long-term GM (geometric mean) recruitment.

The GM recruitment 1960-2005 is 170 million 3 year olds, and this value is used for the 2003-year class. The value is slightly lower than the GM recruitment 1997-2005 (195 million 3 year olds), a period where the SSB has been well above B_{pa}. Preliminary data from the Norwegian 0-group observer program indicate slightly above average recruitment since 2000. This time series is still too short to use in recruitment models together with converged XSA-data.

5.6 Reference points

Due to the change of Fbar from 3-6 to 4-7 and age at recruitment from 2 to 3, the lim and pa reference points were re-estimated at the 2005 WG. The lim reference points were estimated according to the new methodology outlined in ICES CM 2003/ACFM:15, while the pa reference point estimation was based on the old procedure (ICES CM 1998/ACFM:10).

5.6.1 Biomass reference points

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

At the 2005 WG parameter values, including the change-point, were computed using segmented regression on the 1960-2000 time series of SSB-recruitment pairs. The maximum likelihood estimate of the spawning stock biomass at which recruitment is impaired was 136,055 t, and B_{lim} was set at 136,000 t. Applying the “magic formula” $B_{pa} = B_{lim} \exp(1.645*\sigma)$, with a value of 0.3 for σ, gave a B_{pa} of 222,863 t, rounded to 220,000 t. This new B_{pa} for Northeast Arctic saithe was accepted by ACFM.

5.6.2 Fishing mortality reference points (Tables 5.6.1, 5.7.1, Figure 5.1.1)

Yield and SSB per recruit were based on the parameters in Table 5.7.1 and are presented in Table 5.6.1. $F_{0.1}$ and F_{max} were estimated to be 0.14 and 0.32, respectively, which is the same values as obtained last year. The plot of SSB versus recruitment is shown in Figure 5.1.1. The values of F_{low}, F_{med} and F_{high} obtained by the 2002 WG were 0.11, 0.34 and 0.69, respectively.

In 1998 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 1998).

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At the 2005 WG F_{lim} was set on the basis of B_{lim} (ICES CM 2003/ACFM:15). The functional relationship between spawner-per-recruit and F gave the F associated with the R/SSB slope derived from the B_{lim} estimate obtained from the segmented regression. R/SSB = 1.27 from the B_{lim} estimation gave SSB/R = 0.7874 and a F_{lim} = 0.58. Applying the “magic formula” F_{pa} = F_{lim} exp(-1.645*σ), gave a F_{pa} of 0.35. This new F_{pa} for Northeast Arctic saithe was accepted by ACFM.

5.7 Predictions

5.7.1 Input data (Table 5.7.1)

The input data to the predictions based on results from the final XSA-analysis are given in Table 5.7.1. The stock number at age in 2007 was taken from the XSA for age 5 (2002 year class) and older. The recruitment at ages 3 in the last assessment year (2006) was calculated as the long-term GM (geometric mean) recruitment 1960-2005 (Section 5.5.2), and the corresponding numbers at age 4 in the intermediate year (2007) was calculated applying a natural mortality of 0.2 and the F value estimated by XSA (as recommended by the ACFM reviewers in 2004). The GM age 3 recruitment of 170 million was also used for the 2004 and subsequent year classes. The natural mortality is the same as were used in the assessment. For the exploitation pattern the average of 2004-2006 has been used. For weight at age in stock and catch the average of the last three years in the XSA was used. For maturity at age the average of the 2005-2006 annual determinations was applied.

5.7.2 Catch options for 2008 (short term predictions) (Table 5.7.2–5.7.3)

The management option table (Table 5.7.2) shows that the expected catch of 222,525 t in 2007 will increase the fishing mortality compared to 2006 from 0.22 to 0.24, which is well below the F_{pa} of 0.35. A catch in 2008 corresponding to $F_{status\ quo}$ level of 0.20 will give 180,000 t, while a catch at F_{pa} in 2008 is about 290,000 t. A catch in 2008 corresponding to the proposed and evaluated HCR (average TAC level for the coming 3 years based on Fpa, see section 5.10) is 247,000 t. This catch corresponds to a fishing mortality of 0.29 in 2008. The SSB is expected to decrease from about 799,000 t in the beginning of 2007 to 757,000 t in the beginning of 2008, which is well above the prediction made by last year’s working group for a catch in 2007 corresponding to F_{pa}. At $F_{status\ quo}$ in 2008 SSB is estimated to decrease to 721,000 t in the beginning of 2009, for a catch corresponding to the HCR it will decrease to about 656,000 t, while at F_{pa} in 2008 SSB will decrease to about 614,000 t in 2009. This predicted reduction in SSB may be explained by a higher fishing mortalities and incoming year classes of average strength. Table 5.7.3 presents detailed output for fishing according to the HCR in 2008.

5.7.3 Medium term simulations (Figure 5.7.1a–d)

The ACFM review groups have not consider the medium term analyses reliable as the results are mainly driven by the assumption of mean recruitment and ignoring the bias in the assessment. No improved recruitment estimates are available and the problem with bias in the assessment has not been resolved. However, the WG made medium-term simulations just to illustrate a couple of scenarios made under specific assumptions, one fishing at F_{pa} and the other following the HCR.

The input data were the same as used for the short-term predictions (Table 5.7.1). Following the HCR, the catch will decrease to 190,000 t in 2011, while the SSB will be reduced to about

524,000 t (Figure 5.7.1A-B). At F_{pa} the catch will decrease to about 186,000 t in 2011, and the SSB will be reduced to about 457,000 t (Figure 5.7.1C-D).

5.8 Comparison of the present and last year's assessment

The current assessment estimated the total stock to be about 34 % higher and SSB 21 % higher in 2006, compared to the previous assessment. The increase in TSB is due increase in weight at age in 2006 (2003-2005 average used last year) and to the strong 2002 year class (GM recruitment applied last year). The F in 2005 was estimated to be slightly higher than in the previous assessment, and the realized F in 2006 is a little lower than the predicted one.

	TOTAL STOCK (3+) BY 1 JANUARY 2006 (TONNES)	SSB BY 1 JANUARY 2006 (TONNES)	F_{4-7} IN 2006	F_{4-7} IN 2005
WG 2006	976528	650829	0.24 (prediction)	0.19
WG 2007	1309499	787915	0.22	0.20

5.9 Comments on the assessment and the forecast

Difficulties in estimating initial stock size are the major problem in the forecast. This is due to widely divergent indices of abundance used in the tuning of the XSA, in addition to lack of reliable recruitment estimates. Prediction of catches beyond the TAC year will, to a large extent, be dependent on assumptions of average recruitment. In the present assessment a changing retrospective pattern was observed, i.e. from underestimating stock size in the assessment year to an overestimation. This calls for extra precaution when setting the quota.

5.10 Evaluation of harvest control rule

5.10.1 Introduction

Autumn 2004 the Norwegian Directorate of Fisheries suggested a management strategy for the stock of Northeast Arctic saithe (Anon. 2004d). The management strategy was sent on a public hearing (Mehl *et al*. WD 4, Annex 1). The Norwegian Ministry of Fisheries and Coastal Affairs 27 February 2007 asked ICES to evaluate whether the following harvest control rule for setting the annual fishing quota (TAC) for Northeast Arctic saithe is consistent with the precautionary approach:

1) estimate the average TAC level for the coming 3 years based on F_{pa}, TAC for the next year will be set to this level as a starting value for the 3-year period.

2) the year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development, however the TAC should not be changed by more than +/- 15% compared with the previous year's TAC.

3) if the spawning stock biomass (SSB) in the beginning of the year for which the quota is set (first year of prediction), is below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at SSB=B_{pa} to 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC.

5.10.2 General considerations for evaluation of harvest control rules

Evaluation of HCRs is usually done using simulation models for the population(s) in question. The scope, nature and quality standards of simulation models that may be used in order to evaluate HCRs are discussed e.g. by Skagen *et al*. (2003) and described by SGMAS (ICES

2005/ACFM:09, ICES 2006/ACFM:15, ICES 2007/ACFM:04). SGMAS also gives guidelines for evaluation of management strategies.

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Important issues for evaluation of harvest control rules are:

- Choice of population model
- Inclusion of uncertainty in population model
- Use of long-term and/or medium-term simulations
- Choice of initial values for simulations
- Choice of harvest control rules for use in the evaluation (constant F rules, how to reduce F when SSB<B_{pa} , limit on year-to-year variation in catch etc.)
- Performance measures for harvest control rules (yield, stock size, F, probability of SSB<B_{lim}, annual variation in catches etc.)

These issues are addressed below.

5.10.3 Population model used

2000 simulations for the period 2006-2126 were performed and the results for the last 100 years of this period were considered. This is done in order to exclude the effect of the initial values. The stock size for 2006 (initial data) was taken from the 2006 assessment.

The ‘default’ model was:

- A Beverton-Holt spawning stock-recruitment model with lognormal error distribution
- Assessment error and bias are estimated as age-dependent, normally distributed.
- Density-dependent weight at age in catch (average for 1981-2005 used for age groups where density-dependence was not found)
- Weight at age in stock is set equal to weight at age in catch
- Time series (1986-2005) average used for maturation at age without density-dependence
- No uncertainty in weight at age, maturity at age or natural mortality at age
- Exploitation pattern: 1997-2005 averages used for all age groups in all years
- Implementation of catch: First, the catch at age is calculated from the perceived stock using the fishing mortality derived from the harvest control rule and the given exploitation pattern. This catch at age is then applied to the actual stock.
- Implementation error and bias is estimated using the same percentage for all age groups

More details about the model, parameter estimation and input data are given in Annex 1.

5.10.4 Software used

The simulations were carried out using the PROST software for stochastic projections (Åsnes 2007). PROST was especially developed for this purpose because existing software for harvest control rule simulations such as WGMTERM, STPR and CS5 do not incorporate the 3-year averaging process for setting TAC given by the agreed decision rule. However, PROST is intended as a general tool for stochastic projections.

5.10.5 Mathematical formulation of the rule

If SSB(y) > B_{pa} then

if SSB(y-1) > B_{pa} and SSB(y+1) > B_{pa} and SSB(y+2) > B_{pa}

F(y) set by 3-year rule(0.35, 15)

else

F(y) set by 3-year rule(0.35, unconstrained)

else

F(y) set by 3-year rule ($0.35\dfrac{SSB(y)}{B_{pa}}$,unconstrained)

SSB(y+1) and SSB(y+2) in this calculation is derived using F=0.35 in years y and y+1

In addition, we will test the performance of the rule in a situation where stock rebuilding is needed.

5.10.6 Long-term simulations (Tables 5.10.1-5.10.2)

The various settings used in long-term simulations are presented in Table 5.10.1, and the results of the simulations are described in Table 5.10.2. Most of the results of the simulations are quite similar. Catches range from 157 000 to 200 000 tons, recruits from 182 to 214 millions, while the variations in estimated biomasses are larger, SSB range from 203 000 to 850 000 tonnes. Only in a couple of cases, both with an opposite of the retrospective trend observed in later years until the 2006 assessment (i.e. an overestimation of B and underestimation of F in the assessment year) and for the highest F alternative, there is a very small risk of falling below $B_{lim.}$, especially in the run with an unfavourable fishing pattern (from 1976-1979). However, the risk is so low that it is not considered inconsistent with the precautionary approach. Catches are in general highest for option 3 and lowest for option 2, and the opposite for the biomass estimates, while option 1 (no assessment error) is intermediary. In a situation with underestimation of stock size in the assessment year (option 2), the highest exploitation rate (F=0.35) give the highest catches, for the opposite trend in assessment error F=0.25 gave the highest catches, while for no assessment error (option 1) the long-time yield is quite similar for all exploitation levels. The lowest long-term yield was obtained for the run with an unfavourable fishing pattern. For all three options the highest biomass estimates are found at the lowest exploitation level. And in a situation with an opposite trend in assessment error (option 3) the risk of falling below B_{lim} will increase for increasing exploitation level and/or for increasing assessment bias. The historic amount of implementation error (the difference between TAC and catch) is low (3 % on average). Consequently, whether or not implementation error is included, does not change the result significantly. The highest average year-to-year change in TAC of 11 % was found in run 8 where the limit was set to 20 %. The part of the HCR limiting the annual change in TAC to 15 % is therefore probably not too restrictive and it was large enough to maintain SSB above B_{lim} in practically all the simulated cases.

5.10.7 Long-term yield versus exploitation level (Figure 5.10.1)

Long-term runs were made with the same settings as in run 2 above (no assessment and implementation error) for exploitation levels from 0.2 to 0.4. The highest long-term yield of 195,500 t was obtained for F = 0.32, but the curve is rather flat and the maximum is poorly defined (Figure 5.10.1). F_{max} was also estimated to 0.32 in the yield per recruit analyses in the assessment.

5.10.8 Consequences of the rule in a period of recovery (Tables 5.10.3–5.10.8)

404 To study the performance of the rule in a stock recovery situation we made runs starting in 1986 and ending in 1993. 1986 was chosen because it was a year with a fairly low stock size, the total stock size was 284 000 tonnes and the SSB was 98 000 t, i.e. below B_{lim}.

For 1986, the weight at age in the stock and in the catch, maturity-at-age, natural mortality at age, fishing pattern and F were set to the same values as used in the assessment made by the ICES Arctic Fisheries Working Group in 2006. For later years, the following values were used:

Recruitment at age 3: Two options were used; one where the recruitment in 1987 and 1988 was set to the same values as calculated in the 2006 assessment with a CV of 0.25, while for later years the stock-recruitment relationship from the long-term simulations of the HCR was used. In the other option the recruitment for the whole rebuilding period, including the starting year, was set equal to the average of 1988-1990 (lowest historic recruitment).

Weight, maturity and natural mortality at age: The same values as used in the 2006 assessment were used.

Fishing pattern: The average of the 1987-1990 pattern estimated by the 2006 WG was used.

Three runs were made, one with no bias in the assessment and two with an “opposite trend” in assessment bias compared to what is experienced in later years (option 3 in the long-term simulations). In third run the recruitment for the whole rebuilding period was set equal to the average of 1988-1990 (lowest historic recruitment). A CV of 0.25 was set for initial stock size in all runs and future stock assessments in the run with no bias (run 1), while for run 2 and 3 the same bias and CV as in option 3 in the long-term simulations was used for future stock assessments. The implantation error was the same as in the long-term simulations of the HCR for all runs. 2000 simulations were performed in each case. The various settings used in recovery simulations are described in Table 5.10.3.

The results of the simulations are given in Tables 5.10.4-8. In run 1 the probability of SSB being below B_{lim} is 1 for the first year (1987), very low the next year and zero the following years. The probability for the SSB to be below B_{pa} is 1 during the first two years, but then decreases during the next three years. Also in run 2 the probability of SSB being below B_{lim} is 1 for the first year (1987), low the next year, very low the following two years and zero in the last year presented (1991). The probability for the SSB to be below B_{pa} is 1 during the first two years, close to 1 in the next two years but then decreases in the last year. In run 3 the probability of SSB being below B_{lim} is high until the fifth year, and the probability for the SSB to be below B_{pa} is 1 during the whole period. The SSB reaches B_{pa} one year earlier in run 1 than in run 2, while in run 3 it is below B_{pa} also after five years. The realised F and catches are highest for run 2.

5.10.9 Conclusions

In accordance with the Precautionary Approach: The analyses presented indicate that the HCR proposed by The Norwegian Ministry of Fisheries and Coastal Affairs is in agreement with the precautionary approach, provided that the assessment uncertainty and error are not greater than those calculated from historic data and used in the evaluation. This also holds true when an implementation error equal to the historic level of 3 % is included, as well as for one of the most unfavourable fishing patterns observed in the time series. However, in none of the simulations the long-term catch exceeded 200,000 t.

Management objectives: The objective of the evaluations presented in this report is to classify HCR’s as being in accordance to the Precautionary Approach (PA) or not by estimating risk of falling below B_{lim}. The evaluations has also given information that can be used to shed some light on how the HCR's perform relative to potential management objectives. The reduction of recruitment at the lower spawning stock levels appear to be quite modest (the consequences relating to recruitment are modest) and most of the dynamics in average yield is caused by changes to the exploitation pattern in combination with high fishing mortalities. The avoidance of low yield corresponds more to the avoidance of growth overfishing than to avoid recruitment overfishing (SSB falling below B_{lim}). The highest long-term yield was obtained for an exploitation level of 0.32, i.e. a little below F_{pa}, and ICES recommends using a lower value than the proposed one in the HCR.

Recruitment: The long term evaluations are based on average recruitment dynamics. The average recruitment will in some periods be better than this and in other periods worse. The 1980's gave on average low recruitment, while the early 1990's saw better recruitment. This means that the yield will vary between periods even with "perfect" assessments and implementation of the HCR.

Rebuilding: According to the simulations made, the HCR will help rebuild the stock to above B_{lim} level within three years from the lowest observed stock level and in a favourable recruitment situation. With recruitment equal to the lowest observed, the rebuilding to a level above B_{lim} take five years.

Probability levels: It should be noted that the conclusions drawn here is based on a probability level of 5 % (probability of falling below B_{lim}). They will then of course hold also for higher probability levels. The probability level to use should be decided by managers. If lower probability levels than 5 % is preferred, the harvest control rule should be evaluated against that level.

5.11 Response to ACFM technical minutes

The review group commented "no real SPALY assessment was made". However, run 2 was a real SPALY assessment (see Table 5.4.1 in ICES CM 2006/Assess:25 for settings), and the resulting F_{4-7} and SSB were presented in Figure 5.4.1.

The reviewers requested "abundance indices by fleets in figures in the WG report in order for the reader to be able to evaluate the consistency in trends". Figures presenting abundance indices from the acoustic survey and from Norwegian trawl CPUE has been included in Figure 5.3.1 in the present report.

It was also mentioned "The dropping of a fleet, without full sensitivity testing is outside the remit of an update assessment." No fleet was dropped during the 2006 assessment. That was done during the 2005 assessment when the Norwegian purse seine fleet was excluded from the tuning. It was clearly explained in section 5.3.5 (tuning data). The only change made last year was to leave out quarter one in the Norwegian trawl CPUE data when averaging over the year. The rest of the comments regarded the next benchmark assessment.

[redacted]

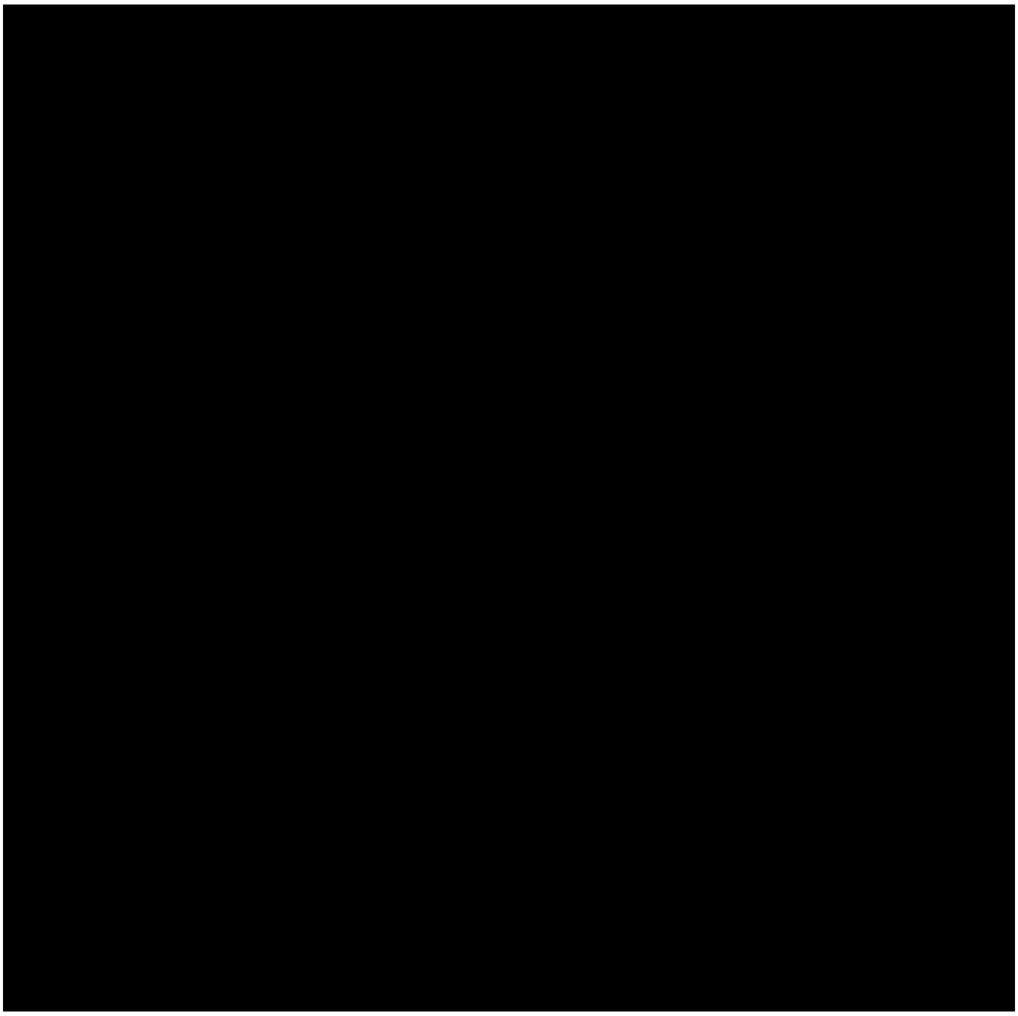

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Table 5.3.1 Catch numbers at age
Run title : North-East Arctic saithe
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Table 1 Catch numbers at age Numbers*10**-3

	YEAR	1960	1961	1962	1963	1964	1965	1966
	AGE							
	3	10509	17824	37266	42050	9001	37115	22392
	4	13083	9131	11131	28925	59601	5001	54537
	5	13545	12506	4421	5888	13154	26300	13124
	6	5064	3799	8290	4650	2718	10142	12899
	7	4883	1332	2427	3861	3472	2861	4652
	8	2401	968	1024	1099	2655	2110	1374
	9	1315	520	938	1075	1251	2733	933
	10	743	405	451	697	1221	699	965
	+gp	1525	1229	1728	1777	3559	3593	2900
0	TOTAL	53068	47714	67676	90022	96632	90554	113776
	TONSL	133515	105951	120707	148627	197426	185600	203788
	SOPCO	129	142	123	122	121	115	112

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

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	29664	25196	77333	43540	77019	65178	76296	36782	60832	125030
	4	24836	18384	11949	62846	59280	52389	25206	44027	11691	30576
	5	35956	5101	16939	13987	26961	29146	26911	15671	16366	7947
	6	4125	8282	4747	16189	9556	10186	16031	20419	4436	8712
	7	5616	787	4798	5122	9592	5616	7114	12148	7808	3435
	8	2916	1913	1126	7950	2901	3547	3935	4802	6789	3212
	9	1413	900	1711	2504	4352	1865	2871	3258	2914	2679
	10	1397	577	675	3697	2195	2140	2610	2505	2350	1724
	+gp	3493	1166	511	2799	5490	3149	3924	3821	4140	2880
0	TOTAL	109416	62306	119789	158634	197346	173216	164898	143433	117326	186195
	TONSL	181326	110247	140060	264924	241272	214334	213859	274121	233453	242486
	SOPCO	96	119	98	101	80	85	82	104	115	108

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

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	99049	48969	61963	40796	83954	34733	17244	41466	48917	22115
	4	34317	27685	23328	36644	21822	65052	23768	33233	11974	12895
	5	10140	12476	14122	9211	21528	13060	32700	12064	7189	6062
	6	2062	4534	4400	6379	3619	8212	3226	11204	5279	4525
	7	4332	1468	2901	3200	2550	1054	3008	1135	3740	2805
	8	1456	1848	963	1338	2008	1251	1177	1772	775	1399
	9	1606	938	1356	147	369	461	760	560	878	351
	10	963	976	438	730	279	263	247	557	134	454
	+gp	1134	2150	1192	1629	629	448	760	897	701	285
0	TOTAL	155059	101044	110663	100074	136758	124534	82890	102888	79587	50891
	TONSL	182817	154464	164180	144554	175516	168034	156936	158786	107183	70458
	SOPCO	107	115	122	99	102	103	106	105	100	101

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

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	17869	8126	12550	23792	68681	44608	22614	7058	17178	10510
	4	49829	35847	19285	16930	13630	33266	61398	35593	52109	54886
	5	4339	32827	33233	9054	5752	5982	30848	49248	40145	18499
	6	3118	4560	18479	10238	4883	5408	3716	18999	30451	18357
	7	3490	2328	1751	7341	3877	4748	1744	2053	4177	17834
	8	755	1219	350	1076	2381	3173	1366	723	483	2849
	9	620	966	176	160	383	1461	1018	421	125	485
	10	257	320	187	112	61	286	790	278	259	214
	+gp	797	102	204	269	179	442	146	655	293	474
0	TOTAL	81074	86295	86215	68972	99827	99374	123640	115028	145220	124108
	TONSL	92391	114242	122310	95848	107326	127516	153584	146544	168378	171348
	SOPCO	104	100	105	102	101	105	101	98	100	100

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

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	11789	3091	9655	9175	3833	6614	2335	991	26083	5355
	4	11698	16215	12236	22767	7979	17554	50447	6111	12478	57221
	5	35011	11946	22872	7747	27071	11592	13374	33548	9696	13994
	6	13567	31818	10347	10676	8802	25702	7008	10441	22822	9148
	7	13452	8376	18930	6123	7147	5323	9467	7321	10640	13248
	8	7058	5539	3374	8303	3158	4284	5411	8133	5595	6132
	9	812	2873	3343	2530	4706	2390	3497	2742	7745	2874
	10	55	727	2290	2652	1943	3443	2492	3026	2644	2673
	+gp	146	394	597	1219	1942	2392	4102	5336	2276	3074
0	TOTAL	93588	80979	83644	71192	66581	79294	98133	77649	99979	113719
	TONSL	143629	153327	150373	135945	136402	155246	159757	162140	176678	212480
	SOPCO	100	100	100	101	100	100	100	100	100	100

Table 5.3.2 Catch weight at age
Run title : North-East Arctic saithe
At 18/04/2007 15:09

Table 2 Catch weights at age (kg)

	YEAR	1960	1961	1962	1963	1964	1965	1966
	AGE							
	3	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	4	1.11	1.11	1.11	1.11	1.11	1.11	1.11
	5	1.63	1.63	1.63	1.63	1.63	1.63	1.63
	6	2.33	2.33	2.33	2.33	2.33	2.33	2.33
	7	3.16	3.16	3.16	3.16	3.16	3.16	3.16
	8	4.03	4.03	4.03	4.03	4.03	4.03	4.03
	9	4.87	4.87	4.87	4.87	4.87	4.87	4.87
	10	5.63	5.63	5.63	5.63	5.63	5.63	5.63
	+gp	8.03	8.039	7.924	7.851	7.781	7.959	8.106
0	SOPC(	1.2863	1.4159	1.2326	1.2169	1.2138	1.1472	1.1222

Table 2 Catch weights at age (kg)

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	4	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
	5	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
	6	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
	7	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16
	8	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03
	9	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87
	10	5.63	5.63	5.63	5.63	5.63	5.63	5.63	5.63	5.63	5.63
	+gp	7.994	7.716	7.479	7.404	7.052	7.477	7.385	7.217	7.127	7.32
0	SOPC(	0.9593	1.1889	0.9829	1.0067	0.8017	0.8492	0.8246	1.0407	1.1549	1.0845

Table 2 Catch weights at age (kg)

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	0.71	0.71	0.71	0.79	0.73	0.77	1.05	0.71	0.75	0.59
	4	1.11	1.11	1.11	1.27	1.4	1.12	1.33	1.26	1.33	1.22
	5	1.63	1.63	1.63	2.03	2.05	2.02	1.86	2.02	2.07	1.97
	6	2.33	2.33	2.33	2.55	2.76	2.61	2.8	2.7	2.63	2.3
	7	3.16	3.16	3.16	3.29	3.3	3.27	4	3.88	3.28	2.87
	8	4.03	4.03	4.03	4.34	4.38	3.91	4.18	4.47	3.96	3.72
	9	4.87	4.87	4.87	5.15	5.95	4.69	5.33	5.36	4.54	4.3
	10	5.63	5.63	5.63	5.75	6.39	5.63	5.68	6.06	5.55	4.69
	+gp	7.394	7.527	7.809	6.937	6.841	7.558	8.665	7.19	8.012	6.597
0	SOPC(	1.0695	1.1465	1.2199	0.9879	1.0237	1.0323	1.0564	1.051	1.0011	1.0079

Table 2 Catch weights at age (kg)

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	0.53	0.62	0.74	0.71	0.68	0.67	0.61	0.52	0.56	0.59
	4	0.84	0.87	0.95	1	1.05	1.01	0.99	0.76	0.79	0.82
	5	1.66	1.31	1.4	1.45	1.85	1.92	1.65	1.24	1.19	1.33
	6	2.32	2.43	1.78	2.09	2.39	2.28	2.46	2.12	1.71	1.84
	7	2.97	3.87	2.96	2.49	3.08	2.77	2.85	3.22	2.87	2.48
	8	4	5.38	3.73	3.75	3.35	3.2	3.03	3.83	3.78	3.73
	9	4.72	5.83	4.62	3.9	4.48	3.73	3.71	4.69	4.06	4.32
	10	5.44	5.36	4.67	6.74	4.66	6.35	4.49	5.31	5.3	5.34
	+gp	6.904	7.448	7.19	6.27	6.58	7.63	6.29	5.97	7.56	7.07
0	SOPC(	1.0384	1.0023	1.0484	1.0226	1.0085	1.0517	1.0106	0.9848	0.999	1.0018

Table 2 Catch weights at age (kg)

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
	3	0.62	0.68	0.67	0.6	0.75	0.69	0.66	0.71	0.59	0.76
	4	0.95	1	1.05	1.03	1.12	1.01	0.91	1.03	0.89	1.14
	5	1.24	1.48	1.45	1.63	1.54	1.5	1.42	1.37	1.49	1.61
	6	1.72	1.87	1.93	2.1	2.04	1.97	1.9	1.9	2.09	2.21
	7	2.35	2.58	2.27	2.67	2.6	2.54	2.54	2.42	2.16	2.78
	8	3.1	3.07	2.97	3.14	3.14	3.25	2.59	2.99	3	3.35
	9	4.19	4.13	3.61	3.81	3.63	3.77	3.49	3.45	3.24	4
	10	5.79	5.44	4.1	4.41	4.54	4.31	3.75	3.73	3.82	4.56
	+gp	7.44	8.07	5.58	6.13	5.36	5.62	4.9	4.9	5.49	6.17
0	SOPC(	1.0011	1.0014	1.0009	1.0053	1.001	1.0013	1.0018	1.0026	1.0033	1.0019

Table 5.3.4. NEA saithe. 3-year running average maturity ogive 1985-2006.

412

	Age group									
Year	2	3	4	5	6	7	8	9	10	11+
1985	0	0	0.04	0.76	0.87	0.92	1	1	1	1
1986	0	0	0.03	0.76	0.89	0.95	1	1	1	1
1987	0	0	0.03	0.63	0.88	1	1	1	1	1
1988	0	0	0.09	0.56	0.74	1	1	1	1	1
1989	0	0	0.16	0.56	0.64	1	1	1	1	1
1990	0	0	0.17	0.66	0.62	0.91	1	1	1	1
1991	0	0	0.12	0.72	0.75	0.9	1	1	1	1
1992	0	0	0.05	0.64	0.84	0.89	1	1	1	1
1993	0	0	0.03	0.54	0.91	0.98	1	1	1	1
1994	0	0	0.09	0.5	0.85	0.97	1	1	1	1
1995	0	0	0.14	0.53	0.81	0.9	0.98	1	1	1
1996	0	0	0.14	0.5	0.73	0.84	0.97	1	1	1
1997	0	0	0.11	0.42	0.59	0.74	0.82	1	1	1
1998	0	0	0.08	0.27	0.53	0.69	0.76	1	1	1
1999	0	0	0.04	0.28	0.54	0.72	0.75	1	1	1
2000	0	0	0.05	0.27	0.7	0.81	0.88	1	1	1
2001	0	0	0.05	0.38	0.78	0.94	0.93	1	1	1
2002	0	0	0.07	0.45	0.86	0.94	0.96	1	1	1
2003	0	0	0.09	0.46	0.87	0.95	0.93	1	1	1
2004	0	0	0.13	0.55	0.84	0.92	0.9	1	1	1
2005	0	0	0.17	0.61	0.85	0.92	0.87	1	1	1
2006	0	0	0.17	0.73	0.86	0.90	0.89	1	1	1

Table 5.3.5 Tuning data sets applied in final XSA run (flt12 CPUE from Quarter 2,3,4)

```
North-East Arctic saithe (Sub-areas I and II)
102
FLT12: Nor new trawl revised 2006 (Catch: Unknown) (Effort:
Unknown)
1994 2006
1 1 0.00 1.00
4  8
   1   126.0   424.3   263.6    36.4     8.1
   1   211.0   292.9   318.3    50.5     8.3
   1   105.9   141.5   205.7   271.3    31.1
   1    40.4   210.1   214.0   275.3   173.3
   1    32.4    54.3   239.5    91.2    55.5
   1    39.0   109.8    83.2   192.8    44.2
   1    80.1    85.6   160.5   124.3   166.9
   1    50.4   276.1   198.8   187.8    79.5
   1    75.7   123.1   383.2    86.4    88.7
   1   130.4   199.1   132.1   190.5   122.9
   1     7.8   192.7   143.3   183.9   230.6
   1    37.1    99.2   293.5   140.1    78.8
   1    98.3   118.3   155.2   299.3   153.2
FLT13: Norway Ac Survey extended 2000 (Catch: Unknown) (Effort:
Unknown)
1994 2006
1 1 0.75 0.85
3  7
   1    87.1   108.9    41.4     8.1     0.7
   1   166.1    86.5    46.5    16.5     2.4
   1   122.6   207.4    31.7    15.1     4.0
   1    38.0   184.8    79.8    50.6     9.6
   1    96.7   202.6    69.3    84.3     6.6
   1   233.8    72.9    62.2    21.0    19.2
   1   142.5   176.3    11.6    11.5     8.0
   1   275.9    45.9    53.8     5.6     6.1
   1   230.2    92.6    18.9    10.6     2.2
   1    87.5   151.7    26.1     6.2     6.4
   1   212.4   118.7    49.1    19.2     4.7
   1   228.1    67.2    20.3    16.5     7.7
   1    42.6   142.9    19.4     4.6     8.5
```

Table 5.4.1. Data and parameter settings of exploratory and final XSA-runs

414

Run No.	1	2	3	4
Ass. type	SPALY	SFT	SFT	FINAL
Catch data	1960-05	1960-06	1960-06	1960-06
Age range	3-11+	3-11+	3-11+	3-11+
F bar	4-7	4-7	4-7	4-7
Fleet 12 Norw. trawl	1994-05 age 4-8 Q2-4	1994-06 age 4-8 Q2-4		1994-06 age 4-8 Q2-4
Fleet 13 ac. survey	1994-05 age 3-7		1994-06 age 3-7	1994-06 age 3-7
Time series weights	Tricubic over 20y	Tricubic over 20y	Tricubic over 20y	Tricubic over 20y
Power model	No	No	No	No
Catchability (q) plateau	8	8	8	8
Survivor est. shrunk tow. Mean of	5 years 5 oldest ages	5 years 5 oldest ages	5 years 5 oldest ages	5 years 5 oldest ages
SE of mean	0.5	0.5	0.5	0.5
Min. fleet SE for pop. Est.	0.3	0.3	0.3	0.3
Prior weight.	None	None	None	None

Table 5.5.1. Tuning diagnostics

Lowestoft VPA Version 3.1
18/04/2007 15:09
Extended Survivors Analysis

North-East Arctic saithe

CPUE data from file flt-12-13-06.dat

Catch data for 47 years. 1960 to 2006. Ages 3 to 11.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT12: Nor new tra	1994	2006	4	8	0	1
FLT13: Norway Ac	1994	2006	3	7	0.75	0.85

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 67 iterations

1

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	0.069	0.027	0.038	0.076	0.022	0.022	0.023	0.008	0.072	0.047
4	0.116	0.127	0.143	0.12	0.088	0.135	0.234	0.076	0.126	0.223
5	0.214	0.167	0.266	0.127	0.204	0.178	0.145	0.241	0.167	0.204
6	0.279	0.309	0.213	0.19	0.208	0.305	0.155	0.161	0.257	0.235
7	0.306	0.279	0.305	0.188	0.188	0.187	0.175	0.241	0.245	0.233
8	0.255	0.199	0.172	0.212	0.14	0.164	0.295	0.224	0.293	0.218
9	0.16	0.156	0.177	0.189	0.178	0.149	0.196	0.238	0.345	0.241
10	0.199	0.21	0.18	0.208	0.217	0.192	0.229	0.26	0.381	0.191

XSA population numbers (Thousands)

416

YEAR	AGE 3	4	5	6	7	8	9	10
1997	1.97E+05	1.18E+05	2.00E+05	6.15E+04	5.63E+04	3.47E+04	6.07E+03	3.37E+02
1998	1.27E+05	1.50E+05	8.60E+04	1.32E+05	3.81E+04	3.40E+04	2.20E+04	4.24E+03
1999	2.83E+05	1.01E+05	1.08E+05	5.96E+04	7.96E+04	2.36E+04	2.28E+04	1.54E+04
2000	1.38E+05	2.23E+05	7.19E+04	6.80E+04	3.95E+04	4.81E+04	1.63E+04	1.56E+04
2001	1.91E+05	1.05E+05	1.62E+05	5.19E+04	4.60E+04	2.68E+04	3.18E+04	1.10E+04
2002	3.33E+05	1.53E+05	7.86E+04	1.08E+05	3.45E+04	3.12E+04	1.91E+04	2.18E+04
2003	1.15E+05	2.67E+05	1.10E+05	5.39E+04	6.52E+04	2.34E+04	2.17E+04	1.34E+04
2004	1.43E+05	9.19E+04	1.73E+05	7.76E+04	3.78E+04	4.48E+04	1.43E+04	1.46E+04
2005	4.14E+05	1.16E+05	6.97E+04	1.11E+05	5.41E+04	2.43E+04	2.93E+04	9.22E+03
2006	1.29E+05	3.16E+05	8.39E+04	4.83E+04	7.04E+04	3.47E+04	1.48E+04	1.70E+04

Estimated population abundance at 1st Jan 2007

0.00E+00	1.01E+05	2.07E+05	5.61E+04	3.13E+04	4.57E+04	2.28E+04	9.56E+03

Taper weighted geometric mean of the VPA populations:

1.99E+05	1.58E+05	1.00E+05	6.32E+04	3.71E+04	1.94E+04	1.02E+04	5.33E+03

Standard error of the weighted Log(VPA populations) :

0.4783	0.5044	0.5238	0.622	0.8056	1.0239	1.246	1.5012

Log catchability residuals.
Fleet : FLT12: Nor new trawl

Age	1994	1995	1996
3	No data for this fleet at this age		
4	0.48	1.35	0.02
5	0.58	0.42	0.12
6	1.04	0.15	-0.14
7	1.1	-0.16	0.29
8	0.25	0.42	-0.11

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	No data for this fleet at this age									
4	-0.04	-0.5	0.09	0.01	0.28	0.34	0.37	-1.45	-0.11	-0.09
5	-0.24	-0.77	-0.25	-0.15	0.24	0.14	0.28	-0.17	0.04	0.05
6	0.28	-0.36	-0.66	-0.15	0.35	0.32	-0.12	-0.4	0	0.18
7	0.37	-0.36	-0.34	-0.13	0.13	-0.36	-0.21	0.33	-0.3	0.19
8	0.38	-0.77	-0.64	-0.01	-0.2	-0.23	0.44	0.39	-0.04	0.24

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

Age	4	5	6	7	8
Mean Log q	-7.785	-6.42	-5.715	-5.4455	-5.4577
S.E(Log q)	0.6188	0.3264	0.3923	0.3731	0.3978

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
4	0.67	1.16	9.19	0.57	13	0.41	-7.78
5	0.85	0.655	7.22	0.66	13	0.28	-6.42
6	1.43	-0.874	3.34	0.31	13	0.57	-5.72
7	1.39	-1.641	3.39	0.66	13	0.48	-5.45
8	1.09	-0.62	5.03	0.83	13	0.45	-5.46

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

Age	4	5	6	7	8
Mean Log q	-7.785	-6.42	-5.715	-5.4455	-5.4577
S.E(Log q)	0.6188	0.3264	0.3923	0.3731	0.3978

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
4	0.67	1.16	9.19	0.57	13	0.41	-7.78
5	0.85	0.655	7.22	0.66	13	0.28	-6.42
6	1.43	-0.874	3.34	0.31	13	0.57	-5.72
7	1.39	-1.641	3.39	0.66	13	0.48	-5.45
8	1.09	-0.62	5.03	0.83	13	0.45	-5.46
1							

Fleet : FLT13: Norway Ac Sur

Age	1994	1995	1996
3	-0.54	-0.46	0.18
4	-0.36	-0.16	0.01
5	-0.23	0.1	0.1
6	0.35	-0.14	-0.11
7	0.59	0.08	-0.62
8	No data for this fleet at this age		

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
3	-1.23	0.1	0.2	0.45	0.74	0	0.1	0.76	-0.18	-0.71
4	0.76	0.62	0.01	0.08	-0.53	-0.17	-0.16	0.54	-0.23	-0.39
5	0.27	0.93	0.67	-0.71	0.08	-0.27	-0.3	-0.05	-0.09	-0.29
6	1.49	1.25	0.58	-0.17	-0.6	-0.62	-0.58	0.19	-0.24	-0.71
7	0.3	0.29	0.64	0.37	-0.05	-0.78	-0.36	-0.07	0.07	-0.11
8	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	-7.104	-6.97	-7.7623	-8.2057	-8.5677
S.E(Log q)	0.5744	0.4067	0.4378	0.7063	0.4239

Regression statistics :
418

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	1.32	-0.593	5.47	0.27	13	0.78	-7.1
4	1.42	-1.039	4.84	0.4	13	0.58	-6.97
5	0.8	0.67	8.53	0.55	13	0.36	-7.76
6	0.72	0.624	9.06	0.35	13	0.52	-8.21
7	1.14	-0.575	8.27	0.64	13	0.5	-8.57

1

Terminal year survivor and F summaries :

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

Year class = 2003

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	1	0	0	0	0	0	0
FLT13: Norway Ac	49335	0.6	0	0	1	0.399	0.094
F shrinkage mean	161999	0.5				0.601	0.029

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
100850	0.38	0.92	2	2.4	0.047

1

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

Year class = 2002

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	189809	0.646	0	0	1	0.154	0.241
FLT13: Norway Ac	149296	0.347	0.097	0.28	2	0.524	0.298
F shrinkage mean	365515	0.5				0.322	0.132

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
206742	0.26	0.28	4	1.077	0.223

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

Year class = 2001

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	57166	0.302	0.063	0.21	2	0.387	0.2
FLT13: Norway Ac	53165	0.277	0.287	1.04	3	0.436	0.214
F shrinkage mear	61260	0.5				0.177	0.188

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
56067	0.19	0.12	6	0.652	0.204

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

Year class = 2000

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	28668	0.244	0.367	1.5	3	0.465	0.254
FLT13: Norway Ac	33664	0.26	0.242	0.93	4	0.379	0.22
F shrinkage mear	33934	0.5				0.156	0.218

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
31280	0.17	0.17	8	0.994	0.235

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

Year class = 1999

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	47831	0.212	0.098	0.46	4	0.488	0.224
FLT13: Norway Ac	40945	0.235	0.033	0.14	5	0.371	0.257
F shrinkage mear	51786	0.5				0.141	0.208

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
45657	0.15	0.05	10	0.338	0.233

Age 8 Catchability constant w.r.t. time and dependent on age
420

Year class = 1998

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	22832	0.19	0.152	0.8	5	0.553	0.218
FLT13: Norway Ac	23135	0.229	0.152	0.66	5	0.316	0.215
F shrinkage mear	22064	0.5				0.131	0.224

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
22825	0.14	0.09	11	0.626	0.218

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

Year class = 1997

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	10527	0.191	0.087	0.46	5	0.528	0.221
FLT13: Norway Ac	7656	0.231	0.15	0.65	5	0.299	0.292
F shrinkage mear	10432	0.5				0.173	0.223

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9556	0.15	0.08	11	0.537	0.241

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

Year class = 1996

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT12: Nor new tra	13540	0.195	0.122	0.63	5	0.505	0.164
FLT13: Norway Ac	9893	0.239	0.135	0.57	5	0.278	0.219
F shrinkage mear	9487	0.5				0.217	0.227

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11489	0.16	0.09	11	0.56	0.191

Table 5.5.2

Run title : North-East Arctic saithe
At 18/04/2007 15:09
Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1960	1961	1962	1963	1964	1965	1966
AGE							
3	0.1412	0.2383	0.2772	0.1747	0.108	0.1562	0.1876
4	0.1843	0.1755	0.2297	0.3606	0.4012	0.0805	0.3616
5	0.5007	0.2695	0.1204	0.1825	0.276	0.3093	0.3131
6	0.2407	0.2519	0.2882	0.1797	0.1198	0.3557	0.2447
7	0.3847	0.0915	0.253	0.2108	0.1978	0.1786	0.2736
8	0.4184	0.1206	0.0942	0.1734	0.2195	0.1772	0.1219
9	0.3585	0.1479	0.1645	0.1355	0.3055	0.369	0.1106
10	0.3832	0.177	0.1849	0.1771	0.2248	0.2795	0.2138
+gp	0.3832	0.177	0.1849	0.1771	0.2248	0.2795	0.2138
0 FBAR 4	0.3276	0.1971	0.2228	0.2334	0.2487	0.231	0.2983

Table 8 Fishing mortality (F) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0.1886	0.2041	0.3402	0.188	0.3511	0.5893	0.4905	0.6669	0.5962	0.9054
4	0.3278	0.1709	0.1406	0.5146	0.4216	0.4299	0.4766	0.5911	0.459	0.6942
5	0.4319	0.1024	0.2354	0.2432	0.4348	0.3782	0.411	0.6231	0.4556	0.661
6	0.1522	0.1649	0.1307	0.3709	0.261	0.2894	0.3693	0.637	0.3552	0.4704
7	0.1595	0.0391	0.1356	0.2034	0.3929	0.2409	0.3373	0.5334	0.5379	0.5163
8	0.2757	0.0747	0.0721	0.348	0.1697	0.2451	0.2654	0.4017	0.656	0.4431
9	0.1777	0.1274	0.0885	0.2271	0.3262	0.1569	0.321	0.3673	0.4563	0.592
10	0.2406	0.102	0.133	0.28	0.3188	0.2635	0.3429	0.5166	0.496	0.541
+gp	0.2406	0.102	0.133	0.28	0.3188	0.2635	0.3429	0.5166	0.496	0.541
0 FBAR 4	0.2679	0.1193	0.1606	0.333	0.3776	0.3346	0.3986	0.5961	0.4519	0.5855

Table 8 Fishing mortality (F) at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0.786	0.6157	0.4447	0.5173	0.4113	0.4036	0.2139	0.7555	0.7856	0.1169
4	0.6807	0.524	0.6834	0.5184	0.5846	0.6568	0.5372	0.8244	0.5077	0.4851
5	0.5207	0.5675	0.5606	0.6405	0.6683	0.8688	0.8444	0.5814	0.4129	0.5259
6	0.3522	0.467	0.3991	0.5357	0.5632	0.5853	0.5406	0.81	0.5472	0.4993
7	0.4538	0.4574	0.6258	0.5721	0.4246	0.3134	0.4399	0.3683	0.7109	0.6401
8	0.4306	0.3556	0.6249	0.6732	0.8957	0.3812	0.6972	0.5068	0.4643	0.641
9	0.4163	0.5508	0.4825	0.1766	0.3908	0.5214	0.4222	0.8814	0.5099	0.3958
10	0.4379	0.4833	0.543	0.5238	0.5936	0.5384	0.5939	0.6353	0.5333	0.5449
+gp	0.4379	0.4833	0.543	0.5238	0.5936	0.5384	0.5939	0.6353	0.5333	0.5449
0 FBAR 4	0.5019	0.504	0.5672	0.5666	0.5602	0.6061	0.5905	0.646	0.5447	0.5376

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0.1239	0.1168	0.2321	0.457	0.3637	0.1272	0.0865	0.036	0.0496	0.0775
4	0.4176	0.3905	0.445	0.5631	0.5198	0.3005	0.2588	0.1908	0.401	0.2213
5	0.2965	0.5398	0.7785	0.3877	0.3765	0.4548	0.5058	0.3416	0.3419	0.2407
6	0.5704	0.5853	0.6773	0.5858	0.374	0.7444	0.5742	0.6837	0.3675	0.2584
7	0.9417	1.2083	0.467	0.6348	0.4594	0.7734	0.5715	0.7413	0.3058	0.3823
8	0.3493	1.1009	0.5641	0.5919	0.4327	0.8744	0.5279	0.4949	0.3793	0.3538
9	0.6662	1.0593	0.4368	0.5501	0.4323	0.5205	0.7932	0.3035	0.1453	0.8342
10	0.5696	0.9084	0.5898	0.5546	0.4179	0.6798	0.5997	0.5171	0.3098	0.3959
+gp	0.5696	0.9084	0.5898	0.5546	0.4179	0.6798	0.5997	0.5171	0.3098	0.3959
0 FBAR 4	0.5566	0.681	0.5919	0.5428	0.4324	0.5683	0.4776	0.4893	0.3541	0.2757

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR
AGE											
3	0.0686	0.0272	0.0385	0.0762	0.0224	0.0222	0.0227	0.0077	0.0721	0.0469	0.0422
4	0.116	0.127	0.1432	0.1198	0.0878	0.1354	0.2343	0.0763	0.1262	0.2235	0.142
5	0.2145	0.1666	0.2656	0.1268	0.2044	0.1778	0.1449	0.2413	0.1669	0.2036	0.2039
6	0.2794	0.3086	0.2129	0.1905	0.2077	0.3052	0.1551	0.161	0.2572	0.2348	0.2177
7	0.3063	0.2785	0.3048	0.1881	0.1882	0.1869	0.175	0.2409	0.2452	0.2331	0.2397
8	0.255	0.1988	0.172	0.2118	0.1397	0.1644	0.2946	0.224	0.2934	0.2176	0.245
9	0.1599	0.156	0.1769	0.1886	0.1783	0.1492	0.1963	0.2383	0.3454	0.2407	0.2748
10	0.199	0.2103	0.1795	0.2076	0.2165	0.1917	0.2292	0.2603	0.3812	0.1911	0.2775
+gp	0.199	0.2103	0.1795	0.2076	0.2165	0.1917	0.2292	0.2603	0.3812	0.1911	
0 FBAR 4	0.2291	0.2202	0.2316	0.1563	0.172	0.2013	0.1773	0.1799	0.1989	0.2238	

Table 5.5.3

Run title : North-East Arctic saithe

At 18/04/2007 15:09

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Terminal Fs derived using XSA (With F shrinkage)

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

	YEAR	1960	1961	1962	1963	1964	1965	1966
	AGE							
	3	88173	92920	170143	289935	97186	283653	144689
	4	85921	62681	59948	105582	199330	71425	198653
	5	38001	58508	43057	39010	60271	109269	53953
	6	26165	18857	36586	31252	26611	37443	65664
	7	16897	16840	12001	22453	21379	19328	21479
	8	7761	9416	12582	7630	14890	14362	13236
	9	4823	4181	6833	9375	5252	9788	9850
	10	2580	2759	2953	4746	6703	3168	5541
	+gp	5253	8334	11260	12044	19432	16183	16565
0	TOT/	275574	274496	355364	522026	451054	564620	529629

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

	YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	AGE										
	3	190738	150801	296371	280751	287484	161777	217484	83523	149692	231999
	4	98200	129322	100667	172674	190463	165682	73476	109025	35101	67514
	5	113296	57927	89245	71607	84508	102299	88245	37350	49425	18160
	6	32298	60225	42811	57741	45971	44794	57383	47899	16400	25657
	7	42090	22711	41814	30755	32626	28991	27458	32476	20741	9413
	8	13376	29379	17882	29893	20546	18033	18655	16044	15597	9916
	9	9593	8313	22322	13622	17281	14197	11554	11713	8790	6627
	10	7220	6576	5992	16728	8887	10210	9936	6862	6641	4560
	+gp	17951	13243	4518	12585	22073	14934	14828	10361	11585	7538
0	TOT/	524762	478496	621623	686356	709838	560918	519019	355252	313972	381384

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

	YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	AGE										
	3	201094	117719	190762	111632	275149	115583	98953	86429	99348	221457
	4	76813	75018	52071	100116	54483	149309	63204	65413	33242	37077
	5	27609	31838	36369	21524	48811	24861	63382	30241	23485	16381
	6	7677	13430	14778	16999	9288	20484	8538	22305	13843	12723
	7	13123	4420	6893	8118	8145	4330	9340	4071	8124	6557
	8	4599	6825	2290	3018	3751	4362	2591	4925	2306	3267
	9	5212	2448	3916	1004	1261	1254	2439	1056	2429	1187
	10	3001	2814	1155	1979	689	698	610	1309	358	1194
	+gp	3503	6140	3111	4370	1535	1177	1854	2083	1855	742
0	TOT/	342632	260651	311345	268760	403112	322057	250911	217832	184989	300586

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

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE										
	3	169435	81457	66951	71685	248921	412751	301586	220712	392109	155774
	4	161304	122553	59339	43459	37162	141654	297569	226456	174317	305488
	5	18688	86977	67902	31133	20262	18093	85876	188074	153201	95569
	6	7927	11375	41508	25523	17297	11385	9401	42397	109420	89105
	7	6322	3669	5187	17263	11633	9743	4428	4334	17521	62033
	8	2830	2019	897	2662	7491	6016	3681	2047	1691	10565
	9	1409	1634	550	418	1206	3979	2055	1778	1022	947
	10	654	593	464	291	197	641	1936	761	1074	723
	+gp	2006	186	500	691	574	978	354	1775	1207	1589
0	TOT/	370575	310462	243297	193124	344744	605240	706885	688333	851562	721794

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 60-**	AMST 60-**
AGE													
3	196575	127223	282806	138241	191374	333362	114848	143168	414480	129094	0	166694	186320
4	118027	150275	101365	222806	104881	153215	266949	91917	116319	315747	100850	101978	120248
5	200450	86048	108363	71919	161818	78649	109559	172913	69726	83943	206742	56747	70981
6	61506	132435	59641	68025	51872	107990	53904	77598	111214	48313	56067	30195	39825
7	56343	38081	79639	39467	46034	34505	65159	37792	54084	70404	31280	16357	22927
8	34651	33958	23599	48074	26773	31222	23434	44781	24317	34653	45657	8743	13634
9	6072	21984	22791	16269	31847	19062	21686	14290	29305	14846	22825	4684	8118
10	337	4237	15399	15634	11030	21816	13444	14591	9219	16985	9556	2592	5104
+gp	890	2284	3996	7150	10967	15083	22009	25576	7872	19439	24636		

Table 5.5.4

Run title : North-East Arctic saithe
At 18/04/2007 15:09

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1960	1961	1962	1963	1964	1965	1966
AGE							
3	0	0	0	0	0	0	0
4	859	627	599	1056	1993	714	1987
5	20901	32179	23681	21455	33149	60098	29674
6	22240	16028	31098	26564	22619	31827	55815
7	16559	16503	11761	22004	20952	18941	21049
8	7761	9416	12582	7630	14890	14362	13236
9	4823	4181	6833	9375	5252	9788	9850
10	2580	2759	2953	4746	6703	3168	5541
+gp	5253	8334	11260	12044	19432	16183	16565

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	982	1293	1007	1727	1905	1657	735	1090	351	675
5	62313	31860	49085	39384	46480	56264	48535	20543	27184	9988
6	27453	51191	36389	49080	39076	38075	48776	40714	13940	21809
7	41248	22256	40978	30140	31973	28412	26909	31826	20326	9225
8	13376	29379	17882	29893	20546	18033	18655	16044	15597	9916
9	9593	8313	22322	13622	17281	14197	11554	11713	8790	6627
10	7220	6576	5992	16728	8887	10210	9936	6862	6641	4560
+gp	17951	13243	4518	12585	22073	14934	14828	10361	11585	7538

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

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	768	750	521	1001	545	1493	632	654	1330	1112
5	15185	17511	20003	11838	26846	13674	34860	16632	17849	12450
6	6526	11415	12561	14449	7895	17411	7257	18959	12043	11324
7	12861	4331	6755	7955	7982	4243	9153	3990	7474	6229
8	4599	6825	2290	3018	3751	4362	2591	4925	2306	3267
9	5212	2448	3916	1004	1261	1254	2439	1056	2429	1187
10	3001	2814	1155	1979	689	698	610	1309	358	1194
+gp	3503	6140	3111	4370	1535	1177	1854	2083	1855	742

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	4839	11030	9494	7388	4459	7083	8927	20381	24404	42768
5	11774	48707	38025	20548	14589	11580	46373	94037	81196	47784
6	6976	8417	26565	15824	12973	9563	8555	36037	88630	65047
7	6322	3669	5187	15709	10470	8671	4339	4204	15769	52107
8	2830	2019	897	2662	7491	6016	3681	2047	1657	10248
9	1409	1634	550	418	1206	3979	2055	1778	1022	947
10	654	593	464	291	197	641	1936	761	1074	723
+gp	2006	186	500	691	574	978	354	1775	1207	1589

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	12983	12022	4055	11140	5244	10725	26695	11949	19774	53677
5	84189	23233	30342	19418	61491	35392	50397	95102	42533	61279
6	36289	70191	32206	47617	40460	92872	46896	65182	94532	41549
7	41694	26276	57340	31969	43272	32435	61901	34768	49757	63363
8	28414	25808	17700	42305	24899	29974	21794	40303	21156	30841
9	6072	21984	22791	16269	31847	19062	21686	14290	29305	14846
10	337	4237	15399	15634	11030	21816	13444	14591	9219	16985
+gp	890	2284	3996	7150	10967	15083	22009	25576	7872	19439

Table 5.5.5

Run title : North-East Arctic saithe

At 18/04/2007 15:09 424

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1960	1961	1962	1963	1964	1965	1966
AGE							
3	62603	65973	120802	205854	69002	201394	102729
4	95372	69576	66543	117196	221257	79282	220505
5	61942	95368	70183	63586	98241	178108	87943
6	60964	43936	85246	72817	62003	87243	152998
7	53395	53214	37924	70952	67559	61076	67874
8	31275	37946	50706	30748	60005	57880	53339
9	23490	20363	33278	45655	25578	47668	47968
10	14524	15534	16625	26719	37736	17837	31196
+gp	42179	66999	89226	94556	151201	128799	134275
0 TOTAL	445745	468910	570532	728082	792583	859287	898826

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	135424	107069	210424	199333	204113	114862	154413	59301	106281	164719
4	109002	143548	111741	191669	211414	183907	81559	121018	38962	74941
5	184672	94421	145470	116720	137749	166747	143840	60881	80563	29600
6	75254	140323	99749	134536	107113	104371	133702	111605	38212	59781
7	133004	71766	132132	97187	103098	91613	86767	102623	65541	29746
8	53906	118396	72064	120468	82799	72671	75178	64656	62856	39962
9	46718	40484	108710	66337	84157	69137	56270	57040	42809	32272
10	40649	37021	33734	94177	50032	57485	55938	38634	37392	25674
+gp	143497	102186	33793	93178	155656	111662	109506	74774	82569	55175
0 TOTAL	922127	855213	947816	1113606	1136132	972455	897173	690532	555183	511871

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

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	142777	83580	135441	88189	200859	88999	103901	61364	74511	130660
4	85262	83270	57799	127147	76276	167226	84061	82420	44211	45234
5	45003	51896	59282	43694	100063	50220	117891	61086	48614	32272
6	17888	31291	34432	43347	25635	53463	23905	60222	36407	29263
7	41470	13966	21781	26707	26880	14158	37361	15796	26646	18819
8	18533	27504	9230	13100	16428	17054	10831	22016	9132	12153
9	25384	11921	19069	5169	7500	5881	13000	5663	11028	5103
10	16898	15844	6505	11378	4401	3931	3462	7934	1988	5602
+gp	25902	46214	24293	30317	10502	8894	16066	14976	14859	4894
0 TOTAL	419117	365487	367831	389048	468544	409825	410477	331478	267398	284000

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	89800	50503	49543	50896	169266	276543	183968	114770	219581	91907
4	135495	106621	56372	43459	39021	143070	294593	172106	137711	250500
5	31023	113940	95063	45142	37485	34739	141696	233211	182309	127106
6	18390	27640	73884	53343	41340	25957	23126	89882	187109	163954
7	18778	14198	15352	42985	35829	26989	12619	13956	50284	153841
8	11321	10860	3347	9983	25096	19252	11153	7840	6392	39408
9	6650	9527	2539	1630	5403	14842	7622	8337	4148	4093
10	3558	3176	2166	1960	920	4069	8692	4041	5695	3863
+gp	13850	1384	3597	4331	3778	7459	2224	10595	9127	11236
0 TOTAL	328866	337849	301864	253730	358138	552920	685692	654739	802355	845908

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	121877	86512	189480	82945	143530	230020	75800	101649	244543	98111
4	112126	150275	106433	229490	117466	154748	242923	94675	103524	359951
5	248558	127351	157126	117227	249199	117974	155573	236891	103891	135149
6	105791	247654	115107	142852	105819	212741	102417	147436	232436	106773
7	132406	98250	180779	105378	119688	87643	165504	91456	116822	195723
8	107418	104251	70090	150952	84067	101473	60694	133897	72950	116087
9	25443	90792	82274	61983	115604	71865	75686	49300	94948	59385
10	1950	23048	63136	68948	50078	94026	50416	54425	35215	77451
+gp	6619	18434	22297	43828	58782	84766	107846	125323	43219	119936
0 TOTAL	862188	946566	986722	1003604	1044233	1155254	1036859	1035050	1047550	1268566

Table 5.5.6

Run title : North-East Arctic saithe
At 18/04/2007 15:09

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1960	1961	1962	1963	1964	1965	1966
AGE							
3	0	0	0	0	0	0	0
4	954	696	665	1172	2213	793	2205
5	34068	52452	38601	34972	54033	97959	48369
6	51820	37346	72459	61894	52703	74156	130048
7	52327	52150	37165	69533	66207	59854	66516
8	31275	37946	50706	30748	60005	57880	53339
9	23490	20363	33278	45655	25578	47668	47968
10	14524	15534	16625	26719	37736	17837	31196
+gp	42179	66999	89226	94556	151201	128799	134275
0 TOTSF	250637	283486	338725	365249	449676	484948	513916

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	1090	1435	1117	1917	2114	1839	816	1210	390	749
5	101570	51931	80009	64196	75762	91711	79112	33484	44310	16280
6	63966	119275	84787	114356	91046	88715	113647	94864	32480	50814
7	130344	70330	129489	95243	101036	89781	85031	100571	64230	29151
8	53906	118396	72064	120468	82799	72671	75178	64656	62856	39962
9	46718	40484	108710	66337	84157	69137	56270	57040	42809	32272
10	40649	37021	33734	94177	50032	57485	55938	38634	37392	25674
+gp	143497	102186	33793	93178	155656	111662	109506	74774	82569	55175
0 TOTSF	581740	541059	543703	649873	642603	583001	575498	465234	367034	250078

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

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	853	833	578	1271	763	1672	841	824	1768	1357
5	24752	28543	32605	24032	55035	27621	64840	33597	36947	24526
6	15204	26597	29267	36845	21790	45443	20320	51189	31674	26044
7	40641	13687	21345	26173	26342	13875	36614	15480	24514	17878
8	18533	27504	9230	13100	16428	17054	10831	22016	9132	12153
9	25384	11921	19069	5169	7500	5881	13000	5663	11028	5103
10	16898	15844	6505	11378	4401	3931	3462	7934	1988	5602
+gp	25902	46214	24293	30317	10502	8894	16066	14976	14859	4894
0 TOTSF	168166	171143	142892	148285	142761	124371	165972	151679	131912	97558

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	4065	9596	9020	7388	4682	7154	8838	15490	19279	35070
5	19544	63806	53235	29794	26989	22233	76516	116606	96624	63553
6	16184	20454	47286	33073	31005	21804	21044	76399	151558	119686
7	18778	14198	15352	39117	32246	24020	12366	13538	45256	129226
8	11321	10860	3347	9983	25096	19252	11153	7840	6264	38226
9	6650	9527	2539	1630	5403	14842	7622	8337	4148	4093
10	3558	3176	2166	1960	920	4069	8692	4041	5695	3863
+gp	13850	1384	3597	4331	3778	7459	2224	10595	9127	11236
0 TOTSF	93950	133000	136542	127275	130120	120832	148456	252845	337951	404953

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
3	0	0	0	0	0	0	0	0	0	0
4	12334	12022	4257	11475	5873	10832	24292	12308	17599	61192
5	104394	34385	43995	31651	94696	53088	71564	130290	63374	98659
6	62417	131256	62158	99996	82539	182957	89103	123846	197571	91824
7	97981	67792	130161	85356	112507	82384	157228	84139	107476	176150
8	88083	79231	52568	132838	78182	97414	56445	120507	63467	103318
9	25443	90792	82274	61983	115604	71865	75686	49300	94948	59385
10	1950	23048	63136	68948	50078	94026	50416	54425	35215	77451
+gp	6619	18434	22297	43828	58782	84766	107846	125323	43219	119936

Table 5.5.7

Run title : North-East Arctic saithe

426

At 18/04/2007 15:09

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RE(Age 3	TOTALE	TOTSPE	LANDIN	YIELD/S:	FBAR 4- 7
1960	88173	445745	250637	133515	0.5327	0.3276
1961	92920	468910	283486	105951	0.3737	0.1971
1962	170143	570532	338725	120707	0.3564	0.2228
1963	289935	728082	365249	148627	0.4069	0.2334
1964	97186	792583	449676	197426	0.439	0.2487
1965	283653	859287	484948	185600	0.3827	0.231
1966	144689	898826	513916	203788	0.3965	0.2983
1967	190738	922127	581740	181326	0.3117	0.2679
1968	150801	855213	541059	110247	0.2038	0.1193
1969	296371	947816	543703	140060	0.2576	0.1606
1970	280751	1113606	649873	264924	0.4077	0.333
1971	287484	1136132	642603	241272	0.3755	0.3776
1972	161777	972455	583001	214334	0.3676	0.3346
1973	217484	897173	575498	213859	0.3716	0.3986
1974	83523	690532	465234	274121	0.5892	0.5961
1975	149692	555183	367034	233453	0.6361	0.4519
1976	231999	511871	250078	242486	0.9696	0.5855
1977	201094	419117	168166	182817	1.0871	0.5019
1978	117719	365487	171143	154464	0.9025	0.504
1979	190762	367831	142892	164180	1.149	0.5672
1980	111632	389048	148285	144554	0.9748	0.5666
1981	275149	468544	142761	175516	1.2294	0.5602
1982	115583	409825	124371	168034	1.3511	0.6061
1983	98953	410477	165972	156936	0.9456	0.5905
1984	86429	331478	151679	158786	1.0469	0.646
1985	99348	267398	131912	107183	0.8125	0.5447
1986	221457	284000	97558	70458	0.7222	0.5376
1987	169435	328866	93950	92391	0.9834	0.5566
1988	81457	337849	133000	114242	0.859	0.681
1989	66951	301864	136542	122310	0.8958	0.5919
1990	71685	253730	127275	95848	0.7531	0.5428
1991	248921	358138	130120	107326	0.8248	0.4324
1992	412751	552920	120832	127516	1.0553	0.5683
1993	301586	685692	148456	153584	1.0345	0.4776
1994	220712	654739	252845	146544	0.5796	0.4893
1995	392109	802355	337951	168378	0.4982	0.3541
1996	155774	845908	404953	171348	0.4231	0.2757
1997	196575	862188	399220	143629	0.3598	0.2291
1998	127223	946566	456961	153327	0.3355	0.2202
1999	282806	986722	460846	150373	0.3263	0.2316
2000	138241	1003604	536075	135945	0.2536	0.1563
2001	191374	1044233	598260	136402	0.228	0.172
2002	333362	1155254	677333	155246	0.2292	0.2013
2003	114848	1036859	632580	159757	0.2525	0.1773
2004	143168	1035050	700138	162140	0.2316	0.1799
2005	414480	1047550	622869	176678	0.2837	0.1989
2006	170027	1309499	787915	212480	0.2697	0.2238
Arith. Mean	189957	694231	363603	161278	0.6016	0.3823
0 Units	(Thousar	(Tonnes	(Tonnes	(Tonnes)		

Table 5.7.1 Prediction input data

MFDP version 1a
428
Run: 00
Time and date: 12:05 21.04.2007
Fbar age range: 4-7

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	170027	0.2	0	0	0	0.686667	4.22E-02	0.686667
4	132829	0.2	0.17	0	0	1.02	0.142	1.02
5	206742	0.2	0.73	0	0	1.49	0.203933	1.49
6	56067	0.2	0.86	0	0	2.066667	0.217667	2.066667
7	31280	0.2	0.9	0	0	2.453333	0.239767	2.453333
8	45657	0.2	0.89	0	0	3.113333	0.245	3.113333
9	22825	0.2	1	0	0	3.563333	0.2748	3.563333
10	9556	0.2	1	0	0	4.036667	0.277533	4.036667
11	24636	0.2	1	0	0	5.52	0.277533	5.52

2008

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	170027	0.2	0	0	0	0.686667	4.22E-02	0.686667
4	.	0.2	0.17	0	0	1.02	0.142	1.02
5	.	0.2	0.73	0	0	1.49	0.203933	1.49
6	.	0.2	0.86	0	0	2.066667	0.217667	2.066667
7	.	0.2	0.9	0	0	2.453333	0.239767	2.453333
8	.	0.2	0.89	0	0	3.113333	0.245	3.113333
9	.	0.2	1	0	0	3.563333	0.2748	3.563333
10	.	0.2	1	0	0	4.036667	0.277533	4.036667
11	.	0.2	1	0	0	5.52	0.277533	5.52

2009

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	170027	0.2	0	0	0	0.686667	4.22E-02	0.686667
4	.	0.2	0.17	0	0	1.02	0.142	1.02
5	.	0.2	0.73	0	0	1.49	0.203933	1.49
6	.	0.2	0.86	0	0	2.066667	0.217667	2.066667
7	.	0.2	0.9	0	0	2.453333	0.239767	2.453333
8	.	0.2	0.89	0	0	3.113333	0.245	3.113333
9	.	0.2	1	0	0	3.563333	0.2748	3.563333
10	.	0.2	1	0	0	4.036667	0.277533	4.036667
11	.	0.2	1	0	0	5.52	0.277533	5.52

Input units are thousands and kg - output in tonnes

Table 5.7.2 Short term prediction

MFDP version 1a
Run: ypr
00MFDP Index file 21.04.2007
Time and date: 12:34 21.04.2007
Fbar age range: 4-7

2007				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
1150939	799029	1.1792	0.2368	222525

2008					2009	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
1076899	757185	0.0000	0.0000	0	1234936	898229
.	757185	0.1000	0.0201	19812	1212977	878634
.	757185	0.2000	0.0402	39192	1191507	859489
.	757185	0.3000	0.0603	58148	1170513	840783
.	757185	0.4000	0.0803	76691	1149984	822507
.	757185	0.5000	0.1004	94831	1129910	804650
.	757185	0.6000	0.1205	112576	1110280	787201
.	757185	0.7000	0.1406	129936	1091083	770153
.	757185	0.8000	0.1607	146920	1072310	753494
.	757185	0.9000	0.1808	163536	1053951	737216
.	757185	1.0000	0.2008	179794	1035996	721309
.	757185	1.1000	0.2209	195700	1018436	705766
.	757185	1.2000	0.2410	211264	1001261	690577
.	757185	1.3000	0.2611	226493	984463	675735
.	757185	1.4000	0.2812	241395	968033	661230
.	757185	1.5000	0.3013	255977	951962	647055
.	757185	1.6000	0.3213	270247	936242	633203
.	757185	1.7000	0.3414	284212	920866	619665
.	757185	1.8000	0.3615	297879	905824	606434
.	757185	1.9000	0.3816	311255	891110	593504
.	757185	2.0000	0.4017	324346	876716	580866

Input units are thousands and kg - output in tonnes

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Table 5.10.1. Settings for long-term simulation runs

Run No.	F	3-year rule	Implementation error	Option for assessment error	Fishing pattern	Percent change in TAC	F below Bpa
1	0.35	No	No	1	97-05 av.	15	Flat
2	0.35	Yes	No	1	97-05 av.	15	Linear
3	0.35	Yes	Yes	1	97-05 av.	15	Linear
4	0.35	Yes	Yes	2	97-05 av.	15	Linear
5	0.35	Yes	Yes	3	97-05 av.	15	Linear
6	0.35	Yes	Yes	2	97-05 av.	10	Linear
7	0.35	Yes	Yes	3	97-05 av.	10	Linear
8	0.35	Yes	Yes	2	97-05 av.	20	Linear
9	0.35	Yes	Yes	3	97-05 av.	20	Linear
10	0.30	Yes	Yes	1	97-05 av.	15	Linear
11	0.30	Yes	Yes	2	97-05 av.	15	Linear
12	0.30	Yes	Yes	3	97-05 av.	15	Linear
13	0.25	Yes	Yes	1	97-05 av.	15	Linear
14	0.25	Yes	Yes	2	97-05 av.	15	Linear
15	0.25	Yes	Yes	3	97-05 av.	15	Linear
16	0.25	Yes	Yes	3	76-79 av.	15	Linear

Table 5.10.2. Results of long-term simulations. Catch, TSB and SSB in 1000 tonnes, recruits in millions

Run No.	Option for assessment error	In-put F	Realised F	Catch	TSB	SSB	Recr.	% years SSB< B_{lim}	% years SSB< B_{pa}	Average year-to-year change in TAC
1	1	0.35	0.35	194	844	439	203	0	0	5
2	1	0.35	0.35	195	846	440	204	0	0	3
3	1	0.35	0.37	194	813	413	202	0	0.001	3
4	2	0.35	0.29	185	1015	602	209	0	0	10
5	3	0.35	0.48	193	703	317	195	0	3	8
6	2	0.35	0.29	184	1016	602	209	0	0	8
7	3	0.35	0.48	193	704	318	195	0.005	3	7
8	2	0.35	0.29	185	1017	603	210	0	0	11
9	3	0.35	0.48	193	702	317	195	0	3	9
10	1	0.30	0.32	196	917	499	206	0	0	3
11	2	0.30	0.25	181	1140	713	212	0	0	10
12	3	0.30	0.41	198	790	384	201	0	0.049	8
13	1	0.25	0.26	194	1044	609	210	0	0	3
14	2	0.25	0.21	174	1291	850	214	0	0	9
15	3	0.25	0.33	200	897	473	205	0	0	8
16	3	0.35	0.44	157	477	203	182	2.6	68	8

Table 5.10.3. Settings for recovery simulation runs

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Run No.	F	3-year rule	Recruitment	Impleme ntation error	Option for assessment error	Percent change in TAC	F below Bpa
1	0.35	Yes	Modelled	Yes	1	15	Linear
2	0.35	Yes	Modelled	Yes	3	15	Linear
3	0.35	Yes	Lowest obs.	Yes	3	15	Linear

Table 5.10.4 Mean SSB (1000 tonnes) in 1986-1991 for different runs in a period of recovery

Run no.	Mean SSB 1986	Mean SSB 1987	Mean SSB 1988	Mean SSB 1989	Mean SSB 1990	Mean SSB 1991
1	98	87	181	203	227	279
2	98	87	164	182	191	231
3	97	84	108	112	131	162

Table 5.10.5 Probability of SSB < B_{pa} in 1986-1991 for different runs in a period of recovery

Run no.	P(SSB < B_{pa}) 1986	P(SSB < B_{pa}) 1987	P(SSB < B_{pa}) 1988	P(SSB < B_{pa}) 1989	P(SSB < B_{pa}) 1990	P(SSB < B_{pa}) 1991
1	1	1	0.9785	0.7795	0.4085	0.0595
2	1	1	1	0.954	0.886	0.413
3	1	1	1	1	1	1

Table 5.10.6 Probability of SSB< B_{lim} in 1986-1991 for different runs in a period of recovery

Run no.	P(SSB < B_{lim}) 1986	P(SSB < B_{lim}) 1987	P(SSB < B_{lim}) 1988	P(SSB < B_{lim}) 1989	P(SSB < B_{lim}) 1990	P(SSB < B_{lim}) 1991
1	1	1	0.0065	0	0	0
2	1	1	0.0745	0.0095	0.005	0
3	1	1	0.9995	0.995	0.667	0.0405

Table 5.10.7 Mean catches (1000 tonnes) in 1986-1991 for different runs in a period of recovery

Run no.	Mean catch 1986	Mean catch 1987	Mean catch 1988	Mean catch 1989	Mean catch 1990	Mean catch 1991
1	71	43	95	114	128	136
2	71	57	100	126	138	138
3	62	35	50	56	67	78

Run no.	Mean F 1986	Mean F 1987	Mean F 1988	Mean F 1989	Mean F 1990	Mean F 1991
1	0.54	0.21	0.36	0.41	0.41	0.39
2	0.54	0.33	0.49	0.57	0.54	0.51
3	0.54	0.30	0.33	0.37	0.40	0.41

434

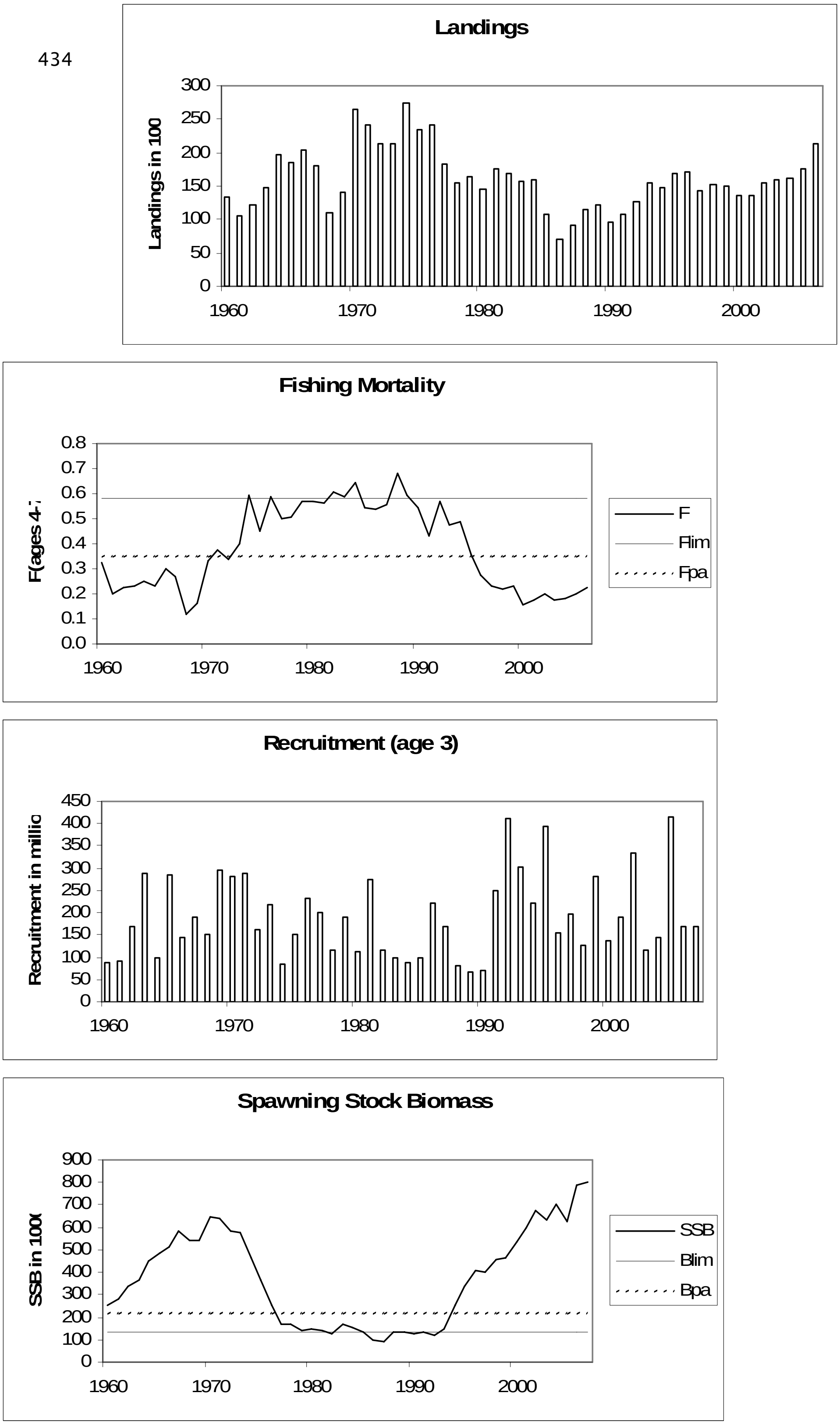
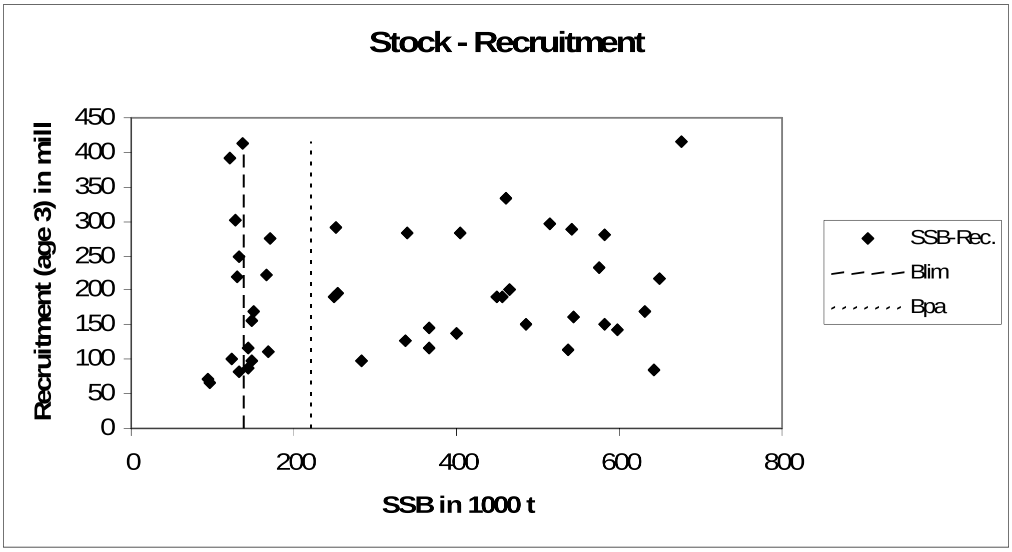
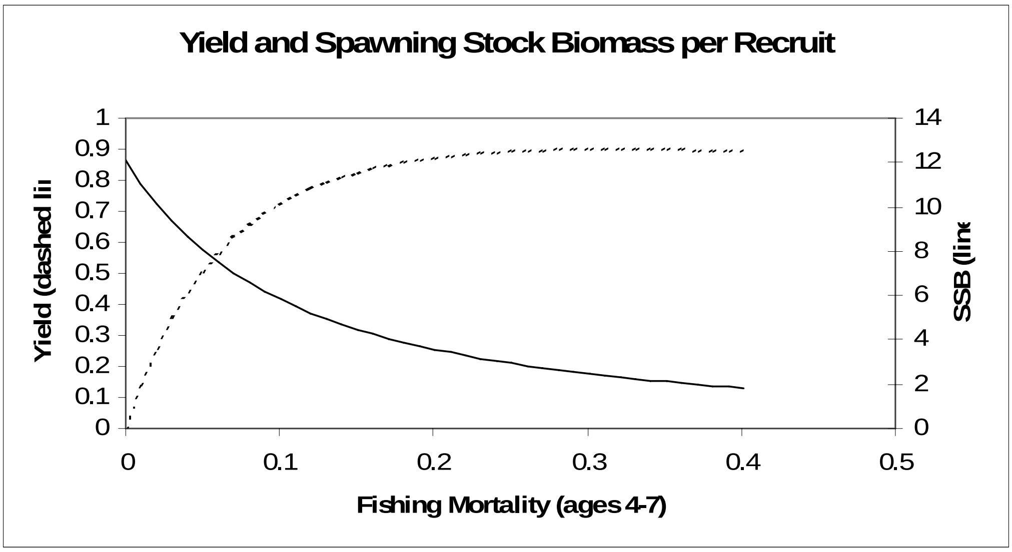


Figure 5.1.1 North-East Arctic saithe (Sub-areas I and II)





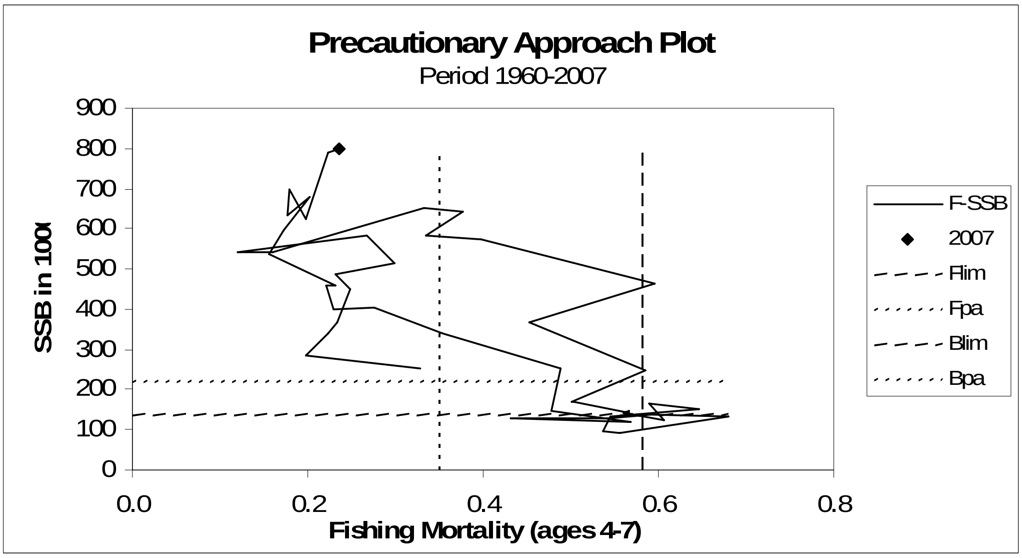


Figure 5.1.1 (continued)

436

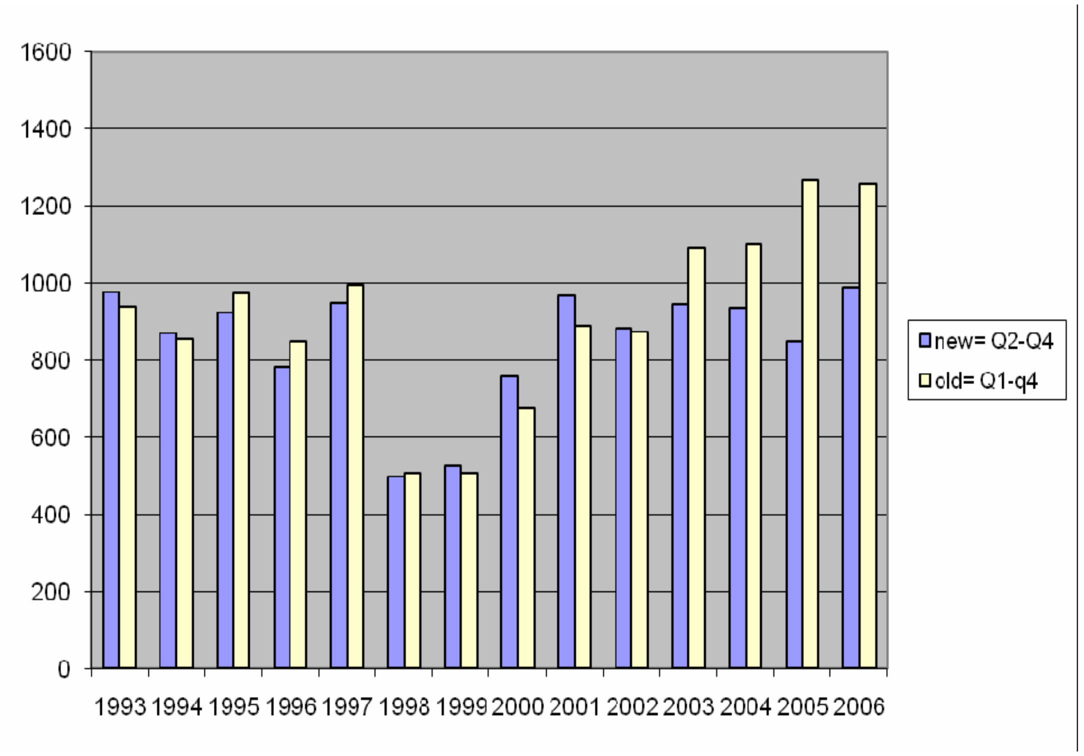
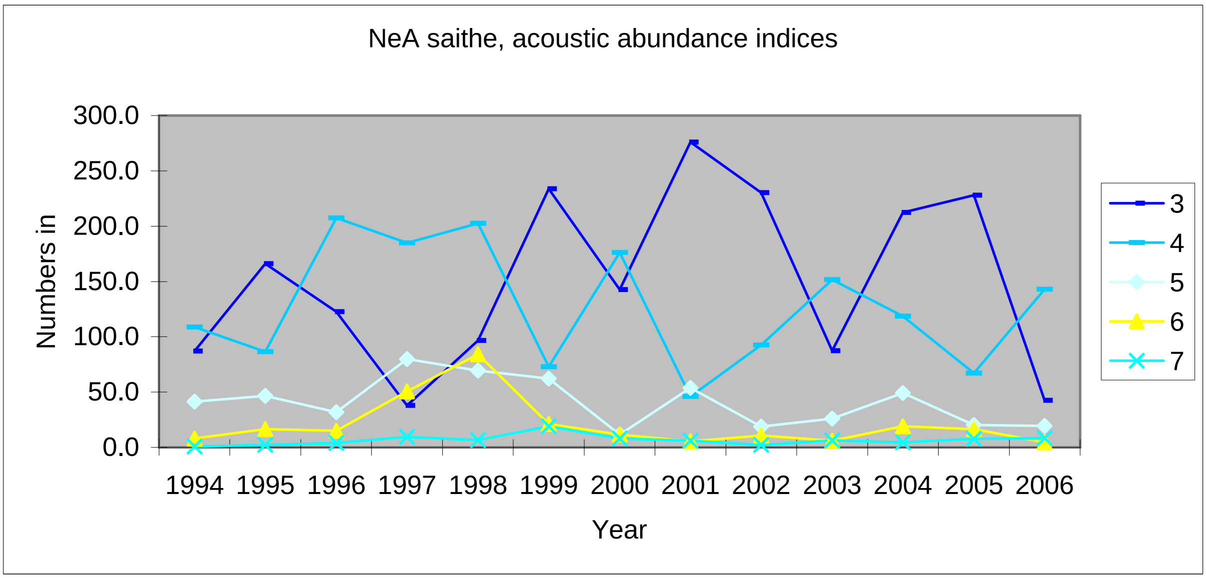


Figure 5.2.1. Norwegian trawl CPUE by year, averaged over quarter 1-4 (old) and over quarter 2-4 (new, applied from AFWG 2006)



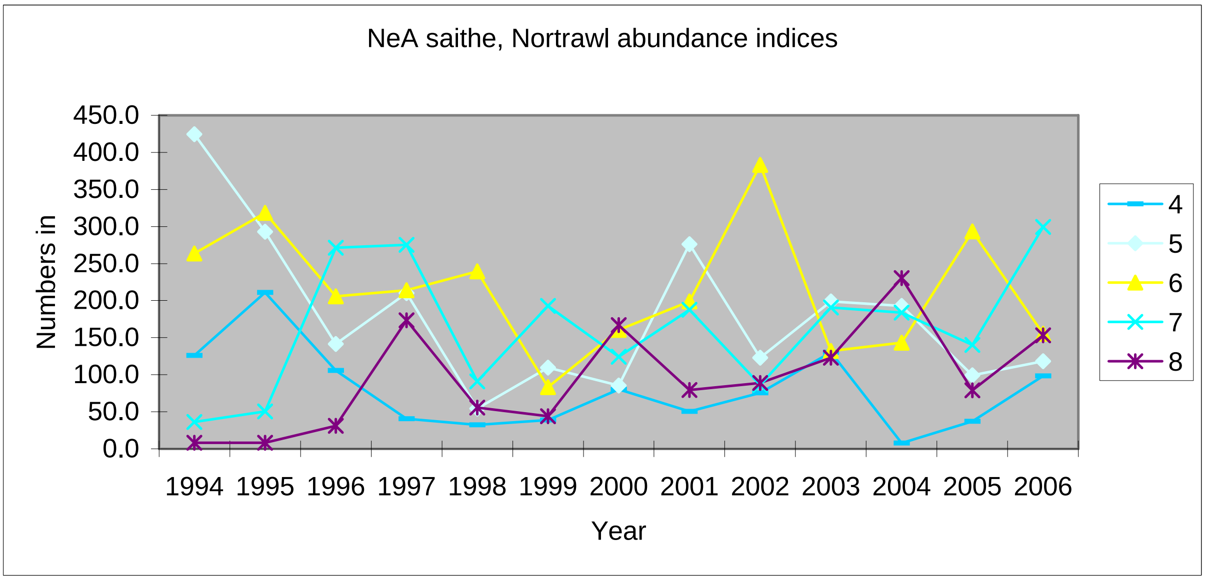


Fig 5.3.5 NeA saithe tuning abundance indices

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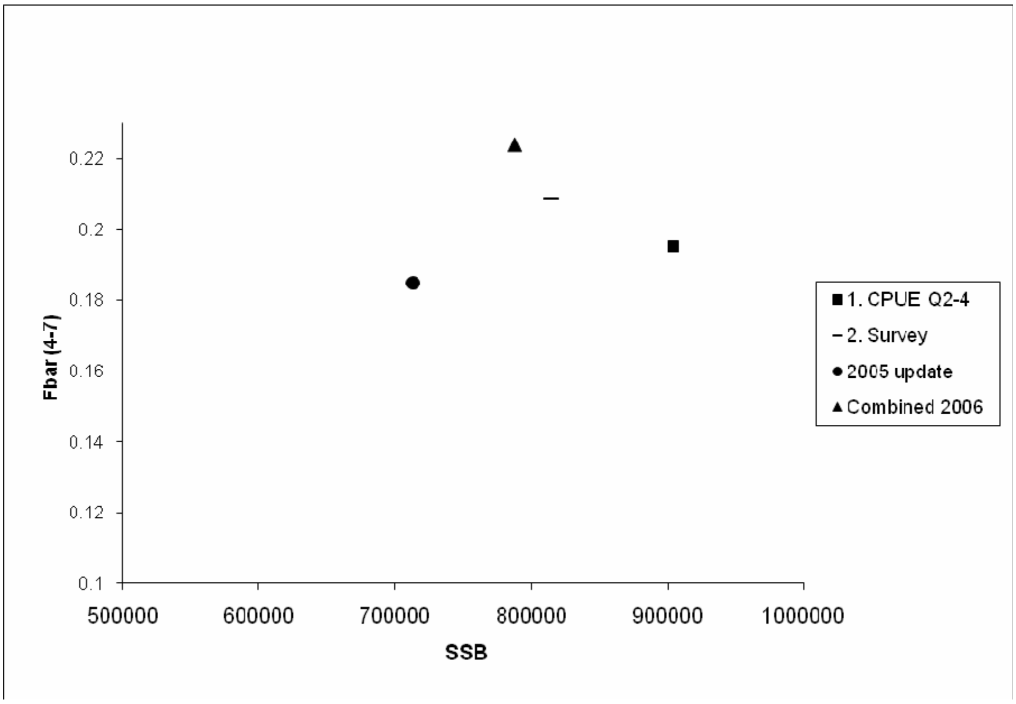


Figure 5.4.1 Comparison of SSB and F4-7 in 2006 from single fleet and combined XSA runs. SSB and F4-7 in 2005 from an updated 2005-data run is also presented.

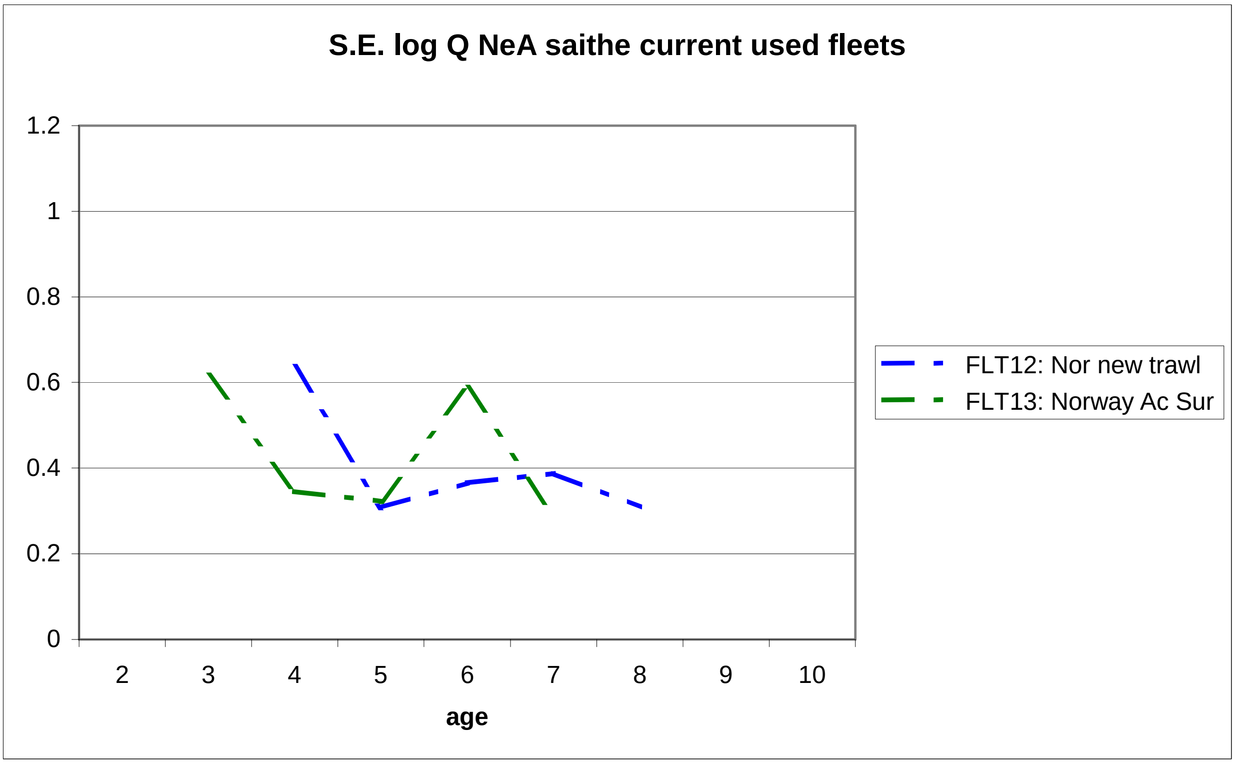
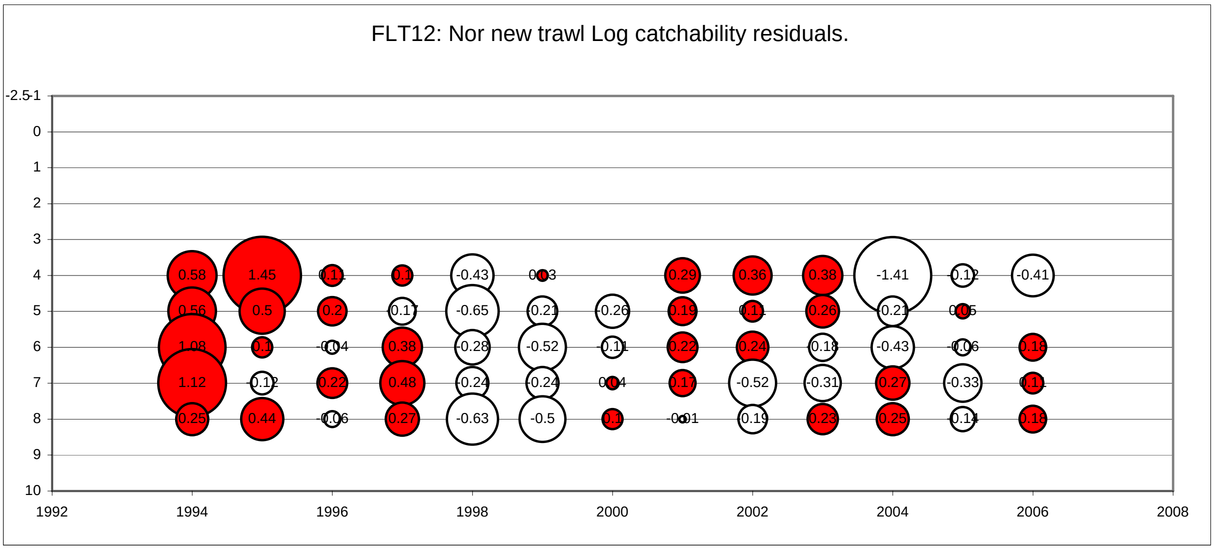


Figure 5.4.2. S.E. log catchability from two XSA single fleet tuning runs



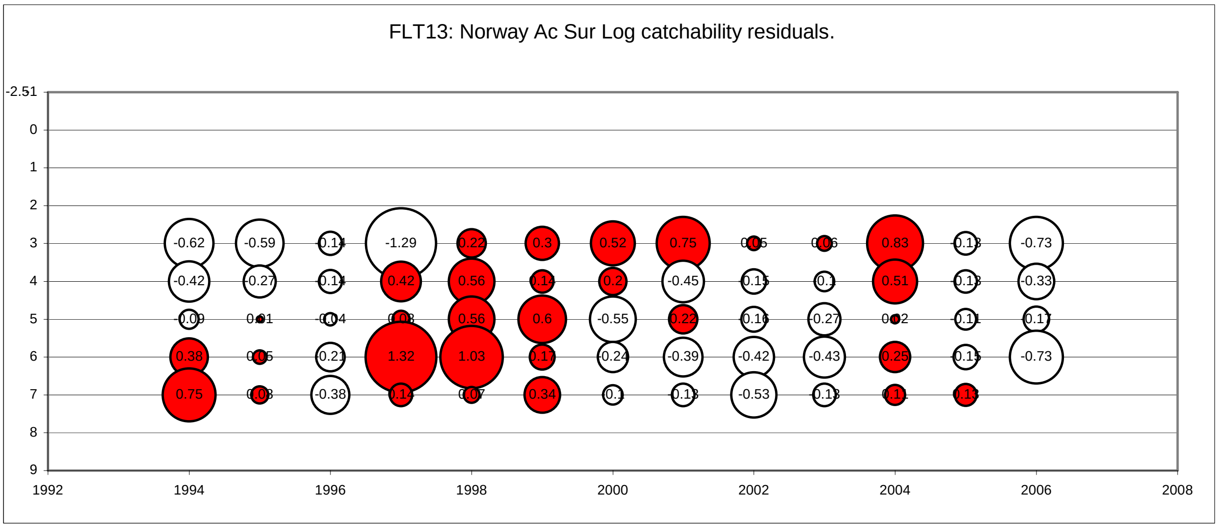


Figure 5.5.1 Final run log Q residuals.

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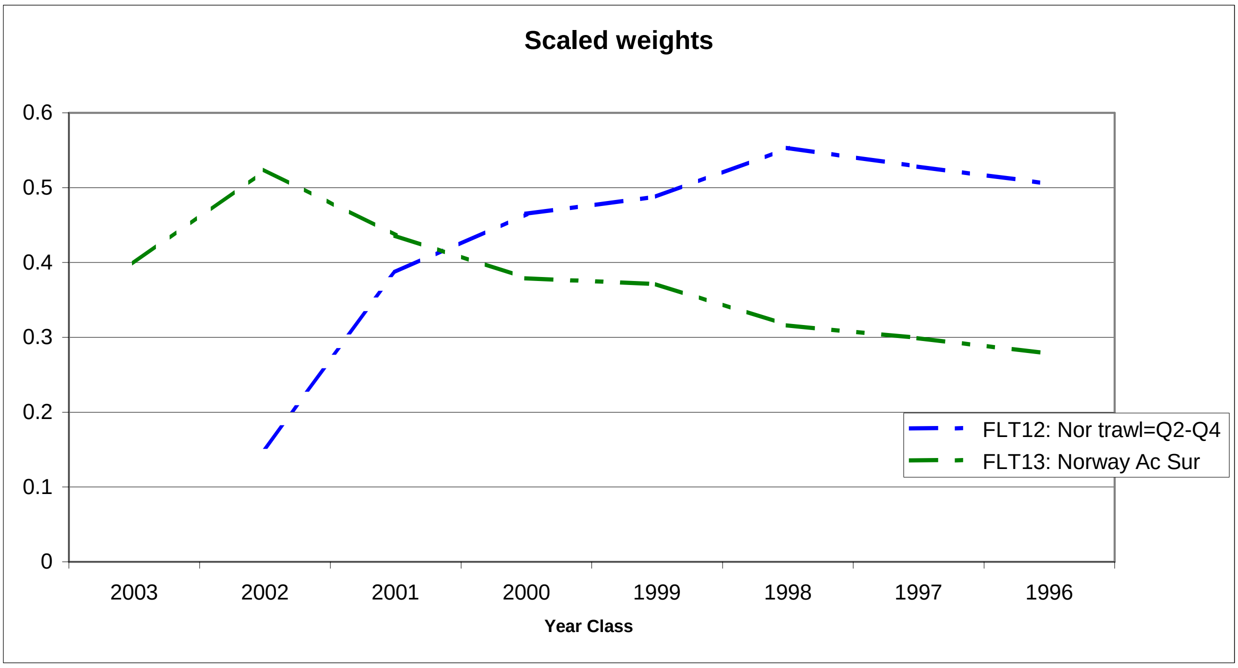


Figure 5.5.2 Scaled weights at age from final XSA run with 2 fleets.

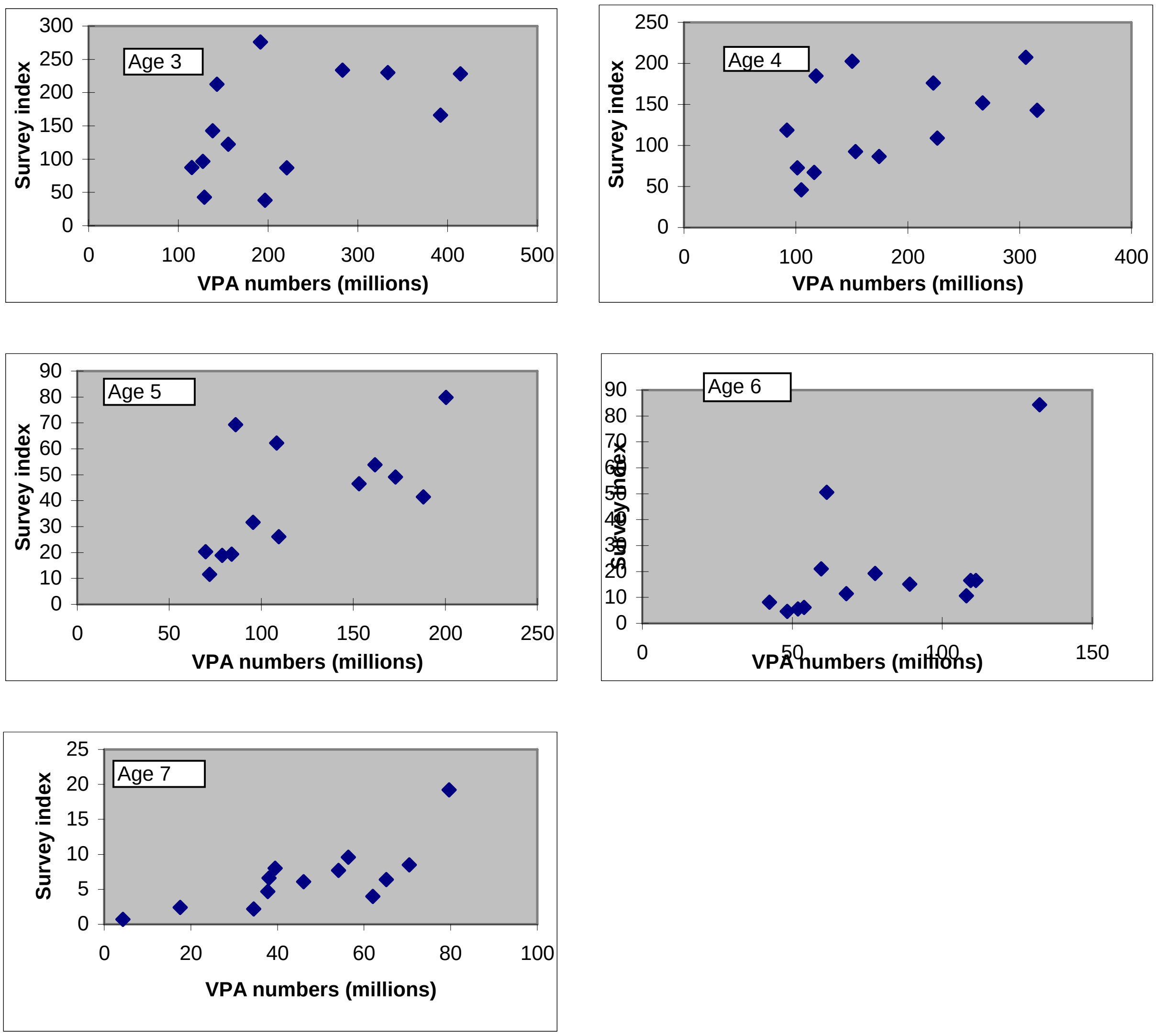


Figure 5.5.3A. North-East Arctic Saithe - Acoustic survey vs VPA

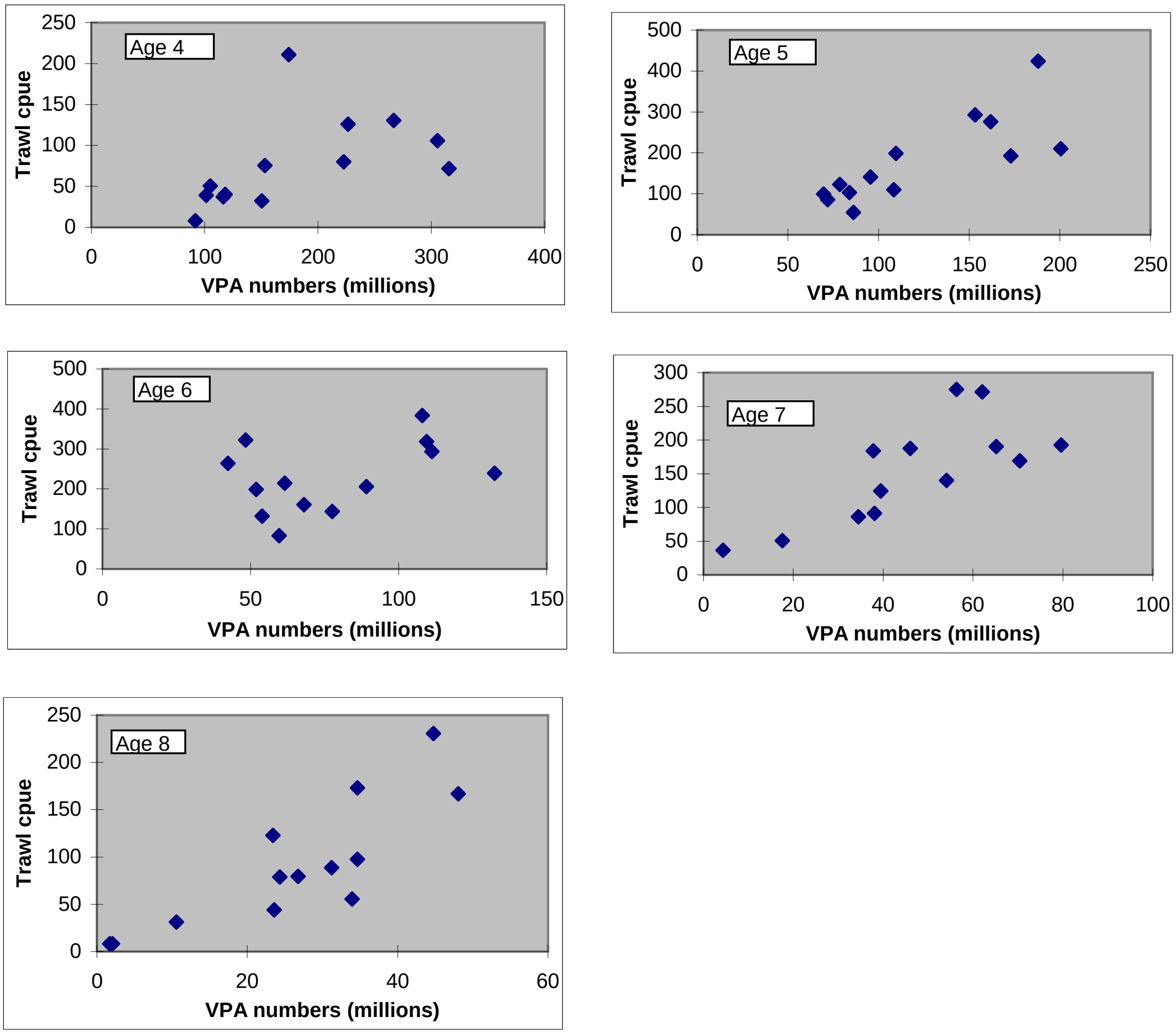


Figure 5.5.3B. North-East Arctic Saithe - Norwegian trawl vs VPA

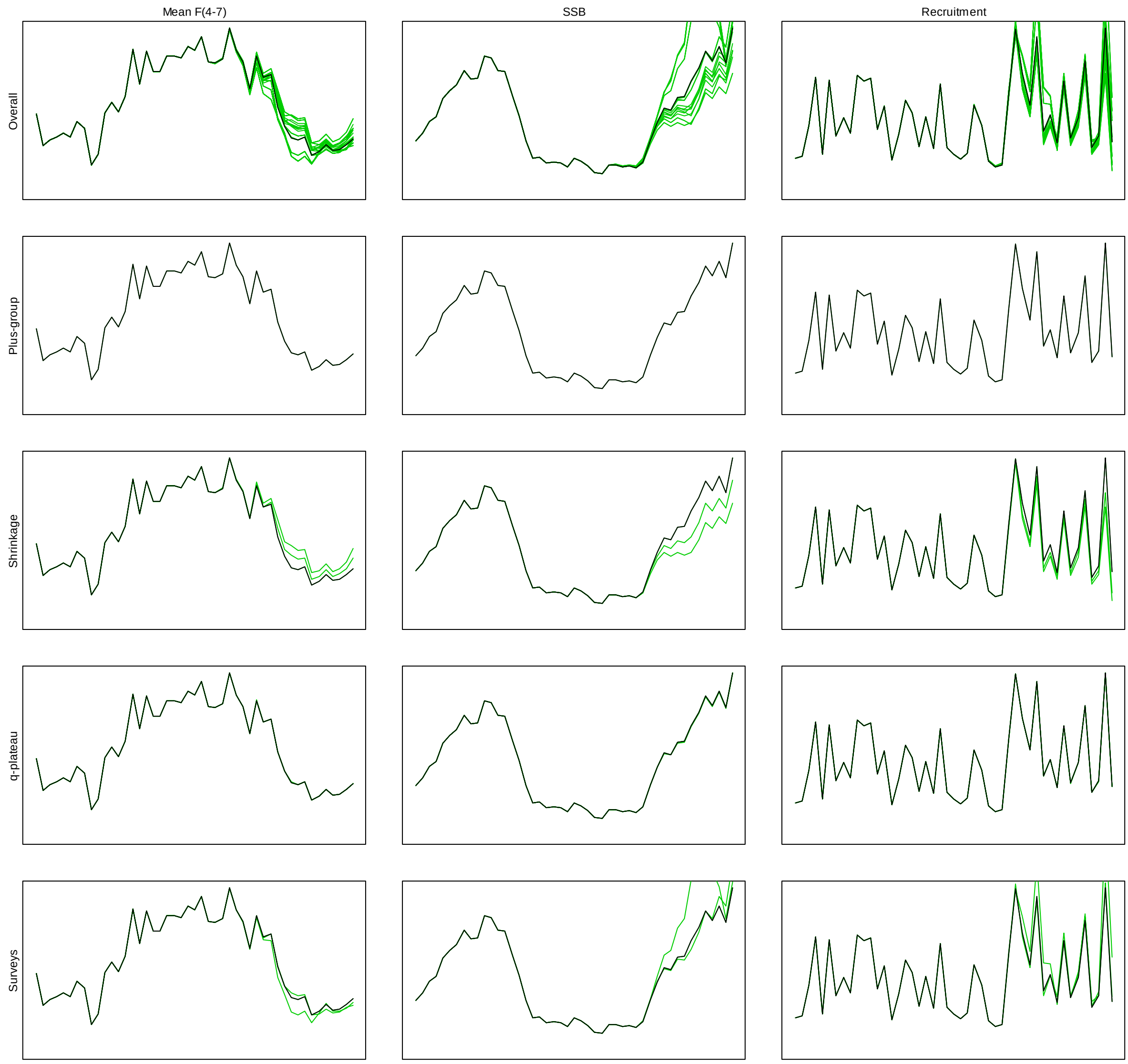


Figure 5.5.4 Sensitivity analysis for final XSA run

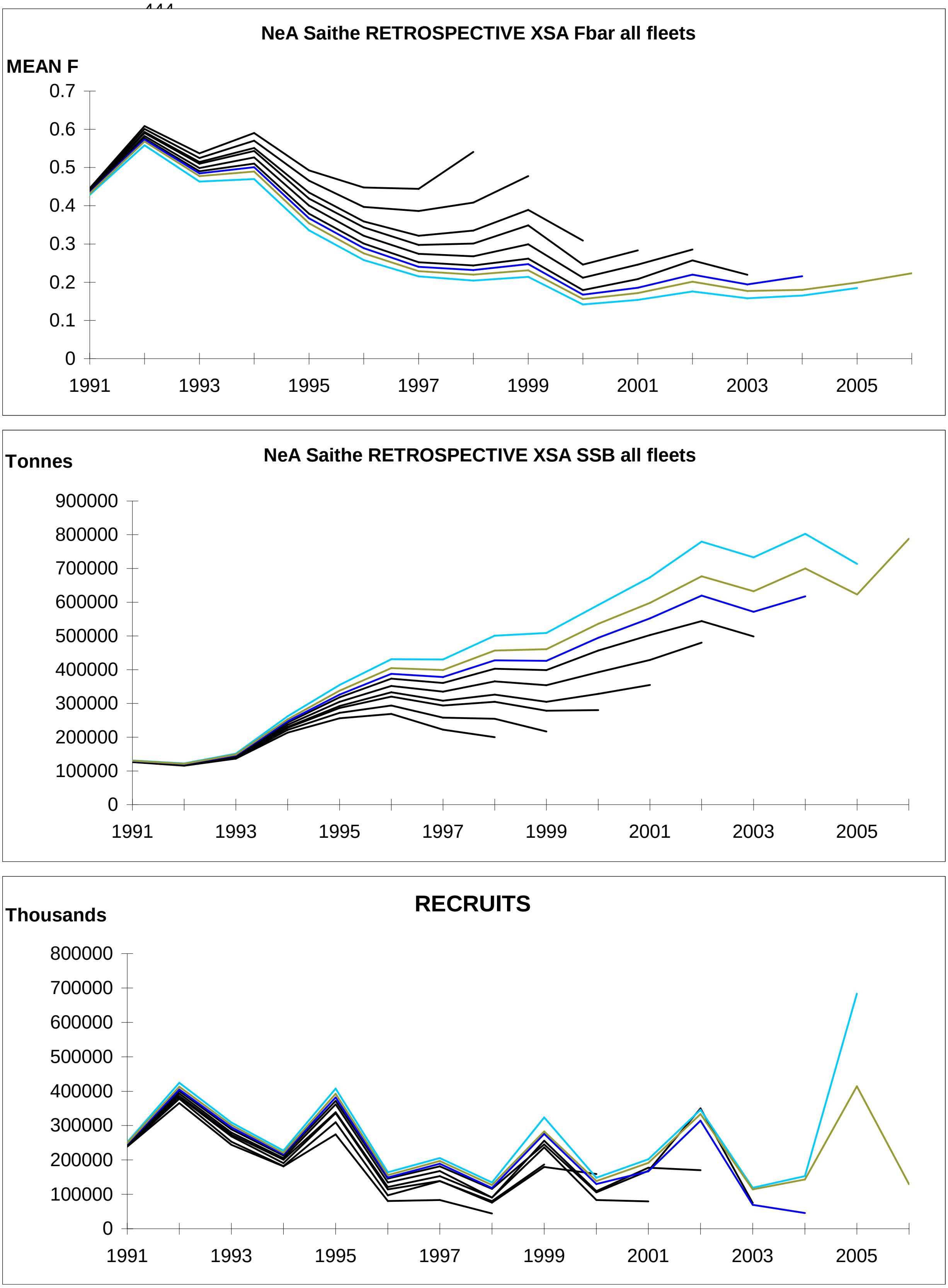
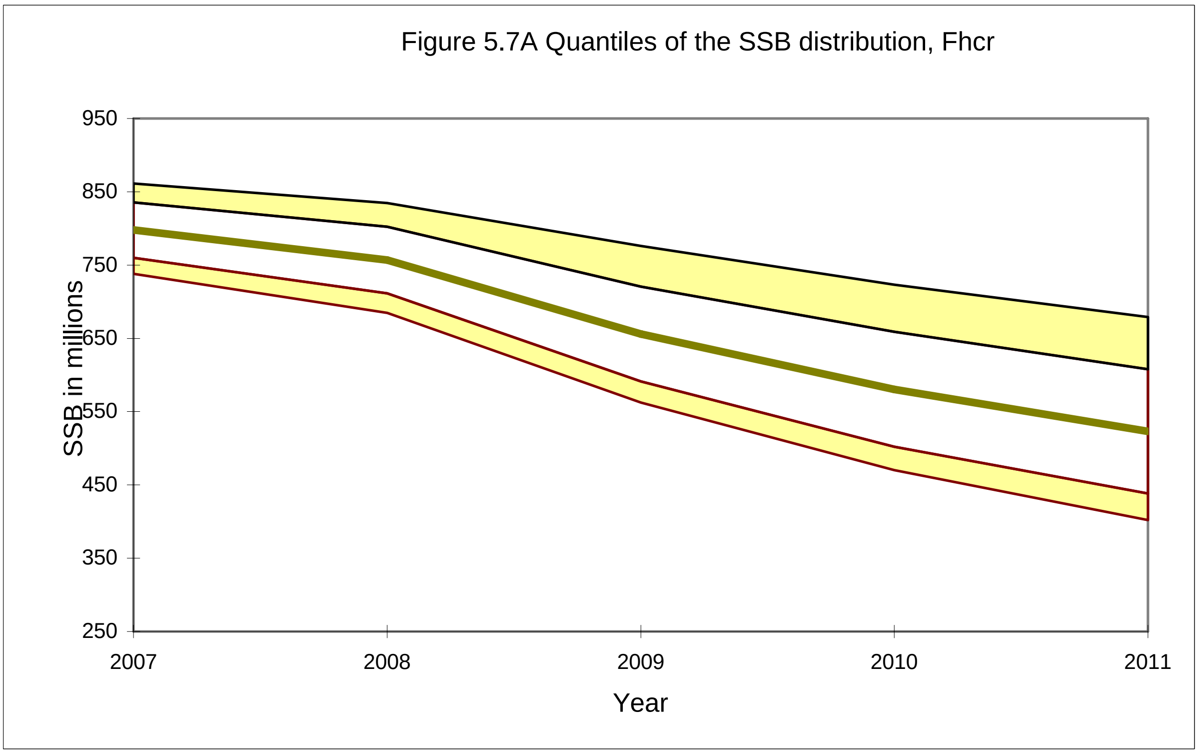


Figure 5.5.5 NeA Saithe RETROSPECTIVE XSA SSB all fleets



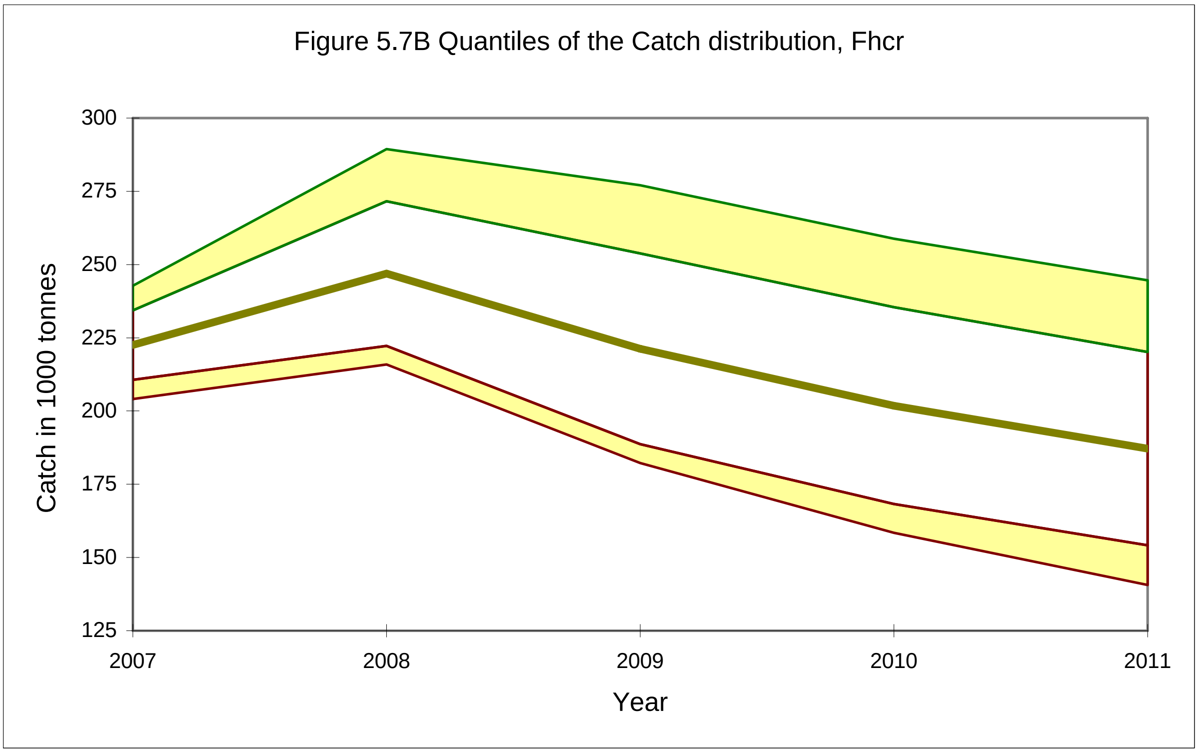
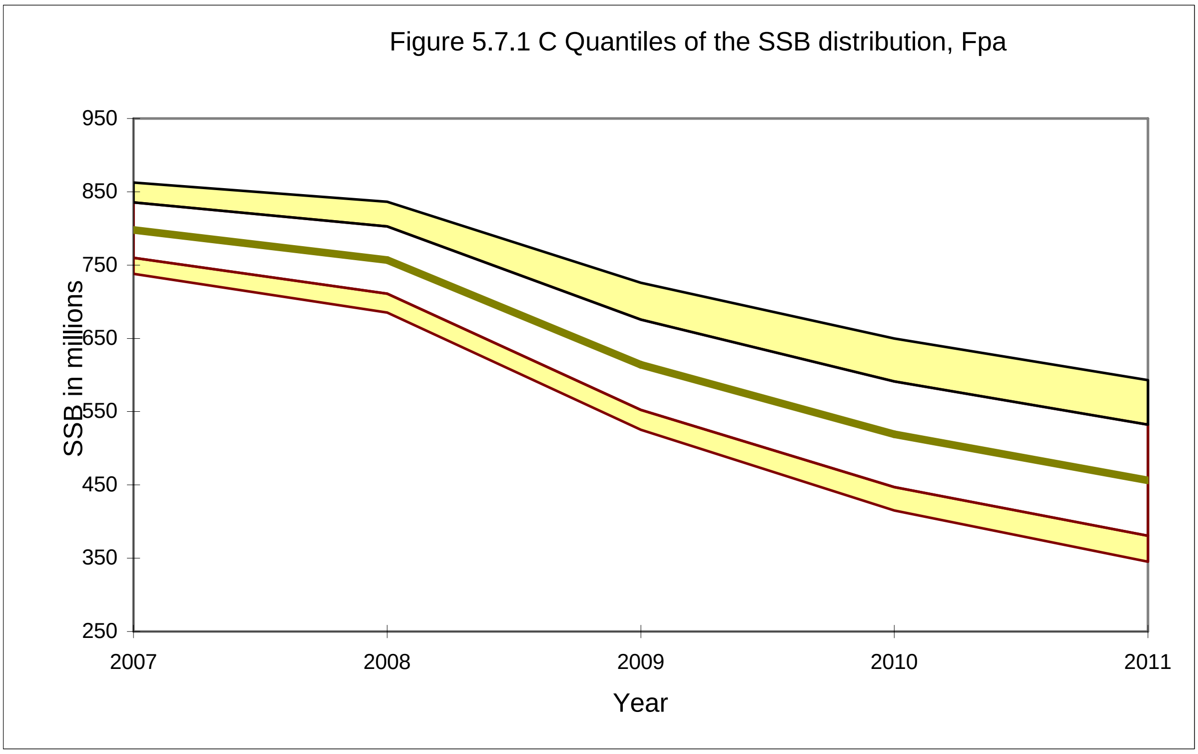


Figure 5.7.1A-b. Quantiles of SSB and catch distribution from mediumterm risk analyses, F_{hcr}



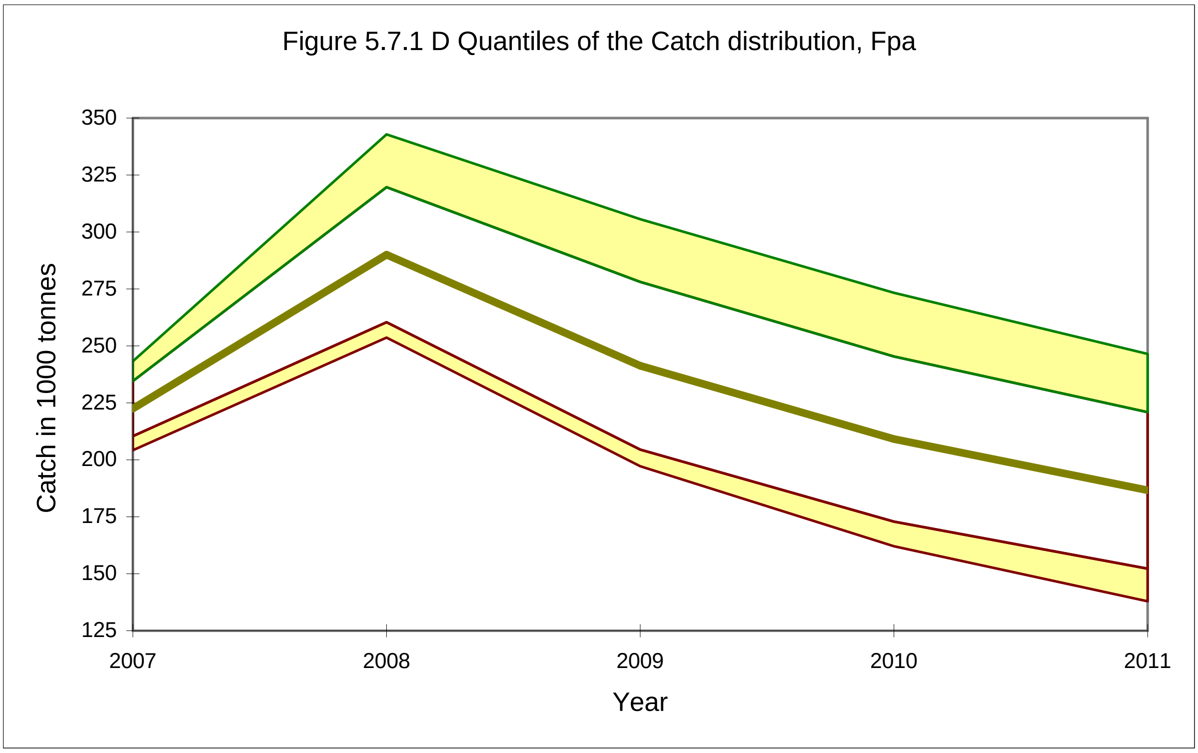


Figure 5.7.1C-D. Quantiles of SSB and catch distribution from mediumterm risk analyses, F_{pa}

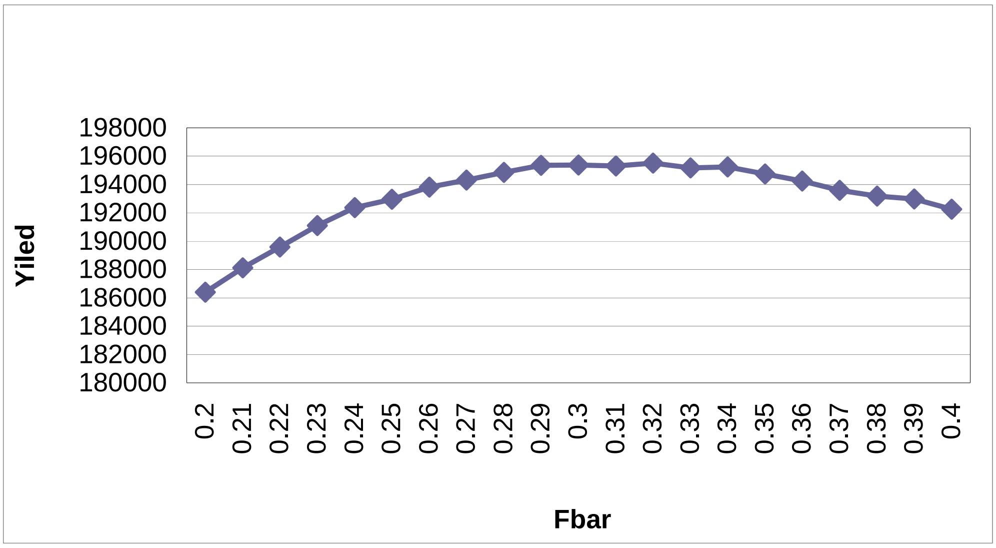


Figure 5.10.1. Long-term yield versus exploitation level

6 *Sebastes mentella* (Deep-sea redfish) in Sub-areas I and II

ACFM considers any analytical assessments for this stock to be experimental. Since ACFM considers it not necessary to assess this stock every year since the status of the stock can clearly be deducted from the surveys, no analytical assessment has been made.

6.1 Status of the Fisheries

6.1.1 Development of the fishery

A description of the historical development of the fishery in Sub-areas I and II except the pelagic fishery is found in the Quality handbook for this stock (see Annex "AFWG-S.mentella"2006).

Since 1 January 2003 the regulations for this stock have been enlarged since from this date all directed trawl fishery for redfish (both *S. marinus* and *S. mentella*) outside the permanently closed areas is forbidden in the Norwegian Economic Zone north of 62°N and in the Svalbard area. When fishing for other species it is legal to have up to 15% redfish (both species together) in round weight as bycatch per haul and on board at any time.

6.1.2 Bycatch in other fisheries (Tables D9, Figures 6.2–6.3.)

Some of the pelagic catches reported on in chapter 5.1.3 are taken as by-catches in the blue-whiting and herring fisheries.

Numbers and weights of the redfish (fully dominated by *S. mentella*) taken as by-catch in the Norwegian shrimp fishery in the Barents Sea during two decades have previously been presented to the AFWG. The results show that shrimp trawlers removed significant numbers of juvenile redfish during the beginning of the 1980's with a peak during 1985 amounting to about 200 millions individuals (Table D9, Figures 6.2. and 6.3.). As sorting grids became mandatory in 1993, by-catches of redfish reduced drastically during the 1990's. From 1 January 2006, the maximum bycatch of redfish juveniles in the international shrimp fisheries in the northeast Arctic has been reduced from ten to three redfish per 10 kg shrimp.

6.1.3 Landings prior to 2007 (Tables 6.1–6.5, D1–D2, Figure 6.1)

Nominal catches of *S. mentella* by country for Subareas I and II combined are presented in Table 6.1, and for both redfish species (i.e., *S. mentella* and *S. marinus*) in Table D1. The nominal catches by country for Sub-area I and Divisions IIa and IIb are shown in Tables 6.2–6.5. Total international landings in 1965-2006 are also shown in Figure 6.1.

The total landings show a continuous decrease from 48,727 t in 1991 to a historical low at about 8,000 t in 1996 and 1997. Apart from a temporary increase of 18,434 t in 2001, caused by Norwegian trawlers obtaining very good catch rates along the continental slope outside the closed areas in winter 2001, the catches decreased to 2,471 t in 2003 due to stronger regulations enforced. An increase in 2004-2006 is explained by the pelagic bycatches in the blue whiting and herring fisheries and direct fishery of pelagic redfish in international waters.

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 total redfish landings from Sub-area IV have been 1,000–3,000 t per year, and show a preliminary landing of about 299 t in 2006 (Table D2).

6.1.4 Expected landings in 2007

There will be no directed demersal fishery for *S. mentella* in 2007, and all the current regulations will be continued in 2007. Based on the present regulations, and reports from the first months in 2007, the total landings of *S. mentella* for 2007 are expected to be maximum 5,000 t. This does not include possible catches in the pelagic fisheries.

6.2 Data used in the Assessment

No analytical assessment was attempted for this stock this year. All input data sets were, however, updated up to and including 2006.

6.2.1 Catch at age (Table 6.6, 6.8)

Catch at age for 2003-2005 was revised according to new catch data. Age data for 2006 for demersal *S. mentella* were available from Norway for all areas, and from Russia in Division IIb. Age data for 2006 for pelagic S.mentella were available from Norway and Poland. Russian total catch-at-length in Division IIa was converted to catch-at-age by using the Norwegian age-length key from Division IIa (southern part). The available length distribution from Germany catches in Division IIa was converted to catch-at-age by using the Norwegian age-length key from Division IIa (southern part). Other countries were assumed to have the same relative age distribution and mean weight as Norway.

6.2.2 Weight at age (Table 6.7, 6.9)

Catch weight-at-age data for 2006 were available from Norway for all areas, and from Russia in Division IIb and Poland from pelagic fishery. The weight at age in the stock was set equal to the weight at age in the catch. It should be investigated further 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.

6.2.3 Maturity at age (Table D8)

Age-based maturity ogives for *S. mentella* (sexes combined) were available for 2000 and 2001 from Russian research vessel observations in spring. For 2002-2004, when no survey was conducted, a weighted (by sample size) average of the 2000 and 2001 data was used.

6.2.4 Survey results (Tables 1.1, 1.4, D3–D7, Figures 6.4–6.8)

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

1) The international 0-group survey in the Svalbard and Barents Sea areas in August-September, now part of the Ecosystem survey (Table 1.1 and Figure 6.4 a, b). A new method to calculate the 0-group series has been adopted (Figure 6.5b). These new indices are calculated by the method of stratified sample mean, and this method allows for confidence limits to be calculated (Anon. 2005). When the new method has been carefully scrutinized and compared to previous methods, the new indices are meant to replace the “Area Index” after a short period of overlap between the two methods.

2) Russian bottom trawl survey in the Svalbard and Barents Sea areas in October-December from 1978–2006 in fishing depths of 100–900 m (Table D3, Figure 6.5).

3) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986–2005 in fishing depths of 100–500 m (swept area down to 800 m). Data disaggregated by age only for the years 1992–2005 (Table D4a,b).

4) Norwegian Barents Sea bottom trawl survey (February) from 1986–2006 (joint with Russia since 2000, Russian vesssel did not take part in survey in 2006) in fishing depths of 100–500 m (swept area down to 800 m). Data disaggregated by age only for the years 1992–2005 (Tables D5a,b).

5) 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 6.6a,b.

6) The Norwegian survey initially designed for redfish and Greenland halibut is now part of the ecosystem survey and covers the Norwegian Economic Zone (NEZ) and Svalbard incl. north and east of Spitsbergen during August 1996-2005 from less than 100 m to 800 m depth (Table D6, Figures 6.7-6.8). This survey includes survey no. 3 above, and has been a joint survey with Russia since 2003.

7) Russian acoustic survey in April-May from 1992–2001 (except 1994 and 1996) on *S. mentella* spawning grounds in the western Barents Sea (Table D7).

A considerable reduction in the abundance of 0-group redfish has been observed since 1991: 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 very 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, and although the 2001-2006 year classes are among the lowest on record, a promising increase is observed since 2002.

Results from the Norwegian ecosystem survey (Table D6 and Figures 6.7-6.8) confirm the stock development as interpreted from the 0-group survey (Figure 6.5), i.e., relative strong 1988-1990 year classes, followed by weaker 1991-1995 year classes, and very weak year classes since 1996. In autumn 2006 the observed improved recruitment in the 0-group survey is confirmed by this demersal survey. For older fish, a clear and sudden decrease of *S. mentella* for ages 9 and older (i.e., larger than about 28 cm) after 2003 is observed. The WG has earlier reported this decrease as likely related to the increase of *S. mentella* observed in the pelagic fisheries in the Norwegian Sea. This decrease was also seen in Figure 6.6a and b. Some improvement in the abundance indices of the same sized (and aged) fish since then may have been caused by fish changing behaviour returning from the pelagic and back to the continental slope.

In the Russian bottom trawl survey the most recent estimates are among the lowest observed (Table D3, Figure 6.5). The overall picture of the relative strength of the year classes is very similar in the Russian and Norwegian surveys. However, both the Russian survey back to 1977 and results from combining the Norwegian Barents Sea February and the Svalbard August surveys back to 1986 (Figure 6.6) show lower and more variable abundance of *S. mentella* in the 1980-ies than could be expected from the 0-group indices and when compared with the abundance observed at present. No signs of improved recruitment has so far shown up in this Russian demersal survey.

The decrease in the abundance of young redfish in the surveys during the 1990-ies is consistent with the decline in the consumption of redfish by cod (Tables 1.5, 1.6; Figure 6.6). It is important that the estimation of the consumption of redfish by cod is being continued as the abundance of larvae and juveniles in the Barents Sea currently is increasing.

Russian acoustic surveys estimating the commercial 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. Table D7 shows a 43% decrease in the estimated spawning stock biomass in 1997 to a low level that was observed up to 2000 inclusive. The strong 1982-year class migrating west-southwest and out of the surveyed area could explain this. The next year classes expected to contribute significantly to the spawning stock (i.e., the 1987–1990 year classes) are now more than 50% mature (males before females), and these year classes contributed in the 2001 survey to a three fold increase in the survey abundance of mature fish (Table D7). This is the only survey targeting commercial sized *S. mentella*, but only a limited area of its distribution. The survey has unfortunately not been run since 2001.

6.3 Results of the Assessment

The signals of the various surveys are in agreement. Since last year's assessment improved recruitment of 0-group and juveniles are seen. This is confirmed by a couple of surveys. It is therefore of vital importance that these 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.

It is likely that the strong protection of the last previous good year-classes (i.e., those born before 1991) as these were growing has caused the increased abundance of fish larger than 25-30 cm during the last ten years (e.g., Figure 6.6).

The WG has previously concluded that any improvement of the stock condition is not expected until a significant increase in spawning stock biomass has been detected in surveys with a following increase in the number of juveniles. Positive signs in that direction are now seen. The only year classes that can contribute to the spawning stock in near future are those prior to 1991 as the following year classes are extremely poor. ICES gave last year the advice that these year classes need to be protected as they offer the only opportunity of increasing the spawning stock for a number of years to come.

6.4 Comments to the assessment

Since ACFM until now has considered it not necessary to assess this stock every year as long as the status of the stock can clearly be deducted from the surveys, no experimental analytical assessment has been attempted. However, the WG is concerned about that this may not hold true anymore as the fish show changes in its pelagic behaviour and are thus not properly covered by demersal survey trawls. As we manage to rebuild the stock, requests of allowing a fishery will come, and the stock may then suffer from lacking an analytical assessment which management plans and harvesting strategies may be based upon.

The survey series may still be improved further, and it is imperative for good results that valuable research survey time series are continued, and that Norwegian and Russian research vessels get full access to each other's exclusive economic zones. In addition, current surveys are not covering the areas where the bulk of the catches were taken in 2006.

6.5 Biological reference points

Until an analytical assessment will be available and used as basis for reference points calculations for this stock, candidate reference points for the biomass could be set at the average biomass level, or at a certain percentage of this level, estimated by the Russian and Norwegian trawl surveys since 1986. ACFM is supporting this suggestions and states that U-type reference points could be developed provided that a sufficient long time series demonstrating a dynamic range is available. Also the reference point would be expressed in biomass units (SSB or fishable stock).

6.6 Management advice

The stock is still historically low and this situation is expected to remain for a considerable period irrespective current management actions. Year-classes recruit to the SSB at old age (e.g. >10 years old) and surveys indicate failure of recruitment over a long time period. However, positive signs are seen. The year-classes born before 1991 seem to have been rather well protected and has led to an increased spawning stock and improved recruitment of larvae and juveniles.

The measures introduced in 2003 should, however, be continued, i.e. there should be no directed trawl fishery on this stock and the area closures and low by-catch limits should be retained, until a significant increase in the spawning stock biomass (and a subsequent increase in the number of juveniles) has been detected in surveys. Recruitment failure has been observed in surveys for more than a decade. In this connection it is of vital importance that the juvenile age classes be given the strongest protection from being caught as by-catch in any fishery, e.g., the shrimp fisheries in the Barents Sea and Svalbard area. This will ensure that the recruiting year classes can contribute as much as possible to the stock rebuilding.

Several of the WG members find the presented documentation and the development of the *S. mentella* stock in Sub-area I and II in recent years sufficient to relate the pelagic *S. mentella* in the Norwegian Sea outside EEZ to the northeast Arctic stock population extruding their larvae along the continental slope (at 400-600 m) from south of 62°N to the Svalbard area, and that advice on stock and fishery should be given accordingly. It can not be excluded that the several years' protection and growth of the year-classes born before 1991 could have caused the higher pelagic abundance and densities in the Norwegian Sea. The ICES advices that these year classes need to be protected as they offer the only opportunity of increasing the spawning stock for a number of years to come, and it is the view of the same WG members that this therefore also should include the pelagic fisheries in the Norwegian Sea.

As a full consensus was not reached, the WG supports that ICES has given the Working Group on Stock Identity (SIMWG) the task to further investigate the stock structure and make final conclusion.

As long as there are uncertainties in linking the pelagic occurrence outside the EEZ to the pelagic and demersal occurrence inside the EEZ, a precautious approach should be applied in management.

The WG is concerned about the actual levels allowed as by-catch, including international waters. Concerning the shrimp fishery, the sorting grid is not capable of sorting out all of the smallest redfish, and closure of areas is therefore necessary.

As fishery-independent information on the abundance and distribution of the pelagic *S. mentella* in the Norwegian Sea outside the continental slope area are missing, an international survey is inevitable. The AFWG support that ICES co-ordinate the planning of such a survey within e.g., the PGNAPES. Furthermore, complete and detailed catch and landings data from all nations fishing on the resource, as well as accompanying biological data, are to be provided to ICES and the AFWG.

6.7 Response to ACFM technical minutes

ACFM considers it not necessary to assess the stock every year, and that updating of the tables and figures would be sufficient. The working group takes this into account, but sees the need for a more analytical assessment to base future catch advice and management plans on.

The working group plan to update all unreported by-catch information annually from all fisheries.

ICES and NEAFC should exchange and preferably harmonize the catch statistics from the NEAFC regulatory areas in ICES Sub-area I and II

6.8 Description of the pelagic redfish and fishery in the Norwegian Sea outside the EEZs

NEAFC has requested ICES to provide a detailed description of the newly developed pelagic fishery for *Sebastes mentella* in the Norwegian Sea as well as the traditional fishery on the slopes, especially with regard to temporal and spatial distribution. Below, the WG has mainly focused on the pelagic fishery and compared this with the fish and fisheries on the slopes.

6.8.1 Description of the fishery

Landings of *S. mentella* taken in the pelagic fishery for blue whiting and herring in the Norwegian Sea have the last two years been reported to the working group (Table 6.5). In 2006 this fishery developed further to become a directed fishery with 11 countries and more than 40 trawlers involved. Although sporadic registrations and scattered catches of *S. marinus* may be observed, biological samples of the catches collected by observers and fishers show that the commercial catches are completely dominated by the deep-water redfish *S. mentella*.

Vinnichenko (WD 9) gives a good and comprehensive description of the previous abundance of pelagic *S. mentella* in the international waters of the Norwegian Sea, and how by-catches and exploratory fishing have developed during 1979-2006. According to Vinnichenko, in 1998-2000 small by-catches of redfish (no more than 8 t per year) were reported from the blue whiting and herring fisheries in the international waters of the Norwegian Sea and in the Norwegian Economic Zone. In 2001-2003 occurrence of redfish was reported from a larger area (Figure 6.9) and catches increased to 60-118 t.

In 2004 the amount of redfish in catches increased significantly. In June-August this species was more frequently occurring in the south of the sea (Figure 6.9). In September catches of redfish (0.5 t per hour haul) were reported from international waters and the NEZ. In October, in the northern part of the international waters, trawlers had a catch of redfish of 0.5-10 t per day, sometimes to 15-40 t. By-catches of redfish were also reported from the Bear Island-Spitsbergen area and the NEZ. The total reported catch of pelagic *S. mentella* in 2004 was 1,512 t.

In summer of 2005 small quantities of redfish were steadily present in catches on the blue whiting and herring fisheries in the international waters of the Norwegian Sea and the Bear Island-Spitsbergen area (Figure 6.9). In the first half of September some vessels operating in the Bear Island-Spitsbergen reported by-catches of *S. mentella* as large as 6-25 t per day. In the end of September in the north of the international waters of the Norwegian Sea large Russian trawlers for the first time began fishing for redfish in a directed fishery. They fished with a gigantic “Gloria” trawl. The fishery finished in the beginning of November after the redfish dispersed. In 2005 the Russian fleet reported a catch of *S. mentella* of 3 299 t, including the by-catch in the blue whiting and herring fisheries. Fishing for redfish was also conducted by a Faroese trawler. Besides, small quantities of redfish were fished by German vessels in the blue whiting fishery.

In 2006 first small catches of redfish (to 50 kg per haul) were reported from the herring fishery in the NEZ in February. In June-August catches of redfish of 70-120 kg per hour haul were reported in the blue whiting and mackerel fisheries in the international waters south of 70° N (Figure 6.9). Targeted redfish fishery by the Faroese and Russian trawlers began at the Mona Ridge (i.e., the ridge separating the Norwegian Sea into two main basins) in August (Figure 1.). By mid-September the number of fishing vessels operating in that area was as high as 40 vessels, including 8-12 vessels from Russia and up to 30 vessels from Iceland, Faroe Islands, Norway and EU. In October 15-25 vessels continued the fishery. It finished in mid-November. The Russian catch in the directed *S. mentella* fishery was 9 157 t. Redfish also occurred in catches by trawlers, that fished for blue whiting and herring. The total reported catch of pelagic *S. mentella* by Russian vessels in 2006 was, according to provisional data, 9 390 t, and a total of 26 940 t by all nations (Table 6.5).

Many countries, i.e., Estonia, the Faroes, France, Lithuania, and UK, have only reported catches taken in Sub-area IIa, without information whether the fish were caught pelagic or demersal. For these countries, the WG has considered all catches not reported to Norwegian authorities as being caught in international waters outside the EEZ. Iceland had only reported to NEAFC, and their catches of 2,610 t *S. mentella* caught pelagic in the Norwegian Sea outside EEZ have been included.

Figure 6.10 shows the areas outside the EEZ where the German, Norwegian and Polish pelagic fisheries targeting *S. mentella* were conducted in 2006. VMS data from the three participating Norwegian trawlers show a slight eastward movement of the fished concentrations from September to November 2006.

6.8.2 Length- and age composition of the fish

According to Vinnichenko (WD 9), the length of redfish collected from pelagic waters of the Norwegian Sea from 1979-2006 (collected with trawls with 20-135 mm mesh size in codend) show lengths from 20 cm to nearly 50 cm, mostly mature fish (95%) of 32-38 cm and 0.5-0.7 kg. Recently, however, few fish less than 30cm have been observed. In summer the catches have, as a rule, been dominated by females in number, in autumn the sex ratio has usually been 1:1. Germany and Poland report 56.5 % and 59 % males in their 2006 fishery, respectively.

Length distributions of the commercial pelagic catches of *S. mentella* in the Norwegian Sea outside EEZ in ICES Sub-areas IIa and IIb in 2006 are shown in Figure 6.11. Similar, length-distributions of the commercial demersal by-catches (no directed fishery allowed, maximum 15% by-catch) inside EEZ in ICES Sub-areas IIa and IIb are shown in Figure 6.12. All length-distributions seem to be rather similar.

The analysis of commercial Russian catches of *S. mentella* in 2006 from outside the economic zones in the Norwegian Sea by area identified that catches contained larger fish in the southern part of the area (Southern Central Basin), than in northern areas (Mona Ridge and Central Plateau) (Fig. 6.13).Similar south-north trend has for decades also been seen in the length distributions along the continental slope from 62°N to Spitsbergen. Since 1997 most of the traditional demersal fishing areas south of Lofoten have been closed for trawling to protect the *S. mentella.*

Due to the slow growth of adult redfish a rather narrow length distribution may contain several age- and year-classes, and this is clearly seen from the age distributions based on otolith readings by Poland and Norway in 2006 (Figure 6.14). The independent age readings by the two countries show the same age composition, i.e., that the bulk of the pelagic *S. mentella* catches in 2006 were composed of the 1990-1991 and older year-classes, even 38-39 years old specimens. Figure 6.15 compares the age composition outside (pelagic) and inside (demersal) the EEZ showing a rather similar age and year-class composition.

In addition to the Barents and Norwegian Seas, fishery and biological information on *S. mentella* from international waters pelagic fishery should be compared with other information from other areas in the North Atlantic, where the redfish live and are fished.

6.8.3 Feeding and parasite infestation (*Sphyrion lumpi*)

According to Vinnichenko (WD 9), the most intensive feeding of pelagic S. mentella in the Norwegian Sea, when the mean index of stomach fullness was 1.4-1.9, took place in July-October. Different species of fish (mostly blue whiting), themisto and euphausiids were the main food items. In addition, *Calanus* spp, hyperiids, hammarids, shrimp, squid and *Sagitta* spp. were found in the stomach content. Stomachs from demersal *S. mentella* in Sub-areas I and II collected and analysed during 1968-1991 the highest frequency of occurrence was observed for zooplankton, shrimp and smaller fish (capelin and own juveniles) (Dolgov and Drevetnyak, 1992).

According to Vinnichenko (WD 9) the mean prevalence of infestation of *S. mentella* with the copepod *Sphyrion lumpi* in the northern part of the Norwegian Sea, including traces of its presence, was 36.9% with an abundance index of 0.7 per redfish, i.e., about the average infestation rate in the North Atlantic. Among the more dispersed redfish in the south of the sea these indices were 65.6% and 1.3, respectively, which is a lot more than the average. Analyses of a smaller material (617 fish) by Norway in 2006-2007 from both inside (demersal) and outside (pelagic) the EEZ showed a generally lower infestation rate in both the pelagic and demersal fish, but did also show a general higher infestation rate in southern demersal areas than in northern. Germany reported that almost all of the sampled fish were infested by this parasitic copepod.

6.8.4 Analyses and results from other biological data collected from the fisheries in 2006/2007

6.8.4.1 Genetics

WD 19, "Population structure of *S. mentella* in the North Atlantic with regard to international waters in the Norwegian Sea" by Stefansson *et al.* presents the results from international genetic analyses of 1,146 *S. mentella* that were sampled at sea in late 2006 or early 2007 (Table 6.10 and Figures 6.16, 6.17). The samples from the Icelandic shelf west, Faroe Islands, Norwegian shelf and Barents Sea were collected using demersal trawls while samples from the Irminger Sea and the international waters in the Norwegian Sea outside EEZ were collected using pelagic trawl (Figures 6.16, 6.17). A summary of this work and results are given in Chapter 0.8 Scientific Presentations.

6.8.4.2 Otolith shapes

In WD 20, "Geographic variation in otolith shapes of deep-sea redfish (Sebastes mentella) in ICES Sub-areas I and II and Sub-areas V, XII and XIV: preliminary results" by Stransky et al. a total of about 700 otoliths from various areas in the Barents Sea, on the Norwegian shelf, in the Norwegian Sea and Irminger Sea were used in a shape analysis (Table 6.11, Figures 6.18, 6.19). Only fish of 30-40 cm length were included to minimise extreme morphometric variation. From digital pictures of the otoliths, the contours were extracted and used in an Elliptical Fourier Analysis (EFA). The Fourier Descriptors (FDs) were tested for differences between areas and samples by Linear Discriminant Analysis (DA). For details on these methods, see Stransky (2005). A summary of this work and results are given in Chapter 0.8 Scientific Presentations.

It is the view of the AFWG that the presented WDs and the description above make an important contribution to the necessary stock identity work to come. The information above should thus be passed on to the ICES Working Group on Stock Identity (SIMWG). This Group is tasked to compile relevant information, and especially new information, and in cooperation with redfish experts evaluate the available information and whether a re-evaluation of the stock structure is warranted.

Table 6.1 ***Sebastes mentella*** **in Sub-areas I and II. 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	1,111	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	-	-	4	37	81	16	6
1998	-	-	20	73	100	14	9
1999	**Iceland**	-	73	26	202	50	3
2000	48	**Estonia**	50	12	62	29	1
2001	3	-	74	16	198	17	4
2002	41	15	75	58	99	18	4
2003	5	-	64	22	32	8	5
2004	10	-	588	13	10	4	3
2005	4	5	1,147	46	33	39	4
2006[1]	2,632	396	2,759	214	2,483	63	9

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	10,455
1988			No species specific data available by country.					15,586
1989	4,633	-	340	13,080	5	174	1	23,512
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	-	12,814
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	4,657	1	474	2,972	272	71	7	8,598
1998	9,733	13	125	3,646	177	93	41	14,045
1999	7,884	6	65	2,731	29	112	28	11,209
2000	6,020	2	115	3,519	87		130[5]	10,075
2001	13,937	5	179	3,775	90		120[5]	18,418
2002	2,152	8	242	3,904	190	**Sweden**	188[5]	6,993
2003	1,210	7	44	952	47	-	124[5]	2,520
2004	1,312[1]	42	235	2,879	257	1	76[5]	5,430
2005	1,760[1]	-	140	5,023	163	**Netherl** -7	95[5]	8,465
2006[1]	4,627	2,476	1,804	11,413	709	**Lithu -** 845	1,025[5]	31,457

[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*** **in Sub-areas I and II. 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]	12	174	1[2]	-	190
1998	20[2]	-	-	26	378	-	-	424
1999	69[2]	-	-	69	489	-	-	627
2000	-	-	-	47	406	-	48[2]	501
2001	-	-	-	8	296	-	3[2]	307
2002	-	-	-	4	587	-	-	591
2003	-	-	-	6	292	-	-	298
2004	-	-	-	2[1]	355	-	-	357
2005	-	-	-	3[1]	327	-	-	330
2006[1]	3	-	-	5	460	-	-	467

[1] Provisional figures.

[2] Split on species according to reports to Norwegian authorities.

[3] Based on preliminary estimates of species breakdown by area.

[4] Includes former GDR prior to 1991.

[5] USSR prior to 1991.

Table 6.3 ***Sebastes mentella*** **in Sub-areas I and II. Nominal catch (t) by countries in Division IIa (including landings from the pelagic trawl fishery in the international water)..**

Year	Estonia	Faroe Islan	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		-	37[2]	77	12[2]	2[2]	4,422
1998		-	73[2]	58[2]	14[2]	6[2]	9,186
1999		-	16[2]	160[2]	50[2]	3[2]	7,358
2000		50[2]	11[2]	35[2]	29[2]	-	5,892
2001		63[2]	12[2]	161[2]	17[2]	4[2]	13,636
2002		37[2]	54[2]	59[2]	18[2]	4[2]	1,937
2003		58[2]	18[2]	17[2]	8[2]	5[2]	1,014
2004		555[2]	8[2]	4[2]	4[2]	3[2]	1,028[1]
2005		1,101[2]	36[2]	17[2]	38[2]	4[2]	1,083[1]
2006[1]	396	2,743	205	2,475	52[2]	8[2]	3,929

Year	Sweden	Portugal	Poland	Russia[5]	Spain	UK (Eng.& W	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]	7,365
1998		118[2]		2,626	55[2]	65[2]	41[2]	12,242
1999		56[2]		1,340	14[2]	94[2]	26[2]	9,117
2000		98[2]		2,167	18[2]	Iceland	103[2,6]	8,403
2001		105[2]		2,716	18[2]	-	95[2,6]	16,827
2002		124[2]		2,615	8[2]	41[2]	157[2,6]	5,055
2003		17[2]		448	8[2]	5[2]	102[2,6]	1,700
2004	1[2]	86[2]		2,081	7[2]	10[2]	18[2,6]	3,806
2005	-	71[2]		3,307	20[2]	2[2]	15[2,6]	5,693
2006[1]	Lithu –845	1,731	2,447	10,110	589	2,632[2,7]	958	29,120

[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.)

[7] As reported to NEAFC

Table 6.4 ***Sebastes mentella*** **in Sub-areas I and II. Nominal catch (t) by countries in Division IIb.**

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland
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[2]	27[2]	-	1[2]
2001	-	-	11[2]	4[2]	37[2]	-	-
2002	-	-	38[2]	4[2]	40[2]	-	-
2003	-	-	6[2]	4[2]	15[2]	-	-
2004	-	-	33[2]	5[2]	6[2]	-	-
2005	Netherl - 7[2]	Iceland - 2[2]	46[2]	10[2]	17[2]	1[2]	-
2006[1]			13[2]	9[2]	8[2]	11[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]	2,828
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	223	1[2]	64[2]	457	263[2]	22[2]	-	1,042
1998	521	13[2]	7[2]	642	122[2]	28[2]	1[2]	1,379
1999	457	6[2]	9[2]	902	15[2]	18[2]	2[2]	1,465
2000	82	2[2]	17[2]	946	69[2]		27[2,7]	1,172
2001	293	5[2]	74[2]	763	72[2]	Estonia	25[2,7]	1,284
2002	210	8[2]	118[2]	702	182[2]	15	31[2,7]	1,348
2003	190	7	27[2]	212	39[2]	-	22[2,7]	522
2004	282[1]	42[2]	149[2]	443	250[2]	-	58[2,7]	1,268
2005	673[1]	-	69[2]	1,389	143[2]	5	80[2,7]	2,442
2006[1]	694	29	73[2]	843	121[2]	-	67[2,7]	1,869

[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 ***Sebastes mentella*** **in Sub-areas I and II. Nominal catch (t) by countries of the pelagic fishery in international waters of the Norwegian Sea (see text for further details)**

Year	Estonia	Faroe Islands	France	Germany	Lithuania	Iceland	Norway
2002				9			
2003				40			
2004		500[1]		2			
2005		1,083[1]		20			
2006[1]	396	2,700	192	2,472	845	2,610[2]	2,775

Year	Poland	Portugal	Russia	Spain	UK	Total
2002						9
2003						40
2004			1,510			1,512
2005			3,299			3,319
2006[1]	2,447	1,697	9,390	575	841	26,943

[1] **Provisional figures.**

[2] **As reported to NEAFC**

Table 6.6. *S.mentella* in Sub-areas I and II ICES. Catch numbers at age

Numbers*10**-3																
YEAR	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
AGE																
6	1653	1873	159	738	662	223	125	37	9	1	117	2	6	11	5	
7	5453	2498	159	730	941	634	533	882	83	24	372	40	37	24	44	9
8	7994	1898	174	722	1279	1699	1287	2904	441	390	542	252	103	108	128	7
9	6781	1622	512	992	719	1554	1247	4236	1511	1235	976	572	93	148	347	87
10	8226	1780	2094	2561	740	1236	1297	3995	2250	2460	925	709	132	427	540	143
11	5344	1531	3139	2734	1230	1078	1244	2741	3262	2149	1712	532	220	624	567	283
12	6227	2108	2631	3060	2013	1146	876	1877	1867	1816	2651	1382	384	931	432	802
13	9880	2288	2308	1535	4297	1413	1416	1373	1454	1205	2660	1893	391	580	1607	1754
14	10824	2258	2987	2253	3300	1865	1784	1277	1447	1001	1911	1617	434	1385	1332	2212
15	4049	2506	1875	2182	2162	880	1217	1595	1557	993	1773	855	466	1047	3174	4157
16	2105	2137	1514	3336	1454	621	537	1117	1418	932	1220	629	513	937	1041	4770
17	9603	1512	1053	1284	757	498	1177	784	1317	505	714	163	199	927	1216	4734
18	6522	677	527	734	794	700	342	786	658	596	814	237	231	549	1024	4035
+gp	19299	9258	6022	3257	2404	2247	3568	6241	3919	5705	16234	4082	1193	2055	4266	35694
TOTALNUM	**103960**	**33946**	**25154**	**26118**	**22752**	**15794**	**16650**	**29845**	**21193**	**19012**	**32621**	**12965**	**4400**	**9754**	**15725**	**58687**
TONSLAND	48727	15590	12866	12721	10284	8075	8597	14045	11209	10075	18418	6993	2520	5430	8466	31457

Table 6.7. *S.mentella* in Sub-areas I and II ICES. Catch weights at age (kg).

YEAR	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
AGE																
6	0.13	0.19	0.17	0.16	0.14	0.2	0.18	0.14	0.15	0.1	0.11	0.13	0.09	0.13	0.13	
7	0.18	0.22	0.23	0.22	0.16	0.2	0.21	0.19	0.22	0.15	0.15	0.17	0.14	0.17	0.17	0.14
8	0.21	0.26	0.25	0.24	0.19	0.25	0.25	0.23	0.22	0.22	0.20	0.22	0.22	0.22	0.21	0.23
9	0.27	0.28	0.28	0.3	0.21	0.31	0.29	0.29	0.28	0.26	0.25	0.29	0.28	0.27	0.28	0.29
10	0.34	0.31	0.33	0.34	0.28	0.42	0.33	0.33	0.33	0.31	0.30	0.34	0.33	0.33	0.34	0.34
11	0.35	0.33	0.38	0.37	0.32	0.44	0.38	0.38	0.37	0.36	0.34	0.38	0.39	0.38	0.38	0.42
12	0.42	0.38	0.44	0.4	0.37	0.47	0.46	0.43	0.44	0.42	0.39	0.43	0.43	0.43	0.43	0.45
13	0.46	0.46	0.47	0.44	0.41	0.59	0.48	0.48	0.49	0.44	0.44	0.44	0.45	0.43	0.45	0.46
14	0.51	0.43	0.5	0.45	0.47	0.67	0.51	0.54	0.53	0.51	0.48	0.52	0.50	0.50	0.50	0.49
15	0.58	0.43	0.57	0.49	0.53	0.69	0.55	0.59	0.56	0.56	0.53	0.56	0.54	0.54	0.55	0.53
16	0.59	0.45	0.58	0.55	0.58	0.71	0.6	0.61	0.62	0.62	0.59	0.57	0.59	0.58	0.56	0.54
17	0.58	0.52	0.62	0.58	0.66	0.74	0.66	0.64	0.66	0.63	0.62	0.60	0.57	0.61	0.59	0.55
18	0.59	0.57	0.65	0.67	0.71	0.74	0.65	0.66	0.67	0.67	0.65	0.59	0.62	0.64	0.61	0.56
+gp	0.70	0.67	0.66	0.79	0.81	0.85	0.79	0.75	0.81	0.77	0.70	0.73	0.75	0.72	0.70	0.66

Table 6.8 Pelagic *Sebastes mentella* in Norwegian Sea (outside EZZ). Catch numbers at age.

Numbers*10**-3					Age				
YEAR	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19+**
2006	23	93	1083	323	1563	3628	2514	3756	29704

Table 6.9 Pelagic *Sebastes mentella* in Norwegian Sea (outside EZZ). Catch weights at age (kg)

					Age				
YEAR	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19+**
2006	0.44	0.44	0.52	0.44	0.49	0.55	0.53	0.56	0.61

Table 6.10 The partition of 13 *S. mentella* samples from the North Atlantic using the program BAPS (Corander et al. 2003; 2004). Maximum posterior probability [p(S|data)=1.000]

Cluste	Habita	Sample
A	(Icelandic shelf	1; 2
B	(Irminger Sea deep-zone; Faroe	3; 4;
C	(Irminger Sea shallow-zone; Faroe Norwegian shelf; Barents Norwegian international	5; 6; 8; 10; 11; 12;

Table 6.11 Samples used for the otolith shape analysis.

Code	Area	Vessel	Dates	n
BS 2000	Barents Sea	G.O. Sars	Feb 2000	51
BS FU	Barents Sea, Tromsøflaket	Commercial vessel	Jan 2007	65
BS NV	Barents Sea, Nordvestbanken	Commercial vessel	Jan 2007	28
IR DEEP	Irminger Sea, deep (650 m)	Walther Herwig III	Jun-Jul 1999	43
IR SHAL	Irminger Sea, shallow (250-300m)	Walther Herwig III	Jun-Jul 1999	69
NO1	Norwegian Shelf, around 67°N 8°E	G.O. Sars	Oct-Nov 1999	20
NO2	Norwegian Shelf, around 63°N 3°E	G.O. Sars	Oct-Nov 1999	18
NO TR	Norwegian Shelf, Trænaegga	Commercial vessel	Oct 2006	87
NS GER	Norwegian Sea, Germany	Commercial vessel	Aug-Sep 2006	156
NS NOR	Norwegian Sea, Norway	Commercial vessels	Sep-Nov 2006	164
			Total	701

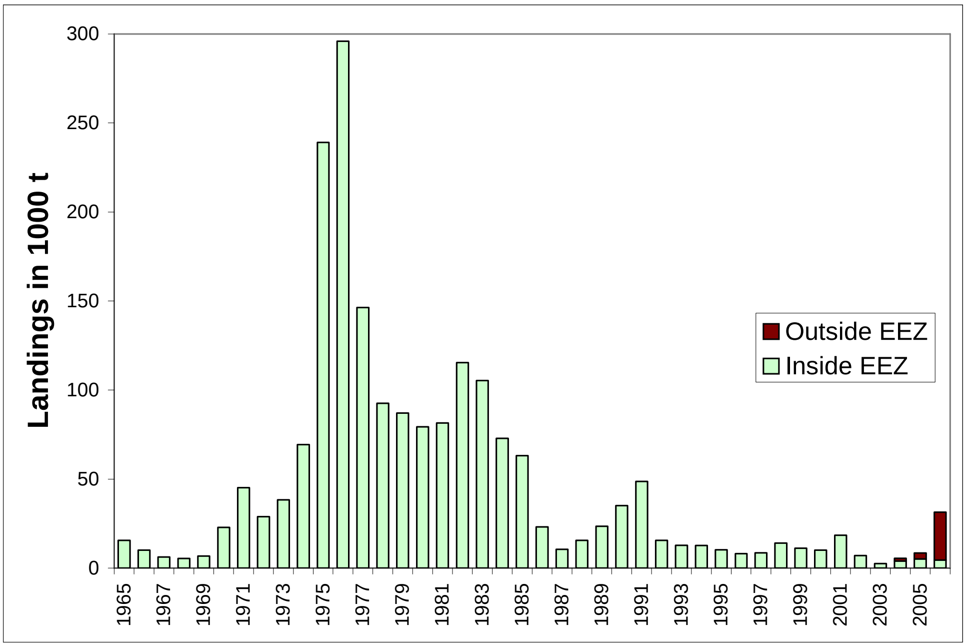


Figure. 6.1. ***Sebastes mentella*** **in Sub-areas I and II. Total international landings 1965-2006 (thousand tonnes).**

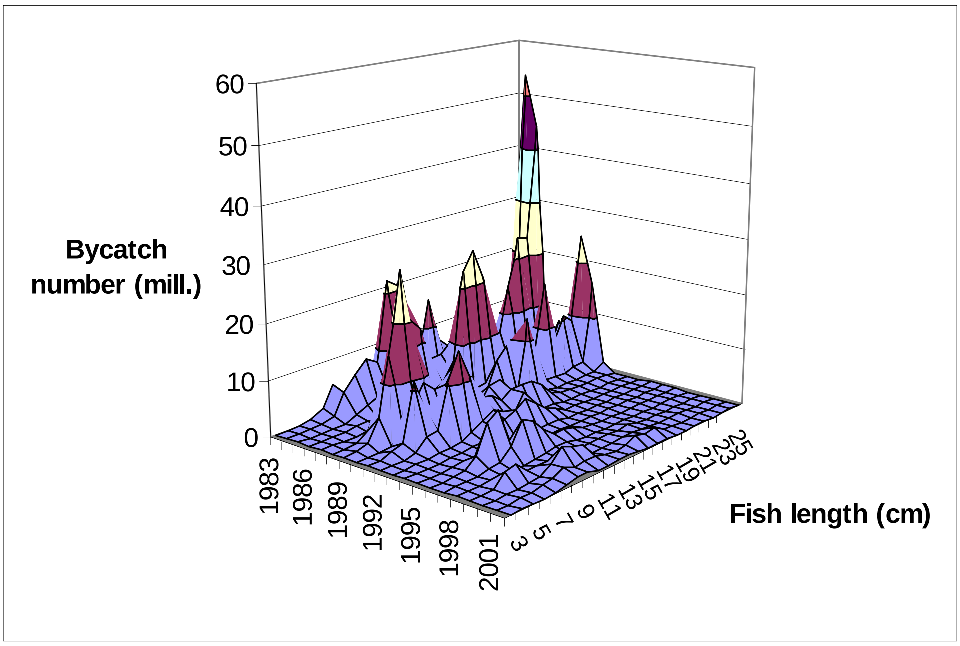


Figure 6.2. ***Sebastes mentella*** **in Sub-areas I and II. Redfish by-catch by year and length group (same data as in Table D9). (Data not yet available for 2002-2006).**

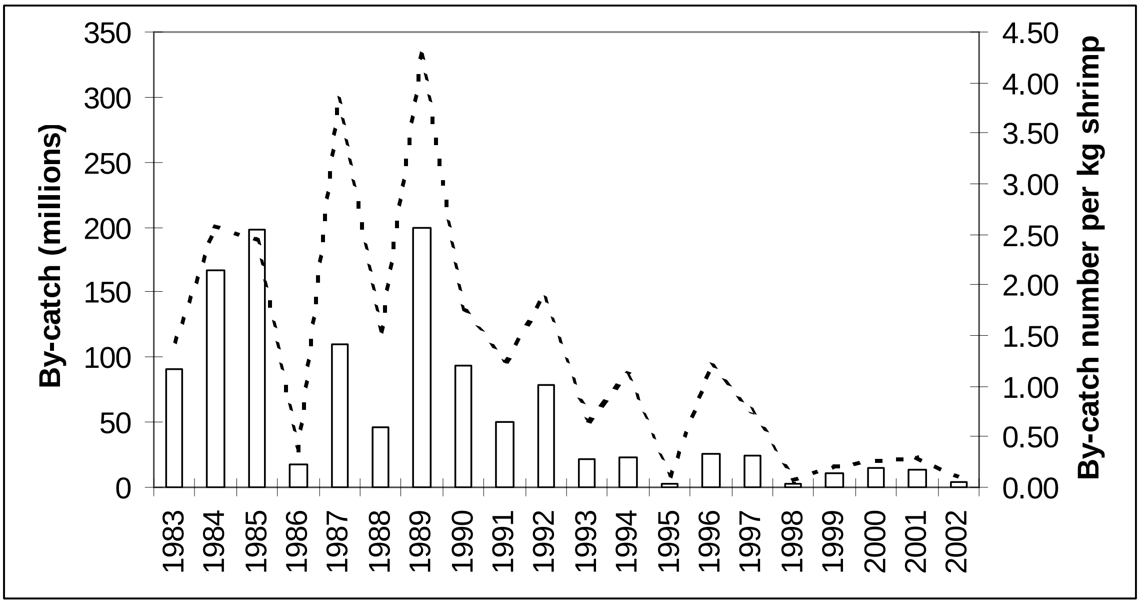


Figure 6.3. ***Sebastes mentella*** **in Sub-areas I and II. Total number of redfish caught by year in the Norwegian shrimp fishery (columns) and bycatch number per kg shrimp (line). (Data not yet available for 2003-2006).**

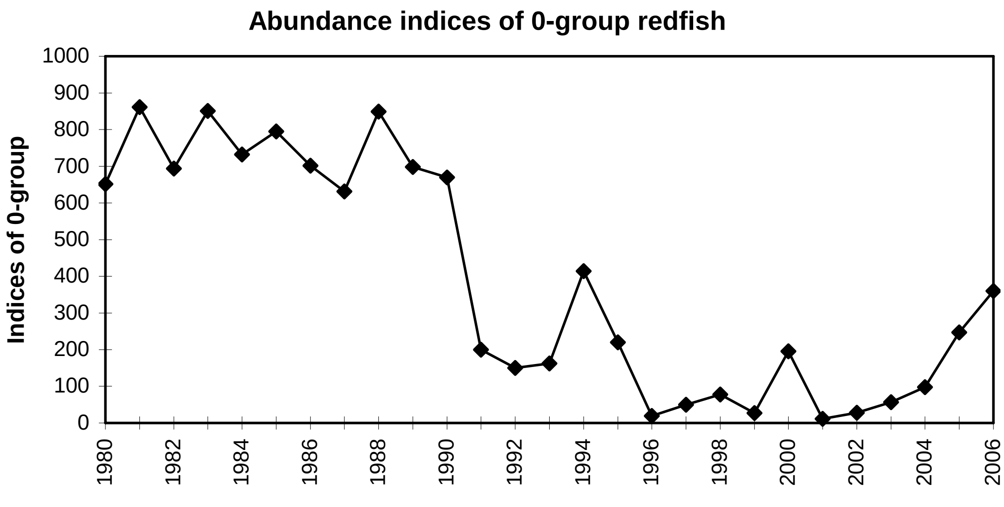


Figure 6.4a. ***Sebastes mentella*** **in Sub-areas I and II. Abundance indices of 0-group redfish (believed to be mostly** ***S.mentella*****) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-2006.**

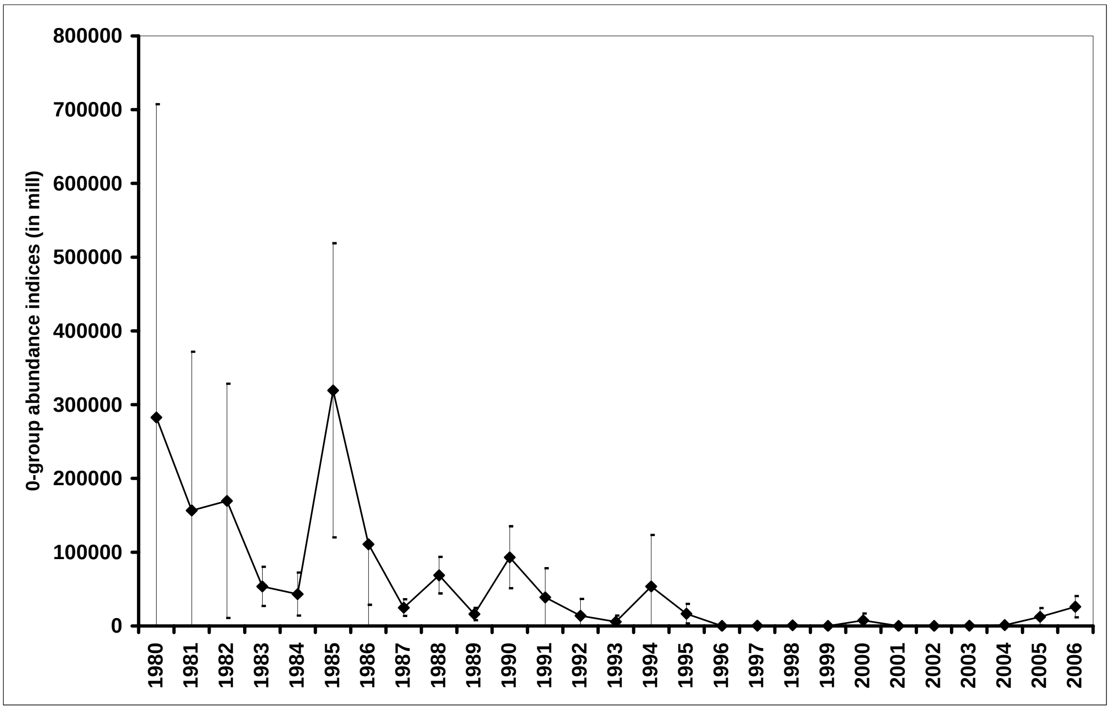


Figure 6.4b. *Sebastes mentella* in Sub-areas I and II. Abundance indices (in millions) with 95% confidence limits of 0-group redfish (believed to be mostly *S.mentella*) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-2006, as calculated by the new method, and not corrected for catching efficiency.

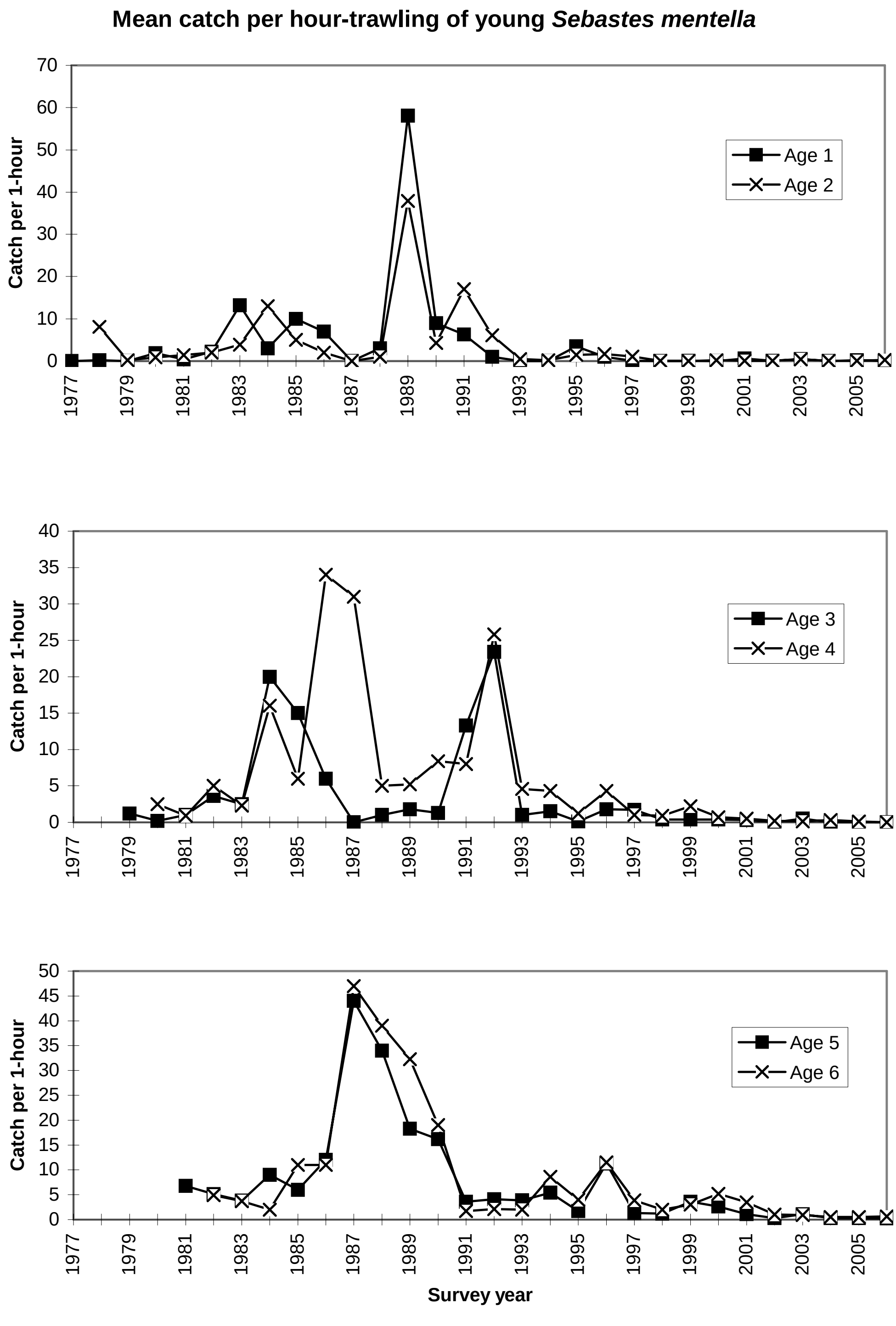
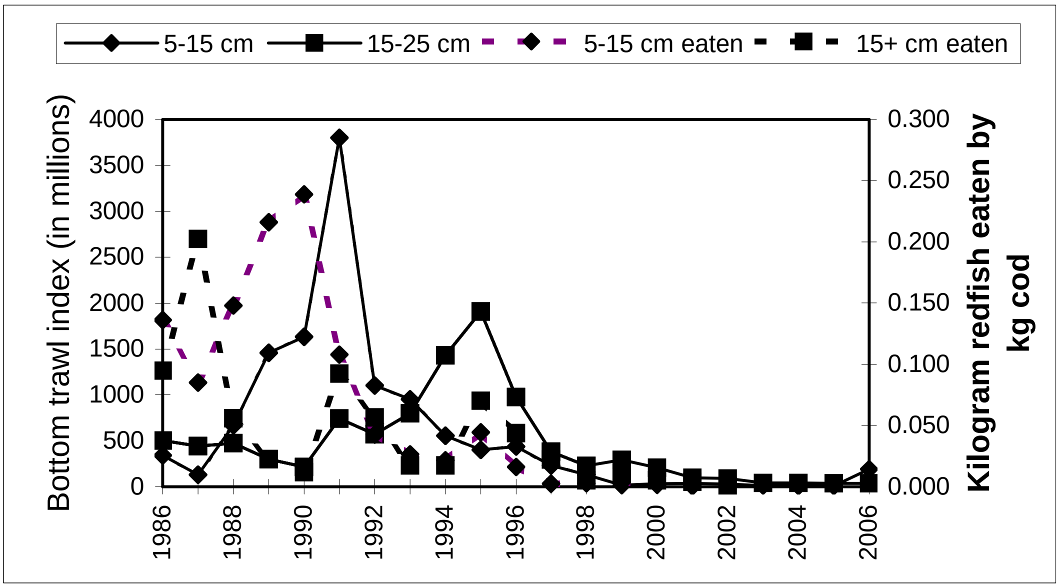


Figure 6.5. Catch (numbers of specimens) per hour trawling of different ages of Sebastes mentella in the Russian groundfish survey in the Barents Sea and Svalbard areas (ref. Table D3).



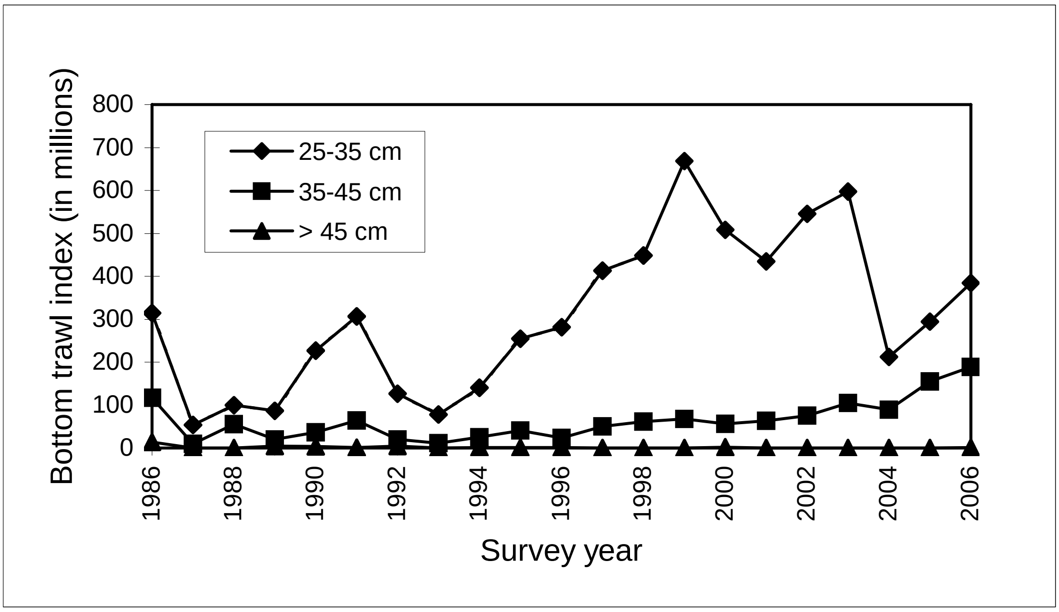


Figure 6.6a. Sebastes mentella. Abundance indices (on length) when combining the Norwegian bottom trawl surveys 1986-2006 at Svalbard (summer/fall) and in the Barents Sea (winter).

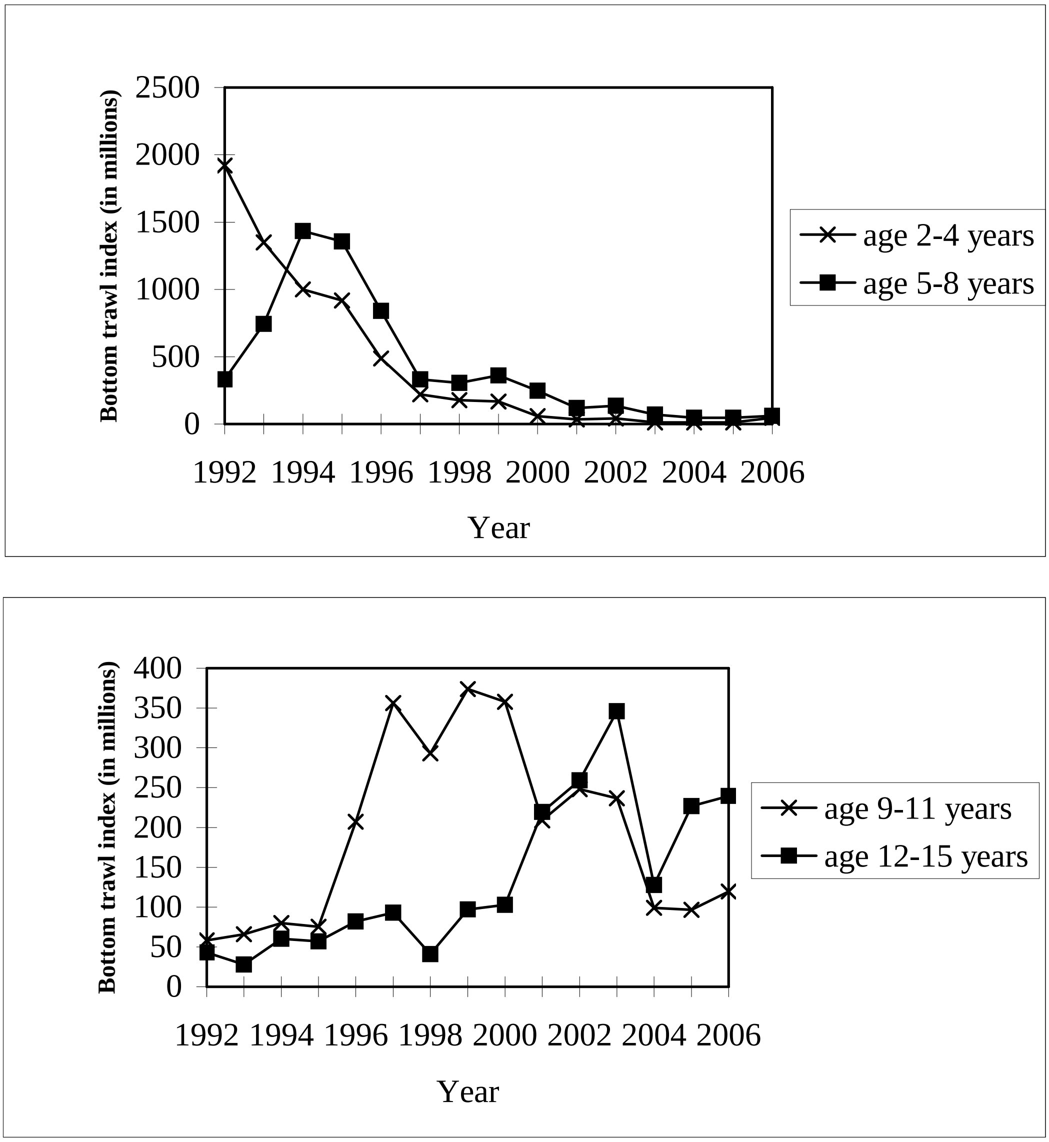


Figure 6.6b. Sebastes mentella. Abundance indices (on age) when combining the Norwegian bottom trawl surveys 1992-2006 at Svalbard (summer/fall) and in the Barents Sea (winter).

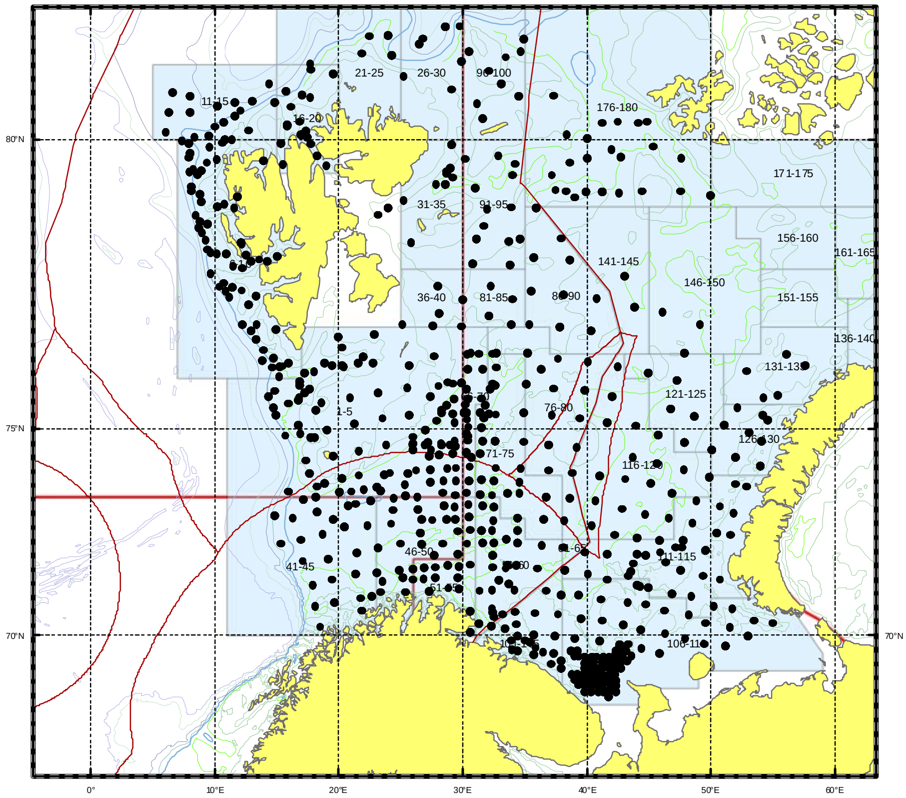


Figure 6.7. Survey regions and subareas in the ecosystem survey in the Barents Sea and adjacent areas as covered in August-September 2006 by the standard 1800 Campelen research trawl shallower than ca. 500 m. The sub-areas are further depth stratified. In addition to the areas shown on the map comes the area between 500-1500 m along the continental slope from 68-80°N (ref. Table D6).

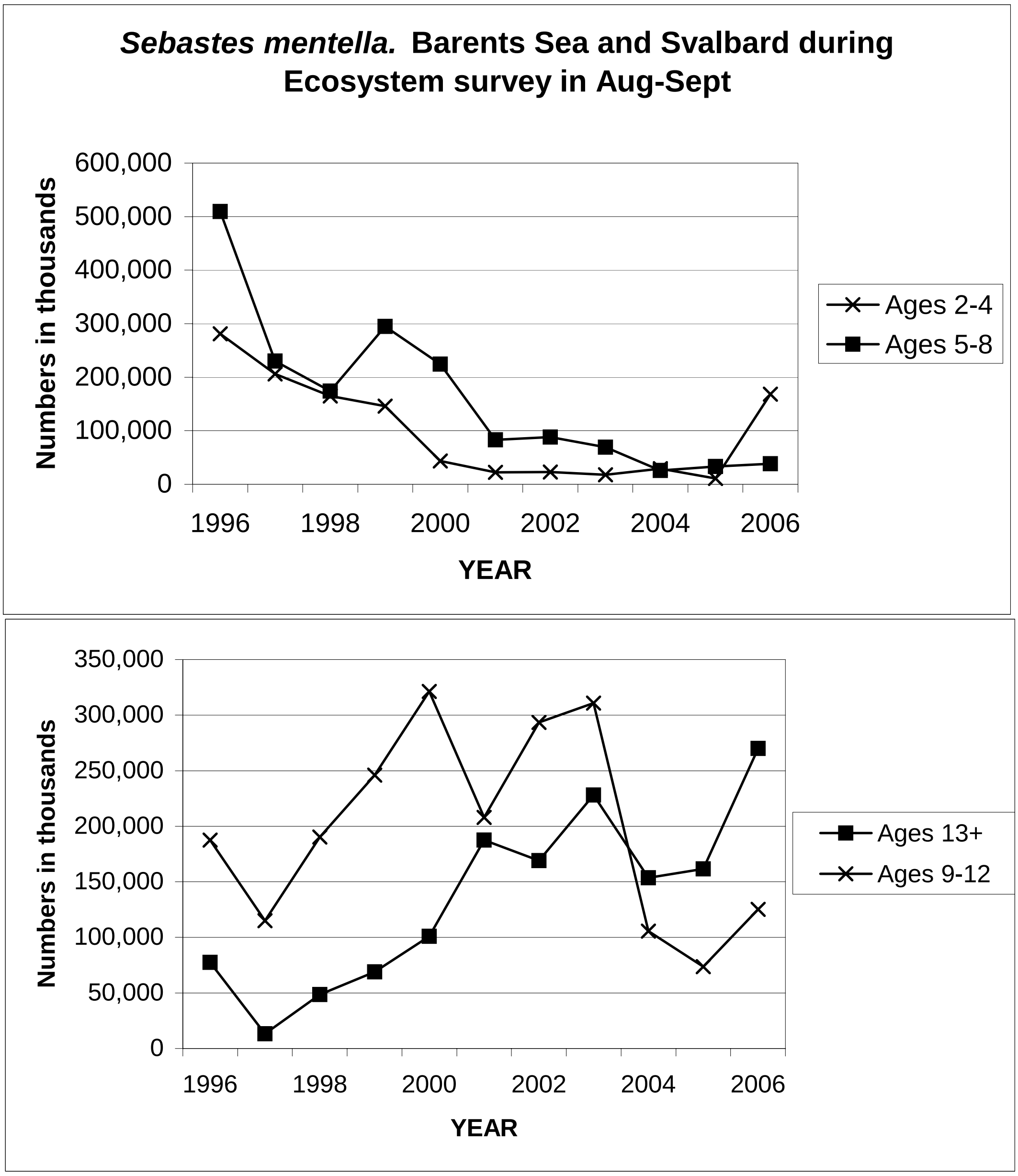
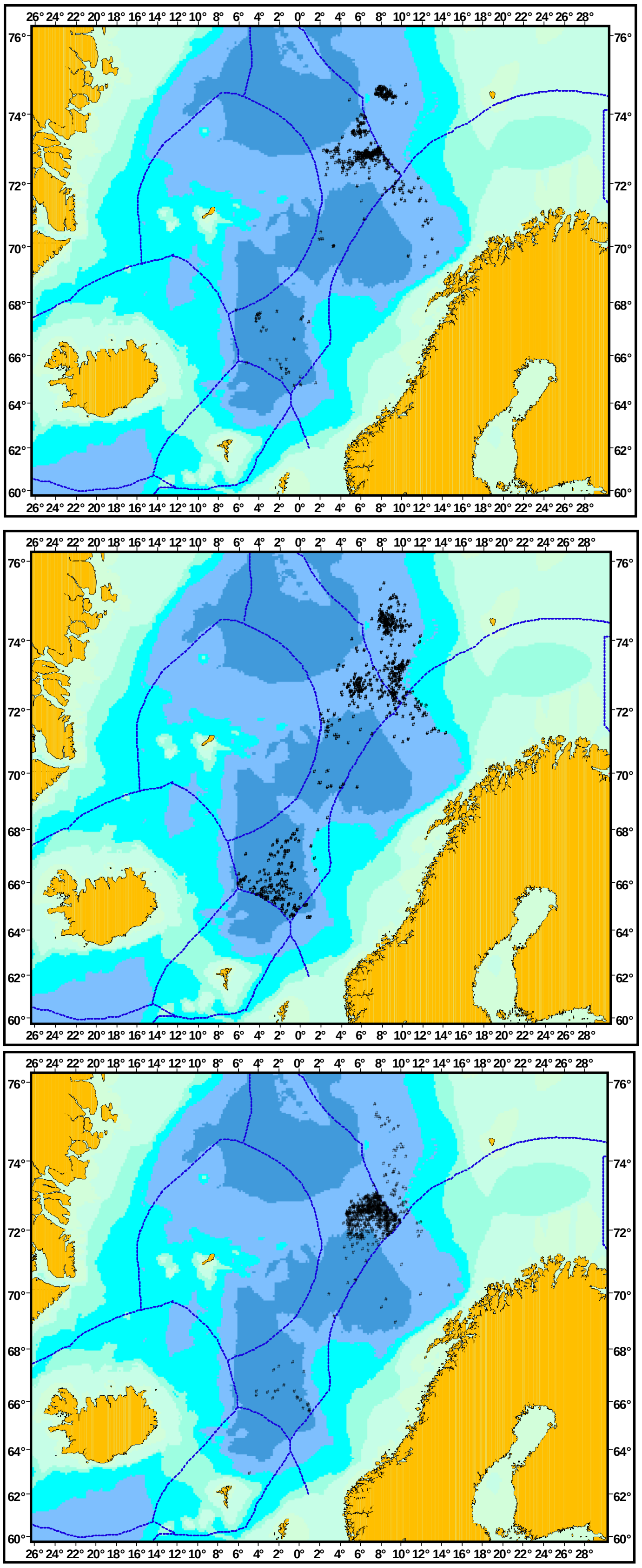


Figure 6.8. Sebastes mentella. Abundance indices (on age) from the Ecosystem survey in August-September 1996-2006 covering the Norwegian Economic Zone (NEZ) and Svalbard incl. the area north and east of Spitsbergen (ref. Table D6).



2004

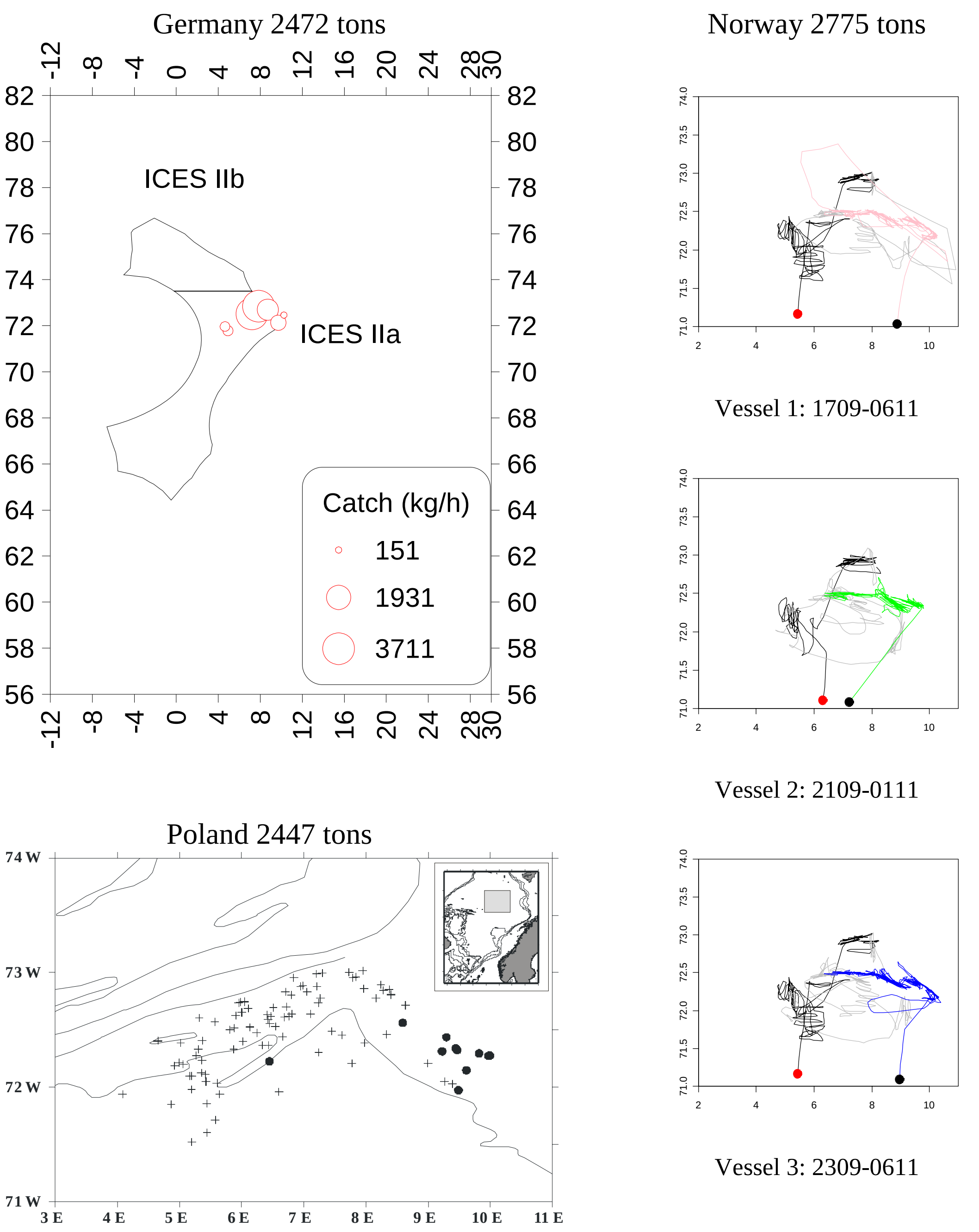
2005

2006

Figure 6.9. Pelagic *S. mentella* in the Norwegian Sea. Where did the Russian fleets fish in 2004-2006?

Pelagic *S. mentella* in the Norwegian Sea

Where did the fleets fish in 2006?



In addition:

Estonia	396	tons	France	192	tons	Spain	575	tons
Faroes	2700	tons	Lithuania	845	tons	UK	841	tons
Russia	9390	tons	Portugal	1697	tons			

TOTAL 24,330 tons

Figure 6.10. Pelagic *S. mentella* in the Norwegian Sea. Where did the fleets fish in 2006?

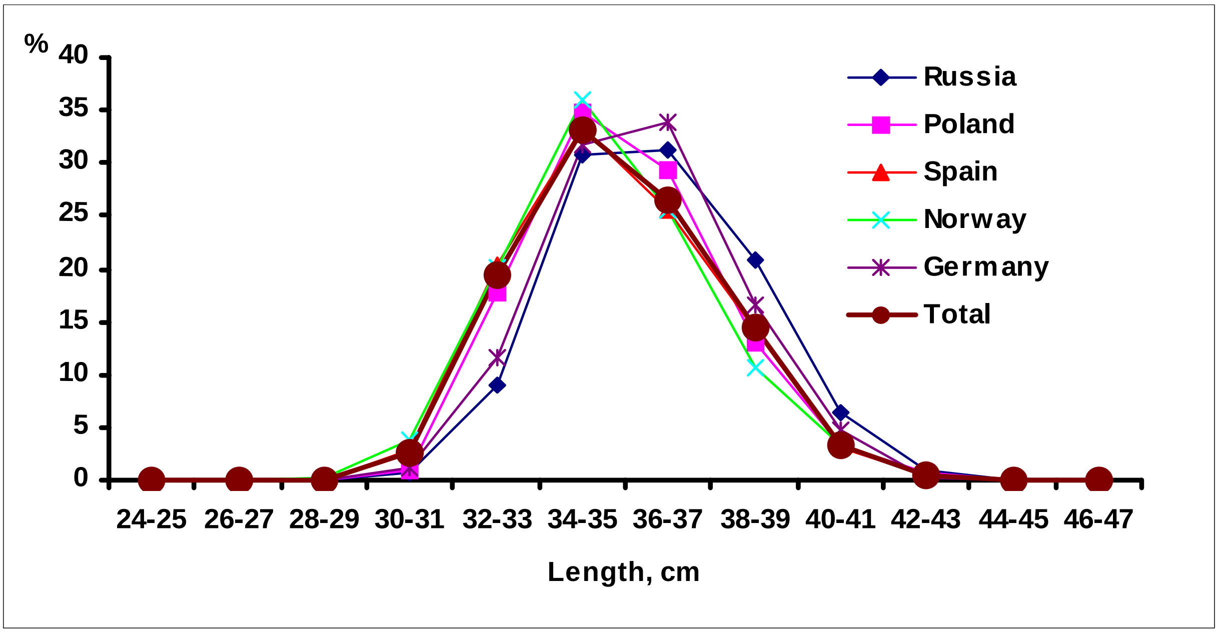


Figure 6.11. Length-distributions of the commercial pelagic catches in the Norwegian Sea outside EEZ in ICES Sub-areas IIa and IIb by those countries providing length data from their pelagic fisheries in 2006.

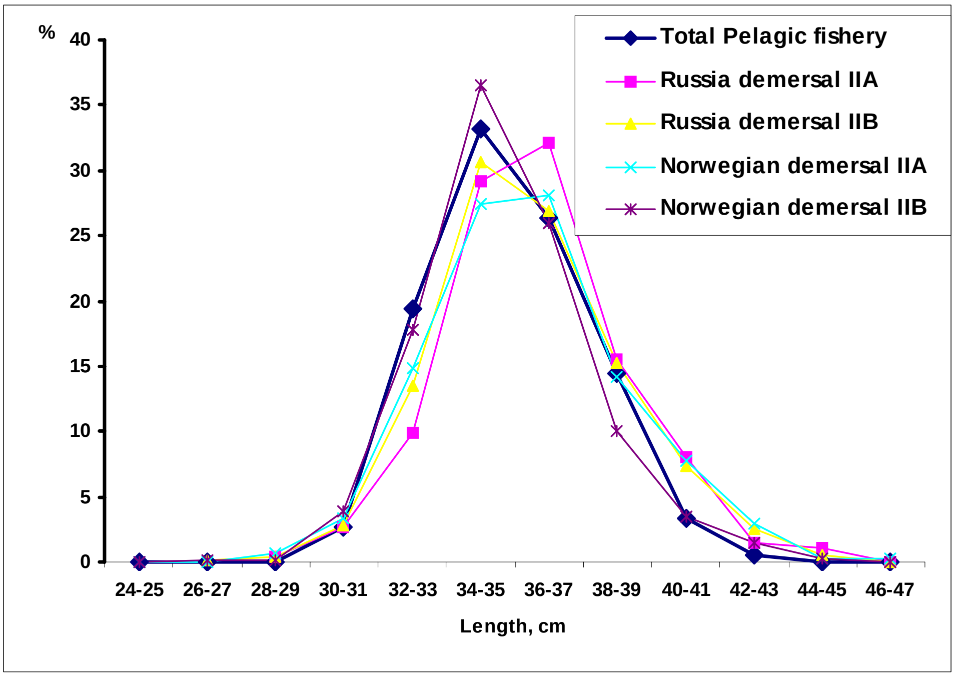


Figure 6.12. Length-distributions of the commercial demersal catches inside EEZ in ICES Sub-areas IIa and IIb by those countries providing length data from their demersal by-catches of *S. mentella* in 2006.

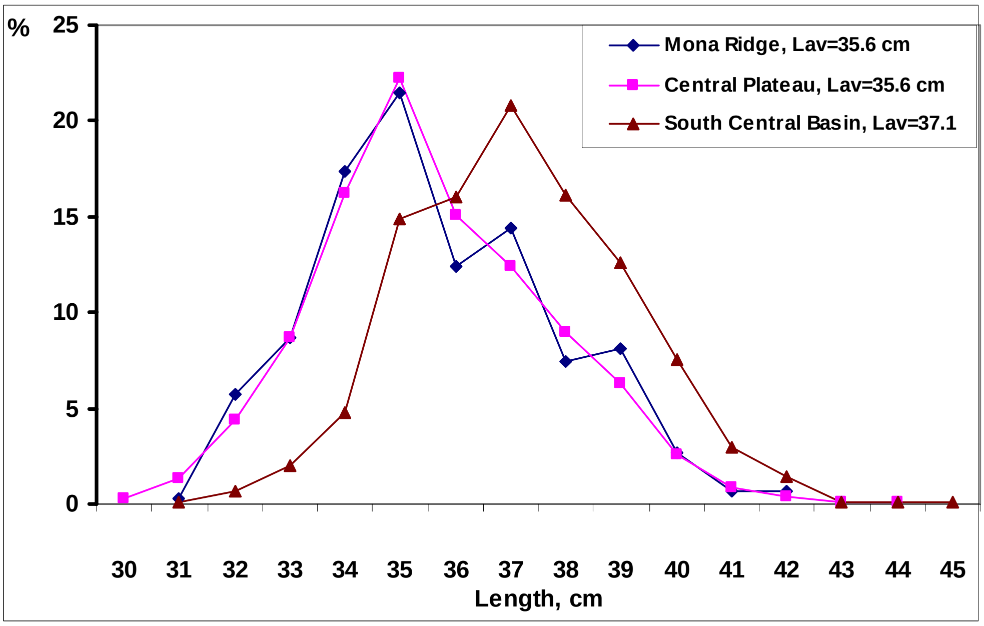
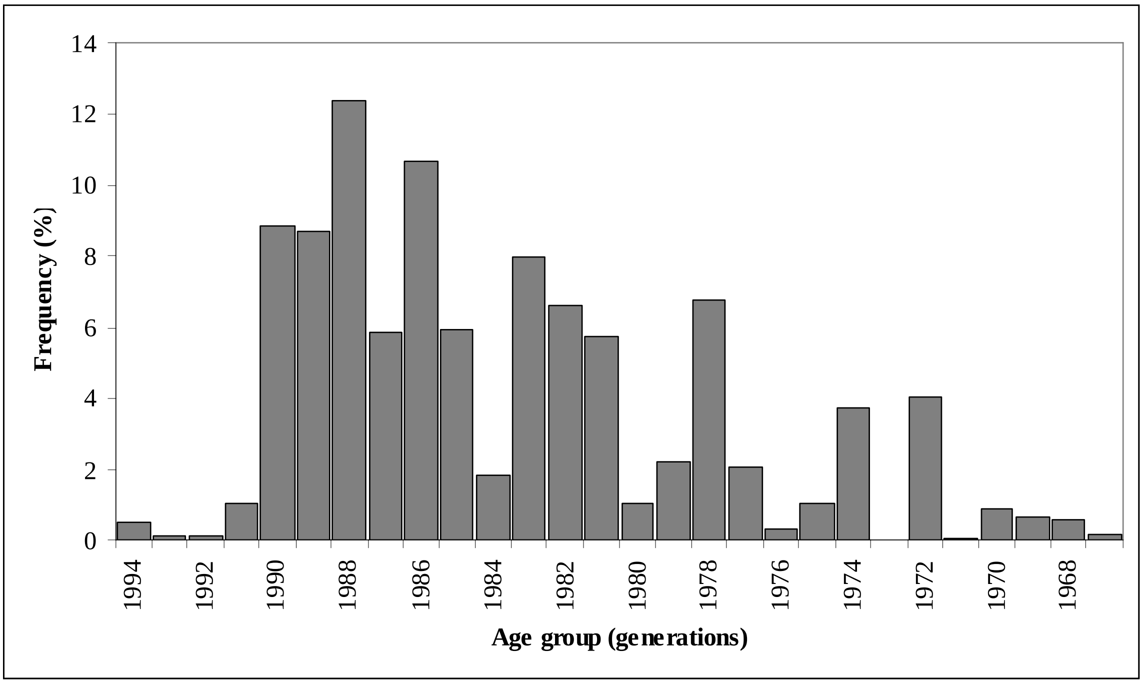


Figure 6.13. Length-distributions of the commercial pelagic in the Norwegian Sea outside EEZ by Russian fleet in 2006.



A.

B.

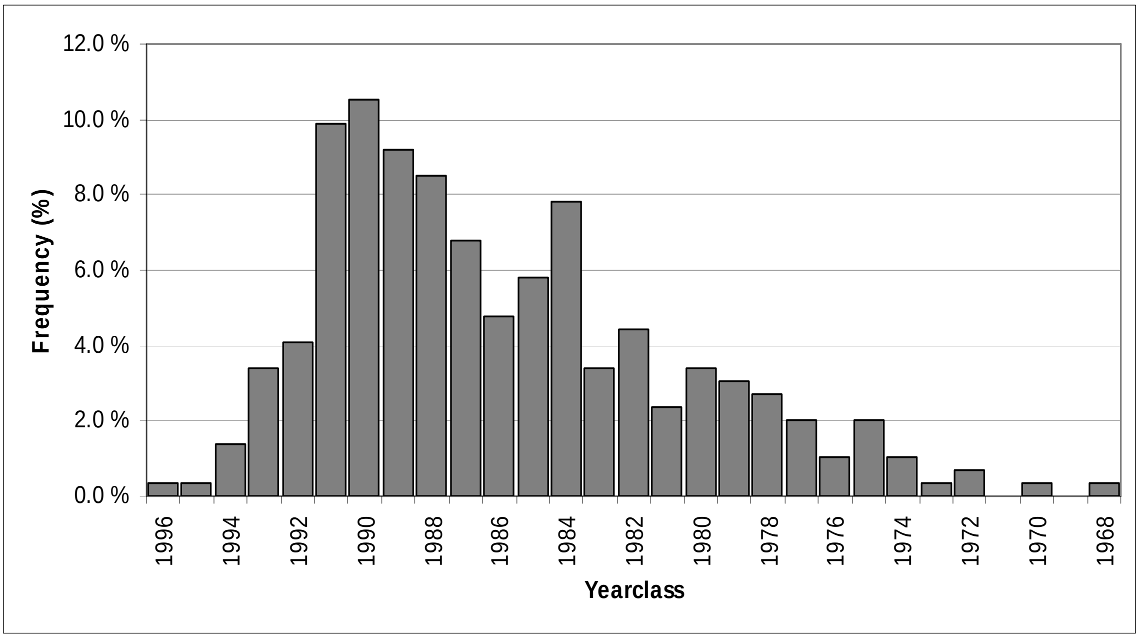


Figure 6.14. Age distributions of the (A) Polish and (B) Norwegian catches of pelagic *S. mentella* in the Norwegian Sea outside EEZ.

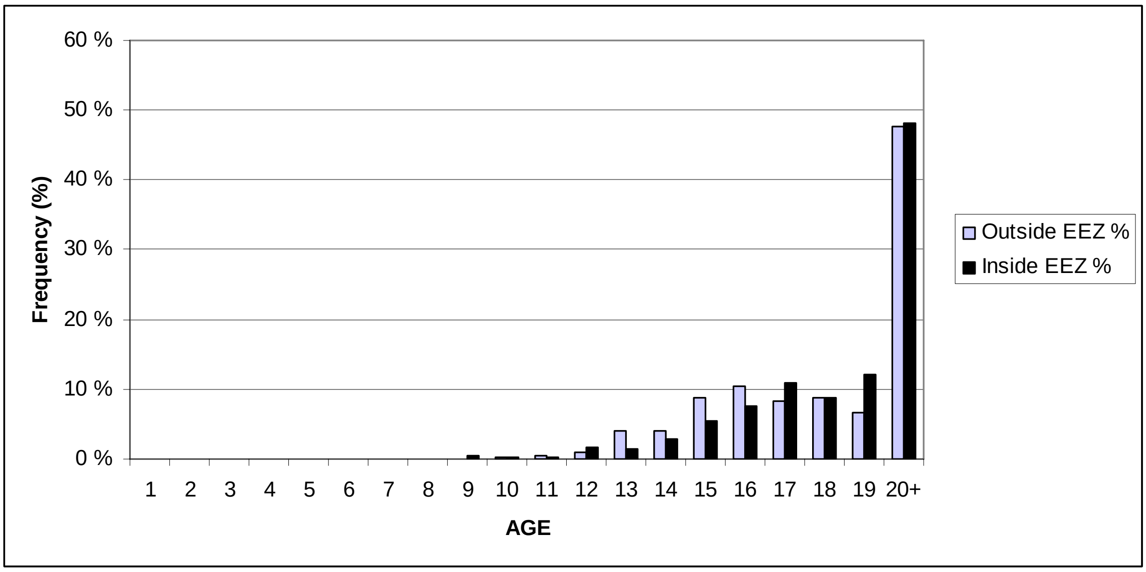


Figure 6.15. Age distributions of the *Sebastes mentella* caught inside (demersal) and outside (pelagic) the economic zone (EEZ) as shown by the age distribution of the Norwegian catches in 2006.

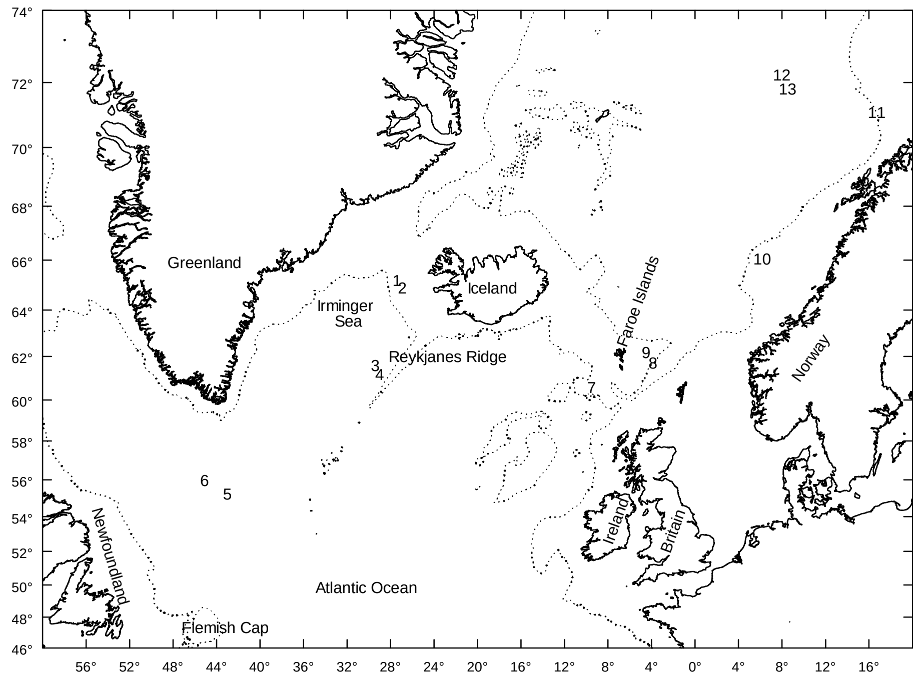


Figure 6.16. Sample locations of 13 samples of *S. mentella* from habitats on the Icelandic shelf west (1, 2); Irminger Sea deep north-east (> 500 m, 3, 4) and shallow south-west (< 500 m 5, 6) zones; Faroe Islands west (7) and east (8, 9); Norwegian shelf (10); Barents Sea (11) and Norwegian international waters (12, 13).

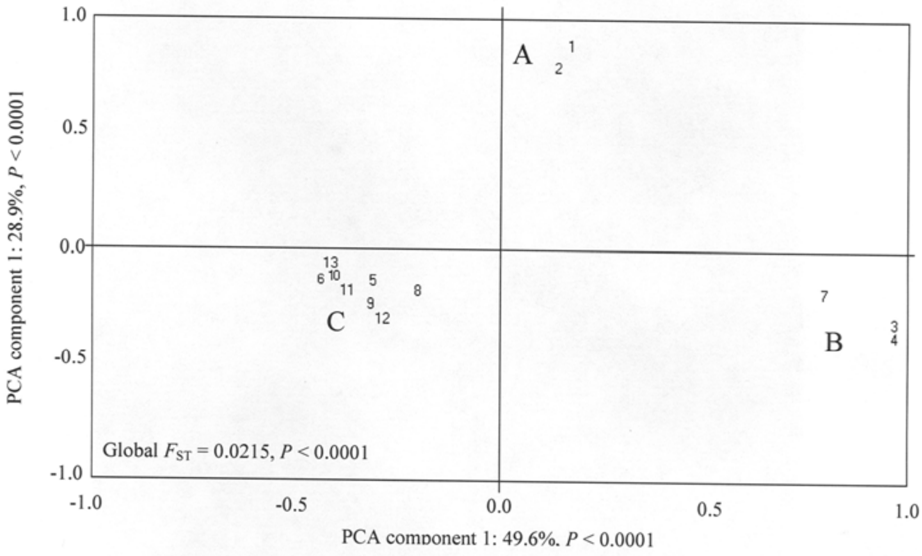


Figure. 6.17. Principal component analysis (PCA) based on 12 microsatellite loci for 13 *S. mentalla* samples from the North Atlantic (See Table 1 for sample codes). Scatter plot for samples is drawn in respect to their score or correlation to the first two principal components. Letters A, B and C denote clusters from Bayesian based cluster analysis in Tables 4 and 5.

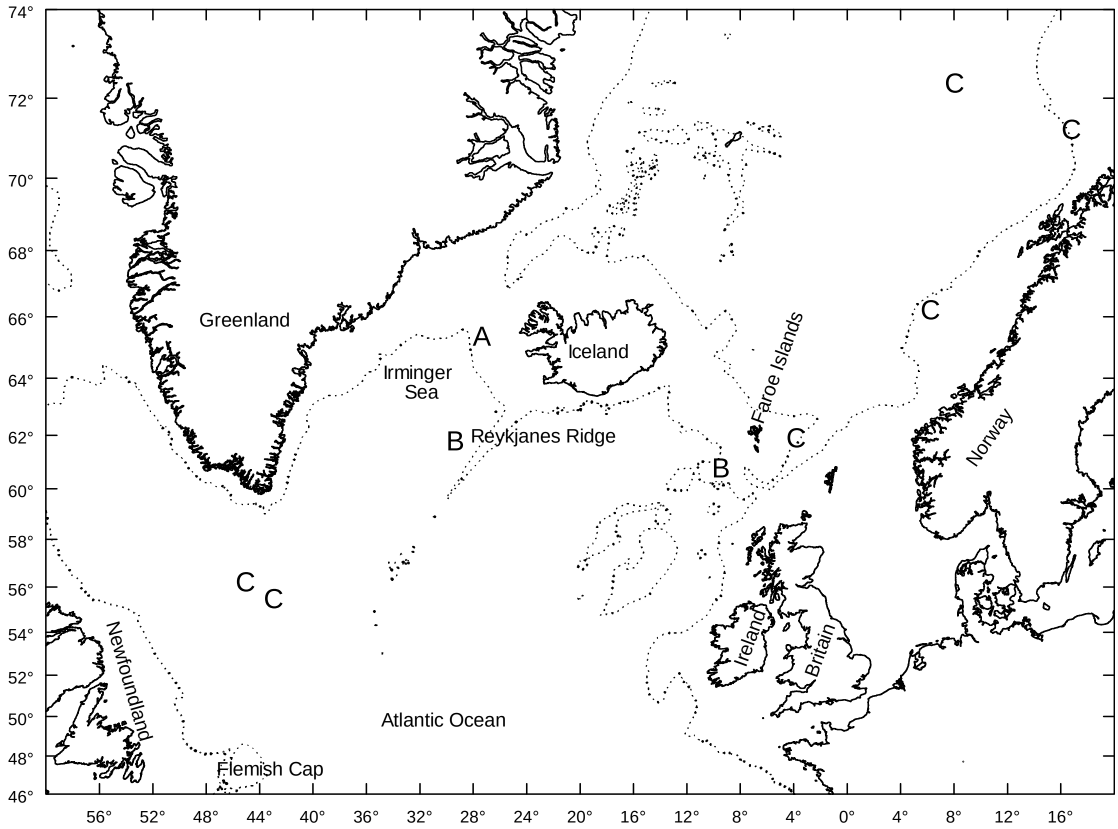


Figure 6.18. Locations of clusters A, B and C as interpreted from Bayesian based cluster analysis.

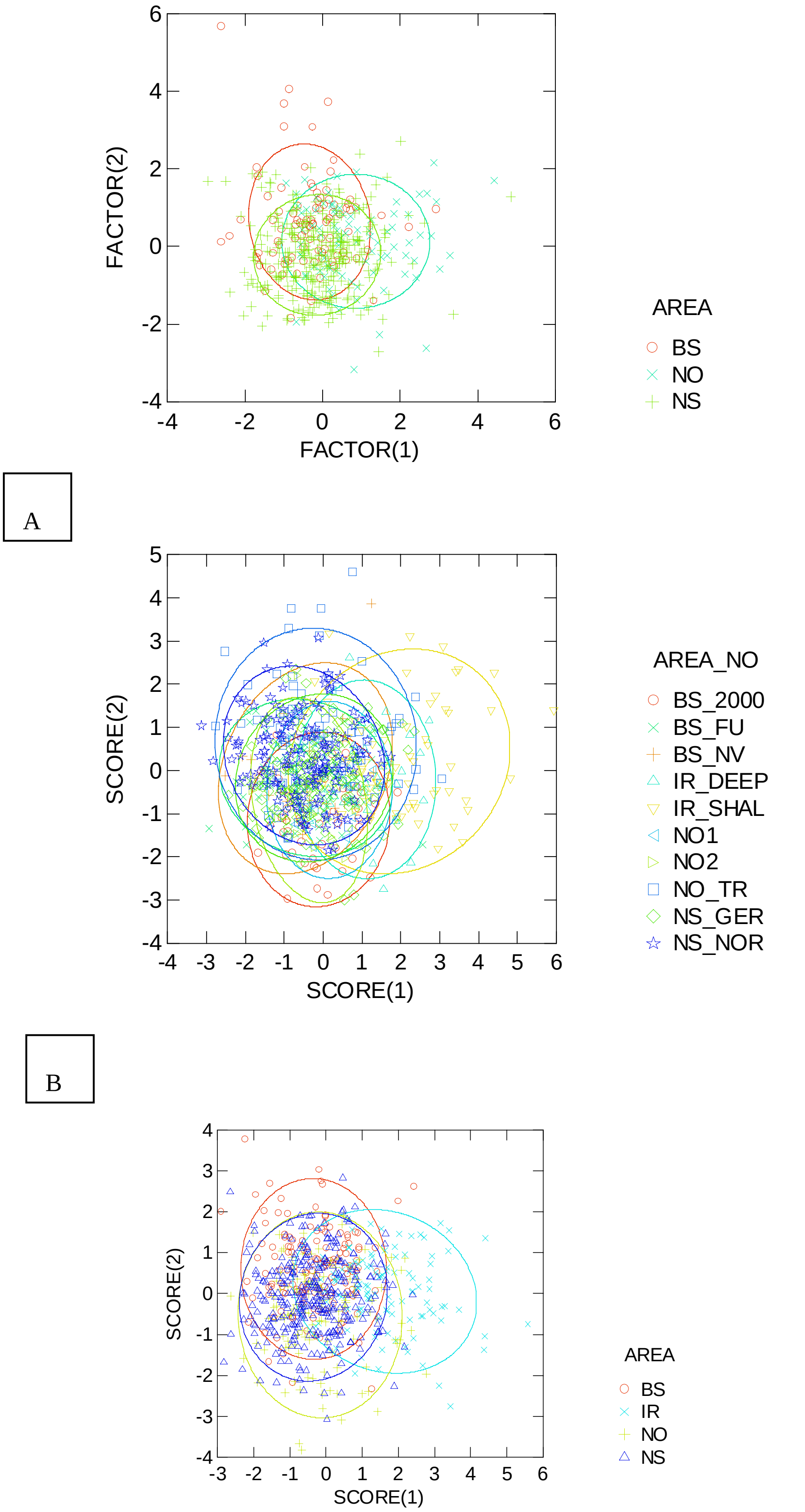


Figure 6.19. Discriminant analysis scores for the Fourier Descriptors of *S. mentella* otoliths from the Barents Sea (BS), Irminger Sea (IR), Norwegian shelf (NO) and Norwegian Sea (NS). See Table 6 for sample codes. 90% confidence ellipses are drawn around the individual points.

Table D1 REDFISH in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined as officially reported to ICES.

Year	Canada	Denmark	Faroe Islands	France	Germany[4]	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	Portugal	Russia[5]	Spain	UK (E&W)	UK (Scot.)	Total
1984	-	-	-	2,970	7,457	-	-	-	-	18,650	-	1,806	69,689	25	716	-	101,313
1985	-	-	-	3,326	6,566	-	-	-	-	20,456	-	2,056	59,943	38	167	-	92,552
1986	-	-	29	2,719	4,884	-	-	-	-	23,255	-	1,591	20,694	-	129	14	53,315
1987	-	+	450[3]	1,611	5,829	-	-	-	-	18,051	-	1,175	7,215	25	230	9	34,595
1988	-	-	973	3,349	2,355	-	-	-	-	24,662	-	500	9,139	26	468	2	41,494
1989	-	-	338	1,849	4,245	-	-	-	-	25,295	-	340	14,344	5[2]	271	1	46,688
1990	-	37[3]	386	1,821	6,741	-	-	-	-	34,090	-	830	18,918	-	333	-	63,156
1991	-	23	639	791	981	-	-	-	-	49,463	-	166	15,354	1	336	13	67,768
1992	-	9	58	1,301	530	614	-	-	-	23,451	-	977	4,335	16	479	3	31,773
1993	8[3]	4	152	921	685	15	-	-	-	18,319	-	1,040	7,573	65	734	1	29,517
1994	-	28	26	771	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	-	-	7	1,011	538	39[2]	-	11	-	18,839	1	535	4,556	308	235	29	26,109
1998	-	-	98	567	231	47[3]	-	28	-	26,273	13	131	5,278	228	211	94	33,199
1999	-	-	108	61[3]	430	97	14	10	-	24,634	6	68	4,422	36	247	62	30,195
2000	-	-	67[3]	25	222	51	65	1	-	19,052	2	131	4,631	87		203[6]	24,537
2001	-	-	111[3]	46	436	34	3	5	-	23,071	5	186	4,738	91	**Estonia**	239[6]	28,965
2002	-	-	135[3]	89	141	49	44	4	-	10,713	8[3]	276	4,736	193[2]	15	234[6]	16,637
2003	**Swed**	-	173[3]	31	154	44[3]	9	5[3]	89	8,063	7	50	1,431	47[2]	-	258[6]	10,361
2004	1	-	607	17[3]	78	24[3]	40	3	33	7,658[1,2]	42	240	3,601[2]	260[2]	-	146[6]	12,749
2005		Lith	1,194	56	106	75[3]	12[2]	4[3]	55[2]	7,844[1,2]	-	196	5,637	171[3]	5	147[6]	15,501
2006[1]		845	3,272	222	2,518	107[3]	2,643[3]	12[3]	21	10,853[2]	2,476[2]	1,873	12,126	719[2]	396	1,064[6]	39,147

[1] Provisional figures.

[2] Working Group figure.

[3] As reported to Norwegian authorities or NEAFC.

[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	Greenland	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	595	21	528	2,330
1998	2	27	12	570	370	-	4	21	1,113	68	681	2,868
1999	3	52	1	-	58	-	39	16	862	67	465	1,563
2000	5	41	-	224	19	-	28	19	443	132	486	1,397
2001	4	96	-	272	13	-	19	+	421	80	458	1,363
2002	2	40	2	98	11	-	7	+	241		524[3]	925
2003	1	71	2	26	2	-	-	-	474		463[3]	1,071
2004	+	42	3	26	1	-	-	-	287		214[3]	578
2005	2	32	n.a.	10	1	-	-	-	85		28[3]	191
2006[1]	1	49	1	12	3	-	-	-	154		79[3]	299

1 Provisional figures.

2 Working Group figure.

3 UK(E/W/)+UK(Scotl)

n.a. = not available.

Table D3. *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	-
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	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
1975	-	7.4	-	1.7	6.4	2.4	3.5	5	-	-	4	-
1976	7	-	8.1	1.2	2.5	6.8	4.9	5	1	13	-	-
1977	-	0.2	0.2	0.2	0.9	5.1	3.7	1	19	2	-	-
1978	0.8	0.02	0.9	1	5	3.8	2	20	6	-	-	-
1979	-	1.9	1.4	3.6	2.3	9	11	16	1	-	-	0.1
1980	0.3	0.4	2	2.5	16	6	11	25	2	-	1.5	2
1981	-	2.2	3.9	20	6	12	47	18	6.3	1.6	0.5	1
1982	19.8	13.2	13	15	34	44	39	32.6	4.3	3.1	4.9	+
1983	12.5	3	5	6	31	34	32.3	13.3	4	4.2	0.6	1.1
1984	-	10	2	-	5	18.3	19	2.2	2.4	0.2	1.7	2.4
1985	107	7	-	1	5.2	16.2	1.7	1.7	0.6	2.8	3.8	0.3
1986	2	-	1	1.8	8.4	3.6	2.1	1.2	5.6	8.2	0.9	0.7
1987	-	3	37.9	1.3	8	4.1	2	10.6	9.6	1.4	2	1.3
1988	4	58.1	4.3	13.3	25.8	3.9	8.6	11.2	2.8	4.2	3	4.7
1989	8.7	9	17	23.4	4.6	5.4	4	6.6	6.6	4.1	7.7	5.3
1990	2.5	6.3	6.1	1	4.3	1.7	11.5	6.5	5.5	6.7	7.4	3.6
1991	0.3	1	0.5	1.5	1.2	11.3	3.9	3.3	4.6	5.8	2.7	1.9
1992	0.6	+	0.2	0.1	4.3	1.3	2	2.3	4.9	2.3	1	4.1
1993[1]	-	+	1.5	1.8	1	1.2	3	4.2	2.6	2	3.2	2.1
1994	0.3	3.5	1.7	1.7	0.9	3.6	5.2	4.3	3.1	3.3	1.8	1.2
1995	2.8	1	1.1	0.4	2.2	2.6	3.5	3.4	2.9	1.2	1	8.5
1996[2]	+	0.1	0.1	0.4	0.7	1.1	1	1.4	1	0.8	3.7	
1997	-	-	+	0.4	0.5	0.3	0.9	0.6	1	1.1		
1998	-	0.1	0.2	0.3	0.2	1.1	0.5	0.7	1			
1999	0.1	-	0.1	+	0.1	0.3	0.5	0.8				
2000	-	0.6	0.1	0.5	0.3	0.3	0.6					
2001	-	0.1	0.4	-	0.1	0.2						
2002[3]	0.1	0.5	0.1	-	-							
2003	-	-	0.1	-								
2004	-	0.2	0.3									
2005	-	-										
2006[4]	0.1											

[1] - Not complete area coverage of Division IIb.
[2] - Area surveyed restricted to Subarea I and Division IIa only.
[3] - Area surveyed restricted to Subarea I and Division IIb only.

Table D4a. *Sebastes mentella*[1] in Division IIb. Abundance indices (on length) from the bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-2006 (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
2001	1	5	3	32	57	228	50	3	0	378
2002	1	4	6	21	62	266	47	4	+	410
2003	1	5	7	11	56	271	50	1	0	403
2004	0	2	7	6	14	78	53	2	0	163
2005	1	1	6	11	19	93	63	1	0	196
2006	82	6	5	7	49	211	101	3	0	463

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.
[2] - Old trawl equipment (bobbins gear and 80 meter sweep length)

Table D4b. *Sebastes mentella*[1] in Division IIb. Norwegian bottom trawl survey indices (on age) in the Svalbard area (Division IIb) in summer/fall 1992-2006 (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
2001	2	4	3	1	9	16	22	30	34	57	57	50	54	6	344
2002	3	2	4	2	5	22	34	23	88	36	62	64	15	21	379
2003	0.3	3	4	3	5	4	29	31	50	59	45	70	38	23	365
2004	1	1	3	3	1	4	2	9	9	18	15	17	19	9	113
2005	1	1	2	3	3	6	9	15	14	16	14	21	22	25	152
2006	33	1	3	3	2	9	17	27	24	35	29	45	25	34	287

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

Table D5a. ***Sebastes mentella*[1]. Abundance indices (on length) from the bottom trawl surveys in the Barents Sea in the winter 1986-2007 (numbers in millions). The area coverage was extended from 1993 onwards.**

	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
2002	16.1	7.2	19.1	41.7	103.9	113.7	22.9	1.4	+	326.0
2003	3.9	3.9	10.0	12.4	70.8	199.8	46.9	6.0	0.3	354.0
2004	2.2	3.0	6.9	18.5	32.9	86.7	31.8	2.0	0.1	184.1
2005	+	6.3	7.3	10.7	28.4	153.4	86.6	3.9	0.2	296.8
2006	98.8	1.9	9.8	14.6	22.7	102.8	81.9	2.7	0.7	336.0
2007	372.3	116.2	2.5	6.5	12.0	118.2	117.7	6.5	0.1	751.8

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

[2] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D5b. *Sebastes mentella*[1] in Sub-areas I and II. Preliminary Norwegian bottom trawl indices (on age) from the annual Barents Sea survey in February 1992-2006 (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
2002	18	4	12	7	4	14	49	55	27	19	34	24	28	11	306
2003	0	2	2	4	6	6	14	39	24	34	39	65	46	20	301
2004	0	2	3	1	9	12	15	20	36	8	28	3	25	12	172
2005	0	4	3	3	6	6	11	15	23	14	21	40	35	49	229
2006	4	1	5	5	5	8	15	12	6	15	21	17	32	36	180

[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 D6. *Sebastes mentella* in Sub-areas I and II. Abundance indices (on age) from the Norwegian (since 2005 joint with Russia) demersal fish survey (ecosystem survey) in August-September 1996-2006 covering the Norwegian Economic Zone (NEZ) and Svalbard incl. the area north and east of Spitsbergen (numbers in thousands) and the continental slope down to 1500 m.

Year	Age														
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+	Total
1996	146198	112742	22353	53507	165531	181980	108738	43328	65310	40546	38254	19843	29446	10931	17414	1366761
1997	62682	130816	12492	23452	74342	55880	76607	82503	17640	14274	675	2238	1723	633	8765	587223
1998	313	78767	85715	39849	25805	23413	84825	100332	54287	24329	11334	7457	15250	576	25212	577670
1999	5359	23240	117170	47851	41608	76797	128677	73306	58018	64781	49890	13565	18458	12171	24672	755562
2000	5964	23169	14336	19960	52666	68081	83857	77513	100442	72294	71148	36599	17183	20590	26501	690837
2001	5026	6541	10957	1093	19766	25591	36594	51644	44407	61704	50083	86122	53952	15699	31877	507131
2002	9112	6646	7379	3821	8635	28215	47456	63903	103368	49964	76133	71970	25241	36765	34957	573565
2003	3954	7394	6142	3540	8030	9388	48564	59051	98554	69901	83192	73521	69970	37162	47323	625687
2004	9068	10837	9008	7292	2510	7896	8193	15268	25544	29654	35249	21142	39581	25976	66792	314030
2005	1310	4406	5241	5031	5722	8740	13452	20672	16207	19353	17430	32028	37564	34815	57103	279072
2006	156578	5162	6695	5217	3768	10754	18771	29174	25278	38958	31869	46885	30895	44299	147951	602255

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 1992-2001. Abundance indices in millions.**

YEAR	PERIOD OF SURVEY	AGE																		TOTAL				AREA OF SURVEY
		1-4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	NUMBERS 10^6	BIOMASS T 10^3	SSN 10^6	SSB T 10^3	IN N.M.^{2}
1992	April	29	27	27	37	36	50	78	39	34	40	44	43	28	17	13	4	7	3	566	218	191	114	25300
1993	April	31	15	13	6	6	20	56	56	38	28	29	27	19	12	7	3	1	2	396	150	151	90	23500
1994													No Data											
1995	May	+	32	51	83	90	41	31	31	41	94	73	48	30	10	9	4	1	+	669	202	211	102	23300
1996													No Data											
1997	Apr-May	86	6	24	102	150	53	48	24	20	26	36	28	11	9	4	2	1	+	630	170	111	58	22400
1998	April	1	+	8	47	77	63	71	46	27	19	23	23	25	6	3	2	1	+	442	153	106	57	22931
1999	Apr-May	11	1	9	14	57	75	63	73	31	25	17	15	11	8	3	1	1	1	415	134	120	55	19333
2000	Apr-May	2	2	14	15	62	100	143	122	54	34	24	29	12	11	7	2	1	1	635	208	114	53	22000
2001	Apr-May	11	1	11	22	24	84	123	134	144	115	78	40	27	19	10	4	+	3	850	316	339	152	23000
2002													No Data											
2003													No Data											
2004													No Data											
2005													No Data											
2006													No Data											

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	1988	1989	1990	1991	1992	1993	1995	1997	1998	1999	2000	2001
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.021	0.000	0.000	0.000
8	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.014	0.016	0.000	0.000
9	0.000	0.000	0.012	0.139	0.013	0.033	0.000	0.027	0.000	0.059	0.048	0.082
10	0.028	0.074	0.131	0.174	0.092	0.133	0.055	0.130	0.074	0.110	0.087	0.196
11	0.125	0.178	0.300	0.138	0.169	0.364	0.111	0.312	0.171	0.333	0.202	0.405
12	0.297	0.473	0.688	0.358	0.396	0.480	0.368	0.281	0.276	0.579	0.375	0.442
13	0.562	0.684	0.714	0.470	0.452	0.696	0.587	0.566	0.622	0.689	0.489	0.442
14	0.760	0.716	0.824	0.637	0.761	0.925	0.696	0.736	0.714	0.788	0.742	0.648
15	0.855	0.794	0.848	0.762	0.939	0.962	0.729	0.831	0.871	0.813	0.833	0.775
16	1.000	1.000	1.000	1.000	0.886	0.953	0.789	0.958	0.919	0.903	0.904	0.865
17	1.000	1.000	1.000	1.000	1.000	0.977	1.000	0.950	1.000	0.923	1.000	0.909
18	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table D9. Estimated number (millions) of redfish caught in the shrimp fishery by length group and year. Sum and estimated catch weight (000 tonnes) are given at the bottom rows. (Data not yet available for 2002-2005).

L(cm)	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	0.06	0.00	0.00	0.00	0.00	0.23	1.03	0.08	0.91	0.05	0.00	0.00	0.01	0.00	0.00	0.00	0.07	0.00	0.17	0.00
6	0.53	0.10	0.01	0.10	0.00	1.85	4.56	0.17	1.64	0.64	0.16	0.09	0.12	0.21	0.01	0.00	2.15	0.06	0.30	0.00
7	1.80	0.94	0.21	0.42	0.01	5.97	14.79	2.76	11.44	2.56	0.47	0.24	0.31	1.81	0.40	0.00	2.69	0.15	0.57	0.09
8	5.37	4.64	0.93	0.44	0.02	3.55	28.90	6.24	5.89	2.94	0.41	0.20	0.17	6.81	0.60	0.00	0.83	0.39	0.73	0.45
9	1.70	7.10	2.12	0.09	0.02	1.01	17.81	9.19	1.88	10.42	0.80	0.64	0.05	8.30	2.75	0.07	0.65	1.61	1.91	0.88
10	3.79	9.35	2.80	0.03	0.09	1.42	8.68	7.22	1.11	15.29	1.49	0.53	0.06	2.37	6.40	0.22	0.66	3.96	1.13	0.82
11	0.62	7.96	3.13	0.25	0.08	0.60	5.70	7.50	2.31	10.14	2.81	2.01	0.08	1.71	5.38	0.65	0.44	3.13	1.34	0.31
12	1.64	22.25	10.82	0.28	2.00	0.50	5.47	10.65	2.57	5.56	4.04	3.08	0.06	2.34	3.36	0.72	0.16	2.63	1.35	0.22
13	1.46	20.66	15.24	1.00	1.34	0.52	2.19	5.90	2.88	5.31	2.88	3.92	0.14	0.94	1.71	0.84	0.47	0.43	0.82	0.45
14	2.68	4.11	12.64	1.15	1.78	0.42	2.48	3.18	5.72	3.65	1.83	5.25	0.33	0.16	1.52	0.41	0.41	0.34	0.43	0.55
15	3.07	2.04	6.26	2.39	7.04	0.46	1.80	1.73	5.91	4.76	4.79	3.50	0.41	0.13	1.09	0.18	0.59	0.41	0.71	0.41
16	6.08	0.33	6.63	3.90	23.00	1.57	1.31	0.82	2.31	5.15	0.81	1.84	0.35	0.03	0.28	0.09	0.62	0.69	1.64	0.18
17	15.13	2.74	8.29	2.91	26.45	2.17	6.82	1.08	1.70	4.95	0.51	1.24	0.14	0.02	0.27	0.02	0.34	0.61	1.10	0.11
18	6.60	0.17	0.42	1.33	21.11	4.33	8.92	0.83	0.63	3.52	0.47	0.13	0.02	0.06	0.00	0.00	0.76	0.35	1.34	0.03
19	4.72	2.23	3.05	0.56	7.13	5.65	8.03	13.78	0.41	1.46	0.27	0.04	0.01	0.05	0.00	0.00	0.23	0.36	0.28	0.01
20	3.22	6.55	6.04	0.32	3.43	6.46	4.13	0.68	0.41	0.61	0.11	0.00	0.00	0.11	0.00	0.00	0.09	0.16	0.27	0.00
21	3.23	5.82	5.53	0.11	1.27	2.93	6.21	1.17	0.22	0.30	0.04	0.00	0.00	0.07	0.00	0.00	0.01	0.05	0.00	0.00
22	3.83	3.43	6.79	0.10	2.89	2.15	18.24	0.81	0.17	0.37	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.15	0.00	0.00
23	3.47	3.63	14.78	0.33	1.27	1.38	6.61	0.94	0.26	0.15	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.02	0.00	0.00
24	1.60	4.96	23.90	0.20	1.70	1.12	10.72	1.29	0.50	0.27	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
25	1.54	3.86	23.48	0.29	2.15	0.83	9.19	1.59	0.26	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
>25	18.95	53.87	44.56	1.60	7.41	0.96	24.98	16.22	1.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	91	167	198	18	110	46	199	94	51	78	22	23	2	25	24	3	11	15	14	5
000T	9.0	17.8	25.5	1.3	8.8	3.3	16.7	6.8	1.3	2.2	0.7	0.7	0.1	0.3	0.4	0.1	0.2	0.4	0.5	0.1

7 *Sebastes marinus* (Golden redfish) in Sub-areas I and II

ACFM considers the analytical assessments for this stock to be experimental for time being. The status of the stock can clearly be deducted from the surveys.

7.1 Status of the Fisheries

7.1.1 Recent regulations of the fishery

A description of the historical development of the fishery and regulations is found in the Quality handbook for this stock (see Annex in AFWG 2006 report).

Until 1 January 2003 there were no regulations particularly for the *S. marinus* fishery, and the regulations aimed at *S. mentella* (see chapter 6.1.1) had only marginal effects on the *S. marinus* stock. After this date, all directed trawl fishery for redfish (both *S. marinus* and *S. mentella*) outside the permanently closed areas have been forbidden in the Norwegian Economic Zone north of 62°N and in the Svalbard area. When fishing for other species it is currently legal to have up to 15% redfish (both species together) in round weight as bycatch per haul and on board at any time. Until 14 April 2004 there were no regulations of the other gears/fleets fishing for *S. marinus*. After this date, a minimum legal catch size of 32 cm has been set for all fisheries, with the allowance to have up to 10% undersized (i.e., less than 32 cm) specimens of *S.marinus* (in numbers) per haul. In addition, a limited moratorium has been enforced in the conventional fisheries (gillnet, longline, handline, Danish seine). For 2007 this moratorium will be during 5 months, i.e., March-June and September, a change from April-May and September in 2006, 20 April-19 June in 2005 and 1-31 May in 2004. When fishing for other species (also during the moratorium) it is allowed to have up to 15% bycatch of redfish (in round weight) summarized during a week fishery from Monday to Sunday.

7.1.2 Landings prior to 2007 (Tables 7.1–7.4, D1 & D2, Figures 7.1–7.2)

Nominal catches of *S. marinus* by country for Sub-areas I and II combined, and for each Sub-area and Division are presented in Tables 7.1- 7.4. The total landings for both *S. marinus* and *S. mentella* are presented in Tables D1 and D2. Landings of *S. marinus* showed a decrease in 1991 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 1991–1999. Since then the landings have decreased further, and the total landings figures for *S. marinus* in 2003-2006 have been remarkable stable between 7,000-7,800 t, the lowest since the mid-1940ies (!). A relative large increase of the Norwegian trawl landings in Sub-area IIb is reported for 2006. The time series of *S. marinus* landings is given in Figure 7.1 and shows a long-term (1908-2006) mean of 17,042 t.

The Norwegian landings are presented by gear and month in Figure 7.2. This shows that the limited moratorium for conventional gears may have lead to a 400 t decrease in the landings in 2006 compared to the year before, while the trawl landings increased by about 400 t. Since 2003 the limited moratorium for conventional gears seems to have reduced the catches taken by these gears from about 5,900 t to about 3,600 t, while the trawl (by)catches have been at more or less the same level of annually 2,000-2,500 t during the last four years. Improved trawl catches of rather big *S. marinus* in the northern areas towards the end of 2006 is also seen in the scientific survey (Table D13a). A reported Faroes catch of 448 t redfish in Sub-area I in 2006 is far more than previously reported and the species identification of this catch should hence have been better documented.

For 2004 and 2005, the AFWG received catch data from Russia on *S. marinus* caught as bycatch in the pelagic trawl fishery for herring and blue whiting in the Norwegian Sea. Of a total reported Russian catch of 722 tonnes in 2004, 117 tonnes were caught as bycatch in these fisheries. In 2005 this pelagic catch decreased to 15 tonnes of a total of 614 tonnes. In 2006 no pelagic catch of *S. marinus* was reported. Other countries have not reported catches and bycatches of *S. marinus* from their pelagic fisheries in the Norwegian Sea.

The bycatch estimates of redfish (*Sebastes* spp.) in the Norwegian Barents Sea shrimp fisheries during 1983-2002 (WD #18 at AFWG2005) are completely dominated by *S. mentella*, and hence will influence the *S. marinus* to a much lesser extent. However, it probably put an extra mortality on the *S. marinus* in the coastal areas before the sorting grid was enforced in 1990. From 1 January 2006, the maximum bycatch of redfish juveniles in the international shrimp fisheries in the northeast Arctic has been reduced from ten to three redfish per 10 kg shrimp.

Information describing the splitting of the redfish landings by species and area is given in the Quality handbook.

7.1.3 Expected landings in 2007

On the basis of reports from the first months of the year, a legal by-catch of 15% in all trawl fisheries, and an assumed effect of the regulations for the other gears, the Norwegian landings in 2007 are not expected to decrease by more than about 500-700 t compared to 2006, expecting a total Norwegian catch of about 5,500 t. The Russian (by)catch is expected to become about 700 t. On this basis landings of at least **6,500 t** are expected in 2007.

7.2 Data Used in the Assessment

7.2.1 Catch-per-unit-effort (Table D11, Figure 7.3)

The CPUE-series for *S. marinus* from Norwegian 32-50 meter freezer trawlers is presented from 1992 onwards (Table D11). Only data from days with more than 10% *S. marinus* in the catches (in weight) are included in the annual averages. Mean CPUEs with standard errors together with number of vessel days meeting the 10% criterion are presented in Table D11 and Figure 7.3. Unfortunately, this series was not updated for 2006.

Although the trawl fishery until 2003 was almost unregulated, the trawlers experienced fewer and fewer fishing days with more than 10% of their catches composed of *S. marinus*. From 1996 until 2001, Figure 7.3 shows an inverse correlation between catch-rates and number of vessel-days. Since 2001, however, both the catch-rates and the number of vessel-days are decreasing, and this is worrying since the criterion for defining it to be a *S. marinus* vessel-day since 2003 (due to regulations) have not been more than 20% or 15% (since 2004) *S. marinus* in each trawl haul. In 2005 a slight increase in numbers of vessel-days led to a further decrease in the catch-rates. With some variation, the average annual catch-rates have decreased from an average level of 350 kg/trawl hour during mid 1990ies to less 150 kg/h in 2003-2005, i.e., less than 40% of the former recent level.

7.2.2 Catch at age (Table 7.5, Figure D1)

Catch at age data for 2003-2005 were revised. Age composition data for 2006 were only provided by Norway, accounting for 81% of the total landings. Russian catch-at-length from each Sub-area were converted to catch-at-age by using the Norwegian age-length keys in Subarea I, Divisions IIa (northern part) and IIb, respectively. Other countries were assumed to have the same relative age distribution and mean weight as Norway. The updated catch-in-numbers at age matrix is shown in Table 7.5. An illustrative way of presenting the sampling levels has been suggested in Figure D1 (will later be translated to English).

7.2.3 Weight at Age (Table 7.6).

Weight-at-age data for ages 7–24+ were available from the Norwegian landings in 2006.

7.2.4 Maturity at age (Figure 7.7)

A maturity ogive has previously not been available for *S. marinus,* and knife-edge maturity at age 15 (age 15 as 100% mature) has hence been assumed. An improved maturity ogive modelled by the Gadget model, and based on maturation data (by length and age) collected from Norwegian surveys and landings, is presented (Figure 7.7). This analysis shows that at age 12 about 50% of the fish are mature.

7.2.5 Survey results (Tables D12a,b–D13a,b–D14, Figures 7.4a,b–7.5a,b)

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

- Norwegian Barents Sea (Division IIa) bottom trawl survey (February) from 1986–2007 (joint with Russia 2000-2006) in fishing depths of 100–500 m. Length compositions for the years 1986–2007 are shown in Table D12a and Fig 7.4a. Age compositions for the years 1992–2007 are shown in Table D12b and Figure 7.4b. This survey covers important nursery areas for the stock.
- Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1985–2006 in fishing depths of 100–500 m (depths down to 800 m incl. in the swept area). Length compositions for the years 1985–2006 and age compositions for the years 1992–2006 are shown in Table D13a and D13b, respectively. This survey covers the northernmost part of the species' distribution.
- Data on length and age from both these surveys have been combined and are shown in Figures 7.5a,b.
- Catch rates (numbers/nautical mile averaged for all stations within subareas and finally averaged, weighted by subarea, for the total surveyed area) of *Sebastes marinus* from the Norwegian Coastal and Fjord survey in 1995-2005 from Finnmark to Møre (Table D14). It was unfortunately not possible to update this series for 2006, but that will be done until next year's assessment.

The bottom trawl surveys covering the Barents Sea and the Svalbard areas show that the abundance indices over the commercial size range (> 25 cm) were relatively stable up to 1998. Since then the abundance has decreased. In addition, fewer pre-recruit sized fish (< 25 cm) will lead to poorer recruitment to the fishable biomass. The surveys in 2006 and 2007 confirm the historic low abundance and especially the poor recruitment.

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 (except for fish > 35 cm) since the mid 1990-ies. Some variation in the results from year to year may be due to a variable number of trawl stations taken in some of the areas from year to year, and annual variations in local fish migrations (Table D14).

7.3 Assessment by use of the GADGET model

Description of the model

ACFM has previously recommended the Working Group to investigate possible alternative methods to conventional catch-at-age analyses. The GADGET model is closely related to the BORMICON model that currently is used by the ICES North-Western WG on *S. marinus* (Björnsson and Sigurdsson 2003). The functioning of a Gadget model, including parameter estimation, is described in Bogstad et al. (2004b). The model used on this stock was for the first time presented to ACFM in 2005 (AFWG 2005, WD #17). The method was more thoroughly reviewed and described in last year's AFWG report (AFWG 2006), and the reviewers were pleased to see that many of the concerns with regard to the Gadget development had been addressed by the WG.

The main model period has been considered to be from 1990, with earlier years acting as a lead-in period to the model. The *S. marinus* has been modelled with a single-species, single-area model, with mature and immature fish considered (at the AFWG 2006 for the first time) as two population groups. The fish were modelled in 1cm length categories. The age and length ranges were defined as 3-30+ and 1-59+ cm, respectively.

The *S. marinus* was considered to have Von Bertanlanffy growth, K=0.11, L-inf=50.2, and t0=0.08 (Nedreaas 1990). The length-weight relationship w=0.000015*l^3.0 (where w is in kilogram and l in cm) was used and kept constant between seasons and years.

There has been no cannibalism or modelled predation – mortality has been exclusively due to fishing and residual natural mortality was set initially at 0.1. Recruitment was handled as a number of recruits estimated per year, and no attempt at closure of the life cycle was attempted. In contrast with the work presented in 2006, maturity is finally modelled, allowing for a direct estimate of the spawning stock.

Each parameter may be estimated during the modelling process. For each parameter a range of possible values was also required. This should be the absolute maximum range the parameters can reach, as the model will not search values outside this range. Where detailed knowledge is available the ranges may be set quite tight, which may improve efficiency during optimisation. In other cases lack of knowledge will dictate a wide range of possible values.

For each of the following parameters both an initial estimate and a likely range were needed. For the selectivities it was enough to give the range from which the fleet goes from almost no catch to maximum selectivity (assuming the L50 style curve). An L50 and slope parameters for the fleets were then estimated .

- Two growth parameters *
- Annual recruitment – one per year
- Four parameters governing commercial selectivity (two per fleet)
- Several parameters per survey governing selectivity (two per fleet)
- Initial population numbers for mature and immature fish by age
- Natural mortality (initially 0.1)

* There was an additional growth parameter governing the distribution of actual growths around the calculated mean growth for fish in each length cell. This is a purely estimated parameter and no initial value need be provided.

Data used for tuning are:

- Quarterly length distribution of the landings from two commercial fishing fleets
- Quarterly age-length keys from the same fishing fleets
- Length disaggregated survey indices from the Barents Sea (Division IIa) bottom trawl survey (February) from 1990–2006 (Table D12a).
- Age-length keys from the same survey (Table D12b).
- Length disaggregated catch rates (numbers/nautical mile) of Sebastes marinus from the Norwegian Coastal and Fjord survey in 1995-2005 from Finnmark to Møre (Division IIa) (Table D14; at the AFWG 2007 for the first time).

The fishing was handled as two main, and two subsidiary fleets. The Norwegian trawl- and gillnet fleets were both fully modelled, with estimated selectivity for each, accounting for about 70-80% of the total catch in tonnes. The amount fished in each time step of one quarter of the year was input from catch data as a fixed amount. No account of possible errors in the catch-in-tons data was made. Two additional fleets have been considered; the international trawl fleet and a fleet made up by combining all other minor Norwegian fishing methods. Both these fleets have quarterly catch-in-tons specified, and have used the same selectivity as the Norwegian trawl fleet. In addition to catch-in-tons, quarterly catch-in-numbers-at-length and age-length keys have been used. The format of the selectivity (L50) was selected and assumed to remain constant over time for each fleet. In order to account for possible errors in age reading the data was split into age-length keys, and purely length based distributions. Both data sets were input into the model, with weights set so that each gave an approximately equal contribution to the overall likelihood score.

The Barents Sea survey data were used as age-length keys giving the distribution within a single year, and as a purely length based survey index giving year to year variations in numbers by length. Prior to 1992 only length and weight data were recorded; after that data on annual age readings (and hence age-length data) are also available. The time period 1990-2006 was used, and the age-length key for 1992 was also used as age-length key for 1990-1991.

Changes made to the model and in input data compared with last year's Working Group:

- the stock has this year been modelled as two stock components, i.e., one immature and one mature part. Input data for doing this have been the proportions mature/immature *S. marinus* both at age and length as collected and classified from Norwegian commercial landings and surveys. Maturation has here been modelled as an age-based process.
- one year revised (2005) and one new year (2006) with catch data, i.e., quarterly catch in numbers at length and catch in numbers at age for each of the two fleets
- one new year (2006) with Barents Sea survey data
- length disaggregated catch rates (numbers/nautical mile) from the Norwegian Coastal and Fjord scientific survey in 1995-2005

Optimization of the model and the likelihood components employed

For the survey a likelihood function was selected. The format of the selectivity (straight line, L50 or dome shaped) was also selected, using L50 for the survey and allowing the model sufficient freedom during optimisation that it could approximate a flat selectivity if that best fitted the data. Gadget was allowed to freely select the survey selectivity. After optimisation the model selected a suitability curve that was flat, with a selectivity of one, for all lengths in the stock. This can been seen as supporting the assumption that the survey indices represent a measure of the stock unbiased by selectivity. This more flexible model was then adopted as the standard one presented here.

By conducting several experiments a number of assumptions on the model structure were tested. In the standard version a parameter or group of parameters were assumed to be known, in an alternative run the model was allowed to estimate those parameters to best fit the data. In this way it could be determined if the initial assumption was reasonable, and if the model was capable of estimating the parameter(s) in question.

A sensitivity test was conducted on the final Gadget solution. This analysis confirmed that the solution was an optimum.

Figure 7.6 shows the comparison of observed and modelled survey indices.

The weighting of different components in a likelihood function is a clear problem in any model combining multiple data sources, and needs to be addressed in a wider fisheries assessment context in order for researchers to make best use of all the available data. This work is ongoing in a number of places (Gadget specific work is currently being done in Bergen and Reykjavik). The scheme employed here is based on a pragmatic approach to allow all data sets to have an influence on the model solution. Weights are assigned such that in the final weighted likelihood score: (1) fleet and survey data have approximately equal influence, and (2) all fleet data sets have approximately equal influence, and all survey data sets have approximately equal influence. This avoids any one data set having a disproportionately high or low influence. Where a likelihood component has been split into a mature and immature component the weighting for each part of the data set has assigned so that the combined mature and immature components have the same contribution as a single data set for all mature and immature individuals.

The likelihood components employed are as described below. The contribution each score makes to the overall likelihood value is given. This “contribution” is the weighted score for each component divided by the total weighted sum. Note that the first two components are mechanistic ones required for the optimisation process: at a valid solution both should give zero contribution to the overall score. The length distributions in the winter survey have been split into a survey index and a length distribution component, this in effect gives a higher weight to the survey length distributions than to the survey index level by length. For the survey index components an additional internal parameter is estimated in the regression process.

- Bounds component – sets bounds on parameters during estimation, purely internal component. Contribution: 0%
- Understocking – prevents selecting models with insufficient fish to match catch data, purely internal component. Contribution: 0%
- Age-length keys in the trawl for all fish – multinomial. Contribution: 13.5%
- Length distribution in the trawl fleet for immature fish – multinomial. Contribution: 8.1%
- Length distribution in the trawl fleet for mature fish – multinomial. Contribution: 7.7%
- Age-length keys in the gillnet for all fish – multinomial. Contribution: 13.1%
- Length distribution in the gillnet fleet for immature fish – multinomial. Contribution: 4.7%
- Length distribution in the gillnet fleet for mature fish – multinomial. Contribution: 6.0%
- Age-length keys in the survey – multinomial. Contribution: 22.2%
- Length distribution in the winter survey, immature fish – multinomial. Contribution: 5.4%
- Survey index in the winter survey, immature fish – log-linear regression fit, estimateing intercept , fixing slope at 1. Contribution: 5.6%
- Length distribution in the winter survey, mature fish – multinomial. Contribution: 7.0%
- Survey index in the winter survey, mature fish – log-linear regression fit, estimating intercept, fixing slope at 1. Contribution: 6.6%

Fleet contribution: 53.2%
Survey contribution: 46.7%

Assessment results using the Gadget model

The text table below compares the results from this year’s Gadget model with the two previous year’s. The main reason for the downscaling of the stock from WG05 to WG06 is considered to be the addition of two more years with data (data which show an even poorer stock situation, and including fish that were 15-20 years old and thus still have an impact on the estimation of the stock back to 1990), and the addition of maturation data which enabled the model to treat the stock as one immature and one mature component. The change from WG06 to WG07 is considered to be related to the addition of a new survey series and the SSB being based on modeled maturation and not simply 15+.

	Total stock (3+) by 1 January 1990 (tons)	Mean weight in stock 1990 (kg)	SSB (15+) by 1 January 1990[1] (tons)	Total stock (3+) by 1 January 2003 (tons)	Mean weight in stock 2003 (kg)	SSB (15+) by 1 January 2003[1] (tons)
WG 2005	232 628	0.41	89 322	101 686	0.69	66 121
WG 2006	179 313	0.39	64 019	71 013	0.71	38 927
WG 2007	163 536	0.35	66 712	64 240	0.64	43 096

1) Since WG2007 based on modeled maturation and not 15+.

The most important conclusions to be drawn from the current assessment using the Gadget model are:

- The recruitment to the stock is very poor (Figure 7.9).
- Average fishing mortalities for ages 12-19 have during 1990-2006 been within the range of 0.1-0.2 (Table 7.7 and Figure 7.8). There may be a tendency to overestimate the fishing mortality in the assessment year. Adding a new survey increased the F somewhat.
- According to the model the total stock biomass (3+) of *S. marinus* has decreased from about 160.000 tonnes around 1990 to less than 50.000 tonnes in 2006 (Figure 7.10, Table 7.8). The stock in numbers is declining faster than stock biomass due to fewer recruits.
- The spawning stock biomass of *S. marinus* has decreased from about 66.000 tonnes in 1990 to 32.500 tonnes in 2006 (Figure 7.10, Table 7.8). Also the spawning stock in numbers (SSN) is declining faster than spawning stock biomass (SSB).
- A maximum exploitation rate of 5% has been suggested sustainable for long lived species like *Sebastes* spp. when the stocks show no sign of reduced reproductive potential (ref. pelagic redfish in the Irminger Sea and for several rockfishes in the Pacific). Based on the selection curves for the fleets, a reasonable classification of the fishable biomass would be the mature biomass. A corresponding 5% harvest of this would yield not more than 1.600 tonnes.

7.4 State of the stock

Presently this stock is in a very poor situation and this situation is expected to remain for a considerable period irrespective current management actions. Year-classes recruit in the SSB at old age and surveys indicate failure of recruitment over a long period.

The new analytical assessment using the Gadget model confirms the poor stock situation, and quantifies the serious development of this stock during the last decade. It is also meant to be an aid for managers to better quantify necessary stronger regulations.

Clearly the stock has at present a reduced reproductive potential. In order to turn this negative development, no directed fishery should be conducted on this stock until an increase in the number of juveniles has been detected in surveys, and an improved stock situation is confirmed by the assessment.

7.5 Comments on the Assessment

All present available information confirms last years' evaluation of stock status.

Gadget is capable of modeling the maturation process explicitly, by calculating the probability of a fish of given characteristics becoming mature in any given time step. Data on the maturity of sampled fish was available and used in this year's assessment, and it has therefore been possible to replace the knife-edge ogive with a fully modeled maturation process. This is considered to have improved the current model, and also provided a comparison to the knife-edged ogive.

The current model assumes constant selectivity through time. It may be possible to extend this to allow for varying selectivity. The model may also be used for comparing modeled mean length at age with the actual data as a contribution to the age reading validation.

S. marinus is considered to be an easier species to age than *S. mentella*, and it is possible to follow year classes through the input survey data series. An annual updated database on catch-in-numbers at age and length, weight-at-age, and trawl survey indices both by length and age should be continued to be used in future assessment methods.

7.6 Biological reference points

Until an analytical assessment can be accepted and used as basis for reference points calculations for this stock, candidate reference points for the biomass could be set at the average biomass level, or at a certain percentage of this level, estimated by the Russian and Norwegian trawl surveys since 1986. ACFM is supporting this suggestions and states that U-type reference points could be developed provided that a sufficient long time series demonstrating a dynamic range is available. Also the reference point should be expressed in biomass units (SSB or fishable stock), and work has hence been initiated to present the survey time series also in biomass units (also as SSB and fishable stock).

7.7 Management advice

AFWG considers that the area closures and low bycatch limits should be retained, but stronger regulations than those recently enforced are needed given the continued decline in SSB and low recruitment. Despite the extended ban on the directed fishery by conventional gears from 3 months in 2006 to 5 months in 2007, the current measures are considered insufficient measures to stop the stock from declining to such low levels that any *S. marinus* fisheries in future will be difficult to conduct. More stringent protective measures should thus be implemented. No directed fishery should be conducted on this stock at the moment, and the percent legal bycatch should be set as low as possible for other fisheries to continue.

7.8 Response to ACFM Technical Minutes (ACFM TM *in italics*)

The WG needs more years of experience with this model to assess how stable its results are year after year. Also, a retrospective analysis should be done to assess internal consistency of repeated annual assessments. In short, there is a need to investigate the stability of the approach.

The WG agrees that more years of experience are needed. This year the WG is illustrating year to year comparisons by presenting a text table in chapter 7.3 which compares some of this year's GADGET results with previous year's.

The reviewers repeat that simpler models (e.g., production analyses or production models) or SURBA has still not been considered by the WG.

There is certainly potential to investigate other models. In general having multiple models should be seen as a positive goal, especially as a discrepancy between different models can be used to highlight areas where the models may be having problems, and which require further investigation. The WG is very positive to use SURBA to analyse and explore the usefulness of the twenty years survey series for a more precise stock evaluation, but lack of time and manpower for necessary inter-sessional work has unfortunately postponed these investigations.

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	796	412	-	-	-	-
1990	278	1,679	387	1	-	-	-
1991	152	706	981	-	-	-	-
1992	35	1,289	530	623	-	-	-
1993	139	871	650	14	-	-	-
1994	22	697	1,008	5	4	-	-
1995	27	732	517	5	1	1	1
1996	38	671	499	34	-	-	-
1997	3	974	457	23	-	5	-
1998	78	494	131	33	-	19	-
1999	35	35	228	47	14	7	-
2000	17	13	160	22	16	-	-
2001	37	30	238	17	-	1	-
2002	60	31	42	31	3	-	-
2003	109	8	122	36	4	-	89
2004	19	4	68	20	30	-	33
2005	47	10	72	36	8	-	48
2006[1]	513	8	35	44	11	3	21

YEAR	NORWAY	PORTUGAL	RUSSIA[3]	SPAIN	UK (ENG. & WALES)	UK (SCOTL)	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	-	23,234
1990	23,917	-	1,549	-	261	-	28,072
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	14,182	61	1,584	36	164	22	17,511
1998	16,540	6	1,632	51	118	53	19,155
1999	16,750	3	1,691	7	135	34	18,986
2000	13,032	16	1,112	-		73[4]	14,461
2001	9,134	7	963	1		119[4]	10,547
2002	8,561	34	832	3		46[4]	9,643
2003	6,853	6	479	-		134[4]	7,840
2004	6,346[1]	5	722	3		69[4]	7,319
2005	6,085[1]	56	614	8		52[4]	7,037
2006[1]	6,225	69	713	9		39[4]	7,690

1 Provisional figures.

2 Includes former GDR prior to 1991.

3 USSR prior to 1991.

4UK(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(SCOTL)	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[2]	-	5[2]	-	2,431	160	2[2]	-	2,601
1998	78[2]	5[2]	-	-	2,109	308	30[2]	-	2,530
1999	35[2]	18[2]	9[2]	14[2]	2,114	360	11[2]	-	2,561
2000	-	1[2]	-	16[2]	1,983	146		12[6]	2,159
2001	4	11[2]	-	-	1,053	128	France	16[6]	1,212
2002	15	5[2]	-	-	693	220	1[2]	9[2,6]	943
2003	15[2]	-	1	-	815	140	-	4[6]	975
2004	7	-	-	-	1,178[1]	213	-	12[2,6]	1,410
2005	10	-	-	-	1,002[1]	61	1	4[2,6]	1,078
2006[1]	448	-	-		681	136	-	-	1,265

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.

6UK(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 (Scotl.)	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[2]	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	-	974[2]	438	18[2]	5[2]	-	11,708	61[2]	1,199	36[2]	162[2]	22[2]	14,623
1998	-	494[2]	116[2]	33[2]	19[2]	-	14,326	6[2]	1,078	51[2]	85[2]	52[2]	16,260
1999	-	35[2]	210[2]	38[2]	7[2]	-	14,598	3[2]	976	7[2]	122[2]	34[2]	16,030
2000	17[2]	13[2]	159[2]	22[2]	-	-	11,038	16[2]	658	-		61[6]	11,984
2001	33[2]	30[2]	227[2]	17[2]	1[2]	-	8,002	6[2]	612	1[2]	**Iceland**	103[2, 6]	9,031
2002	45[2]	30[2]	37[2]	31[2]	-	-	7,761	18[2]	192	2[2]	3[2]	32[2, 6]	8,151
2003	94[2]	9[2]	122[2]	35[2]	-	89[2]	5,970	6[2]	264		4[2]	130[2, 6]	6,722
2004	12[2]	4[2]	68[2]	20[2]	-	33[2]	5,077[1]	5[2]	396	3[2]	3	58[2, 6]	5,705
2005	37[2]	9[2]	60[2]	36[2]	-	48	4,855[1]	56[2]	265	8[2]	8[2]	48[2, 6]	5,430
2006[1]	60[2]	8[2]	35[2]	44[2]	3[2]	21[2]	4,329	59[2]	293	9[2]	11[2]	39[2, 6]	4,911

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.
6UK(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 (Scotl.)	Total
1986	-									+
1987[4]	-	1,533	-	-	-	-	-	-	-	1,533
1988	No species specific data presently available									
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1[2]	210	-	1,157	-	-	-	1,368
1991	-	303	-	44	-	426	-	-	-	773
1992	-	319	9[2]	2	5[2]	180	2	35[2]	-	552
1993	-	177	-	-	-	43	8[3]	10[2]	-	238
1994	-	282	-	18	-	60	4[3]	6[2]	1[2]	371
1995	-	187	-	103	7	33	-	-	-	330
1996	4	51[2]	-	27	5	136	76[2]	3[2]	-	302
1997	-	20	-	43	-	225	-	-	-	288
1998	-	10[2]	-	105	-	246	-	3[2]	-	364
1999	-	-	-	38	-	355	-	2[2]	-	395
2000	-	-	-	10	-	308	-	-	-	318
2001	-	-	-	79	1[2]	223	-	-	-	303
2002	-	-	-	107	16[2]	420	1[2]		5[2, 7]	549
2003	-	-	-	68	-	75	-		-	143
2004	-	-	-	91[1]	-	113	-		-	204
2005	-	13[2]	-	228[1]	-	288	-		-	529
2006[1]	5[2]	-	-	1,215	10[2]	284	-		-	1,514

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.
7UK(E&W)+UK(Scot.)

Table 7.5. *Sebastes marinus* in Sub-areas I and II. Catch numbers at age.

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE															
7	5	0	46	60	9	9	28	78	4	23	14	22	19	40	41
8	22	24	7	85	119	98	51	593	13	23	36	25	48	55	28
9	78	193	292	230	313	156	206	855	70	44	71	30	47	94	76
10	114	359	640	672	361	321	470	572	245	199	143	44	67	80	83
11	394	406	816	908	879	686	721	1006	902	347	414	204	202	165	250
12	549	1036	1930	1610	1234	1065	968	1230	958	482	686	359	279	173	225
13	783	1022	2096	2038	1638	1781	1512	1618	1782	1120	1199	705	514	393	263
14	1718	1523	2030	2295	2134	2276	1736	1480	1409	1342	1943	1687	600	779	842
15	3102	2353	1601	1783	1675	2172	1582	1612	2121	1674	1377	1338	689	741	628
16	2495	1410	2725	1406	1614	1848	1045	1239	2203	1653	1274	1071	976	916	905
17	2104	1655	2668	785	1390	1421	1277	1407	1715	1243	1196	937	1074	926	933
18	1837	1678	1409	563	952	851	970	1558	753	568	388	481	800	743	829
19	998	745	617	670	679	804	1018	1019	483	119	313	367	444	376	553
20	858	716	733	593	439	608	846	394	458	183	99	146	169	210	362
21	688	534	514	419	560	511	443	197	132	154	104	84	186	189	311
22	547	528	256	368	334	205	764	459	230	112	117	51	110	129	138
23	268	576	177	250	490	334	486	174	224	135	113	18	81	111	160
+gp	3110	3482	1508	3232	3135	2131	3389	2131	895	254	253	69	191	220	436
TOTALNUM	**19670**	**18240**	**20065**	**17967**	**17955**	**17277**	**17512**	**17622**	**14597**	**9675**	**9740**	**7637**	**6494**	**6338**	**7065**
TONSLAND	16185	16651	18120	15616	18043	17511	19155	18986	14460	10547	9643	7841	7320	7037	7690

Table 7.6. *Sebastes marinus* in Sub-areas I and II. Catch weights at age (kg)

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE															
7	0.18	0.20	0.25	0.33	0.22	0.23	0.37	0.14	0.19	0.15	0.17	0.19	0.21	0.16	0.13
8	0.29	0.33	0.37	0.43	0.49	0.51	0.21	0.26	0.24	0.26	0.25	0.22	0.26	0.21	0.14
9	0.48	0.36	0.38	0.64	0.56	0.53	0.47	0.44	0.32	0.45	0.33	0.31	0.36	0.36	0.27
10	0.42	0.43	0.49	0.61	0.65	0.74	0.62	0.57	0.44	0.55	0.42	0.39	0.45	0.45	0.40
11	0.50	0.51	0.51	0.59	0.71	0.72	0.67	0.69	0.53	0.58	0.54	0.49	0.51	0.52	0.51
12	0.59	0.51	0.64	0.65	0.81	0.78	0.77	0.78	0.64	0.67	0.67	0.58	0.59	0.58	0.57
13	0.58	0.64	0.74	0.74	0.84	0.80	0.77	0.86	0.73	0.80	0.72	0.69	0.68	0.68	0.66
14	0.65	0.64	0.76	0.79	0.88	0.86	0.85	1.04	0.84	0.89	0.84	0.84	0.80	0.82	0.74
15	0.65	0.76	0.86	0.84	0.96	0.91	1.05	1.07	0.96	1.01	0.98	0.96	0.96	0.94	0.84
16	0.71	0.86	0.95	0.92	1.00	0.99	0.96	1.12	1.11	1.14	1.09	1.05	1.07	1.03	0.99
17	0.82	0.89	1.03	1.12	1.02	1.16	1.25	1.18	1.25	1.33	1.20	1.29	1.22	1.16	1.13
18	0.84	0.98	1.07	1.01	1.01	1.18	1.28	1.71	1.32	1.43	1.30	1.36	1.34	1.36	1.27
19	0.94	1.00	1.11	1.01	1.00	1.21	1.30	1.09	1.53	1.62	1.44	1.65	1.57	1.46	1.39
20	1.02	1.03	1.16	1.21	1.03	1.34	1.23	1.18	1.06	1.60	1.78	1.74	1.67	1.51	1.47
21	1.03	1.21	1.15	1.14	1.04	1.28	1.87	1.04	1.29	1.47	1.68	2.09	1.75	1.67	1.42
22	1.15	1.03	1.13	1.09	1.14	1.54	1.46	1.34	1.32	2.00	1.88	1.85	2.09	1.91	1.60
23	1.27	1.20	1.02	1.30	1.09	1.19	1.73	1.18	1.12	2.70	2.12	2.30	1.90	2.23	1.52
+gp	1.27	1.14	1.36	1.01	1.16	1.29	1.29	1.34	1.20	2.31	1.84	2.38	2.04	2.27	2.07

Table 7.7. *Sebastes marinus* in Sub-areas I and II. Fishing mortalities as estimated by Gadget.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
7	0.005	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.003
8	0.038	0.010	0.008	0.008	0.009	0.011	0.009	0.009	0.010	0.008	0.009	0.007	0.007	0.006	0.007	0.008	0.010
9	0.068	0.047	0.020	0.020	0.021	0.023	0.021	0.022	0.025	0.019	0.022	0.017	0.018	0.015	0.016	0.018	0.024
10	0.090	0.071	0.062	0.038	0.041	0.041	0.042	0.042	0.049	0.038	0.043	0.033	0.035	0.029	0.031	0.035	0.046
11	0.116	0.088	0.082	0.087	0.066	0.064	0.068	0.068	0.080	0.062	0.071	0.056	0.056	0.048	0.051	0.057	0.074
12	0.146	0.107	0.097	0.106	0.121	0.093	0.097	0.098	0.115	0.089	0.103	0.081	0.081	0.070	0.074	0.081	0.105
13	0.177	0.127	0.112	0.120	0.139	0.129	0.125	0.127	0.149	0.117	0.135	0.106	0.105	0.092	0.096	0.105	0.134
14	0.210	0.148	0.127	0.134	0.152	0.141	0.170	0.153	0.180	0.143	0.165	0.130	0.128	0.112	0.116	0.126	0.160
15	0.244	0.168	0.142	0.147	0.165	0.151	0.181	0.190	0.206	0.165	0.191	0.151	0.147	0.130	0.133	0.143	0.181
16	0.276	0.188	0.156	0.159	0.176	0.159	0.190	0.199	0.239	0.182	0.213	0.168	0.162	0.144	0.146	0.157	0.197
17	0.306	0.207	0.170	0.170	0.187	0.167	0.198	0.205	0.247	0.203	0.229	0.182	0.174	0.155	0.157	0.167	0.209
18	0.320	0.225	0.182	0.180	0.196	0.173	0.205	0.211	0.253	0.208	0.249	0.192	0.183	0.164	0.164	0.174	0.218
19	0.333	0.232	0.193	0.189	0.204	0.179	0.210	0.216	0.258	0.212	0.253	0.203	0.190	0.170	0.170	0.180	0.224
20	0.344	0.240	0.197	0.197	0.211	0.184	0.215	0.220	0.262	0.215	0.256	0.205	0.197	0.174	0.174	0.183	0.228
21	0.354	0.246	0.202	0.200	0.217	0.188	0.219	0.224	0.265	0.217	0.259	0.207	0.198	0.179	0.176	0.186	0.231
22	0.363	0.251	0.205	0.203	0.219	0.191	0.222	0.226	0.268	0.219	0.261	0.208	0.199	0.180	0.179	0.188	0.232
23	0.370	0.256	0.209	0.206	0.222	0.193	0.225	0.229	0.270	0.221	0.263	0.210	0.200	0.180	0.180	0.189	0.234
24	0.375	0.259	0.211	0.208	0.223	0.194	0.226	0.230	0.272	0.222	0.264	0.211	0.201	0.181	0.180	0.190	0.235
25	0.379	0.262	0.214	0.210	0.225	0.195	0.227	0.231	0.273	0.223	0.265	0.211	0.201	0.181	0.180	0.190	0.235
26	0.383	0.265	0.215	0.211	0.226	0.196	0.228	0.232	0.274	0.224	0.266	0.212	0.202	0.182	0.181	0.190	0.235
27	0.385	0.266	0.216	0.212	0.227	0.196	0.228	0.232	0.274	0.224	0.267	0.212	0.202	0.182	0.181	0.190	0.235
28	0.387	0.267	0.217	0.213	0.228	0.197	0.229	0.233	0.275	0.224	0.267	0.213	0.203	0.182	0.181	0.190	0.236
29	0.388	0.268	0.218	0.213	0.228	0.197	0.229	0.233	0.275	0.225	0.267	0.213	0.203	0.182	0.181	0.190	0.236
30	0.389	0.270	0.219	0.214	0.229	0.143	0.230	0.233	0.276	0.225	0.268	0.213	0.203	0.183	0.181	0.191	0.236
12 - 19	0.252	0.175	0.147	0.151	0.168	0.149	0.172	0.175	0.206	0.165	0.192	0.151	0.146	0.129	0.132	0.141	0.178

Table 7.8. *Sebastes marinus* in Sub-areas I and II. Stock numbers, biomass, mean weight and maturity ogives as estimated by GADGET using two survey series as input.

	Total stock, ages 3+			Immature stock			Mature stock		
Year	Number (in 1000)	Mean weight	Biomass (in tons)	Number (in 1000)	Mean weight	Biomass (in tons)	Number (in 1000)	Mean weight	Biomass (in tons)
1990	467000	0.35	163536	360000	0.27	96824	107000	0.62	66712
1991	439000	0.37	161097	332000	0.28	91852	107000	0.65	69246
1992	410000	0.39	159928	303000	0.29	87730	107000	0.67	72198
1993	386000	0.41	157628	280000	0.30	83079	106000	0.70	74549
1994	346000	0.44	152391	243000	0.32	77268	103000	0.73	75122
1995	307606	0.48	146167	208000	0.34	70850	99606	0.76	75317
1996	270899	0.51	138725	176000	0.37	64272	94899	0.78	74453
1997	238421	0.54	128797	150000	0.38	57052	88421	0.81	71745
1998	204518	0.57	116563	124000	0.40	49289	80518	0.84	67274
1999	177990	0.57	102001	107000	0.39	41339	70990	0.85	60661
2000	151715	0.59	89741	88965	0.39	34924	62750	0.87	54817
2001	129474	0.60	77760	74797	0.39	29024	54676	0.89	48736
2002	112248	0.63	70920	62298	0.40	24863	49951	0.92	46057
2003	100487	0.64	64240	55289	0.38	21144	45197	0.95	43096
2004	108468	0.53	57934	67988	0.27	18180	40480	0.98	39754
2005	105832	0.50	52545	69319	0.23	16053	36513	1.00	36492
2006	107194	0.44	47231	74706	0.20	14659	32488	1.00	32572

	Recruitment Age 3	Maturity ogives					
Year	Number (in 1000)	age	1991-1993	1994-1996	1997-1999	2000-2002	2003-2005
1990	44912	4	0.05	0.05	0.05	0.05	0.05
1991	37431	5	0.08	0.08	0.08	0.08	0.08
1992	30294	6	0.12	0.12	0.12	0.12	0.12
1993	32014	7	0.17	0.17	0.17	0.17	0.17
1994	15142	8	0.21	0.22	0.22	0.22	0.22
1995	11976	9	0.28	0.28	0.28	0.28	0.28
1996	8920	10	0.38	0.35	0.35	0.35	0.35
1997	10234	11	0.46	0.42	0.42	0.42	0.42
1998	6617	12	0.52	0.51	0.50	0.50	0.50
1999	11768	13	0.59	0.60	0.59	0.59	0.59
2000	5524	14	0.65	0.69	0.67	0.67	0.67
2001	6114	15	0.70	0.76	0.75	0.75	0.75
2002	3547	16	0.74	0.82	0.83	0.82	0.82
2003	6566	17	0.81	0.87	0.89	0.88	0.88
2004	24504	18	0.86	0.91	0.93	0.92	0.92
2005	13742	19	0.94	0.94	0.96	0.96	0.96
2006	17464	20	0.98	0.96	0.98	0.98	0.98
		21	1.00	0.98	0.99	0.99	0.99
		22	1.00	0.99	0.99	1.00	1.00
		23	1.00	1.00	1.00	1.00	1.00

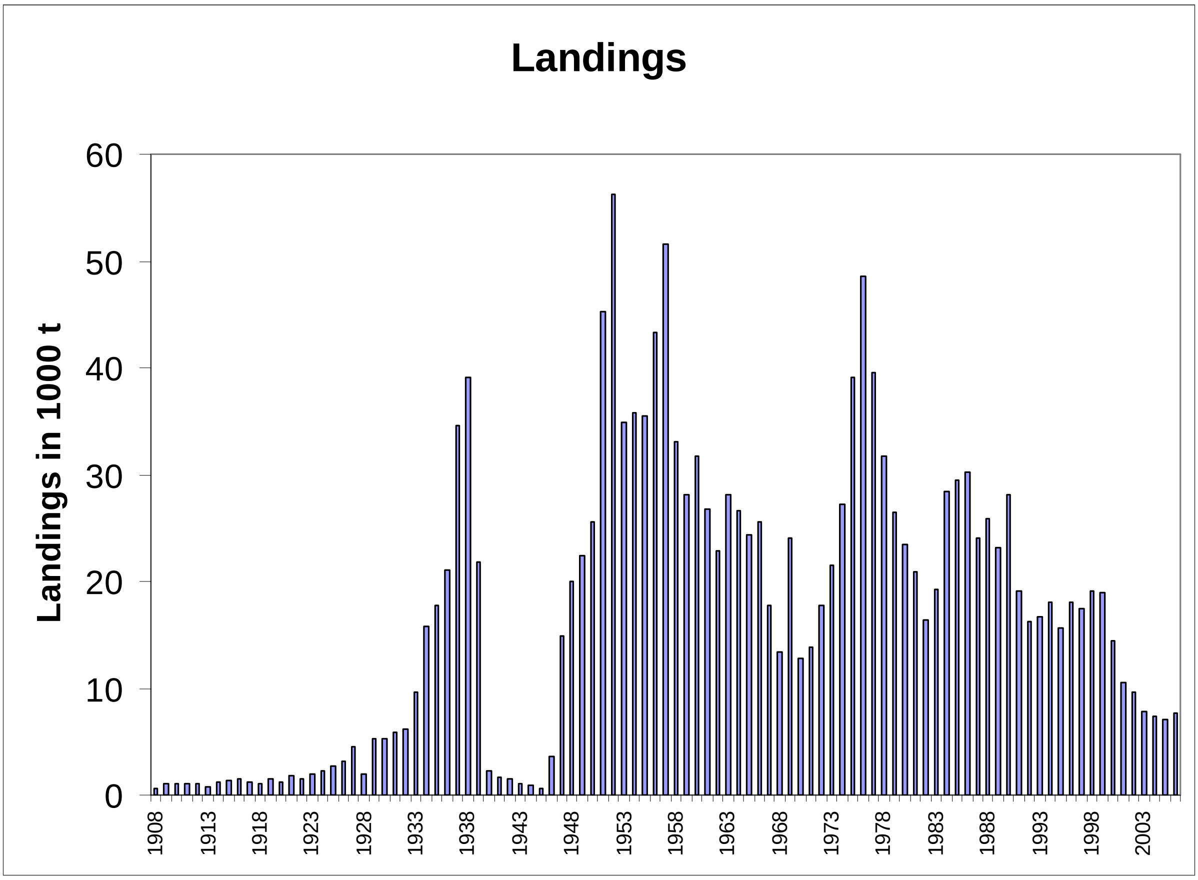


Figure 7.1. *Sebastes marinus* in Sub-areas I and II. Total international landings 1965-2006 (in thousand tonnes).

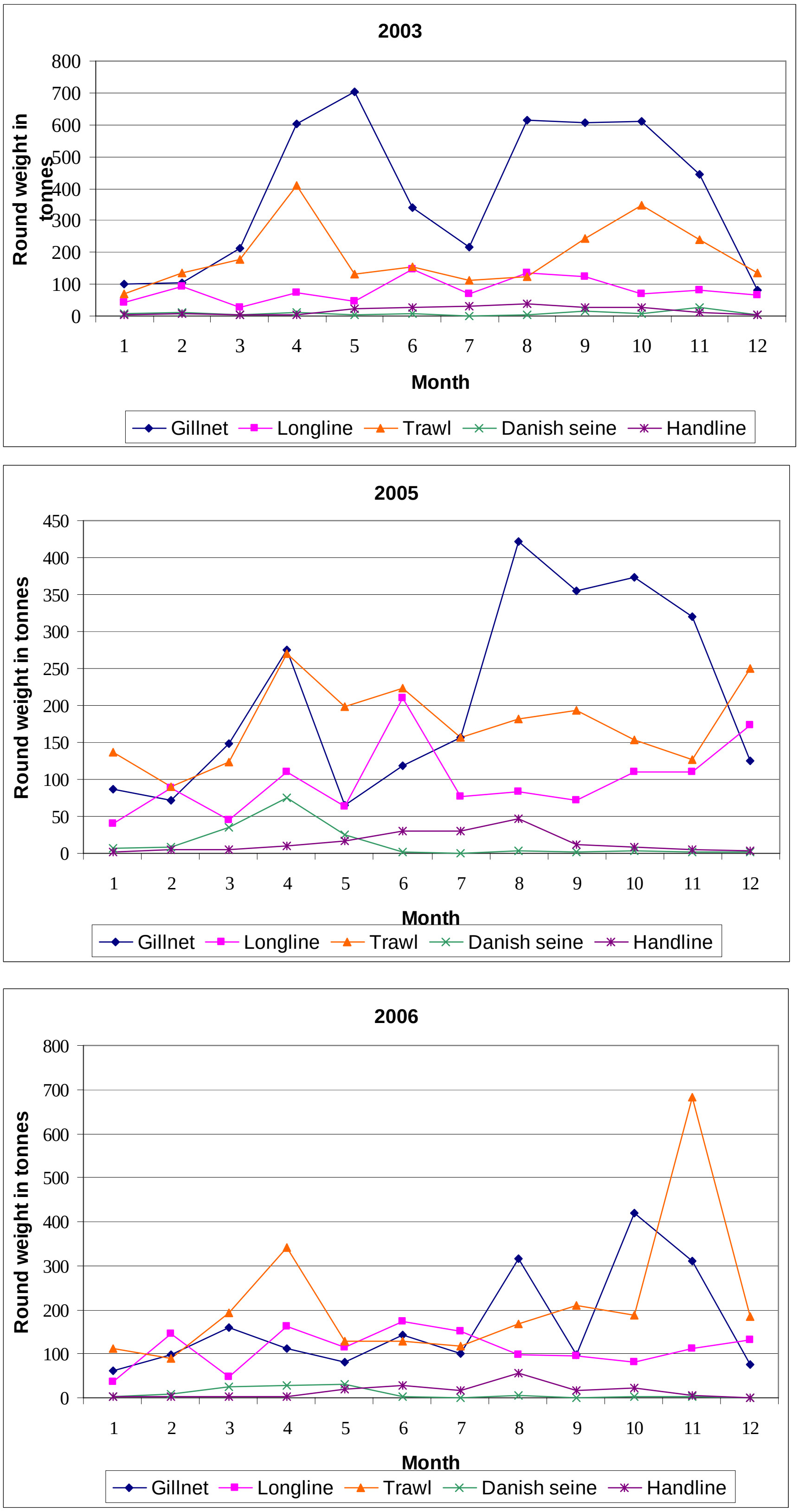


Figure 7.2. *Sebastes marinus* in Sub-areas I and II. Illustration of the seasonality in the different Norwegian *S. marinus* fisheries, also illustrating how the current regulations are working.

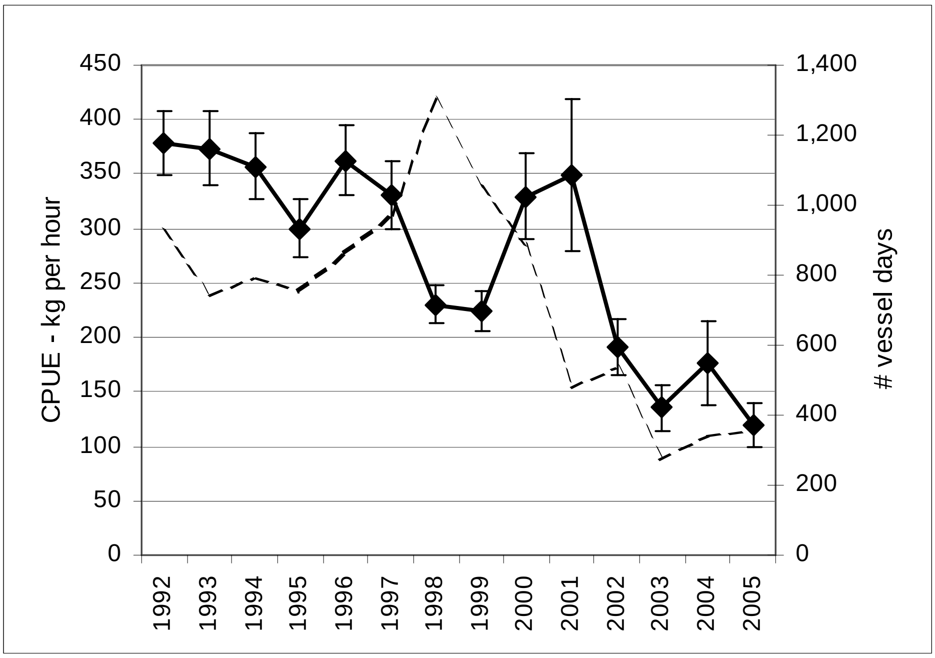
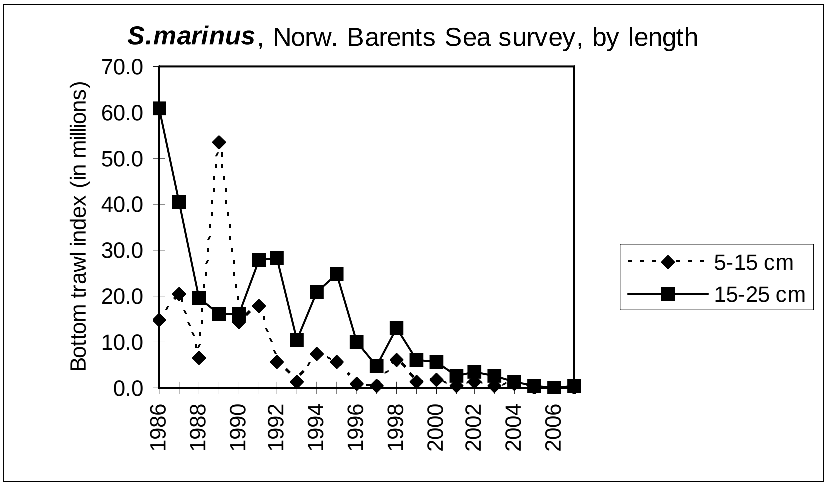


Figure 7.3. *Sebastes marinus* in Sub-areas I and II. Plot of simple mean CPUEs with 2 st. errors from the Norwegian trawl fishery, and numbers of vessel days (stippled curve) meeting the criterium of minimum 10% *S. marinus* in the catch per day. The figure is an illustration of the data given in Table D11.



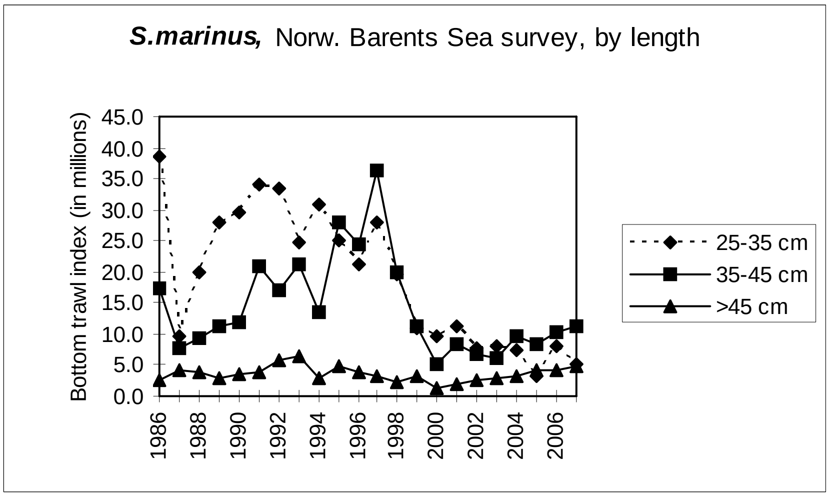
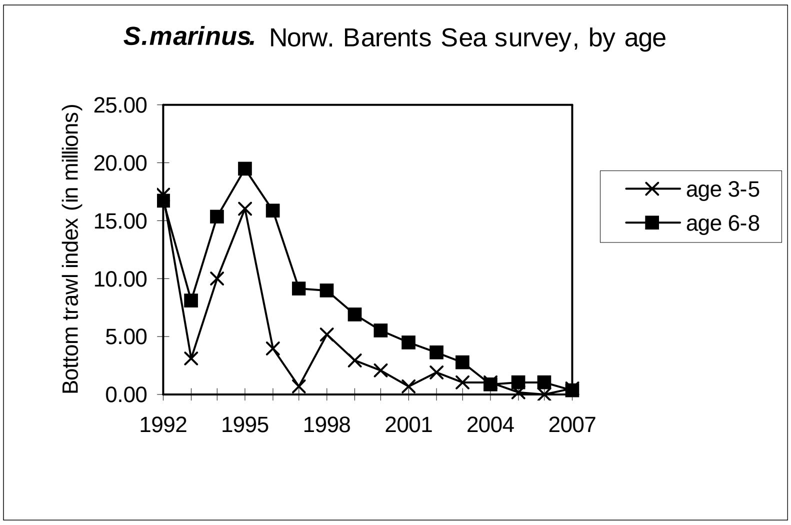


Figure 7.4a. *Sebastes marinus* in Sub-areas I and II. Abundance indices (by length) from the Norwegian bottom trawl survey in the Barents Sea (Division IIa) in winter 1986-2007 (ref. Table D12a).



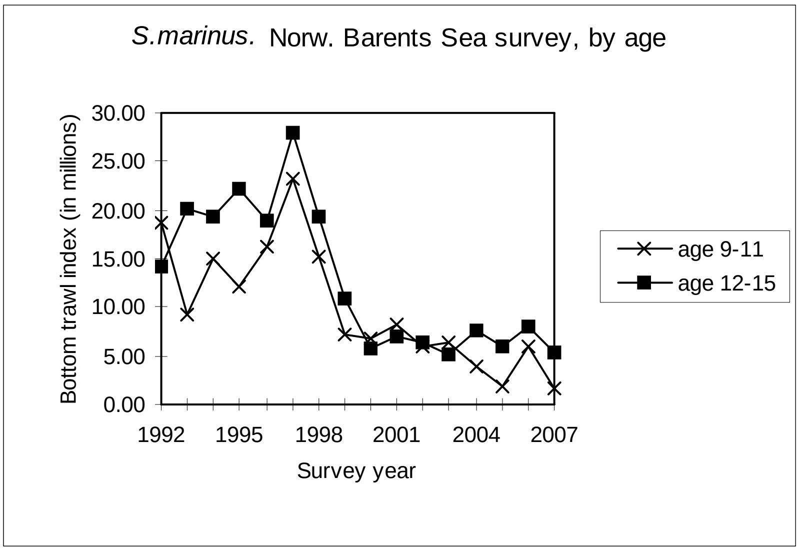
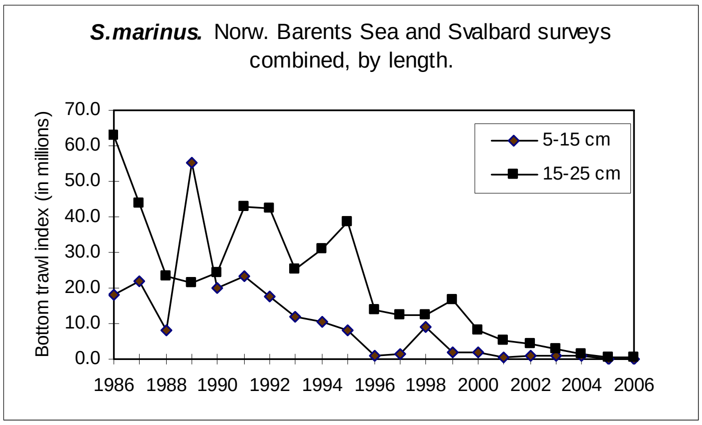


Figure 7.4b. *Sebastes marinus* in Sub-areas I and II. . Abundance indices (by age) from the Norwegian bottom trawl surveys 1992-2007 in the Barents Sea (ref. Table D12b).



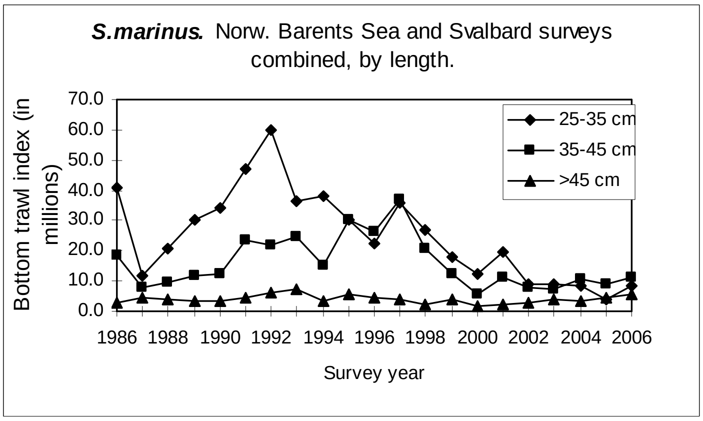
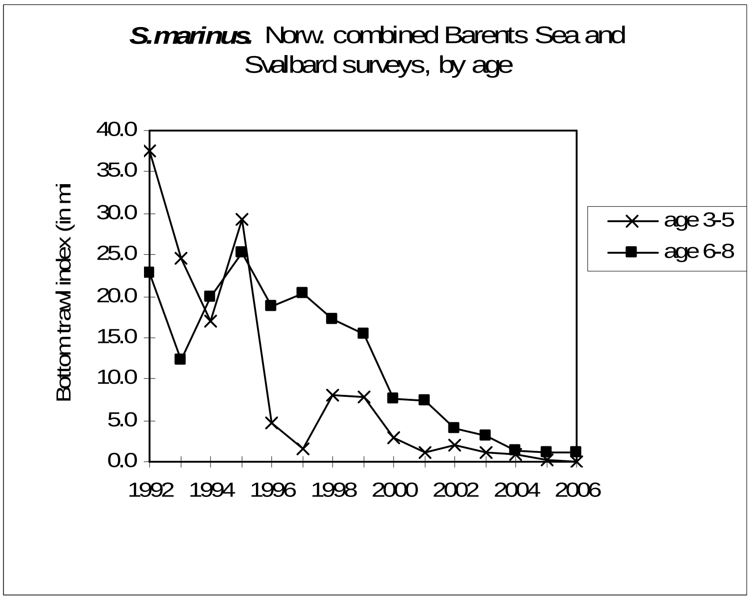


Figure 7.5a. *Sebastes marinus* in Sub-areas I and II. Abundance indices (by length) when combining the Norwegian bottom trawl surveys 1986-2006 in the Barents Sea (Division IIa, winter) and at Svalbard (Division IIb, summer/fall).



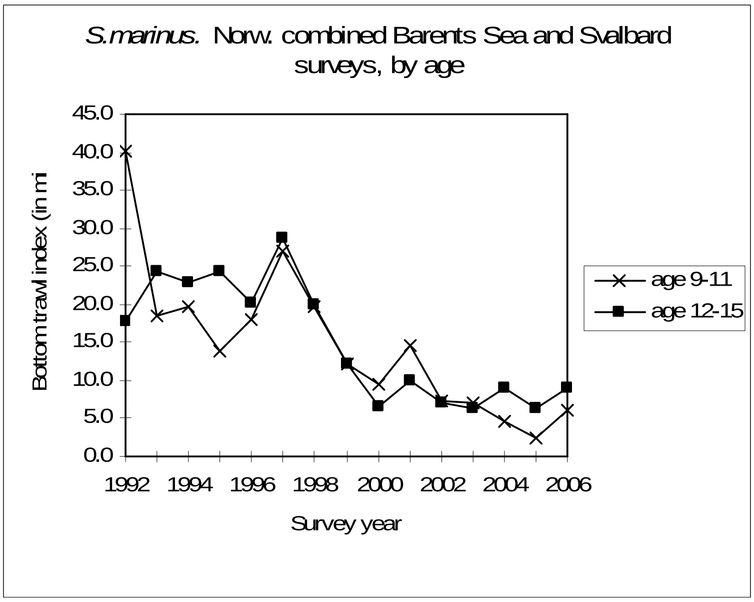
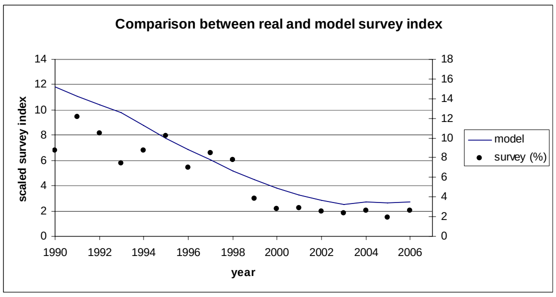


Figure 7.5b. ***Sebastes marinus*** **in Sub-areas I and II. Abundance indices (by age) when combining the Norwegian bottom trawl surveys 1992-2006 in the Barents Sea (Division IIa, winter) and at Svalbard (Division IIb, summer/fall).**



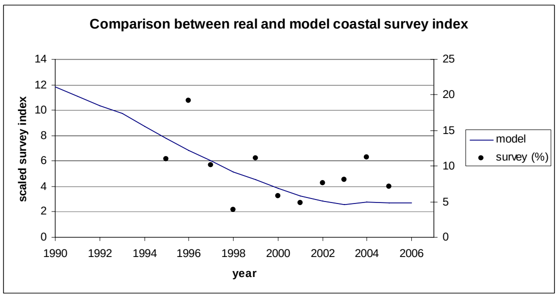


Figure 7.6. *Sebastes marinus* in Sub-areas I and II. Results from the Gadget assessment using two scientific surveys as input. The Figure shows comparison of observed and modelled survey indices (total number scaled to sum=100 during the time period) – the traditional Barents Sea February survey to the left, and the (new) coastal and fjord survey to the right.

NEW

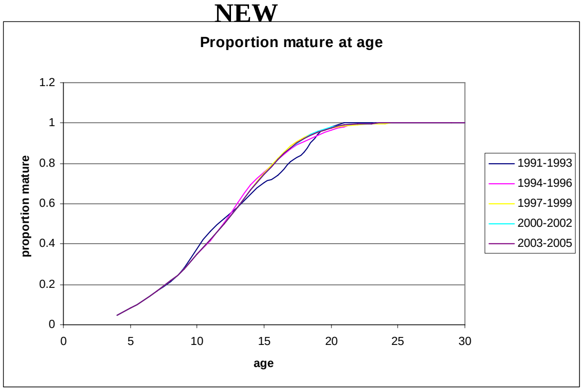


Figure 7.7. *Sebastes marinus* in Sub-areas I and II. Estimates of maturity at age by Gadget. Input data have been proportions of *S. marinus* mature both at age and length as collected and classified from Norwegian commercial landings and surveys. Fewer data together with being the beginning of the modelled time period have caused the more varying pattern for 1991-1996.

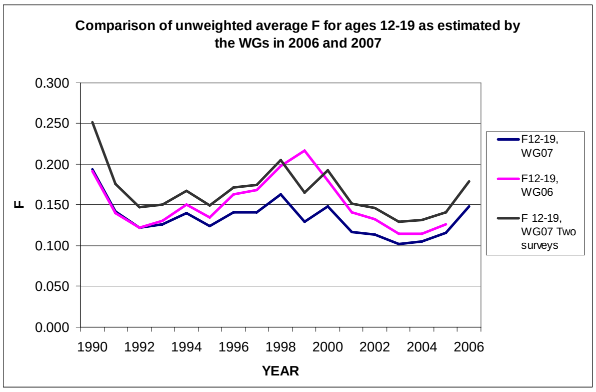


Figure 7.8. ***Sebastes marinus*** **in Sub-areas I and II. Unweighted average fishing mortality for ages 12-19 as estimated by Gadget during the AFWG in 2006 and 2007. Only the one-survey tuning makes this comparison possible. The fishing mortalities estimated by the last Gadget run using two surveys series as input is also shown.**

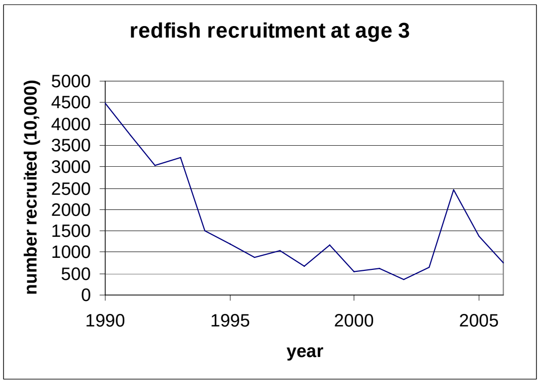


Figure 7.9. ***Sebastes marinus*** **in Sub-areas I and II. Estimates of recruitment at age 3 (in numbers) by Gadget using two surveys as input.**

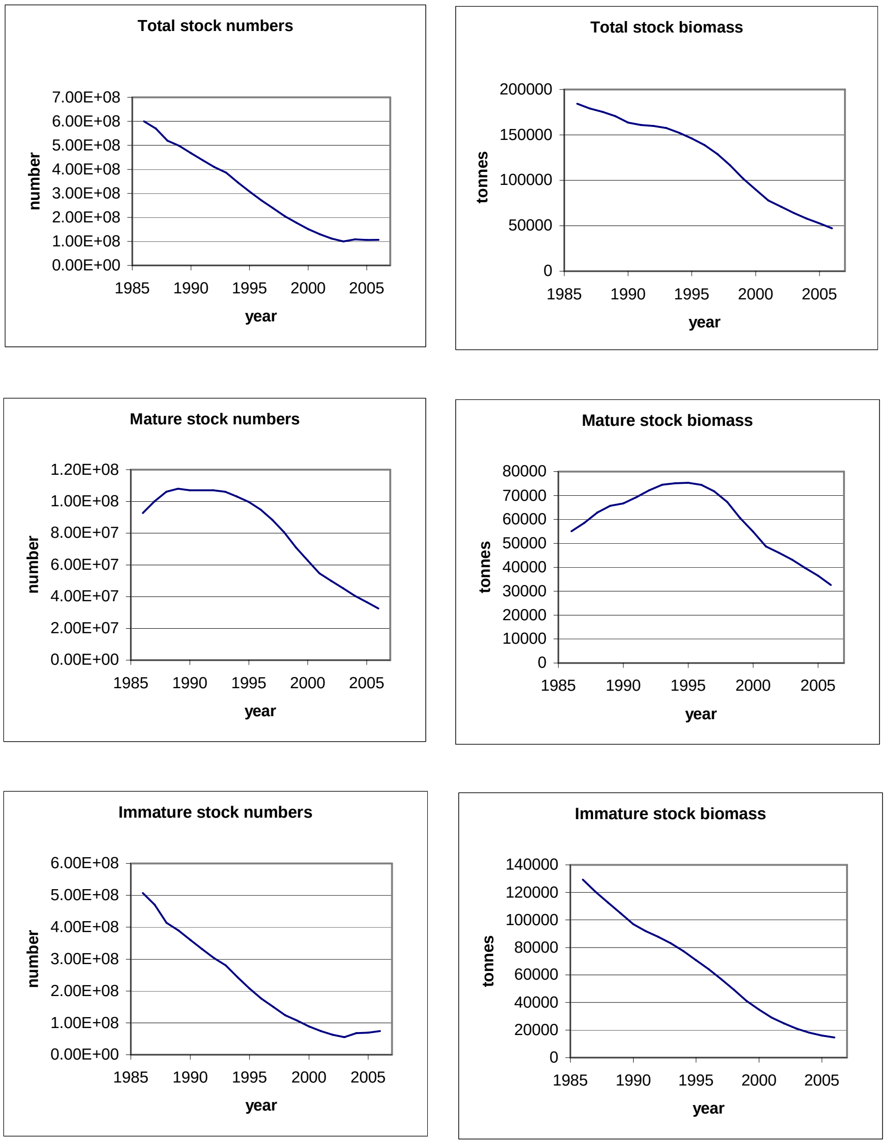


Figure 7.10. *Sebastes marinus* in Sub-areas I and II. Stock numbers (in thousands) and biomass (in tonnes) for the total stock (3+) (upper panel), and the fishable and mature stock, and the immature stock, as estimated by Gadget using two surveys as input.

Table D11. *Sebastes marinus* in Sub-areas I and II. Effort (vessel days) and catch per unit effort (kg per trawl hour) with 2 x st.error for Norwegian freezer trawlers (32-50 meters long).[1]

Year	Number of vessel days meeting the 10% requirement	Mean CPUE per year (kg/hour)	2 x standard error of the mean
1992	926	378	29.4
1993	743	374	34.4
1994	793	357	30.1
1995	754	300	26.7
1996	864	363	32.1
1997	972	331	31.9
1998	1 303	230	17.2
1999	1 054	224	18.8
2000	884	330	39.9
2001	481	349	70.5
2002	536	192	26.0
2003	276	136	21.4
2004	343	176	38.7
2005[2]	360	119	20.0

1 Only including days with more than 10% *S. marinus* in the catches. Only including areas with low mixing of *S. mentella.*
2 Provisional figures.

Table D12a. *Sebastes marinus* in Sub-areas I and II. Abundance indices (on length) from the bottom trawl surveys in the Barents Sea (Division IIa) in the winter 1986-2007 (numbers in millions). The area coverage was extended from 1993.

YEAR	LENGTH GROUP (CM)									TOTAL
	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	35.0-39.9	40.0-44.9	>45.0	
1986	3.0	11.7	26.4	34.3	17.7	21.0	12.8	4.4	2.6	133.9
1987	7.7	12.7	32.8	7.7	6.4	3.4	3.8	3.8	4.2	82.5
1988	1.0	5.6	5.5	14.2	12.6	7.3	5.2	4.1	3.7	59.2
1989	48.7	4.9	4.3	11.8	15.9	12.2	6.6	4.8	3.0	112.2
1990	9.2	5.3	6.5	9.4	15.5	14.0	8.0	4.0	3.4	75.3
1991	4.2	13.6	8.4	19.4	18.0	16.1	14.8	6.0	4.0	104.5
1992	1.8	3.9	7.7	20.6	19.7	13.7	10.5	6.6	5.8	90.3
1993	0.1	1.2	3.5	6.9	10.3	14.5	12.5	8.6	6.3	63.9
1994	0.7	6.5	9.3	11.7	11.5	19.4	9.1	4.4	2.8	75.4
1995	0.6	5.0	13.1	11.5	9.1	15.9	17.2	10.9	4.7	88.0
1996	+	0.7	3.5	6.4	9.4	11.7	16.6	7.9	3.9	60.1
1997[1]	-	0.5	1.3	2.7	6.9	21.4	28.2	8.5	3.3	72.7
1998[1]	0.1	3.9	2.0	7.4	5.8	25.3	13.2	7.0	2.3	67.0
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
2002	0.1	1.0	1.9	1.7	3.7	4.1	3.3	3.6	2.5	22.0
2003	0.0	0.5	1.2	1.5	4.3	3.8	2.7	3.3	2.9	20.2
2004	0.7	0.2	0.4	1.0	2.9	4.4	5.5	4.0	3.2	22.3
2005	+	0.1	0.2	0.4	1.1	2.0	3.7	4.6	4.3	16.4
2006	0.0	0.0	0.0	0.2	2.5	5.4	6.1	4.1	4.2	22.5
2007[2]	0.0	0.1	0.5	0.1	1.0	4.0	5.4	5.9	4.9	21.9

1 - Adjusted indices to account for not covering the Russian EEZ in Subarea I

2 – Indices NOT adjusted to account for not covering the Russian EEZ in Subarea I

Table D12b. *Sebastes marinus* in Sub-areas I and II. Norwegian bottom trawl indices (on age) from the annual Barents Sea survey in February 1992-2007 (numbers in thousands). The area coverage was extended from 1993 onwards.

	AGE													
YEAR	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
1992	2,295	4,261	10,760	2,043	1,474	13,178	4,230	6,302	8,251	3,751	3,865	3,064	3,568	67,042
1993	468	1,218	1,424	2,020	979	5,048	2,968	4,230	2,142	4,634	3,338	2,951	9,148	40,568
1994	2,951	4,485	2,573	3,801	8,338	3,254	1,297	7,231	6,443	248	10,192	6,341	2,612	59,766
1995	2,540	7,450	6,090	7,150	5,820	6,590	5,670	2,000	4,440	6,500	4,320	5,330	6,030	69,930
1996	310	1,300	2,340	3,520	3,660	8,720	5,650	3,960	6,590	5,730	6,230	4,070	2,950	55,030
1997[1]	190	80	360	1,320	2,530	5,370	10,570	6,840	5,810	7,390	8,790	9,740	1,980	60,980
1998[1]	2,380	1,930	850	660	1,140	7,090	6,124	4,962	4,091	5,190	8,790	2,730	2,560	48,487
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	320	170	190	940	1,360	2,220	3,110	2,400	2,690	2,230	2,180	1,200	1,370	20,380
2002	130	910	902	1,590	544	1,546	2,153	1,822	1,900	2,220	1,073	1,294	1,730	17,814
2003	220	250	590	1,080	680	1,020	2,910	1,180	2,250	1,370	1,530	840	1,310	15,230
2004	780	100	100	90	240	540	1,130	1,260	1,590	1,740	1,490	2,570	1,890	13,520
2005	39	85	107	110	321	524	669	497	697	820	1,517	1,905	1,653	8,944
2006	0	0	0	24	52	1,011	1,641	1,999	2,246	1,578	1,550	3,487	1,444	15,030
2007[2]	58	202	248	50	51	185	422	582	592	1,747	1,030	1,127	1,359	7,652

1 - Adjusted indices to account for not covering the Russian EEZ in Subarea I

2 – Indices NOT adjusted to account for not covering the Russian EEZ in Subarea I

Table D13a. *Sebastes marinus* in Sub-area I and II. Abundance indices (on length) from the bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1985-2006 (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
2001	10	110	790	1,470	3,710	4,600	1,880	680	370	13,660
2002	0	0	64	415	459	880	620	565	519	3,522
2003	90	90	108	83	525	565	447	760	769	3,437
2004	0	0	10	50	650	740	670	430	190	2,740
2005	0	45	0	30	315	384	307	159	274	1,513
2006	0	0	70	64	167	376	473	735	1,514	3,398

1 - Old trawl equipment (bobbins gear and 80 meter sweep length)

Table D13b. *Sebastes marinus* in Sub-areas I and II. Norwegian bottom trawl survey indices (on age) in the Svalbard area (Division IIb) in summer/fall 1992-2006 (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
2001	0	40	50	450	330	790	1,760	1,970	3,300	1,200	1,810	150	660	430	12,940
2002	0	0	+	+	65	160	204	326	364	614	442	328	15	0	2,518
2003	30	30	30	+	108	+	219	263	126	259	306	199	248	411	2,229
2004	0	0	0	+	+	20	360	120	430	160	410	360	370	200	2,430
2005	0	45	0	0	0	30	48	228	138	187	194	93	105	109	1,177
2006	0	0	23	23	23	21	22	21	84	0	84	279	194	376	1,148

	Total										
Length range (cm)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0-4	0	0	0	0	0	0	0	0	0	0	0
5-9	41	34	4	0	0	0	0	0	0	2	0
10-14	118	87	9	0	19	2	2	0	1	3	5
15-19	59	124	12	4	242	13	11	0	3	10	3
20-24	54	151	64	12	160	7	14	2	22	36	29
25-29	38	67	112	16	34	10	22	6	50	76	50
30-34	69	210	96	17	43	30	15	29	51	45	51
35-39	214	415	178	110	151	160	83	259	213	340	182
40-44	157	209	190	96	117	155	160	213	185	258	146
45-49	21	64	45	18	15	30	30	26	37	19	39
50-54	2	0	2	3	4	4	2	4	4	3	1
55-59	1	0	1	0	2	0	0	1	0	1	0
60-64	0	0	0	0	0	0	0	0	0	0	0
Total	775	1361	715	277	786	411	340	538	568	793	506
Measured	1026	1233	599	287	459	503	326	326	812	866	696
# trawls	94	84	95	87	102	99	80	96	95	83	87
# trawl with species	61	60	57	40	42	50	41	38	59	52	56

Table D14. *Sebastes marinus* in Sub-area I and II. Mean catch rates (N/nm2) of *Sebastes marinus* from Norwegian Coastal Surveys (Division IIa) in 1995-2005 within 100-350 m depth. Catch rates for the total area.

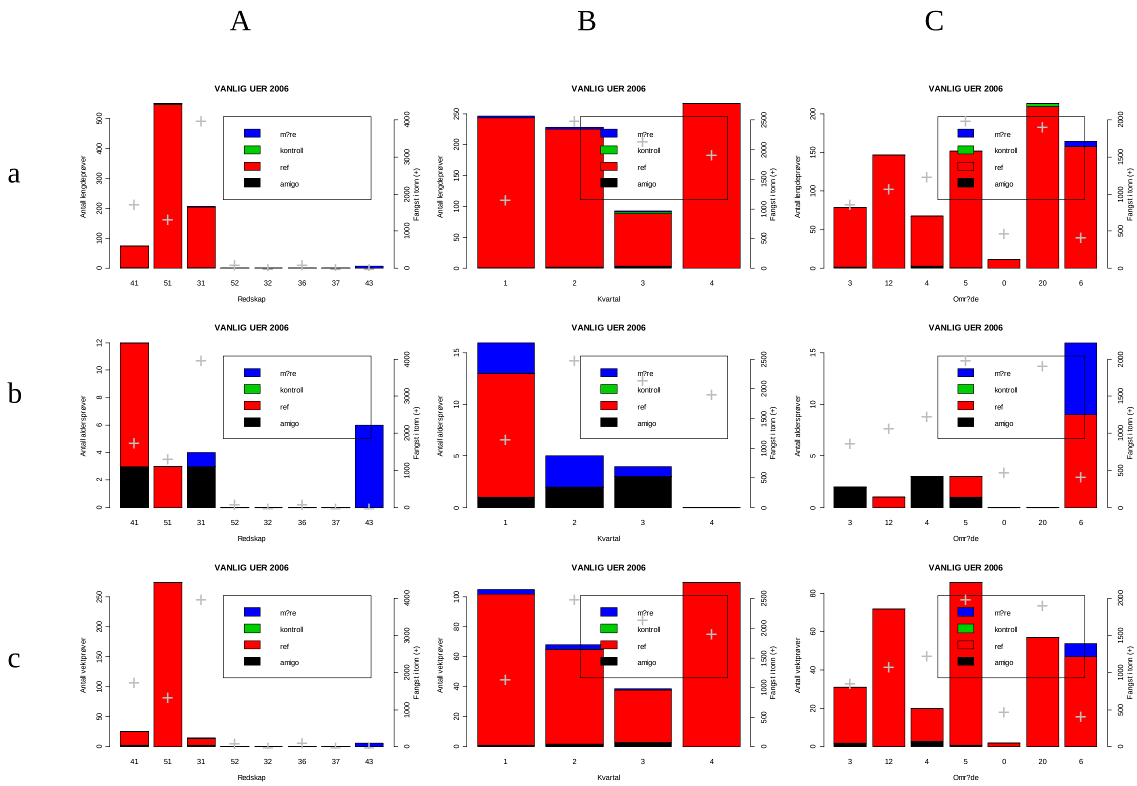


Figure D 1. Overview of biological samples from the commercial fisheries for Sebastes marinus in 2006, and which the input data to the Gadget model are based upon. Column A, B and C show the number of samples per gear, quarter and area, respectively. Row a, b and c show the number of length samples, age (otolith) samples and weight samples, respectively. The colours denote which sampling platform that has been used, e.g., port sampling (blue and black) and by the Reference fleet (red). The crosses show the catch in tonnes for the different gears, quarters and areas.

8 Greenland halibut in subareas I and II

An update assessment is presented for this stock. This should be regarded as an exploratory run and just used to view trends in the stock. The work on the age reading problems are continued, but we still need time before a thorough benchmark assessment can be carried out. The joint Russian-Norwegian program on Greenland halibut is planned to end in 2009. General information about this stock is located in the Quality Handbook.

8.1 Status of the fisheries

8.1.1 Landings prior to 2007 (Tables 8.1 – 8.5, E10)

Nominal catches by country for Subareas I and II combined are presented in Table 8.1. Tables 8.2–8.4 give the catches for Subarea 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 Spanish survey catches. Landings separated by gear type are presented in Table 8.5.

The revised total catch for 2005 is 18,834 t, which is less than that used in the previous assessment (19,248 t). The preliminary estimate of the total catch for 2006 is 17,910 t. This is substantially (more than 2,000 t) smaller than the projected catch for 2006 estimated by the Working Group during its 2006 meeting (20,000 t).

Some fishing for Greenland halibut has taken place in the northern part of Division IVa during the past 20-30 years, varying between a few tonnes and up to 2,500 t in 1999. In the two last years this catch has been below 100 t. (Table E10). This fishery is in another management area and is not restricted by any TAC regulations. Although there is a continuous distribution of this species from the southern part of Division IIa along the continental slope towards the Shetland area, little is known about the stock structure and the catch taken from this area has therefore not been added to the catch from Subareas I and II.

Around Jan Mayen, small catches of Greenland halibut have been taken in some years. Catch of 21 t was reported from this area in 2006. Jan Mayen is within Subarea 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 Subarea II.

8.1.2 ICES advice applicable to 2006 and 2007

The advice from ICES for 2006 was as follows:

Exploitation boundaries in relation to precautionary limits: *The stock has remained at a relatively low size in the last 25 years at catch levels of 15 000-25 000 t. In order to increase the SSB, catches should be kept well below that range. Catches for 2006 should not increase above the recent average of 13 000 t as advised in 2004, to allow for continued increase in the spawning stock..*

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects: *The current estimated fishing mortality is above fishing mortalities that would lead to high long-term yields. This indicates that long-term yield will increase at Fs well below the historic values. Fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of reducing stock productivity..*

The advice from ICES for 2007 was as follows:

Exploitation boundaries in relation to precautionary limits: *The stock has remained at a relatively low size in the last 25 years at catch levels of 15 000–25 000 t. In order to increase the SSB, catches should be kept well below that range. Catches for 2007 should be below 13 000 t as advised in 2005; this is the level below which SSB has increased in the past.*

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects: *There is no estimate of high yield reference points.*

8.1.3 Management applicable in 2006 and 2007

Target Greenland halibut fishery is forbidden since 1992. Management of Greenland halibut is by bycatch regulations and a limited coastal Norwegian fishery using longline and gillnet. From 2001 the bycatch regulations in each haul was not to exceed 12% in each haul and 7% of the landed catch. From early 2004 the Norwegian Department of Fisheries decided that for Norwegian vessels in the NEEZ allowable bycatch at any time on board and by landing should not exceed 7 %. In addition, the annual catch for each trawler are not allowed to exceed 4 % of the sum of the vessels quota on cod, haddock and saithe, and limited by a maximum annual catch of 40 t pr. vessel.

The Norwegian conventional fleet, vessels smaller than 28 m, are allowed to conduct a limited target fishery with longlines and gillnets in a limited area in approximately one month each year. For these vessels the TAC is set to 10, 12 and 14 t, dependent of size of the vessel. This fishery is supposed to keep the total catch at a level which these vessels landed historically (ca. 2,500 t).

The 30. Session of the joint Russian-Norwegian Fisheries Commission (JRNFC) in 2001 stated that both the Russian and the Norwegian party could catch up to 1,500 t of Greenland halibut for research and surveillance purposes in 2002. This research quota was increased in the commission meeting the year after to 3,000 t for each party, and has been at this level until 2005. For the year 2006 this research quota was again increased to 4,500 t to each party (34. Session of the JRNFC). During 35th Session of the JRNFC it was decided to rise research quotas for 2007 up to 4,900 t for each party.

8.1.4 Expected landings in 2007

The total Norwegian catch in 2007 is expected to be at the same level as in 2006, about 11,500 t. In addition 6,000 t is expected to be caught by Russian vessels and 500 t by other countries. Consequently the official landings in 2007 are expected to be 18,000 t. Discards is not regarded as a problem but it is believed that there may be additional landings that are not reported. The catches from Division IVa are expected to be maintained at a low level (below 500 t).

8.2 Status of research

8.2.1 Survey results (Tables A14, E1-E8)

Over the last several years the Working Group has been concerned about trends in catchability within individual surveys used for tuning of the XSA. The trends were seen for younger ages of year classes in the late 80’s and early 90’s that were initially estimated very low in abundance. With increasing age these year classes were estimated much closer to the mean abundance. In previous meetings the Working Group therefore increased the lower age used in tuning to five years in order to reduce the problem. This only partly solved the problem though, and in all subsequent assessments estimated recruitment of the last 2-3 years has increased from one year to the next.

Most of the surveys considered by the Working Group in 2001 covered either the adult population in the slope area or juvenile distribution in northern areas. The problem of underestimation of recruitment in the last few years included in the analyses has been attributed to shortcomings in survey coverage. The Working Group has at previous meetings noted the need for annual surveys that sample most of the population within a short period of time. Prior to the 2002 WG meeting effort was therefore made to combine some of these surveys into a new total index. The new index is termed the Norwegian Combined Survey Index and is established back to 1996, the first year with survey coverage northeast of Svalbard. It includes bottom trawls from the Norwegian bottom trawl survey in August in the Barents Sea and Svalbard (Tables E1 and E2), the Norwegian Greenland halibut survey in August along the continental slope (Table E3), and the Norwegian bottom trawl survey in August-September north and east of Svalbard (Table E4). With exception of the Norwegian Greenland halibut survey all these surveys from 2004 are conducted as one major joint survey between Norway and Russia. Prior to the meeting in 2003 work was done to evaluate the combination of these survey series into one index and this was reported to the Working Group (Pennington, WD 5#2003). Based on these results it was decided to use the combined index in the assessment.

The Norwegian Combined Survey Index (Table E5) indicates an increase in the total stock during the last five years. However, there is no clear year class pattern in the data and some ages are consistently underestimated relative to adjacent age groups (e.g. age 9 and partly age 4). The highest indices were observed for age seven, with exception of the four last years when younger age groups were more abundant. That indicates that the catchability of younger ages (i.e. those primarily from northern surveys) is not comparable with the older ones (i.e. those primarily from the slope). This is probably a result of pooling different surveys using different gears. These weaknesses reduce the applicability of the combined surveys, and the Working Group advises that further work be done to improve the combined index in the future.

Also in the Russian bottom trawl surveys in October-December (Table E6) it is difficult to identify year classes that appear consistently either strong or weak across ages. In previous Working Group reports this survey series was the one with the clearest and strongest trends in catchability with age in the XSA calibrations. These surveys are important since they usually cover large parts of the total known distribution of the Greenland halibut within 100–900 m depth. During the 2002 survey, however, no observations were available from the Exclusive Economic Zone of Norway (NEEZ). The results of the 2003 survey indicated a drastic decline in abundance and biomass of Greenland halibut in the eastern Norwegian Sea in comparison with previous years, however, in 2003 the survey again had significant limitations. Observations on the main spawning grounds in 2003 were conducted three weeks later than usual because access to NEEZ was obtained too late. The number of trawl stations was also insufficient due to the same reason. It was considered therefore imprudent to use the 2002 and 2003 data from this survey series in the current assessment.

The Spanish bottom trawl survey (Table E7) shows an increase of Greenland halibut abundance and biomass in the Svalbard-Bear Island area from 2002 after three years with a declining trend. This survey was not conducted in 2006.

The Norwegian Bottom trawl Survey in the Barents Sea in winter (Table E8) shows no clear trend in the total abundance, but the 2006 total estimate was the second highest in the series.

Although representing a larger part of the stock, the new combined survey indices were not successful in establishing consistency in the relative size of year classes at age. Future inclusion of northern parts of the Russian zone may improve the index.

Also the joint Russian-Norwegian research program on Greenland halibut may eventually contribute by increasing our understanding of the processes involved. The main objectives are to clarify the migration dynamics of the stock, including vertical distribution and relations with Greenland halibut in other areas. The results may improve both biological sampling and the subsequent assessments. The age structured tables of the Norwegian surveys were not updated in 2006 due to change in age reading procedure. This is an important part of the ongoing research program and will eventually end up in total revision of the input data to the assessment.

Abundance indices of 0-group Greenland halibut are shown in Table 1.3. The increase in 0-group abundance after 1996 seems to have stopped. The index in 2003, 2005 and 2006 are well below average.

8.2.2 Commercial catch-per-unit-effort (Table 8.6 and E9)

The CPUE from the experimental fishery was found 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 1800 kg/h with the highest value in 2005 (Table E9). The Russian experimental CPUE series shows an increasing trend since 1997, and this series shows the highest value in 2003. In 2004-2006 a significant decline was observed (Table 8.6) and this was probably caused by the reduced fishing period.

8.2.3 Age readings

The Norwegian age reading were changed in 2006 causing a situation which is not comparable with older data or the Russian age readings. This is a part of the joint research program where the age reading problems are addressed and this will lead to revised age structure in the input data in the future. It is some uncertainties in when this revised age readings can be used in the assessment, but the research program is planned to end in 2009. In 2006, Russian age-length keys were used on the total catch matrix and the Russian survey was the only tuning fleet updated for 2006. The two Norwegian surveys were used as before as tuning series until 2005.

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.

8.3.1 Catch-at-age (Table 8.7)

The catch-at-age data for 2005 were updated using revised catch figures. Catch-at-age data for 2006 were available only from the Russian fisheries. The Russian catch-at-age were used to allocate catches from the other countries by age groups. Total international catch-at-age is given in Table 8.7. Greenland halibut are usually caught in the range of 3–16 years old, but the catch is mainly dominated by ages 5–10. Generally, fish older than age 10 comprise a very low proportion of the catches.

8.3.2 Weight-at-age (Table 8.8)

For the years 1964-1969 separate weight-at-age data were used for the Norwegian and the Russian catches. Both data sets were mean values for the period and were combined as a weighted average for each year. A constant set of weight-at-age data was used for the total catches in the years 1970–1978. For subsequent years annual estimates were used. The

Russian weight-at-age data was used in the catch in 2006 (Table 8.8). 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 8.9)

Annual ogives were derived to estimate the spawning stock biomass based on females only using Russian survey data for the years 1984–2006, except for the year 1991. An average ogive computed for 1984–1987 was applied to 1964–1983. The average of 1990 and 1992 was used to represent the maturity ogive for 1991. For 1984-2002 and 2004-2006 a three-year running average was applied. In previous assessments a similar procedure using the same data set was implemented but was based on sexes combined. The ogive for 2003 was rejected due to the problems with the Russian survey mentioned above (Section 8.2.1) and the data used was the mean value for 2002 and 2004.

8.3.5 Tuning data

The XSA was run with the same tuning series as used in last year's assessment:

Fleet 4: Experimental commercial fishery CPUE from 1992–2005 for ages 5–14.

Fleet 7: Russian trawl survey from 1992-2006 for ages 5-14. The 2002 and 2003 data was not included in this series due to the problems mentioned in section 8.2.1

Fleet 8: Norwegian Combined Survey from 1996-2005 for ages 5-15.

The software XXSA.exe were used.

8.4 Recruitment indices (Tables A14, E1-E9)

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 previous Working Group reports there is no longer evidence for a major recruitment failure in the 1990's. Nevertheless, the relative size of the individual year classes is still poorly estimated, especially at ages below 5 years.

8.5 Methods used in the assessment

8.5.1 VPA and tuning (Figure 8.1, Tables 8.7-8.10)

The Extended Survivors Analysis (XSA) was used to tune the VPA to the fleets as mentioned in Section 8.3.5. The analyses 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 of stock size for all ages and independent of age for ages 10 and older. These are the same settings as used in last years assessment.

Input data and diagnostics of the final XSA run are given in Tables 8.7-8.10 and log catchability residuals for the three fleets used in the tuning are shown in Figure 8.1.

8.6 Results of the Assessment

The diagnostics of the assessment indicate that it is generally unbiased, and describes the trend in stock development reasonably well. The survivor estimates for 2006 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. Nevertheless, the assessment diagnostics also indicated substantial uncertainties in absolute values of the survivor estimates determined by the analysis shown by instances of very high residuals, large S.E. (log q)'s and low R^2's in the regression statistics for certain fleets and ages.

8.6.1 Results of the VPA (Figure 8.2, Tables 8.11–8.15)

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 8.11). 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 continues to represent the average fishing mortality on the major age groups prosecuted by the fishery.

Until 1976 the female spawning stock varied between 60,000 and 140,000 t, then it was relatively stable at around 40,000 t until the mid 1980's after which it declined markedly. It reached an all time low of 14,500 t by 1995-96 but has been increasing since then to an estimate of 45,000 by 2004, which is the highest value estimated since 1976 and slightly lower than the long-term average for the whole period 1964-2006. The female spawning stock has decreased the two last years, but the total stock has increased in the same period. The maturity ogives used has shown a very variable maturity by age in the recent years and this affects the SSB.

Prior to the reduction in the early 1990's the fishing mortality had increased continuously for more than a decade and peaked in 1991 at 0.66. After the reduction the fishing mortality has averaged around 0.25. The high catch in 1999 resulted in an increase in fishing mortality to 0.35 but since then has declined to 0.17-0.18 by 2002 and 2003, the lowest value estimated for the last 20 years. Due to the increased catch in 2004-2006 the fishing mortality again slightly raised (0.21-0.23) but remained lower than average.

Recruitment-at-age 5 has been relatively low in recent years compared to the long term average, and since 1990 lower than in all previous years. Nevertheless, the reduction is not especially dramatic and the 1990-2004 average is about 83% of the average during the 1980's. The estimate for 2006 is the highest after 1970 and above the long-term average.

8.6.2 Biological reference points

Given the continuing levels of uncertainty in the current assessment no further attempts were made to develop reference points for this stock.

8.6.3 Catch options for 2007

Given the uncertainty around the absolute values of population size at age no catch options are provided.

8.7 Comparison of this years assessment with last years assessment

Compared to last year assessment stock size for 2006 has increased while SSB has been reduced, fishing mortality remained at the same level.

	Total stock (5+) by 1 January 2006	SSB by 1 January 2006	F6-10 in 2006	F6-10 in 2005
WG 2006	104234	45909	0.23*	0.23
WG 2007	111734	35749	0.22	0.23

*prediction

8.8 Comments to the assessment (Figures 8.3 – 8.4)

The assessment was classified as an update assessment. The current assessment was using the same catch matrix, surveys series and settings as in the previous year with updated data for 2005 and new data for 2006. Fishing mortalities tend to be overestimated while SSB tends to be underestimated in the assessment year as illustrated by the retrospective plots in Figure 8.3.

The assessment is considered to be still uncertain due to the age-reading and survey data quality problems. Nevertheless the assessment may be accepted as indicative for stock trends. Although many aspects of the assessment remain uncertain, most fishery independent indices of stock size indicate positive trends in recent years. However, the biomass indices from the two Norwegian survey series seem to level out or decrease in the last year. (Figure 8.4).

The main result from the assessment is that the total stock has an increasing trend since 1992 and this is also seen in the SSB from 1995 to 2004. After 2004 the SSB show a decreasing signal. The estimate of the SSB is based on maturity ogives from the Russian survey. Other sources indicates no decreasing trend in the maturity of Greenland halibut in recent years and biomass indices of mature females from the slope area (main adult area) does not reflect a decrease in SSB (Figure 8.5). Further checking of the maturity data from the Russian survey is needed to evaluate if the reduction in maturity by age is correct.

The working group have stated in several previous reports that catches above the mean in the period 1992-2003 (ca. 13,000 t) reduces the stocks ability to rebuild. The high catch in 2004-2006 and expected catch of 2007 will most likely lead to reduction in the spawning stock size, as in the period 1983 to 1990.

8.9 Response to ACFM technical minutes

The Spanish survey (Table E7) was not conducted in 2006, thus the table is not updated and the comments in the technical minutes were not addressed. Also the Norwegian CPUE survey (Table E9) has been stopped from 2007. This is one of the tuning fleets, but an evaluation of this survey has revealed a lot of inconsistencies in the series. When the age reading problem is solved, the Norwegian combined series and the Russian autumn survey will be the tuning fleets. It is accepted that these two survey series cover most of the distribution of the NEA Greenland halibut.

During the March (2006) meeting, the Norwegian and Russian scientists developed a new 3-year joint research program aimed at improvement of methods for assessment of Greenland halibut. This program includes all items mentioned in the ACFM technical minutes for the 2006 assessment. This work is in progress but more time is needed before any firm conclusions can be drawn.

A full assessment should not be conducted before the results from the research program is available.

Table 8.1. GREENLAND HALIBUT in Sub-areas I and II. Nominal catch (t) by countries (Sub-area I, Divisions IIa and IIb combined) as officially reported to ICES.

Year	Den-mark	Esto-nia	Faroe Isl.	France	Fed. Rep. Germa-ny	Gre-enl.	Ice-land	Ire-land	Lithu-ania	Norway	Po-land	Portu-gal	Russia[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	2,564	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	7,661	12	50	1,038	157[2]	67	25	9,410
1998	0	0	57	67	34	0	23	2	0	8,435	31	99	2,659	259[2]	182	45	11,893
1999	0	0	94	0	34	38	7	2	0	15,004	8	49	3,823	319[2]	94	45	19,517
2000	0	0	0	45	15	0	16	1	0	9,083	3	37	4,568	375[2]	111	43	14,297
2001	0	0	0	122	58	0	9	1	0	10,896[2]	2	35	4,694	418[2]	100	30	16,365
2002	0	219	0	7	42	22	4	6	0	7,011[2]	5	14	5,584	178[2]	41	28	13,161
2003[1]	0	0	459	2	18	14	0	1	0	8,347[2]	5	19	4,384	230[2]	41	58	13,578
2004[1]	0	0	0	0	9	0	9	0	0	13,840[2]	1	50	4,662	186[2]	43	0	18,800
2005[1]	0	170	0	32	8	0	0	0	0	13,011[2]	0	23	4,883	660[3]	29	18	18,834
2006[1]	0	0	197	40	8	0	0	0	196	11,150[2]	202	24	6,055	29	10	0	17,910

[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	France	Greenland	Iceland	Ireland	Norway	Poland	Russia[3]	Spain	UK (E & W)	UK (Scot.)	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	-	-	-	-	-	-	-	2,039	-	482	-	+	-	2,521
1990	-	7	-	-	-	-	-	1,304	-	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	-	610	-	170	-[2]	+	-	857
1998	-	47	+	-	-	23	-	859	-	491	-[2]	2	-	1,422
1999	-	91	-	-	13	7	-	1,101	-	1,203	-[2]	+	-	2,415
2000	-	-	+	-	-	16	-	1,021	+	1,169	-[2]	1	-	2,206
2001	-	-	-	-	-	9	-	925[2]	+	951	-[2]	2	-	1,887
2002	-	-	3	-	-	+	-	791[2]	-	1,167	-[2]	+	-	1,961
2003[1]	-	48	+	+	2	+	1	949[2]	1	735	+[2]	+	+	1,736
2004[1]	-	-	-	-	-	+	-	812[2]	-	633	-[2]	3	-	1,449
2005[1]	-	-	-	1	-	-	-	572[2]	-	595	-[2]	3	-	1,171
2006[1]	-	13	1	-	-	-	-	652[2]	0	626	2[2]	2	-	1,296

[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	Esto-nia	Faroe Islands	Fed. Rep. Germ.	France	Green-land	Ice-land	Ire-land	Norway	Poland	Portu-gal	Russia[5]	Spain	UK (E & W)	UK (Scot.)	Total
1984	-	-	265	138	-		-	3,703	-	-	5,459	-	1	-	9,566
1985	-	-	254	239	-		-	4,791	-	-	6,894	-	2	-	12,180
1986	-	6	97	13	-		-	6,389	-	-	5,553	-	5	1	12,064
1987	-	-	75	13	-		-	5,705	-	-	4,739	-	44	10	10,586
1988	-	177	150	67	-		-	7,859	-	-	4,002	-	56	2	12,313
1989	-	67	104	31	-		-	8,050	-	-	4,964	-	6	-	13,222
1990	-	133	12	49	-		-	8,233	-	-	1,246[2]	-	1	-	9,674
1991	1,400	314	21	119	-		-	11,189	-	-	305[2]	-	+	1	13,349
1992	-	16	1	108	13[4]		-	3,586	-	15[3]	58	-	1	-	3,798
1993	-	29	14	78	8[4]		-	7,977	-	17	210	-	2	-	8,335
1994	-	-	33	47	3[4]		4	6,382	-	26	67	+	14	-	6,576
1995	-	-	30	174	12[4]		2	6,354	-	60	227	-	83	2	6,944
1996	-	-	34	219	123[4]		-	9,508	-	55	466	4	278	57	10,744
1997	-	-	23	253	-[4]		-	5,702	-	41	334	1[2]	21	25	6,400
1998	-	-	16	67	-[4]		1	6,661	-	80	530	5[2]	74	41	7,475
1999	-	-	20	-	25[4]		2	13,064	-	33	734	1[2]	63	45	13,987
2000	-	-	10	43	-[4]		+	7,536	-	18	690	1[2]	65	43	8,406
2001	-	-	49	122	-[4]	9	1	8,740	-	13	726	5[2]	56	30	9,751
2002	-	-	9	7	22[4]	4	-	5,780[2]	-	3	849	-[2]	12	28	6,714
2003[1]	-	390	5	2	12[4]	+	+	6,778[2]	+	10	1,762	14[2]	5	58	9,036
2004[1]	-	-	4	-	-[4]	9	-	11,633[2]	-	24	810	4[2]	1	-	12,485
2005[1]	-	-	3	31	-[4]	-	-	11,216[2]	-	11	1,406	+	5	18	12,690
2006[1]	-	172	-	36	-	-	-	8,680[2]	-	8	950	+	6	-	9,852

[1]Provisional figures. [2]Working Group figure. [3]As reported to Norwegian authorities.

[4]Includes Division Iib. [5] USSR prior to 1991.

Table 8.4. GREENLAND HALIBUT in Sub-areas I and II. Nominal catch (t) by countries in Division IIb as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Fed. Rep. Germ.	Ireland	Lithuania	Norway	Poland	Portugal	Russia[4]	Spain	UK (E&W)	UK (Scot.)	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	1,022	32	5	3,047
1996	+	-	-	-	47	-	-	1,204	-	24	912	196	39	+	2,422
1997	-	-	12	-	33	2	-	1,349	12	9	534	156[2]	46	+	2,153
1998	-	-	10	-	18	1	-	915	31	19	1,638	254[2]	106	4	2,996
1999	-	-	3	-	14	-	-	839	8	16	1,886	318[2]	31	-	3,115
2000	-	-	-	2	5	-	-	526	3	19	2,709	374[2]	46	-	3,685
2001	-	-	-	+	9	-	-	1,231[2]	2	22	3,017	413[2]	42	-	4,736
2002	-	219	-	+	30	6	-	440[2]	5	11	3,568	178[2]	29	-	4,486
2003[1]	+	+	21	-	13	-	-	620[2]	4	9	1,887	216	35	+	2,805
2004[1]	-	-	-	-	5	-	-	1,395[2]	1	26	3,219	182[2]	39	-	4,866
2005[1]	-	170	-	-	5	-	-	1,223[3]	-	12	2,882	660[2]	21	-	4,973
2006[1]	-	-	12	3	7	-	196	1,818[2]	201	16	4,479	27[2]	2	-	6,762

[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	Danish seine	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	6 664		11 882
1999	2 565	6 804	10 177		19 546
2000	1 707	5 029	7 700		14 437
2001	2 041	6 303	7 968		16 312
2002	1 737	5 309	6 115		13 161
2003	2 046	5 483	6 049		13 578
2004	2 290	7 135	8 778	599	18 801
2005	1 842	7 537	9 014	441	18 834
2006	1 495	6 133	10 069	213	17 910

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	-	-	-	-	-
2001	0.82 [11]	-	1.18	1.57	-	-	-	-	-
2002	0.85	-	1.07	1.82	-	-	-	-	-
2003	0.97 [12]	-	0.86	2.45	-	-	-	-	-
2004	0.63 [13]	-	1.16	1.79	-	-	-	-	-
2005	0.61 [12]	-	1.30	2.29	-	-	-	-	-
2006	0.57 [12]	-	0.96	2.09					

[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.

[11] Based on fishery from april-october only, a period with relatively low CPUE. In previous years fishery was carried out throughout the whole year.

[12] Based on fishery from october-december only, a period with relatively high CPUE.

[13] Based on fishery from october-november only.

Table 8.7

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 9:59

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

YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
AGE											
5	372	253	170	156	114	1064	526	80	1109	212	917
6	1480	853	563	332	283	2420	2792	4486	3521	1117	2519
7	2808	1735	1106	623	452	3208	10464	12712	9605	3923	6204
8	5674	3868	2715	2006	1976	6288	18562	12283	6438	3515	3838
9	4951	4203	4054	3237	3923	4921	10034	6130	2775	2551	1834
10	3981	3799	2499	2409	2950	4431	6671	4339	1734	1919	1942
11	1853	1799	1284	1718	2234	2381	2517	2703	1368	1536	1622
12	1018	1002	783	871	792	812	1250	1660	1234	1127	1338
13	364	372	246	315	146	229	616	1044	675	716	734
14	251	282	261	155	43	100	1104	300	200	251	531
+gp	76	50	28	19	7	30	281	143	80	126	216
0 TOTALNUM	22828	18216	13709	11841	12920	25884	54817	45880	28739	16993	21695
TONSLAND	40391	34751	26321	24267	26168	43789	89484	79034	43055	29938	37763
SOPCOF %	100	100	101	100	100	103	94	104	98	92	98

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

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE											
5	840	830	2037	1897	2218	731	1896	1304	1543	915	1219
6	2337	2982	3255	3589	3155	1138	1917	1494	1864	3698	2874
7	6520	5824	4200	4118	2727	1665	1919	1276	1851	3350	2561
8	4118	5002	2524	2365	1234	1341	933	1208	2287	1938	1548
9	2265	3000	1610	1509	495	944	484	1493	1491	1064	972
10	1654	1350	1104	946	319	473	448	1258	1228	1191	1037
11	1857	915	1062	934	296	511	482	838	713	602	614
12	1536	1212	858	438	243	275	380	502	488	340	363
13	1122	698	595	349	103	242	384	324	247	171	161
14	600	526	384	147	45	145	150	108	201	132	120
+gp	368	358	180	112	51	78	62	46	64	71	63
0 TOTALNUM	23217	22697	17809	16404	10886	7543	9055	9851	11977	13472	11532
TONSLAND	38172	36074	28827	24617	17312	13284	15018	16789	22147	21883	19945
SOPCOF %	88	93	101	105	104	109	107	100	98	100	99

Table 8.7 (Continued)

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

	YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
5		1672	1212	907	2080	2139	3312	1098	1140	631	846	1034
6		3335	2972	2540	4453	5163	3889	1195	1088	708	992	2083
7		2712	3572	3141	3655	4642	4716	1069	1608	1252	1719	3795
8		1531	1746	2096	1657	1932	2355	778	1118	817	990	1426
9		1128	752	1182	801	1221	1031	360	140	310	405	262
10		997	828	860	318	499	1284	600	976	642	726	655
11		530	362	481	228	264	774	188	444	416	461	270
12		434	202	313	126	314	673	150	144	330	371	132
13		314	186	133	120	42	177	79	36	88	154	29
14		305	63	140	140	96	266	89	20	39	56	22
	+gp	239	7	47	28	44	517	56	4	3	8	1
0	TOTALNUM	13197	11902	11840	13606	16356	18994	5662	6718	5236	6728	9709
	TONSLAND	22875	19112	19587	20138	23183	33320	8602	11933	9226	11734	14347
	SOPCOF %	98	101	100	103	102	105	95	102	99	101	101

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

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
5		330	359	433	380	441	277	397	290	429	624
6		921	1116	1905	735	1347	921	1025	1016	1072	1563
7		1822	2466	3955	1926	2338	1475	1827	2316	1962	2505
8		953	1464	1810	1464	1325	983	928	1392	1766	1931
9		342	527	914	743	788	631	632	1087	936	1090
10		822	924	1905	1318	1140	1097	1045	778	991	641
11		231	237	380	457	519	563	520	675	616	449
12		150	122	237	330	372	301	311	607	622	478
13		18	15	67	49	115	132	77	199	376	376
14		41	29	42	37	54	59	107	155	244	166
	+gp	1	15	7	14	12	42	26	105	328	172
0	TOTALNUM	5631	7274	11655	7453	8451	6481	6895	8620	9342	9995
	TONSLAND	9410	11893	19517	14437	16307	13161	13578	18800	18834	17910
	SOPCOF %	99	100	102	101	100	100	100	99	97	101

Table 8.8

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 9:59

Table 2 Catch weights at age (kg)

YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
AGE											
5	0.42	0.42	0.42	0.42	0.42	0.42	0.567	0.567	0.567	0.567	0.567
6	0.64	0.64	0.64	0.65	0.66	0.64	0.737	0.737	0.737	0.737	0.737
7	0.9	0.9	0.91	0.93	0.96	0.91	1.079	1.079	1.079	1.079	1.079
8	1.2	1.22	1.24	1.27	1.31	1.25	1.421	1.421	1.421	1.421	1.421
9	1.63	1.66	1.7	1.71	1.74	1.64	1.848	1.848	1.848	1.848	1.848
10	2.26	2.23	2.22	2.2	2.19	2.25	2.281	2.281	2.281	2.281	2.281
11	3.11	3	2.94	2.84	2.79	2.99	2.887	2.887	2.887	2.887	2.887
12	3.74	3.49	3.39	3.3	3.19	3.63	3.247	3.247	3.247	3.247	3.247
13	4.57	4.4	4.38	4.27	4.27	4.68	4.303	4.303	4.303	4.303	4.303
14	5.01	4.91	4.84	4.88	5	5.38	4.931	4.931	4.931	4.931	4.931
+gp	5.94	5.89	5.88	5.8	5.99	5.99	5.794	5.841	6.037	6.006	5.964
0 SOPCOFAC	0.9986	1.0046	1.0054	1.0024	0.9994	1.0262	0.9436	1.0434	0.9752	0.9231	0.9825

Table 2 Catch weights at age (kg)

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE											
5	0.567	0.567	0.567	0.567	0.9	0.702	0.66	0.69	0.75	0.63	0.6
6	0.737	0.737	0.737	0.737	1.2	0.872	0.84	0.84	1.04	0.96	0.89
7	1.079	1.079	1.079	1.079	1.5	1.141	1.15	1.03	1.34	1.18	1.2
8	1.421	1.421	1.421	1.421	1.8	1.468	1.56	1.31	1.57	1.53	1.85
9	1.848	1.848	1.848	1.848	2.2	1.778	2.04	1.74	1.97	2.31	2.59
10	2.281	2.281	2.281	2.281	2.6	2.302	2.57	2.24	2.73	2.87	3.18
11	2.887	2.887	2.887	2.887	3	2.664	2.98	2.77	3.29	3.46	3.62
12	3.247	3.247	3.247	3.247	3.5	3.046	3.43	3.37	4.22	3.77	3.95
13	4.303	4.303	4.303	4.303	4.1	3.368	4.13	4.32	4.71	3.99	4.48
14	4.931	4.931	4.931	4.931	4.8	4.285	4.68	5.35	6.08	4.35	4.25
+gp	5.91	5.923	6.027	5.906	6.176	5.346	5.999	5.833	6.122	4.525	4.825
0 SOPCOFAC	0.8805	0.9255	1.0095	1.0485	1.0364	1.0894	1.068	1.0038	0.9783	1.0009	0.9858

Table 8.8 (Continued)

Table 2 Catch weights at age (kg)

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
5	0.62	0.709	0.74	0.76	0.71	0.77	0.68	0.79	0.72	0.73	0.77
6	0.92	1.003	0.962	1.03	1.06	1.05	0.97	1.02	0.94	0.94	0.97
7	1.28	1.266	1.249	1.32	1.29	1.38	1.27	1.35	1.27	1.25	1.31
8	1.9	1.683	1.626	1.8	1.7	1.75	1.76	1.88	1.72	1.74	1.74
9	2.48	2.482	2.164	2.42	2.1	2.2	2.21	2.46	2.19	2.09	2.24
10	3.11	2.982	2.897	3.13	2.61	2.6	2.56	2.67	2.52	2.51	2.59
11	3.35	3.547	3.406	3.37	2.87	2.79	3.11	3.43	2.97	2.95	3.29
12	3.72	3.8	3.661	4.05	3.45	3.28	3.59	4.29	3.29	3.34	4.02
13	4	4.56	4.247	4.29	3.72	3.89	3.83	5.08	3.84	3.83	4.75
14	4.18	5.002	4.187	4.5	4.09	4.38	4.25	6.33	4.95	4.98	6.24
+gp	4.526	5.953	4.463	4.72	4.52	5.29	4.8	8.91	6.68	8.15	6.09
0											
SOPCOFAC	0.9782	1.0116	0.9973	1.0346	1.0204	1.047	0.9519	1.0183	0.9937	1.0095	1.0066

Table 2 Catch weights at age (kg)

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
5	0.77	0.73	0.7	0.76	0.74	0.69	0.715	0.77	0.669	0.637
6	0.94	0.93	0.95	0.97	1.03	0.94	1.05	1.095	0.952	0.86
7	1.28	1.3	1.27	1.33	1.39	1.36	1.428	1.498	1.306	1.149
8	1.64	1.61	1.55	1.63	1.75	1.68	1.748	1.903	1.653	1.53
9	2.07	2.12	2	2.11	2.29	2.18	2.318	2.463	2.131	2.122
10	2.59	2.57	2.46	2.61	2.68	2.68	2.615	2.775	2.544	2.622
11	3.3	3.25	3.22	3.35	3.33	3.19	3.043	3.128	2.848	2.699
12	4.01	3.91	3.85	3.97	3.92	3.89	3.694	3.809	3.334	3.315
13	4.83	4.9	4.61	4.97	4.81	4.46	4.566	4.291	3.734	3.998
14	5.95	5.66	5.84	5.82	5.81	5.25	5.568	5.453	4.384	4.641
+gp	6.26	4.91	5.98	7.22	7.41	6.32	6.365	6.355	5.791	6.743
0										
SOPCOFAC	0.9851	0.9983	1.0172	1.0055	1.0014	1	0.996	0.9853	0.9655	1.0063

Table 8.9

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 9:59

Table 5 Proportion mature at age

YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
AGE											
5	0	0	0	0	0	0	0	0	0	0	0
6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
7	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
8	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
9	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
10	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
11	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
12	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 5 Proportion mature at age

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE											
5	0	0	0	0	0	0	0	0	0	0	0
6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
7	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
8	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.18	0.18	0.19
9	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.6	0.61	0.65
10	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.82	0.83	0.85
11	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.96	0.97	0.97
12	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 8.9 (Continued)

Table 5 Proportion mature at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
5	0	0	0	0	0	0	0	0.01	0.01	0.01	0
6	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0
7	0.03	0.02	0.01	0.02	0.02	0.04	0.06	0.08	0.07	0.08	0.07
8	0.24	0.22	0.21	0.18	0.17	0.15	0.28	0.32	0.34	0.29	0.25
9	0.74	0.66	0.53	0.49	0.51	0.54	0.66	0.68	0.69	0.58	0.58
10	0.91	0.9	0.87	0.8	0.77	0.77	0.86	0.83	0.81	0.79	0.88
11	0.99	0.95	0.89	0.89	0.91	0.89	0.87	0.88	0.95	0.96	0.97
12	0.98	0.98	0.98	1.000	1.000	1.000	1.000	0.94	0.94	0.89	0.94
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 5 Proportion mature at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
5	0	0	0	0	0.01	0.01	0.01	0	0	0
6	0	0	0	0.01	0.03	0.03	0.02	0.01	0.01	0.01
7	0.07	0.04	0.02	0.03	0.06	0.1	0.11	0.04	0.05	0.05
8	0.21	0.1	0.07	0.1	0.19	0.31	0.34	0.22	0.22	0.21
9	0.53	0.45	0.33	0.37	0.49	0.66	0.72	0.65	0.57	0.51
10	0.85	0.82	0.66	0.63	0.65	0.79	0.88	0.89	0.88	0.87
11	0.94	0.92	0.86	0.87	0.84	0.91	0.92	0.96	0.91	0.89
12	0.94	1.000	0.99	0.96	0.96	0.96	0.97	0.97	0.95	0.95
13	1.000	1.000	1.000	1.000	1.000	0.99	0.98	0.99	0.99	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	0.98	0.98	0.98	1.000
+gp	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 8.10.

Lowestoft VPA Version 3.1

21/04/2007 9:56

Extended Survivors Analysis

Arctic Green.halibut (run: 2007/1)

CPUE data from file fleet

Catch data for 43 years. 1964 to 2006. Ages 5 to 15.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLT04: Norw. Exp. CP	1992	2006	5	14	0.38	0.44
FLT07: Russ.Surv. ne	1992	2006	5	14	0.75	0.92
FLT08: Norw.Comb.Sur	1996	2006	5	14	0.55	0.72

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 :

Terminal year survivor estimates shrunk towards the mean F of the final 2 years.
S.E. of the mean to which the estimates are shrunk = .500

Oldest age survivor estimates for the years 1964 to 2006
shrunk towards1.000 * the mean F of ages 9 - 13

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population estimates from each cohort age = .300

Individual fleet weighting not applied

Tuning converged after 44 iterations
1
Regression weights

	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
5	0.018	0.021	0.032	0.026	0.032	0.017	0.026	0.016	0.017	0.017
6	0.069	0.072	0.141	0.065	0.116	0.082	0.076	0.083	0.071	0.076
7	0.204	0.25	0.367	0.195	0.287	0.171	0.22	0.234	0.216	0.224
8	0.159	0.237	0.278	0.212	0.189	0.177	0.146	0.246	0.266	0.323
9	0.119	0.118	0.215	0.166	0.16	0.122	0.156	0.242	0.246	0.246
10	0.63	0.508	0.742	0.515	0.387	0.328	0.288	0.277	0.342	0.251
11	0.476	0.348	0.38	0.366	0.368	0.316	0.241	0.289	0.347	0.241
12	0.675	0.469	0.661	0.628	0.542	0.357	0.273	0.461	0.444	0.469
13	0.135	0.119	0.481	0.255	0.437	0.352	0.136	0.266	0.548	0.499
14	0.509	0.316	0.529	0.504	0.465	0.395	0.506	0.417	0.569	0.469

Table 8.10 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 5	6	7	8	9	10	11	12	13	14
1997	2.05E+04	1.49E+04	1.07E+04	6.98E+03	3.28E+03	1.90E+03	6.57E+02	3.29E+02	1.53E+02	1.11E+02
1998	1.86E+04	1.73E+04	1.20E+04	7.49E+03	5.12E+03	2.50E+03	8.69E+02	3.51E+02	1.44E+02	1.15E+02
1999	1.50E+04	1.57E+04	1.39E+04	8.05E+03	5.09E+03	3.92E+03	1.30E+03	5.28E+02	1.89E+02	1.10E+02
2000	1.58E+04	1.25E+04	1.17E+04	8.27E+03	5.25E+03	3.53E+03	1.61E+03	7.63E+02	2.35E+02	1.01E+02
2001	1.51E+04	1.32E+04	1.01E+04	8.29E+03	5.76E+03	3.83E+03	1.82E+03	9.58E+02	3.50E+02	1.57E+02
2002	1.77E+04	1.26E+04	1.01E+04	6.53E+03	5.90E+03	4.22E+03	2.24E+03	1.08E+03	4.80E+02	1.95E+02
2003	1.64E+04	1.50E+04	9.96E+03	7.34E+03	4.71E+03	4.50E+03	2.62E+03	1.40E+03	6.52E+02	2.91E+02
2004	1.98E+04	1.37E+04	1.20E+04	6.88E+03	5.46E+03	3.47E+03	2.90E+03	1.77E+03	9.19E+02	4.90E+02
2005	2.72E+04	1.68E+04	1.09E+04	8.16E+03	4.63E+03	3.69E+03	2.26E+03	1.87E+03	9.61E+02	6.06E+02
2006	3.93E+04	2.30E+04	1.35E+04	7.54E+03	5.38E+03	3.12E+03	2.26E+03	1.38E+03	1.03E+03	4.78E+02

Estimated population abundance at 1st Jan 2007

0.00E+00	3.32E+04	1.84E+04	9.27E+03	4.70E+03	3.62E+03	2.09E+03	1.53E+03	7.41E+02	5.39E+02

Taper weighted geometric mean of the VPA populations:

1.88E+04	1.44E+04	1.05E+04	6.61E+03	4.28E+03	2.94E+03	1.51E+03	8.05E+02	3.59E+02	1.88E+02

Standard error of the weighted Log(VPA populations) :

0.3029	0.2412	0.2454	0.2827	0.3541	0.3712	0.5116	0.6324	0.7605	0.7687

1

Log catchability residuals.

Fleet : FLT04: Norw. Exp. CP

Age	1992	1993	1994	1995	1996
5	0.25	0.82	0.57	0.7	0.94
6	-0.22	0.04	0.17	-0.11	0.72
7	-0.52	0.06	0.08	0.08	0.31
8	-0.21	0.16	0.25	0.26	0.15
9	-1.49	-1.47	-0.97	0.24	-0.27
10	-0.44	0.09	0.29	0.75	0.01
11	-0.22	-0.14	-0.21	0.19	-0.67
12	0.09	-0.19	-0.83	0.16	-0.77
13	-0.37	-0.07	-0.77	-0.21	99.99
14	-1.34	-0.27	-0.57	0.08	-0.23

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
5	0.86	-0.66	-0.24	0.31	-0.38	-0.3	-0.11	-0.24	-0.87	99.99
6	0.14	-0.19	-0.13	0.03	-0.03	-0.13	-0.05	-0.08	-0.02	99.99
7	0.01	0	-0.18	0.27	-0.16	0.24	-0.05	-0.18	-0.12	99.99
8	-0.24	-0.14	-0.23	-0.17	0.3	-0.1	-0.48	0.08	0.48	99.99
9	-0.05	-0.25	-1.18	0.07	0.32	0.24	0.62	0.68	0.88	99.99
10	0.47	-1.06	0.19	0.35	-0.14	-0.03	0.12	-0.44	0.02	99.99
11	0.51	-1.02	-1.15	-1.17	-0.8	-0.78	-0.35	-0.43	-0.23	99.99
12	0.45	-0.91	0.5	-0.15	-0.15	-0.69	-0.01	0.01	0.26	99.99
13	0.07	99.99	-0.69	0.26	-0.92	-1.67	-0.28	-0.28	0.32	99.99
14	-0.14	99.99	-0.13	99.99	-0.51	-0.06	-0.19	-0.06	0.05	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	-5.0226	-4.0423	-3.2331	-3.6875	-4.4956	-3.6017	-3.6017	-3.6017	-3.6017	-3.6017
S.E(Log q)	0.594	0.2197	0.1971	0.2865	0.7208	0.4419	0.7464	0.496	0.7512	0.3654

Table 8.10 (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
5	10.35	-0.952	-39.49	0	14	6.18	-5.02
6	1.04	-0.112	3.8	0.43	14	0.24	-4.04
7	0.95	0.207	3.55	0.64	14	0.2	-3.23
8	1.21	-0.547	2.61	0.43	14	0.36	-3.69
9	0.54	1.412	6.26	0.52	14	0.37	-4.5
10	1.24	-0.505	2.56	0.34	14	0.57	-3.6
11	1.25	-0.634	3.34	0.43	14	0.65	-4.13
12	0.87	0.639	4.13	0.73	14	0.42	-3.75
13	0.98	0.053	4.03	0.57	12	0.65	-4
14	0.9	0.781	3.94	0.9	12	0.27	-3.81

1

Fleet : FLT07: Russ.Surv. ne

Age	1992	1993	1994	1995	1996
5	1.9	0.76	0.06	-0.44	-0.32
6	0.95	0.64	0.23	-0.14	0
7	0.5	0.53	0.03	0.01	0.07
8	0.33	0.31	0.05	0.3	0.16
9	-0.61	-0.06	0.02	0.33	0.75
10	-0.44	-0.02	0.26	0.2	-0.85
11	0.36	-0.14	-0.47	-0.06	-0.66
12	0.26	0.38	-0.05	0.06	-0.89
13	-0.46	-0.34	-0.42	-0.29	-0.42
14	-4.99	0.69	0.49	-1.77	-0.37

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
5	-0.96	-0.2	-0.25	0.29	0.82	99.99	99.99	-0.08	-0.18	-0.07
6	-0.53	-0.43	-0.5	-0.1	0.77	99.99	99.99	0.15	-0.26	0.1
7	-0.28	-0.3	-0.52	-0.22	0.4	99.99	99.99	-0.01	-0.03	0.36
8	-0.05	0.02	-0.11	0.08	-0.34	99.99	99.99	-0.11	-0.27	0.23
9	-0.14	0.15	0.04	0.11	-0.32	99.99	99.99	0.04	-0.37	-0.03
10	-0.03	0.17	0.08	0.18	0.09	99.99	99.99	0.05	-0.11	0.08
11	0.3	0.72	-0.25	0.51	0.07	99.99	99.99	-0.16	-0.19	0.03
12	-0.42	0.54	0.21	0.53	0.76	99.99	99.99	0.1	-0.07	0.65
13	0.41	0.39	0.61	-0.83	1.07	99.99	99.99	0.07	-0.01	0.62
14	-0.36	-0.31	-0.23	0.43	0.44	99.99	99.99	0.58	0.11	0.53

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	-0.5253	0.5059	0.9743	1.1634	0.7075	0.3963	0.3963	0.3963	0.3963	0.3963
S.E(Log q)	0.5832	0.4419	0.3168	0.2162	0.3086	0.2807	0.386	0.5098	0.5925	1.0971

Table 8.10 (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
5	4.89	-1.398	-35.86	0.02	13	2.71	-0.53
6	7.28	-1.654	-63.86	0.01	13	2.94	0.51
7	2.03	-1.355	-11.51	0.18	13	0.61	0.97
8	1.72	-2.161	-8.37	0.54	13	0.31	1.16
9	1.43	-1.094	-4.55	0.46	13	0.43	0.71
10	0.77	1.187	1.55	0.77	13	0.21	0.4
11	1.1	-0.35	-1.19	0.6	13	0.45	0.41
12	0.82	0.897	0.68	0.77	13	0.39	0.59
13	0.87	0.593	0.29	0.73	13	0.52	0.52
14	0.8	0.549	0.81	0.48	13	0.91	0.31
1							

Fleet : FLT08: Norw.Comb.Sur

Age	1992	1993	1994	1995	1996
5	99.99	99.99	99.99	99.99	0.21
6	99.99	99.99	99.99	99.99	0.27
7	99.99	99.99	99.99	99.99	0.27
8	99.99	99.99	99.99	99.99	0.43
9	99.99	99.99	99.99	99.99	-0.05
10	99.99	99.99	99.99	99.99	0.72
11	99.99	99.99	99.99	99.99	0.02
12	99.99	99.99	99.99	99.99	0.17
13	99.99	99.99	99.99	99.99	-0.46
14	99.99	99.99	99.99	99.99	0.13

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
5	-0.15	-0.31	-0.26	0.13	-0.08	0.05	0.26	-0.09	0.21	99.99
6	0.12	-0.37	-0.05	-0.09	0.11	-0.02	0.11	-0.02	-0.01	99.99
7	0	0.1	-0.1	-0.2	0.17	0.2	0.15	-0.01	-0.49	99.99
8	-0.42	-0.23	0.22	-0.13	-0.02	0.13	0.03	0.08	-0.06	99.99
9	-0.5	-0.74	-0.45	0.35	-0.25	0.36	0.4	0.14	0.44	99.99
10	0.27	0.24	0.3	-0.36	0.05	-0.29	-0.07	-0.33	-0.18	99.99
11	-0.03	-0.03	-0.45	-1.03	-0.79	-0.23	-0.81	-0.9	-0.29	99.99
12	0.34	0.68	0.7	-0.38	-0.17	0.1	-0.18	0.14	-0.16	99.99
13	-1.17	-3.02	-0.02	-0.67	-0.68	-0.21	-0.32	-0.06	-0.08	99.99
14	0.03	0.25	0.15	-0.66	-0.25	-0.16	-0.51	0.15	-0.44	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	-0.2044	0.3467	0.9883	0.5207	-0.0656	0.784	0.784	0.784	0.784	0.784
S.E(Log q)	0.2039	0.1613	0.2336	0.2202	0.4334	0.3313	0.6477	0.3823	1.1021	0.3631

Table 8.10 (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
5	0.79	0.669	2.24	0.59	10	0.17	-0.2
6	1.74	-0.843	-7.74	0.16	10	0.29	0.35
7	2.07	-0.643	-12	0.05	10	0.5	0.99
8	4.85	-1.389	-36.77	0.02	10	1.01	0.52
9	0.76	0.488	2.07	0.38	10	0.35	-0.07
10	3.18	-2.697	-20.1	0.18	10	0.79	0.78
11	1.97	-2.35	-7.71	0.46	10	0.62	0.3
12	1.48	-1.983	-4.56	0.71	10	0.46	0.89
13	0.59	1.92	2.3	0.76	10	0.45	0.16
14	1.13	-0.698	-1.37	0.81	10	0.38	0.63
1							

Terminal year survivor and F summaries :

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

Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	1	0	0	0	0	0	0
FLT07: Russ.Surv. ne	31043	0.612	0	0	1	0.396	0.018
FLT08: Norw.Comb.Sur	1	0	0	0	0	0	0
F shrinkage mean	34730	0.5				0.604	0.017

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
33221	0.39	0.09	2	0.225	0.017

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

Table 8.10 (Continued)

Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	7681	0.621	0	0	1	0.102	0.173
FLT07: Russ.Surv. ne	18303	0.37	0.135	0.36	2	0.29	0.076
FLT08: Norw.Comb.Sur	22722	0.3	0	0	1	0.436	0.062
F shrinkage mean	18034	0.5				0.172	0.077

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
18366	0.2	0.16	5	0.799	0.076

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

Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	8690	0.27	0.084	0.31	2	0.235	0.237
FLT07: Russ.Surv. ne	10498	0.248	0.197	0.8	3	0.292	0.2
FLT08: Norw.Comb.Sur	8783	0.212	0.041	0.19	2	0.38	0.235
F shrinkage mean	9174	0.5				0.093	0.226

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9267	0.13	0.07	8	0.503	0.224

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

Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	4254	0.201	0.014	0.07	3	0.266	0.351
FLT07: Russ.Surv. ne	5362	0.202	0.085	0.42	3	0.305	0.288
FLT08: Norw.Comb.Sur	4254	0.174	0.22	1.26	3	0.351	0.351

Table 8.10 (Continued)

F shrinkage mean	6120	0.5				0.077	0.257

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4696	0.11	0.08	10	0.721	0.323

Age 9 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. Exp. CP	3980	0.169	0.175	1.04	4	0.289	0.226
FLT07: Russ.Surv. ne	3247	0.187	0.084	0.45	3	0.298	0.271
FLT08: Norw.Comb.Sur	3673	0.152	0.038	0.25	4	0.348	0.243
F shrinkage mean	3651	0.5				0.065	0.245

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3622	0.1	0.06	12	0.612	0.246

Age 10 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. Exp. CP	2139	0.166	0.132	0.79	5	0.255	0.245
FLT07: Russ.Surv. ne	1956	0.176	0.151	0.86	4	0.345	0.265
FLT08: Norw.Comb.Sur	2308	0.147	0.082	0.56	5	0.332	0.229
F shrinkage mean	1633	0.5				0.067	0.311

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2089	0.09	0.07	15	0.688	0.251

Table 8.10 (Continued)

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

Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	1478	0.16	0.146	0.91	6	0.263	0.248
FLT07: Russ.Surv. ne	1599	0.181	0.111	0.61	5	0.306	0.232
FLT08: Norw.Comb.Sur	1599	0.139	0.061	0.44	6	0.36	0.232
F shrinkage mean	1107	0.5				0.072	0.319

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1526	0.09	0.06	18	0.638	0.241

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

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	656	0.162	0.094	0.58	7	0.251	0.516
FLT07: Russ.Surv. ne	849	0.184	0.139	0.76	6	0.3	0.42
FLT08: Norw.Comb.Sur	710	0.14	0.101	0.72	7	0.343	0.485
F shrinkage mean	769	0.5				0.107	0.455

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
741	0.1	0.06	21	0.61	0.469

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	611	0.165	0.094	0.57	8	0.249	0.452
FLT07: Russ.Surv. ne	507	0.193	0.143	0.74	7	0.267	0.523
FLT08: Norw.Comb.Sur	473	0.141	0.093	0.66	8	0.354	0.553
F shrinkage mean	691	0.5				0.13	0.409

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
539	0.11	0.06	24	0.595	0.499

Table 8.10 (Continued)

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Exp. CP	250	0.181	0.083	0.46	9	0.236	0.48
FLT07: Russ.Surv. ne	239	0.208	0.119	0.57	8	0.251	0.498
FLT08: Norw.Comb.Sur	219	0.151	0.084	0.55	9	0.31	0.533
F shrinkage mean	377	0.5				0.204	0.343

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
258	0.13	0.06	27	0.484	0.469

Table 8.11

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 10:00

Terminal Fs derived using XSA with final year & oldest age shrinkage.

Table 8 Fishing mortality (F) at age

YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
AGE											
5	0.0094	0.0053	0.0032	0.0024	0.0019	0.0207	0.0139	0.0027	0.0363	0.0074	0.0378
6	0.0484	0.0255	0.0138	0.0072	0.0051	0.0484	0.0659	0.1491	0.151	0.0442	0.1079
7	0.1146	0.0699	0.0397	0.018	0.0116	0.0691	0.2864	0.4473	0.511	0.237	0.3447
8	0.2531	0.216	0.1411	0.0891	0.0694	0.2081	0.6556	0.6021	0.4033	0.3335	0.3623
9	0.4566	0.2848	0.3476	0.2356	0.2381	0.2332	0.5603	0.4392	0.2444	0.2597	0.2744
10	0.7003	0.7254	0.2583	0.3382	0.3302	0.435	0.5339	0.4738	0.1999	0.2516	0.3041
11	0.6375	0.7606	0.5421	0.2684	0.5684	0.4571	0.4457	0.4037	0.2511	0.2585	0.3297
12	0.5666	0.8214	0.8585	0.8373	0.1802	0.3905	0.4362	0.5627	0.3063	0.3191	0.3546
13	0.4065	0.391	0.4515	1.0092	0.2945	0.0686	0.5465	0.7562	0.4414	0.2765	0.3347
14	0.5568	0.6004	0.4943	0.5409	0.3237	0.3182	0.5074	0.5302	0.2898	0.2741	0.3208
+gp	0.5568	0.6004	0.4943	0.5409	0.3237	0.3182	0.5074	0.5302	0.2898	0.2741	0.3208
0 FBAR 6-10	0.3146	0.2643	0.1601	0.1376	0.1309	0.1988	0.4204	0.4223	0.3019	0.2252	0.2787

Table 8 Fishing mortality (F) at age

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE											
5	0.041	0.0413	0.0973	0.1046	0.1293	0.0433	0.1214	0.0771	0.0916	0.0569	0.0682
6	0.1211	0.1895	0.2135	0.2346	0.2395	0.0859	0.1447	0.1257	0.1429	0.3106	0.2405
7	0.4197	0.4666	0.4176	0.4305	0.2658	0.1815	0.1933	0.1283	0.2142	0.3867	0.3468
8	0.3818	0.6251	0.3557	0.4141	0.2074	0.1911	0.1387	0.1695	0.3355	0.3434	0.2923
9	0.3558	0.5001	0.3927	0.3521	0.1333	0.2292	0.0924	0.3239	0.3078	0.2427	0.2728
10	0.4017	0.3509	0.3249	0.398	0.1094	0.1723	0.1532	0.346	0.455	0.4072	0.3726
11	0.5023	0.3824	0.4847	0.4738	0.1957	0.2423	0.2518	0.446	0.3177	0.3978	0.3581
12	0.5617	0.6829	0.7081	0.3551	0.2023	0.2657	0.2704	0.4254	0.4785	0.2322	0.4189
13	0.5355	0.5074	0.818	0.6672	0.1238	0.3004	0.6805	0.3675	0.3611	0.2875	0.1553
14	0.474	0.4874	0.5489	0.4516	0.1533	0.2428	0.2908	0.3836	0.3859	0.3148	0.3168
+gp	0.474	0.4874	0.5489	0.4516	0.1533	0.2428	0.2908	0.3836	0.3859	0.3148	0.3168
0 FBAR 6-10	0.336	0.4264	0.3409	0.3659	0.1911	0.172	0.1445	0.2187	0.2911	0.3381	0.305

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Table 8.11 (Continued)

Terminal Fs derived using XSA with final year & oldest age shrinkage.

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
5	0.095	0.0696	0.0434	0.1143	0.1726	0.3302	0.1188	0.0993	0.0377	0.0522	0.0622
6	0.254	0.2306	0.1928	0.292	0.4294	0.5074	0.1792	0.1569	0.0783	0.0727	0.1665
7	0.354	0.4461	0.3833	0.4394	0.5288	0.8421	0.2371	0.3664	0.2575	0.2612	0.4085
8	0.3395	0.3823	0.4834	0.3373	0.4138	0.5289	0.292	0.3933	0.3027	0.3145	0.3393
9	0.3389	0.2623	0.4561	0.3229	0.4208	0.3824	0.1322	0.0735	0.1687	0.2277	0.1206
10	0.468	0.4217	0.5082	0.1992	0.3228	1.0194	0.3783	0.589	0.5219	0.6931	0.6547
11	0.3121	0.29	0.437	0.2282	0.2391	1.16	0.3586	0.503	0.5062	0.8477	0.5657
12	0.4364	0.1769	0.4124	0.1825	0.5278	1.6092	0.6794	0.4843	0.8312	1.1482	0.5868
13	0.7399	0.3181	0.1603	0.258	0.0807	0.6075	0.7883	0.3164	0.5841	1.2129	0.2175
14	0.4615	0.295	0.3967	0.239	0.3196	0.9635	0.6701	0.4351	0.6318	0.8832	0.498
+gp	0.4615	0.295	0.3967	0.239	0.3196	0.9635	0.6701	0.4351	0.6318	0.8832	0.498
0 FBAR 6-10	0.3509	0.3486	0.4048	0.3182	0.4231	0.6561	0.2438	0.3158	0.2658	0.3139	0.3379

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
AGE											
5	0.0175	0.0211	0.0315	0.0263	0.032	0.017	0.0265	0.0159	0.0171	0.0173	0.0168
6	0.0687	0.072	0.1406	0.0653	0.1164	0.0823	0.0764	0.0831	0.0713	0.076	0.0768
7	0.2035	0.2502	0.3673	0.1953	0.2868	0.1709	0.2202	0.2338	0.2163	0.2238	0.2246
8	0.1592	0.2366	0.2776	0.2118	0.1892	0.177	0.1465	0.2459	0.2657	0.3232	0.2783
9	0.1194	0.1176	0.2152	0.1656	0.1596	0.1224	0.1562	0.2416	0.2457	0.2462	0.2445
10	0.6299	0.5077	0.7421	0.5148	0.3872	0.3284	0.2884	0.2769	0.3418	0.2505	0.2897
11	0.4762	0.3481	0.3799	0.3663	0.3682	0.3165	0.2409	0.2889	0.3474	0.2414	0.2926
12	0.6754	0.4688	0.661	0.6279	0.5419	0.3566	0.273	0.4613	0.4441	0.4692	0.4582
13	0.1352	0.1189	0.4807	0.2549	0.4366	0.3517	0.1362	0.2657	0.5478	0.4987	0.4374
14	0.5094	0.3161	0.5288	0.5042	0.4649	0.395	0.5057	0.4174	0.5685	0.4687	0.4849
+gp	0.5094	0.3161	0.5288	0.5042	0.4649	0.395	0.5057	0.4174	0.5685	0.4687	
0 FBAR 6-10	0.2362	0.2368	0.3486	0.2305	0.2278	0.1762	0.1775	0.2163	0.2281	0.2239	

Table 8.12

Run title : Arctic Green.halibut (run: 2006/1)

At 26/04/2006 16:47

	Table 10	Stock number at age (start of year)			Numbers*10**-3							
	YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
	AGE											
5		42840	51686	57828	70443	64280	55932	41112	31550	33556	31062	26643
6		33792	36528	44251	49616	60486	55221	47154	34898	27081	27853	26538
7		27961	27712	30648	37565	42397	51798	45284	37995	25875	20043	22937
8		27353	21461	22243	25353	31755	36072	41607	29268	20909	13360	13611
9		14559	18279	14883	16626	19961	25498	25214	18591	13796	12024	8238
10		8521	7938	11833	9049	11307	13541	17381	12393	10314	9300	7983
11		4237	3641	3307	7867	5554	6995	7544	8771	6641	7269	6224
12		2537	1928	1465	1656	5177	2707	3812	4158	5042	4447	4831
13		1175	1239	730	534	617	3721	1577	2121	2039	3195	2782
14		634	673	721	400	168	395	2990	786	857	1128	2085
	+gp	190	118	77	49	27	118	756	372	341	564	844
0	TOTAL	163799	171203	187988	219157	241727	251999	234430	180903	146451	130243	122716
	Table 10	Stock number at age (start of year)			Numbers*10**-3							
	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	AGE											
5		22541	22099	23690	20593	19704	18609	17881	18938	19011	17821	19932
6		22081	18622	18251	18501	15965	14902	15339	13631	15090	14931	14490
7		20505	16837	13261	12689	12594	10814	11770	11424	10346	11259	9421
8		13986	11600	9089	7518	7101	8310	7763	8350	8649	7188	6583
9		8155	8218	5343	5481	4276	4967	5908	5816	6067	5322	4389
10		5389	4917	4290	3105	3318	3221	3399	4636	3621	3838	3594
11		5069	3104	2980	2668	1795	2559	2334	2510	2823	1977	2199
12		3852	2640	1823	1580	1430	1271	1729	1562	1383	1769	1143
13		2917	1891	1148	773	953	1005	838	1136	878	738	1207
14		1713	1470	980	436	341	725	641	365	677	527	476
	+gp	1044	993	456	330	386	388	264	155	214	282	249
0	TOTAL	107251	92390	81310	73673	67863	66772	67866	68523	68759	65652	63681
	Table 10	Stock number at age (start of year)			Numbers*10**-3							
	YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
5		19877	19443	23000	20763	14543	12694	10569	12995	18388	17916	18479
6		16025	15557	15611	18955	15941	10533	7853	8078	10127	15241	14636
7		9805	10698	10633	11080	12183	8931	5458	5650	5944	8059	12198
8		5732	5924	5894	6238	6145	6180	3311	3706	3372	3954	5342
9		4230	3514	3479	3129	3832	3497	3134	2128	2153	2144	2485
10		2876	2594	2327	1897	1950	2165	2053	2364	1702	1565	1470
11		2131	1550	1464	1205	1338	1215	672	1211	1129	869	674
12		1323	1343	998	814	825	907	328	404	630	586	321
13		647	736	968	569	584	419	156	143	214	236	160
14		889	266	461	710	378	464	196	61	90	103	60
	+gp	692	29	154	141	173	890	122	12	7	15	3
0	TOTAL	64227	61654	64988	65500	57893	47894	33854	36753	43754	50689	55826

Table 8.12 (Continued)

	Table 10	Stock number at age (start of year)				Numbers*10**-3								
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 64-**	AMST 64-**
	AGE													
5		20472	18571	15032	15758	15079	17747	16375	19834	27211	39270	0	22863	25739
6		14945	17314	15651	12537	13210	12570	15018	13726	16802	23023	33221	18881	21677
7		10665	12009	13867	11703	10108	10120	9964	11975	10872	13467	18366	14373	17127
8		6978	7489	8049	8266	8286	6531	7342	6881	8158	7537	9267	9496	12067
9		3275	5122	5087	5248	5757	5903	4710	5459	4632	5383	4696	6187	7949
10		1896	2502	3920	3531	3828	4224	4495	3467	3690	3118	3622	4158	5212
11		657	869	1296	1606	1816	2237	2618	2900	2263	2257	2089	2372	3062
12		329	351	528	763	958	1082	1403	1771	1869	1376	1526	1352	1795
13		153	144	189	235	350	480	652	919	961	1032	741	694	1004
14		111	115	110	101	157	195	291	490	606	478	539	393	596
	+gp	3	59	18	38	35	138	70	330	809	492	523		
0	TOTAL	59484	64545	63747	59785	59585	61226	62938	67751	77873	97433	74591		

Table 8.13

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 10:00

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

	YEAR	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
	AGE											
5		17993	21708	24288	29586	26998	23491	23311	17889	19026	17612	15106
6		21627	23378	28321	32250	39921	35341	34752	25720	19959	20528	19559
7		25165	24941	27890	34936	40701	47136	48861	40997	27919	21626	24749
8		32824	26182	27581	32199	41599	45090	59124	41590	29712	18984	19342
9		23731	30343	25301	28430	34732	41817	46595	34356	25495	22221	15223
10		19258	17701	26270	19908	24762	30467	39647	28267	23526	21213	18208
11		13178	10923	9724	22342	15494	20915	21779	25322	19172	20985	17969
12		9488	6728	4965	5463	16515	9828	12376	13501	16370	14438	15687
13		5368	5452	3196	2281	2634	17415	6786	9127	8772	13746	11970
14		3175	3306	3491	1952	838	2128	14746	3875	4226	5565	10283
	+gp	1131	697	452	282	163	707	4378	2171	2060	3388	5034
0	TOTALBIO	172936	171359	181480	209628	244355	274335	312354	242815	196239	180305	173130

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

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	AGE											
5		12781	12530	13432	11676	17734	13064	11801	13067	14258	11227	11959
6		16274	13724	13451	13635	19158	12994	12885	11450	15694	14334	12896
7		22125	18167	14309	13691	18891	12339	13536	11766	13864	13285	11305
8		19874	16483	12915	10683	12782	12199	12110	10939	13578	10997	12178
9		15070	15186	9875	10129	9408	8831	12053	10120	11951	12294	11367
10		12292	11217	9785	7083	8626	7416	8736	10385	9885	11016	11428
11		14634	8961	8603	7702	5386	6818	6955	6953	9289	6841	7959
12		12509	8572	5918	5129	5004	3870	5930	5263	5837	6667	4516
13		12552	8136	4940	3325	3908	3386	3463	4905	4137	2944	5406
14		8448	7247	4831	2150	1638	3106	2998	1955	4115	2292	2024
	+gp	6168	5883	2747	1949	2382	2076	1581	903	1312	1276	1201
0	TOTALBIO	152726	126107	100805	87153	104916	86099	92049	87707	103919	93175	92239

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

	YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
5		12324	13785	17020	15780	10326	9774	7187	10266	13239	13079	14228
6		14743	15604	15017	19523	16897	11060	7617	8240	9519	14327	14197
7		12551	13544	13281	14625	15717	12324	6932	7628	7548	10074	15979
8		10892	9969	9584	11228	10447	10815	5828	6967	5799	6880	9295
9		10489	8721	7528	7572	8047	7693	6926	5236	4714	4481	5566
10		8943	7735	6740	5939	5089	5630	5257	6311	4289	3928	3806
11		7139	5498	4988	4060	3840	3391	2091	4153	3353	2564	2216
12		4921	5102	3655	3298	2847	2974	1177	1735	2073	1956	1288
13		2589	3356	4112	2440	2172	1630	598	727	823	905	760
14		3717	1330	1929	3195	1547	2031	835	386	444	512	377
	+gp	3133	175	686	668	780	4706	588	108	46	118	17
0	TOTALBIO	91441	84819	84540	88327	77709	72027	45036	51756	51848	58826	67730

Table 8.13 (Continued)

	Table 12	Stock biomass at age (start of year)			Tonnes						
	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
5		15763	13557	10522	11976	11159	12245	11708	15272	18204	25015
6		14049	16102	14868	12160	13607	11816	15769	15030	15995	19800
7		13651	15612	17611	15566	14051	13764	14229	17938	14198	15474
8		11444	12057	12475	13474	14501	10973	12834	13095	13486	11532
9		6779	10858	10175	11074	13183	12868	10917	13445	9870	11424
10		4910	6429	9642	9215	10259	11320	11755	9622	9387	8175
11		2169	2825	4173	5381	6048	7136	7966	9070	6444	6090
12		1320	1374	2033	3028	3757	4208	5183	6744	6233	4561
13		741	707	872	1167	1685	2140	2976	3944	3588	4126
14		659	653	644	586	910	1023	1618	2670	2659	2219
	+gp	17	292	109	273	256	872	446	2095	4684	3319
0	TOTALBIO	71502	80464	83125	83900	89415	88365	95402	108925	104748	111734

Table 8.14

Run title : Arctic Green.halibut (run: 2007/1)

At 21/04/2007 10:00

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

YEAR		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
	AGE											
5		0	0	0	0	0	0	0	0	0	0	0
6		649	701	850	968	1198	1060	1043	772	599	616	587
7		755	748	837	1048	1221	1414	1466	1230	838	649	742
8		6893	5498	5792	6762	8736	9469	12416	8734	6240	3987	4062
9		15900	20330	16952	19048	23270	28018	31218	23018	17082	14888	10200
10		16562	15223	22592	17121	21295	26201	34096	24310	20233	18243	15659
11		12914	10704	9529	21895	15184	20496	21343	24816	18789	20565	17610
12		9298	6594	4866	5354	16185	9631	12129	13231	16043	14150	15373
13		5368	5452	3196	2281	2634	17415	6786	9127	8772	13746	11970
14		3175	3306	3491	1952	838	2128	14746	3875	4226	5565	10283
	+gp	1131	697	452	282	163	707	4378	2171	2060	3388	5034
0	TOTSPBIO	72644	69254	68557	76709	90723	116540	139620	111283	94880	95796	91520

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

YEAR		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	AGE											
5		0	0	0	0	0	0	0	0	0	0	0
6		488	412	404	409	575	390	387	343	471	573	516
7		664	545	429	411	567	370	406	353	416	399	452
8		4174	3461	2712	2243	2684	2562	2543	2297	2444	1980	2314
9		10097	10175	6616	6786	6303	5917	8075	6780	7171	7500	7388
10		10571	9646	8415	6092	7418	6378	7513	8931	8106	9143	9714
11		14342	8781	8431	7548	5278	6682	6816	6814	8917	6636	7720
12		12258	8401	5799	5027	4904	3793	5811	5157	5720	6534	4471
13		12552	8136	4940	3325	3908	3386	3463	4905	4137	2944	5406
14		8448	7247	4831	2150	1638	3106	2998	1955	4115	2292	2024
	+gp	6168	5883	2747	1949	2382	2076	1581	903	1312	1276	1201
0	TOTSPBIO	79762	62688	45324	35940	35657	34659	39594	38440	42808	39276	41207

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

YEAR		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	AGE											
5		0	0	0	0	0	0	0	103	132	131	0
6		442	156	150	195	169	111	76	82	95	143	0
7		377	271	133	293	314	493	416	610	528	806	1119
8		2614	2193	2013	2021	1776	1622	1632	2230	1972	1995	2324
9		7762	5756	3990	3710	4104	4154	4571	3560	3253	2599	3228
10		8138	6962	5864	4751	3919	4335	4521	5238	3474	3104	3349
11		7068	5223	4439	3613	3495	3018	1819	3654	3185	2462	2150
12		4822	5000	3582	3298	2847	2974	1177	1631	1949	1741	1211
13		2589	3356	4112	2440	2172	1630	598	727	823	905	760
14		3717	1330	1929	3195	1547	2031	835	386	444	512	377
	+gp	3133	175	686	668	780	4706	588	108	46	118	17
0	TOTSPBIO	40663	30421	26897	24183	21123	25074	16233	18329	15902	14516	14534

Table 8.14 (Continued)

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

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	AGE										
5		0	0	0	0	112	122	117	0	0	0
6		0	0	0	122	408	354	315	150	160	198
7		956	624	352	467	843	1376	1565	718	710	774
8		2403	1206	873	1347	2755	3402	4364	2881	2967	2422
9		3593	4886	3358	4097	6460	8493	7860	8739	5626	5826
10		4173	5272	6364	5806	6668	8943	10344	8563	8261	7113
11		2039	2599	3588	4681	5080	6494	7328	8707	5864	5420
12		1241	1374	2013	2907	3607	4040	5028	6542	5921	4333
13		741	707	872	1167	1685	2119	2917	3905	3552	4126
14		659	653	644	586	910	1023	1585	2616	2606	2219
	+gp	17	292	109	273	256	872	446	2095	4684	3319
0											
TOTSPBIO		15822	17612	18174	21453	28784	37238	41870	44916	40350	35749
1											

Table 8.15

At 21/04/2007 10:00

Table 16 Summary (without SOP correction)

	RECRUITS Age 5	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 6-10
1964	42840	172936	72644	40391	0.556	0.3146
1965	51686	171359	69254	34751	0.5018	0.2643
1966	57828	181480	68557	26321	0.3839	0.1601
1967	70443	209628	76709	24267	0.3163	0.1376
1968	64280	244355	90723	26168	0.2884	0.1309
1969	55932	274335	116540	43789	0.3757	0.1988
1970	41112	312354	139620	89484	0.6409	0.4204
1971	31550	242815	111283	79034	0.7102	0.4223
1972	33556	196239	94880	43055	0.4538	0.3019
1973	31062	180305	95796	29938	0.3125	0.2252
1974	26643	173130	91520	37763	0.4126	0.2787
1975	22541	152726	79762	38172	0.4786	0.336
1976	22099	126107	62688	36074	0.5755	0.4264
1977	23690	100805	45324	28827	0.636	0.3409
1978	20593	87153	35940	24617	0.6849	0.3659
1979	19704	104916	35657	17312	0.4855	0.1911
1980	18609	86099	34659	13284	0.3833	0.172
1981	17881	92049	39594	15018	0.3793	0.1445
1982	18938	87707	38440	16789	0.4368	0.2187
1983	19011	103919	42808	22147	0.5174	0.2911
1984	17821	93175	39276	21883	0.5572	0.3381
1985	19932	92239	41207	19945	0.484	0.305
1986	19877	91441	40663	22875	0.5626	0.3509
1987	19443	84819	30421	19112	0.6283	0.3486
1988	23000	84540	26897	19587	0.7282	0.4048
1989	20763	88327	24183	20138	0.8327	0.3182
1990	14543	77709	21123	23183	1.0975	0.4231
1991	12694	72027	25074	33320	1.3289	0.6561
1992	10569	45036	16233	8602	0.5299	0.2438
1993	12995	51756	18329	11933	0.651	0.3158
1994	18388	51848	15902	9226	0.5802	0.2658
1995	17916	58826	14516	11734	0.8083	0.3139
1996	18479	67730	14534	14347	0.9871	0.3379
1997	20472	71502	15822	9410	0.5948	0.2362
1998	18571	80464	17612	11893	0.6753	0.2368
1999	15032	83125	18174	19517	1.0739	0.3486
2000	15758	83900	21453	14437	0.673	0.2305
2001	15079	89415	28784	16307	0.5665	0.2278
2002	17747	88365	37238	13161	0.3534	0.1762
2003	16375	95402	41870	13578	0.3243	0.1775
2004	19834	108925	44916	18800	0.4186	0.2163
2005	27211	104748	40350	18834	0.4668	0.2281
2006	39270	111734	35749	17910	0.501	0.2239
Arith. Mean	26088	120406	48203	25045	0.5803	0.2852
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

1

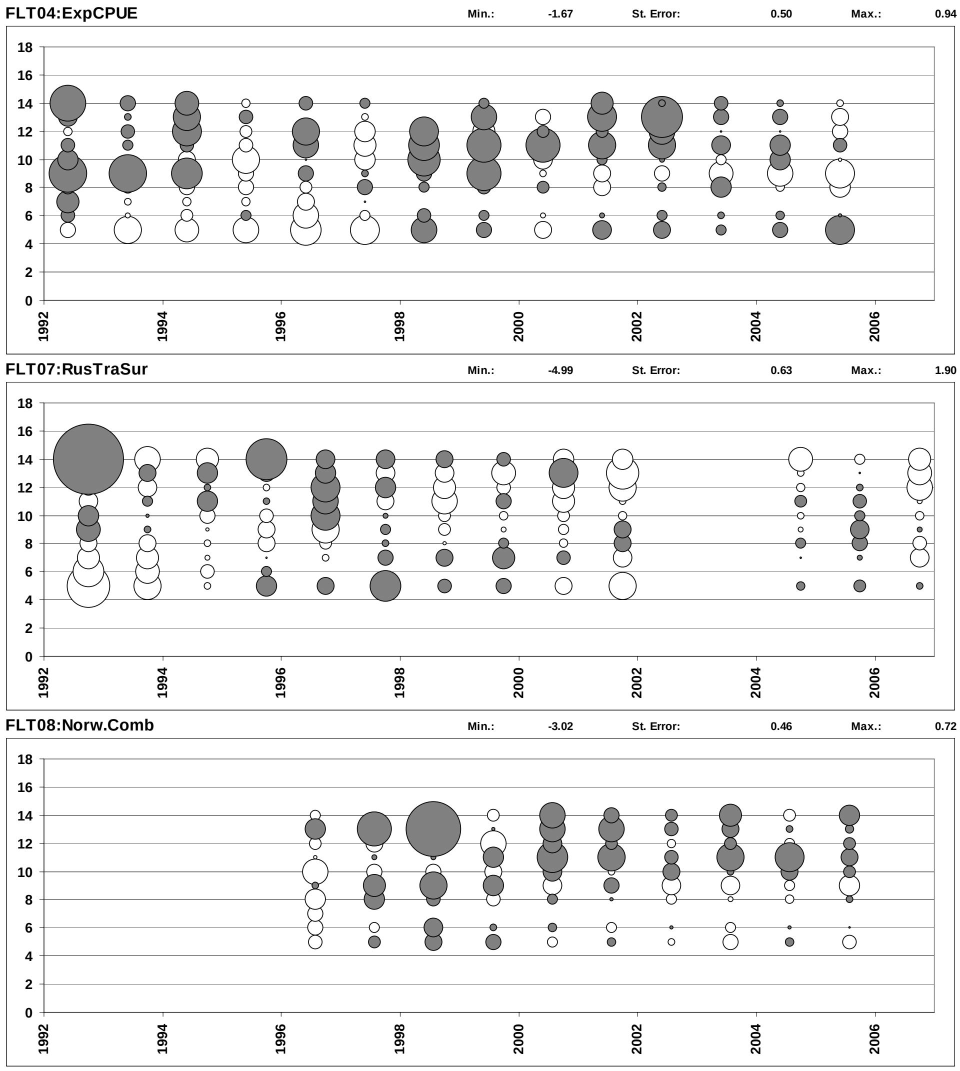

Figure 8.1. NEA Greenland halibut. Log catchability residuals by age and year for the tuning fleets included in the assessments. For each graph all bubbles are normalized to the same maximum bubble-size. Open bubbles represent positive values; filled bubbles represent negative values.

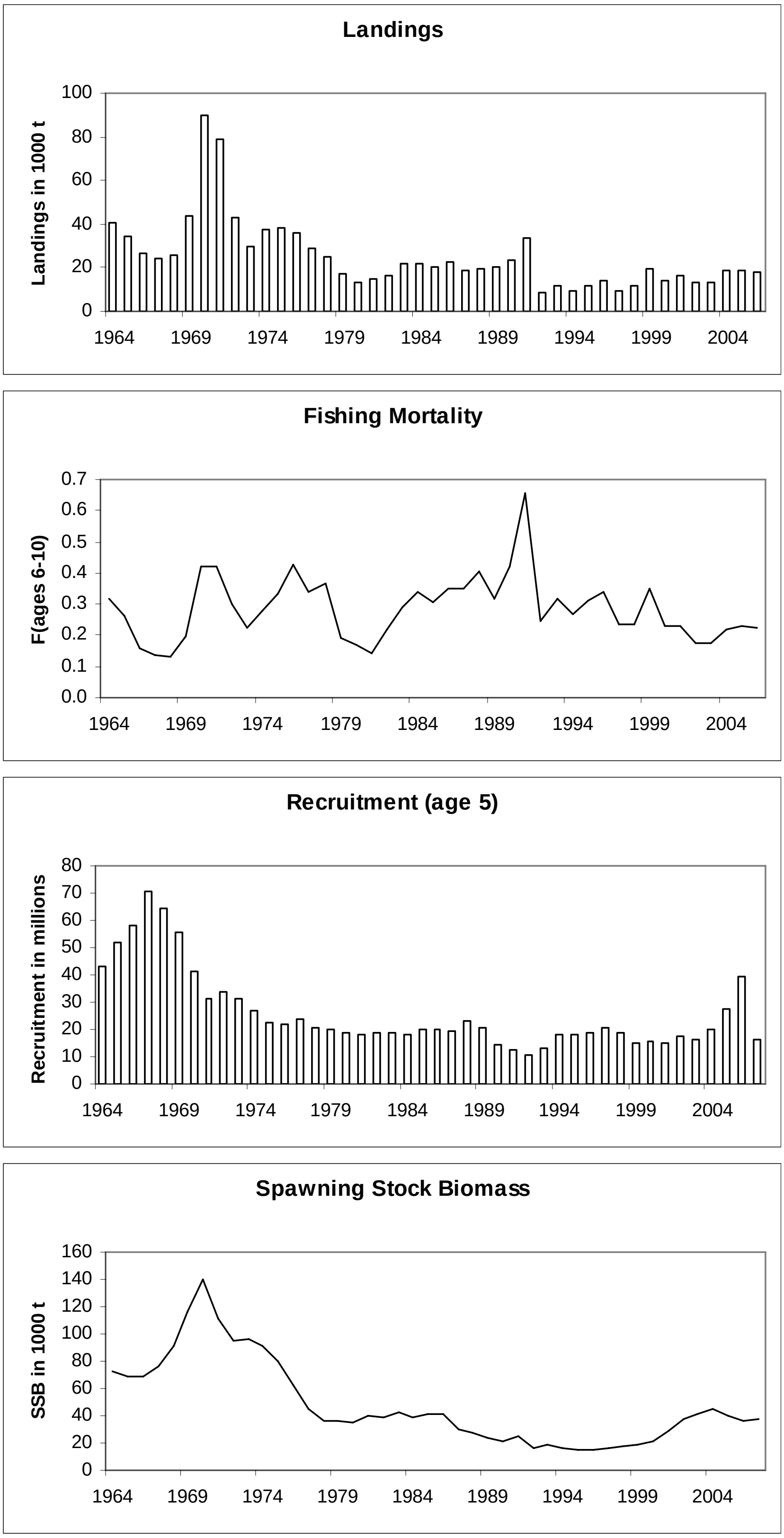

Figure 8.2. NEA Greenland halibut. Historical landings, recruitment, fishing mortality and spawning stock biomass.

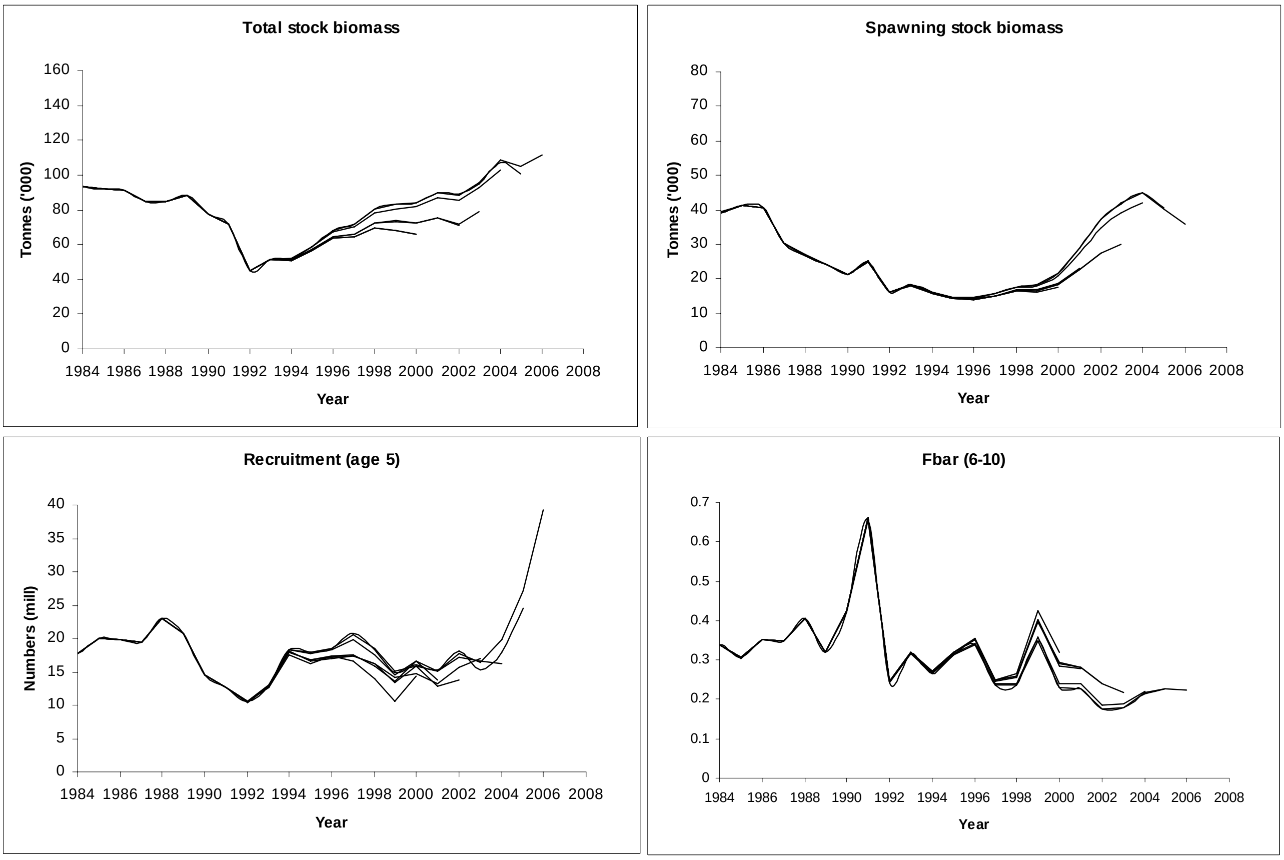

Figure 8.3. NEA Greenland halibut. Retrospective plots.

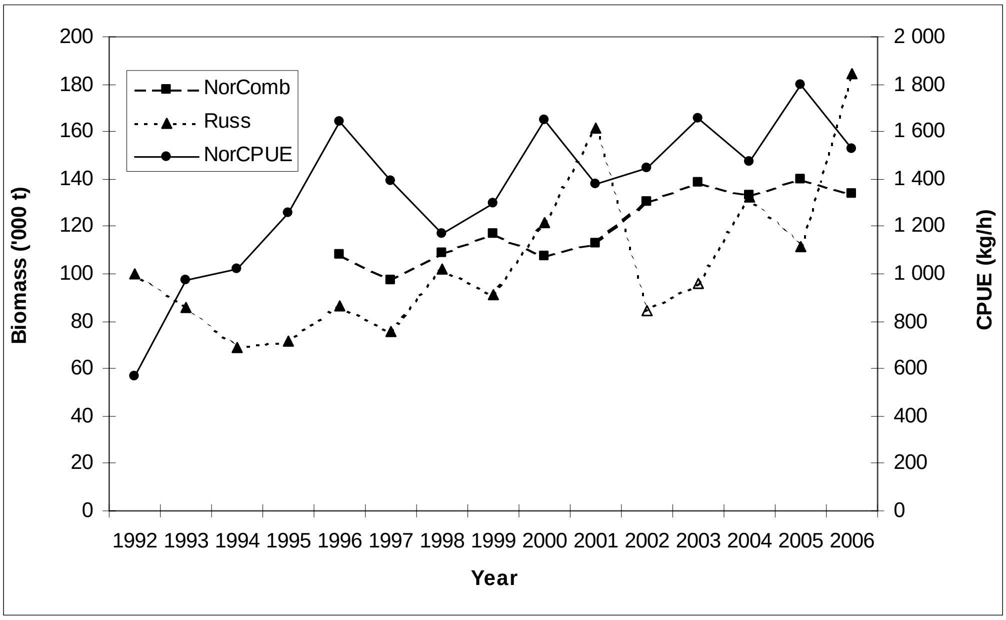

Figure 8.4. NEA Greenland halibut. Biomass estimates from the tuning series used in the assessment. Years with open symbols in the Russian series excluded from the tuning.

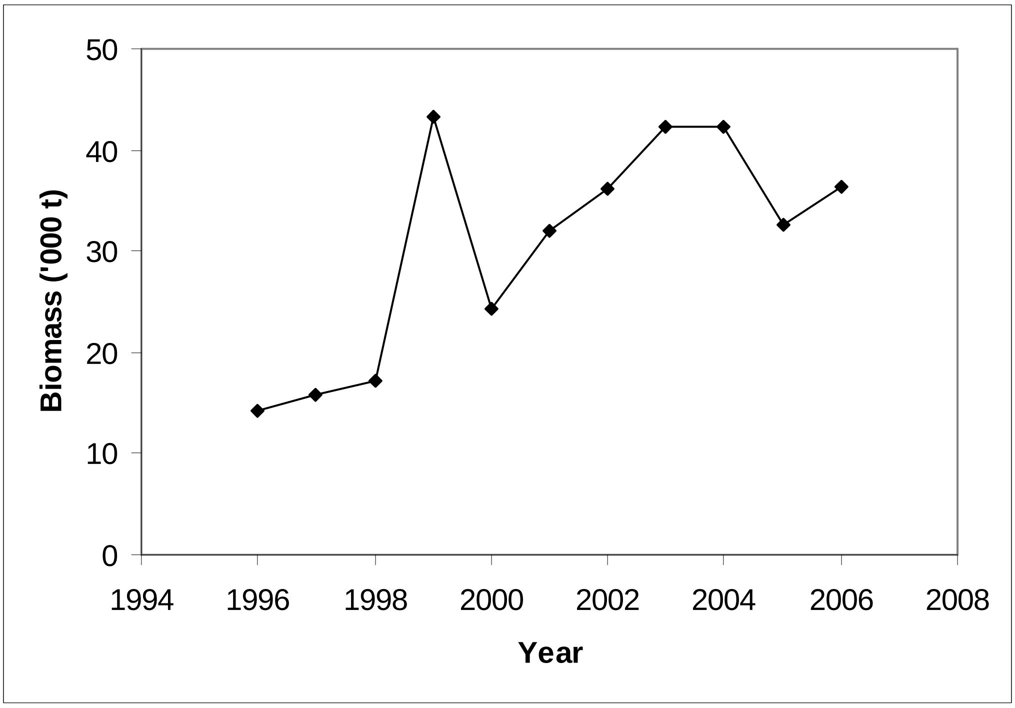

Figure 8.5. NEA Greenland halibut. Swept area estimate of the mature female biomass based on the data from the Norwegian Greenland halibut survey along the continental slope.

Table E1. GREENLAND HALIBUT in Sub-area I and II. Norwegian bottom trawl survey indices (numbers in thousands) in the Svalbard area (Division IIb).

Year	Fish<20 cm[2]	Age									Total
		1	2	3	4	5	6	7	8	9+	
1981	2.1										20 100
1982	0.7					No age data					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
2001 [1]	4.3	4 258	1 235	873	1 506	2 456	1 718	1 504	558	1 079	15 187
2002 [1]	2.3	1 435	2 019	1 176	2 437	3 413	2 685	3 304	847	2 229	19 545
2003 [1]	0.8	410	638	901	2 937	2 630	3 146	2 602	452	684	14 400

[1]New standard trawl equipment (rockhopper gear and 40 meter sweep length).

[2]In millions.

Not updated, new ecosystem survey

Table E2. GREENLAND HALIBUT in Sub-area I and II. Abundance indices from bottom trawl surveys in the Barents Sea and Svalbard area in August (in thousands).

A: The Barents Sea area; **B**: The expanded Svalbard area.

A Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1995	42	-	-	596	989	1 239	1 673	1 020	-	195	-	-	-	5 754
1996	12 028	900	-	-	-	415	829	861	85	261	118	82	-	15 579
1997[1]	143	1 162	53	331	589	1 579	2 736	1 120	550	44	-	-	-	8 307
1998[1]	46	446	328	416	481	323	1 828	924	432	234	-	-	-	5 458
1999	11 637	5 910	384	280	201	1 508	1 729	215	134	661	255	218	-	23 132
2000	-	619	302	417	816	620	1 163	844	605	270	54	221	-	5 931
2001	-	-	259	203	743	1 120	293	697	-	215	107	-	-	3 637
2002	-	-	-	85	773	2 509	3 047	165	290	839	-	255	-	7 963
2003	-	-	-	420	450	1 630	1 070	840	250	410	-	-	-	5 070

B Year	Age 1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1995	77	-	-	429	1 255	1 720	2 535	665	135	281	136	95	-	7 328
1996	1 760	360	105	291	1 144	2 717	3 525	1 290	309	603	30	92	45	12 271
1997	593	2 357	311	116	593	3 053	3 019	478	312	20	-	-	-	10 852
1998	2 295	2 836	2 918	540	770	2 477	3 248	1 472	340	346	130	-	65	17 437
1999	387	263	1 516	3 095	809	836	2 773	486	333	360	-	87	140	11 085
2000	1 976	818	1 280	2 836	3 946	3 216	2 112	1 560	460	199	-	95	-	18 498
2001	4 659	1 690	1 789	2 517	3 536	2 474	1 889	690	383	773	134	27	50	20 611
2002	2 174	2 475	1 718	2 962	4 291	3 620	4 205	1 031	293	1 267	453	304	212	25 005
2003	1 390	600	1 170	3 510	3 350	4 310	3 470	640	520	150	90	140	-	19 340

[1] Only Norwegian and international zones covered. Adjusted (according to the mean distribution in the period 1991-1999) to include the Russian EEZ.

Not updated, new ecosystem survey

Table E3. 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 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
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
2001	0	10	95	986	6 107	15 068	22 584	10 086	3 130	5 442	1 146	1 147	267	180	67	66 315
2002	0	3	427	2 492	7 730	10 913	21 660	9 847	6 327	4 248	2 468	1 642	619	208	183	68 767
2003	6	18	662	3 972	10 293	14 552	20 438	9 191	4 507	6 388	1 902	1 795	861	253	125	74 963
2004	0	5	328	3 637	6 962	12 909	20 674	8 692	3 771	3 908	1 663	2 886	1 276	865	641	68 217
2005	3	24	2 036	9 170	10 195	13 477	8 785	7 683	4 611	4 388	2 500	2 250	995	401	693	67 210

Not updated from 2006 due to new age reading method

Table E4. 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	Age						Total
Year	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
2001	26 206	15 765	4 515	1 767	802	465	49 520
2002	40 186	34 065	15 441	3 862	1 320	556	95 430
2003	49 146	37 344	6 336	3 188	1 035	327	97 376
2004 [1]	15 257	28 540	48 286	12 598	3 562	1 153	109 396
2005 [1]	138 248	23 689	25 989	32 052	6 735	893	227 606

B	Age						Total
Year	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				
2001	38 112	40 377	7 960	4 300	1 215	510	92 475
2002	96 231	58 113	31 500	5 665	1 576	556	193 641
2003			No coverage in Russian EEZ				
2004 [1]	23 560	47 023	77 374	14 081	3 719	1 232	166 989
2005 [1]	253 127	40 975	40 231	40 858	6 955	893	383 039

[1] **From 2004 part of the new joint ecosystem survey.**

Not updated from 2006 due to new age reading method

Table E5. GREENLAND HALIBUT in Sub-area I and II. Abundance indices from three Norwegian bottom trawl surveys in the Barents Sea in August - September (from 2004 two of them are part of the joint ecosystem survey covering the whole Barents Sea) combined to one index (in thousands).

A: Old strata system used B: Ecosystem survey combined with Norw. GrHal survey

A	Age															Total
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	
1996	17 926	14 906	10 134	4 486	16 194	22 217	30 014	10 163	1 857	3 954	957	523	175	100	2	133 608
1997	4 050	18 107	14 547	4 481	12 917	20 753	22 984	6 362	1 563	3 312	936	600	87	165	16	110 880
1998	10 704	21 705	12 521	7 603	9 915	14 680	27 784	7 800	1 937	4 586	1 353	1 027	13	241	14	121 883
1999	5 895	9 451	5 200	7 116	8 412	17 437	24 175	12 857	2 407	6 595	1 294	1 387	273	183	144	102 826
2000	11 474	17 755	9 870	11 359	13 093	14 139	20 608	9 704	5 707	3 548	901	695	204	75	16	119 148
2001	30 631	17 452	6 521	5 115	10 077	17 548	24 465	10 973	3 440	6 280	1 302	1 147	267	180	67	135 464
2002	42 348	36 537	17 472	9 105	13 649	15 040	27 076	10 130	6 679	5 104	2 909	1 893	619	257	183	188 999
2003	50 512	37 972	8 298	11 410	15 428	20 553	24 664	10 521	5 437	6 958	1 992	1 955	861	253	125	196 939
2004	17 233	29 072	50 471	17 112	13 233	16 459	24 970	9 753	4 568	4 170	1 963	3 042	1 460	865	726	195 096
2005	153 834	29 173	32 072	46 345	24 680	20 381	14 189	9 919	5 261	4 929	2 709	2 392	1 242	540	776	348 443

B	Age															Total
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	
2004	16 513	37 564	56 050	12 858	11 967	18 047	25 933	10 060	4 974	4 413	2 151	3 600	1 276	865	641	206 912
2005	182 754	40 350	40 139	40 760	25 334	21 739	15 320	10 504	5 594	5 131	2 967	2 494	1 249	686	758	395 780

Not updated from 2006 due to new age reading method

Table E6. 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
2001	1 592	6 884	17 365	37 881	27 661	14 163	6 576	3 988	1 875	1 713	929	217	180	121 024
2002[3]	2 145	7 127	10 771	44 220	33 675	18 747	5 947	5 477	1 216	1 877	1 973	60	120	133 355
2003	1 735	6 479	10 029	19 751	14 160	7 592	3 519	2 555	2 200	1 664	831	141	470	71 126
2004	3 305	8 342	9 461	21 834	22 876	14 187	8 331	3 776	2 544	1 745	1031	811	966	99 209
2005	2 096	7 668	11 657	17 933	20 555	14 140	4 658	3 264	1 844	1 585	789	554	420	87 164
2006	3 099	13 954	18 873	34 869	37 481	20 542	7 631	3 586	2 489	2 329	1 663	720	785	148 021

[1] Age composition based on combined age-length-keys for 1990 and 1992.

[2] Only half of standard area investigated.

[3] Adjusted assuming area distibution as in 2001.

Table E7. GREENLAND HALIBUT catch in weight, numbers, and biomass (in tonnes) and abundance (in thousands) estimated from Spanish survey 1997-2005.

Year	Catch (Kg)	Catch (numbers)	Biomass™	Abundance (‘000)
1997	195 056	211 533	344 014	379 444
1998	180 974	187 259	351 466	373 149
1999	198 781	172 687	436 956	377 792
2000	169 389	140 355	340 619	291 265
2001	152 681	129 289	283 511	249 219
2002	144 335	115 213	256 460	207 466
2003	151 952	132 117	283 644	256 327
2004	153 859	135 631	320 485	283 965
2005	144 573	134 566	317 320	313 459

No survey in 2006

Table E8. 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	Age													
Year	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
2002	-	-	32	609	1 019	1 148	989	362	139	591	106	54	54	5 103

B	Age													
Year	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
2002	233	104	248	1 373	2 748	3 265	3 641	932	449	1 714	365	177	178	15 427
2003	50	89	151	785	1 786	2 860	5 411	1 313	289	951	356	189	92	14 322
2004	67	118	128	527	1 294	1 099	3 207	1 220	624	504	201	281	266	9 536
2005	259	300	2 318	1 512	4 106	3 554	5 373	2 072	862	278	372	305	824	22 135
2006	45	46	1 119	5 518	6 912	5 640	1 353	603	562	321	365	61	115	22 660

[1]Adjusted (according to the 1996 distribution) to include the Russian EEZ which was not covered by the survey.

Not updated from 2007 due to new age reading method

'Table E9 GREENLAND HALIBUT in Sub-areas I and II. Results from a research program using trawlers in a limited commercial fishery 1992-2005. 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	2001	2002	2003	2004	2005
1														
2														
3	0.1			0.1		0.0	0.0	0.0					0.1	0.2
4	4.6	4.2	3.2	0.7	0.5	0.9	0.2	0.7	1.2	1.3	0.7	1.8	1.4	1.8
5	19.1	25.0	24.7	22.5	19.5	24.8	6.6	7.7	10.8	6.3	7.7	8.5	8.9	5.4
6	23.0	18.4	23.8	22.6	31.6	22.9	25.5	23.0	17.1	20.2	16.8	21.7	18.9	20.4
7	25.9	27.1	26.8	30.2	35.6	30.5	44.5	39.6	43.0	28.5	42.5	30.5	31.3	25.4
8	13.3	12.4	11.2	11.0	8.7	10.1	15.5	14.5	12.3	24.5	12.4	9.6	14.8	21.5
9	1.7	0.7	1.0	2.7	1.3	2.6	4.5	1.6	4.5	7.8	7.1	8.1	9.5	8.2
10	6.8	7.4	5.9	6.6	2.0	5.0	2.0	9.7	8.5	7.3	8.8	11.0	4.7	6.5
11	2.9	3.1	2.4	2.0	0.5	1.9	0.8	1.0	0.9	1.9	2.2	4.1	4.0	3.1
12	1.7	1.0	0.6	1.1	0.2	0.8	0.3	1.8	1.1	1.7	1.2	3.1	3.5	4.0
13	0.5	0.4	0.2	0.3	0.0	0.3		0.2	0.6	0.3	0.2	1.2	1.5	2.1
14	0.2	0.2	0.1	0.2	0.1	0.2		0.2	0.0	0.2	0.4	0.5	0.9	1.0
15	0.1					0.0		0.0	0.0	0.2	0.1	0.0	0.4	0.5

Mean individual weight (kg)														
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1														
2														
3	0.26			0.40		0.39							0.27	0.24
4	0.50	0.53	0.52	0.47	0.48	0.45	0.41	0.51	0.50	0.60	0.44	0.48	0.44	0.48
5	0.71	0.76	0.73	0.70	0.74	0.69	0.76	0.74	0.69	0.66	0.69	0.68	0.65	0.64
6	0.96	0.98	0.95	0.94	0.94	0.88	0.96	0.92	0.98	0.94	0.93	1.00	0.88	0.84
7	1.29	1.33	1.28	1.24	1.23	1.15	1.19	1.25	1.23	1.12	1.22	1.28	1.17	1.14
8	1.77	1.85	1.79	1.71	1.66	1.55	1.79	1.64	1.57	1.48	1.39	1.67	1.43	1.40
9	2.00	2.28	2.23	2.03	2.00	1.87	2.26	2.18	1.90	1.84	1.69	1.97	1.73	1.67
10	2.46	2.65	2.55	2.50	2.50	2.34	2.54	2.38	2.40	2.30	2.31	2.37	2.14	2.26
11	3.10	3.43	3.37	3.28	3.16	2.95	3.47	3.17	3.13	2.92	3.19	3.20	2.34	2.62
12	3.86	4.32	4.22	3.71	3.70	3.46	4.16	3.79	4.04	3.82	3.91	3.48	2.77	2.87
13	4.44	5.18	5.01	4.62		4.52		5.07	4.47	3.68	5.20	4.28	2.92	2.98
14	6.00	6.44	6.29	5.59		5.47		5.60	6.00	5.74	5.59	4.74	3.89	3.30
15	5.22								8.79	5.52	7.03	9.17	4.65	3.32

'Table E9 (Continued) GREENLAND HALIBUT in Sub-areas I and II. Results from a research program using trawlers in a limited commercial fishery 1992-2005. All areas combined. Spring and autumn combined in 1992-1993, otherwise only spring-data.

	CPUE (N) on age													
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1														
2														
3	0			1	0	0	0	0	0	0	0	0	1	2
4	19	30	26	7	7	11	2	7	14	12	7	19	15	24
5	80	176	198	219	286	298	59	72	132	63	81	90	96	70
6	97	130	191	220	463	275	229	214	208	201	176	229	203	263
7	109	191	215	294	521	366	400	369	524	284	447	322	337	328
8	56	87	90	107	127	121	139	135	150	244	130	101	159	278
9	7	5	8	26	19	31	40	15	55	78	75	86	102	106
10	29	52	47	64	29	60	18	90	104	73	92	116	51	84
11	12	22	19	19	7	23	7	9	11	18	23	43	43	40
12	7	7	5	11	3	10	3	17	13	17	12	32	38	52
13	2	3	2	3	0	4	0	2	7	3	2	12	16	27
14	1	1	1	2	1	2	0	2	0	2	4	5	10	13
15	0			0	0	0	0	0	0	2	1	0	4	6

	CPUE (kg) on age													
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1														
2														
3	0			0	0	0	0	0	0	0	0	0	0	1
4	10	16	13	3	4	5	1	3	7	7	3	9	6	11
5	57	134	145	153	211	207	45	53	91	41	56	61	63	44
6	93	127	182	207	435	243	220	197	204	189	164	229	179	220
7	140	254	276	364	641	423	476	461	645	318	543	411	396	373
8	99	162	161	183	211	189	249	221	236	361	181	169	228	389
9	14	11	18	53	38	59	91	32	105	143	127	169	177	176
10	70	138	121	161	73	141	46	215	250	167	213	275	109	189
11	38	75	65	64	23	68	25	30	33	54	74	138	101	104
12	28	30	20	40	11	33	11	64	53	66	48	113	105	150
13	9	15	8	13	0	16	0	9	32	11	9	52	48	79
14	5	9	5	11	0	13		10	2	10	24	23	38	43
15	2			0	0	0		0	3	11	4	4	20	20

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Overall mean individual weight (kg)	1.35	1.38	1.27	1.29	1.12	1.16	1.30	1.39	1.35	1.38	1.38	1.57	1.37	1.39
CPUE (kg round weight per trawlhour)**	567	973	1020	1255	1640	1393	1169	1294	1647	1377	1449	1657	1475	1795
CPUE (Number fish per trawlhour)**	420	705	803	973	1464	1201	899	931	1220	998	1050	1055	1077	1291
Catch (in tonnes)	695	862	811	368	436	274	272	269	295	297	288	298	304	292

***) Preliminary**

*** *) Average for freezer- and factorytrawler**

Not updated from 2006 due to new age reading method

Table E10. 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	Green-land	Ire-land	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	-	-	873	-	1	162	1 355
1998	+	-	71[1]	10	-	10	804	-	35	435	1 365
1999	+	-		1	-	18	2 157	-	43	358	2 577
2000	+		41	10	-	19	498[1]	-	67	192	827
2001	+		43	-	-	10	470	-	122	202	847
2002[1]	+		8	+	-	2	200	-	10	246	466
2003[1]	-	-	1	+	+	+	453	-	+	122	576
2004[1]	-	-	-	-	-	-	413	-	90	-	503
2005[1]	-	-	2	-	-	-	58	-	4	-	64
2006[1]	-	-	3	-	-	-	89	-	7	-	99

[1] **Provisional figures**

9 Barents Sea Capelin

9.1 Regulation of the Barents Sea Capelin Fishery

Since 1979, the Barents Sea capelin fishery has been regulated by a bilateral fishery management agreement between Russia (former USSR) and Norway. A TAC has been set separately for the winter fishery and for the autumn fishery. In recent years no autumn fishery has taken place, except for a small Russian experimental fishery. The fishery was closed from 1 May to 15 August until 1984. After 1984, the fishery was closed from 1 May to 1 September. A minimum landing size of 11 cm has been in force for several years. From the autumn of 1986 to the winter of 1991, from the autumn 1993 to the winter 1999, and in 2004-2006, no commercial fishery took place.

9.2 Catch Statistics (Table 9.1, 9.2)

The international catch by country and season in the years 1965-2007 is given in Table 9.1. No commercial catches were taken during 2006 and spring 2007. In spring 2007, a research quota of 4 000 tonnes (2 000 tonnes to Norway and 2 000 tonnes to Russia) was fished in connection with methodological research on the prespawning capelin approaching the coast to spawn (Table 9.2).

9.3 Stock Size Estimates

9.3.1 Larval and 0-group estimates in 2006 (Table 9.3)

Norwegian larval surveys based on Gulf III plankton samples have been carried out in June each year since 1981. The estimated total number of larvae is shown in Table 9.3. These larval abundance estimates do not show a high correlation with year class strength at age one, but should reflect the amount of larvae produced each year (Gundersen and Gjøsæter, 1998). The year 1986 was exceptional, in that no larvae were found. This may have been due to late spawning that year, and eggs may have hatched after the survey was carried out. Also in other years some spawning is known to have taken place during the summer, and offspring from such late spawning is not reflected in the larval abundance estimates in Table 9.3. Since 1997, permission has not been granted to enter the Russian EEZ during the larval survey or permission has been granted so late that it could not be employed to good purpose, and consequently the total larval distribution area has not been covered. The estimate of $17.1 \cdot 10^{12}$ larvae in 2006 is more than twice as high as the average for the period 1981-2005. A swept volume index (Dingsør, 2005) of abundance of 0-group capelin in August-September is given in Table 9.3 (see also general description, chapter 1). This index is calculated both without correction and with correction for catching efficiency correspondingly (Anon. 2006). Both 0-group indices indicate that the abundance of 0-group is well above average; in fact only the exceptionally rich year classes from early 1980s and in 1989 have had a higher abundance at this stage.

9.3.2 Acoustic stock size estimates in 2006 (Table 9.4-9.5)

Two Russian and three Norwegian vessels jointly carried out the 2006 acoustic survey as part of an ecosystem-survey during autumn (Anon., 2006). The geographical coverage of the total stock was considered complete. The results from the survey are given in Table 9.4, and are compared to previous years' results in Table 9.5. The stock size was estimated at 0.79 million tonnes. More than 50% (0.44 mill t) of the stock biomass consisted of maturing fish (> 14.0 cm).

9.3.3 Other surveys and information from 2006-2007

During the Norwegian bottom fish survey in February-March 2007 maturing capelin were detected in the southern Barents Sea and along the Norwegian coast from about 15º-30º E. An acoustic estimation of the prespawning capelin was not attempted. A research quota allowed for investigations using fishing vessels during the prespawning period 2007. Preliminary results indicate that in the order of 0.5-0.7 million tonnes of capelin were going to spawn during winter 2007. This amount is higher than the prognosis given during autumn 2006 based on the autumn acoustic survey. There are considerable sources of error to acoustic estimates of capelin during the winter period. Reliable estimates have never been obtained at this time of the year, but normally such estimates have been underestimates, and the main reason has been considered to be insufficient coverage of the prespawning fish migrating towards the coast. However, experiments made during recent years (Jørgensen and Olsen, 2004) have shown that the TS for capelin is dependent on depth. Consequently, the TS applied during acoustic surveys (19.1 log L –74.0 dB) may be too low in situations where capelin is found in more shallow distributions than is normally found during autumn. This would lead to overestimation when capelin is found in typical migrating schools in near surface waters, as is often the case during the prespawning period. Mixing with e.g. young herring could also make problems when the number of pelagic identification trawl hauls are scarce during a survey mainly assigned for bottom trawl investigations.

Based on this information it is not possible to conclude whether the autumn estimate is an underestimate, the spring estimate is an overestimate, or both.

9.4 Historical stock development (Tables 9.6-9.12)

An overview of the development of the Barents Sea capelin stock in the period 1997-2006 is given in Tables 9.6-9.12. The methods and assumptions used for constructing the tables are explained in Appendix A to ICES CM1995/Assess: 9. In that report, the complete time series back to 1973 can also be found. It should be noted that several of the assumptions and parameter values used in constructing these tables differ from those used in the assessment. For instance, in the assessment model the M-values for immature capelin are calculated using new estimates of the length at maturity and M-values for mature capelin are calculated taking the predation by cod into account. This will also affect the estimates of spawning stock biomass given in the stock summary table (Table 9.12). It should be noted that these values, coming from a deterministic model cannot directly be compared to those coming from the probabilistic assessment model (Bifrost, Gjøsæter *et al*. 2002) used for this stock. However, as a crude overview of the development of the Barents Sea capelin stock the tables may be adequate.

Estimates of stock in number by age group and total biomass for the period are shown in Table 9.6. Catch in numbers at age and total landings are shown for the spring and autumn seasons in Tables 9.7 and 9.8. Natural mortality coefficients by age group for immature and mature capelin are shown in Table 9.9. Stock size at 1 January in numbers at age and total biomass is shown in Table 9.10. Spawning stock biomass per age group is shown in Table 9.11. Table 9.12 gives an aggregated summary for the entire period 1973-2006.

9.5 Reference points

A B_{lim} (SSB_{lim}) management approach has been suggested for this stock (Gjøsæter et al. 2002). In 2002, the Mixed Russian-Norwegian Fishery Commission agreed to adopt a management strategy based on the rule that, with 95% probability, at least 200 000 t of capelin should be allowed to spawn. Consequently, 200 000 t was used as a B_{lim}. There is clearly also a need for a target biomass reference point for capelin, and calculations of B_{target} are also in progress.

9.6 Stock assessment autumn 2006

As decided by the Arctic Fisheries Working Group at its 2006 meeting (ICES 2006), the assessment of Barents Sea capelin was left to the parties responsible for the autumn survey, i.e. IMR in Bergen and PINRO in Murmansk. In accordance with this, the assessment was made during at meeting in Kirkenes after the survey, where the AFWG chair and two members met, together with other personnel taking part in the cruise.

A probabilistic projection of the spawning stock to the time of spawning at 1 April 2007 was made using the spreadsheet model CapTool (implemented in the @RISK add-on for EXCEL). The projection was based on a maturation and predation model with parameters estimated by the model Bifrost and data on cod abundance and size at age from the 2006 Arctic Fisheries Working Group. The methodology is described in "Stock assessment methodology for the Barents Sea capelin", WD1.

Probabilistic prognoses for the maturing stock from October 1 2006 until April 1 2007 were made, with a CV of 0.20 on the abundance estimate. With no catch, the estimated mean spawning stock size in 2007 is 189,000 tonnes. The simulations also indicate that with no catch, the probability for the spawning stock in 2007 to be below 200 000 t the $\mathbf{B}_{\text{lim}}$ value used by ACFM in recent years is > 50 %.

Capelin recruitment in 2007 could be seriously negatively affected by the large stock of young herring now found in the Barents Sea. The abundance of young herring in the Barents Sea is expected to be high also in 2007 (ICES 2007), for a more detailed analysis of this, see in WD1 to the capelin assessment meeting in autumn 2006 (WD # 8 to AFWG 2006)

9.7 Regulation of the fishery for 2007

During its Autumn 2006 meeting, the Mixed Russian-Norwegian Fishery Commission decided that no fishing should take place on Barents Sea capelin for the winter season 2007.

9.8 Management advice for the fishery in 2008

Since the assessment of the stock is directly based on the acoustic survey conducted annually in September-October, and the main fishing season does not begin until January, advice for this stock must be given during the autumn ACFM meeting and the TAC must be set by the Mixed Norwegian-Russian Fishery Commission during its meeting in November-December. As previously decided by the Arctic Fisheries Working Group, the assessment of Barents Sea capelin is left to the parties responsible for the autumn survey, i.e. IMR in Bergen and PINRO in Murmansk, who will meet in Murmansk in October 2007 and reported directly to the 2007 ACFM autumn meeting.

9.9 Predicting the capelin stock 1.5 year ahead

9.9.1 Introduction

Previously, the CapTool model gave a prognosis for the mature part of the stock from the survey in September in year *Y* until the spawning next spring (1 April year *Y+1*). In 2002, this model was enhanced, by including a prognosis of the immature part of the capelin stock up to 1 October in year *Y+1*, to be able to give a forecast of the spawning stock at 1 April in year *Y+2*. This prognosis was made by repeating the first step but basing the calculations on the stock prognosis by 1 October year *Y+1* instead of the survey. As a by-product of this model enhancement, a prognosis of the total stock at 1 January year *Y+2* is produced.

The method for predicting the stock by 1 October in year *Y+1* from the stock at 1 October in year *Y* was evaluated by Bogstad et al. (2005a). In 18 out of the 23 years the observed stock sizes are within the 90% confidence interval of the predictions. It is found that there is a tendency for overestimating stock size in periods when the stock decreases and vice versa. The ratio between predicted and observed stock sizes is variable and some times quite high for stock sizes below one million tonnes (collapsed stock size) but varies between about 0.5 and 1.5 and is unrelated to stock size for larger stock sizes. The model can be further improved by relating capelin growth to capelin stock size, prey abundance or environmental conditions (Bogstad et al. 2005b).

9.9.2 Methodology

The 1.5-year prognosis is based on a number of assumptions, of which the most important are:

- The parameters in the maturation function (needed to split the total stock measured in autumn into an immature and a mature part) were estimated based on data from the time series 1972-1980, a period where the natural mortality was rather constant.
- Annual values of the natural mortality of immature capelin is estimated together with the parameters in the maturation function (because these are interdependent) from survey data. For prognostic runs, natural mortality for immature capelin is drawn randomly from historic values. Natural mortality of mature capelin during the autumn period is set equal to that of immature capelin.
- The natural mortality of mature capelin during the period 1 January to 1 April is estimated from the predicted consumption by cod, in the same way as for 0.5 year prognostic runs.
- Total spawning mortality is assumed.
- The recruitment (number of one-year-olds in year *Y+1*) is estimated from a regression between the number of 1-group of capelin and the 0-group index (see section 9.9.3)
- The length growth and weight-at-length in prognostic runs are randomly drawn from the time series for the period 1981-2006. The length distribution of age 1 capelin in year *Y+1* is drawn at random from the time series of length distributions of 1-year-olds. The individual growth in length (cm/year) for each age group is calculated from values obtained by comparing the mean length at age of immature capelin one year with the mean length at age of the total stock next year. The length growth is implemented by shifting the distribution of immature capelin upwards with the number of 0.5cm length intervals, which corresponds to the growth in length, for each age group and year.
- The capelin length-weight relationship for use in the 1-year prediction is drawn randomly from historical data for the period 1981-2006.
- No weight increase during winter (1 October to 1 April) is assumed.
- Zero catch is assumed.

9.9.3 Recruitment (Figure 9.1)

Gundersen and Gjøsæter (1998) established a linear regression between the logarithms of the 0-group area based indices and the logarithm of the 1-group acoustic abundance 1 year later. The period after 1981 was chosen. The reason for this is that before 1981, the coverage of 1-group capelin during the acoustic survey was incomplete (Gjøsæter et al., 1998). This regression has been annually updated with new data, and used in the predictions of capelin stock size. Revised 0-group indices from Anon. (2006) are now available for the period 1980-2006. Using these indices (without or with correction for length-dependent selectivity in the trawl), we found that a linear regression gave better fit than a log-log regression. The new regressions, using data from the 1981-2005 year classes, are shown in Fig. 9.1. They both gave the same coefficient of determination (0.5), and since the index series without correction for length-dependent selectivity is at present considered as the official one, that series was used in the further calculations. To include uncertainty into the prognosis for 1-group capelin, the replicates of capelin of age 1 in 2007 were constructed by bootstrapping. From the 25 pairs of 0-group/1-group data from the year classes 1981-2005 25 new pairs of data were drawn at random with equal probability. These data were used in a new regression, and from the new regression the number of 1-year-old capelin in 2007 was calculated from the 0-group value in 2006. This procedure was repeated 1000 times. In order to avoid bias, the regressions were forced through the origin.

9.9.4 Results (Table 9.13, Figure 9.2)

The prognoses are given in Table 9.13 and in Figure 9.2. The stock size will, according to this prognosis remain at a low level during 2007, and the SSB in 2008 will also be low.

9.10 Sampling

The sampling from scientific surveys of capelin in 2006 is summarised below:

Investigation	No. of samples	Length measurements	Aged individuals
Capelin larval survey, May-June 2006	8	1499	0
Acoustic survey autumn 2006 (Norway)	335	11958	2334
Acoustic survey autumn 2006 (Russia)	315	14424	1217

Table 9.1 Barents Sea CAPELIN. International catch ('000 t) as used by the Working Group.

Year	Winter				Summer-Autumn			Total
	Norway	Russia	Others	Total	Norway	Russia	Total	
1965	217	7	0	224	0	0	0	224
1966	380	9	0	389	0	0	0	389
1967	403	6	0	409	0	0	0	409
1968	460	15	0	475	62	0	62	537
1969	436	1	0	437	243	0	243	680
1970	955	8	0	963	346	5	351	1314
1971	1300	14	0	1314	71	7	78	1392
1972	1208	24	0	1232	347	11	358	1591
1973	1078	35	0	1112	213	10	223	1336
1974	749	80	0	829	237	82	319	1149
1975	559	301	43	903	407	129	536	1439
1976	1252	231	0	1482	739	366	1105	2587
1977	1441	345	2	1788	722	477	1199	2987
1978	784	436	25	1245	360	311	671	1916
1979	539	343	5	887	570	326	896	1783
1980	539	253	9	801	459	388	847	1648
1981	784	428	28	1240	454	292	746	1986
1982	568	260	5	833	591	336	927	1760
1983	751	374	36	1161	758	439	1197	2358
1984	330	257	42	628	481	367	849	1477
1985	340	234	17	590	113	164	278	868
1986	72	51	0	123	0	0	0	123
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	528	156	20	704	31	195	226	929
1992	620	247	24	891	73	159	232	1123
1993	402	170	14	586	0	0	0	586
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997*	0	0	0	0	0	1	1	1
1998*	0	0	0	0	0	1	1	1
1999	50	32	0	82	0	23	23	105
2000	279	95	8	382	0	28	28	410
2001	376	180	8	564	0	11	11	575
2002	398	228	17	643	0	16	16	659
2003	180	93	9	282	0	0	0	282
2004	0	0	0	0	0	0	0	0
2005*	1	0	0	1	0	0	0	1
2006	0	0	0	0	0	0	0	0
2007*	2	2	0	4				

Catches in 1997, 1998, 2005, and 2007 were based on research quotas.

Table 9.2 Barents Sea Capelin. Catch in number (billions) and biomass (tonnes) by age and length during the research activities in February-March 2007

	1 year		2 years		3 years		4 years		5+ years		Sum			
	N	B	N	B	N	B	N	B	N	B	N	%	B	%
5.0-5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.5-6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.0-6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.5-7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0-7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5-8.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.0-8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5-9.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.0-9.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.5-10.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0-10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.5-11.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.0-11.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.5-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.0-12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5-13.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.0-13.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.5-14.0	0	0	0	0	0	5	0	0	0	0	0	0	5	0
14.0-14.5	0	0	0	0	1	11	0	0	0	0	1	1	11	0
14.5-15.0	0	0	0	5	2	22	0	0	0	0	2	1	27	1
15.0-15.5	0	0	0	0	8	112	1	10	0	0	9	5	123	3
15.5-16.0	0	0	0	0	11	173	2	25	0	0	12	7	198	5
16.0-16.5	0	0	0	0	21	385	2	40	0	0	24	14	425	11
16.5-17.0	0	0	0	0	10	202	4	93	0	0	15	9	295	7
17.0-17.5	0	0	0	0	11	229	17	380	0	0	27	16	609	15
17.5-18.0	0	0	0	0	10	257	20	489	1	25	31	18	770	19
18.0-18.5	0	0	0	0	2	62	14	399	3	77	19	11	537	13
18.5-19.0	0	0	0	0	1	42	8	260	3	98	13	7	400	10
19.0-19.5	0	0	0	0	0	6	6	203	6	203	12	7	413	10
19.5-20.0	0	0	0	0	0	0	2	88	2	61	4	2	149	4
20.0-20.5	0	0	0	0	0	0	0	14	0	15	0	0	29	1
20.5-21.0	0	0	0	0	0	0	0	0	0	3	0	0	3	0
21.0-21.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.5-22.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	0	0	0	5	78	1505	76	2001	14	483	168	100	3994	100

Table 9.3 Barents Sea CAPELIN. Larval abundance estimate (10^{12}) in June, and 0-group indices (10^{12}) in August-September. The 0-group indices were revised in 2007, and differ slightly from those presented earlier.

Year	Larval abundance	New 0-group Index (10^{12} ind.) without K eff	with K eff
1980	-	197.3	740.3
1981	9.7	123.9	477.3
1982	9.9	168.1	599.6
1983	9.9	100.0	340.2
1984	8.2	68.1	275.2
1985	8.6	21.3	63.8
1986	0.0	11.4	41.8
1987	0.3	1.2	4.0
1988	0.3	19.6	65.1
1989	7.3	251.5	862.4
1990	13.0	36.5	115.6
1991	3.0	57.4	169.5
1992	7.3	1.0	2.3
1993	3.3	0.3	1.0
1994	0.1	5.4	13.9
1995	0.0	0.9	2.9
1996	2.4	44.3	136.7
1997	6.9	54.8	189.4
1998	14.1	33.8	113.4
1999	36.5	85.3	287.8
2000	19.1	39.8	140.8
2001	10.7	33.6	90.2
2002	22.4	19.4	67.1
2003	11.9	94.9	340.9
2004	2.5	16.7	53.9
2005	8.8	41.8	148.5
2006	17.1	166.4	515.8
Average	9.0	62.8	196.8

Table 9.4. Barents Sea CAPELIN. Estimated stock size from the acoustic survey in September 2006.

Length (cm)			Age/Year class				Sum	Biomass	Mean
			1	2	3	4+	(10^6)	(10^3 t)	weight (g)
			2005	2004	2003	2002-			
6.5	-	7.0	280				280	0.3	1.0
7.0	-	7.5	1461				1461	1.7	1.2
7.5	-	8.0	2056				2056	4.1	2.0
8.0	-	8.5	5035				5035	10.1	2.0
8.5	-	9.0	3519				3519	8.8	2.5
9.0	-	9.5	4022				4022	11.7	2.9
9.5	-	10.0	4297				4297	15.3	3.6
10.0	-	10.5	6648	164			6812	29.2	4.3
10.5	-	11.0	9452				9453	46.9	5.0
11.0	-	11.5	6497	214			6711	38.1	5.7
11.5	-	12.0	8455	271			8727	56.0	6.4
12.0	-	12.5	3371	70			3441	26.7	7.8
12.5	-	13.0	3486	1170			4656	38.8	8.3
13.0	-	13.5	1143	1444	107		2693	26.6	9.9
13.5	-	14.0	351	2654	55		3060	35.1	11.5
14.0	-	14.5	19	3802	234		4055	53.9	13.3
14.5	-	15.0		2773	325	2	3100	48.4	15.6
15.0	-	15.5	2	2668	437	23	3130	55.0	17.6
15.5	-	16.0		2618	475	1	3094	61.2	19.8
16.0	-	16.5		1961	778	10	2749	62.4	22.7
16.5	-	17.0		1155	986	33	2175	54.9	25.2
17.0	-	17.5		460	668	3	1131	32.8	29.0
17.5	-	18.0		155	979	86	1220	38.9	31.9
18.0	-	18.5		85	361	163	608	21.2	34.9
18.5	-	19.0		10	158	17	184	6.8	36.8
19.0	-	19.5		12	12	7	31	1.4	46.6
TSN (10^6)			60094	21686	5575	345	87700		
TSB (10^3 t)			290.0	347.2	139.1	10.9		787.1	
Mean length (cm)			10.5	14.7	16.6	17.7	11.9		
Mean weight (g)			4.8	16.1	24.8	30.6			9.0
SSN (10^6)			21	15699	5413	345	21477		
SSB (10^3 t)			0.3	288.4	137.4	10.9		437.0	

Based on TS value: 19.1 log L - 74.0, corresponding to $\sigma = 5.0 \cdot 10^{-7} \cdot L^{1.9}$

Table 9.5 Barents Sea CAPELIN. Stock size in numbers by age, total stock biomass and biomass of the maturing component. Stock in numbers (unit:10^9) and stock and maturing stock biomass (unit:10^3 tonnes) are given at 1. October.

Year	Stock in numbers (10^9)						Stock in weight (10^3 t)	
	Age 1	Age 2	Age 3	Age 4	Age 5	Total	Total	Maturing
1973	528	375	40	17	0	961	5144	1350
1974	305	547	173	3	0	1029	5733	907
1975	190	348	296	86	0	921	7806	2916
1976	211	233	163	77	12	696	6417	3200
1977	360	175	99	40	7	681	4796	2676
1978	84	392	76	9	1	561	4247	1402
1979	12	333	114	5	0	464	4162	1227
1980	270	196	155	33	0	654	6715	3913
1981	403	195	48	14	0	660	3895	1551
1982	528	148	57	2	0	735	3779	1591
1983	515	200	38	0	0	754	4230	1329
1984	155	187	48	3	0	393	2964	1208
1985	39	48	21	1	0	109	860	285
1986	6	5	3	0	0	14	120	65
1987	38	2	0	0	0	39	101	17
1988	21	29	0	0	0	50	428	200
1989	189	18	3	0	0	209	864	175
1990	700	178	16	0	0	894	5831	2617
1991	402	580	33	1	0	1016	7287	2248
1992	351	196	129	1	0	678	5150	2228
1993	2	53	17	2	2	75	796	330
1994	20	3	4	0	0	28	200	94
1995	7	8	2	0	0	17	193	118
1996	82	12	2	0	0	96	503	248
1997	99	39	2	0	0	140	911	312
1998	179	73	11	1	0	263	2056	931
1999	156	101	27	1	0	285	2776	1718
2000	449	111	34	1	0	595	4273	2099
2001	114	219	31	1	0	364	3630	2019
2002	60	91	50	1	0	201	2210	1290
2003	82	10	11	1	0	104	533	280
2004	51	25	6	1	0	82	628	294
2005	27	13	2	0	0	42	324	174
2006	60	22	6	0	0	88	787	437

Table 9.6 Barents Sea CAPELIN. Estimated stock size in numbers (unit:10^9) by age group and total, and biomass ('000 t) of total stock, by 1. August, back-calculated from the survey in September-October.

[redacted]

Table 9.7 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the spring season.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.2	0.5	0.4	0.0	0.0	0.0	0.0
3	0.0	0.0	1.6	5.5	7.6	10.0	2.1	0.0	0.0	0.0
4	0.0	0.0	1.2	8.4	12.1	14.2	10.8	0.0	0.0	0.0
5	0.0	0.0	0.1	1.0	2.2	0.7	1.4	0.0	0.0	0.0
Sum	0.0	0.0	3.0	15.1	22.5	25.3	14.3	0.0	0.1	0.0
Landings	0	0	78	386	557	635	282	0	1	0

Table 9.8 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the autumn season.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.9	0.9	0.4	0.3	0.0	0.0	0.0	0.0
3	0.0	0.0	0.2	0.4	0.2	0.6	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	0.0	0.1	1.6	1.5	0.6	0.9	0.0	0.0	0.1	0.0
Landings	1	1	23	28	11	16	0	0	0	0

Table 9.9 Barents Sea CAPELIN. Natural mortality coefficients (per month) for immature fish (Mimm), used for the whole year, and for mature fish (per season) (Mmat) used January to March, by age group and average for age groups 1-5.

	1997		1998		1999		2000		2001	
Age	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}
1	0.062	0.185	0.026	0.077	0.047	0.142	0.028	0.083	0.060	0.180
2	0.062	0.185	0.026	0.077	0.047	0.142	0.028	0.083	0.060	0.180
3	0.062	0.185	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
4	0.014	0.041	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
5	0.014	0.041	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
Avr	0.042	0.127	0.053	0.158	0.034	0.101	0.027	0.080	0.048	0.144

Table 9.9 (Continued)

	2002		2003		2004		2005		2006	
Age	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}
1	0.019	0.056	0.152	0.456	0.100	0.300	0.100	0.300	0.100	0.300
2	0.019	0.056	0.152	0.456	0.100	0.300	0.100	0.300	0.100	0.300
3	0.091	0.273	0.140	0.421	0.100	0.300	0.100	0.300	0.100	0.300
4	0.091	0.273	0.140	0.421	0.100	0.300	0.100	0.300	0.100	0.300
5	0.091	0.273	0.140	0.421	0.100	0.300	0.100	0.300	0.100	0.300
Avr	0.062	0.186	0.145	0.435	0.100	0.300	0.100	0.300	0.100	0.300

Table 9.10 Barents Sea CAPELIN. Estimated stock size in numbers (unit:10^9) by age group and total, and biomass (‘000 t) of total stock, by 1. January.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	172.0	225.5	238.5	576.1	194.7	70.5	323.8	126.0	66.3	147.9
2	72.5	82.2	165.8	135.3	413.3	94.6	56.2	52.3	37.9	19.9
3	10.2	32.5	67.3	88.1	100.9	182.6	85.4	6.1	18.4	9.6
4	1.8	1.6	8.5	24.7	31.1	27.0	38.2	7.2	4.2	1.3
5	0.1	0.1	0.5	0.8	0.7	0.9	0.4	0.9	0.5	0.1
Sum	256.6	341.9	480.6	824.9	740.6	375.7	504.0	192.5	127.2	178.8
Biomass	779	1240	2456	3571	4558	3490	2394	570	608	549

Table 9.11 Barents Sea CAPELIN. Estimated spawning stock biomass (‘000 t) by 1. April.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0	0	0	0	0	0	0	0	0	0
2	1	1	2	24	5	0	192	27	102	90
3	175	217	650	819	943	733	567	117	80	24
4	49	34	193	472	539	267	0	19	10	1
5	2	2	10	0	0	6	0	0	1	0
Sum	228	254	856	1315	1487	1007	759	163	193	115

Table 9.12 Barents Sea CAPELIN. Stock summary table. Recruitment (number of 1 year old fish, unit:10^9) and stock biomass ('000 t) given at 1. August. Spawning stock ('000 t) at time of spawning (1. April). Landings ('000 t) are the sum of the total landings in the two fishing seasons within the year indicated.

Year	Stock biomass August 1.	Maturing biomass survey Oct. 1	Recruitment Age 1, August 1.	Forward Prediction of SSB as of April 1	Landings	Herring biomass age 1 and 2
1965					224	
1966					389	
1967					409	
1968					537	
1969					680	
1970					1314	
1971					1392	
1972	5831	2182			1592	
1973	6630	1350	1140	33	1336	1
1974	7121	907	737	*	1149	48
1975	8841	2916	494	*	1439	73
1976	7584	3200	433	253	2587	38
1977	6254	2676	830	22	2987	46
1978	6119	1402	855	*	1916	51
1979	6576	1227	551	*	1783	39
1980	8219	3913	592	*	1648	65
1981	4489	1551	466	316	1986	46
1982	4205	1591	611	106	1760	8
1983	4772	1329	612	100	2358	12
1984	3303	1208	183	109	1477	1263
1985	1087	285	47	*	868	1176
1986	157	65	9	*	123	171
1987	107	17	46	34	0	142
1988	361	200	22	*	0	53
1989	771	175	195	84	0	140
1990	4901	2617	708	92	0	371
1991	6647	2248	415	643	929	691
1992	5371	2228	396	302	1123	1653
1993	991	330	3	293	586	2615
1994	259	94	30	139	0	1785
1995	189	118	8	60	0	557
1996	467	248	89	60	0	199
1997	866	312	112	85	1	308
1998	1860	931	188	94	1	405
1999	2580	1718	171	382	106	1273
2000	3840	2099	475	599	414	1894
2001	3480	2019	128	626	568	1050
2002	2145	1290	62	496	651	401
2003	700	280	112	427	282	1468
2004	724	293	63	94	0	1943
2005	374	174	33	122	1	2858
2006	902	437	73	72	0	1966
2007				189		
Average	3392	1247	320	223	824	730

Table 9.13 Prognosis for capelin biomass, thousand tonnes:

Date	Median	5%	95%
1 October 2007 immature	1830	1097	2628
1 October 2007 maturing	324	32	940
1 January 2008 maturing	301	16	957
1 April 2008 spawning	159	7	516

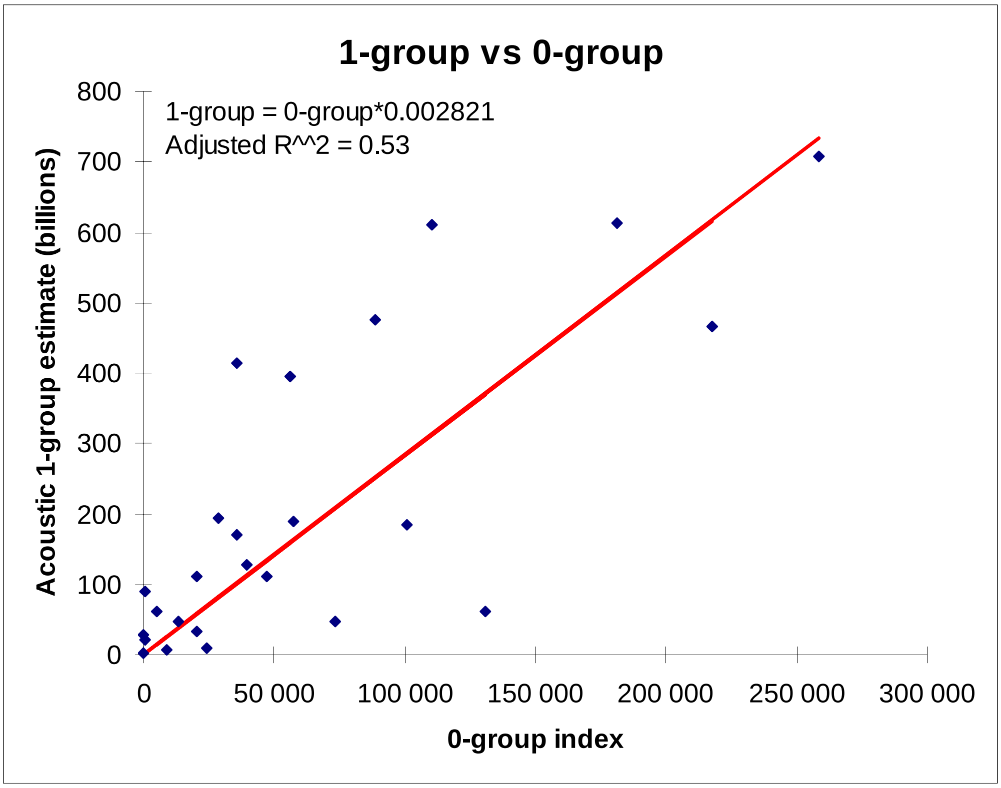

Figure 9.1. Regression of abundance of capelin at age 0 (0-group index without K_{eff}) and age 1 (acoustic estimate) of year classes 1981-2005. The regression line is forced through the origin, to avoid systematic overestimation of weak year classes.

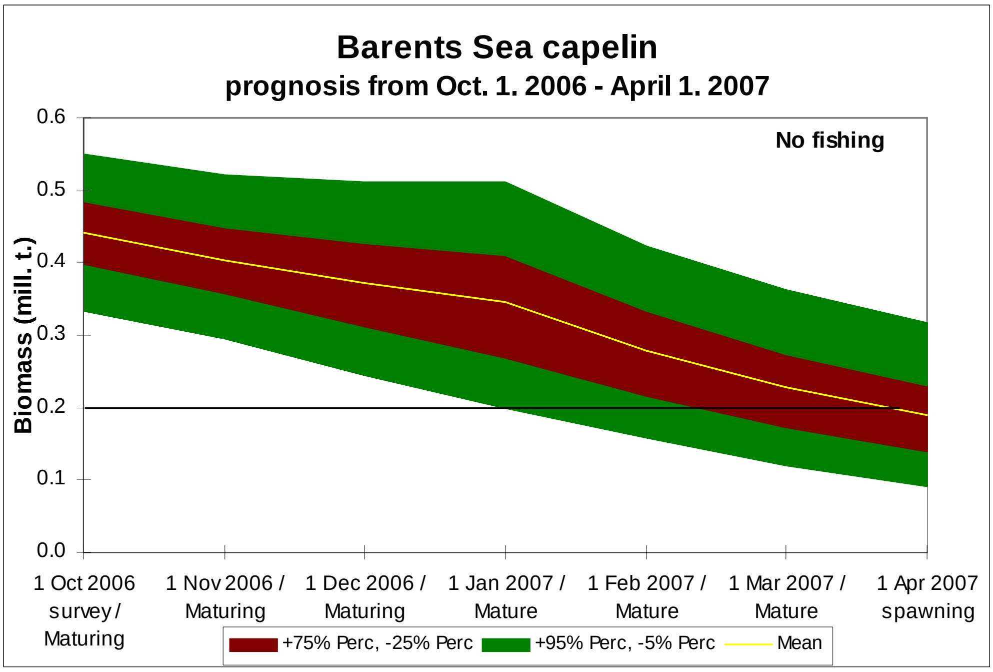

Figure 9.2. Capelin prognosis from 1 Oct 2006 to 1 Apr 2007 with no catch during the period.

10 Working documents

WD#	Title	Authors
1	German landings and biological data of deep-sea redfish (Sebastes mentella) in ICES Sub-areas I and II	Stransky C.
2	Consumption of various prey species by cod in 1984-2006	Dolgov A.V.
3	Revised indices of the Northeast Arctic cod abundance according to the 1982-2006 data from Russian trawl-acoustic survey (TAS)	Golovanov S.E., Sokolov A.M., Yaragina N.A.
4	Evaluation of the proposed harvest control rule for Northeast Arctic saithe – background, preparation of population model, parameters, data and preliminary analyses	Mehl, S, Fotland, Å, Bogstad B. and Gjøsæter, H.
5	Acoustic abundance of saithe, coastal cod and juvenile herring Finnmark – Møre Autumn 2006	Aglen, A., Berg, E., Mehl, S. and Sunnanå, K.
6	Observer program for juvenile northeast arctic saithe. Status report	Mehl, S.
7	Assessment of arctic cod stocks and total allowable catch in 2008-2010.	Bulatov O.A., Borisov V.M., Kotenev B.N., Moiseenko G.S.,Vasilyev D.A and Bulgakova T.I
8	Report from BS winter survey 2007	Aglen A.
9	Russian investigations and fishery of the pelagic redfish in the Norwegian Sea	V.I.Vinnichenko
10	Northeast Arctic haddock stock assessment by means of ISVPA model	Bulgakova T.I.
11	Report of the Portuguese fishery in 2006: ICES Div. I, IIa and IIb.	Alpoim, R., Vargas, J. and Santos, E.
12	The Spanish NE Arctic Cod Fishery in 2006	Casas, J.M. and J. Ruiz
13	Stocobar model for simulation of the cod stock dynamics in the Barents Sea taking into account ecosystem considerations	Filin A.A.

14	Ecological considerations for AFWG 2007	J.E. Stiansen, A.A. Filin, A. Aglen, N.A. Anisimova, B. Bogstad, P. Budgell, P. Dalpadado, A.V. Dolgov, K.V. Drevetnyak, K. Drinkwater, H. Gjøsæter, A. A. Grekov, K.H. Hauge, G. Huse, Å. Høines, R. Ingvaldsen, E. Johannesen, L.L. Jørgensen, A.L. Karsakov, J. Klungsøyr, T. Knutsen, P.A. Liubin, H. Loeng, L.J. Naustvoll,K. Nedreaas, I.E. Manushin, M. Mauritzen, S. Mehl, P.B. Mortensen, N.V. Muchina, E. Olsen, E.L. Orlova, G. Ottersen, V.K. Ozhigin, A.P. Pedchenko, N.F. Plotitsina, M. Skogen, O.V. Smirnov, K.M. Sokolov, E.K. Stenevik, J. Sundet, O.V. Titov, I.I. Trofimov, V.B. Zabavnikov, S.V. Ziryanov, N. Øien, B. Ådlandsvik, S. Aanes
15	Report of Polish fishing activity and survey on redfish (Sebastes mentella) in the NEAFC Regulatory Area (ICES IIa) in 2006	Janusz, J and K. Trella
16	Report of Polish fishing survey on Greenland halibut (Reinhardtius hippoglossoides) in the Svalbard Protection Area ((ICES IIb) in October 2006	Janusz, J and K. Trella
17	Results from the Norwegian acoustic Lofoten-survey, 17 March- 07 April 2007	Erik Berg
18	Long-term dynamics of maturation rate in Northeast Arctic cod yearclasses	V.L.Tretyak
19	Population structure of *S. mentella* in the North Atlantic with regard to international Norwegian Sea waters.	Stefánsson, *et al.*
20	Geographic variation in otolith shapes of deep-sea redfish (*Sebastes mentella*) in ICES Sub-areas I and II and Sub-areas V, XII and XIV: preliminary results	C. Stransky, K. Nedreaas, A. Harbitz, and H. Høie
21	SHORT STATUS OF THE RESULTS FROM THE NORWEGIAN-RUSSIAN COD AND HADDOCK COMPARATIVE AGE READINGS	K.H. Nedreaas, N.A.Yaragina and age readers
22	Some information about unreported landings of cod fished in the Barents Sea 'loop-hole', and the Norwegian Coast Guard inspections and reactions in 2006.	K.H. Nedreaas
23	Report from the Norwegian research on capelin during winter 2007.doc	Harald Gjøsæter
24	Assessment report capelin 2006.doc	Harald Gjøsæter
25	Spanish Experimental Pelagic Redfish Fisheries in ICES Division IIa 2006.	Casas, J.M

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Annex 2: Working Document No. 4

Working Document No. 4
Arctic Fisheries Working Group
Vigo 18 – 27 April 2007

Evaluation of the proposed harvest control rule for Northeast Arctic saithe – background, population model, parameters, data and preliminary analyses

by

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1. INTRODUCTION

This working document addresses the first part of a request to ICES from the Norwegian Ministry of Fisheries and Coastal Affairs (MFCA) 4 December 2006:

"**Northeast Arctic saithe – management objectives**

Norwegian authorities are close to adopting a fishing strategy for saithe in the Norwegian waters north of 62nd latitude (northeast arctic saithe). A draft prepared by the Norwegian Directorate of Fisheries was sent on a public hearing December 7. 2004.

As a member country Norway takes ICES' advice into account when deciding on the total allowable catch for saithe. The Ministry therefore asks ICES to evaluate and give advice on the long-term strategy. In order to facilitate for this, a translated version of the strategy is enclosed.

We will ask ICES to evaluate the potential excess value by setting the fishing mortality less than F_{pa}. Finally we would appreciate any advice from ICES on the effect of allowing live catch of saithe below minimum length for feeding.

Strategy for the harvesting of Northeast Arctic saithe

The yearly Total Allowable Catch (TAC) for Northeast Arctic saithe shall, within safe biological limits, be determined so that the highest potential economical yield is realized both from the harvest of saithe and from the harvest of other species in interaction with saithe.

To achieve the abovementioned objective yearly Total Allowable Catch of north east arctic saithe shall, when circumstances does not order otherwise, be determined as follows:

1) The TAC for North East arctic saithe shall be set with basis in an average fishing mortality of 0,35 for the next three years within the year-classes 4-7.
2) Annual change in TAC shall not be more than 15 %.
3) Should the spawning stock level fall below B_{pa}, fishing mortality according to the above shall have a linear reduction from F_{pa} at B_{pa}, to zero when spawning stock is zero. At spawning stock below B_{pa}, there is no restriction on the maximum annual change of the TAC."

7 February 2007 ICES sent a letter to MFCA to clarify some points in the preliminary plan in order to be able to simulate the likely effects:

"In Paragraph 1, there is some uncertainty as to what is meant with the formulation average fishing mortality of 0,35 for 3 years', in particular what the term average refers to. With respect to the SSB referred to in Paragraph 3, it is unclear at which time the SSB should be considered. It could for example be the SSB in the last assessment year or the SSB after the TAC has been taken. Finally, it is also unclear what is meant with "the effect of allowing live catch of saithe below minimum length for feeding". Does that mean a directed fishery for juveniles in addition to the fishery for older fish, and if so, what magnitudes of such fishery would be relevant to consider?"

After consulting The Institute of Marine Research (IMR), MFCA 27 February confirmed that "Norway asks ICES to evaluate whether the following harvest control rule for setting the annual fishing quota (TAC) for Northeast Arctic saithe is consistent with the precautionary approach:

1) estimate the average TAC level for the coming 3 years based on F_{pa}, TAC for the next year will be set to this level as a starting value for the 3-year period.
2) the year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development, however the TAC should not be changed by more than +/- 15% compared with the previous year's TAC.
3) if the spawning stock biomass (SSB) in the beginning of the year for which the quota is set (first year of prediction), is below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at SSB=B_{pa} to 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC."

MFCA withdrew the original request on advice from ICES on the effect of allowing live catch of saithe below minimum landing for feeding.

2. THE NORWEGIAN DIRECTORATE OF FISHERIE'S SUGGESTION TO A MANAGEMENT STRATEGY

ICES gives advice on annual TAC level based on the precautionary fishing mortality (F_{pa}). If the annual quotas are set according to this fishing mortality, the risk for stock collapse is low. Beyond that a TAC at this level does not imply any optimisation of neither biological nor economic yield from the stock. Evaluated as a natural resource, a fish stock should be managed to give the highest total economic yield for the society. This implies that one has to take into account a number of factors such as total yield for different stock sizes, stability, prices, costs and the stocks effect on other fish stocks.

During autumn 2004 the Norwegian Directorate of Fisheries (FDIR) suggested a management strategy for the stock of Northeast Arctic saithe (Anon 2004). Figure 1 shows the elements FDIR meant was important to take into account when choosing a management strategy:

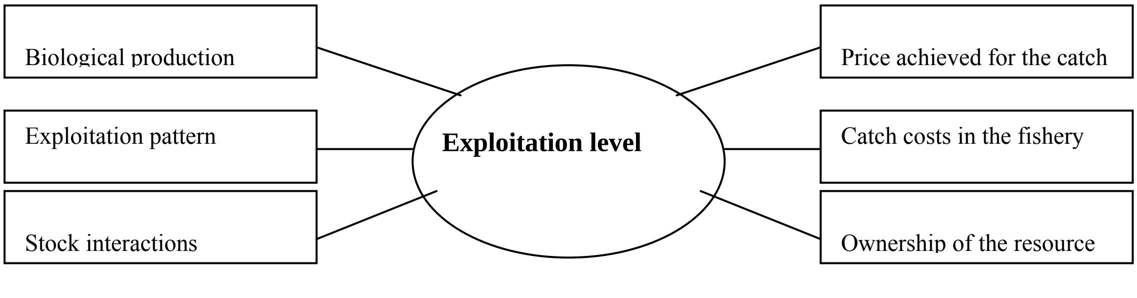

Figure 1 Some factors the exploitation level of NEA saithe may affect, and therefore should be taken into account when deciding the exploitation level.

Based on discussions and an over all evaluation of these factors FDIR suggested a management strategy similar to that for Northeast Arctic cod (Skagen et al. 2003; Bjordal *et a*l. 2004; Bogstad *et al*. 2004, 2005; ICES 2004/ACFM:28, ICES 2005/ACFM:20, Kovalev and Bogstad 2005), but with an exploitation level somewhat lower than what is biologically safe (F_{pa}). The strategy was based on a fishing mortality of F=0.20, and F_{pa} was at that time 0.26.

The complete suggestion for a management strategy were as follows:

1) The total quota for Northeast Arctic saithe shall be based on the average of the total quotas that a fishing mortality of 0.20 will produce the next three years.

2) The TAC shall not be changed from year to year by more than 10 %.

3) If the spawning stock falls below B_{pa}, the rule above shall be based on a fishing mortality that is changed linearly from 0.20 at B_{pa} to zero at spawning stock equal to zero. At such low spawning stock levels there is not set any limitation on variation in total quota from the year-to-year.

One reason for setting a lower fishing mortality than what is biologically safe was to aim at a somewhat larger saithe stock that may produce a higher long time yield. FDIR did not suggest an even lower fishing mortality (e.g. $F_{0.1}$) due to the role of saithe as a predator on economically important stocks in the ecosystem, or what is called ”Stock interactions” in Figure 1. A larger saithe stock is expected to consume more of other fish stocks that may be valuable for Norwegian fishermen.

3. PUBLIC HEARING AND FOLLOW UP

The management strategy drafted by FDIR was sent on a public hearing 7 December 2004. Most governmental organizations and some NGOs were positive to the suggestion. The Institute of Marine Research (IMR) also supported the strategy, but pointed out that the reference age groups used for calculating the reference F in the assessment were about to be evaluated in AFWG spring 2005 and might be changed from 3-6 years to 4-7 years, which would also effect PA reference points and the choice of F in the harvest rule. A few local community organizations and most stakeholder organizations were more critical. They found the strategy too rigid and wanted more room for quota adjustments (level out total quotas) when the quotas of NEA cod and haddock and North Sea saithe are low. If a management strategy has to be implemented it should be based on an exploitation at F_{pa}-level, similar to that for NEA cod and haddock. But first the PA reference points should be evaluated, and effects of stock interactions should be analysed. Having a large saithe stock, the costs in form of consumption of other fish species may be considerable. With the knowledge we have about this to day, they found it unwise to suggest such a low exploitation level as the Directorate of Fisheries did.

The Department of Marine Resources and Environment, MFCA, recommended further work with an aim of adopting a strategy for setting the annual TAC within the end of 2005. The Department suggested that ICES should evaluate the rule for different exploitation levels (0.20, 0.23 and 0.26) with different trigger points for reduction in F for the three alternatives, and with an alternative limit for annual change in TAC (25 %), as well as the effect of changing the reference age in the assessment from 3-6 years to 4-7 year. In a letter of 11 April 2005 MFCA asked FDIR and IMR to evaluate the usefulness of single species management strategies, the relation between cod, haddock and saithe, the suitability of multispecies models including the three species and the appropriateness of treating Northeast Arctic saithe as a “buffer stock” in relation to cod and haddock. MFCA further asked for an evaluation of the strategy applied in the setting of the TAC in later years and, if possible, what would the development of the saithe stock have been if the suggested management strategy had been applied in the setting of the TAC. Finally MFCA asked if it would be difficult to adjust the strategy to possible new reference points if ICES AFWG changed the reference age used in the assessment.

FDIR and IMR answered the different points in a joint letter. Regarding single species strategies, the few adopted have proven useful, giving predictability for the industry and preventing stock collapse. However, these strategies are built on simplified interactions both between stocks and fisheries. For predator stocks, where prey species also are commercially exploited, the usefulness of the management strategy would increase if the most important stock interactions were incorporated. For NEA saithe the economically most important interactions is with Norwegian spring spawning (NSS) herring. Quantification of this interaction is important, and FDIR and IMR already had planed to work on this autumn 2005. Beyond this there were no clear indications of strong biological linkage between saithe and cod/haddock, but the knowledge on this field is still scarce. Regarding the question about treating Northeast Arctic saithe as a "buffer stock" in relation to cod and haddock, FDIR and IMR answered that this could be possible, but would be a special kind of strategy in itself and no replacement for the suggested one. It could imply that in some years the fishing mortality would be well above F_{pa}, and this would have to be evaluated by ICES whether or not it is in accordance with the PA principle. It would also have to be evaluated against the different stakeholders and vessel groups.

ICES advice for NEA saithe has since 1999 been to reduce F below F_{pa} or keep F below F_{pa}. In the last years there has been a tendency to overestimate F and underestimate stock size in the assessment year. The exploitation pattern has improved over the last ten years with much lower catches of 2 and 3 year old fish, while the element of larger fish has been increasing. The estimation of F_{pa} performed in 1998 was based on the exploitation pattern in 1960-1996, and the F_{pa} of 0.26 was probably conservative compared to the exploitation pattern in later years. In later years the TAC has been set in accordance with the advice. These circumstances contributed to keep the exploitation well below F_{pa} and there was a rapid increase in stock size. The realized F has been closed to the suggested F of 0.2 in the management strategy. It would, however, mainly be speculations to evaluate what would the development of the saithe stock have been if the suggested management strategy had been applied in the setting of the TAC. Advised TAC would have been a little lower in the beginning of the period and the increase in stock size may be even more rapid. The realized F could have been even lower than 0.2, but this would probably have resulted in a demand of increasing F in the strategy towards F_{pa}.

The final question from the Ministry regarded adjustments to new reference points if ICES AFWG changed the reference age used in the assessment. At the AFWG spring 2005 (ICES CM 2005/ACFM:20) F_{bar} was changed from 3-6 to 4-7 and age at recruitment from 2 to 3, and the lim and pa reference points were re-estimated. The lim reference points were estimated according to the new methodology outlined in ICES CM 2003/ACFM:15, while the pa reference point estimation was based on the old procedure (ICES CM 1998/ACFM:10). The new F_{pa} of 0.35 estimated with reference age 4-7 years does not necessarily imply a higher yield than a F_{pa} of 0.26 estimated with reference age 3-6 years. However, the catches of 3-year olds have been low in the last ten years, and $F_{3\text{-}6}$ have become lower than the F on the dominating age groups in the fishery since it is estimated as an arithmetic unweighted average over the actual age groups. Also the realized F_{bar} in the fishery will be higher with the new reference age. The F of 0.20 in the suggested management strategy was a compromise between high long term yield at $F_{0.1}$ = 0.12 and a higher F taking stock interactions into account, limited upwards against the F_{pa} of 0.26. With the new reference age, the exploitation level should probably be in the upper half of the interval between the corresponding re-estimated values of 0.15 ($F_{0.1}$) and 0.35 (F_{pa}), i.e. between 0.25 and 0.35. FDIR and IMR therefore recommended that ICES should evaluate the rule for exploitation levels 0.25, 0.30 and 0.35 and limits for annual change in TAC of 10 and 25 %. It was further recommended that the trigger point for reduction in F was set independent of exploitation level since all alternatives were at or below F_{pa} for stock sizes above $B_{pa.}$

4. ANALYSIS OF EFFECTS OF STOCK INTERACTIONS

Even if FDIR to some extent took predator interactions into account in the suggested management strategy, these costs could of course legitimize a higher exploitation level. To evaluate this it was necessary to quantify the saithe stock's predation and what economic loss this predation implies in form of lost catch in other fisheries. One of the most important prey items for NEA saithe is young age groups of NSS herring (Mehl WD 7 2005) and the costs of this predation was estimated (Mehl *et al.* 2006a and b; Mehl *et al.* WD 10 2006). Such predator costs will also depend on how one manages/exploits the herring, but only the management strategy adopted for Norwegian spring spawning herring by the coastal states in 2001 was applied. This implies that herring consumed by saithe alternatively could have materialized as catch through the adopted management strategy, of which Norway would have received a fixed amount.

First the saithe stock's annual consumption of different age groups of herring was estimated. Then it was projected what the consumed herring could have produced in form of yield in the herring fishery if it not had been eaten by saithe. The costs of the saithe's consumption were estimated as what economic yield this herring could have given Norwegian herring fishers. Figure 2 presents one of analyses made where the expected spawning stock, gross catch value in the saithe fishery, predator costs and total catch value (gross catch value in the saithe fishery minus predator costs) changes with increasing fishing mortality.

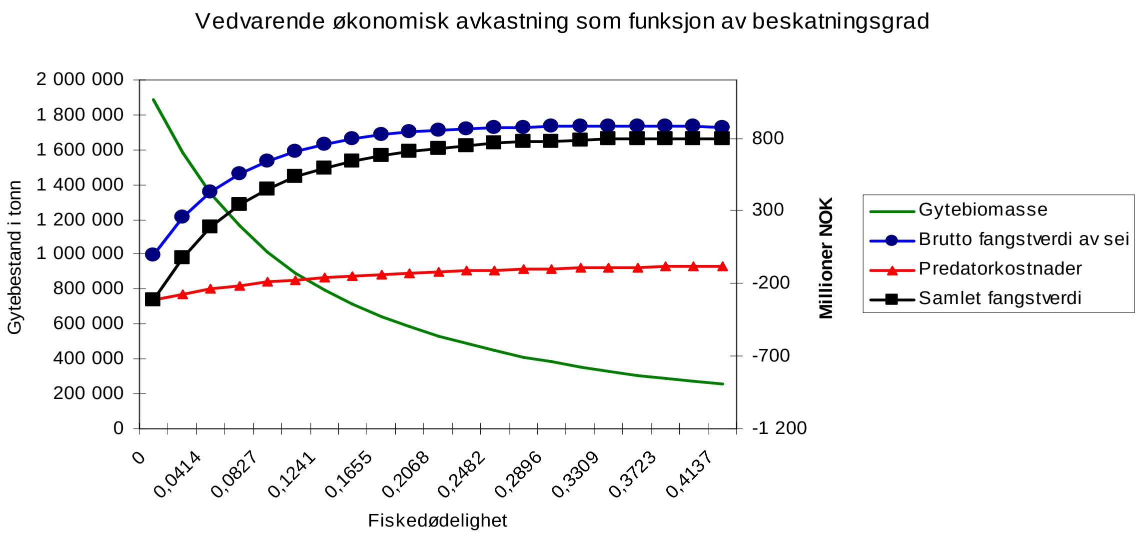

Figure 2 Spawning stock biomass, gross first hand value of saithe, predator costs and total catch value in relation to fishing mortality. First hand value of saithe is 6 NOK/kg., first hand value of herring is 2 NOK/kg.

Finally it was evaluated if these costs imply that the suggested management strategy should be changed. There are large uncertainties connected to all the factors that enter the estimations. The estimations was, however, carried out to get an indication of what the costs of the saithe's predation on herring could imply and how it could affect the choice of management strategy for saithe.

The following was concluded:

- The saithe's predation on herring reduces the economic yield in the herring fishery
- When the price of saithe increases relative to the price of herring, the costs of predation are of less importance for the total economic yield in the saithe and herring fisheries.
- If the predation on herring is reduced proportionally with a reduction in saithe stock size, the total economic yield will increase with increasing fishing mortality in the saithe fishery in the whole interval considered (0-0.41), but the increase is marginal for Fs above 0.30.

Depending on the assumptions made, these analyses indicate that the exploitation level of Northeast Arctic saithe should be in the interval 0.30 – 0.35. The total economic yield in the saithe and herring fisheries will, however, not increase significantly if the fishing mortality of saithe is increased from 0.30 to 0.35, while the expected spawning stock biomass of saithe is somewhat reduced. Considering the uncertainties in all data and stock assessment and the need for stability in quotas from year to year, one should consider carefully if such a marginal increase in expected economic yield is preferred.

5. GENERAL CONSIDERATIONS FOR EVALUATION OF HARVEST CONTROL RULES

Evaluation of HCRs is usually done using simulation models for the population(s) in question. The scope, nature and quality standards of simulation models that may be used in order to evaluate HCRs are discussed e.g. by Skagen *et al*. (2003) and described by SGMAS (ICES 2005/ ACFM:09, ICES 2006/ACFM:15, ICES 2007/ACFM:04). SGMAS also gives guidelines for evaluation of management strategies.

Important issues for evaluation of harvest control rules are:

- Choice of population model
- Inclusion of uncertainty in population model
- Use of long-term and/or medium-term simulations
- Choice of initial values for simulations
- Choice of harvest control rules for use in the evaluation (constant F rules, how to reduce F when SSB<B_{pa} , limit on year-to-year variation in catch etc.)
- Performance measures for harvest control rules (yield, stock size, F, probability of SSB<B_{lim}, annual variation in catches etc.)

These issues are addressed below.

6. POPULATION MODEL USED

Several variants of the population model were tried. In all cases, 2000 simulations for the period 2006-2126 were performed and the results for the last 100 years of this period were considered. This is done in order to exclude the effect of the initial values. The stock size for 2006 (initial data) was taken from the 2006 assessment.

The 'default' model was:

- A Beverton-Holt spawning stock-recruitment model with lognormal error distribution
- Assessment error and bias are estimated as age-dependent, normally distributed.
- Density-dependent weight at age in catch (average for 1981-2005 used for age groups where density-dependence was not found)
- Weight at age in stock is set equal to weight at age in catch

- Time series (1986-2005) average used for maturation at age without density-dependence
- No uncertainty in weight at age, maturity at age or natural mortality at age
- Exploitation pattern: 1997-2005 averages used for all age groups in all years
- Implementation of catch: First, the catch at age is calculated from the perceived stock using the fishing mortality derived from the harvest control rule and the given exploitation pattern. This catch at age is then applied to the actual stock.
- Implementation error and bias is estimated using the same percentage for all age groups

Recruitment

The recruitment dynamics shows some relatively clear changes over time. This is not to easily infer from the pattern of residuals over time, but are quite clear when visualizing the dynamics using 5 year running means for both SSB and recruitment.

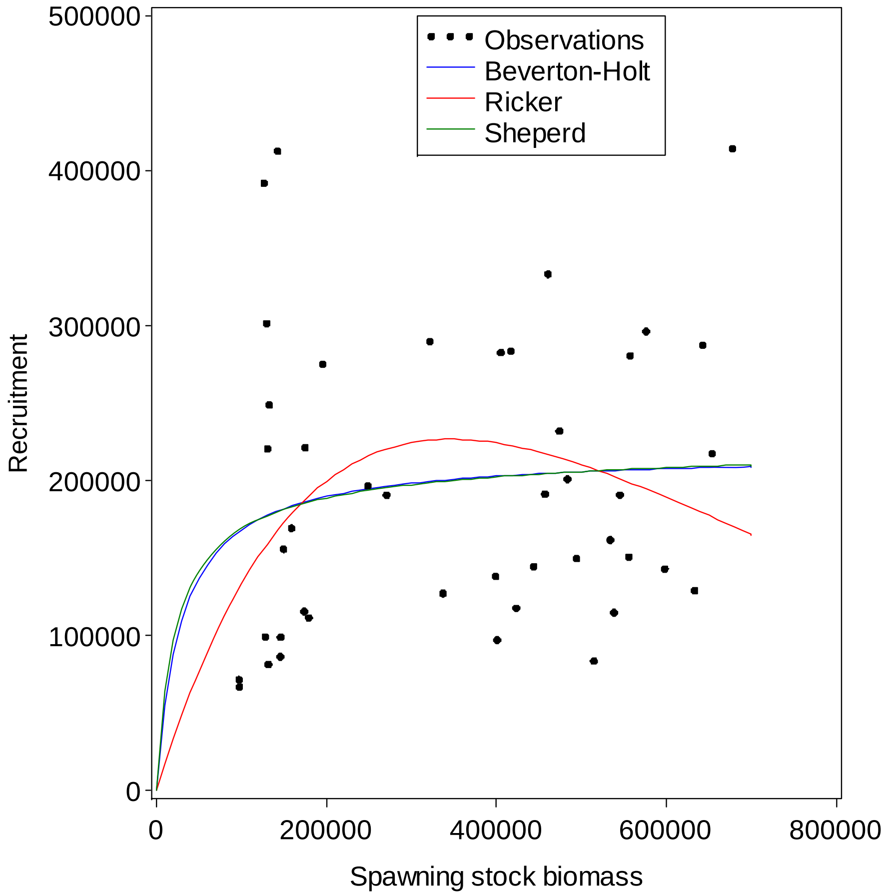

Figure 3. Spawning Stock - Recruitment (age 3) plot for North East Arctic Saithe.

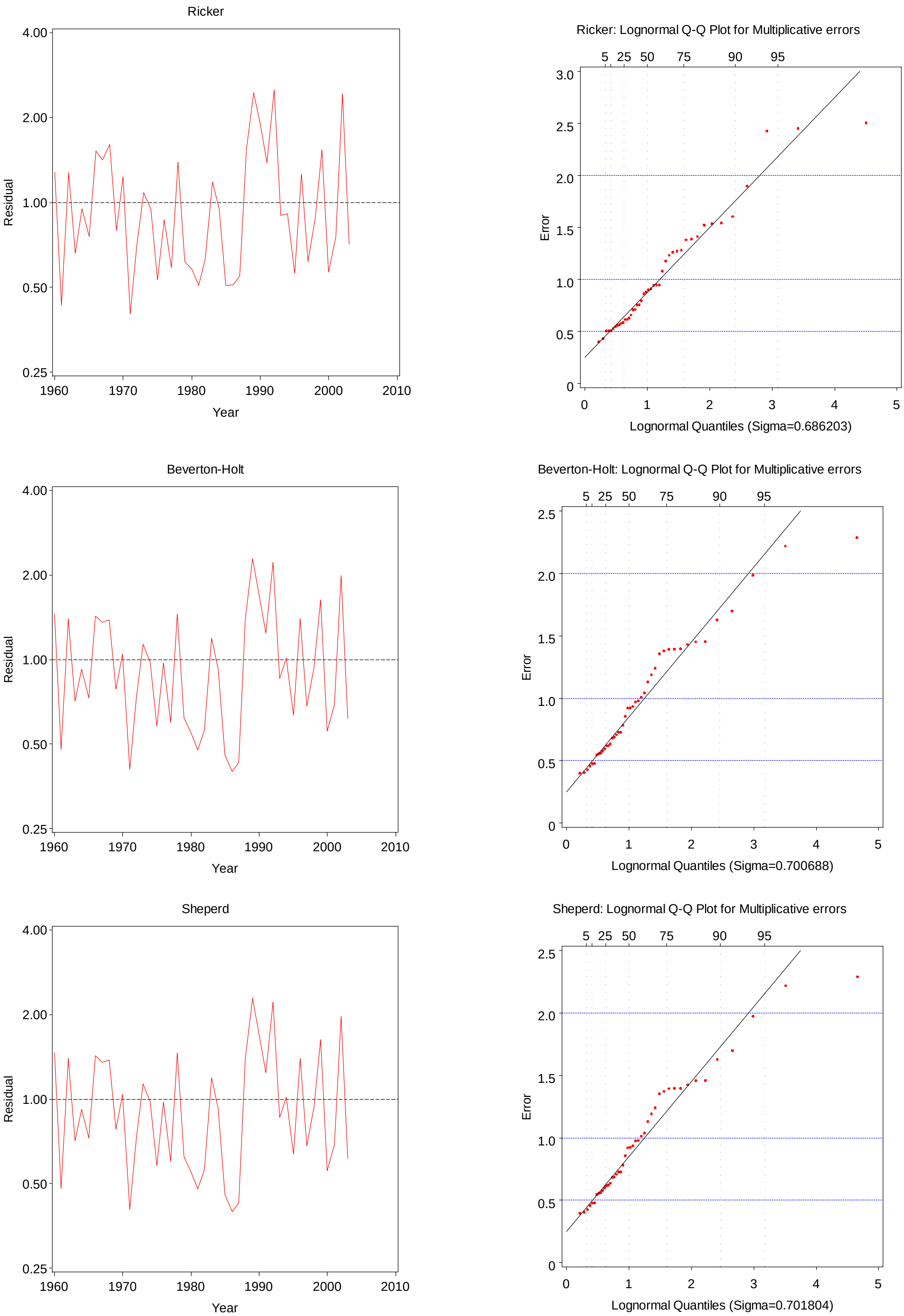

Figure 4. Multiplicative residuals (left) and their Lognormal Q-Q plot (right) for different SR model fits.

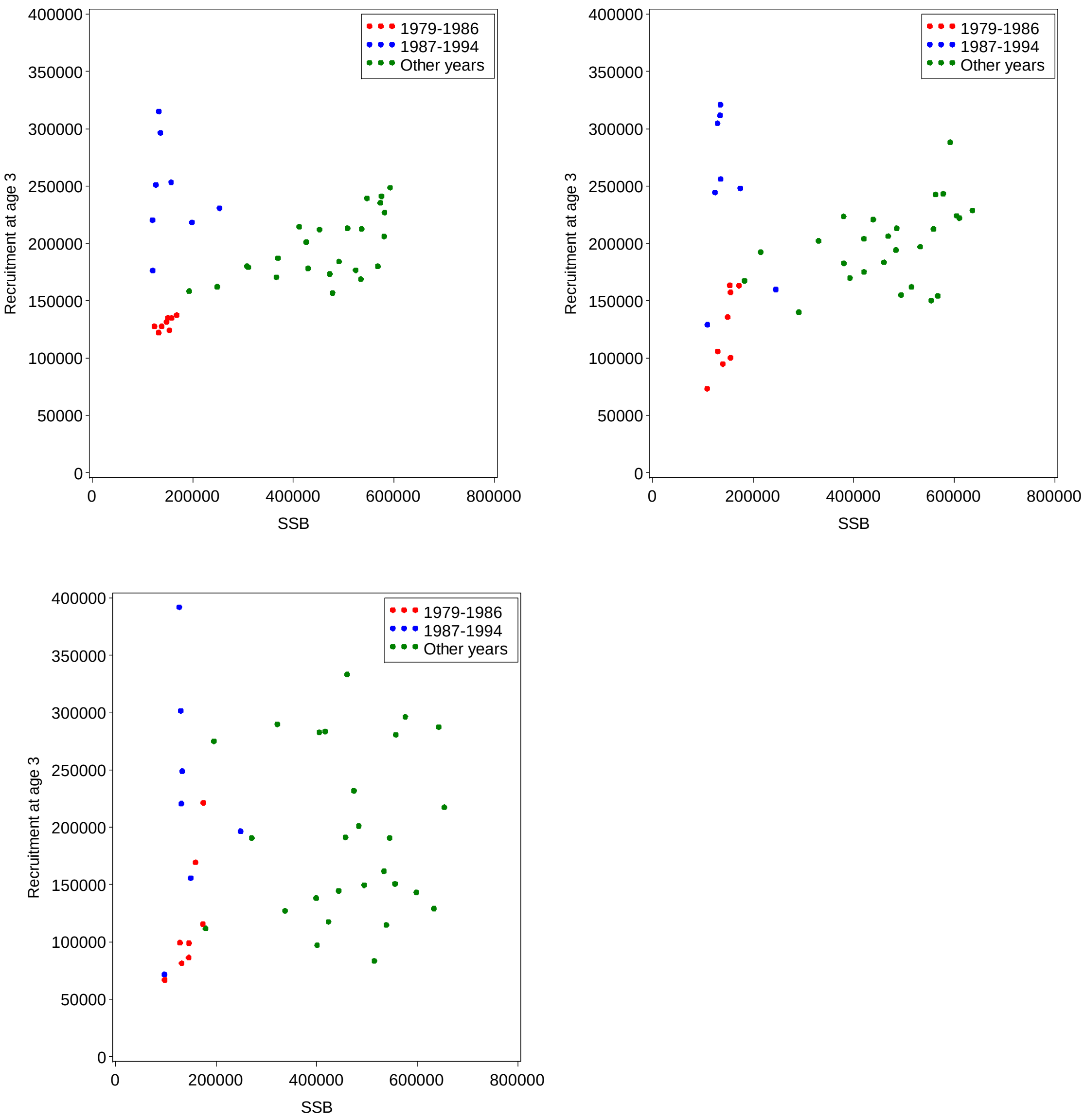

Figure 5. SSB vs R using 5 year running mean (upper left), SSB - R using a 3 year running mean (upper right) and the SSB-R plot (bottom left) with the points grouped into different time periods.

For modelling recruitment, we followed the approach outlined by Skagen and Aglen (2002). They suggested 3 quality criteria for stochastic stock-recruitment functions:

1) Independence between residuals and SSB
2) Probability coverage
3) The recruitment estimates should be unbiased.

We tried both a Beverton-Holt, Ricker and segmented regression stock-recruitment relationship as well as normal and log-normal error distributions, and found a Beverton-Holt relationship with a log-normal error distribution to give the best fit to the data. A constraint on the sum of the difference between modelled and observed recruitments being zero was applied.

The Beverton-Holt stock-recruitment function with a log-normal error distribution is given by

$$R = \frac{a * SSB}{b + SSB} e^{\varepsilon}$$

where the stochastic term ε is normally distributed N(0,σ).

The fit was done using Solver in Excel spreadsheets described by Skagen and Aglen (2002).

The following values of a, b and σ were estimated (units: tonnes and thousand of fish)

a=207703, b=49415, σ = 0.478

Criterion 1) was been tested for by looking at the deterministic stock-recruitment function (Fig. 6). The residuals are not correlated with SSB, but the variability in recruitment seems to be higher at low SSBs, and this could be modelled by making the variance a function of SSB.

2) is a control that the distribution assumed for the residuals is adequate, while 3) may be used as an additional constraint when finding the parameters of the stock-recruitment function.

Assuming that each of the historic residuals is equally likely, the rank of each of them, divided by the number of observed residuals, gives the empirical cumulated probability of the historical residuals. On the other hand, according to the model that is assumed for the residuals in the prediction, there corresponds a cumulated probability for the value of each observed residual. Each of these model probabilities should be close to the empirical cumulated probability of the same historic residual. The Kolmogorov goodness of fit test is based on this reasoning, and the Kolmogorov test statistic can be derived directly from the pairs of modelled and observed values.

Figures 7 and 8 show the probability coverage and observed vs. modelled recruitment for this distribution. The fit seems to be rather satisfactory.

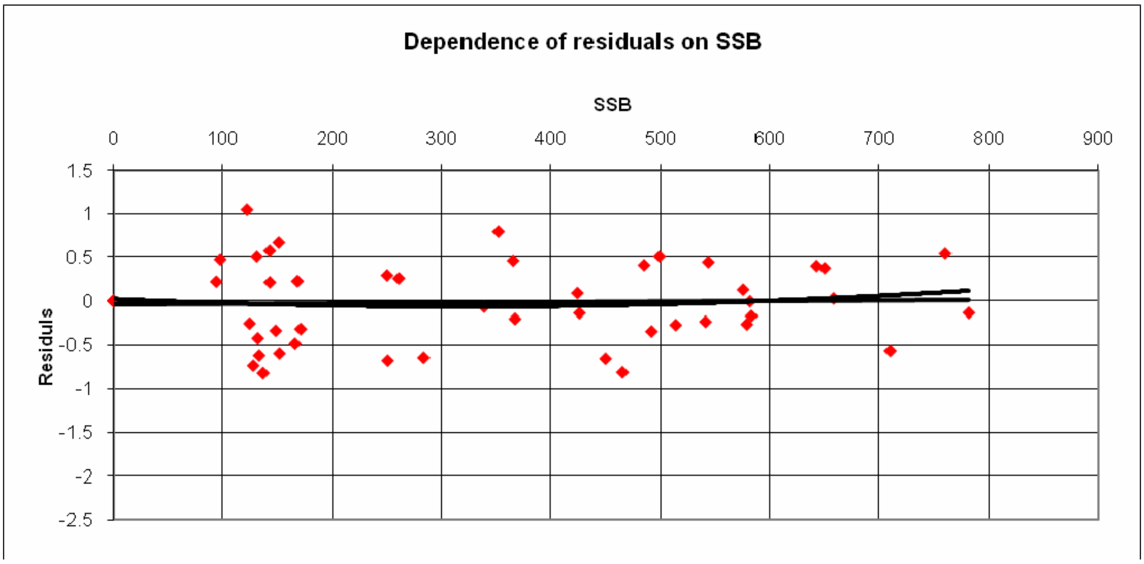

Figure 6. Residuals with linear and 2nd order trend lines relative to SSB.

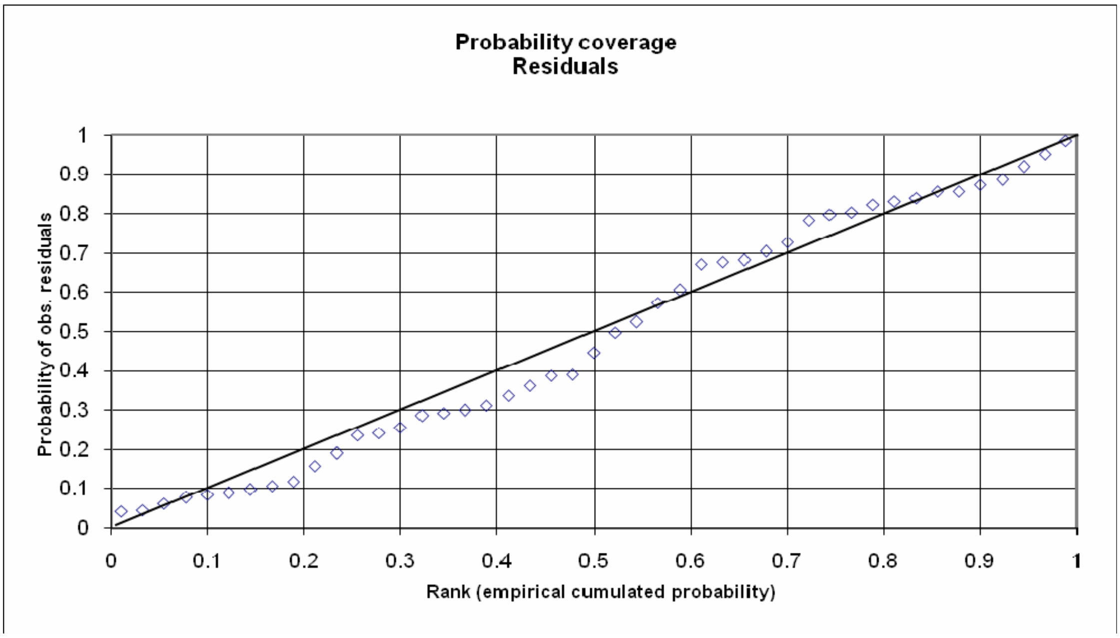

Figure 7. Probability coverage of residuals

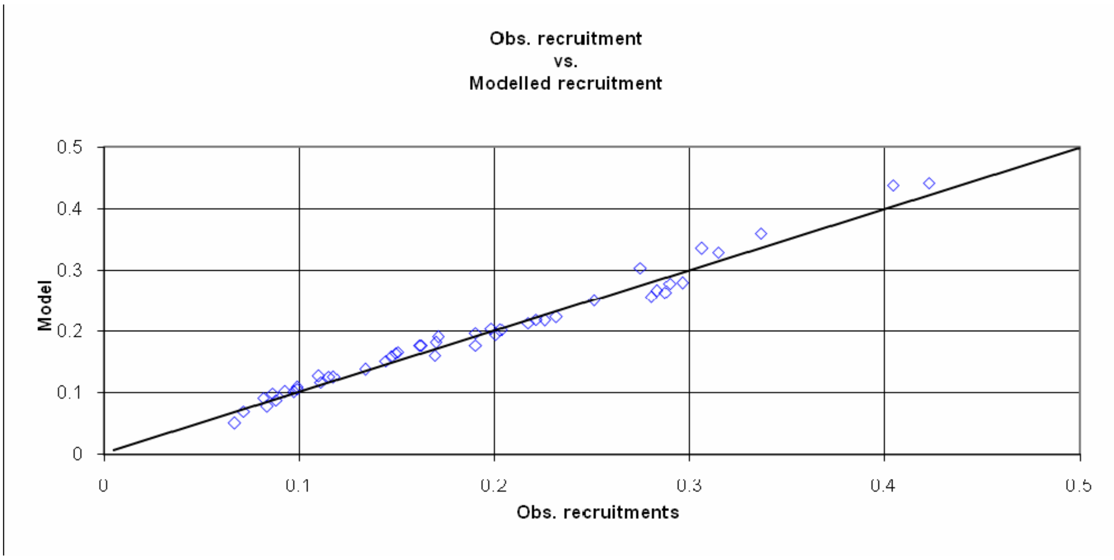

Figure 8. Observed cumulative frequency of recruitment vs. modelled cumulative frequency of recruitment

Growth (weight at age)

Growth is modelled as density dependent. We have used the time series of catch weights in 1990-2005 vs. total stock biomass in 1989-2004 to fit a density-dependent model for weight at age (kg) in the stock $ws_{a,y}$ for ages 3-10. The model is of the form

$$ws_{a,y} = -\alpha_a TSB_{y-1} + \beta_a \text{ , where}$$

TSB_y is the total stock biomass in year y, a is age and α_a and β_a are constants. Regressions are shown in Figure 9a-i and the parameters in the regressions are given in Table 1.

Age	α_a	β_a	R^2	p
3	-0.0489	0.70432	0.0257	> 0.05
4	-0.1487	1.12823	0.0903	> 0.05
5	-0.4365	1.89119	0.2803	> 0.05
6	-0.599	2.58340	0.3783	0.029
7	-0.931	3.51032	0.4217	0.024
8	-1.1976	4.38208	0.4562	0.030
9	-1.3471	5.20247	0.4244	0.046
10	-1.5778	6.15132	0.4258	0.002

Table 1. Parameters in regression for density-dependent weight at age in catch

The relationship for ages 3-5 is insignificant. For those ages TSB could not be used as predictor and we use average values for these age groups. For age 10+ we also use a historic average.

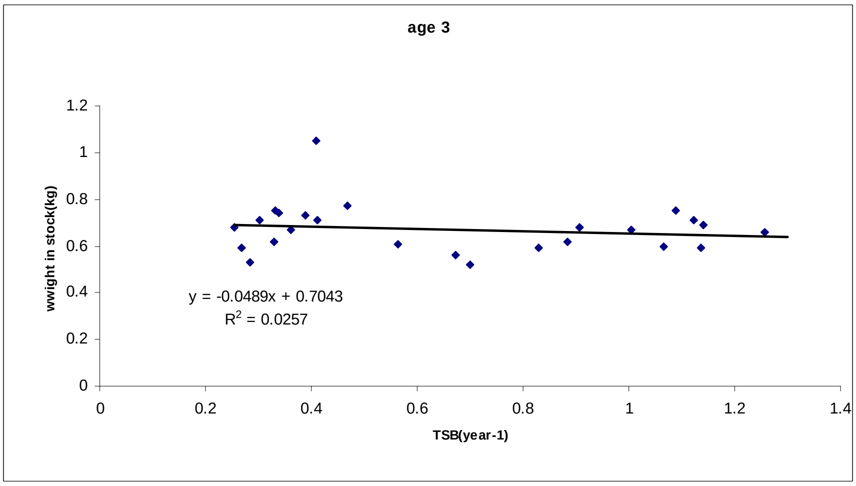

Figure 9a. Weight in catch vs. total stock biomass for age 3 saithe

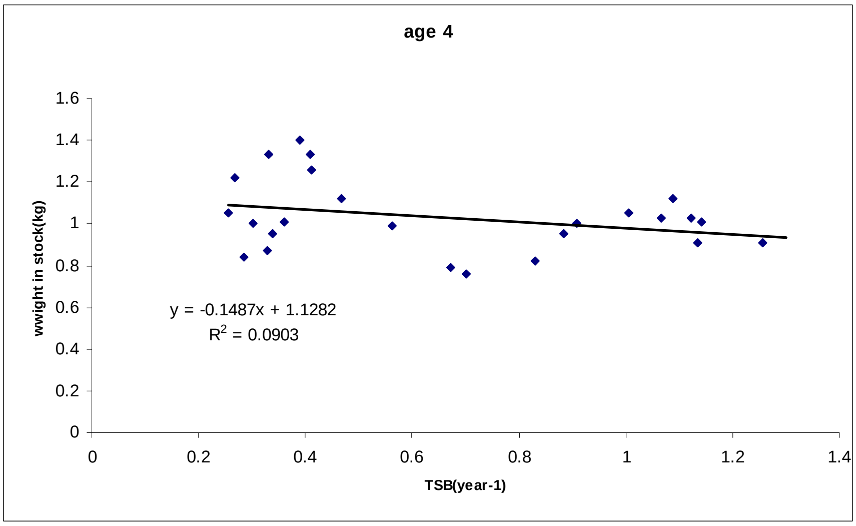

Figure 9b. Weight in catch vs. total stock biomass for age 4 saithe

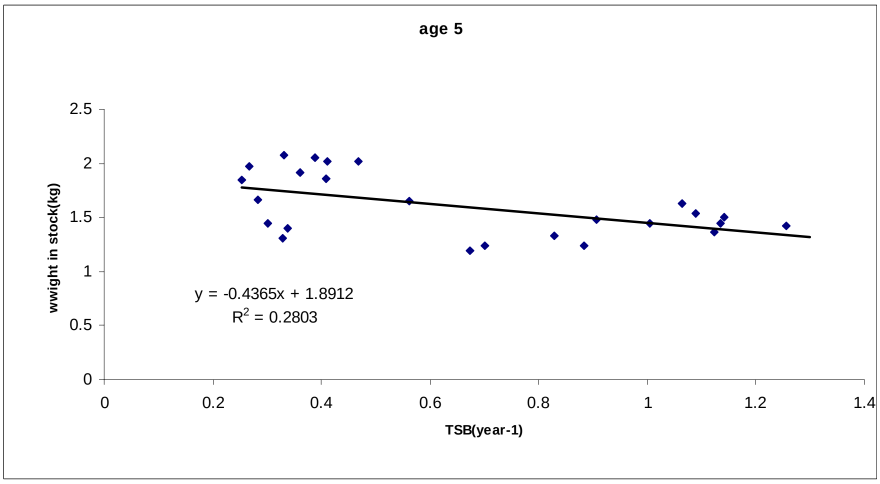

Figure 9c. Weight in catch vs. total stock biomass for age 5 saithe

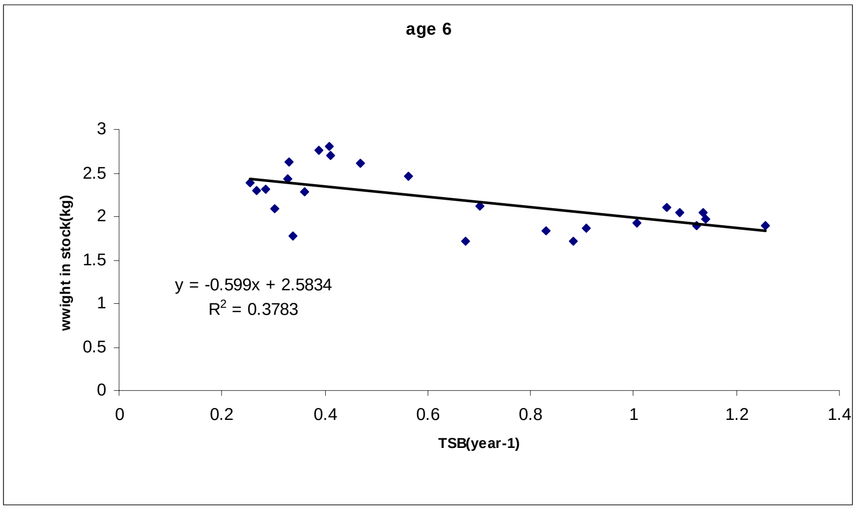

Figure 9d. Weight in catch vs. total stock biomass for age 6 saithe

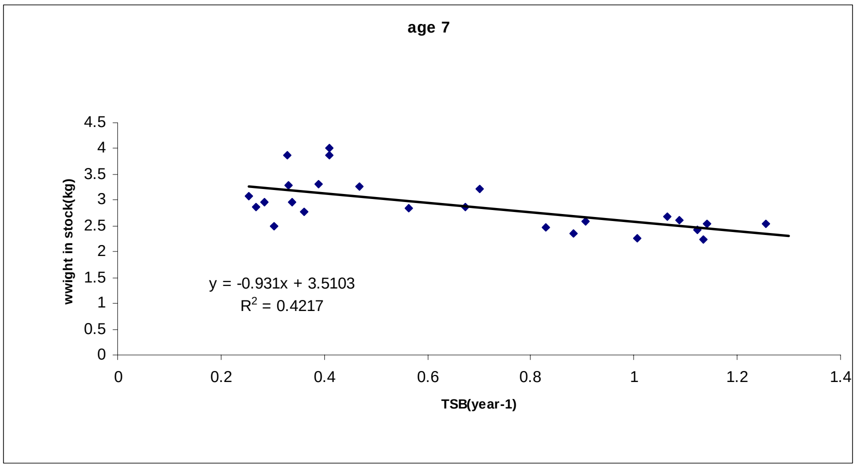

Figure 9e. Weight in catch vs. total stock biomass for age 7 saithe

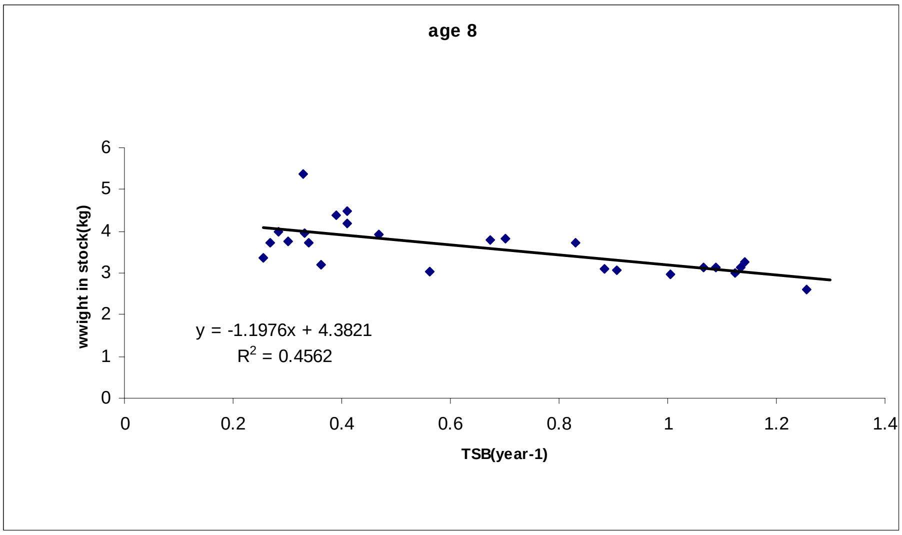

Figure 9f. Weight in catch vs. total stock biomass for age 8 saithe

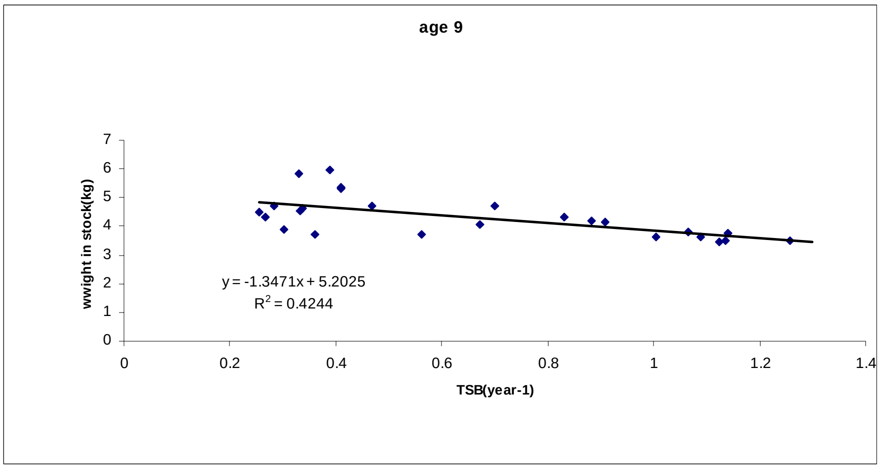

Figure 9g. Weight in catch vs. total stock biomass for age 9 saithe

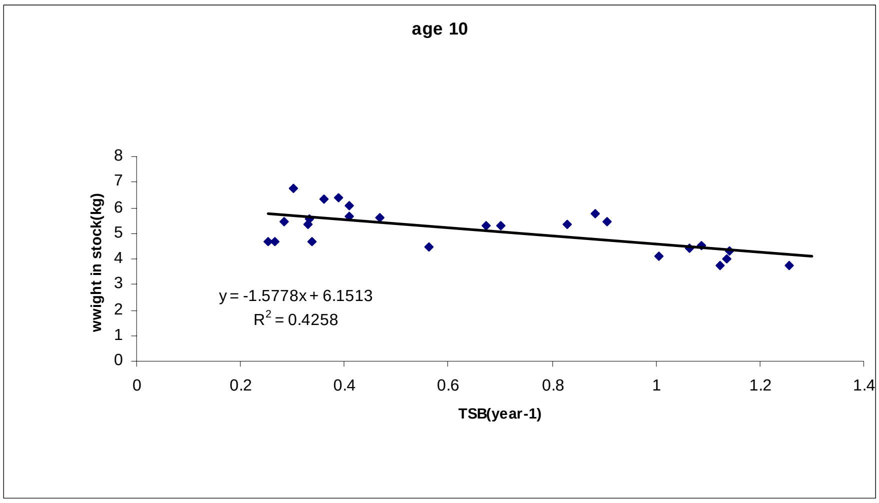

Figure 9h. Weight in catch vs. total stock biomass for age 10 saithe

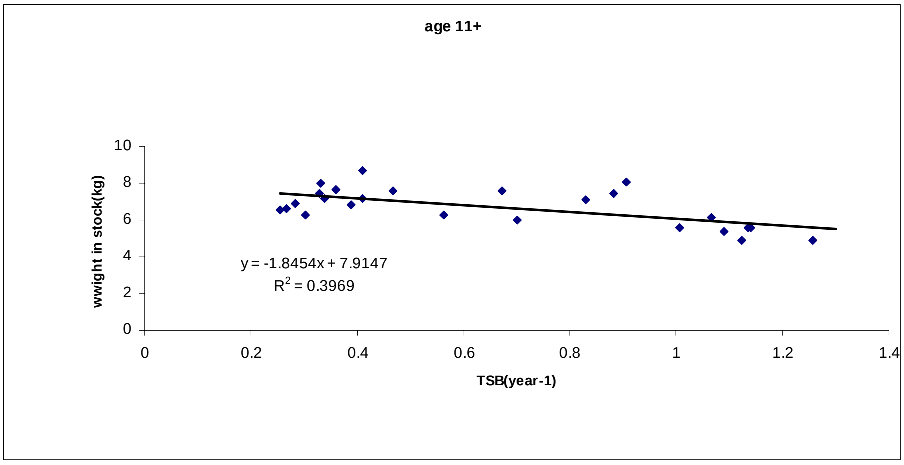

Figure 9i. Weight in catch vs. total stock biomass for age 11 saithe

Maturity

Maturity at age was analysed for density dependence, but no significant results were found. Therefore the time series (1986-2005) average was used for maturation at age.

Fishing mortality/fishing pattern

The exploitation pattern has improved over the last ten years with much lower catches of 2 and 3 year old fish, while the element of larger fish has been increasing. The minimum landing size was increased in 1999, but the improvement started even before this, partly due to regulations and partly due to better prices for larger saithe. There is no reason to include periods when the pattern was significantly different from what it can be expected to be in the future, due to different regulations. We have therefore used the 1997-2005 averages by age for all years (Table 2). Since the fishing patterns are calculated by a VPA, the computed Fs contain all the noise in the catch data. It may be necessary to smooth the fishing pattern in order not to include more noise than appropriate.

Table 2. Exploitation pattern 1997-2005 with average for the period

	Year									1997
Age	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2005**
3	0.0662	0.0258	0.0344	0.0713	0.0215	0.0220	0.0237	0.0064	0.0444	0.0351
4	0.1105	0.1221	0.1351	0.1064	0.0818	0.1299	0.2317	0.0796	0.1224	0.1244
5	0.2049	0.1576	0.2533	0.1186	0.178	0.1640	0.1382	0.2379	0.1644	0.1797
6	0.2655	0.2910	0.1991	0.1795	0.1921	0.2561	0.1410	0.1523	0.2447	0.2135
7	0.2927	0.2605	0.2816	0.1734	0.1753	0.1702	0.1408	0.2148	0.2202	0.2144
8	0.2278	0.1875	0.1583	0.1915	0.1270	0.1512	0.2617	0.1727	0.2461	0.1915
9	0.1435	0.1361	0.1650	0.1709	0.1579	0.1338	0.1776	0.2048	0.2113	0.1668
10	0.1720	0.1849	0.1530	0.1909	0.1921	0.1659	0.2013	0.2299	0.3186	0.2010
11+	0.1720	0.1849	0.1530	0.1909	0.1921	0.1659	0.2013	0.2299	0.3186	0.2010

Assessment and implementation error

Assessment and implementation error and bias are estimated explicitly as percentages of stock over/under estimation and over/under fishing. The assessment bias and error are modelled as age-dependent, with no correlation between age groups. The pattern used is based on an historical analysis. Two approaches were used to estimate the pattern. First, the bias in the number at age in the period 1999-2005 was calculated by comparing the estimated number at age in the year when the assessment was carried out, to the number at age from the 2006 assessment (Year-by-year method). The mean and standard deviation of this ratio was calculated for each age group. Second, the retrospective VPA-runs were compared to the assessment in 2006, to estimate the bias (Retrospective method). Data from 1999 to 2005 were used to calculate the relative bias and corresponding standard deviations. It was decided to apply for all age groups normal distributed errors around the mean values for the age group with the largest σ, truncated at ± 2.5σ. The two approaches are compared in the text table below:

Method	Age	3	4	5	6	7	8	9	10	11+
Year-by-year method	Bias	1.00	1.05	0.58	0.56	0.49	0.43	0.43	0.38	0.61
	St. dev	0.37	0.39	0.29	0.25	0.19	0.17	0.18	0.19	0.58
Retrospective method	Bias	1.00	1.05	0.62	0.60	0.50	0.47	0.46	0.42	0.71
	St. dev	0.39	0.47	0.26	0.21	0.17	0.15	0.18	0.20	0.65

The two methods gave quite similar results, and a year-by-year analysis for the period 1995-2001 also gave similar results, but with a slightly lower bias. For both methods the 11+ group showed an opposite trend in the last year (2005), i.e. an overestimation in the assessment year. This result was confirmed by preliminary analysis of 2006 data (2007 assessment), and it was decided not to smooth or average the 11+ group data. Because the assessment methodology and settings have varied considerably during the period, it was decided to base the analysis on the estimated bias and variance from the retrospective runs. In periods of stock decrease, the trend of the bias may change from positive to negative, as for NEA cod in the last half of the 1990s. It was therefore decided to also perform analyses with the opposite trend in assessment bias.

Implementation error and bias is modelled using the same percentage for all age groups. To explore the amount of bias and error to introduce, the relation between catch and quota for the period 1989-2006 was fitted to a normal distribution. The fit was considered acceptably good for the purpose and the estimated parameters were $\mu = 1.032$ and $\sigma = 0.09$. Thus, it was decided to include a bias of 3% with normally distributed error with a CV of 0.08 truncated at $\pm 2.5\sigma$ for all age groups.

Reality check

A reality check of the 'default' model was made with $F_{4\text{-}7} = 0.38$ for all SSB levels, 50% maximum year-to-year-change in TAC and three options for assessment error. $F_{4\text{-}7} = 0.38$ is equal to the average fishing mortality for the period 1960-2005. Three runs were performed, one with no assessment error (option 1), one with assessment error estimates based on the period 1999-2005 (option 2) and one with an opposite trend in assessment error (option 3). For option 1 the realised F is slightly higher than 0.38 due to the implementation error included in the simulations. Recruitment, TSB and SSB are all close to the VPA average. The stock sizes are much higher for option 2 with a positive retrospective trend in assessment error while with the opposite trend (option 3) the stock sizes are lower than the historic averages. The catches from all simulations are higher than the historic average due to a better fishing pattern in the simulations. The runs indicate that the model performs reasonably well at this level of fishing mortality. The small difference between the VPA average F and the average F in the simulation option 1 is due to the implementation bias.

	$F_{4\text{-}7}$	Recruitment (million)	TSB (1000 t)	SSB (1000 t)	Catch (1000 t)
VPA average 1960-2005	0.38	189	696	366	160
Simulation result opt. 1	0.395	200	771	378	193
Simulation result opt. 2	0.30	209	983	572	186
Simulation result opt. 3	0.53	195	673	292	192

7. SOFTWARE USED

The simulations were carried out using the PROST software for stochastic projections (Åsnes 2007). PROST was especially developed for this purpose because existing software for harvest control rule simulations such as WGMTERM, STPR and CS5 do not incorporate the 3-year averaging process (hereafter called the '3-year-average-rule') for setting TAC given by the agreed decision rule. However, PROST is intended as a general tool for stochastic projections.

8. MATHEMATICAL FORMULATION OF THE RULE

Let y denote the year for which the quota is to be set. Let the term "3-year rule (F1, x)" denote applying the 3-year average rule described above with $F_{4\text{-}7}$ = F1 and an x % limit on year-to-year changes in TAC. The limit on increase of TAC from year to year could be set different from the limit on decrease from year to year, but such asymmetric rules were not tested. It is assumed that SSB(y) is not affected by F(y), which is in line with the current settings used by AFWG (the proportion of F and M before spawning is set to 0).

The rule can then be described in the following way:

If SSB(y) > B_{pa} then

if SSB(y-1) > B_{pa} and SSB(y+1) > B_{pa} and SSB(y+2) > B_{pa}

F(y) set by 3-year rule(0.35, 15)

else

F(y) set by 3-year rule(0.35, unconstrained)

else

F(y) set by 3-year rule($0.35\dfrac{SSB(y)}{B_{pa}}$,unconstrained)

SSB(y+1) and SSB(y+2) in this calculation is derived using F=0.35 in years y and y+1.

In addition, we will test the performance of the rule in a situation where stock rebuilding is needed.

9. LONG-TERM SIMULATIONS

The various settings used in long-term simulations are described in Table 3, and the results of the simulations are described in Table 4.

Table 3. Settings for each run

Run No.	F	3-year rule	Option for assessment error	Percent change TAC	F below Bpa
1	0.35	No	1	15	Flat
2	0.35	Yes	1	15	Linear
3	0.35	Yes	2	15	Linear
4	0.35	Yes	3	15	Linear
5	0.35	Yes	2	10	Linear
6	0.35	Yes	3	10	Linear
7	0.35	Yes	2	20	Linear
8	0.35	Yes	3	20	Linear
9	0.30	Yes	1	15	Linear
10	0.30	Yes	2	15	Linear
11	0.30	Yes	3	15	Linear
12	0.25	Yes	1	15	Linear
13	0.25	Yes	2	15	Linear
14	0.25	Yes	3	15	Linear

Most of the results of the simulations are quite similar. Catches range from 174 000 to 200 000 tonnes, recruits from 195 to 214 millions, while the variations in estimated biomasses are larger, SSB range from 317 000 to 850 000 tonnes. Only in one case, with an opposite retrospective trend and for the highest F alternative, there is a very small risk of falling below

Table 4 Results of long-term simulations. Catch, TSB and SSB in 1000 tonnes, recruits in millions.

Run No.	Error option	In-put F	Realised F	Catch	TSB	SSB	Recr.	% years SSB< B_{lim}	% years SSB< B_{pa}	Average year-to-year change in TAC
1	1	0.35	0.36	194	823	421	202	0	0	5
2	1	0.35	0.37	194	813	413	202	0	0.001	3
3	2	0.35	0.29	185	1015	602	209	0	0	10
4	3	0.35	0.48	193	703	317	195	0	3	8
5	2	0.35	0.29	184	1016	602	209	0	0	8
6	3	0.35	0.48	193	704	318	195	0.005	3	7
7	2	0.35	0.29	185	1017	603	210	0	0	11
8	3	0.35	0.48	193	702	317	195	0	3	9
9	1	0.30	0.32	196	917	499	206	0	0	3
10	2	0.30	0.25	181	1140	713	212	0	0	10
11	3	0.30	0.41	198	790	384	201	0	0.049	8
12	1	0.25	0.26	194	1044	609	210	0	0	3
13	2	0.25	0.21	174	1291	850	214	0	0	9
14	3	0.25	0.33	200	897	473	205	0	0	8

$B_{lim.}$ However, the risk is so low that it is not considered not to be consistent with the precautionary approach. Catches are in general highest for option 3 and lowest for option 2, and the opposite for the biomass estimates, while option 1 (no assessment error) is intermediary. In a situation with underestimation of stock size in the assessment year (option 2), the highest exploitation rate (F=0.35) give the highest catches, for the opposite trend in assessment error F=0.25 gave the highest catch, while for no assessment error (option 1) the long-time yield is quite similar for all exploitation levels. For all three options the highest biomass estimates are found at the lowest exploitation level. And in a situation with an opposite trend in assessment error (option 3) the risk of falling below B_{lim} will increase for increasing exploitation level and/or for increasing assessment bias. The highest average year-to-year change in TAC of 11 % was found in run 7 where the limit was set to 20 %. The part of the HCR limiting the annual change in TAC to 15 % is therefore probably not too restrictive and it was large enough to maintain SSB above B_{lim} in practically all the simulated cases.

10. CONSEQUENCES OF THE RULE IN A PERIOD OF RECOVERY

To study the performance of the rule in a stock recovery situation we made runs starting in 1986 and ending in 1993. 1986 was chosen because it was a year with a fairly low stock size, the total stock size was 284 000 tonnes and the SSB was 98 000 t, i.e. below B_{lim}.

For 1986, the weight at age in the stock and in the catch, maturity-at-age, natural mortality at age, fishing pattern and F were set to the same values as used in the assessment made by the ICES Arctic Fisheries Working Group in 2006. For 1986 and later years, the following values were used:

Recruitment at age 3: For the recruitment in 1987 and 1988 the same values as calculated in the 2006 assessment with a CV of 0.25 were used while for later years the stock-recruitment relationship from the long-term simulations of the HCR was used.

Weight, maturity and natural mortality at age: The same values as used in the 2006 assessment were used.

Fishing pattern: The average of the 1987-1990 pattern estimated by the 2006 WG was used.

Two runs were made, one with no bias in the assessment and on with an “opposite trend” in assessment bias compared to what is experienced in later years (option 3 in the long-term simulations). A CV of 0.25 was set for initial stock size in both runs and future stock assessments in the run with no bias (run 1), while for run 2 the same bias and bias and CV as in option 3 in the long-term simulations was used for future stock assessments. The implantation error was the same as in the long-term simulations of the HCR for both runs. 2000 simulations were performed in each case.

The results of the simulations are given in Tables 5-9. In run 1 the probability of SSB being below B_{lim} is 1 for the first year (1987), very low the next year and zero the following years. The probability for the SSB to be below B_{pa} is 1 during the first two years, but then decreases during the next three years. Also in run 2 the probability of SSB being below B_{lim} is 1 for the first year (1987), low the next year, very and zero the following two years and zero in the last year presented (1991). The probability for the SSB to be below B_{pa} is 1 during the first two years, close to 1 in the next two years but then decreases in the last year. The SSB reaches B_{pa} one year earlier in run 1 than in run 2, while realised F and catches are highest for run 2.

Table 5 Mean SSB (1000 tonnes) in 1986-1991 for different runs.

Run no.	Mean SSB 1986	Mean SSB 1987	Mean SSB 1988	Mean SSB 1989	Mean SSB 1990	Mean SSB 1991
1	98	87	181	203	227	279
2	98	87	164	182	191	231

Table 6 Probability of SSB <> B_{pa} in 1986-1991 for different runs.

Run no.	P(SSB < B_{pa}) 1986	P(SSB < B_{pa}) 1987	P(SSB < B_{pa}) 1988	P(SSB < B_{pa}) 1989	P(SSB < B_{pa}) 1990	P(SSB < B_{pa}) 1991
1	1	1	0.9785	0.7795	0.4085	0.0595
2	1	1	1	0.954	0.886	0.413

Table 7 Probability of SSB<> B_{lim} in 1986-1991 for different runs.

Run no.	P(SSB < B_{lim}) 1986	P(SSB < B_{lim}) 1987	P(SSB < B_{lim}) 1988	P(SSB < B_{lim}) 1989	P(SSB < B_{lim}) 1990	P(SSB < B_{lim}) 1991
1	1	1	0.0065	0	0	0
2	1	1	0.0745	0.0095	0.005	0

Table 8 Mean catches (1000 tonnes) in 1986-1991 for different runs

Run no.	Mean catch 1986	Mean catch 1987	Mean catch 1988	Mean catch 1989	Mean catch 1990	Mean catch 1991
1	71	43	95	114	128	136
2	71	57	100	126	138	138

Table 9 Mean F values in 1986-1991 for different runs

Run no.	Mean F 1986	Mean F 1987	Mean F 1988	Mean F 1989	Mean F 1990	Mean F 1991
1	0.54	0.21	0.36	0.41	0.41	0.39
2	0.54	0.33	0.49	0.57	0.54	0.51

These runs were made for a situation where the stock was low, but a strong year class was entering the fishable stock (the 1983 year class). Thus, this analysis does not cover all recovery situations.

11. CONCLUSIONS

The analyses presented indicate that the HCR proposed by The Norwegian Ministry of Fisheries and Coastal Affairs is in agreement with the precautionary approach, provided that the assessment uncertainty, assessment error and implementation error are not greater than those calculated from historic data and used in the evaluation.

According to the simulations made, the HCR will help rebuild the stock to above B_{lim} level within three years.

It should be noted that the conclusions drawn here is based on a risk level of 5 %. They will also hold for higher risk levels. The risk level to use should be decided by managers. If lower risk levels than 5 % is preferred, the harvest control rule should be evaluated against that level.

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Annex 3: Ad hoc group on NEA haddock HCR evaluation (14–16 June 2006)

Sondre Aanes, Bjarte Bogstad, Harald Gjøsæther and Knut Korsbrekke

1 Further simulations made to evaluate the NEA Haddock HCR

1.1 Background.

ICES (ie. the 2006 ACFM spring meeting) want a re-evaluation of management plan for NEA haddock, using another stock/recruitment relationship/pattern for haddock. Quote from mail from Hans Lassen to Harald Gjøsæter, dated 29 May 2006:

"*The result that was presented by the NEA Haddock management plan evaluation group was found by the review group to be lacking in particular with respect to the influence of the recruitment pattern. It was argued that the recruitment pattern is rather abnormal and that the standard model that was used did not fully include the special features that pertain to haddock. As the request from Norway and Russia in particular mentions the recruitment pattern we find that this should be addressed explicitly and with a model that include the special features of the haddock recruitment. It has been proposed that this should be done using the PROST model but also that this might involve some additional programming.*

The other issue is the implementation error and the management plan needs to be checked against (the evaluation report only includes 0% and 27% implementation error. we would like to see a more continuous range of values e.g. 0, 10, 20, 30 and 40%).

I hope that it will be possible for IMR to provide this background calculations within say 2 weeks to enable an advice before the end of June."

This document is not describing all aspects of the simulations and more information can be found in the WKHAD report and in AFWG report.

http://www.ices.dk/iceswork/wgdetailacfm.asp?wg=WKHAD

http://www.ices.dk/iceswork/wgdetailacfm.asp?wg=AFWG

1.2 Recruitment simulation

1.2.1 Previous simulations

The previous evaluations were based on simulations assuming a "hockey-stick" relationship between SSB and recruitment with lognormal multiplicative noise. This approach is limited in its ability to mimic the occasional strong yearclasses and periodicity in the recruitment. Predation from cod has a strong influence on the natural mortality before age 3. Estimated total natural mortality for age 1 and 2 (M=0.2+predation mortality) ranges from around M_{1-2}=0.5 to around M_{1-2}=4. This correspond to survival from age=1 to age=3 varying with a factor of more than 20. One should then expect periodicity in recruitment at age=3 due to the predation from cod.

1.2.2 Recruitment pattern

The stock/recruitment analysis given here is based on the summary table from the final assessment run (Table 4.21 in the working group report). Recruitment at age 3 was used and the year classes 1950-2002 were included in the analysis. The assessment was not used for predictions, but is assumed to reflect the recruitment dynamics.

Initial analysis: The 1950, 1964, 1969, 1983 and 1990 year classes are quite outstanding in the overall picture. The SSB and recruitment relationship is shown in Figure 1.1. The SSB and recruitment relationships were fitted without the "outstanding" year classes. The fitted curves are almost identical.

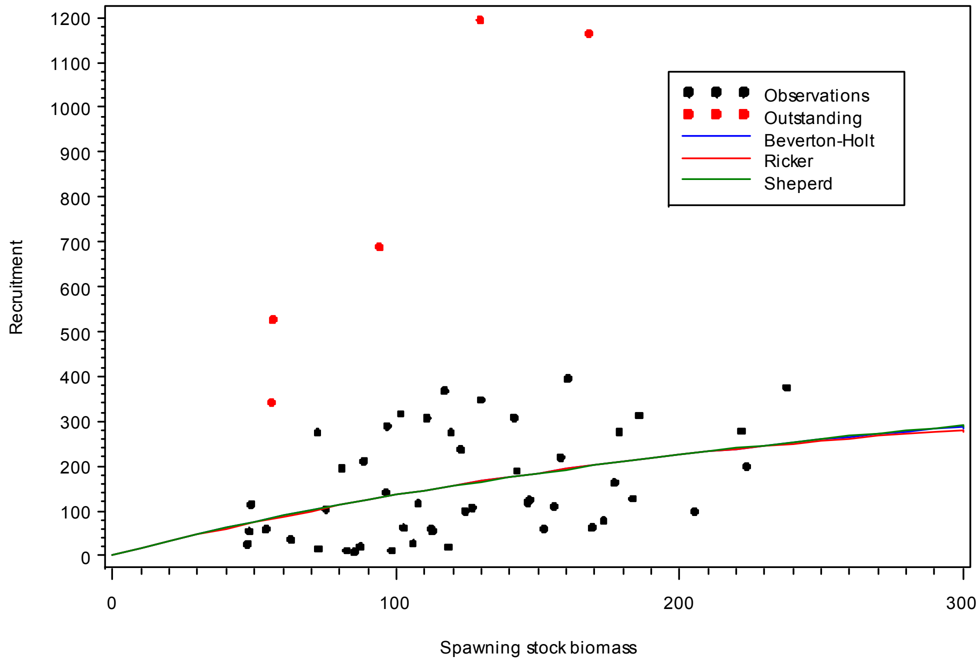

Figure 1.1 SSB and recruitment at age 3 1950-2002. The 3 recruitment functions shown were fitted with yearclasses 1950, 1964, 1969, 1983 and 1990 excluded.

The residual (multiplicative) error was calculated using the Ricker relationship. The distribution of the residuals was modelled assuming a lognormal distribution. The overall fit was rather poor. A histogram of the residual with the modelled lognormal distribution is shown in Figure 1.2. Part of the upper tail of the distribution is rather "heavy" corresponding to residuals around 2.0 being overly represented relative to a lognormal distribution.

The residuals were plotted against year in Figure 1.3. There are clear signs of periodicity in the later part of the time series. The 4 yearclasses closest to the 1983 and 1990 yearclasses are around twice as good as the fitted Ricker relationship and the years 1998-2000 seems to be in the same range, but without the "outstanding" yearclass. These yearclasses are marked with red in Figure 1.3. The highest residuals in the pre 1980 period are also shown in red. Some of these are neighbouring an outstanding yearclass (1963 and 1970) while 1959-1961 are more comparable with 1998-2000.

Choosing a recruitment pattern: The initial analysis described above suggests grouping the recruitment in three. The overall "low" recruitment, good recruitment related to some periods possibly linked with the "outstanding" yearclasses and the "outstanding" yearclasses themselves. The length of the periods with "low" recruitment is highly variable. The later part of the series (after 1980) shows period of length 4 or 5 years. The seventies was a long period with "low" recruitment while the early part had a more varying pattern.

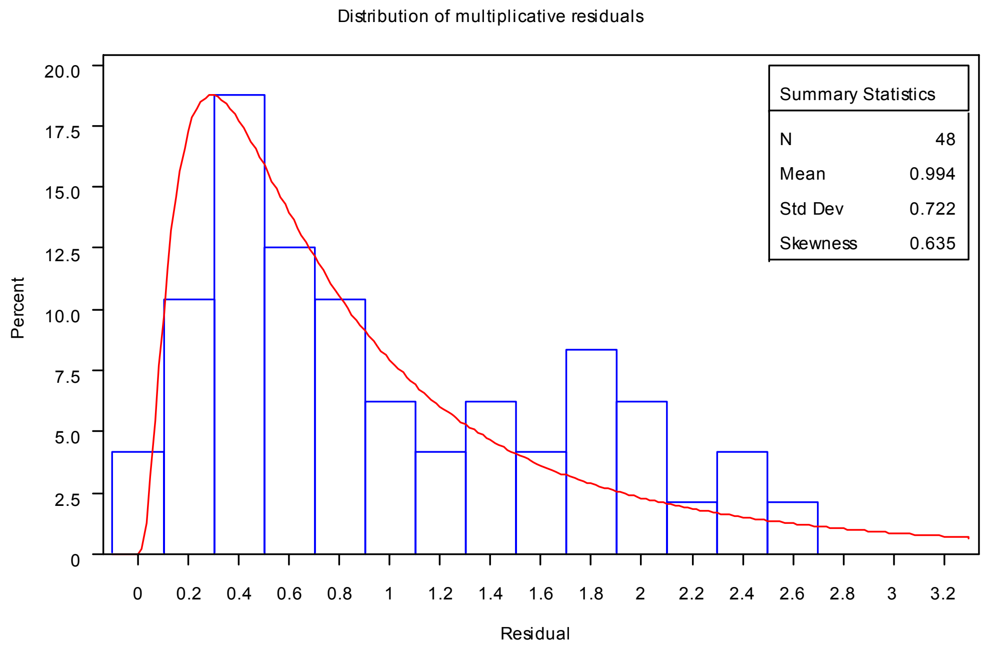

Figure 1.2 Distribution of multiplicative residuals with the modelled lognormal distribution.

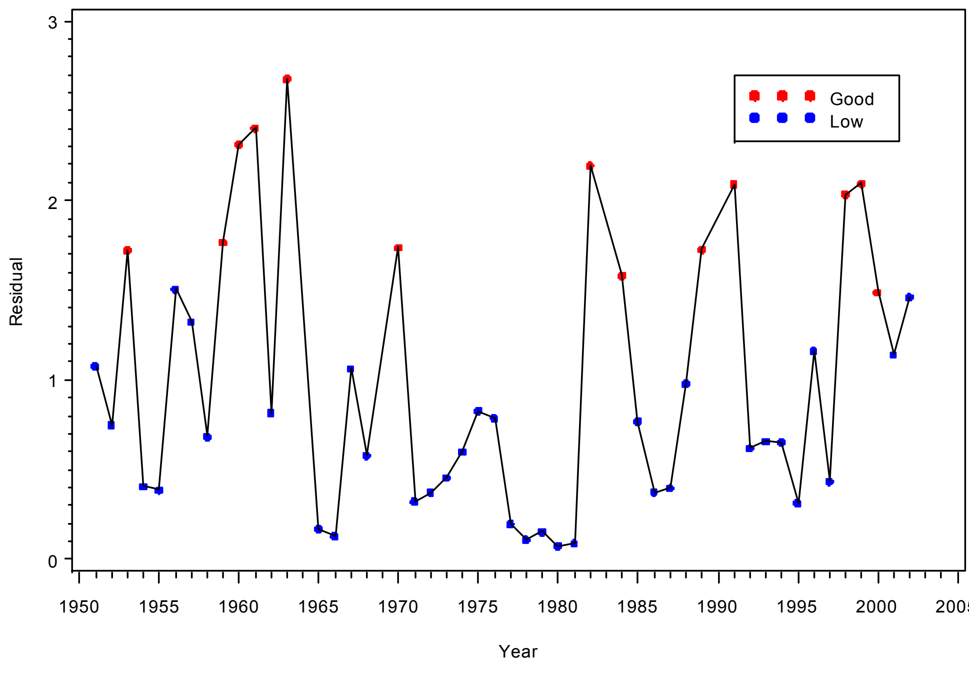

Figure 1.3 Multiplicative residual plotted against years (excluding 1950, 1964, 1969, 1983 and 1990).

1.2.3 "Low" recruitment

A separate recruitment function was fitted too the years with "low" recruitment identified as blue points in Figure 1.3. The fit is shown below with the actual fit in Figure 1.4 and relative to all observations in Figure 1.5. Please note the choice of 200 kt as a cutoff point for the Ricker function.

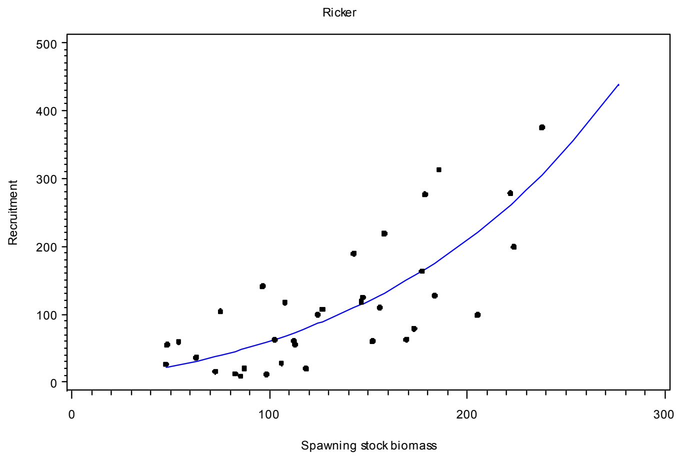

Figure 1.4 The Ricker fit for "low" recruitment periods.

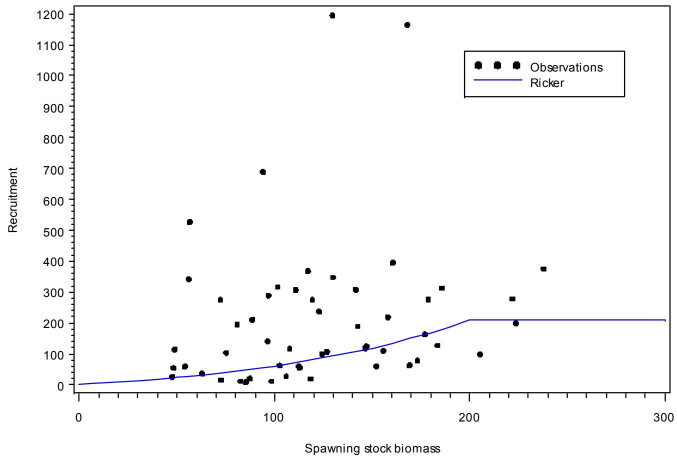

Figure 1.5 The Ricker fit compared with all observations.

1.2.4 "Good" recruitment

A similar recruitment function was fitted too the years with "good" recruitment identified as red points in Figure 1.3. The fit is shown below with the actual fit in and relative to all observations in . Please note the choice of 150 kt as a cutoff point for the Ricker function.

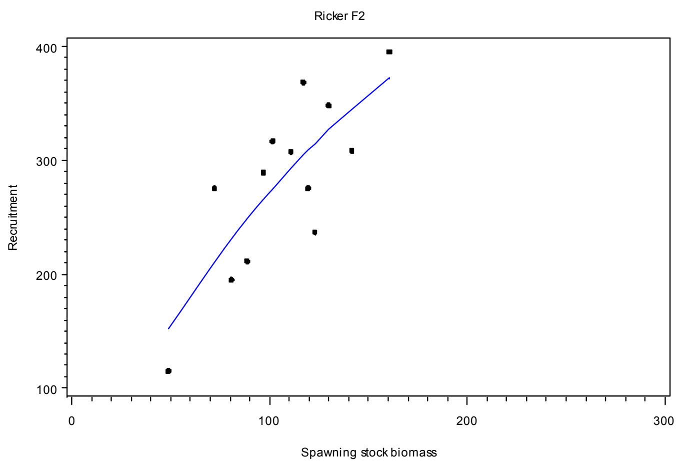

Figure 1.6 The Ricker fit for "good" recruitment periods.

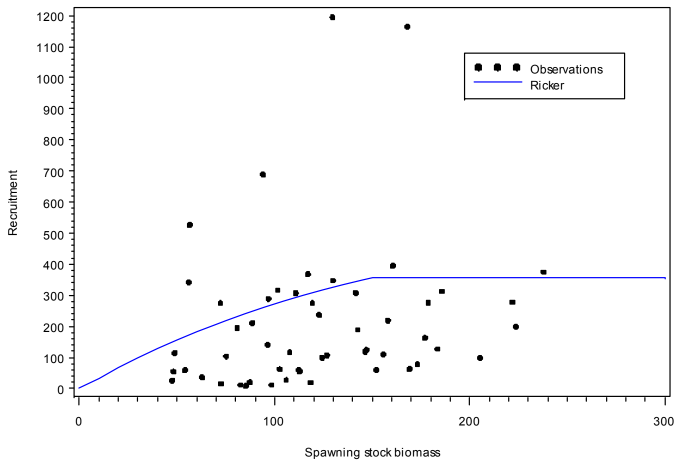

Figure 1.7 The Ricker fit compared with all observations.

1.2.5 "Outstanding" recruitment

Five of the yearclasses has a much higher recruitment relative to SSB than the other yearclasses. The yearclasses are 1950, 1964, 1969, 1983 and 1990 (red points in Figure 1.1). The "hockey-stick function showed in was chosen to represent "outstanding" recruitment. The 1950 and 1969 yearclasses are about twice as strong as the other yearclasses and appear to have been harvested at very high fishing mortalities well above the target mortality in this HCR. This is a source of potential extrapolation since the history does not contain information of "outstanding" yearclasses harvested around F_{PA}.

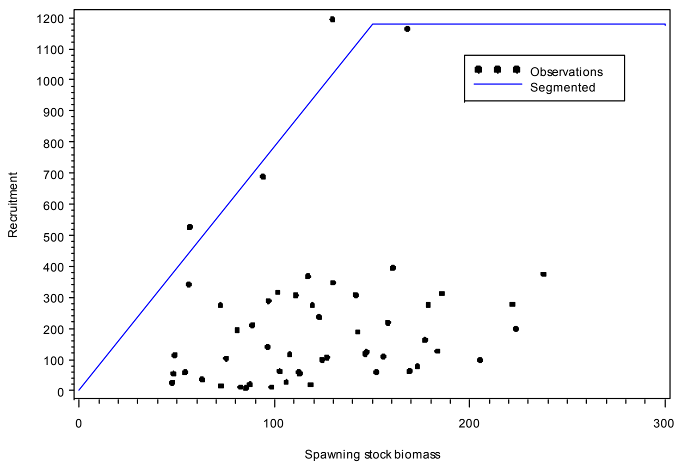

Figure 1.8 Hockey-stick function fitted (by eye) to 5 outstanding yearclasses.

1.2.6 Summary recruitment

A lognormal distribution was modelled for the residuals in both the low recruitment and good recruitment series. The parameters can be found in 1.3.1.

1.3 Prost simulations

1.3.1 General settings/description

The only changes to the basic setting of the PROST simulations relative to the WKHAD and AFWG simulations was the relationship/pattern of recruitment. The following table is summing up the setting for the different recruitment periods.

Description	Type	S-R parameters			Parameters of the residual distribution		
		alfa	beta	cutoff	Mean	St. dev	cutoff
F1: Low recruitment	Ricker	0.3514	-0.00545	200	1.151097	0.970358	0.19-2.6
F2: Good recruitment	Ricker	3.5422	0.00264	150	0.998582	0.180377	0.7-1.3
F3: Outstanding yearclasses	Hockey stick	1180	150	150	0.998582	0.180377	0.7-1.3

The residual parameters for the “outstanding” yearclasses was assumed equal to the parameters for “good” recruitment.

Description of cycle: 4 years with ”Low recruitment”, 1 year with ”Good”, 1 year with ”Outstanding” (Prob=0.3) or ”Good” (Prob=0.7) and then 1 year with ”Good”. This simulation will be similar to the conditions observed in the 1980’s and early 1990’s. The simulation is slightly on the conservative side in that respect relative to the current recruitment conditions, but longer periods of low recruitment have been observed previous to 1980.

1.3.2 Reality check

In order to check the realism of this recruitment function, a reality check was carried out. The historic mean value for F was used, in order to check that recruitment, stock size and catches were close to the historic averages calculated from the VPA.

Settings: F=0.48 (independent of SSB)

1-year rule

No limit on annual variation in TAC

Otherwise same settings for weight, M, fishing pattern etc. as used at AFWG, except that the simulations are now made for 120 years, of which the results for the last 100 are considered (20 years of burn-in time).

Runs using the recruitment functions above gave somewhat higher stock, recruitment and catch values than the historic mean. This is probably linked to two different aspects:

1) The historic time series has long periods with fishing mortalities well above the average (F=0.48) driving the stock to down to low and less productive levels.
2) The present exploitation pattern (used in the simulations) are probably more favourable than the historic pattern.

The results are shown in the Table below.

Basis	F	Mean catch	Mean SSB	Mean TSB	Mean Recruitment
Historic mean AFWG 2006	0.48	124	129	348	218
”Reality check” simulation	0.48	145	159	424	248

1.3.3 Simulations

The different simulations and their results are summarised in Table 1. The following figures are also summarising results from different runs.

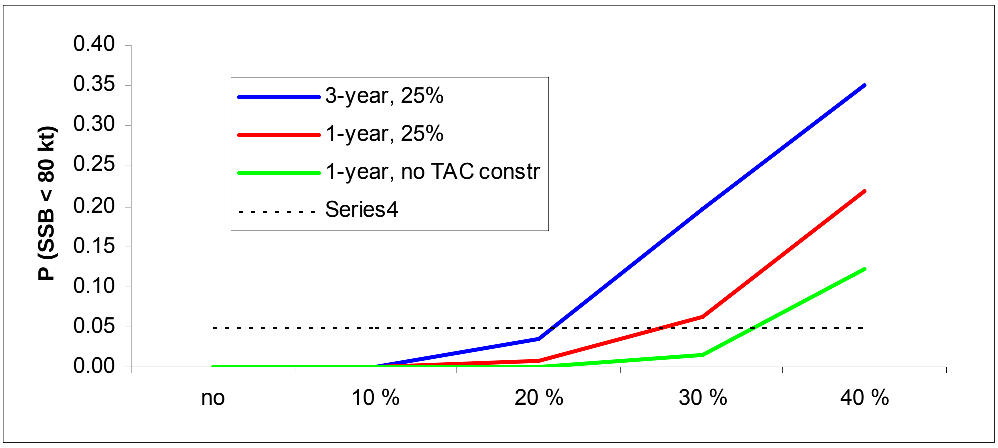

Figure 1.9 The probability of SSB being below 80000 tonnes (y-axis) associated with implementation error (x-axis) for the 3-year rule with 25% TAC constraint (blue), for the 1-year rule with 25% TAC constraint (red), and for the 1-year rule with no TAC constraint (green). The numbers are taken from Table 1.

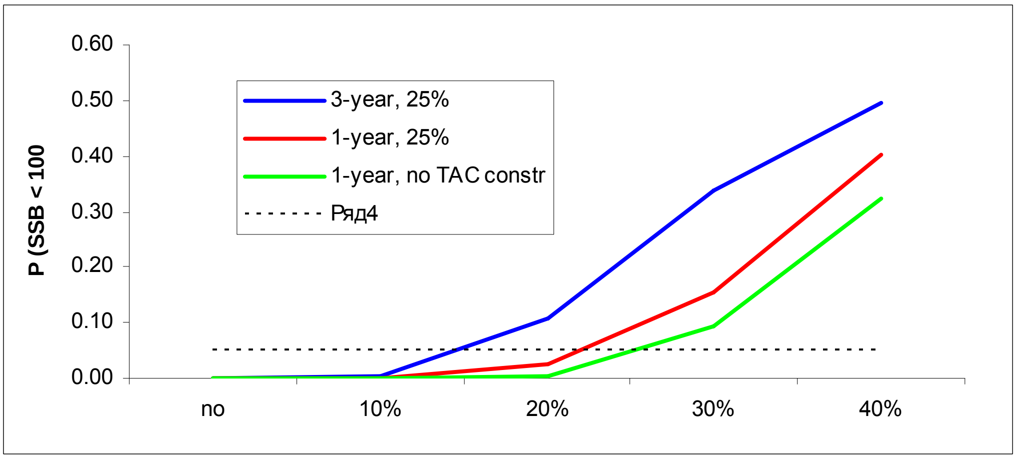

Figure 1.10 The probability of SSB being below 100000 tonnes (y-axis) associated with implementation error (x-axis) for the 3-year rule with 25% TAC constraint (blue), for the 1-year rule with 25% TAC constraint (red), and for the 1-year rule with no TAC constraint (green). The numbers are taken from Table 1.

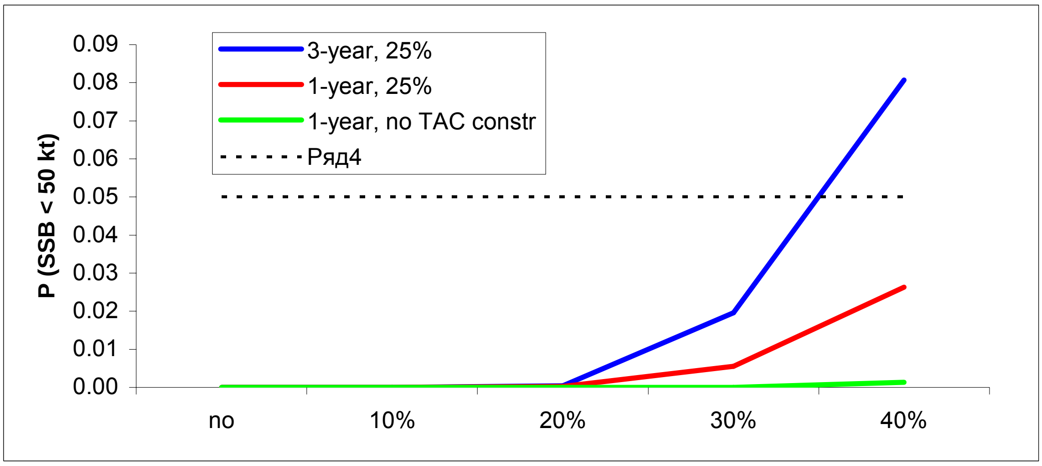

Figure 1.11 The probability of SSB being below 50000 tonnes (y-axis) associated with implementation error (x-axis) for the 3-year rule with 25% TAC constraint (blue), for the 1-year rule with 25% TAC constraint (red), and for the 1-year rule with no TAC constraint (green). The numbers are taken from Table 1.

3 year rule; TAC constraint=25%, Trigger point=80000, implementation error=0%

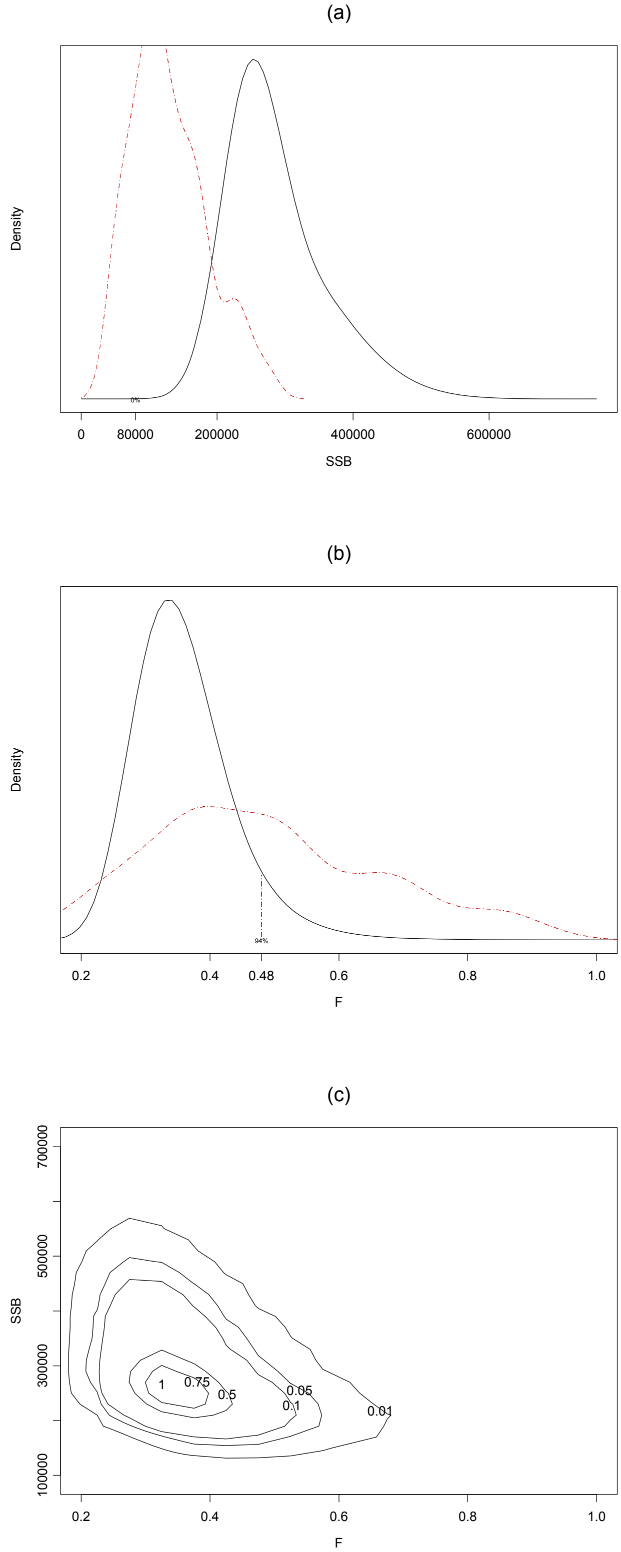

Figure 3.12. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 1 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1 year rule; TAC constraint=25%, Trigger point=80000, implementation error=10%

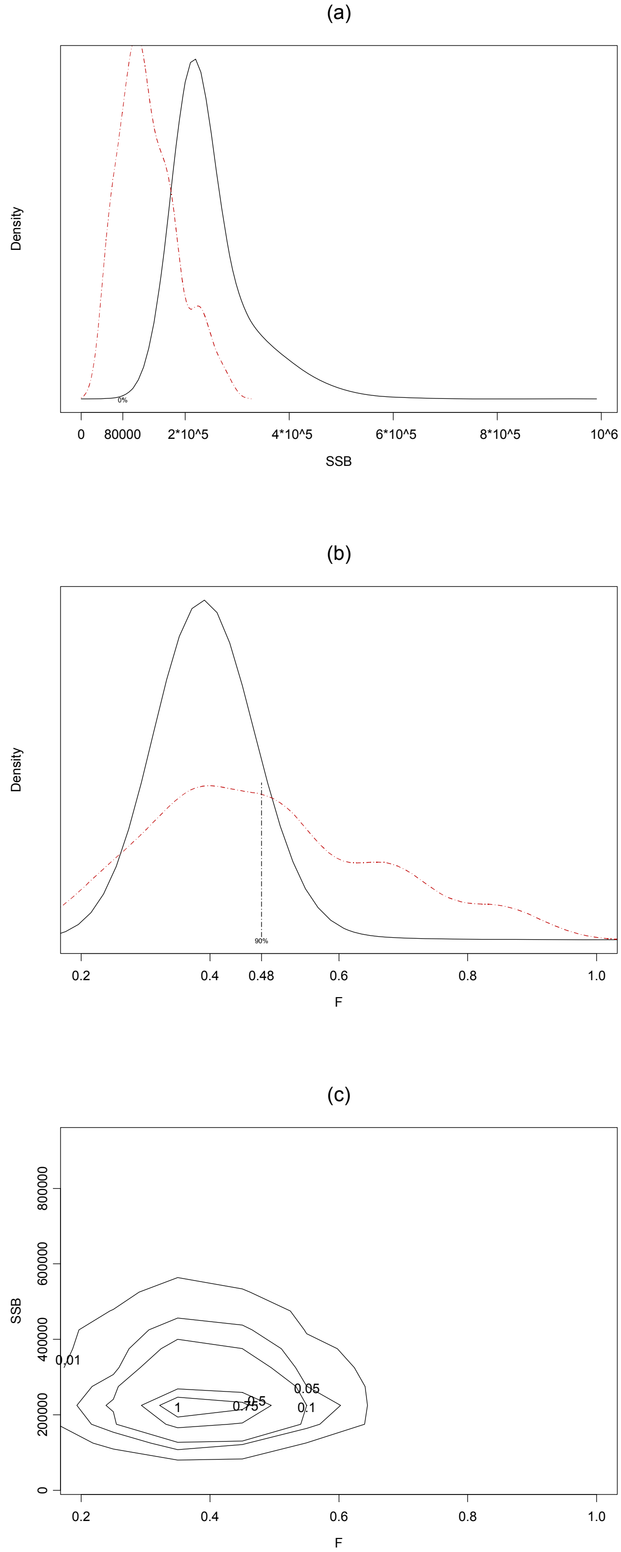

Figure 3.13. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 7 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1 year rule; TAC constraint=25%, Trigger point=80000, implementation error=30%

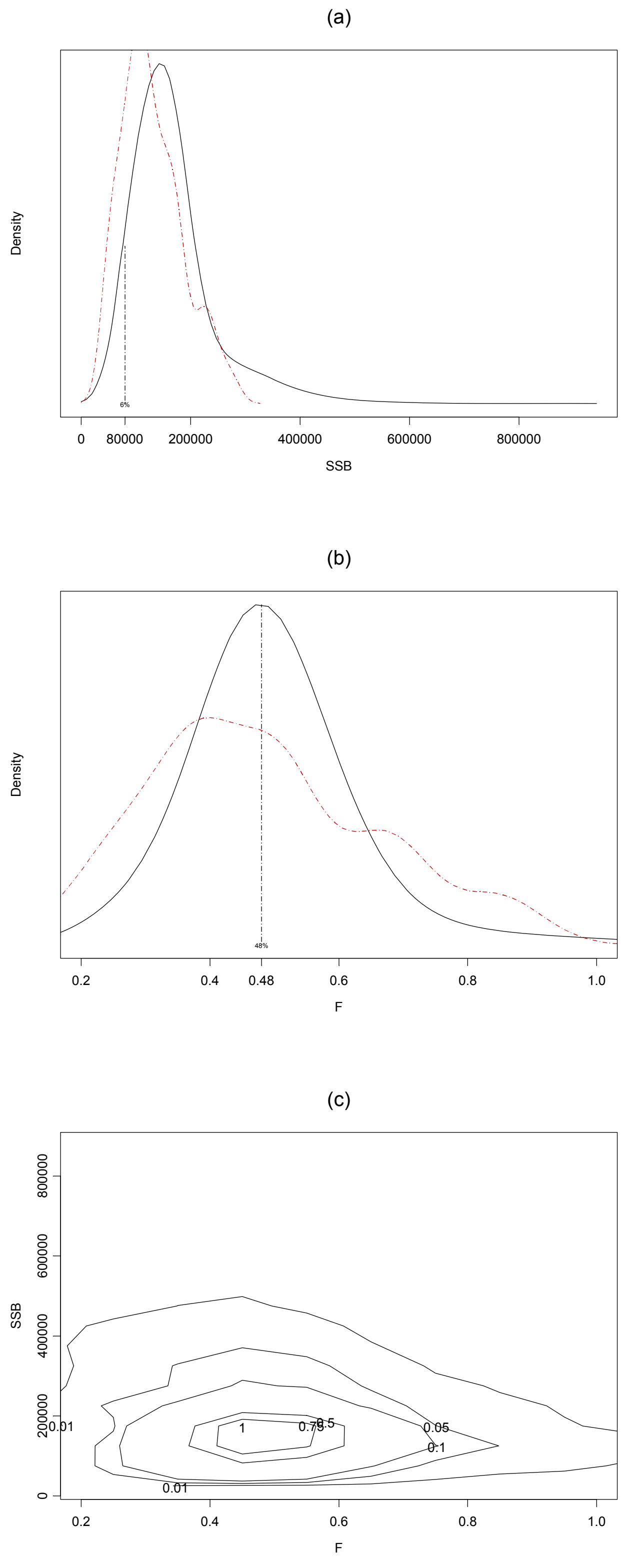

Figure 3.14. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 9 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1 year rule; TAC constraint=none Trigger point=80000, implementation error=10%

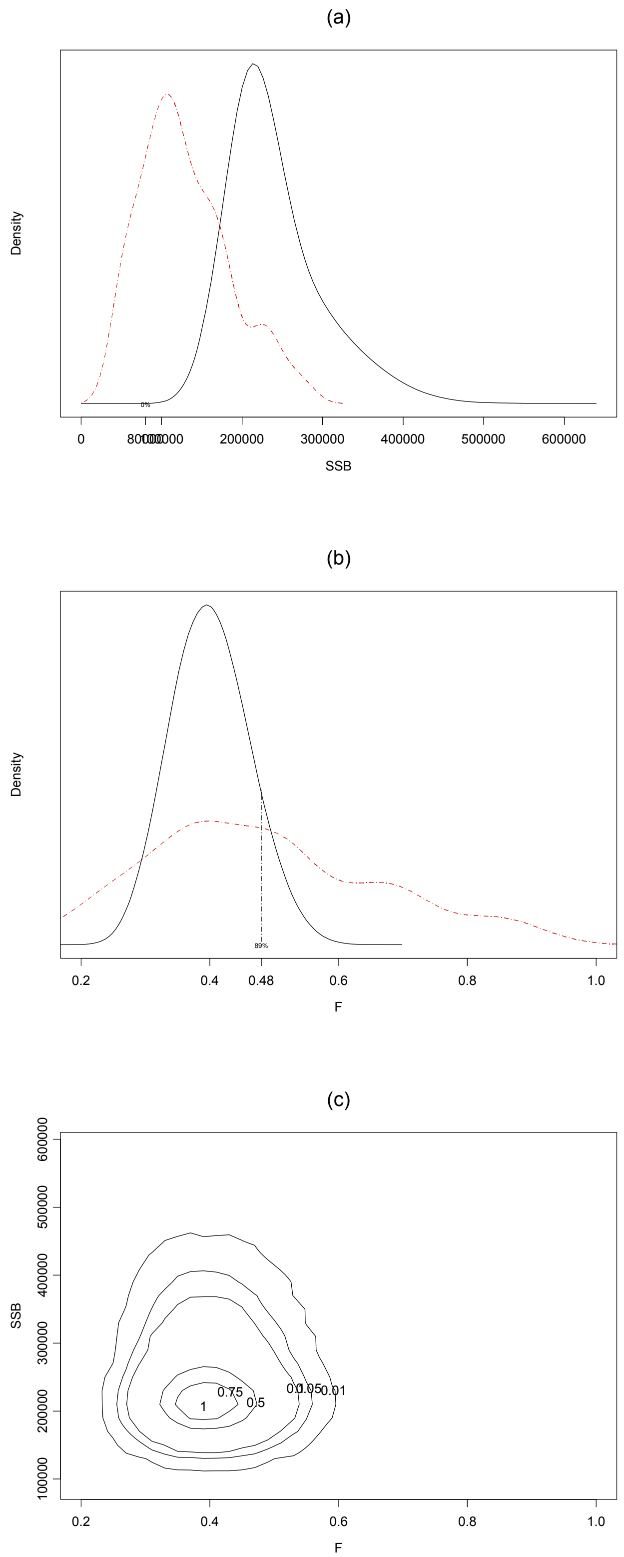

Figure 3.15. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 12 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1 year rule; TAC constraint=none, Trigger point=80000, implementation error=30%

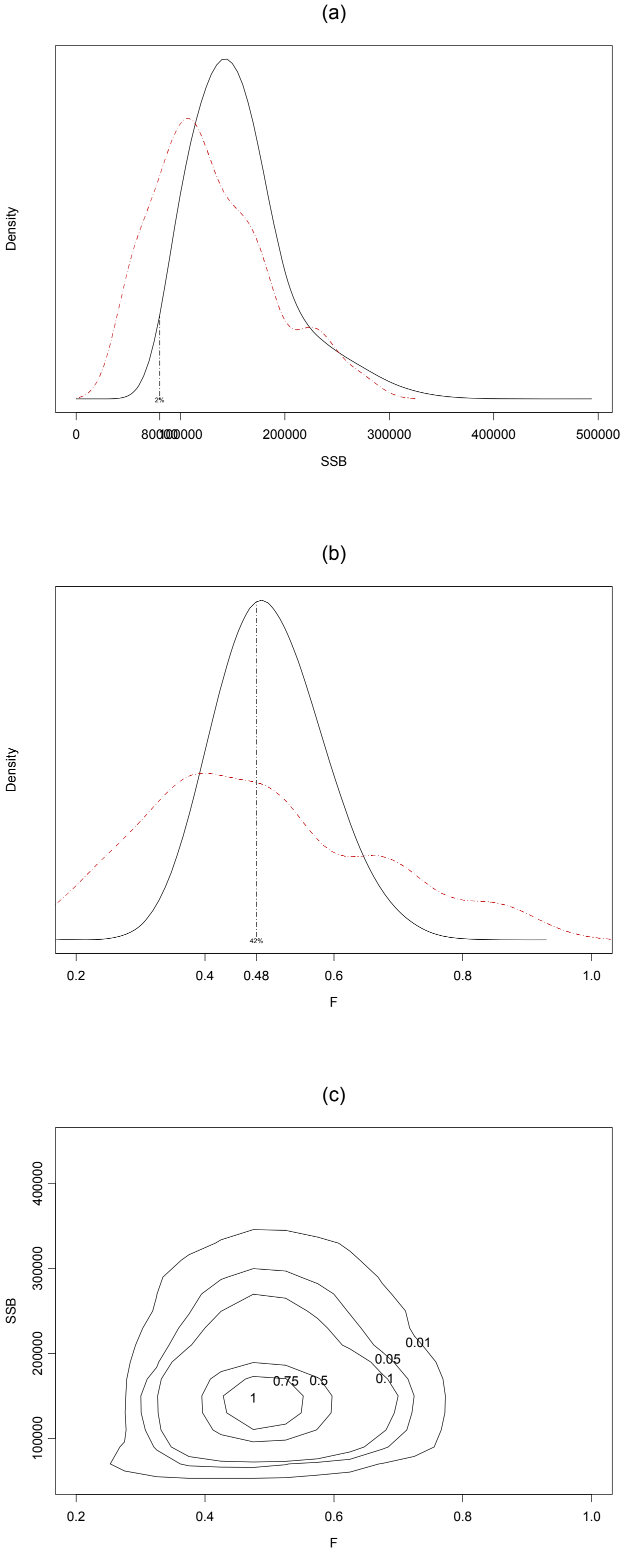

Figure 3.16. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 14 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1 year rule; TAC constraint=25%, Trigger point=145000, implementation error=0%

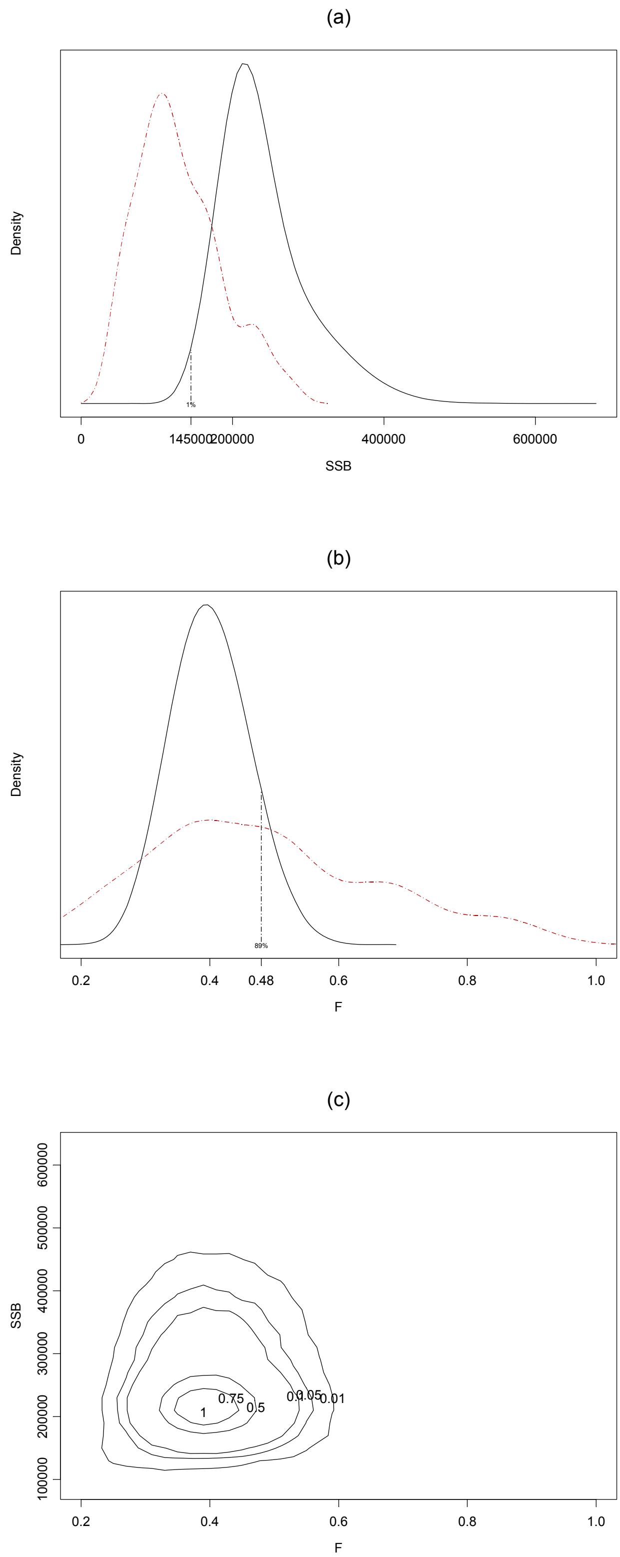

Figure 3.17. Smoothed distribution of simulated SSB (panel a), F (panel b), and the associated cumulative bivariate distribution of SSB and F (panel c) (black solid lines) for run 16 (Table 1). The broken red line shows the observed distributions of SSB and F in panel a and b, respectively. The SSB trigger point (80000) is indicated along with probability of simulated SSB being below the trigger point in panel a and Flim is indicated along with probability of simulated F being below Flim in panel b.

1.3.4 Comments

3-year rule vs 1-year rule:

The current (agreed) HCR is simulated in Run 1. The rule is performing very well under the assumption of no implementation error. Zero probability of producing SSB's below 100 kt, but with a probability of 5.3% to fish above Flim. The 3-year rule is not very robust to implementation errors (runs 2, 3, 4 and 5). The 1-year rule is more robust to implementation error.

TAC constraint vs no constraint:

The 1-year rule with a TAC constraint was compared to a 1-year rule without a TAC constraint in run 6 and 11, 7 and 12 etc. The performance was quite similar, but with the rule without a TAC constraint performing slightly better relative to the probabilities of reduced SSB or F above Flim.

Trigger point:

The SSB and recruitment analysis forming the basis for the simulations suggested increased recruitment for SSB up to 150 kt (and even higher). This is indicating that a triggerpoint higher than 80 kt could be considered.

Robustness relative to implementation error:

In these simulations fishing at Flim corresponds to an equilibrium SSB around 160 kt which is well above any Blim candidate. This is why the probabilities of fishing above Flim is higher than the probabilities of SSB below 100 kt (or 80 kt or 50 kt). One important issue relating to implementation error should be mentioned: The simulations assume the same assessment error for situations with and without implementation error. Estimating unreported landings are introducing additional uncertainty in the catch at age matrix. This increased uncertainty has not been investigated in these simulations and there are clear reasons to believe that the current simulated performance of the HCR with such uncertainty are too optimistic

Limitations:

The following consideration represent an additional limitation to the limitations described in the AFWG report. The simulations which includes implementation error are mimicking a situation where a TAC is set, but is overfished with a certain percentage AND that this percentage is known and accounted for in the following assessment. The effect is similar to setting a TAC corresponding to a higher F. These simulations represent a situation where it still is (potentially) possible to track trends in F and stock size. The simulations are not covering the situation where information of unreported landings (or discarding) is not available and in such situations are assessments likely to be biased.

Run no	Rule	TAC constr.	Trigger point	Impl. error	Intended F	Realised F	Catch (tonnes)	SSB (tonnes)	Prob. SSB<50kt	Prob. SSB<80kt	Prob. SSB<100kt	Prob. F>Flim	Prob upper constr.	Prob lower constr.
1	3-year	25 %	80	no	0.35	0.36	170583	285771	0.000	0.000	0.000	0.053	0.083	0.035
2	3-year	25 %	80	10 %	0.38	0.43	166415	225059	0.000	0.000	0.003	0.231	0.105	0.050
3	3-year	25 %	80	20 %	0.41	0.53	146807	166376	0.000	0.034	0.106	0.491	0.139	0.090
4	3-year	25 %	80	30 %	0.43	0.64	132582	129565	0.020	0.197	0.339	0.630	0.098	0.148
5	3-year	25 %	80	40 %	0.44	0.72	122663	108073	0.081	0.351	0.496	0.724	0.046	0.180
6	1-year	25 %	80	no	0.35	0.35	170185	289197	0.000	0.000	0.000	0.010	0.165	0.086
7	1-year	25 %	80	10 %	0.35	0.39	169244	249254	0.000	0.000	0.001	0.078	0.190	0.105
8	1-year	25 %	80	20 %	0.35	0.44	158765	207645	0.000	0.006	0.024	0.264	0.228	0.144
9	1-year	25 %	80	30 %	0.35	0.50	143088	166750	0.006	0.061	0.156	0.482	0.230	0.192
10	1-year	25 %	80	40 %	0.36	0.57	125689	125637	0.026	0.219	0.402	0.633	0.141	0.200
11	1-year	No[1]	80	no	0.35	0.36	171332	280743	0.000	0.000	0.000	0.006	0.001	0.000
12	1-year	No	80	10 %	0.35	0.40	170216	239414	0.000	0.000	0.000	0.080	0.002	0.000
13	1-year	No	80	20 %	0.35	0.45	160677	196835	0.000	0.000	0.005	0.279	0.004	0.000
14	1-year	No	80	30 %	0.35	0.50	143145	154704	0.000	0.016	0.094	0.531	0.006	0.000
15	1-year	No	80	40 %	0.34	0.55	127700	124576	0.001	0.121	0.323	0.701	0.005	0.000
16	1-year	25 %	145	no	0.35	0.40	170923	240182	0.000	0.000	0.000	0.080	0.001	0.000

Table 1 Summary table of simulation settings and results.

1 Approximated by using a 100% constraint. As seen in the second column from the right there is a very small probability that “no more than a doubling” will constrain the TAC.

1.3.5 Conclusion

Given the limitations and assumptions in these evaluations the results indicate that the agreed HCR are not in accordance with the precautionary approach because realised fishing mortalities have a relatively high probability of being above F=0.49. (Probability=5.3%).

Replacing the 3-year rule in the prediction with a 1-year rule will reduce the probability of high fishing mortalities to 1.0%. The results indicate that with this modification to the HCR it will be in accordance with the precautionary approach. The evaluation does not indicate that the 3-years rule increases the average yield and due to the uncertainties in 3-years predictions, the working group doubts that the rule will have a stabilizing effect on the annual yield compared to a 1-year rule.

The conclusions above are (close to) identical to the conclusions made during AFWG 2006

The ad hoc group would like to point out that managers should consider replacing the current trigger point of 80 000 t with a higher value. This will reduce the probabilities of reduced SSB and high F without any loss of yield.

Annex 4: AFWG Review 15-17 May 2007, IJmuiden – Minutes

Present were:

Mark Dickey-Collas	The Netherlands (Chair of review)
Alain Biseau	France
Maris Plikshs	Latvia
Yuri Kovalev	The Russian Federation (Chair of AFWG)
Mette Bertelsen	ICES Secretariat

The reviewers thank the AFWG for the report that generally described the methods and the issues well. It was clear that a large amount of work had gone into the preparation of the report. Yuri Kovalev is thanked for his presentations and explanations which assisted the reviewers greatly throughout the review.

Chapter 1 – Ecosystem considerations

Points to note from the chapter

RCT3 used for basis of advice on recruitment, other models (STOCOBAR) only used for additional information on growth and consumption etc. Sea temp the warmest ever recorded in 2006. 2007 expected to be similar to 2006, this suggests that good recruitment is expected and no strong chances in cod growth during 2007-2008. Temp has more significant impact on cod growth than capelin abundance. Capelin abundance expected to be same or a little higher than in previous years. Gadget is not in agreement with other models when estimating recruitment – more pessimistic than the other models this was due to differences in the maturity ogive.

Review group Comments

This section is outstanding compared to other ecosystem sections in the advice report. However readability is still poor, mainly due to the section large size and organisation. The general description at the beginning is still very long. For the review process it may be better if the chapter started with section 1.3 and the earlier general sections were placed elsewhere. Having the conclusions split between 3 sections reduced impact, thus the review group would like to see one final conclusion section at the end of the chapter.

The reviewers felt that chapter 1 is very focused on cod and its environment. They are aware that this reflects the dominance of the cod as a funded research area. However the chapter should be considered in the light of other commercial and non-commercial fish species too. With this in mind, the RG noted that Table 1.10 shows interaction between species in diet composition. Information is collected but not applied elsewhere in the report.

Chapter 2 – Norwegian Coastal cod

Points to note from the chapter

AFWG was tasked with carrying out a benchmark assessment on this stock in 2007. This did not happen.

The TAC on coastal cod is not a true TAC as it is applied after landing by researchers (the timing of this allocation is also unclear). Fishers cannot specifically fish to fill the coastal cod quota, therefore it has limited impact as a conservation measure, especially as the fishers fish against the NEA cod TAC.

Only survey data is used for the assessment of this stock.

There are year effects in the surveys, especially when broken done to area. Figures have been added to show proportion of cod by age and area for the 2006 survey has been added in the report as requested from technical minutes 2006.

The proportion of coastal cod to NEA cod increases to the south, and the proportion of NEA cod in the catches also increases with age. Spawning areas of the two cod are similar.

The RG noted that the assessment was not very sensitive to assumptions about shrinkage.

The conflict between the surveys and the catch is clear throughout the chapter.

The AFWG concluded that assessment is not robust enough to provide fully quantifiable projection and advice and thus the advice should be based on trends in surveys.

AFWG actions based on last review

The comments by the previous reviewers were addressed. WG have followed up RG 2006 suggestions, particularly: 1) some catch curve analyses were made, 2) more details on survey results are presented and 3) the time and space variations in coastal cod /arctic cod ratios were better documented both for survey samples and commercial samples. However, RG 2007 noted that quality of survey data (year effects) need to be more broadly analysed in relation to the spatial distribution of both stock and proportions at age. Additionally the historical sampling levels other than otolith number of otolith collected to determine stock identity were still not presented.

Review group Comments

Despite being disappointed at the lack of a benchmark assessment, the RG accepted the reasoning for not carrying out a bench mark on this stock.

The criticism by the RG made last year about the lack of information on what it is in the otolith structure that determines the allocation of a cod to coastal or NEA still stands. This is still not explained in the report or in cited references.

This stock was on the observation list last year, but is not this year. Neither the AFWG or the RG know why this change occurred **(Action ACFM).**

The working group should justify the use of a tricubic time tamper when using survey data. The RG feels that this is only valid when using CPUE tuning series.

The lack of information on discards and the recreational fishery for cod worries the RG. It is important to note, that with declining commercial landings, the recreational fishery will have an impact whether the numbers caught per year are constant or have a trend. More work is needed to estimate the mortality caused by discarding and the recreational fishery.

There is no mention of cannibalism of this stock in the chapter. Why is it considered important for NEA cod and not for coastal cod. However the RG felt that trying to estimate the catch better was more of a priority than estimating cannibalism.

Please describe better how the survey based estimates of biomasses are obtained.

As was described by the RG in 2006, this report as a whole is still very XSA centric. The way the AFWG report is structured suggests that there is a tendency to carry out an XSA assessment and then further explore the data. The RG requests again that the WG consider carefully the structure of the chapter and the communication of the "message".

The RG supports the WG in their conclusions of the trends in the stock but still encourage the WG to look further into survey issues using SURBA – and to explore other models than XSA.

In section 2.2.1 3rd paragraph '…there are even some signs of increase in the most recent survey' – this is considered a bit too optimistic. This also goes for section 2.61 '….survey gives a slightly more optimistic impression than the XSA'. The Review group did not interpret the survey results with the same optimism as AFWG. .The RG would like AFWG to consider their descriptions of trends within the noise of the time series and not to over interpret trends in the descriptions in the text.

Overall, the RG accepts the interpretation of the data and models outputs by the AFWG for this stock and thinks that AFWG is a basis for advice.

Chapter 3 – Northeast Arctic cod

This stock is on the observation list. A broad update assessment was carried out this year, as much previous work has been carried out on this stock.

The NEA cod chapter was dominated by the issue of illegal, unreported and unallocated catches (IUU). Like the AFWG, the RG spent much time discussing and exploring the issue. The RG referred to documents produced by the ad hoc ICES review of the IUU issue for NEA cod and haddock that was carried out in October 2006. It was stated by one of the ad hoc reviewers:

"that the ICES advice should take into account any uncertainty about the level of IUU catches. This could be done by carrying out assessments with the maximum and minimum estimates rather than selecting a single figure and provide the appropriate catch options related to these. However, this would only show that a fixed harvest control rule does not help to manage the fisheries exploiting the NEA cod sustainably, because the two extremes will result in a range of options to choose from, while there is no scientific argument why one option would be better that the other. If countries are faced with IUU fishing, they should set as their first priority to solve this problem rather than expecting from scientists that they can provide reliable advice."

ICES then wrote in a letter to Ministry of Agriculture of the Russian Federation in October 2006 stating:

"The reviewers did not conclude whether the estimate used by AFWG or the one presented here was the better one. The data on underreporting should be carefully analysed by Norwegian and Russian scientists taking the Russian remarks into account and the assessment could be redone using estimates of underreported catches agreed by both Parties."

This did not occur in 2007, and no agreed catch data was brought to the AFWG in 2007. With the information available to the RG, they could not fully understand the methods used to raise the estimates of IUU, or distinguish at a broader level the differences between the Russian and Norwegian methods. There was limited transparency in the WD provided on the Russian method. The data on underreporting should be carefully analysed by Norwegian and Russian scientists taking the Russian remarks into account and the assessment could be redone using estimates of underreported catches agreed by both Parties.

Therefore the RG supported the approach taken by the AFWG that both sets of catch data should be sent forward, and separate advice based for each catch matrix should be provided. As accurate as possible catch information must be agreed. On the information available neither the AFWG and the RG could determine what the accurate catches are.

Points to note from the chapter

Two reports on IUU catches (Norwegian and Russian) and thus 2 catch matrices were used. Last year there was just one estimate from Norway and this is the first time Russia produced an estimate. Both catch matrices result in very similar estimates of SSB and F, which are well within the probable confidence intervals of the assessment.

Due to problems in the coverage of the surveys, the survey indices were corrected by the AFWG, a similar procedure has occurred in the past.

The Russian commercial tuning fleet is only part of the fleet as it uses the activities of older types of vessels. As the number of newer ships continually increases and there is a changed catchability in the whole fleet and this may not be reflected in the tuning index. The loss of older boats will effect the integrity of the tuning index.

Most other models and approached that were looked at express similar trends (survey based and Gadget) although the new GIS method results in a different perception of the stock. The RG agrees with AFWG, that there are problems with the GIS method, and much more work is required if the reservations of AFWG at to be resolved.

AFWG actions based on last review

The comments by the previous reviewers were addressed partly. The sampling level table is still missing in the report. The group has improved the text and the table headings, and given more clarity of the iterative process to determine the effect of cannibalism but this still needs more work (see below). The reviewers again noted that the description of incorporating cod predation into the haddock assessment was clearer.

Review group comments

Cannibalism:

The whole procedure leading to a natural mortality (M) taking into account cannibalism should be fully explained and the various steps clearly identified. The RG advises that the process of including cannibalism needs clarification. The RG attempted to carry this out:

Before starting, all the raw information (% of ages eaten by age groups) and actual catch at age matrix should be presented. They should replace current Tables 3.9 and 3.8 (or 3.10).

Then comes the first XSA using M=0.2 and actual catch at age matrix (current Tables 3.16).

This is the first step. The stock numbers at age are taken from the output of this first XSA run to calculate the first guess of the amount of cod eaten. These figures were then added to the actual catches, and a new XSA were performed using this new ‘catch’ at age matrix and still M=0.2. This gave new stock numbers at age, which provided new estimates of eaten cod. This new estimates replaced the previous ones and summed to the catch at age numbers, and so on until the differences between estimates are less than 1%.

Then the estimated ‘Fs’ are split, according to actual catches and numbers of cod eaten, to the fishing mortality (F) and to additional natural mortality due to cannibalism (M2) (Tables 3.20 and 3.22). Since, information of cod cannibalism are only available since 1984, a new matrix of natural mortality was built: M=0.2 prior to 1984, and M=0.2+M2 since then.

These are the input data for the final run, which was carried out as a separable VPA using terminal Fs as given by the final runs of the iterative process described above.

This gives Fs and Ns for the whole series (Tables 3.21, 3.23…)

There may be a conflict between using a CPUE and the current cannibalism approach. The RG still felt that there where many issues around the inclusion of cannibalism in the assessment that need to be resolved (eg the veracity of surveys and CPUE using this method, why is this method better than an approach that tries to adjust M at first, how sensitive it is to annual noise?).

Surveys

The treatment of surveys needs to be further considered. The Norwegian survey, which takes place in the first quarter, is back-shifted. This RG commented about the disadvantage of this practice (bias due to mortalities at the beginning of the year, prior to the survey, not taken into account in the backshift procedure), compared to advantages (having indices for the end of the preceding year).

The review group is worried about the integrity of the surveys. The methods used to maintain the time series by the inclusion of the 2006 survey index, accounting for different spatial coverage, were different for different surveys. Although the RG accepted the outcomes, they were not happy with the approach. More attention should be given to adjusting the time series based on the spatial distribution and inherent variability in the surveys.

Other issues

There is a lack of transparency in the input data– discrepancy between abundance indices in table A3 and table 3.14.

Retro-plot goes 20 years back – but the tuning is using tricubic time taper, meaning that only the last 6-7 years of data are used in the assessment (not using the first 10 years of data).

RCT3 assumes there should be good information (better than there is) on the young year classes. This should be considered when doing the next benchmark assessment.

The chapter in general

The chapter is still difficult to read and follow. Criticism of lack of explanation to the process used has been stated in the technical minutes for a few years. The chapter needs to be re-written using a different approach. The RG group advises that the AFWG use the chapters to “tell a story”. Begin with fisheries and TAC, then the raw data, then the adjusted data, then the data exploration (including all models used), then the agreed assessment followed by predictions and management considerations etc. The RG does not like each chapter having two blocks of tables.

Chapter 4 – Northeast Arctic haddock

Points to note from the chapter

Benchmark assessment was planned but update assessment was carried out.

The IUU issue (see above) also dominated this chapter. Different methods for estimating IUU were used for NEA haddock compared to NEA cod.

Surveys did not cover the full historic area, and so the indices were thus adjusted. However due to the high estimates, the readjusted values were then reduced to the series maximum.

The assessment was carried out using XSA.

The additional ISVPA assessment was carried out, but the diagnostics were not clearly shown in the report.

AFWG actions based on last review

The comments by the previous reviewers were well addressed with only exception on metrics for retrospective bias that should be included in the analysis. As the AFWG is asking for reference or example of such analyses RGAF suggests:

i) Mohn, R. 1999. The retrospective problem in sequential population analyses: An investigation using cod fishery and simulated data. ICES J.Mar.Sci., 56:773-488,

ii) HAWG report 2005

ACFM however, also requested greater explanation of the effect of the reworked data sets on the assessment, which was missing in last year's report, but apparently available in a working document.

Review group comments

The RG did not accept the estimates of IUU for NEA haddock. The methods used by both Norway and Russia assumed that the fishing behaviour, catchability, the distribution of the fish and illegal behaviour are the same for haddock as for cod. In other words that "*cod equals haddock*". This assumption was not backed up by any evidence, in fact it is often argued to the contrary in the AFWG report, and the RG did not accept the assumption without further analysis. Thus the RG did not accept the adjusted catch information as sound. Apparently independent estimates of IUU of haddock have been made, but are very noisy. These should be compared with the "cod equals haddock" approach.

The use of both sets of IUU data in the catch matrix (Norwegian and Russia) gave a strange result, in that the F in recent years differs greatly but the SSB in the last year is the same. This appears to conflict with the "normal" outcomes in an assessment where changes in F are reflected in inverse change in SSB. However does a lower F result in the same SSB? This was not explained in the AFWG report, or even considered unusual. The RG briefly considered the issue and could not find a solution. The RG felt that this problem lead to the quality of the assessment being questioned.

The surveys and the catch do give a different perception of stock dynamics. Different methods, without explanation, were used for adjusting the survey results of haddock, compared to cod. The method of reducing the 2006 estimates to the series maximum will impact of on the estimation of q. This was not further analysed by AFWG and thus the impact on the assessment is unknown.

It appears strange that for the IUU estimates "*cod equals haddock*" but for the surveys "*cod doesn't equal haddock*".

The 1996 year class is excluded from the survey, the RG would like to see more explanation in the report about why this is done. There seems to be a tendency to exclude anything that doesn't look good in the diagnostics, which may not be the right approach.

Reviewers would like to see a retrospective plot without a taper..

An 0-group survey has been taken place but the index is not used in the assessment – there should be an explanation why it is not used.

In table 4.10 the Russian bottom survey label should be age 0 instead of age 1.

There was still no accounting or discussion of the change in input data carried out last year.

The conclusion of the RG was not to accept the assessment (with either IUU from Norway or from Russia) as a basis for advice. The RG felt that the issues about the catch matrix (inclusion of IUU), the treatment of surveys and the strange lack of interaction between F and

SSB between the two IUU estimates combined to make them question the whole assessment. After discussion the RG decided that it did not trust the current assessments and felt that more explanation was needed, but was not available. Thus assessment and surveys should only be used as indicators of stock trends. This poses problems with regard to the management rule, but it is clear that the stock is currently being harvested sustainably, and thus a role over TAC should cause no problems to the stock.

Chapter 5 – Northeast Arctic saithe

Points to note from the chapter

An up date assessment was carried out. XSA was used with same settings as last year. A small change was made to CANUM and weights compared to last year.

The retrospective plots show a change in direction for the first time.

There is a discrepancy in SOP (table 5.3.1). This is apparently due to weight not catch in numbers.

AFWG actions based on last review

Comments by the previous reviewers were well addressed with regards to updated assessment. The RG reiterates its request that during next benchmark assessment the following be carried out:

"*As is generally known for this stock, the retrospective bias in this stock assessment is still very strong. This has been investigated by previous AFWGs. The SSB tends to be underestimated, while the Fs are overestimated. There does not seem to be any convergence in this pattern. At the next benchmark assessment, the WG should look into the retrospective pattern again and try to explain why this pattern is so strong for such a long time. Metrics for retrospective bias must be included in the analysis.*

Review why there is an apparent conflict between catch and surveys at the next benchmark assessment.

The comments from last years review of the saithe, although not expected to be dealt with during this years assessment are still valid. These are, investigating the discarding problems, investigate the noisy indices some with conflicting trends and finally to try other assessment models.

Also in the next bench mark, the reviewers would like to WG to consider the appropriateness of "traditional" stock assessment models when the estimated Fs are much smaller than the assumed natural mortality (M)."

Review group comments

There were no comments on the assessment.

Short term prediction: perhaps GM over the more recent period should be used because of variability and the poor recruitment during lower biomass time period. This would however, result in a more optimistic forecast.

Management plan evaluation: The AFWG appeared to use an approach consistent with SGMAS. The Beverton-Holt stock-recruitment relationship was accepted as there was no pattern in recruitment and no periodicity or one off recruitment events in the time series. . The RG is acknowledges that management plan simulations are very sensitive to assumptions about recruitment, but other than annually varying the parameters of the S/R relationship, AFWG seems to have characterised recruitment variability in a reasonable manner. Thus the RG felt that the approach to recruitment was appropriate.

The RG accepted the simulations as a suitable test of the management plan and the RG agrees with AFWG that the management plan as tested is precautionary.

Chapter 6 – *Sebastes mentella* in subareas I and II

Points to note from the chapter

The WG was asked to answer a request from NEAFC on description of the fishery in recent years. There was a minority statement in the AFWG report that answered more than the NEAFC question, and stated that the evidence collected shows that the fish caught outside the EEZ were from the same stock as that inside the EEZ. The remainder of the AFWG suggested this issue should be passed to SIMWG which is dealing with the NEAFC request on stock structure.

AFWG actions based on last review

The comments by the previous reviewers were addressed, apart from the improved estimates of bycatch of *Sebastes mentella,* and this is still planned by the working group. Also the sampling levels has not been presented.

Review group comments

AFWG appears to have fully answered the NEAFC request.

The RG felt that until there is evidence to the contrary, landings in adjacent areas should be included in the catch tables.

It is clear that a directed fishery for deep sea redfish has begun, despite recent the advice. This fishery has resulted in three to four times higher landings in recent year although some bycatch has also increased.

A draft response for the advice to NEAFC will be drafted at the ACFM subgroup based on section in AFWG report.

Chapter 7 – *Sebastes marinus* in subareas I and II

Points to note from the chapter

The gadget assessment model has been further developed. Landings are going down in the most recent years.

AFWG actions based on last review

Comments by the previous reviewers were addressed. The RGAF is still reiterate its last years proposal to consider use of more simple model eg SURBA. Also the sampling levels have not been presented.

Review group comments

It will be difficult to model F when M is of a similar size (0.1 and 0.15).

Chapter 8 – Greenland halibut in subareas I and II

Points to note from the chapter

There are still problems with age reading as described in previous technical minutes. However is should be pointed out the timetable for a resolution (if one can be found) is 2009, which means that management measures based on this will not be available until 2011.

There was no age data from Norway this year for the survey and catch as the age reading has changed. The Russian age matrix was applied used to the CPUE data but not applied to the survey.

AFWG actions based on last review

Comments by the previous reviewers were addressed. Reviewers agreed with AFWG that majority of last years comments can be addressed only after the age reading is for this stock is sorted out.

Review group comments

Shrinkage has too much weight in determining recent recruitment (especially for age 5 but also for age 6). For yearclass 2000 there is quite a bit of discrepancy between the estimates from the surveys. The RG stated that the current estimates of recruitment are very uncertain and should not be viewed as an up turn in the recruitment of the stock.

Section on management considerations is missing – should be included.

Again the RG was worried about the large scientific quotas for Norway and Russia and now sums 9800 which is a majority of the quota. There appear to be no scientific results coming from this scientific quota.

The RG suggestesd to use a production model until age reading problem has been resolved. The deadline for the Russian Norwegian programme on this stock is 2009, which will mean data for ICES in 2010 and perhaps advice for 2011. A time series of at least 15-20 years must be available. The RG was not sure that this stock could wait another 4 years before advice is given. The review group proposed that another model be explored for use in the meantime.

Chapter 9 Capelin.

Points to note from the chapter

No major points to be made, this will be reviewed by ACFM in the autumn.

AFWG actions based on last review

None to be addressed.

Review group comments

The issue of the timing of advice from ICES may make the provision of capelin difficult in the future, as it is survey based. It will be difficult to give advice on capelin in the spring.

Report as a whole

The way the AFWG report is structured suggests that there is a tendency to carry out an XSA assessment and then further explore the data. This is not a thorough robust approach. XSA is still seen as the default model.

The report must be structured in a way that allows readers to follow logical reasoned arguments.

The use of FLR is to be welcomed, but throughout the AFWG report the legends asscoaited with FLR plots were poor. Overall legends must be improved.

All working documents referred to in the text should be made available to the RG, even the historic ones. Perhaps the SharePoint site can be used for this