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Report of the Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG) 2023

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Author(s):

Daniel Howell, Bjarte Bogstad (IMR), Anatoly Chetyrkin (VNIRO), Johanna Fall (IMR), Anatoly Filin (VNIRO), Elvar H. Hallfredsson, Hannes Höffle, Edda Johannesen (IMR), Yuri Kovalev (VNIRO), Andrey Mikhailov (VNIRO), Alexey Russkikh (VNIRO), Aleksi Stesko (VNIRO), Dmitri Vasilyev (VNIRO), Mikko Vihtakari, Kristin Windsland (IMR) and Natalia Yaragina (VNIRO)

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Approved by: Research Director(s): Geir Huse Program leader(s): Maria Fossheim

Partners

Content

1 - Executive Summary

On 30 th March 2022 all Russian participation in ICES was temporally suspended. Although the announcement of the suspension stressed the role of ICES as a “multilateral science organization”, this suspension applied not only to research activities, but also to the ICES work providing fisheries advice for the sustainable management of fish stocks and ecosystems. As a result of the suspension, the ICES AFWG provided advice only for saithe, coastal cod north, coastal cod south, and golden redfish (*Sebastes norvegicus*). Northeast Arctic (NEA) cod, haddock and Greenland halibut assessments have been conducted outside of ICES in a newly constituted Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG). Although this work has been conducted independently of ICES, the methodologies agreed at ICES benchmarks and agreed HCRs (Harvest Control Rules) have been followed in providing this advice.

The Greenland halibut model has been revised at an ICES benchmark in 2023. The JRN-AFWG has agreed to use the new ICES model, with the addition of revising the Russian survey tuning index (as was recommended at the benchmark). Although the overall biomass level in the model has been revised, the trends and advice are similar to the old model. The Greenland halibut advice is for one year to bring the timing back in line with the slope survey, after this a two-year advice cycle will resume. The main worry with that stock is a history of TACs and catches well above advice. Given that the model is now indicating that the stock will drop below B_{pa} by the end of 2023, continuing to set quota above advice poses a risk of serious harm to the stock.

Advice on fishing opportunities for NEA cod

The NEA cod stock is continuing to decline following a period of moderate to poor recruitment. Following the agreed HCR, the advice is constrained by the interannual stability constraint criteria of 20% annual change in quota. Advice is that catches in 2024 should not exceed 453 427 tonnes.

Advice on fishing opportunities for NEA haddock

Advice is that catches in 2024 should not exceed 127 550 tonnes, down 25% from the advice for 2023 (constrained by the interannual stability constraint criteria of 25% annual change in quota. The haddock total stock biomass is declining as the relatively large 2016 yearclass is caught.

Advice on fishing opportunities for Greenland halibut

Advice is that catches in 2024 should not exceed 15 560 tonnes, down 16% from the advice for 2023. The stock is projected to drop below B_{pa} by the end of 2023. Note that this stock has a history of being fished above advice, and the advised quota is 38% below the TAC for 2023. There are signs of recent good recruitment, and projections indicate that the stock should increase in the medium term if catches are in line with advice.

23.06.23: Tables and figures in chapter 3 have been updated

2 - Introduction and ecosystem overview

This report presents the details of the stock assessments conducted for Northeast Arctic cod, haddock and Greenland halibut in ICES subareas 1 and 2. Due to the temporary suspension of Russian scientists from ICES, this is a joint Russian-Norwegian advice and explicitly not an ICES advice. However, the assessment methodology has followed the standard ICES procedure, using the models approved at ICES benchmarks and the Harvest Control Rules which have been evaluated as precautionary by ICES.

The work presented here would typically form a part of the ICES Arctic Fisheries Working Group (AFWG). In order to keep continuity with previous reports, and to minimize the chances of errors arising from renumbering given the tight deadline to prepare this report, the chapter numbers for each stock chapter are maintained from the last AFWG report (ICES 2021). This also allows for anyone with previous AFWG experience to locate information rapidly and easily. As a result, this report contains Chapter 1 (executive summary), Chapter 2 (this introduction, and the ecosystem overview), Chapter 3 (Northeast Arctic cod), Chapter 4 (Northeast Arctic haddock), and Chapter 8 (Greenland halibut).

2.1 - Introduction and ecosystem overview

The aim of this chapter is to identify important ecosystem information influencing the fish stocks. Ecosystem and climate changes, along with fishery, determine the stock dynamics of commercial species. Water temperature and ice conditions influence on distribution of the commercial fishes in the Barents Sea. Apart from this, temperature impacts on growth rate and mortality at the early stages (larvae, juveniles). Currents affect the strength of year-classes by providing transport of eggs, larvae and 0-group of commercial species from the spawning areas into the Barents Sea. Food availability is another important ecosystem driver that influence on the rate of growth and maturation of commercial fishes. It depends not only on the prey availability, but also on feeding competition. Mortality due to predation, including cannibalism, can greatly affect population abundance of commercial species. The impact of ecosystem changes on the dynamics of bycatches of juveniles and non-target species in mixed fisheries should also be taken into account.

Specification of the ecosystem impact on the assessed species :

Cod

The cod stock is decreasing. A further reduction is expected in stock size, which will lead to reduction of cod predation pressure on its prey species. It should be expected relatively less consumption of capelin, haddock and shrimp. The main effect of the ecosystem impact on cod stock dynamics is manifested in the change in the abundance of its recruitment. There were no strong year-classes of cod since 2005 despite high cod SSB. Meso-zooplankton is important for survival of larvae and 0-group cod, so their distribution must overlap with areas of relatively high plankton biomasses. Despite a large number of studies (see e.g. summary in Ottersen et. al, 2014), the underlying mechanism of the impact of the Barents Sea ecosystem on cod recruitment is still not well understood.

Haddock

Warm conditions are positive, but not sufficient to ensure good recruitment and growth. Plankton bloom (timing and strength) and influx are important for recruitment, and feeding conditions indices for the different age classes is important for growth and reproduction. In 2019-2020 feeding conditions of haddock in the Barents Sea were poor, which reduced its condition. Older haddock include a high proportion of benthic invertebrates in their diet, the availability of this prey group is not known. Reduction in cod stock, and increase in capelin could lead to less predation on haddock by cod, and therefore lower mortality on both pre-recruits and younger haddock recruited into the fishery.

Greenland halibut

The distribution of the Greenland halibut stock is very uneven in the Barents Sea and adjacent waters and strongly depends on the migrations that it makes throughout its life. The highest densities of adult fish are observed in spawning grounds on the slope of the continental shelf. Juveniles are widely distributed along the northern part of the shelf and their abundance in the Barents Sea may be affected by water temperature and currents, although the effect of these factors is not fully understood and uncertain. Growth and maturation of the Greenland halibut depend on prey abundance. Greenland halibut feed on zooplankton, capelin, herring, polar cod and other small fishes. Cod can be both predator and food competitor for Greenland halibut. Cannibalism can be also observed in areas with overlapping of adults and juveniles. Mammals can consume Greenland halibut in the spawning areas.

Beaked redfish

As a boreal species, it is benefiting from the warming in the Barents Sea. Its stock has increased in recent years. Feeding condition for beaked redfish in 2021-2022 were likely to be relatively stable. Cod and Greenland halibut are main predators for the beaked redfish. However, as abundance of these species is declining and abundance of capelin and polar cod is increased, the predation pressure on redfish probably is relatively low. In recent years, the mortality rate of young beaked redfish has been high due to bycatches in the shrimp fishery (ICES AFWG, 2023). This strongly depends on the overlap between the distribution areas of redfish juveniles and shrimp fishery areas. The stock size and distribution of shrimp as well as currents and temperature affect this.

Current situation :

Some features of the Barents Sea ecosystem that determined the distribution and development of fish stocks in 2022 and that will affect stocks dynamics in 2023 were considered at the annual meeting between Russian and Norwegian scientists, 15-17 March 2023 and are presented in the national Russian and Norwegian ecosystem status reports. The lack of synopticity and incomplete spatial coverage in the 2022 joint ecosystem survey (van der Meeren and Prozokevitch, 2023) makes the evaluation of the ecosystem status more uncertain than usual. In particular, the abundance of pelagic and 0-group fish is uncertain.

A warming was evident in 2022 in the Barents Sea, with temperatures well above the long-term mean (1981-2010). Ice coverage of the Barents Sea in 2022 was below average and close to that in 2021. Compared to 2021, the area averaged sea surface temperature in the northwest of the Barents Sea was higher by 0.3°C, in the southwest by 0.5°C, and in the southeast by 0.7°C. The area of the Barents Sea occupied by bottom waters with a temperature < 0°C amounted to 37% and was close to the level of the last three years (Fig. 1). According to the expert evaluation, Atlantic water temperature in the Murman Current in 2023 is expected to decline slightly but remain typical of warm years. Due to high temperatures and low sea-ice extent in recent years, the ice coverage of the Barents Sea is expected to remain below normal. Lower than average ice coverage and longer duration of ice-free season, increase primary productivity of the Barents Sea.

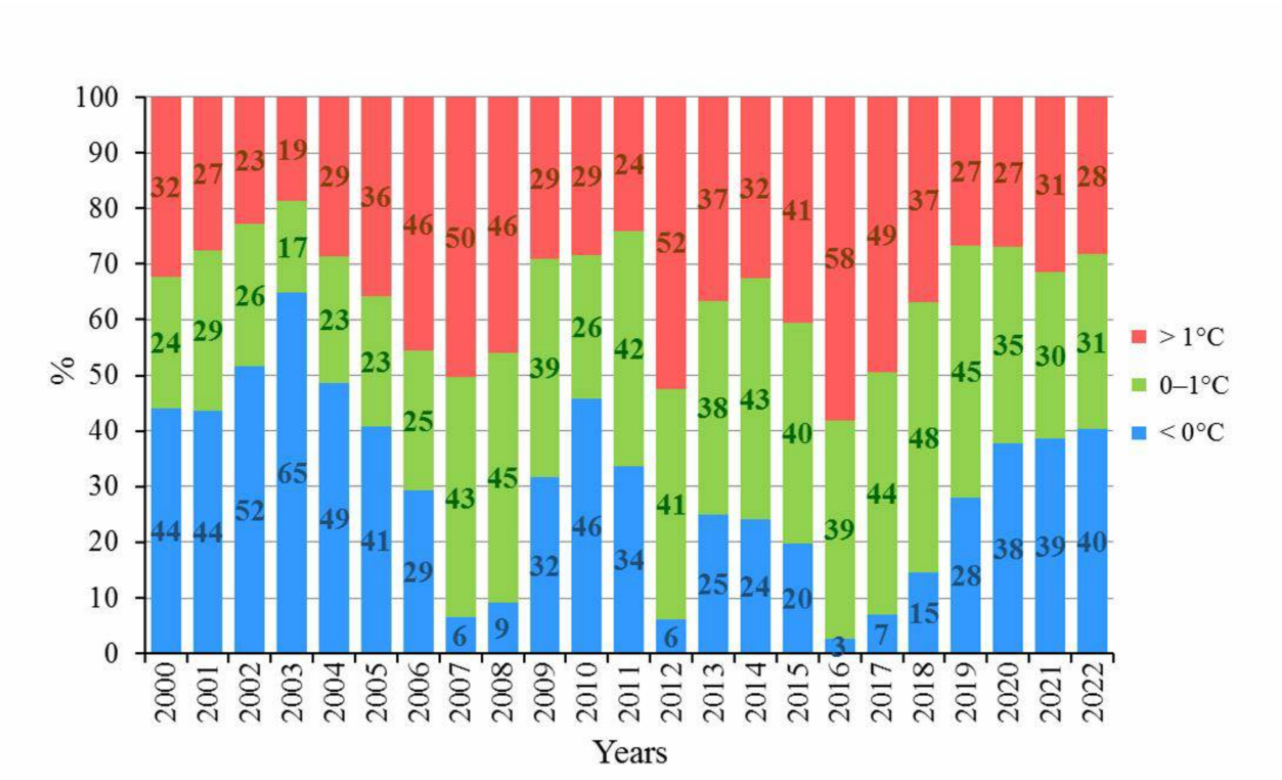

Figure 1. Area of bottom waters with different temperature ranges in the Barents Sea in September-October 2000-2022.

Euphausiids, amphipods and shrimp are important prey for most commercial fish in the Barents Sea. In 2022 the total biomass of euphausiids was slightly less than long term mean (2015-2021). In recent years, the northern shrimp stock has remained stable, showing fluctuations but without a clear trend.

Capelin, polar cod and young herring are the main forage pelagic fish in the Barents Sea, which are important prey for most predators in the area, including commercial demersal species. These species are very sensitive to various changes in the ecosystem, the influence of predators, fishing, or the plankton availability. Historically, their stocks change rapidly depending on year-classes strength. Capelin abundance is still around average level, although the lack of coverage of pelagic fish in the eastern part of the Barents Sea during the ecosystem survey in 2022 makes the situation somewhat uncertain. The capelin stock is expected to decrease in 2023-2024 due to below average recruitment. The 2022 year- class of herring was very abundant in the ecosystem survey as 0-group and also frequently found in cod stomachs in autumn 2022. This strong herring year class may have a negative impact on capelin recruitment. Polar cod biomass index was at a high level in 2021, the situation in 2022 and the outlook is uncertain due to lack of synoptic coverage during the ecosystem survey.

Cod is a main predator in the Barents Sea. Its diet was relatively stable in recent years; capelin was the main prey. The diet composition of cod in 2022 was similar to that in 2021 (Fig. 2). However, it should be mentioned increased importance of polar cod (up to 12 % by weight), as well as red king crab (from approximately 1 % by weight in previous years to 3.2 % in 2022) and herring. Fig. 3 shows the consumption by cod in the period 1984-2022. Consumption of most prey decreased from 2021 to 2022 due to decrease in cod abundance. Figs 2 and 3 are calculated using the same data but somewhat different methodology (see e. g. ICES AFWG 2021).

Fig. 4 and 5 show the proportion of cod and haddock in the diet of cod. Predation of cod on juvenile cod and haddock was relatively low in recent years, in particular in 2020 when the low abundance of the 2019 and 2020 year-classes of cod and haddock resulted in low abundance of the youngest (ages 0 and 1) cod and haddock for cod as predator.

Individual growth of cod has increased somewhat in the last couple of years. Feeding conditions for cod are expected to be adequate in the near future, as the cod likely will be able to feed on other prey if the capelin stock decreases (see Gjøsæter et al. 2009 for a discussion of ecosystem effects of capelin collapses). Also, the cod stock is decreasing so there will be less competition for food.

The diet composition of haddock is presented in Fig. 6

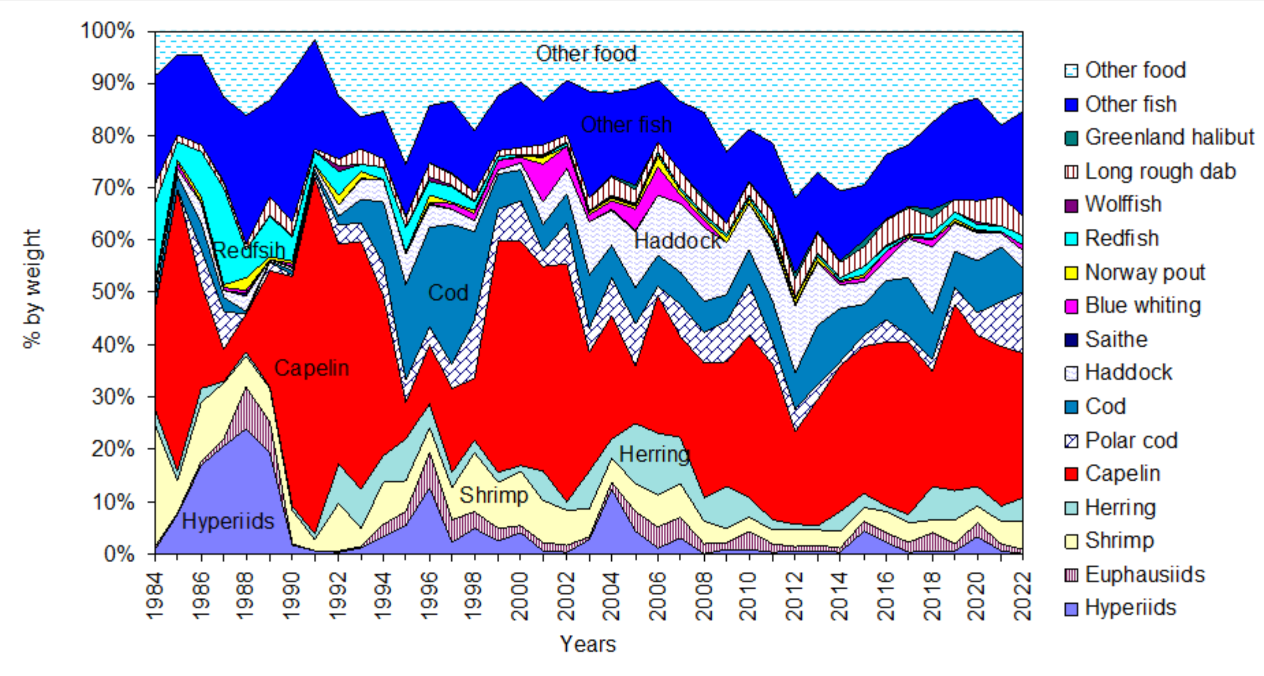

Figure 2. Diet composition of cod in 1984-2022, % by weight (The state …, 2023).

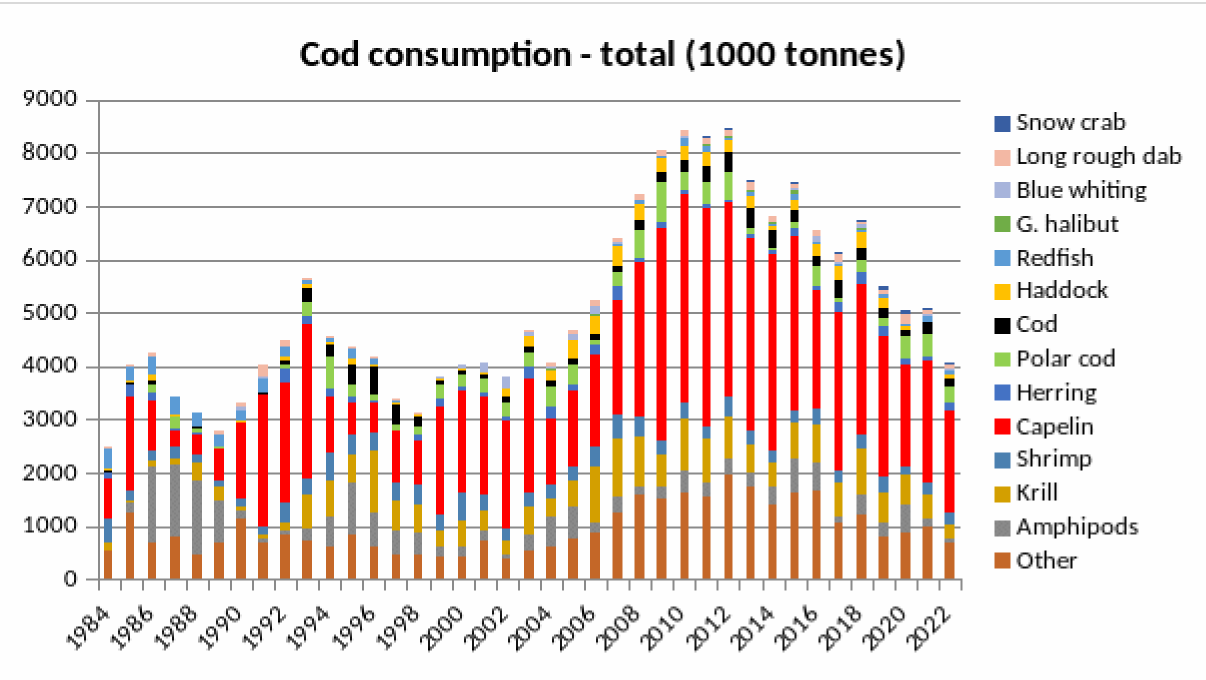

Figure 3. Consumption of various prey items by cod in 1984-2022. Norwegian calculations.

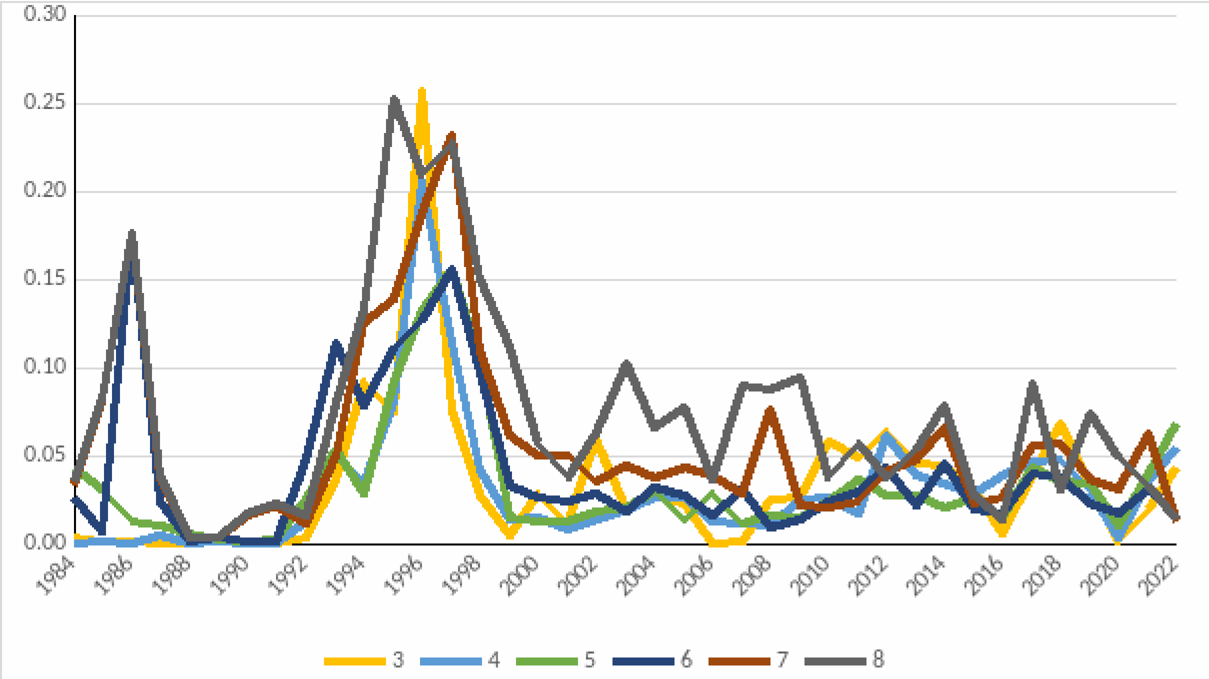

Figure 4. Proportion of cod in cod diet by predator age group.

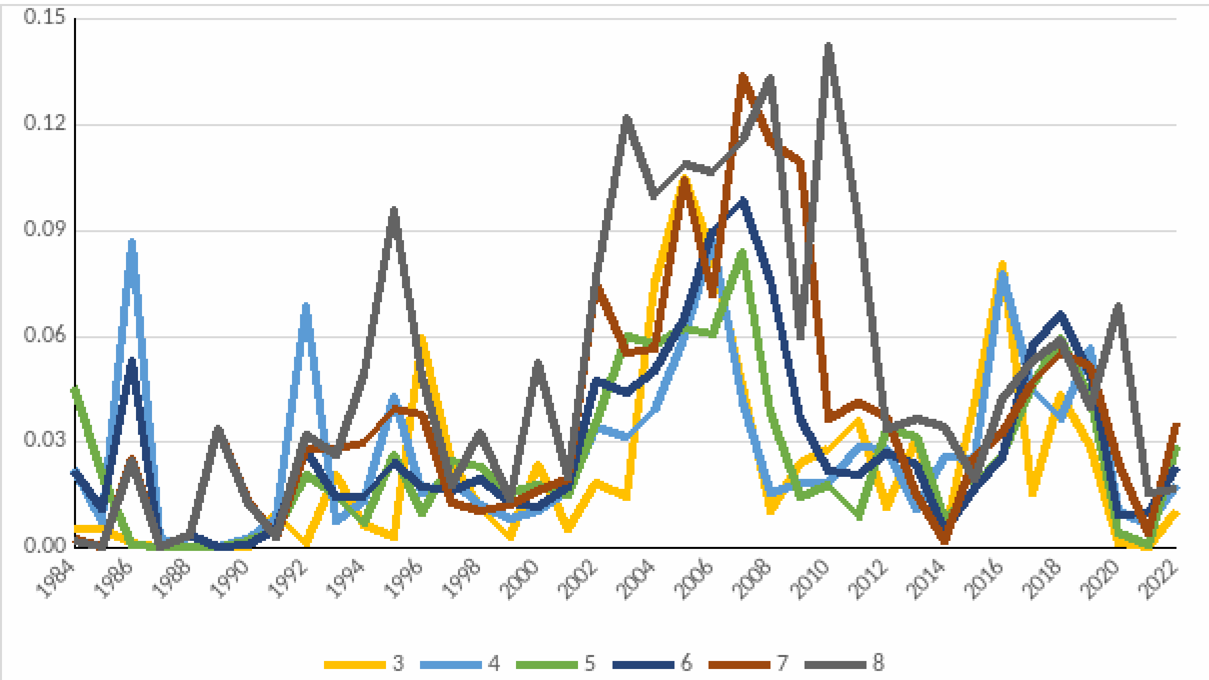

Figure 5. Proportion of haddock in cod diet by predator age group.

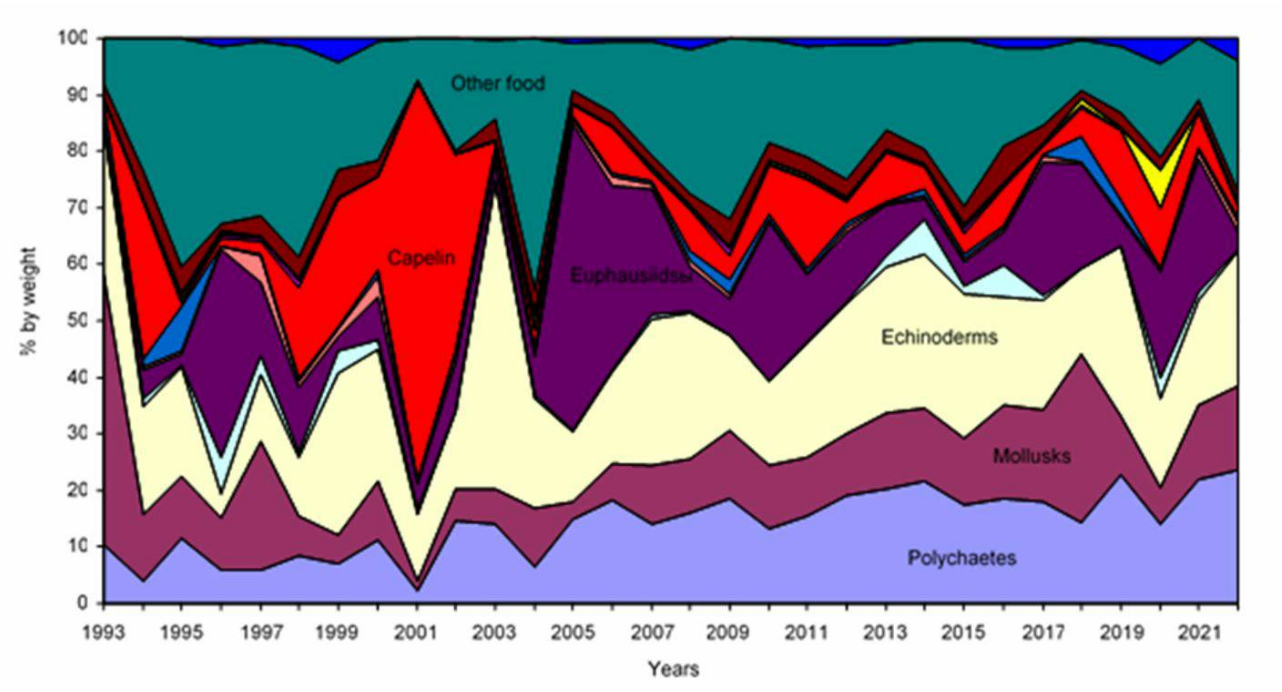

Figure 6. Diet composition of haddock in 1993-2022, % by weight

Reference

Gjøsæter, H., Bogstad, B., and Tjelmeland, S. 2009. Ecosystem effects of three capelin stock collapses in the Barents Sea. In Haug, T., Røttingen, I., Gjøsæter, H., and Misund, O. A. (Guest Editors). 2009. Fifty Years of Norwegian-Russian Collaboration in Marine Research. Thematic issue No. 2, Marine Biology Research 5(1):40-53. Doi: 10.1080/17451000802454866

Ottersen, G., Bogstad, B., Yaragina, N. A., Stige, L. C., Vikebø, F., and Dalpadado, P. 2014. A review of early life history dynamics of Barents Sea cod (Gadus morhua). ICES Journal of Marine Science 71(8): 2064-2087.

The state of biological resources of the Barents, White and Kara Seas and the North Atlantic in 2023. Murmansk, PINRO 2023, 170 p.

van der Meeren, G. and Prozorkevitch, D. (eds.) 2023. Survey report from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August- December 2022. IMR/PINRO-report series x/2023 (in prep)

3 - Northeast Arctic Cod (Subareas 1 and 2)

3.1 - Status of the fisheries

3.1.1 - Historical development of the fisheries (Table 3.1)

From a level of about 900 000 t in the mid-1970s, total catch declined steadily to around 300 000 t in 1983—1985 (Table 3.1). Catches 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, stabilized around 750 000 t in 1994—1997 but decreased to about 414 000 t in 2000. From 2000—2009, the reported catches were between 400 000 and 520 000 t, in addition there were unreported catches (see below). Catches have been above the long-term average since 2011 and have decreased from a peak of 986 000 tonnes in 2014 to 693 000 tonnes in 2019-2020 before increasing to 767 000 tonnes in 2021 and decreasing again to 719 000 tonnes in 2022. 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 bycatch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

3.1.2 - Reported catches prior to 2023 (Tables 3.1-3.4, Figure 3.1)

The provisional catch of cod in Subarea 1 and divisions 2.a and 2.b for 2022 reported to the working group is 759 520 t (including both NEA cod and NCC catches).

The historical practice (considering catches between 62°N and 67°N for the whole year and catches between 67°N and 69°N for the second half of the year to be Norwegian coastal cod) has been used for estimating the Norwegian landings of Northeast Arctic cod up to and including 2011 (Table 3. 2). The catches of coastal cod subtracted from total cod catches in Subarea 1 and divisions 2.a and 2.b for the period 1960—2022 are given in Table 3.2. For 2012–2022 the Norwegian catches have been analysed by an ECA-version designed for simultaneously providing estimates of catch numbers-at-age for each of the two stocks.

Coastal cod catches in 2022 for the southern and northern area combined were 40 309 tonnes and this amount was as in previous years subtracted from the total cod catch north of 62° N to get the figure for NEA cod used in that assessment (Table 3.1 and 3.2).

The time series for coastal cod catches are now inconsistent with the coastal cod catches presented in ICES AFWG 2023 Chapter 2, as the coastal cod catch time series were revised at WKBarFar, but not the NEA cod time series. At WKBarFar, the proposal for revision of NEA cod catch data series was rejected, as Norwegian data for many years and age groups (especially ages 12+ in years prior to 2013) were changed considerably and the reason for this was not sufficiently explained. WKBarFar recommended that when the revision of the historical Norwegian catch data is ready it should be submitted to ICES for review, ideally by a review attached to the AFWG.

The catch by area is shown in Table 3.1, and further split into trawl and other gears in Table 3.3. The distribution of catches by areas and gears in 2022 was similar to 2021. The nominal landings by country are given in Table 3.4.

There is information on cod discards (see ICES AFWG 2021 section 0.4) but it was not included in the assessment because these data are fragmented and different estimates are in contradiction with each other. Moreover the level of discards is relatively small in the recent period and inclusion of these estimates in the assessment should not change our perception on NEA cod stock size.

In summer/autumn 2018, a Norwegian vessel caught 441 t of cod in the Jan Mayen EEZ, which is a part of ICES area 2a, mostly by long-line. Cod is known to occasionally occur in this area, but rarely in densities which are suitable for commercial fisheries. The cod caught in this area in 2018 was large (65-110 cm), and otolith readings and genetics both showed this cod to be a mix of Northeast Arctic and Icelandic cod. Norway did in 2019-2020 carry out an experimental long-line fishery during four different periods in each year in order to investigate further the occurrence of cod in this area in space and time as well as stock identity. A description of this fishery as well as a historic overview of cod observations around Jan Mayen is given in Bogstad (2023).

Quotas, catches and advice for the period 2019-2023 for cod in the Jan Mayen area are given in Table 3.1a. These catches are not included in the catch statistics for Northeast Arctic cod.

3.1.3 - Unreported catches of Northeast Arctic cod (Table 3.1)

In the years 2002—2008 certain quantities of unreported catches (IUU catches) have been added to the reported landings. More details on this issue are given in the Working group reports for that period.

There are no reliable data on level of IUU catches outside the periods 1990—1994 and 2002—2008, but it is believed that their level was not substantial enough to influence on historical stock assessment.

According to reports from the Norwegian-Russian analysis group on estimation of total catches the total catches of cod since 2009 were very close to officially reported landings.

3.1.4 - TACs and advised catches for 2022 and 2023

The Joint Norwegian-Russian Fisheries Commission (JNRFC) agreed on a cod TAC of 708 480 t for 2022, and in addition 21 000 t Norwegian coastal cod. The total reported catch of 759 520 t in 2022 was 30 040 t above the agreed TAC. Since 2015 JNRFC has decided that Norway and Russia can transfer to next year or borrow from last year 10% of the cod country’s quota. That may lead to some deviation between agreed TAC and reported catch. As an extraordinary measure due to expected underfishing of the TAC in 2021, JNRFC decided that it should be possible to transfer 15% of the TAC between 2021 and 2022, but for 2022-2023 the transfer was reset back to the agreed 10%.

The advice for 2023 given by JRN-AFWG in 2022 was 566 784 t based on the agreed harvest control rule. The quota established by JNRFC for 2023 was set equal to the advice. In addition, the TAC for Norwegian Coastal Cod was set to the same value for 2023 as for 2022: 21 000 t.

3.2 - Status of research

3.2.1 - Fishing effort and CPUE (Table A1, Figure 3.4-3.5)

CPUE series of the Norwegian and Russian trawl fisheries are given in Table A1. The data reflect the total trawl effort (Figure 3.4), both for Norway and Russia. The Norwegian series is given as a total for all areas. Norwegian data for 2011–2022 are not necessarily compatible with data for 2007 and previous years. Norwegian CPUE declined from 2020 to 2022 and reached the lowest level in the 2011-2022 time series (Figure 3.5). Note that double trawl is now the dominant gear in the Norwegian trawl fishery (Nedreaas WD02), but trends are the same for single and double trawl. Russian CPUE was the lowest since 2008 in all areas and in area 2a it was the lowest since 1999.

3.2.2 - Survey results - abundance and size at age (Tables 3.5, A2-A14)

Joint Barents Sea winter survey (bottom trawl and acoustics) Acronyms: BS-NoRu-Q1 (BTr) and BS-

NoRu-Q1 (Aco)

The survey was carried out as planned with relatively good spatial coverage, although bad weather and ice limited the coverage somewhat.

Before 2000 this survey was made without participation from Russian vessels, while in 2001—2005, 2008—2016 and 2018-2023 Russian vessels have covered important parts of the Russian zone. In 2006—2007 the survey was carried out only by Norwegian vessels. In 2007, 2016, and 2021-2023 the Norwegian vessels were not allowed to cover the Russian EEZ. The methods for adjustment for incomplete area coverage are described in detail in Fall et al. (2023) and references therein. Table 3.5 shows areas covered in the time-series and the additional areas implied in the method used to adjust for missing coverage in the Russian Economic Zone.

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. Changes in the survey methodology through time are described in Fall et al. 2023 (Appendix 2). 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.

It is likely that in recent years the coverage in the February survey (BS-NoRu-Q1 (BTr) and BS-NoRu-Q1 (Aco)) has been incomplete, in particular for the younger ages. This could cause a bias in the assessment, but the magnitude is unknown. The 2014–2023 surveys covered considerably larger areas than earlier winter surveys, and showed that most age groups of cod (particularly ages 1 and 2) were distributed far outside the standard survey area. The bottom trawl survey estimates including the extended area for 2014-2023 were used in the tuning data separately from the same index before 2014, as decided at WkBarFar 2021.

Lofoten acoustic survey on spawners Acronym: Lof-Aco-Q1

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 2023 survey results in biomass terms was 128 thousand tonnes, this is 30 % below the 2022 level and the lowest since 2001.

A pilot survey on spawning grounds north of the area covered by the Lofoten survey was carried out in 2023 (Korsbrekke 2023 WD03), at about the same time and in the same way as the Lofoten survey. The total abundance in that area was about 16% of that in the Lofoten area. The area covered by this pilot survey is mostly covered also by the winter survey, but with much larger distance between transects at that time.

Russian autumn survey Acronym: RU-BTr-Q4

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 was in 2007 revised backwards to 1982 (Golovanov *et al* ., 2007, WD3), using the same method as in the revision presented in 2006, 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 2a and 2b were adequately investigated in the survey in contrast to Subarea 1, where the survey covered approximately 40% of the long-term average area coverage. The Subarea 1 survey indices were calculated based on actual covered area (40 541 sq. miles). The 2007 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.

This survey was not conducted in 2016 , but was carried out in 2017, when 79% of the standard survey area was covered (Sokolov *et al* 2018, WD 11). The index shows a reliable internal consistence and it was decided to use it in the assessment. This survey was not carried out in 2018-2022 and is discontinued.

Joint Ecosystem survey Acronym: Eco-NoRu-Q3 (Btr)

Swept area bottom trawl estimates from the joint Norwegian-Russian ecosystem survey in August-September for the period 2004–2022 are given in Table A14. This survey normally covers the entire distribution area of cod at that time of the year.

In 2014 this survey had an essential problem with area coverage in the north-west region because of difficult ice conditions. In the area covered by ice in 2014 a substantial part of population was distributed during 2013 survey. So, based on those observations AFWG decided in 2015 to exclude 2014 year from that tuning series in current assessment. In 2016 there was incomplete coverage in the international waters and close to the Murman coast. An adjustment for this incomplete coverage was made based on interpolation from adjacent areas (Kovalev *et al* 2017, WD 12). At this time of the year, usually a relatively small part of the cod stock is found in the area which was not covered in 2016. In 2017 and 2019 the coverage was close to complete, although the far northeastern part of the survey area (west of the north island of Novaya Zemlya) was not covered due to military restrictions. In 2018, a large area in the eastern part of the Barents Sea was not covered. Thus it was decided not to include 2018 data from this survey in the assessment.

The coverage in 2020 was less synoptic than usual, but it was decided to keep them in the assessment. The 2021 coverage was good, although as in several previous years, most of the international waters in the Barents Sea was not covered.

In 2022 the coverage of the Russian EEZ was done much later than the coverage of the Norwegian EEZ, with the entire survey period being from 15 August to 3 December (van der Meeren and Prozorkevitch, 2023). Also some areas were not covered. Indices based on the combined data have been calculated (Table A14), but due to the poor synopticity and incomplete coverage it was decided not to use this index in this year’s assessment.

The survey indices are calculated both the BioFox and StoX calculation methods, and as in earlier years, the Biofox series was used in the tuning. A research recommendation from WkBarFar was to unify these two methods for estimating indices from ecosystem survey. However, the benchmark decided to use weight at age from the StoX in calculations of weight at age used in the assessment.

Survey results - length and weight-at-age (Tables A5-A8, A11-A12, A15, A16)

Length-at-age is shown in Table A5 for the Joint 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, Table A12 for the Russian survey in October-December and Table A15 for the BESS survey (calculated using StoX). Table A16 presents combined data on Weight-at-age from winter survey and Lofoten survey.

Length and weight at age in the Joint winter survey in the Barents Sea was fairly stable from 2022 to 2023, with some increase noted for ages 4 and 7. Weight at age in the Lofoten survey increased from 2022 to 2023 for age groups 7 and decreased for ages 9 and 10. The size at age in the BESS survey increased from 2021 to 2022 for ages 3 and older, this could be partly related to the later timing of the survey.

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 ICES AFWG 2021 chapter 0.7). The results of fifteen years of annual comparative age readings are described in Yaragina *et al*. (2009). Zuykova *et al*. (2009) re-read old otoliths and found no significant difference in contemporary and historical age determination and subsequent length at age. However, age at first maturation in the historical material as determined by contemporary readers is younger than that determined by historical readers. Taking this difference into account would thus have effect on the spawning stock-recruitment relationship and thus on the biological reference points. The overall percentage agreement for the 2017–2018 exchange was 87.7% (Zuykova et al. 2020) . The main reason for cod ageing discrepancies between Russian and Norwegian specialists remains the same, representing the latest summer growth zone, and different interpretations of the false zones. The general trend is that the Russian readers assign slightly lower ages than the Norwegian readers compared to the modal age for all age groups. This is opposite of what we have seen in previous readings, where the Russian readers has tended to be slightly overestimating the age compared to the Norwegian readers.

The trend with bias in NEA cod age determination registered for some years of the period 1992–2018 between experts of both countries is a solid argument to continue comparative cod age reading between PINRO and IMR to monitor the situation. The German participant has expressed an intention to join the age reading cooperation in future.

3.3 - Data available for use in assessment

Data for the period 1946–1983 are taken from the AFWG 2001 report (ICES CM 2001/ACFM:19) and were not revised at the WKBarFar benchmark in 2021.

3.3.1 - Catch-at-age (Table 3.6)

For 2022, age compositions from all areas were available from Norway, Russia, Spain and Germany.

There is still a concern about the biological sampling from parts of the Norwegian fishery that may be too low. Also the split between NEA cod and coastal cod may be affected by the sampling coverage. Data from Norwegian Coast Gard vessels' length measurements onboard Russian vessels in some quarters of 2022 were used for calculation of age composition of Russian catches in Division 2b.

3.3.2 - Survey indexes available for use in assessment (Table 3.13, A13)

The following survey data series were available:

Fleet code	Name	Place	Season	Age	Years
Fleet 15*	Joint bottom trawl survey	Barents Sea	Feb-Mar	3–12+	1981–2013, 2014-2023
Fleet 16	Joint acoustic survey	Barents Sea+Lofoten	Feb-Mar	3–12+	1985–2023
Fleet 18	Russian bottom trawl surv.	Barents Sea	Oct-Dec	3–12+	1982–2017
Fleet 007	Ecosystem surv.	Barents Sea	Aug-Sep	3–12+	2004–2021**

*Survey indices for Fleet 15 were divided by two series (before and after 2014) in model tuning as decided at WKBarFar 2021.
**2022 data not used in the assessment

The tuning fleet file is shown in Table 3.13. Note that the joint acoustic survey (sum of Barents Sea and Lofoten acoustic survey indices) is given in Table A13.

Survey indices for Fleet 15 have been multiplied by a factor 100, while survey indices for Fleets 007, 16 and 18 have been multiplied by a factor 10. This is done to keep the dynamics of the surveys even for very low indices, because some models (e.g. XSA) adds 1.0 to the indices before the logarithm is taken.

3.3.3 - Weight-at-age (Tables 3.7-3.9, A2, A4, A6, A8, A12, A16).

Catch weights

For 2022, weight-at-age in the catch for areas 1, 2a and 2b was provided by Norway, Russia, Spain and Germany (Table 3.7). For ages up to and including 11, observations are used. Following the WKBarFar 2021 decision, weight at age in catch for the years 1983-present for ages 12-15+ are calculated by a cohort-based von Bertalanffy approach used to replace previous fixed values.

Stock weights

For ages 1—11 stock weights-at-age at the start of year y ($W_{a,y}$) for 1983—2023 are calculated combining, when available, weight at age from the Winter, Lofoten, Russian autumn and ecosystem surveys. The details are given in the Stock Annex. For ages 12-15+ a similar approach as for weight at age in the catch was used.

3.3.4 - Natural mortality including cannibalism (Table 3.12, Table 3.17)

A natural mortality (M) of 0.2 + cannibalism was used. Cannibalism is assumed to only affect natural mortality of ages 3-6.

2022 data are available and 2021 data have been updated.

The method used for calculation of the prey consumption by cod described by Bogstad and Mehl (1997) is used to calculate the consumption of cod by cod for use in cod stock assessment. The consumption is calculated based on cod stomach content data taken from the joint PINRO-IMR stomach content database (methods described in Mehl and Yaragina 1992). On average about 9000 cod stomachs from the Barents Sea have been analysed annually in the period 1984—2022.

These data are used to calculate the per capita consumption of cod by cod for each half-year (by prey age groups 0—6 and predator age groups 1–11+). 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.

An iterative procedure was applied to include the per capita consumption data in the SAM run. It is described in detail in Stock Annex.

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 data on cod cannibalism for the historical period (1946—1983) was included in assessment during the benchmark to make the time-series consistent (ICES 2015, WKARCT 2015). These estimates were based on hindcasted values of NEA cod natural mortality at ages 3—5 using PINRO data base on food composition from cod stomach for the historical period (Yaragina *et al* . 2018).

It was noted that for 2022, the consumption estimates may somewat overestimate age 1 consumption and underestimate age 3+ consumption. This is due to lack of length measurements for stomachs which contained high cod weight, they likely represent large prey but have partly been allocated to small prey as length measurements were mostly available for stomachs containing low weight of cod.

3.3.5 - Maturity-at-age (Tables 3.10-3.11)

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 3.10). For the years 1985—2023, Norwegian maturity-at-age ogives have been obtained by combining the Barents Sea winter survey and the Lofoten survey. 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 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.

Russian data for the autumn survey for 2018 and later years were not available as the survey was not conducted. In WD1 5 , 2019, updated correction factors to allow for this when calculating the combined maturity-at-age in 2019 were calculated, based on historical differences between Norwegian and Russian data. These correction factors were then applied to the Norwegian data for 2020-2023.

The approach used for calculating maturity at age is the same as previously used and consistent with the approach used to estimate the weight-at-age in the stock, except that no data from the BESS survey are used. However, since survey data, both abundance indices and proportion mature, have been revised, the entire time series of ogives back to 1994 was revised at the benchmark. The proportions of mature cod for age 13–15 are set to 1 for the period 1984–present.

Maturity-at-age for cod has been variable the last years, particularly for ages 6–9. According to the combined data, maturity at age increased from 2022 to 2023 for age groups 7-9 (Table 3.11).

3.4 - Assessment using SAM

3.4.1 - SAM settings (Table 3.14)

The SAM model settings optimised by WKBarFar are shown in Table 3.14.

3.4.2 - SAM diagnostics (Figure 3.2 a-e)

Residuals for the SAM run are shown in Figure 3.2a, while model retrospective plots of F, SSB and recruitment are shown in Figure 3.2b. Historical retrospective pattern for final SAM run are shown in Figure 3.2c. Figure 3.2d compares observed and modelled catches in tonnes and Figure 3.2e shows the catchability by survey and age group.

The retrospective pattern is generally good (Figure 3.2b), with absolute values of Mohn's rho < 10% for SSB, R and F.

The observed catch in tonnes in 2021 and 2022 is higher than modelled, and for 2021 just inside the confidence interval.

3.4.3 - Results of assessment (Tables 3.15-3.18, Figure 3.1)

Summaries of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1946 are given in Table 3.18 and Figure 3.1.

The fishing mortalities and population numbers are given in Tables 3.15 and 3.16.

The estimated $F_{5\text{-}10}$ in 2022 is 0.574, which is above F_{pa} and within the F_{msy} range (Table 3.18). Fishing mortality has been increasing steadily in recent years. The spawning stock biomass in 2023 is estimated to be 719 kt (Table 3.20), which is high but much lower than the peak in 2013 (2,239 kt). One should bear in mind that in the early part of the time-series (before the 1980s) the fraction at age of mature fish was considerably lower.

Total stock biomass in 2023 is estimated to 1,610 kt, which is somewhat below the long-term mean and well below the highest level observed after 1955 (3,728 kt in 2013).

It is noted that the exploitation pattern is still dome-shaped with a marked decrease in selectivity above age 12, although the dome-shape is not as strong than in assessments made before the 2021 benchmark.

M values (M = 0.2+cannibalism mortality) are given in Table 3.17. For ages 3—5 the M matrix in 1946—1983 also includes cannibalism mortality since the benchmark meeting in 2015 (WKARCT 2015).

3.5 - Reference points and harvest control rules

The current reference points for Northeast Arctic cod were estimated by SGBRP (ICES CM 2003/ACFM:11) and adopted by ACFM at the May 2003 meeting.

At the 46th session of JRNFC a new version of the management rule was adopted (see section 3.7.3) . The TAC advice for 2024 is based on the agreed harvest control rule.

3.5.1 - Biomass reference points

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

3.5.2 - Fishing mortality reference points

The values adopted by ACFM in 2003 are F_{lim} = 0.74 and F_{pa} = 0.40 (ICES CM 2003/ACFM:11). The F_{msy} for NEA cod was estimated by WKBaRFar 2021 to be in the range 0.40 - 0.60.

3.5.3 - Harvest control rule

The history of how the harvest control rule has developed is given in the 2017 AFWG report. JNRFC in 2015 asked ICES to explore the consequences of 10 different harvest control rules. This was done by WKNEAMP (ICES 2015, 2016). JNRFC in 2016 adopted one of the rules explored by WKNEAMP (Rule 6 in that report).

The current rule reads as follows:

The TAC is calculated as the average catch predicted for the coming 3 years using the target level of exploitation (F_{tr}).

The target level of exploitation is calculated according to the spawning stock biomass (SSB) in the first year of the forecast as follows:

- *if $SSB < B_{pa}$, then $F_{tr} = SSB / B_{pa} \times F_{msy}$;*
- *if $B_{pa} \le SSB \le 2\times B_{pa}$, then $F_{tr} = F_{msy}$;*

- if $2 \times B_{pa} < SSB < 3 \times B_{pa}$, then $F_{tr} = F_{msy} \times (1 + 0.5 \times (SSB - 2 \times B_{pa}) / B_{pa})$;

- if $SSB \geq 3 \times B_{pa}$, then $F_{tr} = 1.5 \times F_{msy}$;

where F_{msy}=0.40 and B_{pa} =460 000 tonnes.

If the spawning stock biomass in the present year, the previous year and each of the three years of prediction is above B_{pa}, the TAC should not be changed by more than +/- 20% compared with the previous year's TAC. In this case, F_{tr} should however not be below 0.30.

3.6 - Prediction

3.6.1 - Prediction input (Tables 3.19a)

The input data to the short-term prediction with management option table (2023—2026) are given in Table 3.19a. For 2023 stock weights and maturity were calculated from surveys as described in Sections 3.3.2 and 3.3.4.

Catch weights in 2023 onwards and stock weights in 2024 and onwards for age 3–11 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. The method is given by the equation

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. Since 2005 working group an average of the 3 most recent values of annual increments have been used for predicting stock weights. For catch weights the last 5-year period for averaging the increments is used (changed from 10-year period at the 2021 benchmark).

The maturity ogive for the years 2024—2026 was predicted by using the 2021-2023 average. The fishing pattern in 2023 and later years was set equal to the previous 3 years. The stock annex prescribes average over 5 years, but as there has been a clear shift in the fishing pattern in recent years towards exploiting younger fish, a 3-year average was considered to be more appropriate.

The stock number-at-age in 2023 was taken from the final SAM run (Table 3.16) for ages 4 and older. The recruitment at age 3 in the years 2023—2026 was estimated as described in section 3.7.2. Figure 3. 3 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—2022. There was a decreasing trend in natural mortality, but the average M values for the last 3 years are used to predict natural mortality of age groups 3—6 for years 2023—2026 (based on benchmark decision, WKARCT 2015 and unchanged at WKBaRFar 2021). Predation mortalities in 2022 for age 3 and older could be somewhat underestimated as described in section 3.3.4.

The assessment shows an increasing F from 2012 to 2022. In accordance with the benchmark decision (WKARCT 2015, not reviewed at WKBarFar 2021) and with support from AFWG-2019 WD 11 (Kovalev and Chetyrkin, 2019), the last year's assessment F in terminal year 2022 (*status quo*) is used for F in the intermediate year (2023). Table 3.19 shows input data to the predictions. The results of prediction show that the catch in 2023 predicted using F_{sq} is very close to the agreed TAC.

3.6.2 - Recruitment prediction (Table 3.19b-d)

At the 2008 AFWG meeting it was decided to use a hybrid model, which is a weighted arithmetic mean of different recruitment models. It was agreed to use the same approach this year. The input data for those models are the following time-series; ice coverage, intensity of interaction between the arctic and boreal oceanic systems on the shelf of the Barents Sea, temperature and oxygen saturation at the Kola section. Input data to the prediction are presented in Tables 3.19b-c and prognosis from all the models, including the hybrid is presented in Table 3.19d. Since 2014 the hybrid model is based on objective weighting of different sub-models and includes the RCT3 model (see AFWG report 2021 section 1.4 for details). The numbers-at-age 3 calculated by the hybrid method were: 446 million for the 2020 year class, 209 million for the 2021 year class, 439 million for the 2022 year class and 400 million for the 2023 year class (Table 3.19d).

Although age 3 indices from the winter bottom trawl and acoustic surveys are now also included in the SAM tuning, it was decided at the benchmark to continue using in the predictions recruitment estimates at age 3 in the assessment year (intermediate year in prediction) from the hybrid model. The difference between the SAM estimate and the hybrid model estimate of age 3 in 2023 was large (188 vs. 446 million individuals). Such a discrepancy was also observed in the 2022 assessment (189 vs. 476 million individuals for 2019 year class), and the SAM estimate for the 2019 year class at age 3 is practically unchanged this year (from 189 million in 2022 assessment to 197 million in this year's assessment). It is also noted that the retrospective pattern for recruitment estimated by SAM in recent years is quite good as shown in Fig. 3.2b (Mohn's rho 7%).

Despite these discrepancies between hybrid and SAM in recent years and the associated inconsistent historical retrospective pattern for recruitment (Fig 3.2c), it was decided to use the hybrid model also this year. One reason for this is that the predicted generally low recruitment level is in line with recent survey observations of trends year-class strength, although the recruitment values by year differ.

However, a review of the methodology for predicting recruitment should be carried out before next year's working group and if possible an improved methodology should be proposed.

3.6.3 - Prediction results (Tables 3.20-3.21)

The catch corresponding to F_{sq} in 2023 is 573 kt (Table 3.20). The resulting SSB in 2024 is 588 kt, which is 18 % lower than the SSB in 2023. Table 3.20 shows the short-term consequences over a range of F-values in 2024. The detailed outputs corresponding to F_{sq} in 2023 and the F corresponding to the HCR and F_{pa} in 2024 is given in Table 3.21. Summarised results are shown in the text table below.

Since SSB in 2023 is between B_{pa} =460 000 t and 2 × B_{pa} = 920 000 t, F = 0.40 is used in the 3-year prediction, giving catches of 357 377, 354 196 and 355 390 tonnes in 2024, 2025 and 2026, respectively. The average of this is 355 655 tonnes. According to the HCR the maximum year-to-year decrease in TAC is limited by 20 % which corresponds to a TAC of 453 427 tonnes for 2024. The HCR also says that SSB in the 3 preceding years (2024-2026) should be above B_{pa} for the 20% limit to apply, and a prediction with F=0.40 gives a SSB in 2026 of 558 361 tonnes, which is above B_{pa} .

Cod in ICES subareas 1 and 2. Annual catch options. All weights are in tonnes.

Basis	**Total catch (202 4)**	**Ftotal (202 4)**	**SSB(202 5)**	**% SSB change ***	**% TAC change ****	**% Advice change *****
ICES advice basis						
Management plan^	453 427	0. 540	506 615	- 14	-20	-20
Other options						
F = 0 .4****	357 377	0.40	586 401	0	-37	-37

F = 0	0	0	900 153	53	-100	-100
F = F202 2	475 016	0.574	489 013	-17	-16	-16
F_{pa}	357 377	0.40	586 401	0	-37	-37
F_{lim}	571 054	0.74	412 367	-30	1	1

Weights in tonnes.

^ 20 % decrease from TAC 2023

*** SSB 2025 relative to SSB 2024.**

**** Catch 2024 relative to TAC 2023**

***** Advice for 2024 relative to advice for 2023**

****** F = 0.40 corresponds to the lower bound of the F_{MSY} range (0.40-0.60).**

This catch forecast 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.

3.6.4 - Medium-term predictions (Figure 3.8)

The inputs for medium-term prediction are the same as for short-term ones. For years after terminal year in short-term prediction the same value as for this year are used for all parameters except target fishing mortality which is according to the HCR.

The stock size has been decreasing in recent years due to low incoming recruitment, downward adjustment of the stock size (due to model modifications at the benchmark in 2021) and increasing fishing mortality. The increase in fishing mortality is partly due to the 20% limit on annual reduction of TAC and 10-15 % transferring of quotas between years. Recruitment in coming years (2021-2024 year classes) is also estimated to be below average. The reason for low recent recruitment is not known. Previous periods of low recruitment have mainly occurred when temperature is below average, which is not the case at present.

The predictions for 2025 and following years indicate that a further 20% reduction in catch from 2024 to 2025 will be advised and then catches will stabilize around 350 000 tonnes and stock size will also stabilize around 1.3 million tonnes (Figure 3.8). However, SSB is now approaching B_{pa} , below which level recruitment may be impaired. Also, due to rather uncertain medium-term forecast in stock size, SSB might fall below Bpa in coming years in which case advice according to the agreed HCR will be further reduced and the 20 % stability constraint will no longer be applied.

3.7 - Comparison with last year's assessment and prediction

3.7.1 - Comparison to 2022 assessment

The text table below compare this year's estimates with the final 2022 JRN-AFWG estimates for numbers at age (millions), total biomass, spawning biomass (thousand tonnes) in 2022, as well as reference F for the year 2021.

		N(2022)															
Assessment year (specification)	F(2021)	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13	age14	age15	TSB (2022)	SSB (2022)	F (2022)
RN-AFWG 2022	0.481	476*	275	264	198	123	81	27	13	11	4.8	1.4	0.7	2.5	1985	833	0.481**
RN-AFWG 2023	0.545	197	266	257	196	116	75	24	11	8	3.4	1.2	0.6	1.4	1746	712	0.574
Ratio 2023 RN-AFWG/ 2022 RN-AFWG	1.13	0.41	0.97	0.97	0.99	0.95	0.93	0.89	0.86	0.73	0.72	0.84	0.79	0.55	0.88	0.85	1.19

*estimated by recruitment models **assuming Fsq

In the current assessment, the number at all ages was adjusted downwards compared to the 2022 JRN-AFWG assessment.

3.7.2 - Comparison to prediction

The change in the advice is large compared to last year. The advice for 2024 is 453 427 tonnes, while the advice for 2023 given by JRN-AFWG was 566 784 tonnes.

The 2023 assessment adjusted the stock size in recent years downwards. The main tendency for stock decrease in recent years was similar to last year’s assessment.

3.8 - Concerns with the assessment

The WG realizes that imprecise input data, in particular the catch-at-age matrix, and discontinuation of some surveys as well as incomplete spatial coverage and reduced synopticity in surveys could be a main obstacle to producing precise stock assessments, regardless of which model is used.

3.9 - Additional assessment methods

All models use the same tuning data.

3.9.1 - TISVPA (Tables 3.22-3.24, Figure 3.6a-c)

This year the TISVPA model was applied to NEA cod with the same settings as last year and using the same data as SAM except that natural mortality values from cannibalism were taken from the SAM runs. During WG the results of exploratory runs using the TISVPA model (Tables 3.22-3.24) were discussed. The residuals of the model approximation of catch-at-age and “fleets” data are presented in Figure 3.6a. Likelihood profiles for different data source are presented in Figure 3.6b. Retrospective run results are shown in Figure 3.6c.

3.9.2 - Model comparisons (Figures 3.2a, 3.6a, 3.7)

Figure 3.7 compares the results of SAM and TISVPA, showing F, SSB, TSB and recruitment. Trends are similar in all models, but TISVPA gives higher F in 2022 and lower biomass in 2023 than SAM. However, recruitment in 2022 is higher in TISVPA than in SAM. Both models show a reasonable retrospective pattern (F igures 3.2a, 3.6c).

3.10 - New and revised data sources

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

3.10.1 - Consistency between NEA cod and coastal cod catch data (Table 3.2)

Consistency between the catch data used for NEA cod and coastal cod should be ensured. The revised catch figures used in the coastal cod assessment do not correspond to the difference between the total cod catch and the catch used in the NEA cod assessment (Table 3.2). These discrepancies will be adjusted when the NEA cod catch series are revised (section 3.2.2).

3.10.2 - Discard and bycatch data

Work on updating discard and bycatch data series is ongoing. Revised bycatch estimates in numbers for the period 2005-2022 are shown in ICES AFWG-2023 Fig. 0.1. At WKARCT in 2015 it was, however, decided not to include those data in the catch-at-age matrix.

The bycatch mainly consists of age 1 and 2 fish, but the bycatch is generally small compared to other reported sources of mortality: catches, discards and the number of cod eaten by cod. From 1992 onwards, bycatches of age 3 and older fish are negligible, because use of sorting grids was made mandatory. However, in 1985, bycatches of age 5 and 6 cod were about one third of the reported catches for those age groups. The year class for which the bycatches were highest, was the 1983 year class (total bycatch of age 2 and older fish of about 60 million, compared to a stock estimate of about 1300 million at age 3.

3.11 - References

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Table 3.1. Northeast Arctic COD. Total catch (t) by fishing areas and unreported catch.

Year	Subarea 1	Division 2.a	Division 2.b	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

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
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	184 789	189 013	71 242	90 000	535 045
2003	163 109	222 052	51 829	115 000	551 990
2004	177 888	219 261	92 296	117 000	606 445
2005	159 573	194 644	121 059	166 000	641 276
2006	159 851	204 603	104 743	67 100	537 642
2007	152 522	195 383	97 891	41 087	486 883
2008	144 905	203 244	101 022	15 000	464 171
2009	161 602	207 205	154 623		523 431
2010	183 988	271 337	154 657		609 983
2011	198 333	328 598	192 898		719 829
2012	247 938	331087	148 638		727 663
2013	360 673	421678	183 858		966 209
2014	320 347	468 934	197 168		986 449
2015	272405	375328	216651		864384
2016	321347	351468	176607		849422
2017	309902	360477	197898		868276
201 8	249397	321548	207681		778627
201 9	234985	318539	139084		692609
2020	234029	298707	160166		692903
2021	281198	268942	217144		767284

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
2022[1]	236173	256394	226644		719211

Data provided by Working Group members

1 Provisional figure

Table 3.1a Advice, quota and official Norwegian catches (tonnes) in the fishery zone around Jan Mayen (part of ICES area 2a).

Year	Advice		TAC	CATCH
2018	-		-	441
2019	-		800	628
2020	-		800	522
2021	600		600	146
2022	347		347	276
2023	315			

Table 3.2. Catches of Norwegian Coastal Cod in subareas 1 and 2, 1000 tonnes, which are removed from the NEA cod assessment.

Year	Norwegian catches of cod removed from the NEAC cod -assessment
v1960–70	38.6
1971–79	no data
1980	40
1981	49
1982	42
1983	38
1984	33
1985	28
1986	26
1987	31
1988	22
1989	17
1990	24
1991	25
1992	35
1993	44
1994	48
1995	39
1996	32
1997	36
1998	29

Year	Norwegian catches of cod removed from the NEAC cod -assessment
1999	23
2000	19
2001	14
2002	20
2003	19
2004	14
2005	13
2006	15
2007	13
2008	13
2009	15
2010	13.5
2011	18.8
2012	35.5
2013	30.1
2014	33.6
2015	35.8
2016	54.9
2017	51.0
2018	36.3
2019	40.1
2020	45.3
2021	42.0
2022	40.3

Table 3.3. Northeast Arctic COD. Total nominal catch ('000 t) by trawl and other gear for each

		Subarea 1		Division 2.a		Division 2.b	
Year		**Trawl**	**Others**	**Trawl**	**Others**	**Trawl**	**Others**
1967		238	84.8	38.7	90	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	-
1973		459	33.7	39.4	172.4	88.2	-
1974		677	46.5	41	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	-
1978		360.4	57.9	117	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	21	-
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	88	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	84	40	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	147.7	6.8
1997		235.6	37.7	150.5	176.2	154.7	7.6
1998		219.8	31	127	130.4	82.7	1.7
1999		133.3	25.7	101.9	115	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	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	107.7	115.4	5.6
2006		141.8	18.1	91.2	113.4	100.1	4.6
2007		129.6	22.9	84.8	110.6	91.6	6.3
2008		123.8	21.1	94.8	108.4	95.3	5.7
2009		130.1	31.5	102	105.2	142.1	11.4
2010		151.1	32.9	130	141.4	149.2	5.4
2011		158.1	38.4	163.5	167	181	11.9

2012		212.1	35.9	172.7	158.4	133.8	14.9
2013		308.5	52.2	216.9	204.7	159.7	24.1
2014		268.8	51.5	246.8	222.1	177.9	19.3
2015		224.3	48.1	192.2	183.2	197.7	19.0
2016		285.5	35.8	181.7	169.8	156.3	20.3
2017		265.4	44.5	189.5	171.0	180.0	17.9
201 8		204.7	44.7	156.7	164.9	192.0	15.6
201 9		199.4	35.6	177.8	140.7	128.9	10.1
2020		199.4	34.6	157.2	141.5	153.5	6.7
2021		220.8	60.4	120.2	148.7	202.1	15.1
2022	1	192.9	43.3	108.9	147.4	212.9	13.7

Data provided by Working Group members

1 Provisional figures

Table 3.4. Northeast Arctic COD. Nominal catch(t) by countries. (Subarea 1 and divisions 2a and 2b combined, data provided by Working group members

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain	Others	Total
1961	3934	13755	3921	8129			268377	-	158113	325780		1212	7832
1962	3109	20482	1532	6503			225615	-	175020	476760		245	9092
1963	-	18318	129	4223			205056	108	129779	417964		-	7755
1964	-	8634	297	3202			149878	-	94549	180550		585	4376
1965	-	526	91	3670			197085	-	89962	152780		816	4449
1966	-	2967	228	4284			203792	-	103012	169300		121	4837
1967	-	664	45	3632			218910	-	87008	262340		6	5726
1968	-	-	225	1073			255611	-	140387	676758		-	10740
1969	29374	-	5907	5543			305241	7856	231066	612215		133	11972
1970	26265	44245	12413	9451			377606	5153	181481	276632		-	9332
1971	5877	34772	4998	9726			407044	1512	80102	144802		215	6890
1972	1393	8915	1300	3405			394181	892	58382	96653		166	5652
1973	1916	17028	4684	16751			285184	843	78808	387196		276	7926
1974	5717	46028	4860	78507			287276	9898	90894	540801		38453	11024
1975	11309	28734	9981	30037			277099	7435	101843	343580		19368	8293
1976	11511	20941	8946	24369			344502	6986	89061	343057		18090	8674
1977	9167	15414	3463	12763			388982	1084	86781	369876		17771	9053
1978	9092	9394	3029	5434			363088	566	35449	267138		5525	6987
1979	6320	3046	547	2513			294821	15	17991	105846		9439	4405
1980	9981	1705	233	1921			232242	3	10366	115194		8789	3804
1981	12825	3106	298	2228			277818		5262	83000	14500	-	3990
1982	11998	761	302	1717			287525		6601	40311	14515	-	3637

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain	Others	Total
1983	11106	126	473	1243			234000		5840	22975	14229	-	2899
1984	10674	11	686	1010			230743		3663	22256	8608	-	2776
1985	13418	23	1019	4395			211065		3335	62489	7846	4330	3079
1986	18667	591	1543	10092			232096		7581	150541	5497	3505	4301
1987	15036	1	986	7035			268004		10957	202314	16223	2515	5230
1988	15329	2551	605	2803			223412		8107	169365	10905	1862	4349
1989	15625	3231	326	3291			158684		7056	134593	7802	1273	3324
1990	9584	592	169	1437			88737		3412	74609	7950	510	1870
1991	8981	975		2613			126226		3981	119427***	3677	3278	2691
1992	11663	2		3911	3337		168460		6120	182315	6217	1209	3832
1993	17435	3572		5887	5389	9374	221051		11336	244860	8800	3907	5316
1994	22826	1962		8283	6882	36737	318395		15579	291925	14929	28568	7460
1995	22262	4912		7428	7462	34214	319987		16329	296158	15505	15742	7399
1996	17758	5352		8326	6529	23005	319158		16061	305317	15871	14851	7322
1997	20076	5353		6680	6426	4200	357825		18066	313344	17130	13303	7624
1998	14290	1197		3841	6388	1423	284647		14294	244115	14212	8217	5926
1999	13700	2137		3019	4093	1985	223390		11315	210379	8994	5898	4849
2000	13350	2621		3513	5787	7562	192860		9165	166202	8695	5115	4148
2001	12500	2681		4524	5727	5917	188431		8698	183572	9196	5225	4264
2002	15693	2934		4517	6419	5975	202559		8977	184072	8414	5484	4450
2003	19427	2921		4732	7026	5963	191977		8711	182160	7924	6149	4369
2004	19226	3621		6187	8196	7201	212117		14004	201525	11285	6082	4894
2005	16273	3491		5848	8135	5874	207825		10744	200077	9349	7660	4752
2006	16327	4376		3837	8164	5972	201987		10594	203782	9219	6271	4705
2007	14788	3190		4619	5951	7316	199809		9298	186229	9496	5101	4457
2008	15812	3149		4955	5617	7535	196598		8287	190225	9658	7336	4491
2009	16905	3908		8585	4977	7380	224298		8632	229291	12013	7442	5234
2010	15977	4499		8442	6584	11299	264701		9091	267547	12657	9185	6099
2011	13429	1173		4621	7155	12734	331535		8210	310326	13291	17354^	7198
2012	17523	2841		8500	8520	9536	315739		11166	329943	12814	11081	7276
2013	13833	7858		8010	7885	14734	438734		12536	432314	15042	15263	9662
2014	33298	8149		6225	10864	18205	431846		14762	433479	16378	13243	9864
2015	26568	7480		6427	7055	16120	377983		11778	381778	19905	9880	8643
2016	24084	7946		6336	8607	16031	348949		13583	394107	14640	15139	8494
2017	28637	9554		5977	13638	11925	357419		16731	396180	14414	13802	8682
2018	26152	6605		9768	12743	10708	333539		11533	340364	13143	14071	7786
2019	22270	6371		8470	7553	12294	282120		11214	316813	13939	11565	6926
2020	21679	5796		9725	7391	9734	289472		12113	312683	11403	12908	6929
2021	21767	4459		6190	8246	8933	337931		5426	352064	11080	11188	767284
2022*	21530	4988		7134	7688	6214	310145		7024	333697	12214	8577	719211

* Provisional figures

** USSR prior to 1991.

*** Includes Baltic countries.

^ Includes unspecified EU catches.

^^ In 2022 and 2023 assessment and advice was carried out by the Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG) which compiled catches for 2021 and 2022 and gave advice for 2023 and 2024.

Table 3.5. Barents Sea winter survey. Area covered ('000 square nautical miles) and areas implied in the method used to adjust for missing coverage in Russian Economic Zone (REZ). "Index ratio by age" means that the index by age (for the area outside REZ) was scaled by the observed ratio between total index and the index outside REZ observed in the years prior to the survey.

Year	Area covered	Additional area implied in adjustment	Adjustment method
1981-92	88.1		
1993	137.6		
1994	161.1		
199 5	191.9		
1996	166.1		
1997	88.4	56.2	Index ratio by age
1998	100.4	51.1	Index ratio by age
1999	118.5		
2000	163.2		
2001	164.7		
2002	157.4		
2003	147.4		
2004	164.4		
2005	179.9		
2006	170.1	18.1	Partly covered strata raised to full strata area
2007	123.9	56.7	Index ratio by age
2008	165.2		
2009	171.8		
2010	160.5		
2011	174.3		
2012	151.3	16.7	Index ratio by age
2013	20 3.6		
2014	2 66.8		
2015	243.3		
2016	228.0		
2017	184.4	37.5	Index ratio by age
2018	236.3		
2019	241.2		
2020	203.2	25.1	Index ratio by age

Year	Area covered	Additional area implied in adjustment	Adjustment method
2021	232.0	10.9	Index ratio by age
2022	232.7		
2023	253.3		

Table 3.6. Northeast Arctic cod. Catch numbers-at-age (Thous) SAM Wed May 31 08:24:02 2023

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	4008	10387	18906	16596	13843	15370	59845	22618	10093	9573	5460	1927	750
1947	710	13192	43890	52017	45501	13075	19718	47678	31392	9348	9330	4622	4103
1948	140	3872	31054	55983	77375	21482	15237	9815	30041	7945	4491	3899	4205
1949	991	6808	35214	100497	83283	29727	13207	5606	8617	13154	3657	1895	2167
1950	1281	10954	29045	45233	62579	30037	19481	9172	6019	4133	6750	1662	1450
1951	24687	77924	64013	46867	37535	33673	23510	10589	4221	1288	1002	3322	611
1952	24099	120704	113203	73827	49389	20562	24367	15651	8327	3565	647	467	1044
1953	47413	107659	112040	55500	22742	16863	10559	10553	5637	1752	468	173	156
1954	11473	155171	146395	100751	40635	10713	11791	8557	6751	2370	896	268	123
1955	3902	37652	201834	161336	84031	30451	13713	9481	4140	2406	867	355	128
1956	10614	24172	129803	250472	86784	51091	14987	7465	3952	1655	1292	448	166
1957	17321	33931	27182	70702	87033	39213	17747	6219	3232	1220	347	299	173
1958	31219	133576	71051	40737	38380	35786	13338	10475	3289	1070	252	40	141
1959	32308	77942	148285	53480	18498	17735	23118	9483	3748	997	254	161	98
1960	37882	97865	64222	67425	23117	8429	7240	11675	4504	1843	354	102	226
1961	45478	132655	123458	51167	38740	17376	5791	6778	5560	1682	910	280	108
1962	42416	170566	167241	89460	28297	21996	7956	2728	2603	1647	392	280	103
1963	13196	106984	205549	95498	35518	16221	11894	3884	1021	1025	498	129	157
1964	5298	45912	97950	58575	19642	9162	6196	3553	783	172	387	264	131
1965	15725	25999	78299	68511	25444	8438	3569	1467	1161	131	61	79	197
1966	55937	55644	34676	42539	37169	18500	5077	1495	380	403	77	9	70
1967	34467	160048	69235	22061	26295	25139	11323	2329	687	316	225	40	14
1968	3709	174585	267961	107051	26701	16399	11597	3657	657	122	124	70	46
1969	2307	24545	238511	181239	79363	26989	13463	5092	1913	414	121	23	46
1970	7164	10792	25813	137829	96420	31920	8933	3249	1232	260	106	39	35
1971	7754	13739	11831	9527	59290	52003	12093	2434	762	418	149	42	25
1972	35536	45431	26832	12089	7918	34885	22315	4572	1215	353	315	121	40
1973	294262	131493	61000	20569	7248	8328	19130	4499	677	195	81	59	55
1974	91855	437377	203772	47006	12630	4370	2523	5607	2127	322	151	83	62

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1975	45282	59798	226646	118567	29522	9353	2617	1555	1928	575	231	15	37
1976	85337	114341	79993	118236	47872	13962	4051	936	558	442	139	26	53
1977	39594	168609	136335	52925	61821	23338	5659	1521	610	271	122	92	54
1978	78822	45400	88495	56823	25407	31821	9408	1227	913	446	748	48	51
1979	8600	77484	43677	31943	16815	8274	10974	1785	427	103	59	38	45
1980	3911	17086	81986	40061	17664	7442	3508	3196	678	79	24	26	8
1981	3407	9466	20803	63433	21788	9933	4267	1311	882	109	37	3	1
1982	8948	20933	19345	28084	42496	8395	2878	708	271	260	27	5	5
1983	3108	19594	20473	17656	17004	18329	2545	646	229	74	58	20	5
1984	6942	14240	18807	20086	15145	8287	5988	783	232	153	49	12	8
1985	24634	45769	27806	19418	11369	3747	1557	768	137	36	31	32	8
1986	28968	70993	78672	25215	11711	4063	976	726	557	136	28	34	14
1987	13648	137106	98210	61407	13707	3866	910	455	187	227	21	59	20
1988	9828	22774	135347	54379	21015	3304	1236	519	106	69	43	14	5
1989	5085	17313	32165	81756	27854	5501	827	290	41	13	1	11	16
1990	1911	7551	12999	17827	30007	6810	828	179	59	15	6	5	2
1991	4963	10933	16467	20342	19479	25193	3888	428	48	12	1	1	2
1992	21835	36015	27494	23392	18351	13541	18321	2529	264	82	3	9	1
1993	10094	46182	63578	33623	14866	9449	6571	12593	1749	377	63	22	1
1994	6531	59444	102548	59766	32504	10019	6163	3671	7528	995	121	19	4
1995	4879	42587	115329	98485	32036	7334	3014	1725	1174	1920	222	41	1
1996	7655	28782	80711	100509	54590	10545	2023	930	462	230	809	84	1
1997	12827	36491	69633	83017	65768	28392	4651	1151	373	213	144	238	1
1998	31887	88874	48972	40493	34513	26354	6583	965	197	69	42	22	53
1999	7501	77714	92816	31139	15778	15851	8828	1837	195	40	34	8	30
2000	4701	33094	93044	47210	12671	6677	4787	1647	321	71	11	1	14
2001	5044	35019	62139	62456	22794	5266	1773	1163	343	85	6	7	22
2002	2348	31033	76175	67656	42122	11527	1801	529	223	120	21	9	6
2003	7263	20885	64447	71109	36706	14002	2887	492	142	97	21	43	1
2004	2090	38226	50826	68350	50838	18118	6239	1746	295	127	39	16	8
2005	5815	19768	113144	61665	44777	20553	6285	2348	562	100	21	24	7
2006	8548	47207	33625	78150	31770	15667	7245	1788	737	210	26	45	155
2007	25473	43817	62877	26303	34392	11240	4080	1381	505	285	44	13	35
2008	8459	51704	40656	35072	14037	20676	5503	1794	715	229	42	26	13
2009	4866	38711	83998	46639	20789	8417	8920	1957	872	987	76	21	20
2010	1778	16193	53855	75853	36797	17062	4784	4325	3034	913	189	49	35

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2011	1418	8033	32472	70938	73875	21116	11708	5058	3237	600	434	12	0
2012	2695	10462	16646	40372	70014	48315	12326	5214	1926	1124	317	70	24
2013	2903	13659	22752	21020	54231	74451	47124	9143	2963	694	449	89	145
2014	5234	19226	38407	36633	29901	56109	47540	22738	3717	1169	313	210	157
2015	4315	31383	41181	51209	33745	22530	23609	24553	16071	2510	468	134	254
2016	2076	11291	50231	43609	35265	23417	14592	20105	15862	4781	871	249	308
2017	6535	13128	28365	66504	46136	28507	15307	10073	12169	6465	1927	399	285
2018	6120	28569	27128	33816	54328	28323	16208	9722	7132	3740	2295	840	271
2019	4389	21405	48422	29849	26548	39759	17395	8883	4606	2109	715	564	322
2020	3992	22446	37649	52454	31009	20904	23618	11768	6130	1572	591	310	278
2021	2983	17935	54005	59732	59136	22397	14744	13589	4919	1737	678	228	344
2022	5725	23486	53467	68112	47067	30569	11776	6046	3797	1489	575	164	107

Table 3.7. Northeast 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	7.262	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
2007	0.53	1.07	1.70	2.37	3.26	4.36	5.45	6.71	8.08	8.56	9.75	11.72	12.72	15.58
2008	0.65	1.12	1.70	2.44	3.32	4.41	5.61	6.84	8.25	9.31	10.54	12.45	13.59	21.15
2009	0.56	0.98	1.47	2.10	2.83	3.90	5.06	5.76	7.31	7.79	7.81	10.68	11.83	14.76
2010	0.55	0.95	1.46	2.06	2.93	4.02	5.40	6.44	7.19	8.43	9.11	10.46	11.39	15.55
2011	0.53	1.09	1.50	2.06	2.85	3.70	5.01	6.26	7.33	8.34	9.87	13.23		
2012		0.83	1.32	1.92	2.65	3.52	4.71	6.34	8.11	9.92	11.31	13.45	15.75	
2013	0.43	0.95	1.40	2.00	2.64	3.44	4.51	5.67	7.29	8.80	10.33	11.38	12.56	
2014	0.59	1.07	1.55	2.15	2.80	3.70	4.57	5.78	6.97	8.35	9.46	10.99	12.28	15.49
2015	0.64	0.96	1.42	1.96	2.57	3.30	4.13	5.49	6.46	7.18	8.63	10.37	12.24	14.60
2016	0.59	0.96	1.46	1.99	2.71	3.57	4.56	5.78	6.82	8.08	9.33	10.01	11.68	14.79
2017	0.55	0.99	1.53	2.06	2.69	3.64	4.72	5.91	6.91	7.88	9.41	10.93	11.78	15.07
2018	0.62	1.05	1.51	2.11	2.80	3.48	4.54	5.80	6.97	7.64	9.11	10.29	11.35	14.05
201 9	0.51	0.96	1.43	2.02	2.72	3.60	4.51	5.80	6.91	7.94	8.89	10.94	11.55	14.49
2020	0.58	0.94	1.42	2.01	2.66	3.50	4.59	5.77	7.03	8.46	9.78	10.97	12.74	16.08
2021	0.39	0.75	1.27	1.86	2.55	3.42	4.52	5.86	7.13	8.55	10.09	11.79	12.98	15.75
2022	0.32	0.71	1.15	1.73	2.42	3.36	4.47	5.79	7.18	8.65	10.09	11.45	12.93	16.43

Table 3.7. Northeast Arctic COD. Weights-at-age (kg) in landings from various countries (continued)

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			
2007		0.23	0.67	1.12	1.66	2.25	3.31	4.57	6.27	8.20	10.02	12.36	12.42		
2008		0.28	0.64	1.16	1.74	2.65	3.58	4.74	5.73	7.32	8.07	9.52	12.52		
2009		0.31	0.64	1.09	1.58	2.11	3.19	4.80	6.58	7.97	9.84	11.51			
2010		0.25	0.57	1.00	1.64	2.28	3.14	4.53	5.98	8.03	9.71	10.70	13.53		
2011		0.25	0.62	1.05	1.56	2.18	2.95	4.33	6.21	8.04	10.13	12.25	15.18		
2012		0.29	0.60	1.07	1.66	2.25	2.95	4.17	6.23	8.58	11.08	12.24	14.07	15.22	16.39
2013		0.33	0.63	1.05	1.54	2.26	3.09	4.08	5.47	7.37	9.59	12.57	15.54	17.05	
2014		0.32	0.61	1.05	1.61	2.26	3.15	4.00	5.24	7.13	9.46	11.18	14.47		
2015		0.30	0.60	0.97	1.49	2.11	3.13	4.64	5.78	7.13	9.53	12.12	16.71	17.37	
2016		0.26	0.55	0.97	1.53	2.20	3.19	4.50	6.12	7.97	9.55	10.95	14.35	14.74	17.25
2017		0.33	0.63	1.03	1.56	2.24	3.24	4.67	6.34	7.74	9.40	11.12	14.43	16.67	11.91
2018		0.33	0.68	1.06	1.62	2.40	3.22	4.66	6.23	7.79	8.91	10.26	11.26	13.41	10.14
2019		0.29	0.62	1.10	1.60	2.33	3.22	4.44	6.45	8.10	9.60	11.02	13.83	10.65	10.65
2020		0.27	0.47	0.93	1.44	2.05	2.95	4.28	5.73	7.59	8.45	10.66	12.26	12.18	12.23
2021		0.19	0.44	0.76	1.35	2.02	2.81	4.25	6.26	7.81	9.59	10.67	10.86	13.62	12.31
2022		0.39	0.62	0.91	1.42	2.21	3.22	4.45	6.15	8.16	9.91	10.83	11.96		10.33

Table 3.7. Northeast Arctic COD. Weights-at-age (kg) in landings from various countries (continued)

Germany (Division IIa and IIb)															
Year				**Age**											
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1994			0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995			0.44	0.84	1.5	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	3.9	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	8.8		
1998		0.23	0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.5	8.57	8.42	11.45	8.79	

1999	1		0.853	1.448	1.998	2.65	3.473	4.156	5.447	6.82	5.902		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	
2007	3	0.59	1.35	1.79	2.51	3.53	4.00	4.95	6.55	7.54	9.71	11.40	11.57	23.34	15.61
2008	3	0.23	0.51	1.14	1.76	2.57	3.15	4.40	5.43	7.18	8.39	10.15	10.03	10.99	14.26
2009	3	0.35	0.60	1.19	1.83	2.96	4.08	5.61	6.97	8.55	9.13	10.54	13.34	10.30	17.06
2010	3	0.36	0.67	0.93	1.71	2.46	3.21	4.93	6.75	7.80	8.70	8.53	10.17	12.36	14.11
2011	1			1.75	3.09	3.30	3.28	4.13	4.99	6.61	7.91	9.38	10.79	14.67	14.91
2013	3			1.03	1.37	1.87	2.65	3.45	4.49	7.26	11.42	12.86	13.07		
2014	4		0.68	0.96	1.39	1.69	3.06	4.07	5.65	8.15	10.36	13.07	13.52		
2015	4	0.82	1.05	1.67	2.33	3.56	4.50	5.41	6.20	6.39					
2016	1		1.38	2.60	3.55	4.81	6.33	7.61	8.90	9.26	10.83	13.41	16.84	17.03	17.76
2017	1		1.58	2.79	3.93	3.93	4.77	6.35	8.16	9.09	10.39	11.24	12.48	14.39	13.04
2018	3	0.58	1.16	1.76	2.45	3.34	4.13	5.81	7.16	8.99	9.96	10.85	11.73	14.01	17.79
2019	1		0.82	1.37	1.80	2.26	3.49	4.45	5.44	7.08	9.25	9.39	13.30	12.24	15.25
2020	5			1.6	1.63	2.48	3.13	5.01	5.93	8.36	9.31	12.16	12.96	12.77	14.08
2021	2		0.68	1.3	1.52	2.25	3.22	4.58	6.49	7.43	10.37	11.73	14.64	14.34	15.74
2022	1		0.59	0.82	1.40	2.20	3.04	4.13	5.54	7.36	8.56	10.79	13.12	14.96	15.18

[1] Division IIa only

[2] IIa and IIb combined

[3] I,IIa and IIb combined

[4] Division II b only

[5] I and IIa combined

Table 3.7. Northeast Arctic COD. Weights at age (kg) in landings from various countries (continued)

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				
2007		0.42	0.60	1.20	1.76	2.40	3.18	3.96	5.19	6.61	9.48	7.65	12.65	15.74	19.66
2009	1	0.12	0.45	0.95	1.60	2.18	3.36	4.52	6.04	7.30	9.42	10.35	11.47	12.54	
2010	2	0.18	0.56	1.11	1.73	2.36	3.36	5.14	6.88	8.64	9.65	6.83			
2011	1		0.45	0.90	1.26	1.84	2.55	4.08	5.61	8.17	8.14	7.31	8.91		
2012	2		0.40	0.84	1.29	1.96	2.78	3.71	4.99	7.42		7.19	9.32		
2013		0.17	0.72	1.06	1.63	2.36	3.14	3.90	4.36	6.55					
2014		0.24	0.43	0.74	1.27	1.85	2.60	3.56	4.51	5.52	7.18	9.42	9.26	13.16	15.05
2015	2		0.40	0.80	1.19	1.79	2.45	3.38	4.41	5.85	6.64	7.48	6.77		
2016	3	0.11	0.38	0.76	1.20	1.72	2.50	3.39	4.96	7.11	8.56				
2017	2	0.12	0.42	0.75	1.17	1.69	2.50	3.39	4.47	5.69	5.93	6.00	10.91	13.57	10.52
2018	2	0.19	0.45	0.83	1.30	1.86	2.57	3.55	4.92	5.51	7.84	7.08	7.28		
2019	2	0.19	0.39	0.90	1.30	1.85	2.65	3.48	4.83	5.96	5.67	7.04	8.36		
2021	2		0.36	0.60	1.20	1.83	2.49	3.11	4.55	6.10	6.50	7.03		9.013	17.13
2022	2		0.49	0.80	1.25	1.83	2.77	4.06	5.52	7.71	8.87	12.18			
1	IIa and IIb combined														
2	I,IIa and IIb combined														
3	I and IIb combined														
Iceland (Sub-area I)															
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)															
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)															
2006		0.18	0.51	0.89	1.55	2.23	3.6	5.28	6.95	8.478	11	10.8	15.6	18.9	
2008			0.49	0.90	1.45	2.24	2.79	3.82	4.68	5.015	6.45	7.02	7.22	5.99	6.91
2009				1.02	1.72	2.65	3.81	5.23	6.91	8.862	11.1	13.6	16.5		
2010				1.39	1.66	2.29	2.98	3.92	5.18	6.313	6.66	8.72	9.05		
2011				0.99	1.50	2.17	3.15	4.43	7.45	7.28					
2016	1		0.84	1.59	2.29	2.81	3.91	4.78	5.61	6.709	7.89	8.54	11.6	13.7	16.09
2017	2		0.71	1.23	1.52	2.47	3.52	4.78	6.97	9.193	9.95	10.9	14.1		
2018	3		0.74	1.15	1.66	2.45	3.55	4.48	6.06	6.31	7.59	7.91	8.28	8.52	9.40
2019	1				1.57	2.00	2.69	4.04	5.61	7.23	9.13	11.62	12.41	13.46	11.47
	1	Division IIa													
	2	Division IIa and IIb													
	3	I and IIb combined													

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Table 3.8. Northeast Arctic COD. Catch weights at age (kg)

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.35	0.59	1.11	1.69	2.37	3.17	3.98	5.05	5.92	7.2	8.15	8.13	9.25
1947	0.32	0.56	0.95	1.5	2.14	2.92	3.65	4.56	5.84	7.42	8.85	8.79	10
1948	0.34	0.53	1.26	1.93	2.46	3.36	4.220	5.31	5.92	7.09	8.43	8.18	9.43
1949	0.37	0.67	1.11	1.66	2.5	3.23	4.070	5.27	5.99	7.08	8.22	8.26	8.7
1950	0.39	0.64	1.29	1.7	2.36	3.48	4.520	5.62	6.4	7.96	8.89	9.07	10.27
1951	0.4	0.83	1.39	1.88	2.54	3.46	4.880	5.2	7.14	8.22	9.39	9.5	9.52
1952	0.44	0.8	1.33	1.92	2.64	3.71	5.060	6.05	7.42	8.43	10.19	10.13	10.56
1953	0.4	0.76	1.28	1.93	2.81	3.72	5.060	6.34	7.4	8.67	10.24	11.41	11.93
1954	0.44	0.77	1.26	1.97	3.03	4.33	5.400	6.75	7.79	10.67	9.68	9.56	11.11
1955	0.32	0.57	1.13	1.73	2.75	3.94	4.900	7.04	7.2	8.78	10.08	11.02	12.11
1956	0.33	0.58	1.07	1.83	2.89	4.25	5.550	7.28	8	8.35	9.94	10.25	11.56
1957	0.33	0.59	1.02	1.82	2.89	4.28	5.490	7.51	8.24	9.25	10.61	10.82	12.07
1958	0.34	0.52	0.95	1.92	2.94	4.21	5.610	7.35	8.67	9.58	11.63	11	13.83
1959	0.35	0.72	1.47	2.68	3.59	4.32	5.450	6.44	7.17	8.63	11.62	11.95	13
1960	0.34	0.51	1.09	2.13	3.38	4.87	6.120	8.49	7.79	8.3	11.42	11.72	13.42
1961	0.31	0.55	1.05	2.2	3.23	5.11	6.150	8.15	8.68	9.6	11.95	13.18	13.42
1962	0.32	0.55	0.93	1.7	3.03	5.03	6.550	7.7	9.27	10.56	12.72	13.48	14.44
1963	0.32	0.61	0.96	1.73	3.04	4.96	6.440	7.91	9.62	11.31	12.74	13.19	14.29

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1964	0.33	0.55	0.95	1.86	3.25	4.97	6.410	8.07	9.34	10.16	12.89	13.25	14
1965	0.38	0.68	1.03	1.49	2.41	3.52	5.730	7.54	8.47	11.17	13.72	13.46	14.12
1966	0.44	0.74	1.18	1.78	2.46	3.82	5.360	7.27	8.63	10.66	14.15	14	15
1967	0.29	0.81	1.35	2.04	2.81	3.48	4.890	7.11	9.03	10.59	13.83	14.15	16.76
1968	0.33	0.7	1.48	2.12	3.14	4.21	5.270	6.65	9.01	9.66	14.85	16.3	17
1969	0.44	0.79	1.23	2.03	2.9	3.81	5.020	6.43	8.33	10.71	14.21	15	17
1970	0.37	0.91	1.34	2	3	4.15	5.590	7.6	8.97	10.99	14.07	14.61	16
1971	0.45	0.88	1.38	2.16	3.07	4.22	5.810	7.13	8.62	10.83	12.95	14.25	15.97
1972	0.38	0.77	1.43	2.12	3.23	4.38	5.830	7.62	9.52	12.09	13.67	13.85	16
1973	0.38	0.91	1.54	2.26	3.29	4.61	6.570	8.37	10.54	11.62	13.9	14	15.84
1974	0.32	0.66	1.17	2.22	3.21	4.39	5.520	7.86	9.82	11.41	13.24	13.7	14.29
1975	0.41	0.64	1.11	1.9	2.95	4.37	5.740	8.77	9.92	11.81	13.11	14	14.29
1976	0.35	0.73	1.19	2.01	2.76	4.22	5.880	9.3	10.28	11.86	13.54	14.31	14.28
1977	0.49	0.9	1.43	2.05	3.3	4.56	6.460	8.63	9.93	10.9	13.67	14.26	14.91
1978	0.49	0.81	1.45	2.15	3.04	4.46	6.540	7.98	10.15	10.85	13.18	14	15
1979	0.35	0.7	1.24	2.14	3.15	4.29	6.580	8.61	9.22	10.89	14.34	14.5	15.31
1980	0.27	0.56	1.02	1.72	3.02	4.2	5.840	7.26	8.84	9.28	14.45	15	15.5
1981	0.49	0.98	1.44	2.09	2.98	4.85	6.570	9.16	10.82	10.77	13.93	15	16
1982	0.37	0.66	1.35	1.99	2.93	4.24	6.460	8.51	12.24	10.78	14.04	15	16
1983	0.84	1.37	2.09	2.86	3.99	5.58	7.770	9.29	11.55	11.42	12.8	14.18	15.55
1984	1.42	1.93	2.49	3.14	3.91	4.91	6.020	7.4	8.13	11.42	12.8	14.18	15.55
1985	0.94	1.37	2.02	3.22	4.63	6.04	7.660	9.81	11.8	11.42	12.8	14.18	15.55
1986	0.64	1.27	1.88	2.79	4.49	5.84	6.830	7.69	9.81	11.42	12.8	14.18	15.55
1987	0.49	0.88	1.55	2.33	3.44	5.92	8.600	9.6	12.17	11.42	12.8	14.18	15.55
1988	0.54	0.85	1.32	2.24	3.52	5.35	8.060	9.51	11.36	11.42	12.8	14.18	15.55
1989	0.74	0.96	1.31	1.92	2.93	4.64	7.520	9.12	11.08	11.42	12.8	14.18	15.55
1990	0.81	1.22	1.64	2.22	3.24	4.68	7.300	9.84	13.25	11.42	12.8	14.18	15.55
1991	1.05	1.45	2.15	2.89	3.75	4.71	6.080	8.82	11.8	11.42	12.8	14.18	15.55
1992	1.16	1.57	2.21	3.1	4.27	5.19	6.140	7.77	10.12	11.42	12.8	14.18	15.55
1993	0.81	1.52	2.16	2.79	4.07	5.53	6.470	7.19	7.98	11.457	12.8	14.18	15.55
1994	0.82	1.3	2.06	2.89	3.21	5.2	6.800	7.57	8.01	9.955	13.012	14.18	15.55
1995	0.77	1.2	1.78	2.59	3.81	4.99	6.230	8.05	8.74	9.774	11.388	14.546	15.55
1996	0.79	1.11	1.61	2.46	3.82	5.72	6.740	8.04	9.28	10.451	11.19	12.819	16.045
1997	0.67	1.04	1.53	2.22	3.42	5.2	7.190	7.73	8.61	11.145	11.926	12.608	14.234
1998	0.68	1.05	1.62	2.3	3.3	4.86	6.870	9.3	10.3	10.754	12.676	13.394	14.011
1999	0.63	1.01	1.54	2.34	3.21	4.29	6	6.73	10.08	11.151	12.255	14.191	14.839

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2000	0.57	1.04	1.61	2.34	3.34	4.48	5.72	7.52	8.02	11.93	12.682	13.743	15.675
2001	0.66	1.05	1.62	2.51	3.51	4.78	6.04	7.54	9	10.23	13.519	14.197	15.206
2002	0.72	1.13	1.56	2.31	3.52	4.78	6.2	7.66	9.14	10.379	11.687	15.081	15.681
2003	0.67	1.12	1.83	2.5	3.58	5.04	6.36	8.2	10.71	10.167	11.848	13.138	16.602
2004	0.72	1.13	1.61	2.43	3.27	4.72	6.71	7.98	9.19	10.84	11.619	13.31	14.571
2005	0.69	1.08	1.57	2.21	3.26	4.44	6.23	8.19	9.72	10.626	12.347	13.066	14.752
2006	0.72	1.16	1.6	2.39	3.32	4.54	5.47	6.78	7.7	10.8	12.116	13.842	14.494
2007	0.74	1.21	1.83	2.51	3.82	5.04	6.58	8.08	8.94	10.349	12.304	13.596	15.309
2008	0.77	1.27	1.87	2.82	3.79	5.12	6.22	7.75	8.4	10.139	11.816	13.795	15.052
2009	0.75	1.17	1.74	2.42	3.86	5.35	6.43	8.01	8.67	10.055	11.588	13.276	15.261
2010	0.78	1.2	1.74	2.44	3.4	5.04	6.25	7.32	8.53	10.378	11.496	13.033	14.715
2011	0.78	1.31	1.72	2.37	3.2	4.62	6.18	7.47	8.57	10.387	11.847	12.935	14.459
2012	0.67	1.14	1.73	2.34	3.12	4.4	6.28	8.24	10.35	10.367	11.857	13.309	14.356
2013	0.71	1.17	1.67	2.36	3.19	4.22	5.58	7.31	9.08	11.029	11.835	13.32	14.75
2014	0.79	1.2	1.73	2.34	3.28	4.21	5.49	6.98	8.67	10.823	12.551	13.297	14.761
2015	0.78	1.09	1.55	2.18	3.14	4.46	5.61	6.62	7.34	10.215	12.328	14.058	14.737
2016	0.78	1.14	1.66	2.26	3.25	4.5	5.98	7.31	8.54	9.372	11.67	13.822	15.536
2017	0.71	1.15	1.66	2.32	3.32	4.67	6.13	7.15	8.14	9.597	10.752	13.121	15.288
2018	0.86	1.17	1.71	2.5	3.31	4.61	6.03	7.32	8.06	9.707	10.998	12.137	14.552
2019	0.68	1.15	1.66	2.39	3.33	4.45	6.11	7.29	8.41	9.806	11.117	12.401	13.513
2020	0.709	1.084	1.604	2.195	3.092	4.39	5.731	7.218	8.406	9.989	11.226	12.529	13.793
2021	0.527	0.896	1.487	2.159	2.982	4.364	6.048	7.348	8.796	9.991	11.424	12.645	13.928
2022	0.623	0.956	1.478	2.245	3.247	4.441	5.877	7.328	8.738	10.122	11.427	12.858	14.051

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Table 3.9. Northeast Arctic COD. Stock weights at age (kg)

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.35	0.59	1.11	1.69	2.37	3.17	3.98	5.05	5.92	7.2	8.146	8.133	9.253
1947	0.32	0.56	0.95	1.5	2.14	2.92	3.65	4.56	5.84	7.42	8.848	8.789	9.998
1948	0.34	0.53	1.26	1.93	2.46	3.36	4.22	5.31	5.92	7.09	8.43	8.181	9.433
1949	0.37	0.67	1.11	1.66	2.5	3.23	4.07	5.27	5.99	7.08	8.218	8.259	8.701
1950	0.39	0.64	1.29	1.7	2.36	3.48	4.52	5.62	6.4	7.96	8.891	9.07	10.271
1951	0.4	0.83	1.39	1.88	2.54	3.46	4.88	5.2	7.14	8.22	9.389	9.502	9.517
1952	0.44	0.8	1.33	1.92	2.64	3.71	5.06	6.05	7.42	8.43	10.185	10.134	10.563
1953	0.4	0.76	1.28	1.93	2.81	3.72	5.06	6.34	7.4	8.67	10.238	11.409	11.926
1954	0.44	0.77	1.26	1.97	3.03	4.33	5.4	6.75	7.79	10.67	9.68	9.557	11.106

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1955	0.32	0.57	1.13	1.73	2.75	3.94	4.9	7.04	7.2	8.78	10.077	11.023	12.105
1956	0.33	0.58	1.07	1.83	2.89	4.25	5.55	7.28	8	8.35	9.944	10.248	11.564
1957	0.33	0.59	1.02	1.82	2.89	4.28	5.49	7.51	8.24	9.25	10.605	10.825	12.075
1958	0.34	0.52	0.95	1.92	2.94	4.21	5.61	7.35	8.67	9.58	11.631	11	13.832
1959	0.35	0.72	1.47	2.68	3.59	4.32	5.45	6.44	7.17	8.63	11.621	11.95	13
1960	0.34	0.51	1.09	2.13	3.38	4.87	6.12	8.49	7.79	8.3	11.422	11.719	13.424
1961	0.31	0.55	1.05	2.2	3.23	5.11	6.15	8.15	8.68	9.6	11.952	13.181	13.422
1962	0.32	0.55	0.93	1.7	3.03	5.03	6.55	7.7	9.27	10.56	12.717	13.482	14.44
1963	0.32	0.61	0.96	1.73	3.04	4.96	6.44	7.91	9.62	11.31	12.737	13.193	14.287
1964	0.33	0.55	0.95	1.86	3.25	4.97	6.41	8.07	9.34	10.16	12.886	13.251	14
1965	0.38	0.68	1.03	1.49	2.41	3.52	5.73	7.54	8.47	11.17	13.722	13.465	14.118
1966	0.44	0.74	1.18	1.78	2.46	3.82	5.36	7.27	8.63	10.66	14.148	14	15
1967	0.29	0.81	1.35	2.04	2.81	3.48	4.89	7.11	9.03	10.59	13.829	14.146	16.756
1968	0.33	0.7	1.48	2.12	3.14	4.21	5.27	6.65	9.01	9.66	14.848	16.3	17
1969	0.44	0.79	1.23	2.03	2.9	3.81	5.02	6.43	8.33	10.71	14.211	15	17
1970	0.37	0.91	1.34	2	3	4.15	5.59	7.6	8.97	10.99	14.074	14.611	16
1971	0.45	0.88	1.38	2.16	3.07	4.22	5.81	7.13	8.62	10.83	12.945	14.25	15.973
1972	0.38	0.77	1.43	2.12	3.23	4.38	5.83	7.62	9.52	12.09	13.673	13.852	16
1973	0.38	0.91	1.54	2.26	3.29	4.61	6.57	8.37	10.54	11.62	13.904	14	15.841
1974	0.32	0.66	1.17	2.22	3.21	4.39	5.52	7.86	9.82	11.41	13.242	13.704	14.291
1975	0.41	0.64	1.11	1.9	2.95	4.37	5.74	8.77	9.92	11.81	13.107	14	14.293
1976	0.35	0.73	1.19	2.01	2.76	4.22	5.88	9.3	10.28	11.86	13.544	14.311	14.284
1977	0.49	0.9	1.43	2.05	3.3	4.56	6.46	8.63	9.93	10.9	13.668	14.255	14.906
1978	0.49	0.81	1.45	2.15	3.04	4.46	6.54	7.98	10.15	10.85	13.177	14	15
1979	0.35	0.7	1.24	2.14	3.15	4.29	6.58	8.61	9.22	10.89	14.344	14.5	15.315
1980	0.27	0.56	1.02	1.72	3.02	4.2	5.84	7.26	8.84	9.28	14.448	15	15.5
1981	0.49	0.98	1.44	2.09	2.98	4.85	6.57	9.16	10.82	10.77	13.932	15	16
1982	0.37	0.66	1.35	1.99	2.93	4.24	6.46	8.51	12.24	10.78	14.041	15	16
1983	0.37	0.92	1.6	2.44	3.82	4.76	6.17	7.7	9.25	12.621	14.544	16.466	18.388
1984	0.42	1.16	1.81	2.79	3.78	4.57	6.17	7.7	9.25	12.621	14.544	16.466	18.388
1985	0.413	0.875	1.603	2.81	4.059	5.833	7.685	10.117	14.29	12.621	14.544	16.466	18.388
1986	0.311	0.88	1.47	2.467	3.915	5.81	6.58	6.833	11.004	12.621	14.544	16.466	18.388
1987	0.211	0.498	1.254	2.047	3.431	5.137	6.523	9.3	13.15	12.621	14.544	16.466	18.388
1988	0.212	0.404	0.79	1.903	2.977	4.392	7.812	12.112	13.107	12.621	14.544	16.466	18.388
1989	0.299	0.52	0.868	1.477	2.686	4.628	7.048	9.98	9.25	12.621	14.544	16.466	18.388
1990	0.398	0.705	1.182	1.719	2.458	3.565	4.71	7.801	8.956	12.621	14.544	16.466	18.388

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1991	0.518	1.136	1.743	2.428	3.214	4.538	6.88	10.719	9.445	12.621	14.544	16.466	18.388
1992	0.44	0.931	1.812	2.716	3.895	5.176	6.774	9.598	12.427	12.621	14.544	16.466	18.388
1993	0.344	1.172	1.82	2.823	4.031	5.497	6.765	8.571	10.847	12.621	14.544	16.466	18.388
1994	0.237	0.757	1.419	2.458	3.845	5.374	6.648	7.653	8.136	12.916	16.114	16.466	18.388
1995	0.197	0.487	1.141	2.118	3.504	4.915	6.949	9.051	9.775	11.409	15.248	18.62	18.388
1996	0.206	0.482	0.98	2.041	3.52	5.507	7.74	9.922	10.63	12.093	13.533	17.659	21.171
1997	0.211	0.537	1.11	1.876	3.381	5.258	8.546	10.653	10.776	13.232	14.313	15.745	20.122
1998	0.242	0.561	1.179	1.936	2.944	4.583	7.092	10.7	12.042	13.771	15.607	16.617	18.021
1999	0.209	0.514	1.183	2.007	3.037	4.479	6.512	10.028	11.117	14.698	16.215	18.057	18.981
2000	0.194	0.465	1.218	1.963	3.064	4.12	5.746	7.157	9.961	14.589	17.26	18.733	20.557
2001	0.284	0.513	1.21	2.25	3.299	5.066	6.373	9.29	11.456	13.317	17.138	19.887	21.294
2002	0.23	0.603	1.184	2.138	3.336	4.81	6.912	8.809	10.475	12.534	15.703	19.752	22.549
2003	0.233	0.551	1.317	2.022	3.239	4.984	6.727	8.422	14.226	12.524	14.815	18.164	22.403
2004	0.24	0.55	1.074	2.038	2.911	4.402	6.263	8.535	10.197	12.371	14.803	17.176	20.674
2005	0.225	0.61	1.083	1.87	3.002	3.971	5.789	8.127	12.759	12.611	14.63	17.163	19.594
2006	0.252	0.591	1.219	2.014	3.028	4.434	5.999	7.774	9.954	13.679	14.902	16.97	19.58
2007	0.249	0.663	1.329	2.127	3.183	4.59	6.477	8.88	12.124	12.261	16.111	17.274	19.368
2008	0.286	0.726	1.418	2.41	3.331	4.914	6.747	8.851	10.393	12.776	14.504	18.617	19.701
2009	0.274	0.652	1.353	2.312	3.803	5.103	6.75	9.252	10.119	12.323	15.09	16.83	21.168
2010	0.258	0.608	1.208	2.01	3.088	4.903	6.498	7.992	9.689	12.467	14.574	17.483	19.214
2011	0.225	0.6	1.097	1.926	2.861	4.403	6.531	8.648	9.885	12.508	14.738	16.909	19.929
2012	0.227	0.555	1.182	1.834	2.831	4.124	6.056	8.584	11.498	12.249	14.785	17.092	19.3
2013	0.247	0.577	1.134	1.998	2.841	4.015	5.523	8.077	10.304	13.207	14.491	17.144	19.501
2014	0.216	0.577	1.137	1.791	2.781	3.85	5.245	6.992	9.378	12.746	15.578	16.816	19.558
2015	0.229	0.54	1.134	1.934	2.753	4.081	5.315	7.135	8.947	11.778	15.056	18.025	19.198
2016	0.21	0.536	1.001	1.812	2.72	3.958	5.64	7.064	8.569	10.885	13.954	17.445	20.522
2017	0.255	0.675	1.107	1.896	2.826	4.158	5.7	7.628	9.071	10.634	12.934	16.216	19.888
2018	0.286	0.62	1.188	1.949	2.768	4.059	5.749	7.38	9.097	10.8	12.646	15.073	18.54
2019	0.24	0.603	1.085	1.82	3.025	4.296	5.891	7.293	9.667	11.186	12.837	14.749	17.28
2020	0.148	0.503	1.055	1.692	2.59	4.064	5.617	7.673	9.313	11.306	13.278	14.964	16.922
2021	0.17	0.437	0.954	1.718	2.669	3.804	5.822	7.396	9.334	11.187	13.415	15.459	17.159
2022	0.293	0.48	0.929	1.616	2.741	3.933	5.744	8.012	9.648	11.255	13.279	15.613	17.706
2023	0.271	0.645	1.022	1.71	2.876	4.353	5.925	7.864	9.824	11.36	13.478	15.46	17.876

Table 3.10. Northeast 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	0	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	0	5	18	31	56	90	99	100
1985	0	1	10	33	59	85	92	100
1986	0	2	9	19	56	76	89	100
1987	0	1	9	23	27	61	81	80
1988	0	1	3	25	53	79	100	100
1989	0	0	2	15	39	59	83	100
1990	0	2	6	20	47	62	81	95
1991	0	3	1	23	66	82	96	100
1992	0	1	8	31	73	92	95	100
1993	0	3	7	21	56	89	95	99
1994	0	1	8	30	55	84	95	98
1995	0	0	4	23	61	75	94	97
1996	0	0	1	22	56	82	95	100
1997	0	0	1	10	48	73	90	100
1998	0	0	2	15	47	87	97	96
1999	0	0.2	1.3	9.9	38.4	74.9	94	100
2000	0	0	6	19.2	51.4	84	95.5	100
2001	0.1	0.1	3.9	27.9	62.3	89.4	96.3	100
2002	0.1	1.9	10.9	34.4	68.1	82.8	97.6	100
2003	0.2	0	11	29.2	65.9	89.6	95.1	100
2004	0	0.7	8	33.8	63.3	83.4	96.4	96.4
2005	0	0.6	4.6	24.2	61.5	84.9	95.3	98.1
2006	0	0	6.1	29.6	59.6	89.5	96.4	100
2007	0	0.4	5.7	20.8	60.4	83.5	96	100

2008	0	0.5	4	24.6	48.3	84.4	94.7	98.7
2009	0	0	6	28	66	85	97	100
2010	0	0.2	1.5	22.8	47	77.4	90.2	95.5
2011	0	0	2.2	20.7	50.4	73.7	90.6	95.6
2012	0.2	0	1.5	10.8	43.9	76.1	90.8	96.4
2013	0	0	0.6	10.6	41.8	70.6	89.8	96.9
2014	0	0	1.9	14.1	45.9	76	92	97.5
2015	0	0.2	0.2	7.9	27	60.8	83.4	93.7
2016	0	0	0.2	5.2	22.4	44.1	74.8	92.5
2017*	0	0	0.8	6.3	20.8	51.6	80.4	98.6
2018	0	0.5	2.5	23.6	53.9	79.4	92.5	96.0
2019**	0	0	4.5	11.9	56.4	91.8	95.1	100
2020**	0	0.4	1.7	15.8	43.8	71.2	74.9	84.9
2021**	0	0	2.7	16.1	44.1	72.2	87.1	88.1
2022**	0	0	0.8	11.6	59.7	72.6	80.4	96.2
2023**	0	0	0.3	12.3	50.9	84.3	92.6	97.5
***Not used in inputs (instead ratios presented in WD 10, 2017 used for further calculations) **Not used in inputs (instead ratios presented in WD 15, 2019 used for further calculations)**								

Norway								
	Percentage mature							
	Age							
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1985	0.31	1.36	8.94	38.33	51.27	85.13	100	79.2
1986	2.92	7	7.85	18.85	49.72	66.52	35.59	80.09
1987	0	0.07	4.49	12.42	16.28	31.23	19.32	
1988	0	2.35	6.16	40.54	53.63	45.36	100	100
1989	1.52	0.67	3.88	30.65	70.36	82.02	100	100
1990	1.52	0.67	4.18	22	57.45	80.95	100	100
1991	0.1	3.4	13.93	38.03	75.52	90.12	95.39	100
1992	0.22	1.85	21.04	52.83	86.95	96.52	99.83	100
1993	0	2.6	10.37	52.6	84.8	97.25	99.3	99.73
1994	0.51	0.33	15.78	36.92	62.84	88.44	97.56	100
1995	0	0.62	8.19	51.48	63.75	81.11	98.01	99.34
1996	0.03	0	2.82	29.56	70.22	82.06	100	100
1997	0	0	1.48	17.91	73.31	93.01	99.12	100
1998	0.12	0.68	3.17	15.42	47.31	75.73	94.3	100
1999	0.42	0.16	1.6	27.46	70.48	94.57	98.99	100

2000	0	0.11	8.15	30.23	77.3	81.95	100	100
2001	0.49	0.51	9.03	43.81	62.52	74.36	94.13	100
2002	0.27	0.73	5.94	43.22	68.4	85.31	92.52	100
2003	0.02	0.18	6.5	35.97	68.56	87.97	96.3	100
2004	0.24	1.36	10.23	54.56	81.84	90.94	98.76	98.91
2005	0	0.27	9	55.16	81.77	93.51	98.03	100
2006	0	0.22	5.92	44.25	69.85	89.89	96.65	100
2007	0.12	0.33	8.7	47.88	84.29	91.68	99.11	100
2008	0	0.27	9.27	34.13	61.39	88.04	91.17	100
2009	0	0	9	46	85	86	98	99
2010	0	0.36	7.5	41.75	67.7	90.1	95.29	98.55
2011	0	0.2	5.2	48	77.7	89.7	97.3	97.2
2012	0	0	7.7	32.2	67.5	81	90.9	96.3
2013	0	0.3	1	20.2	55.3	80	91.8	99.3
2014	0	0.4	2	13.3	56.7	85	93.8	98.7
2015	0	0	1.9	10.9	29.2	79.1	93.1	99.6
2016	0.07	0. 2	1.0	6.4	28.5	71.3	86. 1	98.6
2017	0	0.2	0.5	18	54.8	81.4	95.9	100
2018	0	0.1	3.0	16.2	38.3	61.0	93.7	98.9
2019	0	0. 4	4 .0	24 . 0	6 8. 6	93 . 2	9 6 .7	9 9 . 8
2020	0	0.44	3.18	13.68	42.51	80.06	91.18	94.03
2021	0.28	0.25	0.79	17.11	43.21	68.80	90.75	98.63
2022	1.55	0	1.19	9.54	44.22	70.17	77.19	98.50
2023	0.80	2.10	2.29	8.89	49.84	80.60	94.93	94.05

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Table 3.11. Northeast Arctic cod. Proportion mature-at-age

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0	0	0.01	0.03	0.06	0.11	0.18	0.44	0.65	0.86	0.96	0.96	1
1947	0	0	0.01	0.03	0.06	0.13	0.16	0.42	0.75	0.91	0.95	1	1
1948	0	0	0.01	0.03	0.07	0.13	0.25	0.47	0.73	0.91	0.97	1	1
1949	0	0	0.01	0.03	0.09	0.17	0.29	0.54	0.79	0.88	0.97	1	1
1950	0	0	0.01	0.03	0.09	0.23	0.35	0.52	0.79	0.95	0.97	1	1
1951	0	0	0.01	0.03	0.1	0.24	0.4	0.58	0.72	0.85	0.96	1	1
1952	0	0	0.01	0.03	0.08	0.22	0.41	0.63	0.82	0.92	0.97	1	1
1953	0	0	0.01	0.03	0.07	0.19	0.4	0.64	0.84	0.94	0.97	1	1
1954	0	0	0.01	0.03	0.08	0.16	0.37	0.68	0.87	0.93	0.96	1	1

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1955	0	0	0.01	0.03	0.07	0.13	0.26	0.53	0.83	0.92	0.97	1	1
1956	0	0	0.01	0.03	0.06	0.12	0.14	0.41	0.67	0.91	0.96	1	1
1957	0	0	0.01	0.03	0.06	0.09	0.12	0.22	0.6	0.82	0.97	1	1
1958	0	0	0.01	0.03	0.06	0.1	0.1	0.3	0.5	0.82	0.97	1	1
1959	0	0	0.01	0.04	0.12	0.34	0.49	0.67	0.84	0.87	1	1	1
1960	0	0.01	0.03	0.06	0.1	0.19	0.45	0.69	0.77	0.85	0.99	1	1
1961	0	0	0.01	0.06	0.12	0.31	0.65	0.91	0.98	0.98	1	0.96	1
1962	0	0	0.01	0.05	0.15	0.34	0.61	0.81	0.92	0.97	1	0.932	1
1963	0	0.01	0.01	0.03	0.07	0.28	0.42	0.81	0.98	0.98	1	0.966	1
1964	0	0	0	0.03	0.13	0.37	0.66	0.89	0.95	0.99	1	1	1
1965	0	0	0	0.01	0.06	0.2	0.55	0.73	0.99	0.98	1	1	1
1966	0	0	0.01	0.02	0.06	0.22	0.35	0.74	0.94	0.94	1	1	1
1967	0	0	0	0.03	0.07	0.14	0.38	0.64	0.89	0.9	1	1	1
1968	0	0	0.03	0.05	0.09	0.19	0.39	0.58	0.82	1	1	1	1
1969	0	0	0	0.02	0.04	0.12	0.34	0.55	0.74	0.95	1	1	1
1970	0	0.01	0	0.01	0.07	0.23	0.58	0.81	0.89	0.91	1	1	1
1971	0	0	0.01	0.05	0.11	0.3	0.59	0.79	0.86	0.88	1	1	1
1972	0.01	0.02	0.02	0.01	0.1	0.34	0.64	0.81	0.94	1	1	1	1
1973	0	0	0	0.02	0.16	0.53	0.81	0.92	0.95	0.98	1	1	1
1974	0	0	0	0.01	0.03	0.21	0.5	0.96	1	0.96	1	1	1
1975	0	0	0.01	0.02	0.09	0.21	0.56	0.78	0.79	0.95	1	1	1
1976	0	0	0	0.05	0.12	0.29	0.45	0.84	0.83	1	0.9	1	1
1977	0	0	0.02	0.08	0.26	0.54	0.76	0.87	0.93	0.94	0.9	1	1
1978	0	0	0	0.02	0.13	0.44	0.71	0.77	0.81	0.89	0.8	1	1
1979	0	0	0	0.03	0.13	0.39	0.77	0.89	0.83	0.78	0.9	1	1
1980	0	0	0	0.02	0.13	0.35	0.65	0.82	1	0.9	0.9	1	1
1981	0	0	0.02	0.07	0.2	0.54	0.8	0.97	1	1	1	1	1
1982	0	0.05	0.1	0.34	0.65	0.82	0.92	1	1	1	1	1	1
1983	0.01	0.08	0.1	0.3	0.73	0.88	0.97	1	1	1	1	1	1
1984	0	0.05	0.18	0.31	0.56	0.9	0.99	1	1	1	1	1	1
1985	0	0.01	0.09	0.36	0.55	0.85	0.96	0.9	1	1	1	1	1
1986	0	0.05	0.08	0.19	0.53	0.71	0.62	0.9	1	1	1	1	1
1987	0	0.01	0.07	0.18	0.22	0.46	0.5	0.75	1	1	1	1	1
1988	0	0.02	0.05	0.33	0.53	0.62	1	1	1	1	1	1	1
1989	0.008	0.003	0.029	0.228	0.547	0.705	0.915	1	1	1	1	1	1
1990	0.008	0.013	0.051	0.21	0.522	0.715	0.905	0.975	1	1	1	1	1

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1991	0.001	0.032	0.075	0.305	0.708	0.861	0.957	1	1	1	1	1	1
1992	0.001	0.014	0.145	0.419	0.8	0.943	0.974	1	1	1	1	1	1
1993	0	0.028	0.087	0.368	0.704	0.931	0.972	0.994	1	1	1	1	1
1994	0	0.005	0.119	0.336	0.583	0.876	0.965	0.99	1	1	1	1	1
1995	0	0.005	0.06	0.373	0.614	0.748	0.955	0.98	1	1	1	1	1
1996	0	0	0.016	0.252	0.619	0.817	0.975	1	1	1	1	1	1
1997	0	0	0.014	0.14	0.597	0.842	0.95	0.967	1	1	1	1	1
1998	0	0.005	0.031	0.168	0.468	0.828	0.956	0.98	1	1	1	1	1
1999	0	0.001	0.014	0.17	0.506	0.841	0.961	1	1	1	1	1	1
2000	0	0	0.066	0.261	0.699	0.872	0.978	1	1	1	1	1	1
2001	0.001	0.006	0.069	0.378	0.646	0.851	0.955	1	1	1	1	1	1
2002	0.001	0.015	0.085	0.412	0.695	0.846	0.97	1	1	1	1	1	1
2003	0.001	0	0.089	0.331	0.662	0.882	0.96	1	1	1	1	1	1
2004	0	0.009	0.092	0.438	0.728	0.883	0.973	0.974	1	1	1	1	1
2005	0	0.003	0.066	0.366	0.72	0.897	0.971	0.991	1	1	1	1	1
2006	0	0.015	0.061	0.367	0.633	0.907	0.961	1	1	1	1	1	1
2007	0	0.007	0.076	0.37	0.719	0.884	0.977	1	1	1	1	1	1
2008	0.005	0.008	0.082	0.309	0.539	0.869	0.928	0.994	1	1	1	1	1
2009	0	0	0.081	0.362	0.745	0.859	0.978	0.997	0.994	1	1	1	1
2010	0.005	0.006	0.06	0.335	0.552	0.838	0.931	0.971	0.983	1	1	1	1
2011	0	0	0.04	0.339	0.644	0.798	0.932	0.963	0.991	1	1	1	1
2012	0.001	0	0.058	0.209	0.544	0.799	0.93	0.967	0.99	1	1	1	1
2013	0	0	0.01	0.156	0.482	0.763	0.913	0.982	0.985	1	1	1	1
2014	0	0	0.025	0.137	0.516	0.806	0.935	0.984	0.996	1	1	1	1
2015	0	0.001	0.004	0.074	0.282	0.681	0.891	0.963	0.984	1	1	1	1
2016	0	0	0.002	0.057	0.256	0.569	0.832	0.955	0.984	1	1	1	1
2017	0	0.018	0.003	0.148	0.463	0.749	0.931	0.99	1	1	1	1	1
2018	0	0.003	0.028	0.207	0.478	0.731	0.916	0.971	1	1	1	1	1
2019	0	0	0.01	0.126	0.466	0.842	0.942	0.968	0.996	1	1	1	1
2020	0	0	0.014	0.112	0.356	0.775	0.904	0.955	1	1	1	1	1
2021	0.002	0.002	0.006	0.14	0.386	0.657	0.893	0.974	0.959	1	1	1	1
2022	0.014	0	0.01	0.079	0.402	0.674	0.756	0.975	1	1	1	1	1
2023	0.007	0.02	0.019	0.074	0.454	0.774	0.93	0.931	1	1	1	1	1

Table 3.12. The Northeast Arctic cod stock's consumption of cod in million individuals

Year/age	0	1	2	3	4	5	6
1984	0.000	444.972	22.422	0.216	0.000	0.000	0.000
1985	1637.455	354.699	71.701	0.198	0.000	0.000	0.000
1986	69.519	1120.596	343.865	87.590	0.000	0.000	0.000
1987	652.577	194.829	326.521	14.415	0.000	0.000	0.000
1988	32.259	486.347	26.538	1.794	0.000	0.000	0.000
1989	953.436	142.971	0.000	0.000	0.000	0.000	0.000
1990	0.000	110.123	23.502	0.000	0.000	0.000	0.000
1991	118.142	139.027	182.621	1.622	0.000	0.000	0.000
1992	3151.834	895.370	143.893	4.190	0.000	0.000	0.000
1993	3866.066	18279.371	480.685	46.668	1.308	0.420	0.000
1994	7966.736	7022.618	649.249	129.824	49.681	7.907	0.412
1995	8187.453	14882.872	758.834	211.203	67.053	3.734	0.223
1996	10206.699	21734.707	1473.858	136.447	52.739	18.486	1.071
1997	3073.182	17684.439	1899.740	165.816	15.732	1.219	0.220
1998	92.697	5718.231	579.436	204.909	23.507	1.461	0.467
1999	636.930	2113.085	304.436	50.842	4.195	0.004	0.000
2000	1918.192	2556.567	188.542	38.403	13.994	3.844	0.042
2001	94.644	2400.015	114.714	23.824	11.639	1.794	0.917
2002	7562.139	456.858	404.711	41.312	5.314	0.806	0.017
2003	5399.637	4113.972	107.659	24.129	0.000	0.000	0.000
2004	6491.276	2402.169	566.858	20.404	10.403	1.310	0.223
2005	2476.323	3035.950	133.405	79.995	4.526	5.498	0.512
2006	3319.747	2130.275	150.618	6.259	2.020	0.075	0.000
2007	2296.859	1152.611	189.151	74.223	3.411	0.126	0.000
2008	14429.785	704.780	85.607	96.516	31.818	4.202	0.000
2009	9632.264	7349.412	143.271	66.372	20.512	5.093	0.217
2010	4178.921	7164.249	301.457	53.687	27.753	16.665	2.209
2011	12554.996	4425.216	452.354	172.861	40.389	10.589	5.068
2012	21163.926	11949.604	1017.947	101.742	30.631	4.331	0.000
2013	26528.422	4791.451	1554.036	173.389	16.685	7.397	1.115
2014	36229.443	6090.830	728.424	192.786	52.474	5.093	0.063
2015	1539.488	10543.474	305.912	67.449	38.833	16.406	1.616
2016	11978.708	2534.319	501.554	11.760	18.186	26.553	6.267
2017	21533.301	1582.206	385.778	115.850	7.938	4.288	2.936
2018	7268.588	13522.863	275.855	35.641	2.227	0.268	0.000
2019	844.766	8504.830	837.120	53.976	5.723	0.019	0.000

Year/age	0	1	2	3	4	5	6
2020	3206.167	2581.250	340.399	148.635	43.880	10.862	0.563
2021	23808.050	1592.617	235.029	72.359	23.731	13.086	1.557
2022	9979.849	4582.560	292.036	12.354	1.297	0.059	0.000

Table 3.13. Northeast Arctic COD. Tuning data

104

FLT15_I: NorBarTrSur_I

1981 2023

1 1 0.085 0.189

3 12

1 1640 2330 4000 3840 480 100 30 NA NA NA

1 2830 2770 2360 1550 1600 140 20 NA NA NA

1 2495 5234 4333 1696 582 321 97 NA NA NA

1 9749 2828 2144 1174 407 40 8 NA NA NA

1 16679 12598 1992 767 334 21 7 NA NA NA

1 80500 14393 6414 830 191 34 4 NA NA NA

1 24038 39115 5435 1570 200 45 3 NA NA NA

1 14803 8049 17331 2048 358 53 3 NA NA NA

1 4636 7586 3779 9019 982 94 10 NA NA NA

1 2835 3487 3459 2056 2723 161 38 NA NA NA

1 4585 3367 2565 2149 1215 1267 61 NA NA NA

1 15826 5771 1782 1283 767 429 272 NA NA NA

1 27389 14013 7248 1583 624 389 223 NA NA NA

1 29392 30704 15333 4572 795 261 148 55 55 13

1 28284 24236 25101 7642 1798 242 107 50 61 19

1 16308 11743 13859 10888 2443 264 37 17 12 16

1 31799 6844 7426 5999 2667 485 64 91 8 NA

1 35510 16694 3167 2615 1752 816 79 52 4 4

1 18848 18075 6139 1271 681 514 101 26 2 6

1 24581 13003 11173 2675 456 184 121 33 10 5

1 18279 19511 8290 3796 945 117 44 19 4 1

1 11836 13756 10895 4579 1440 220 32 18 5 2

1 37670 12631 9393 6688 1750 467 102 17 4 4

1 6388 18462 5346 4324 3059 685 165 28 7 2

1 24888 5506 10297 2238 1636 381 92 30 4 10

1 11649 11538 2832 4342 1372 524 136 24 18 18

1 36113 12773 6851 1365 2360 682 230 41 11 10

1 19437 30059 11190 4024 1734 811 179 36 3 3

1 12628 19670 22023 6069 1790 902 524 51 17 7

1 3681 11425 15480 14450 3956 1124 367 160 58 12

1 8540 5037 12970 13866 10351 1637 436 120 82 39

1 7572 6459 3371 9069 13258 4861 902 226 88 111

1 6884 11409 6318 4043 6454 7638 3352 222 287 84

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

FLT15_II: NorBarTrSur_II

2014 2023

1 1 0.085 0.189

3 12

1 22685 9379 8859 5639 3274 5305 3619 981 101 120

1 14407 22825 14729 11353 7443 2922 5351 1808 338 98

1 9937 13548 18831 11347 7233 2856 1317 1606 677 180

1 17925 6215 8454 9016 3782 2633 818 326 261 451

1 13941 18478 6181 6417 7388 2588 928 587 129 419

1 28157 17915 22190 7965 3296 3831 815 262 54 70

1 23773 16024 13156 11488 4983 2426 2044 453 166 243

1 11150 11935 11231 5428 3798 1357 727 353 125 103

1 5198 8868 8660 6651 4460 3042 570 229 208 255

1 4121 3982 4652 4317 3224 1426 749 158 34 35

FLT16: NorBarLofAcSur

1985 2023

1 1 0.085 0.26

3 12

1 1530 1416 204 151 157 33 13 10 5 NA

1 4996 1343 684 116 77 31 3 NA 4 NA

1 628 2049 502 174 14 30 7 NA NA NA

1 504 355 578 109 40 3 0 1 NA NA

1 170 344 214 670 166 32 5 2 NA NA

1 148 206 262 269 668 73 6 3 NA NA

1 502 346 293 339 367 500 37 2 2 NA

1 1765 658 215 184 284 254 824 43 17 NA

1 3572 1911 1131 354 255 252 277 442 49 NA

1 3239 3745 2293 961 234 118 103 42 187 29

1 1377 1395 2036 1016 281 47 45 29 26 81

1 994 896 1128 974 462 59 11 4 9 15

1 1586 442 503 459 510 215 23 7 1 8

1 3912 1898 449 415 349 271 51 10 2 1

1 1476 1303 523 139 118 187 99 10 2 1

1 2948 1673 1492 546 146 69 50 13 6 2

1 1774 1606 851 621 191 27 8 6 3 1

1 614 1062 1011 713 366 94 12 8 6 0

1 3067 1168 1271 1461 677 235 38 4 1 2

1 334 852 349 456 480 217 88 24 2 7

1 1250 333 693 341 438 180 75 18 1 3

1 648 538 186 420 176 159 87 23 3 10

1 585 304 308 129 466 151 80 33 9 4

1 1999 2887 1166 789 248 352 55 28 17 7

1 1078 1825 1415 560 415 128 266 36 17 4

1 228 880 1614 1750 618 314 108 125 40 29

1 404 283 674 1595 2727 645 233 68 75 9

1 828 494 344 895 2266 1335 257 104 38 28

1 606 845 724 541 1336 2338 1617 215 111 88

1 2869 1242 1115 777 553 1490 1739 980 146 105

1 1387 2356 1300 1442 964 498 969 686 325 127

1 563 769 1199 664 594 409 356 565 344 286

1 1115 424 444 742 486 484 268 167 146 230

1 1090 1499 540 584 775 456 193 141 61 137

1 2036 1254 1446 639 493 739 273 218 65 111

1 1173 1173 819 943 506 509 495 195 84 80

1 649 591 558 402 369 163 114 144 82 35

1 294 530 570 504 476 345 116 68 53 39

1 287 265 336 346 278 183 135 32 17 15

FLT18: RusSweptArea

1982 2022

1 1 0.9 1

3 12

1 1413 1525 721 198 551 174 37 19 15.1 1.5

1 520 642 506 358 179 252 94 NA NA NA

1 1189 700 489 357 154 69 61 17 14.6 7.4

1 1188 1592 1068 365 165 37 8 16 1.5 20.9

1 1622 1532 1493 481 189 42 2 6 NA NA

1 557 3076 900 701 184 60 25 4 0.7 3.3

1 993 938 2879 583 260 47 24 NA NA NA

1 490 978 1062 1454 1167 299 112 47 18.5 11.7

1 167 487 627 972 1538 673 153 49 9.1 1.7

1 1077 484 532 583 685 747 98 14 2.6 NA

1 675 308 239 273 218 175 25 25 4.0 0.1

1 1604 1135 681 416 354 87 3 7 0.6 0.7

1 1363 1309 1019 354 128 49 21 11 5.7 2.2

1 589 1065 1395 849 251 83 19 18 9.5 5.8

1 733 784 1035 773 348 132 19 5 12.0 1.6

1 1342 835 613 602 348 116 32 30 NA NA

1 2028 1363 788 470 259 130 48 5 NA 0.9

1 1587 2072 980 301 123 94 42 4 NA NA

1 1839 1286 1786 773 114 52 23 9 3.9 0.4

1 1224 1557 1290 1061 304 50 14 5 25.4 13.1

1 980 1473 1473 896 600 182 29 8 0.8 0.5

1 1246 1057 1166 1203 535 241 40 9 3.1 1.1

1 329 1576 880 1111 776 279 93 23 3.6 2.5

1 1408 631 1832 744 605 244 88 28 6.4 1.1

1 927 1613 777 1801 662 342 161 43 17.5 7.4

1 2579 1617 1903 846 1525 553 226 86 49.0 18.5

1 2203 3088 1635 1472 830 863 291 115 33.0 19.0

1 974 2317 3687 2016 1175 620 413 205 65.0 41.0

1 334 1070 2505 3715 1817 789 395 299 155.9 75.2

1 882 508 1432 3065 3300 917 439 176 175.5 105.4

1 815 1114 839 2122 3358 1878 432 195 45.7 76.3

1 747 1174 1177 884 2349 3132 1367 306 92.4 98.5

1 1399 1368 1725 1483 1111 1929 1297 383 93.4 55.1

1 657 1583 1742 1932 1610 925 1158 761 241.6 113.6

1 NA NA NA NA NA NA NA NA NA NA

1 1456 884 1063 1952 1231 567 266 120 119.8 103.8

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

1 NA NA NA NA NA NA NA NA NA NA

FLT007: Ecosystem_2018corr

2004 2022

1 1 0.65 0.75

3 12

1 1477 4215 1502 798 402 101 22 5 1.3 2

1 2166 558 1009 280 156 57 12 5 1.2 0.5

1 1861 2056 599 698 176 81 26 6 2.5 0.4

1 5862 1592 791 246 269 60 22 9 1.5 2.4

1 6526 4834 1323 511 128 175 33 9 2.3 3.9

1 2023 2806 2896 1017 319 127 73 26 8.1 5.1

1 568 1770 3972 4249 1427 385 105 68 15.9 6.2

1 1236 1015 2402 3004 1784 323 77 18 13.4 8.7

1 2291 1464 700 1508 1652 845 127 44 15.5 20.8

1 2491 1836 1257 632 1182 1302 538 91 33.2 24.6

1 NA NA NA NA NA NA NA NA NA NA

1 1744 2252 1413 726 486 262 353 266 78.7 27

1 772 937 1216 701 444 272 138 132 54.2 30.2

1 3750 1415 1049 1209 626 280 112 64 44.5 71.7

1 NA NA NA NA NA NA NA NA NA NA

1 4166 2323 2151 766 422 444 161 49 21.9 29.5

1 1395 1356 934 829 308 142 107 31 10.3 14.8

1 847 998 811 457 336 124 47 50 23.8 16.8

1 NA NA NA NA NA NA NA NA NA NA

Table 3.14. Parameters settings used in SAM run

Where a matrix is specified rows corresponds to fleets and columns to ages.

Same number indicates same parameter used

Numbers (integers) starts from zero and must be consecutive

#

$minAge

The minimium age class in the assessment

3

$maxAge

The maximum age class in the assessment

15

$maxAgePlusGroup

Is last age group considered a plus group (1 yes, or 0 no).

1 1 1 1 1 1

$keyLogFsta

Coupling of the fishing mortality states (nomally only first row is used).

0 1 2 3 4 5 6 7 8 9 10 11 11

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$corFlag

Correlation of fishing mortality across ages (0 independent, 1 compound symmetry, or 2 AR(1)

0

$keyLogFpar

Coupling of the survey catchability parameters (nomally first row is not used, as that is covered by fishing mortality).

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

0 1 2 3 4 5 6 7 8 8 -1 -1 -1

9 10 11 12 13 14 15 16 17 17 -1 -1 -1

18 19 20 21 22 23 24 25 26 26 -1 -1 -1

27 28 29 30 31 32 33 34 35 35 -1 -1 -1

36 37 38 39 40 41 42 43 44 44 -1 -1 -1

$keyQpow

Density dependent catchability power parameters (if any).

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarF

Coupling of process variance parameters for log(F)-process (nomally only first row is used)

0 1 1 1 1 1 1 1 1 1 1 1 1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarLogN

Coupling of process variance parameters for log(N)-process

0 1 1 1 1 1 1 1 1 1 1 1 1

$keyVarObs

Coupling of the variance parameters for the observations.

0 1 2 2 2 2 2 2 3 3 4 4 4

5 6 6 6 6 7 7 7 7 7 -1 -1 -1

5 6 6 6 6 7 7 7 7 7 -1 -1 -1

8 8 8 8 8 8 9 9 9 9 -1 -1 -1

10 10 10 10 10 10 11 11 11 11 -1 -1 -1

12 12 12 12 12 12 12 12 12 12 -1 -1 -1

$obsCorStruct

Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for unstructured). | Possible values are: "ID" "AR" "US"

"ID" "AR" "AR" "AR" "AR" "AR"

$keyCorObs

Coupling of correlation parameters can only be specified if the AR(1) structure is chosen above.

NA's indicate where correlation parameters can be specified (-1 where they cannot).

#3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-11 11-12 12-13 13-14 14-15

NA NA NA NA NA NA NA NA NA NA NA NA

0 0 0 0 1 1 2 2 3 -1 -1 -1

0 0 0 0 1 1 2 2 3 -1 -1 -1

4 4 4 5 6 6 6 7 8 -1 -1 -1

9 9 9 9 9 10 10 10 11 -1 -1 -1

12 12 12 13 13 13 14 14 15 -1 -1 -1

$stockRecruitmentModelCode

Stock recruitment code (0 for plain random walk, 1 for Ricker, and 2 for Beverton-Holt).

0

$noScaledYears

Number of years where catch scaling is applied.

0

$keyScaledYears

A vector of the years where catch scaling is applied.

$keyParScaledYA

A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).

$fbarRange

lowest and higest age included in Fbar

5 10

$keyBiomassTreat

To be defined only if a biomass survey is used (0 SSB index, 1 catch index, and 2 FSB index).

-1 -1 -1 -1 -1 -1

$obsLikelihoodFlag

Option for observational likelihood | Possible values are: "LN" "ALN"

"LN" "LN" "LN" "LN" "LN" "LN"

$fixVarToWeight

If weight attribute is supplied for observations this option sets the treatment (0 relative weight, 1 fix variance to weight).

0

SAM Wed May 31 08:24:02 2023

Table 3.15. Northeast Arctic cod. Fishing mortality

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1946	0.003	0.020	0.069	0.137	0.270	0.248	0.379	0.396	0.572	0.562	0.626	0.646	0.646	0.250
1947	0.002	0.021	0.090	0.187	0.387	0.294	0.450	0.446	0.692	0.635	0.689	0.781	0.781	0.309
1948	0.001	0.021	0.095	0.220	0.464	0.346	0.512	0.450	0.713	0.694	0.742	0.922	0.922	0.348
1949	0.002	0.030	0.138	0.302	0.473	0.367	0.459	0.476	0.771	0.752	0.788	1.029	1.029	0.369
1950	0.002	0.043	0.163	0.314	0.436	0.363	0.480	0.538	0.839	0.855	0.816	1.151	1.151	0.382
1951	0.009	0.079	0.232	0.343	0.445	0.393	0.496	0.567	0.780	0.866	0.841	1.199	1.199	0.413
1952	0.014	0.104	0.278	0.431	0.476	0.408	0.523	0.639	0.843	0.921	0.844	1.201	1.201	0.459
1953	0.020	0.112	0.251	0.360	0.402	0.373	0.473	0.612	0.813	0.823	0.799	1.021	1.021	0.412
1954	0.017	0.116	0.268	0.383	0.423	0.356	0.489	0.707	0.831	0.822	0.790	0.929	0.929	0.438
1955	0.015	0.108	0.295	0.494	0.497	0.509	0.565	0.751	0.895	0.866	0.790	0.862	0.862	0.519
1956	0.018	0.122	0.350	0.581	0.559	0.599	0.590	0.740	0.892	0.987	0.825	0.804	0.804	0.570
1957	0.021	0.137	0.291	0.529	0.548	0.588	0.536	0.674	0.880	0.914	0.822	0.718	0.718	0.528
1958	0.035	0.181	0.359	0.543	0.540	0.511	0.508	0.692	0.829	0.880	0.720	0.629	0.629	0.526
1959	0.035	0.203	0.426	0.524	0.527	0.527	0.552	0.721	0.786	0.801	0.707	0.643	0.643	0.546
1960	0.036	0.212	0.406	0.509	0.494	0.546	0.523	0.754	0.854	0.802	0.697	0.711	0.711	0.539
1961	0.038	0.225	0.491	0.576	0.546	0.644	0.696	0.849	0.897	0.864	0.741	0.749	0.749	0.634

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1962	0.036	0.225	0.584	0.750	0.632	0.683	0.796	1.010	0.935	0.845	0.775	0.738	0.738	0.743
1963	0.024	0.194	0.584	0.800	0.759	0.773	0.893	1.083	1.081	0.851	0.802	0.735	0.735	0.816
1964	0.019	0.159	0.412	0.554	0.585	0.699	0.935	0.883	0.979	0.802	0.882	0.756	0.756	0.678
1965	0.023	0.143	0.365	0.459	0.472	0.589	0.785	0.798	0.804	0.669	0.892	0.759	0.759	0.578
1966	0.031	0.140	0.287	0.388	0.469	0.600	0.752	0.790	0.713	0.655	0.799	0.675	0.675	0.548
1967	0.029	0.155	0.265	0.329	0.463	0.639	0.829	0.811	0.770	0.665	0.793	0.609	0.609	0.556
1968	0.025	0.176	0.356	0.433	0.495	0.632	0.847	0.832	0.747	0.600	0.799	0.631	0.631	0.599
1969	0.026	0.182	0.405	0.483	0.630	0.812	1.006	0.923	0.835	0.631	0.757	0.620	0.620	0.710
1970	0.034	0.164	0.376	0.468	0.589	0.824	0.996	0.933	0.796	0.576	0.712	0.630	0.630	0.698
1971	0.030	0.155	0.306	0.354	0.505	0.809	0.981	0.920	0.801	0.604	0.690	0.616	0.616	0.646
1972	0.051	0.183	0.333	0.402	0.427	0.719	1.059	1.014	0.895	0.652	0.745	0.635	0.635	0.659
1973	0.132	0.226	0.386	0.439	0.459	0.699	0.921	0.860	0.845	0.673	0.756	0.620	0.620	0.627
1974	0.159	0.297	0.482	0.520	0.509	0.622	0.666	0.870	0.910	0.714	0.893	0.628	0.628	0.611
1975	0.115	0.276	0.507	0.622	0.641	0.729	0.721	0.728	0.938	0.778	0.953	0.597	0.597	0.658
1976	0.143	0.307	0.529	0.615	0.687	0.852	0.874	0.672	0.796	0.821	0.942	0.675	0.675	0.705
1977	0.129	0.335	0.634	0.678	0.707	0.901	1.128	0.857	0.894	0.810	1.052	0.810	0.810	0.818
1978	0.110	0.253	0.571	0.737	0.767	0.893	1.219	0.946	1.304	1.008	1.201	0.917	0.917	0.855
1979	0.056	0.202	0.410	0.621	0.711	0.803	1.093	0.992	1.295	1.096	1.125	1.010	1.010	0.772
1980	0.038	0.158	0.345	0.628	0.723	0.809	0.998	1.058	1.230	0.997	1.163	0.907	0.907	0.760
1981	0.032	0.141	0.282	0.581	0.784	0.973	1.160	0.976	1.071	0.937	1.045	0.835	0.835	0.793
1982	0.040	0.158	0.286	0.641	0.841	0.918	1.132	0.826	0.822	0.925	0.866	0.822	0.822	0.774
1983	0.028	0.164	0.300	0.549	0.903	1.079	1.067	0.847	0.713	0.726	0.802	0.866	0.866	0.791
1984	0.024	0.156	0.331	0.582	1.062	1.167	1.168	0.898	0.746	0.701	0.671	0.892	0.892	0.868
1985	0.038	0.161	0.390	0.667	0.944	1.147	0.930	0.778	0.757	0.654	0.593	0.949	0.949	0.809
1986	0.031	0.170	0.455	0.766	0.908	1.141	0.927	1.042	0.887	0.851	0.586	1.073	1.073	0.873
1987	0.039	0.154	0.470	0.827	1.014	1.114	0.894	1.249	0.977	1.003	0.636	1.257	1.257	0.928
1988	0.034	0.127	0.334	0.637	0.936	1.017	1.028	1.355	0.959	0.916	0.731	1.214	1.214	0.885
1989	0.030	0.107	0.251	0.457	0.643	0.833	0.818	1.001	0.753	0.708	0.697	1.432	1.432	0.667
1990	0.020	0.092	0.178	0.308	0.415	0.498	0.548	0.589	0.652	0.610	0.625	1.311	1.311	0.422
1991	0.020	0.101	0.212	0.343	0.434	0.469	0.502	0.481	0.494	0.592	0.570	1.264	1.264	0.407
1992	0.024	0.113	0.280	0.429	0.528	0.554	0.562	0.558	0.515	0.700	0.539	1.253	1.253	0.485
1993	0.014	0.110	0.315	0.523	0.617	0.657	0.692	0.711	0.687	0.826	0.677	1.226	1.226	0.586
1994	0.012	0.109	0.322	0.597	0.924	0.916	0.874	0.851	0.913	0.933	0.777	1.211	1.211	0.748
1995	0.014	0.116	0.323	0.606	0.931	0.895	0.950	0.921	1.010	0.962	0.857	1.123	1.123	0.771
1996	0.021	0.133	0.353	0.618	0.883	0.938	0.853	1.100	0.960	0.960	0.926	1.030	1.030	0.791
1997	0.022	0.168	0.447	0.685	0.895	1.201	1.129	1.268	1.029	1.018	0.924	0.935	0.935	0.937

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1998	0.026	0.181	0.474	0.712	0.852	1.159	1.136	1.313	1.051	0.896	0.830	0.784	0.784	0.941
1999	0.015	0.149	0.463	0.682	0.868	1.099	1.223	1.296	0.953	0.880	0.691	0.692	0.692	0.939
2000	0.009	0.114	0.364	0.587	0.830	1.018	1.107	1.181	0.844	0.897	0.551	0.673	0.673	0.848
2001	0.009	0.096	0.293	0.532	0.754	0.924	0.887	1.045	0.730	0.764	0.438	0.706	0.706	0.739
2002	0.008	0.091	0.276	0.521	0.774	0.884	0.836	0.786	0.620	0.723	0.385	0.666	0.666	0.679
2003	0.010	0.089	0.284	0.474	0.727	0.809	0.771	0.736	0.562	0.623	0.356	0.632	0.632	0.634
2004	0.010	0.090	0.293	0.500	0.766	0.854	0.893	0.940	0.627	0.663	0.336	0.527	0.527	0.707
2005	0.011	0.102	0.318	0.517	0.737	0.865	0.949	0.882	0.660	0.730	0.337	0.473	0.473	0.711
2006	0.016	0.102	0.281	0.442	0.617	0.737	0.800	0.781	0.661	0.754	0.362	0.555	0.555	0.610
2007	0.017	0.091	0.241	0.348	0.447	0.540	0.557	0.527	0.631	0.731	0.372	0.477	0.477	0.443
2008	0.011	0.070	0.162	0.276	0.368	0.446	0.483	0.436	0.578	0.683	0.385	0.391	0.391	0.362
2009	0.010	0.058	0.131	0.221	0.317	0.354	0.457	0.368	0.526	0.735	0.424	0.334	0.334	0.308
2010	0.009	0.049	0.106	0.178	0.281	0.377	0.392	0.419	0.594	0.603	0.484	0.307	0.307	0.292
2011	0.006	0.048	0.105	0.160	0.254	0.352	0.446	0.533	0.558	0.507	0.472	0.252	0.252	0.309
2012	0.007	0.047	0.119	0.161	0.241	0.325	0.419	0.482	0.543	0.469	0.446	0.243	0.243	0.291
2013	0.007	0.048	0.122	0.190	0.269	0.362	0.446	0.516	0.556	0.477	0.429	0.268	0.268	0.317
2014	0.008	0.054	0.141	0.229	0.314	0.393	0.420	0.514	0.596	0.521	0.443	0.288	0.288	0.335
2015	0.010	0.056	0.149	0.270	0.325	0.394	0.365	0.503	0.743	0.594	0.471	0.311	0.311	0.334
2016	0.009	0.053	0.149	0.258	0.341	0.418	0.407	0.552	0.829	0.657	0.521	0.345	0.345	0.354
2017	0.010	0.058	0.153	0.274	0.358	0.477	0.474	0.589	0.898	0.735	0.575	0.369	0.369	0.387
2018	0.012	0.061	0.160	0.270	0.370	0.461	0.519	0.641	0.866	0.799	0.624	0.375	0.375	0.404
2019	0.009	0.064	0.161	0.261	0.381	0.502	0.523	0.689	0.815	0.785	0.619	0.355	0.355	0.419
2020	0.010	0.065	0.174	0.293	0.419	0.532	0.611	0.762	0.839	0.764	0.631	0.333	0.333	0.465
2021	0.012	0.069	0.210	0.371	0.503	0.577	0.741	0.867	0.802	0.787	0.649	0.320	0.320	0.545
2022	0.023	0.081	0.240	0.427	0.544	0.575	0.760	0.899	0.847	0.792	0.669	0.285	0.285	0.574
Mean 2020-2022	0.015	0.072	0.208	0.364	0.489	0.562	0.704	0.843	0.829	0.781	0.650	0.313		

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Table 3.16. Northeast Arctic COD Stock number-at-age (Thous)

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1946	1131733	675633	371631	171708	78187	84440	227414	80757	36044	30527	18856	8112	1998	291704
1947	589231	677696	498210	298341	133553	53547	56352	132866	45827	17370	14637	8429	4517	253058
1948	449846	338009	462717	346413	206946	75360	34959	29936	69670	18420	7655	6075	4972	205097
1949	626523	291696	264329	354381	229201	104008	42958	16918	15975	28243	7444	3000	3605	198828
1950	1024221	396052	230628	187516	208593	114814	57062	22810	8662	6120	11072	2741	1938	227222
1951	2407714	777416	310911	177783	114845	111025	65975	28218	10909	2983	2093	4030	1195	401509

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1952	2328597	1129613	461421	189892	115914	61781	61045	33228	13121	4217	1024	729	1278	440186
1953	2402267	1115835	638140	245280	90934	60040	33163	28518	13940	4523	1347	356	478	463482
1954	833170	1382504	709733	387510	137873	48942	34634	17306	12915	5054	1646	496	245	357202
1955	385036	551772	921576	434864	223730	75020	30565	18107	6940	4694	1836	617	240	265499
1956	750321	246935	395689	550873	211998	112731	35639	14599	7023	2281	1656	691	298	233073
1957	1431458	407134	151471	209080	238264	94890	49087	15396	5682	2355	666	595	362	260644
1958	929503	715984	249912	95908	100409	109310	40962	23270	6425	1911	778	229	381	227498
1959	1312954	486784	428640	141285	47151	47654	54776	20181	9514	2299	639	319	268	255246
1960	1476784	626020	253474	207916	69451	23063	22980	25331	8045	3643	862	256	261	271808
1961	1544518	706397	348084	134365	102607	36315	11330	12030	9809	2788	1373	361	209	291018
1962	1247843	810279	391328	168723	64372	49248	15634	4561	4401	3278	942	540	221	276137
1963	907862	702264	455812	165768	62748	28831	20761	5759	1329	1467	1160	351	300	235441
1964	473547	411911	369740	179218	54781	21590	10562	6923	1519	351	514	432	257	153134
1965	878677	250947	259257	200151	83072	23769	8197	3218	2387	451	123	172	266	171068
1966	1839953	566724	166875	144844	106301	44083	10954	3045	1179	894	192	39	163	288524
1967	1308974	1270075	396538	106241	80547	55334	20430	4379	1136	492	388	73	82	324468
1968	182936	1012919	889833	279771	72366	42267	23741	7296	1619	422	206	146	70	251359
1969	111045	137847	703205	495219	154584	41086	19635	8557	2640	651	194	75	95	167483
1970	206796	86222	88133	369028	238174	64447	15108	5826	2766	915	281	75	75	107784
1971	406737	146005	58021	45451	174361	103279	22554	4582	1861	1030	428	113	65	964488
1972	1052751	313730	105276	37348	27279	81763	36126	6972	1529	696	466	181	80	166419
1973	1700149	752642	212581	63905	21243	15869	32382	9734	1981	500	297	180	114	281157
1974	565981	1199076	516131	123124	35403	11334	6623	10170	3409	701	207	118	131	247240
1975	610161	367082	669058	258350	61584	18470	5370	3072	3311	1119	283	68	109	199803
1976	599582	445367	227371	311620	108455	26035	7503	2269	1299	1003	417	88	82	173109
1977	372307	413520	273382	112894	137056	43303	8837	2627	1047	523	348	136	73	136605
1978	621548	248002	218201	112400	47570	55763	14037	2250	897	384	207	98	77	132143
1979	204031	447468	155572	90733	40802	17638	18405	3267	697	186	116	51	57	979024
1980	131519	156119	301689	87290	39224	16108	6538	5040	981	154	48	31	31	744773
1981	144577	103399	112934	174490	38101	15659	6034	2072	1396	231	47	12	20	598971
1982	181947	125849	83720	63807	81820	15244	4646	1519	641	380	74	13	11	559671
1983	140981	136621	92220	51873	28853	28271	4904	1236	568	230	118	26	9	485909
1984	443366	115166	83583	54126	24632	10647	7717	1355	439	242	95	42	12	741422
1985	529829	386960	82188	44974	24294	6367	2802	1913	439	166	100	41	18	108009
1986	1369810	404115	244534	46407	19160	7428	1602	1008	752	176	73	47	19	209513
1987	357271	1003120	256345	109639	16450	6830	1791	573	288	255	62	35	19	175267

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1988	334096	239244	593379	118927	33012	5010	1737	626	134	90	73	27	12	132636
1989	158520	229171	148275	304719	55009	9890	1481	486	126	40	29	27	10	907782
1990	132388	129404	130196	95726	141754	22871	2912	534	137	48	16	11	7	656006
1991	298599	127183	98217	86322	61802	82032	11465	1379	248	55	22	7	4	767335
1992	714479	272249	101315	69273	48838	33923	46509	6071	804	133	25	10	3	129363
1993	988559	503887	241252	72838	36823	23579	15521	23979	3036	433	57	13	3	190998
1994	749508	733437	399593	146862	39060	15948	10655	6383	9806	1322	160	24	4	211276
1995	537661	491903	524087	231718	63033	12467	5313	3432	2213	3219	423	60	7	187553
1996	402269	303401	336209	282689	104036	19820	4290	1582	1116	619	1015	146	18	145721
1997	777417	208466	204625	182595	120012	37500	6304	1646	437	338	193	331	48	153991
1998	1048459	474057	126705	97658	70885	41679	9505	1624	357	130	95	61	120	187133
1999	626609	600821	263885	62320	32893	26063	11630	2519	344	98	45	33	68	162732
2000	747832	410172	376156	122289	24439	11231	7416	2645	581	108	33	19	42	170296
2001	591465	534376	291579	184953	51964	8994	3405	1934	666	200	35	15	26	166961
2002	374563	431027	368728	186325	82226	20349	3103	1180	566	251	78	18	16	146842
2003	757474	288017	288349	235608	84433	30290	6755	1135	443	264	97	45	15	169292
2004	242780	576499	215269	182819	116290	33915	10947	2632	480	224	126	55	26	138206
2005	694272	185973	407128	136541	94341	39218	11228	3947	830	209	98	79	39	157390
2006	538504	468505	141602	232380	68783	34037	13635	3369	1329	367	82	60	67	150272
2007	1254871	438706	305334	89262	120284	30388	12668	4550	1192	563	145	46	61	225807
2008	1016970	975177	337094	168663	53076	63107	15599	5733	1975	543	217	83	54	263829
2009	590980	796014	744747	249883	89831	33782	29123	7943	3097	953	230	119	76	254677
2010	205517	460527	655384	551852	168890	54623	19139	14872	4690	1636	359	126	116	213773
2011	363991	183782	382476	538159	390293	86742	31659	10764	8249	2066	769	170	145	199926
2012	510052	278762	148241	317718	407445	221791	45411	16283	5363	3915	1024	402	198	195660
2013	471175	373062	228367	129650	243097	266376	137266	23598	8687	2521	2017	537	401	188675
2014	854919	359921	300489	183506	102327	170876	148350	66608	11488	3964	1261	1075	595	220537
2015	452525	573731	302681	215298	132913	68513	98660	76074	31250	5350	1889	658	1029	196057
2016	285806	315948	421706	217130	136747	77157	44556	54447	35594	12006	2412	956	1011	160547
2017	770881	239473	229268	288934	147668	79496	41771	24722	23820	13050	5079	1171	1121	186645
2018	492321	537046	189041	160875	187195	87126	40711	22204	11204	7703	5006	2296	1256	174398
2019	635422	366241	388948	150117	92605	108623	47097	19994	9516	3906	2717	2114	1886	182918
2020	540952	427462	278103	251123	101787	54624	56075	23179	8608	3492	1462	1175	2134	175017
2021	386652	351033	316485	192576	147936	53767	27411	24797	9551	3085	1351	638	1823	151710
2022	197418	265615	256531	195573	116257	75151	23979	10870	8235	3444	1155	584	1376	115618
2023		150647	184991	159696	104371	54409	35086	9129	3602	2802	1259	481	1190	895555

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Table 3.17. Northeast Arctic COD. Natural mortality used in final run

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.490	0.304	0.226	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1947	0.544	0.325	0.231	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1948	0.493	0.305	0.226	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1949	0.434	0.282	0.221	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1950	0.316	0.236	0.210	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1951	0.724	0.394	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1952	0.715	0.391	0.246	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1953	0.537	0.322	0.230	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1954	0.388	0.264	0.217	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1955	0.406	0.271	0.218	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1956	0.590	0.343	0.235	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1957	0.725	0.395	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1958	0.562	0.332	0.233	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1959	0.713	0.390	0.246	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1960	0.704	0.387	0.245	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1961	0.609	0.350	0.237	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1962	0.520	0.315	0.229	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1963	0.788	0.419	0.253	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1964	0.603	0.348	0.236	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1965	0.416	0.275	0.219	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1966	0.353	0.251	0.214	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1967	0.271	0.219	0.206	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1968	0.224	0.201	0.202	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1969	0.206	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1970	0.293	0.227	0.208	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1971	0.256	0.213	0.205	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1972	0.323	0.239	0.211	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1973	0.217	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1974	0.217	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1975	0.232	0.204	0.203	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1976	0.224	0.200	0.202	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1977	0.249	0.210	0.204	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978	0.234	0.205	0.203	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1979	0.208	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

1980	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1983	0.203	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1984	0.201	0.200	0.219	0.210	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1985	0.204	0.224	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1986	0.270	0.216	0.252	0.231	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1987	0.256	0.236	0.219	0.271	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1988	0.222	0.211	0.242	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1989	0.200	0.230	0.200	0.233	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1990	0.200	0.200	0.207	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1991	0.200	0.200	0.200	0.208	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1992	0.207	0.200	0.200	0.203	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1993	0.241	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1994	0.348	0.261	0.215	0.220	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1995	0.530	0.314	0.227	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1996	0.524	0.327	0.243	0.217	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1997	0.421	0.269	0.241	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1998	0.428	0.273	0.218	0.267	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1999	0.264	0.233	0.237	0.223	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2000	0.248	0.212	0.243	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2001	0.236	0.220	0.200	0.231	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2002	0.278	0.212	0.200	0.224	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2003	0.239	0.200	0.200	0.212	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2004	0.250	0.215	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2005	0.297	0.212	0.215	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2006	0.203	0.228	0.200	0.207	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2007	0.247	0.200	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2008	0.258	0.213	0.200	0.233	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.274	0.209	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2010	0.297	0.234	0.207	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2011	0.423	0.312	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2012	0.379	0.300	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.393	0.234	0.205	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2014	0.370	0.293	0.213	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.356	0.261	0.235	0.205	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2016	0.216	0.254	0.264	0.215	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

2017	0.393	0.218	0.215	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2018	0.271	0.212	0.200	0.217	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2019	0.299	0.214	0.213	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2020	0.430	0.232	0.200	0.209	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2021	0.403	0.264	0.241	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2022	0.260	0.212	0.207	0.203	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

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Table 3.18. Northeast Arctic COD. Summary table

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1946	1131733	3934576	952756	706000	0.741	0.250
1947	589231	3387872	903304	882017	0.9764	0.309
1948	449846	3356643	785151	774295	0.9862	0.348
1949	626523	2894848	595159	800122	1.3444	0.369
1950	1024221	2794508	536002	731982	1.3656	0.382
1951	2407714	3691021	495064	827180	1.6709	0.413
1952	2328597	4115925	488824	876795	1.7937	0.459
1953	2402267	4092555	412181	695546	1.6875	0.412
1954	833170	4200228	408246	826021	2.0233	0.438
1955	385036	3538881	328014	1147841	3.4994	0.519
1956	750321	3320390	281300	1343068	4.7745	0.570
1957	1431458	2813924	212225	792557	3.7345	0.528
1958	929503	2356977	205350	769313	3.7463	0.526
1959	1312954	2725170	434392	744607	1.7141	0.546
1960	1476784	2352549	384764	622042	1.6167	0.539
1961	1544518	2348998	386646	783221	2.0257	0.634
1962	1247843	2173881	315444	909266	2.8825	0.743
1963	907862	2009332	216030	776337	3.5937	0.816
1964	473547	1510028	200204	437695	2.1862	0.678
1965	878677	1457908	107974	444930	4.1207	0.578
1966	1839953	2219858	121031	483711	3.9966	0.548
1967	1308974	2733588	128774	572605	4.4466	0.556
1968	182936	3283576	223025	1074084	4.816	0.599
1969	111045	2820868	148985	1197226	8.0359	0.710
1970	206796	2162959	242030	933246	3.8559	0.698
1971	406737	1659988	330272	689048	2.0863	0.646
1972	1052751	1614433	353277	565254	1.6	0.659

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1973	1700149	2275166	334102	792685	2.3726	0.627
1974	565981	2177314	158993	1102433	6.9339	0.611
1975	610161	2091059	133549	829377	6.2103	0.658
1976	599582	1939668	167188	867463	5.1885	0.705
1977	372307	1930350	336002	905301	2.6943	0.818
1978	621548	1585089	227858	698715	3.0665	0.855
1979	204031	1136874	180352	440538	2.4427	0.772
1980	131519	853429	108439	380434	3.5083	0.760
1981	144577	966332	161362	399038	2.4729	0.793
1982	181947	751046	321353	363730	1.1319	0.774
1983	140981	747007	311520	289992	0.9309	0.791
1984	443366	831318	243628	277651	1.1396	0.868
1985	529829	1003000	195463	307920	1.5753	0.809
1986	1369810	1403861	164102	430113	2.621	0.873
1987	357271	1238186	115111	523071	4.5441	0.928
1988	334096	1008624	191558	434939	2.2705	0.885
1989	158520	956866	237290	332481	1.4012	0.667
1990	132388	912593	303044	212000	0.6996	0.422
1991	298599	1348024	636493	319158	0.5014	0.407
1992	714479	1690944	804452	513234	0.638	0.485
1993	988559	2203392	701423	581611	0.8292	0.586
1994	749508	2116329	570797	771086	1.3509	0.748
1995	537661	1850415	533335	739999	1.3875	0.771
1996	402269	1695858	550636	732228	1.3298	0.791
1997	777417	1538124	545650	762403	1.3972	0.937
1998	1048459	1353358	385769	592624	1.5362	0.941
1999	626609	1202556	280600	484910	1.7281	0.939
2000	747832	1225859	255331	414868	1.6248	0.848
2001	591465	1479452	383395	426471	1.1124	0.739
2002	374563	1596045	520889	535045	1.0272	0.679
2003	757474	1682972	571223	551990	0.9663	0.634
2004	242780	1568986	665197	606445	0.9117	0.707
2005	694272	1518705	578178	641276	1.1091	0.711
2006	538504	1542202	581768	537642	0.9242	0.610
2007	1254871	1869439	647938	486883	0.7514	0.443
2008	1016970	2559427	718024	464171	0.6465	0.362

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
2009	590980	3100560	1008860	523430	0.5188	0.308
2010	205517	3342036	1239289	609983	0.4922	0.292
2011	363991	3571135	1798145	719830	0.4003	0.309
2012	510052	3646790	2016129	727663	0.3609	0.291
2013	471175	3727573	2238973	966209	0.4315	0.317
2014	854919	3456531	2123627	986449	0.4645	0.335
2015	452525	3288414	1714210	864384	0.5042	0.334
2016	285806	2864959	1370535	849422	0.6198	0.354
2017	770881	2796188	1395722	868276	0.6221	0.387
2018	492321	2587932	1258206	778627	0.6188	0.404
2019	635422	2472943	1198577	692609	0.5779	0.419
2020	540952	2184578	964937	692903	0.7181	0.465
2021	386652	1977195	835773	767284	0.9181	0.545
2022	197418	1745790	711549	719211	1.0108	0.574
Arith. Mean	726753	2210182	570039	674314	2.0072	0.594

Table 3.19a. Northeast Arctic COD. Input for the short term prediction

2023								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	446000	0.364	0.007	0	0	0.271	0.015	0.630
4	150647	0.236	0.02	0	0	0.645	0.072	0.977
5	184991	0.216	0.019	0	0	1.022	0.208	1.454
6	159696	0.204	0.074	0	0	1.710	0.364	2.151
7	104371	0.2	0.454	0	0	2.876	0.489	3.125
8	54409	0.2	0.774	0	0	4.353	0.561	4.491
9	35086	0.2	0.93	0	0	5.925	0.704	5.904
10	9129	0.2	0.931	0	0	7.864	0.842	7.168
11	3602	0.2	1	0	0	9.824	0.829	8.544
12	2802	0.2	1	0	0	11.360	0.781	10.298
13	1259	0.2	1	0	0	13.478	0.649	11.542
14	481	0.2	1	0	0	15.460	0.313	12.837
15	1190	0.2	1	0	0	17.876	0.313	14.259
2024								
Age	N	M	Mat	PF	PM	SWT	Sel	CWT
3	409000	0.364	0.008	0	0	0.258	0.015	0.629

4		0.236	0.007	0	0	0.588	0.072	0.984
5		0.216	0.012	0	0	1.140	0.208	1.474
6		0.204	0.098	0	0	1.724	0.364	2.128
7		0.2	0.414	0	0	2.797	0.489	3.031
8		0.2	0.702	0	0	4.239	0.561	4.369
9		0.2	0.860	0	0	6.250	0.704	5.953
10		0.2	0.960	0	0	7.955	0.842	7.195
11		0.2	0.986	0	0	9.772	0.829	8.385
12		0.2	1	0	0	11.695	0.781	10.105
13		0.2	1	0	0	13.466	0.649	11.719
14		0.2	1	0	0	15.665	0.313	12.953
15		0.2	1	0	0	17.695	0.313	14.238
2025								
Age	N	M	Mat	PF	PM	SWT	Sel	CWT
3	239000	0.364	0.008	0	0	0.256	0.015	0.629
4		0.236	0.007	0	0	0.575	0.072	0.984
5		0.216	0.012	0	0	1.083	0.208	1.474
6		0.204	0.098	0	0	1.842	0.364	2.128
7		0.2	0.414	0	0	2.811	0.489	3.031
8		0.2	0.702	0	0	4.160	0.561	4.369
9		0.2	0.860	0	0	6.136	0.704	5.953
10		0.2	0.960	0	0	8.279	0.842	7.195
11		0.2	0.986	0	0	9.863	0.829	8.385
12		0.2	1	0	0	11.643	0.781	10.105
13		0.2	1	0	0	13.801	0.649	11.719
14		0.2	1	0	0	15.653	0.313	12.953
15		0.2	1	0	0	17.900	0.313	14.238

Table 3.19b. Northeast Arctic COD. Input for the short term prediction

Year	**Cod3**	**OxSatt39**	**DOxSatt13**	**ITwt43**	**Icet15**	**expIcet40**
1962	1247843	-0.19	-6.6	1.86	0.5	0
1963	907862	-0.94	-2.37	1.59	1.5	0
1964	473547	1.63	1.23	2.47	9	0
1965	878677	0.88	-0.2	3.91	15.7	0
1966	1839953	-1.09	-3.98	7.97	5.3	0
1967	1308974	-0.23	-2.84	8.23	5	9.3

Year	Cod3	OxSatt39	DOxSatt13	ITwt43	Icet15	expIcet40
1968	182936	1.5	-0.13	3.78	15.5	0
1969	111045	0.85	0.63	1.77	15.9	0
1970	206796	-0.17	-0.23	3.51	19.8	7.9
1971	406737	0.06	-0.12	-0.13	18.8	2.7
1972	1052751	-3.32	-6.59	14.55	-0.6	428.9
1973	1700149	-2.1	-10.37	19.14	1.8	768.6
1974	565981	1.06	-1.73	2.4	2	0
1975	610161	1.9	0.78	-2.64	-1.2	0
1976	599582	1.33	-1.28	-3.07	-1.9	0
1977	372307	-0.07	-1.84	-2.44	2.5	0
1978	621548	1.19	0.1	1.05	-1	0
1979	204031	0.5	-1.48	-0.12	3.5	0
1980	131519	-0.31	-2.72	1.98	12.9	0
1981	144577	0.76	-0.18	1.94	14.7	0
1982	181947	0.8	0.61	-3.15	8	0.1
1983	140981	0.78	0.22	1.87	12.2	8.5
1984	443366	-2.21	-2.35	-3.08	12.9	0
1985	529829	-0.1	-1.17	3.59	-1.2	0.1
1986	1369810	-2.14	-4.39	1.39	-8.5	2.9
1987	357271	-0.33	-1.69	2.12	0.6	0
1988	334096	0.87	-1.4	-2.34	3.8	0
1989	158520	0.32	-3.42	-5.17	10.5	0
1990	132388	1.11	-1.32	-4.21	10.5	0
1991	298599	0.88	0.7	2.42	6.5	0
1992	714479	1.34	0.48	1.37	-0.9	0
1993	988559	-1.98	-3.86	6.12	-0.6	0
1994	749508	-0.5	-2.26	8.25	-4.9	0
1995	537661	0.83	-2.42	4.36	1.8	0
1996	402269	0.86	-0.08	0.55	0.7	0
1997	777417	0.88	0.17	3.11	-7.3	0
1998	1048459	0.3	-6.08	-2.32	-2.5	0
1999	626609	-0.72	-2.4	-6.81	2.9	0
2000	747832	1.86	1.55	-2.29	13.6	0
2001	591465	0.62	0.05	-6.04	2.3	0
2002	374563	-0.88	-0.98	3.63	-9.9	0.8
2003	757474	-0.39	-0.64	8.5	-5.8	0

Year	Cod3	OxSatt39	DOxSatt13	ITwt43	Icet15	expIcet40
2004	242780	-2.2	-2.53	-4.62	-1.4	0
2005	694272	-1.65	-1.82	-1.45	4.9	0
2006	538504	-1.18	-1.65	-4	-6	0
2007	1254871	-1.39	-4.42	7.42	-12.3	0
2008	1016970	-1.14	-1.59	3.39	-18	0
2009	590980	0.79	-1.83	-1.61	-17.5	0
2010	205517	-0.38	-2.6	-8.94	-9	0
2011	363991	0.83	-0.07	-5	-4.3	0
2012	510052	0.91	-0.13	-5.05	-4.3	0
2013	471175	0.04	-0.09	1.44	-10.5	0
2014	854919	-0.46	-1	1.43	-17.8	0
2015	452525	-1.26	-1.62	-2.22	-10.5	0
2016	285806	-1.31	-1.92	-7.52	-5.8	0
2017	770881	-0.33	-0.64	-1.69	-14.4	0
2018	492321	-1.24	-1.41	0.1	-20.9	0
2019	635422	-0.63	-1.08	-1.71	-13.2	0
2020	540952	-2.02	-2.19	-6.35	-13.6	0
2021	386652	-0.8	-1.1	-1.33	-9.2	0
2022	197418	-1.55	-2.1	-2.5	-12.7	0
2023	NA	-1.52	-3.02	-4.18	-8.4	0
2024	NA	-0.31	1.68	-5.57	-12.55	0
2025	NA	0.36	NA	-7.48	NA	0
2026	NA	0.46	NA	-3.15	NA	0

Table 3.19c. Northeast Arctic COD. Input for the short term prediction using RCT3

yearclass	**recruitment**	**BST1**	**BST2**	**BST3**	**BSA1**	**BSA2**	**BSA3**
1982	530	NA	NA	NA	NA	NA	NA
1983	1370	NA	NA	NA	NA	NA	NA
1984	357	NA	NA	NA	NA	NA	NA
1985	334	NA	NA	NA	NA	NA	NA
1986	159	NA	NA	NA	NA	NA	NA
1987	132	NA	NA	NA	NA	NA	NA
1988	299	NA	NA	NA	NA	NA	NA
1989	714	NA	NA	NA	NA	NA	NA
1990	989	NA	NA	NA	NA	NA	NA

1991	750	NA	NA	294	NA	NA	324
1992	538	NA	557	283	NA	624	138
1993	402	1044	541	163	903	212	99
1994	777	5356	792	318	2175	272	159
1995	1048	5899	1423	355	1826	565	391
1996	627	5044	496	188	1698	475	148
1997	748	2491	350	246	2524	232	295
1998	591	473	242	183	365	263	177
1999	375	129	78	118	153	51	61
2000	757	713	419	377	364	209	307
2001	243	34	66	64	19	53	33
2002	694	3022	243	249	1505	117	125
2003	539	323	217	116	161	139	65
2004	1255	853	289	361	500	158	58
2005	1017	674	370	194	411	47	200
2006	591	595	102	126	85	94	108
2007	206	69	36	37	51	25	23
2008	364	389	95	85	205	44	40
2009	510	1028	226	76	620	91	83
2010	471	617	100	69	266	40	61
2011	855	703	143	227	496	89	287
2012	453	436	191	144	313	211	139
2013	286	1246	343	99	1759	211	56
2014	771	1642	306	179	1904	202	112
2015	492	312	129	139	241	73	109
2016	635	645	501	282	439	280	204
2017	541	2714	559	238	2058	362	117
2018	387	1791	274	112	1437	158	65
2019	197	165	35	52	93	29	29
2020	NA	81	66	41	46	43	29
2021	NA	668	163	NA	525	103	NA
2022	NA	305	NA	NA	244	NA	NA

Table 3.19d. Overview of available prognoses of NEA cod recruitment (in million individuals of age 3) from different models.

Model	**Variable**		**Years**	**2023**	**2024**	**2025**	**2026**
TitovEL	Age 3		4	513	365	239	400

Model	**Variable**		**Years**	**2023**	**2024**	**2025**	**2026**
	weight			0.36	0.446	1	1
TitovES	Age 3		2	585	444		
	weight			0.344	0.554		
RCT3	Age 3		3	204	448	376	
	weight			0.296			
Hybrid	Age 3		4	**446**	**409**	**239**	**400**

Table 3.20. Northeast Arctic COD. Management option table.

2023					
Biomass (t)	SSB (t)	FMult	FBar	Landings (t)	
1609757	719247	1	0.574	572800	
2024				2025	
Biomass	SSB	FBar	Landings	Biomass	SSB
1412580	587836	0.00	0	1820353	900153
		0.05	52713	1756013	852479
		0.10	102863	1694959	807524
		0.15	150593	1637002	765125
		0.20	196037	1581966	725128
		0.25	239322	1529686	687388
		0.30	280567	1480007	651770
		0.35	319884	1432783	618147
		0.40	357377	1387877	586401
		0.45	393146	1345160	556419
		0.50	427284	1304511	528099
		0.55	459878	1265816	501342
		0.60	491011	1228967	476055
		0.65	520761	1193865	452154
		0.70	549200	1160414	429556
		0.75	576397	1128525	408187
		0.80	602419	1098113	387975
		0.85	627325	1069101	368854
		0.90	651173	1041412	350759
		0.95	674018	1014978	333633

Table 3.21. Northeast Arctic COD. Detailed prediction output assuming Fsq in 20 23 and HCR in 202 4 .

Fbar age

range: 5-10

Year: 2023

F multiplier: 1

Fbar: 0.5740

Age F CatchNos Yield StockNos Biomass SSNos(Jan) SSB(Jan)

3 0.016 6050 4 446000 121 3122 1

4 0.078 10119 10 150647 97 3013 2

5 0.226 33809 49 184991 189 3515 4

6 0.396 47528 102 159696 273 11818 20

7 0.532 39351 123 104371 300 47384 136

8 0.610 22744 102 54409 237 42113 183

9 0.765 17223 102 35086 208 32630 193

10 0.915 5036 36 9129 72 8499 67

11 0.901 1968 17 3602 35 3602 35

12 0.849 1473 15 2802 32 2802 32

13 0.706 584 7 1259 17 1259 17

14 0.340 126 2 481 7 481 7

15+ 0.340 313 4 1190 21 1190 21

Total NA 186326 573 1153663 1610 161427 719

Thous Thou. Thous Thou. Thous Thou.

tonnes tonnes tonnes

Fbar age

range: 5-10

Year: 2024

F multiplier: 0.94

Fbar: 0.5399

Age F CatchNos Yield StockNos Biomass SSNos(Jan) SSB(Jan)

3 0.015 5221 3 409000 106 3136 1

4 0.074 19306 19 304908 179 2236 1

5 0.213 19031 28 110020 125 1284 1

6 0.372 33636 72 118887 205 11611 20

7 0.500 31525 96 87667 245 36294 102

8 0.574 20057 88 50216 213 35235 149

9 0.720 11393 68 24207 151 20810 130

10 0.861 7090 51 13362 106 12828 102

11 0.848 1572 13 2992 29 2951 29

12 0.799 605 6 1197 14 1197 14

13 0.664 436 5 981 13 981 13

14 0.320 127 2 509 8 509 8

15+ 0.320 243 3 973 17 973 17

Total NA 150243 453 1124921 1413 130045 588

Thous Thou. Thous Thou. Thous Thou.

tonnes tonnes tonnes

Table 3.22. Northeast Arctic COD. Assessments results by means of TISVPA

Year	B(3+)	SSB	R(3)	F(5-10)
1984	848315	259576	438301	0.795
1985	1021968	203508	576945	0.634
1986	1413066	183468	1118185	0.830
1987	1252144	134681	295170	1.081
1988	1017331	224093	219760	0.996
1989	939353	246071	179884	0.489
1990	1006289	337439	226371	0.324
1991	1592561	740169	394031	0.240
1992	1955419	961489	680832	0.429
1993	2389501	845419	911676	0.628
1994	2168890	648440	711684	0.820
1995	1827121	550744	468339	0.748
1996	1736798	595151	384281	0.722

Year	B(3+)	SSB	R(3)	F(5-10)
1997	1624589	644463	635610	1.007
1998	1295836	426940	789361	1.033
1999	1103539	288836	480545	0.909
2000	1088474	246892	586038	0.643
2001	1343495	371749	492055	0.505
2002	1489706	504053	424923	0.499
2003	1595022	546868	665568	0.502
2004	1536836	649394	272246	0.605
2005	1492200	587645	520097	0.626
2006	1504824	601797	524445	0.637
2007	1789876	635742	1247697	0.497
2008	2511154	686322	1235842	0.340
2009	3155379	975732	830759	0.326
2010	3426711	1163810	479221	0.352
2011	3617727	1648544	598775	0.310
2012	3734732	1895471	662659	0.286
2013	3853296	2108771	773721	0.298
2014	3567447	2010815	966249	0.333
2015	3363582	1600261	478138	0.364
2016	2975787	1298142	360407	0.340
2017	2964602	1435210	689449	0.417
2018	2674149	1310754	492277	0.477
2019	2447306	1212661	544168	0.429
2020	2121410	956320	495370	0.492
2021	1879219	802243	379310	0.585
2022	1596295	610859	384660	0.715
2023	1300251	527975		

Table 3.23. NEA cod TISVPA estimates of abundance at age (thousands)

	3	4	5	6	7	8	9	10	11	12	13	14	15
1984	438301	144939	73951	43281	27660	11490	9665	1474	596	354	179	30	20
1985	576945	351716	104931	43213	18687	8116	2980	2549	465	297	141	95	24
1986	1118185	451332	242344	60971	19758	6436	2784	1152	1158	224	202	85	35
1987	295170	829710	302210	119904	24649	6567	1909	862	349	379	67	138	47
1988	219760	218217	540129	150298	37400	6546	1980	688	165	121	103	34	12
1989	179884	168327	154118	292761	61326	9772	1648	580	157	34	42	47	68

1990	226371	143305	119224	97243	158336	25836	3475	653	246	90	16	32	13
1991	394031	183665	110469	84441	62653	99572	14593	2043	372	151	59	8	17
1992	680832	318726	141552	76862	52032	35420	59693	8542	1277	253	110	47	5
1993	911676	537528	232547	93040	42696	26315	16747	31401	4423	748	134	84	4
1994	711684	707943	400480	137834	47641	20043	11432	6916	13268	1829	286	61	13
1995	468339	496871	492566	236538	60270	13562	6410	3382	1991	4060	563	132	3
1996	384281	271882	326773	290789	111421	21887	4657	2156	1037	553	1494	265	3
1997	635610	222036	173452	187141	142317	44635	7906	1828	731	353	203	586	2
1998	789361	406832	139568	81954	75002	48047	11480	1847	410	142	67	54	129
1999	480545	491590	240788	68597	30074	26029	12022	3238	452	121	33	21	79
2000	586038	362022	321680	112542	25801	10774	6859	2392	968	150	50	3	48
2001	492055	451910	262756	171470	49192	9634	3532	1864	645	470	59	30	94
2002	424923	383844	330027	162040	81280	20748	3455	1469	621	249	287	41	27
2003	665568	319225	283064	203129	75541	30986	7513	1314	740	308	106	207	5
2004	272246	517526	242293	177119	102888	32039	12632	3496	614	454	164	68	34
2005	520097	209891	381948	153596	86815	39708	11244	4547	1325	242	251	100	29
2006	524445	381249	152590	215261	74478	33558	13833	3956	1550	561	106	178	615
2007	1247697	420629	264835	95013	105837	32685	12968	4623	1577	556	253	62	167
2008	1235842	954684	307913	155319	54148	54032	16148	6496	2251	799	213	163	81
2009	830759	947159	724454	214884	92405	31542	26612	8468	3609	1179	449	136	129
2010	479221	627233	732344	514100	134228	55690	17987	13932	5013	2105	261	299	213
2011	598775	354267	478598	537164	342709	76210	29896	10161	7391	1823	982	79	0
2012	662659	390290	251621	357872	368928	209856	42837	14723	4369	3434	986	481	165
2013	773721	451221	279569	189363	252043	235557	125197	23938	7609	2052	1851	562	916
2014	966249	520116	344099	205706	133787	156705	128580	62660	11802	3741	1088	1138	850
2015	478138	663446	370727	243532	134664	82084	80492	64321	30794	6141	1974	632	1199
2016	360407	331813	483374	255402	152717	78611	46087	43362	30661	11957	2799	1189	1470
2017	689449	288403	246433	324949	165248	91983	42845	24738	18971	12352	5568	1558	1113
2018	492277	460446	219481	171328	201805	91976	48174	20873	11394	6054	4741	2911	939
2019	544168	370882	345394	153315	104505	110205	46961	23708	8491	3723	1970	2077	1186
2020	495370	401148	279601	232262	97020	59633	53456	22659	11288	3197	1384	1027	921
2021	379310	317948	297365	190134	135573	51132	29022	22672	8659	4199	1275	666	1006
2022	384660	248743	227678	185662	99471	57103	21917	11039	7187	2973	1820	519	339
2023		290978	180482	137219	89171	38852	19092	7289	3567	2449	1087	970	277

Table 3.24. NEA cod TISVPA estimates of fishing mortality coefficients

	3	4	5	6	7	8	9	10	11	12	13	14	15	F(5-10)
1984	0.023	0.144	0.284	0.478	1.130	0.732	1.112	1.034	0.374	0.820	0.573	0.573	0.573	0.795

	3	4	5	6	7	8	9	10	11	12	13	14	15	F(5-10)
1985	0.022	0.129	0.335	0.402	0.539	1.063	0.589	0.879	0.757	0.291	0.359	0.466	0.466	0.634
1986	0.023	0.170	0.441	0.751	0.699	0.817	1.504	0.771	1.102	0.907	0.209	0.582	0.582	0.830
1987	0.027	0.166	0.536	0.911	1.294	0.940	0.916	1.891	0.810	1.133	0.515	0.640	0.640	1.081
1988	0.025	0.172	0.448	0.963	1.307	1.518	0.872	0.871	1.509	0.694	0.522	0.597	0.597	0.996
1989	0.014	0.094	0.257	0.396	0.614	0.648	0.603	0.420	0.392	0.556	0.201	0.301	0.301	0.489
1990	0.008	0.061	0.161	0.270	0.329	0.426	0.386	0.369	0.250	0.230	0.198	0.191	0.191	0.324
1991	0.006	0.039	0.118	0.195	0.262	0.275	0.307	0.285	0.256	0.173	0.104	0.141	0.141	0.240
1992	0.009	0.066	0.166	0.331	0.459	0.549	0.496	0.572	0.489	0.426	0.177	0.240	0.240	0.429
1993	0.014	0.079	0.242	0.392	0.674	0.831	0.855	0.777	0.843	0.686	0.352	0.341	0.341	0.628
1994	0.016	0.109	0.258	0.517	0.692	1.098	1.139	1.215	0.982	1.046	0.472	0.426	0.426	0.820
1995	0.014	0.103	0.291	0.433	0.715	0.816	1.079	1.152	1.107	0.880	0.517	0.419	0.419	0.748
1996	0.020	0.094	0.287	0.517	0.618	0.894	0.850	1.164	1.123	1.047	0.474	0.431	0.431	0.722
1997	0.025	0.167	0.336	0.694	1.094	1.105	1.431	1.380	1.904	1.716	0.744	0.596	0.596	1.007
1998	0.029	0.168	0.485	0.598	1.043	1.420	1.129	1.522	1.301	1.678	0.737	0.603	0.603	1.033
1999	0.023	0.180	0.441	0.823	0.773	1.149	1.236	1.030	1.214	1.030	0.650	0.548	0.548	0.909
2000	0.020	0.112	0.371	0.551	0.789	0.619	0.733	0.795	0.635	0.703	0.367	0.386	0.386	0.643
2001	0.015	0.105	0.239	0.497	0.578	0.690	0.469	0.558	0.557	0.446	0.298	0.299	0.299	0.505
2002	0.013	0.088	0.265	0.376	0.642	0.631	0.638	0.445	0.492	0.480	0.241	0.279	0.279	0.499
2003	0.013	0.078	0.220	0.421	0.477	0.705	0.586	0.605	0.396	0.428	0.258	0.261	0.261	0.502
2004	0.014	0.097	0.237	0.435	0.698	0.672	0.864	0.724	0.690	0.436	0.288	0.304	0.304	0.605
2005	0.015	0.093	0.265	0.410	0.615	0.862	0.691	0.914	0.702	0.654	0.257	0.309	0.309	0.626
2006	0.016	0.102	0.261	0.481	0.601	0.786	0.934	0.760	0.930	0.695	0.382	0.327	0.327	0.637
2007	0.013	0.084	0.223	0.356	0.523	0.553	0.606	0.723	0.557	0.649	0.305	0.264	0.264	0.497
2008	0.009	0.061	0.165	0.272	0.346	0.432	0.393	0.435	0.475	0.369	0.260	0.194	0.194	0.340
2009	0.008	0.053	0.154	0.262	0.351	0.387	0.417	0.387	0.400	0.426	0.209	0.187	0.187	0.326
2010	0.007	0.053	0.147	0.272	0.377	0.439	0.418	0.460	0.398	0.403	0.264	0.200	0.200	0.352
2011	0.007	0.044	0.125	0.220	0.331	0.398	0.400	0.388	0.399	0.339	0.215	0.183	0.000	0.310
2012	0.006	0.043	0.107	0.195	0.279	0.366	0.380	0.390	0.354	0.356	0.191	0.176	0.176	0.286
2013	0.007	0.044	0.121	0.190	0.284	0.356	0.407	0.431	0.413	0.367	0.230	0.192	0.192	0.298
2014	0.008	0.051	0.133	0.234	0.299	0.394	0.432	0.507	0.501	0.469	0.256	0.228	0.228	0.333
2015	0.009	0.060	0.152	0.253	0.368	0.409	0.471	0.529	0.580	0.561	0.316	0.267	0.267	0.364
2016	0.008	0.055	0.155	0.247	0.334	0.422	0.405	0.475	0.497	0.532	0.311	0.263	0.263	0.340
2017	0.012	0.064	0.178	0.321	0.420	0.499	0.549	0.537	0.591	0.605	0.383	0.333	0.333	0.417
2018	0.014	0.087	0.189	0.338	0.506	0.575	0.587	0.664	0.600	0.647	0.389	0.384	0.384	0.477
2019	0.012	0.082	0.215	0.293	0.426	0.550	0.533	0.555	0.580	0.515	0.332	0.357	0.357	0.429
2020	0.011	0.082	0.246	0.412	0.450	0.573	0.639	0.631	0.611	0.624	0.332	0.406	0.406	0.492

	3	4	5	6	7	8	9	10	11	12	13	14	15	F(5-10)
2021	0.019	0.083	0.250	0.488	0.675	0.624	0.685	0.788	0.717	0.675	0.403	0.475	0.475	0.585
2022	0.017	0.111	0.301	0.523	0.740	0.896	0.901	0.930	0.877	0.806	0.429	0.429	0.429	0.715

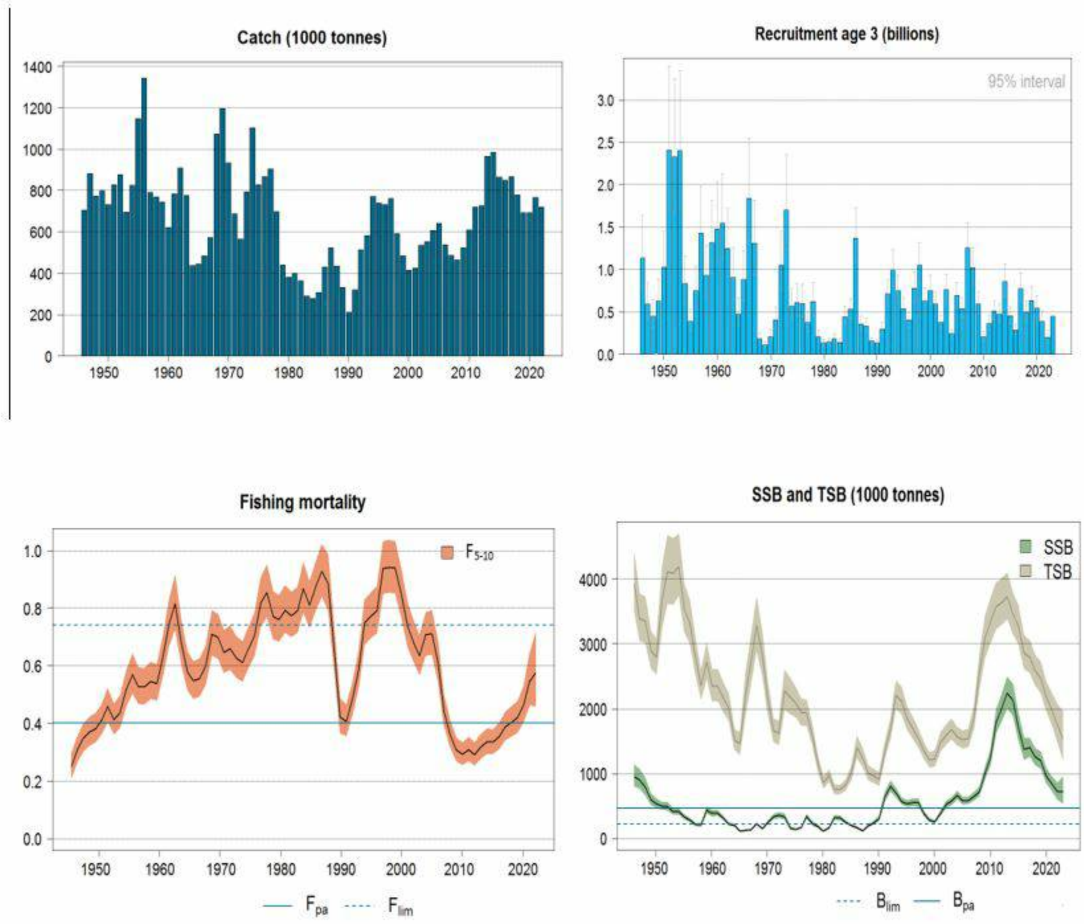

Figure 3.1. Standard plots for Northeast Arctic cod (ICES subareas 1 and 2)

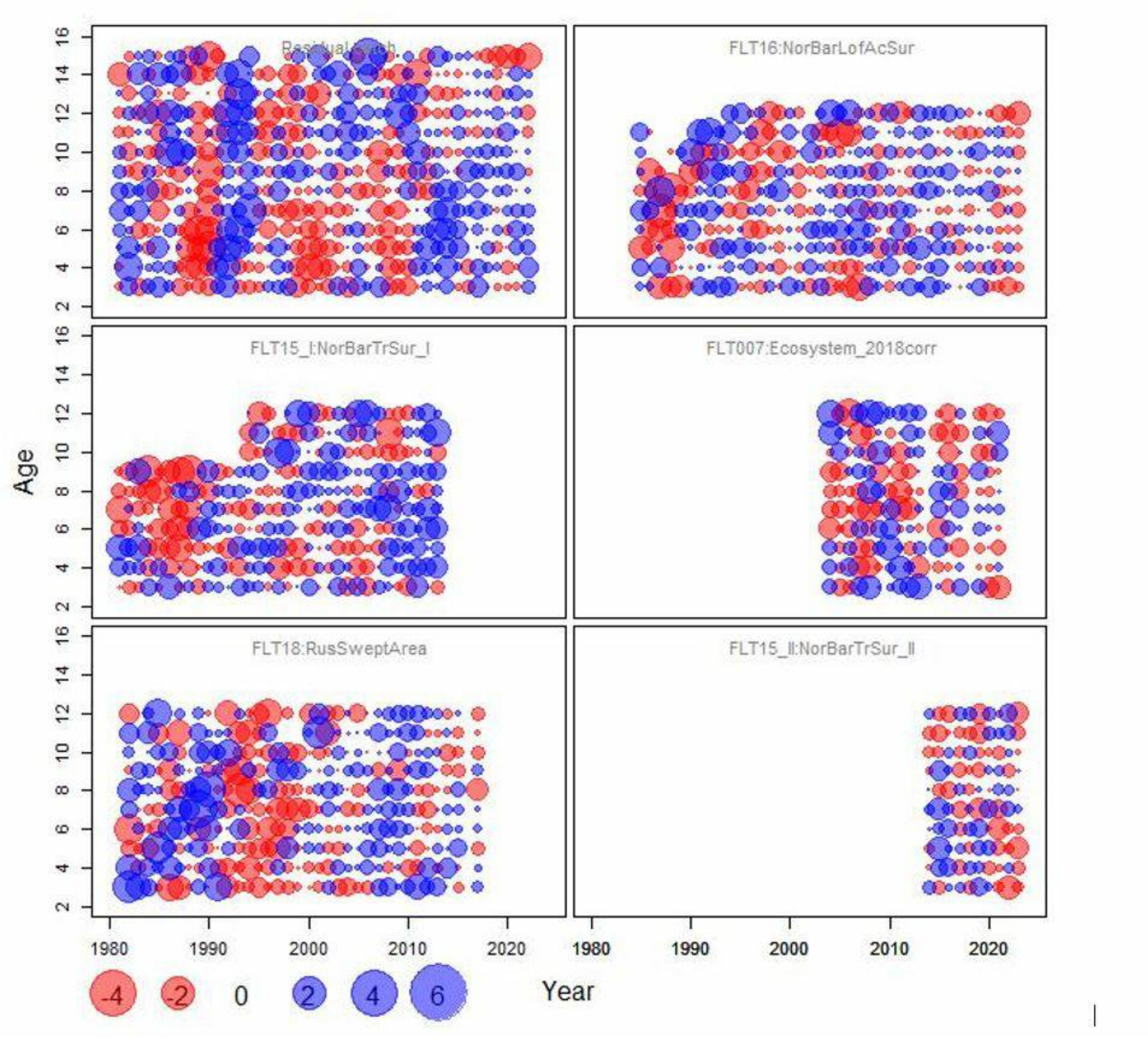

Figure 3.2a. Standardized one-observation-ahead residuals for log-catches and log-indices (Thygesen et al. 2017) in the final SAM run

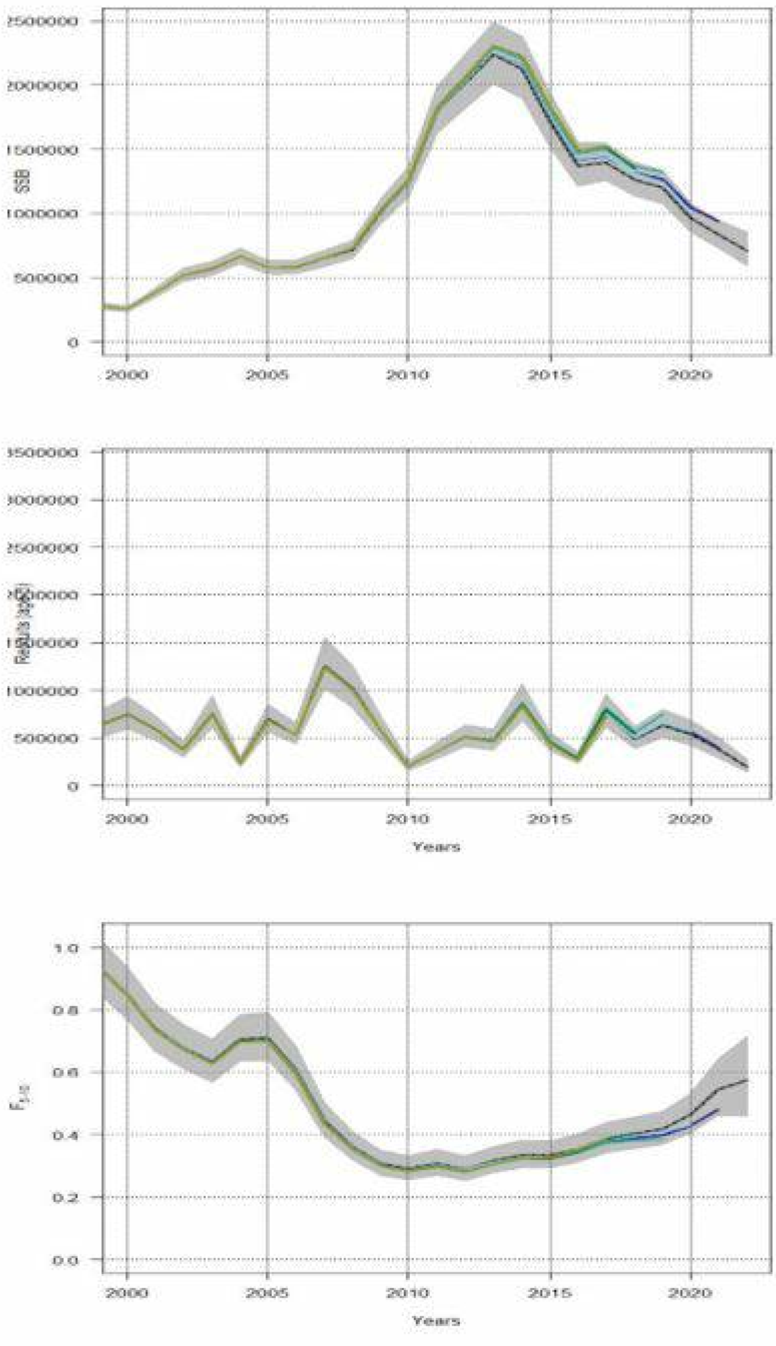

Figure 3.2b. NEA cod SSB, R and F_{bar} model retrospective pattern for final SAM run.

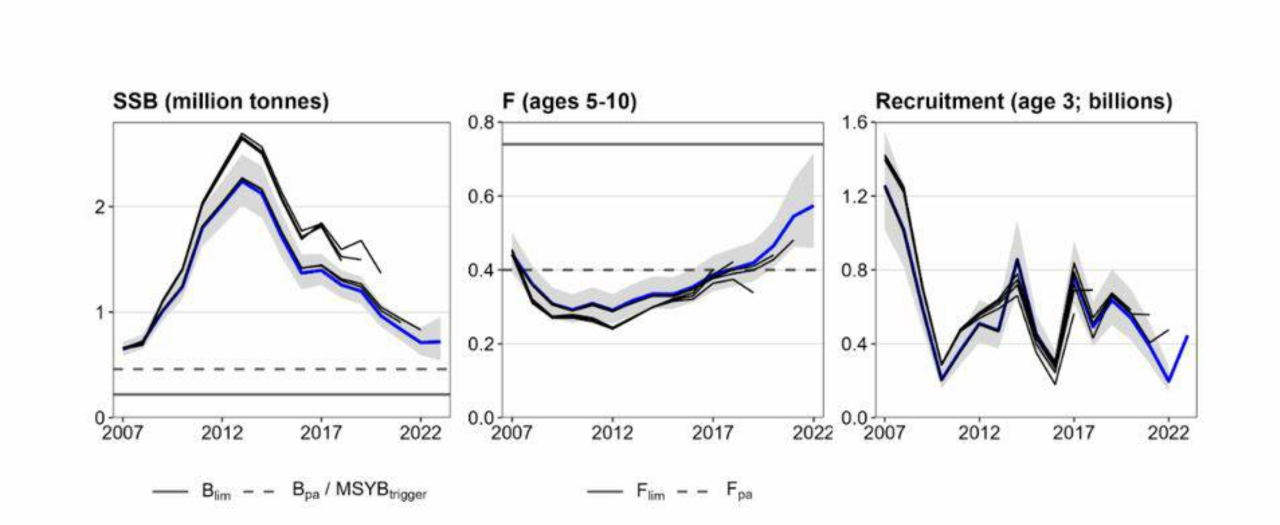

Figure 3.2c. NEA cod SSB, F_{bar} and R historical retrospective pattern for final SAM run

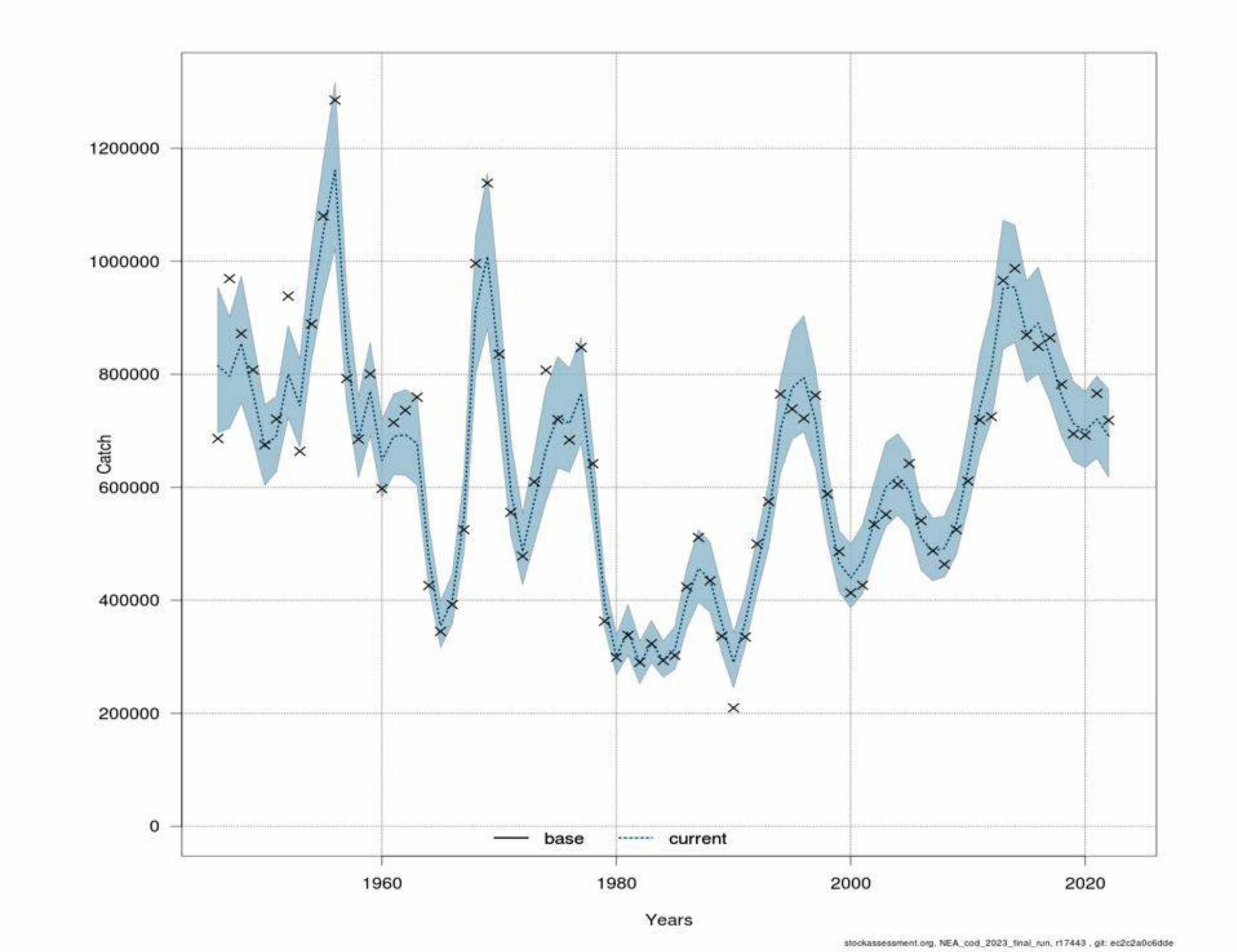

*Figure 3.2d. NEA cod final SAM run fit. Total catch in weight. Modelled catches from the final run and point wise 95% confidence intervals are shown by line and shaded area. The yearly ob-served total catch weight (crosses) are calculated as Catch(y)=sum(W(a,y)*C(a,y)).*

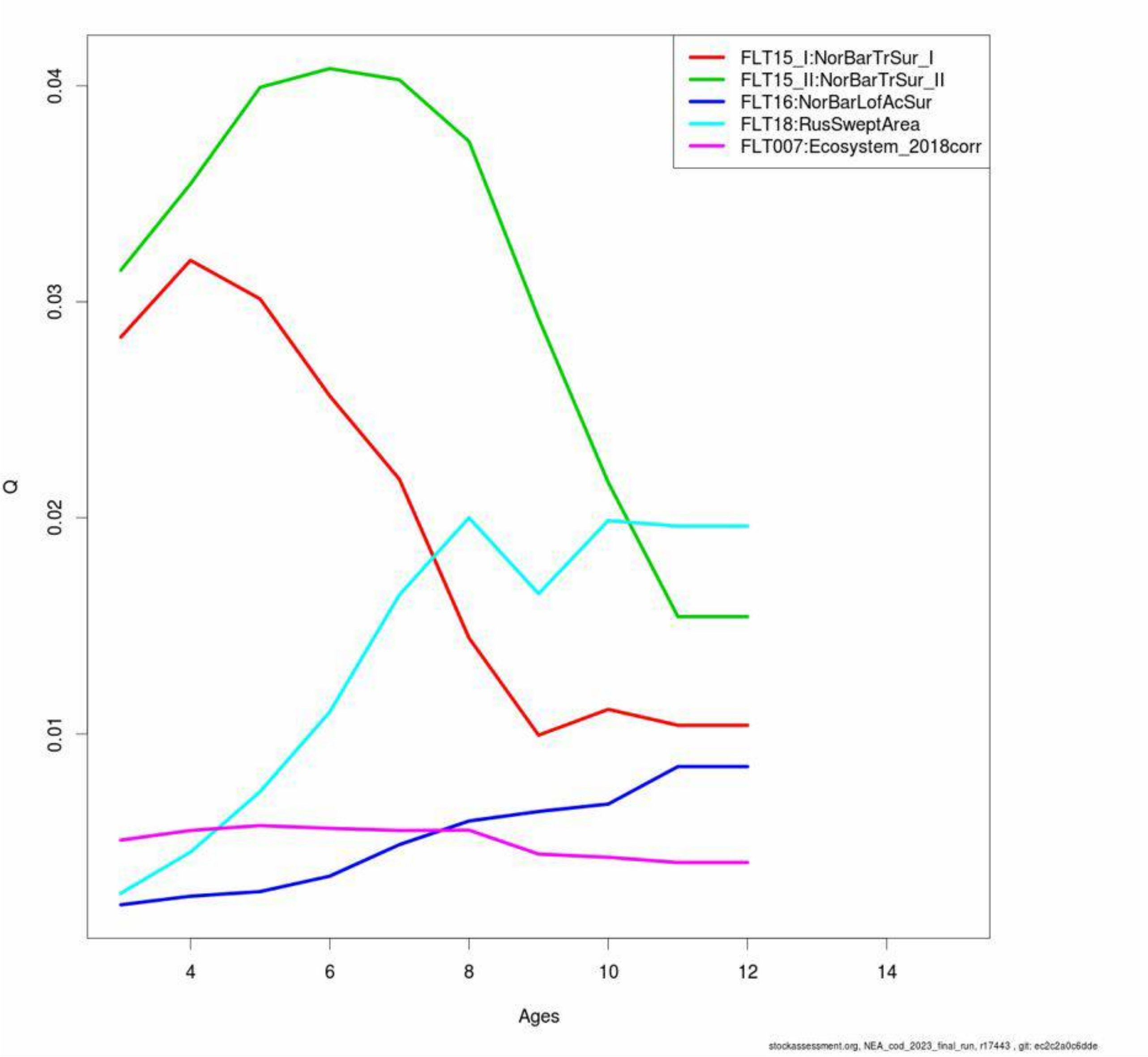

Figure 3.2e. NEA cod. Catchability of different fleets used for final SAM run fit.

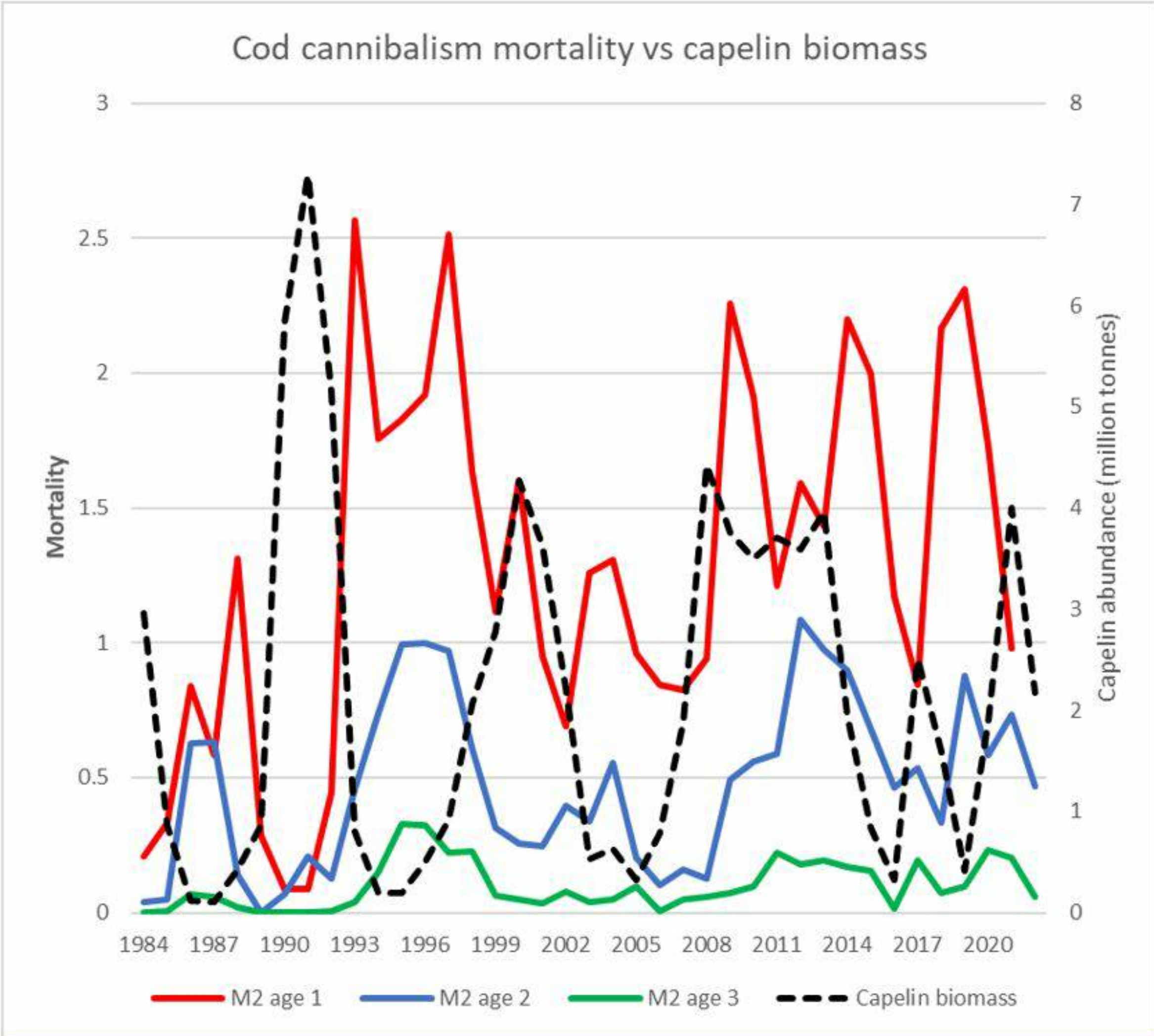

Figure 3.3. NEA cod cannibalism mortality vs. capelin abundance.

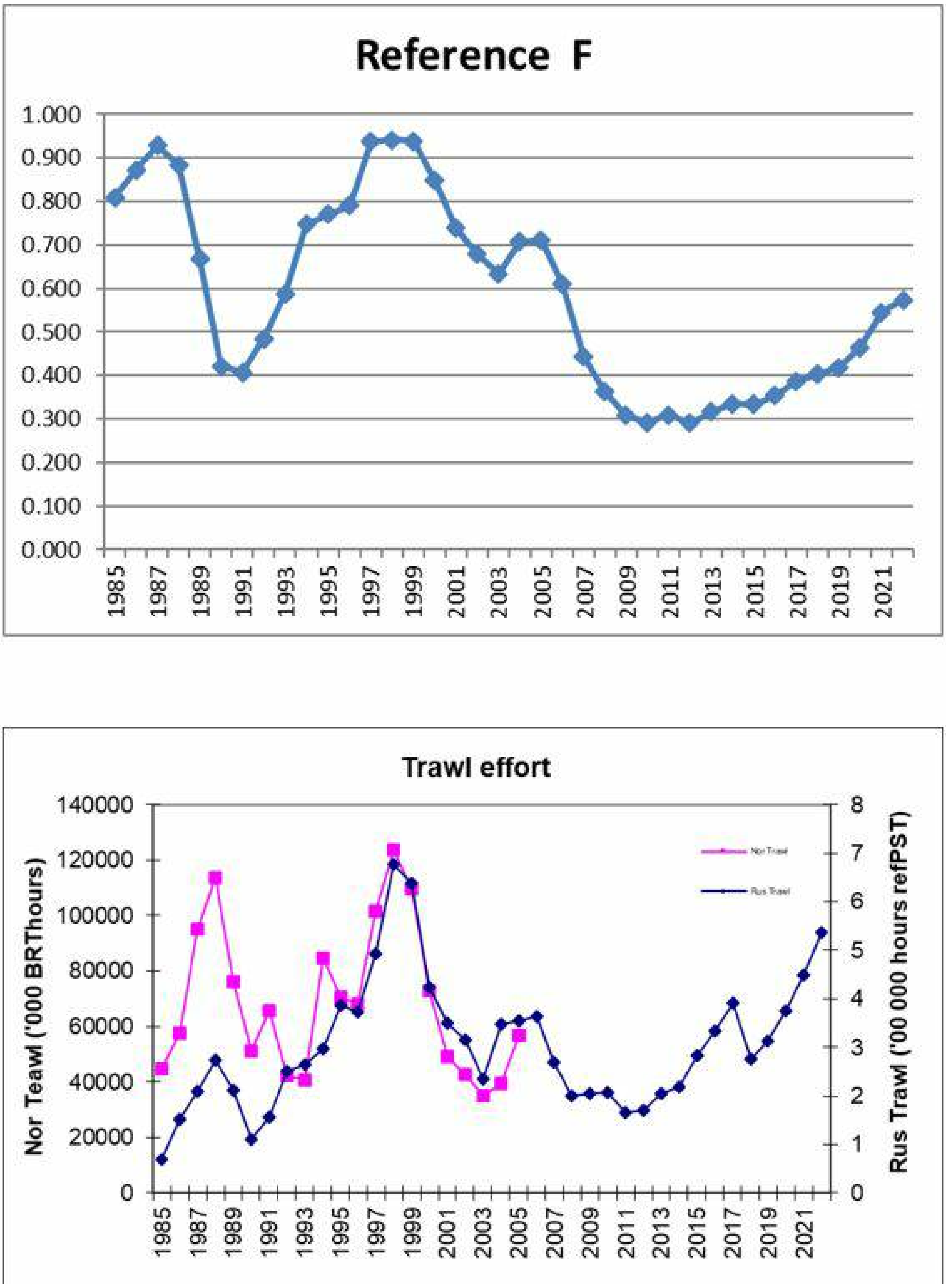

Figure 3.4. Northeast Arctic cod. Fishing mortality (F5-10) (top panel) and trawl efforts (bottom panel)

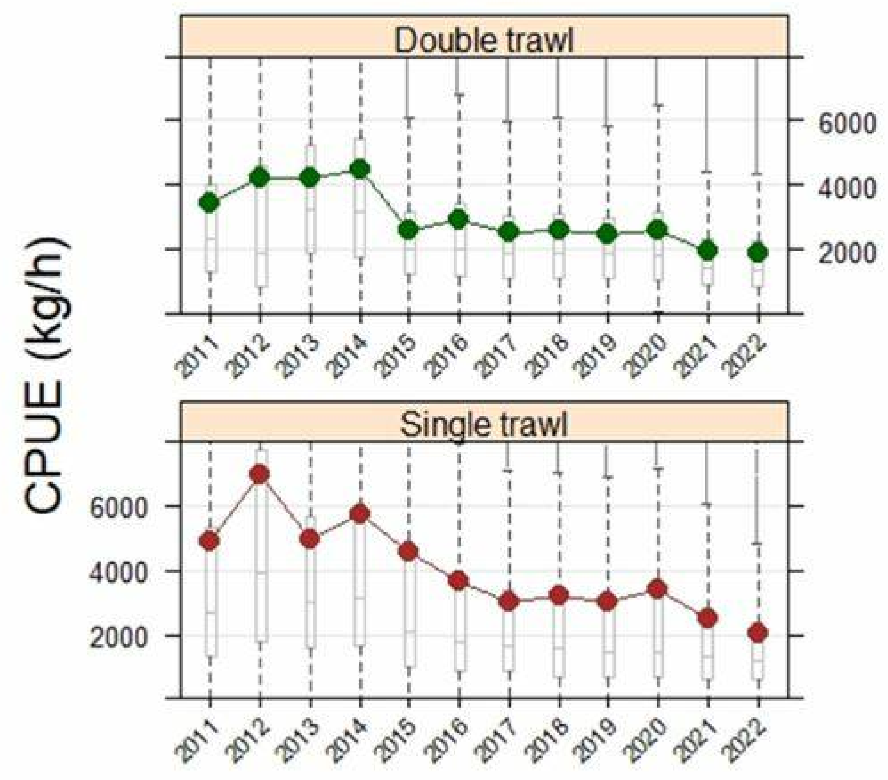

Figure 3. 5. Cod CPUE in Norwegian trawl catches where cod is the main species (double and single trawl, Nedreaas WD02). Connected line shows mean, line inside the box shows the medi-an, and the box shows 25 and 75 percentiles.

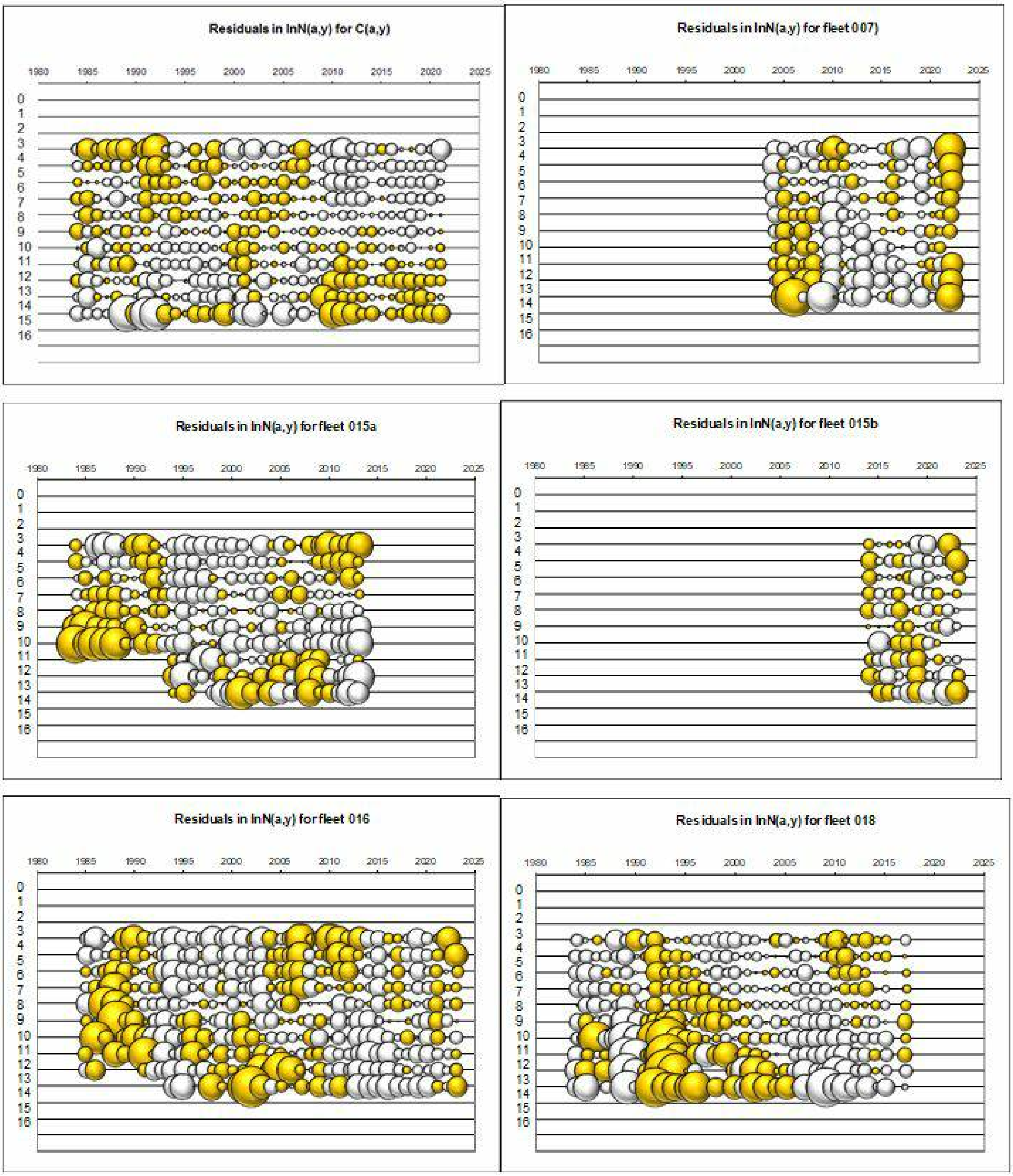

Figure 3.6a. Residuals of the TISVPA data approximation (yellow circles are positive residuals, white – negative).

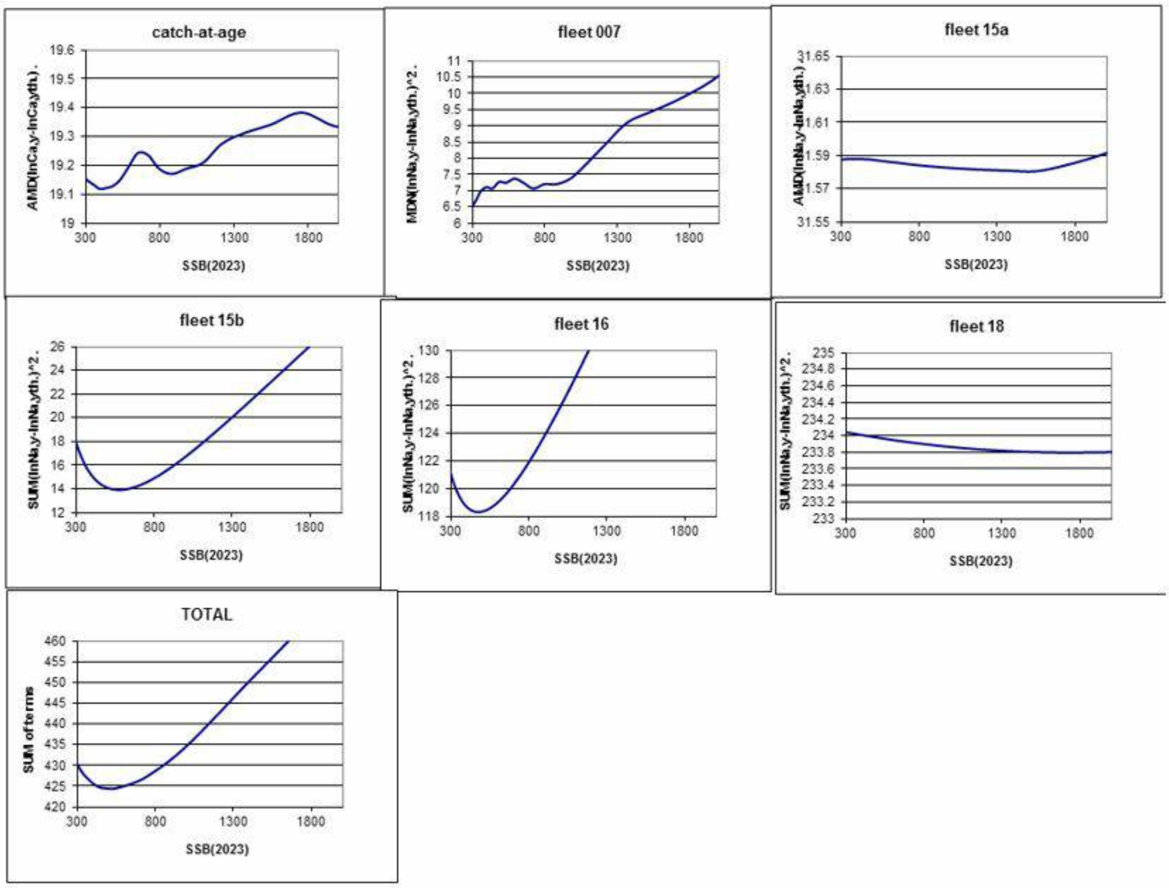

Figure 3.6b. Profiles of the components of the TISVPA objective function.

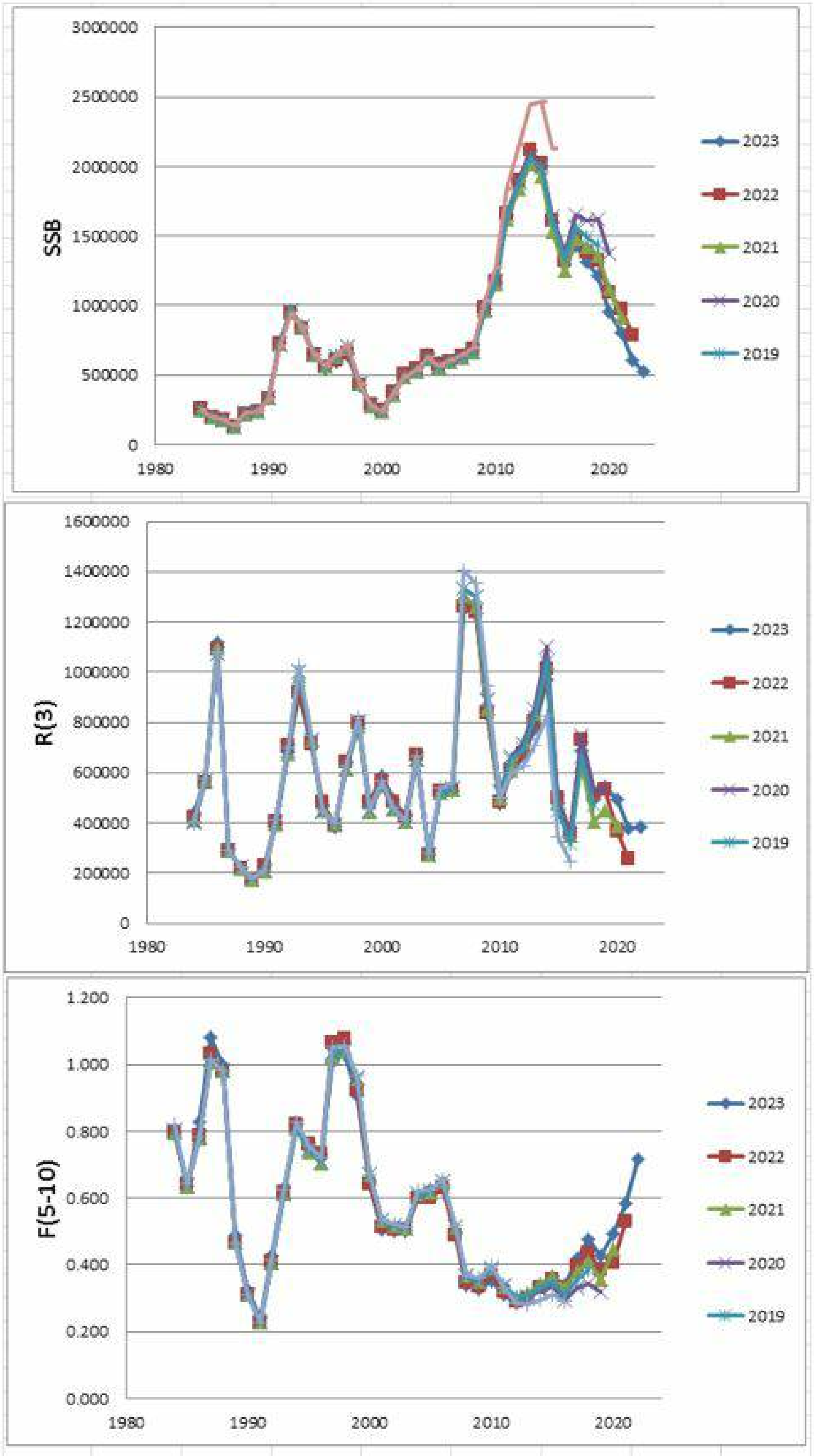

Figure 3.6c. TISVPA retrospective runs.

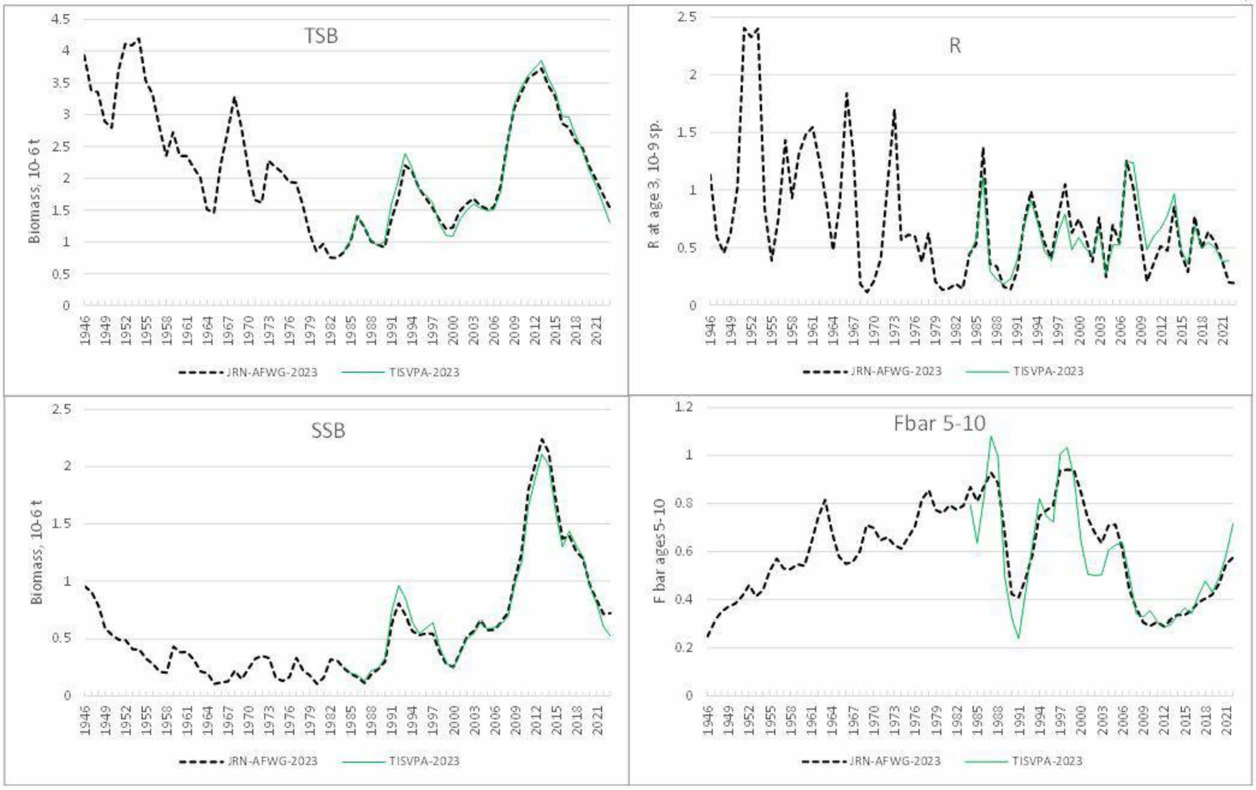

Figure 3.7. Model comparison. TSB (total stock biomass, age 3+), SSB recruitment and F in SAM and TISVPA.

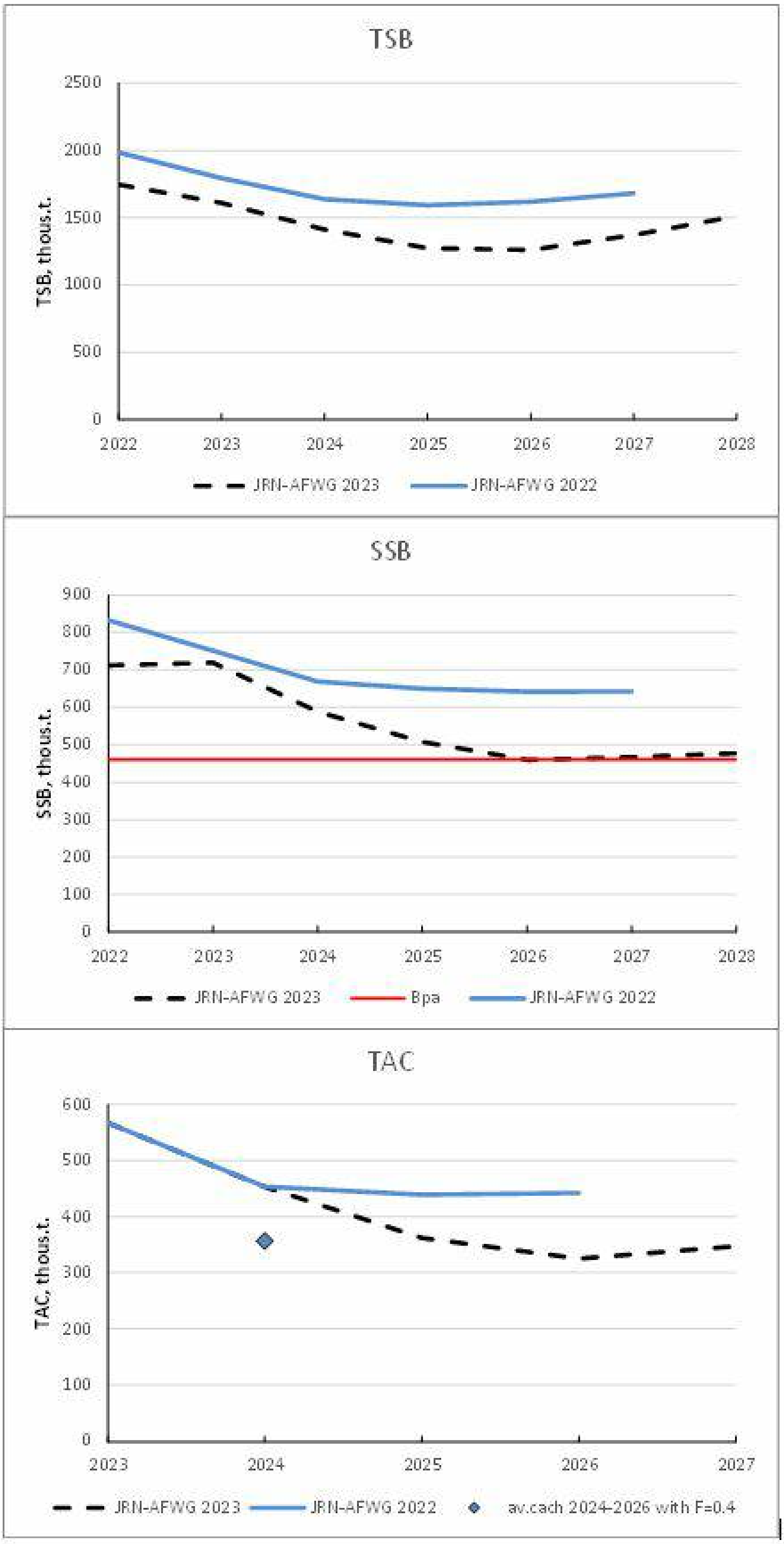

Figure 3.8. Medium term prediction of NEA cod stock dynamics and TAC according to HCR based on assessments of current year and previous year.

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
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			0.49			0.54		0.84	0.88
2007			0.71			0.51		0.88	1.16
2008			0.93			0.79		1.21	
2009			1.33			1.16		0.83	
2010			1.47			1.18		1.16	
2011			1.77			1.69		2.46	4.87 [6]
2012			2.25			1.44		2.11	6.97 [6]
2013			2.30			1.46		2.60	4.96 [6]
2014			2.07			1.54		2.38	5.75 [6]
2015			1.06			1.38		1.93	4.54 [6]
2016			1.15			1.06		1.39	3.64 [6]
2017			1.00			1.0 0		1.0 5	3.01 [6]
2018			1.0 6			1. 40		1. 31	3.20 [6]
2019			1 .01			0.89		1.16	3.02 [6]
2020			0.78			0.68		1.42	3.38 [6]
2021			0.70			0.89		0.86	2.51 [6]
2022 [1]			0.60			0.72		0.49	2.04[6]

[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.

[6] 2011-2022 Norwegian data on t per hr fishing are from single-trawl only, not comparable to data from previous years

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. Data from 1994 onwards corrected for three northern areas and the method of filling in gaps (WD 1, WKBarFar 2021).

				Age														
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	10+	To
1981		8.00	82.00	40.00	63.00	106.00	103.00	16.00	3.00	1.00							1.00	4
1982		4.00	5.00	49.00	43.00	40.00	26.00	28.00	2.00	+							0.00	1
1983		60.49	2.78	5.34	14.27	17.37	11.13	5.58	2.98	0.45							0.06	1
1984		745.44	146.11	39.13	13.59	11.26	7.44	2.81	0.19	0.02							0.00	9
1985		69.06	446.29	153.04	141.59	19.66	7.58	3.32	0.22	0.09							0.04	8
1986		353.63	243.90	499.61	134.27	65.90	8.28	2.15	0.37	0.06							0.02	13
1987		1.62	34.07	62.80	204.93	41.41	10.40	1.22	0.19	0.66							0.00	3
1988		1.98	26.25	50.42	35.53	56.20	6.48	1.35	0.15	0.01							0.00	1
1989		7.53	7.98	17.00	34.39	21.38	53.82	6.88	0.97	0.10							0.05	1
1990		81.13	24.92	14.82	20.63	26.08	24.30	39.78	2.37	0.06							0.03	2
1991		181.04	219.51	50.23	34.64	29.33	28.87	16.89	17.33	0.86							0.03	5
1992		241.38	562.13	176.48	65.79	18.84	13.23	7.58	4.50	2.78							0.21	10
1993		1074.04	494.68	357.24	191.05	108.24	20.84	8.12	4.98	2.25							2.51	22
1994		902.64	624.38	323.88	374.47	205.53	70.24	13	3.59	2.6	0.71	1.15	0.11	0.13	NA	0		25
1995		2175.25	212.29	137.74	139.49	197.08	66.38	15.73	2.43	0.91	0.32	0.48	0.17	NA	NA	0		29
1996		1826.33	271.71	99.4	89.62	111.34	82.96	22.17	2.22	0.3	0.1	0.07	0.05	0.1	0.01	0		25
1997		1698.49	565.31	158.57	44.22	49.91	40.91	23.48	5.02	0.84	0.27	0.09	NA	NA	0.01	0		25
1998		2523.56	475.15	391.16	189.79	44.87	41.22	27.85	16.06	1.81	0.5	0.04	NA	NA	NA	0.06		37
1999		364.84	231.51	147.62	130.29	52.03	11.93	6.94	4.13	1.47	0.24	0.01	0.03	0.01	NA	0		9
2000		153.42	262.81	294.83	167.25	145.55	50.75	11.33	4.7	2.75	0.85	0.18	0.11	0.03	NA	0		10
2001		363.55	51.45	177.44	160.63	80.8	44.47	11.1	1.73	0.46	0.19	0.08	NA	NA	NA	0.01		8
2002		19.22	209.1	61.37	106.23	98.78	52.18	20.07	2.9	0.32	0.52	0.09	NA	NA	NA	0.02		5
2003		1505	52.53	306.71	116.8	124.62	116.52	37.69	10.05	1.93	0.31	0.07	NA	0.08	0.07	0		22
2004		161.2	117.19	33.41	85.21	32.96	28.03	18.14	5.33	1.16	0.31	0.08	0	0.01	NA	0		4
2005		499.71	138.66	125.03	33.28	65.94	21.21	15.02	4.95	1.01	0.25	0.05	0.07	0.05	0.03	0		9
2006		411.21	157.95	64.77	53.82	18.35	29.52	9.5	4.9	1.28	0.2	0.13	0.3	NA	NA	0		7
2007		85.13	47.09	58.49	30.4	29.35	9.04	18.07	6.41	2.67	0.53	0.24	0.07	NA	NA	0		2
2008		50.87	94.2	199.85	288.71	116.17	72.91	21.82	14.43	2.8	0.81	0.04	0.01	0.01	NA	0		8
2009		204.9	25.46	107.83	182.54	138.08	41.48	13.87	4.69	4.32	0.5	0.14	0.02	0.01	NA	0		7
2010		620.25	43.56	22.82	87.98	160.16	154.39	44.56	14.57	3.9	2.89	0.94	0.11	0.12	0.09	0.01		11

2011		266	91	40.36	28.32	65.2	106.97	101.8	19.76	6.11	1.7	0.92	0.25	0.15	0.09	0.02		7
2012		496.49	40.23	82.79	49.38	33.77	72.53	132.31	65.59	8.37	4.39	1.21	0.66	0.47	0.04	0.1		9
2013		313.11	89.17	60.55	84.49	72.18	47.75	98.41	130.54	55.32	5.41	4.02	1.3	0.73	0.2	0.07		9
2014		1758.58	211.04	286.89	124.18	111.14	74.47	39.41	89.89	61.31	22.64	2.56	1.31	0.16	0.05	0.19		27
2015		1903.54	211.41	138.71	235.58	128.8	140.36	80.55	35.07	53.8	24.38	7.91	0.8	0.13	0.05	0.01		29
2016		240.8	201.89	56.29	76.91	119.38	64.84	50.17	25.8	13.49	17.83	7.35	2.15	0.72	0.22	0.1		8
2017		439.4	73.3	111.54	42.35	44.25	65.3	35.75	24.31	11.97	4	2.88	3.15	0.67	0.19	0.11		8
2018		2057.6	280.29	109.03	149.94	53.4	54.93	66.09	34.35	10.78	6.27	1.73	2.25	1.5	0.15	0.23		28
2019		1437.21	362.38	203.63	125.42	144.06	60.98	34.99	37.86	9.64	3.47	0.55	0.32	0.18	0.28	0.24		24
2020		92.68	157.92	117.32	117.32	81.36	90.6	42.35	26.57	21.41	6.23	1.75	0.67	0.66	0.51	0.89		7
2021		45.92	28.51	64.86	59.08	55.48	38.54	30.80	12.41	6.32	4.67	2.17	0.29	0.18	0	0.21		3
2022		524.71	43.42	29.42	52.98	56.69	47.05	42.94	27.77	7.85	2.44	1.51	0.94	0.18	0	0.28		8
2023		244.43	103.24	28.66	26.54	33.54	33.83	23.81	12.62	7.08	1.58	0.33	0.11	0.04	0.00	0.08		5

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. Data from 1994 and onwards corrected - WD 1, WKBarFar 2021

				Age													
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	10+	T
1981		4.60	34.30	16.40	23.30	40.00	38.40	4.80	1.00	0.30							0.00	
1982		0.80	2.90	28.30	27.70	23.60	15.50	16.00	1.40	0.20							0.00	
1983		152.90	13.40	24.95	52.34	43.33	16.96	5.82	3.21	0.97							0.05	
1984		2755.04	379.11	97.49	28.28	21.44	11.74	4.07	0.40	0.08							0.08	3
1985		49.49	660.04	166.79	125.98	19.92	7.67	3.34	0.21	0.07							0.05	1
1986		665.79	399.61	805.00	143.93	64.14	8.30	1.91	0.34	0.04							0.03	2
1987		30.72	444.98	240.38	391.15	54.35	15.70	2.00	0.45	0.03							0.00	1
1988		3.21	72.83	148.03	80.49	173.31	20.48	3.58	0.53	0.03							0.00	
1989		8.24	15.62	46.36	75.86	37.79	90.19	9.82	0.94	0.10							0.07	
1990		207.17	56.72	28.35	34.87	34.59	20.56	27.23	1.61	0.38							0.03	
1991		460.45	220.14	45.85	33.67	25.65	21.49	12.15	12.67	0.61							0.02	
1992		126.56	570.92	158.26	57.71	17.82	12.83	7.67	4.29	2.72							0.22	
1993		534.48	420.40	273.89	140.13	72.48	15.83	6.24	3.89	2.23							2.36	1
1994		1043.78	556.68	293.92	307.04	153.33	45.72	7.95	2.61	1.48	0.55	0.55	0.08	0.05	NA	0		2
1995		5356.43	541.25	282.84	242.36	251.01	76.42	17.98	2.42	1.07	0.5	0.61	0.19	NA	NA	0		6
1996		5899.23	791.62	163.08	117.43	138.59	108.88	24.43	2.64	0.37	0.17	0.12	0.07	0.07	0.02	0		7
1997		5044.09	1422.92	317.99	68.44	74.26	59.99	26.67	4.85	0.64	0.91	0.08	NA	NA	NA	0		7
1998		2490.54	496.48	355.1	166.94	31.67	26.15	17.52	8.16	0.79	0.52	0.04	NA	NA	NA	0.04		3
1999		473.04	350.21	188.48	180.75	61.39	12.71	6.81	5.14	1.01	0.26	0.02	0.04	0.02	NA	0		1

2000		128.57	242.33	245.81	130.03	111.73	26.75	4.56	1.84	1.21	0.33	0.1	0.03	0.02	NA	0	
2001		712.77	78.03	182.79	195.11	82.9	37.96	9.45	1.17	0.44	0.19	0.04	NA	NA	NA	0.01	1
2002		34.11	418.73	118.36	137.56	108.95	45.79	14.4	2.2	0.32	0.18	0.05	NA	NA	NA	0.02	
2003		3022.23	65.78	376.7	126.31	93.93	66.88	17.5	4.67	1.02	0.17	0.04	NA	0.02	0.02	0	3
2004		322.87	242.94	63.88	184.62	53.46	43.24	30.59	6.85	1.65	0.28	0.07	0.01	0.01	NA	0	
2005		853.43	216.67	248.88	55.06	102.97	22.38	16.36	3.81	0.92	0.3	0.04	0.02	0.04	0.04	0	1
2006		674.21	289.39	116.49	115.38	28.32	43.42	13.72	5.24	1.36	0.24	0.18	0.18	NA	NA	0	1
2007		594.69	369.74	361.13	127.73	68.51	13.65	23.6	6.82	2.3	0.41	0.11	0.1	NA	NA	0	1
2008		68.83	101.96	194.37	300.59	111.9	40.24	17.34	8.11	1.79	0.36	0.03	0.02	0.01	NA	0	
2009		389.48	35.59	126.28	196.7	220.23	60.69	17.9	9.02	5.24	0.51	0.17	0.03	0.04	NA	0	1
2010		1027.59	95.14	36.81	114.25	154.80	144.50	39.56	11.24	3.67	1.60	0.58	0.04	0.02	0.04	0.02	1
2011		617.18	225.81	85.40	50.37	129.70	138.66	103.51	16.37	4.36	1.20	0.82	0.19	0.14	0.04	0.02	1
2012		702.97	100.30	75.72	64.59	33.71	90.69	132.58	48.61	9.02	2.26	0.88	0.55	0.44	0.07	0.05	1
2013		435.72	142.96	68.84	114.09	63.18	40.43	64.54	76.38	33.52	2.22	2.87	0.40	0.35	0.06	0.03	1
2014		1245.71	191.48	226.85	93.79	88.59	56.39	32.74	53.05	36.19	9.81	1.01	0.95	0.15	0.02	0.08	2
2015		1642.00	342.76	144.07	228.25	147.29	113.53	74.43	29.22	53.51	18.08	3.38	0.75	0.12	0.07	0.04	2
2016		312.16	305.57	99.37	135.48	188.31	113.47	72.33	28.56	13.17	16.06	6.77	0.97	0.52	0.17	0.14	1
2017		644.51	128.92	179.25	62.15	84.54	90.16	37.82	26.33	8.18	3.26	2.61	3.70	0.58	0.17	0.06	1
2018		2714.35	500.69	139.41	184.78	61.81	64.17	73.88	25.88	9.28	5.87	1.29	2.46	1.23	0.13	0.37	3
2019		1790.57	559.44	281.57	179.15	221.90	79.65	32.96	38.31	8.15	2.62	0.54	0.24	0.16	0.18	0.12	3
2020		164.75	273.82	237.73	160.24	131.56	114.88	49.83	24.26	20.44	4.53	1.66	0.93	0.51	0.26	0.73	1
2021*		80.88	34.87	111.50	119.35	112.31	54.28	37.98	13.57	7.27	3.53	1.25	0.42	0.25	0.04	0.32	
2022		667.82	65.64	51.98	88.68	86.60	66.51	44.60	30.42	5.70	2.29	2.08	1.49	0.16	0.00	0.90	1
2023		305.40	163.06	41.21	39.82	46.52	43.17	32.24	14.26	7.49	1.58	0.34	0.14	0.06	0.00	0.14	

*revised

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	2.80	0.68	0.36	51.72
2008	0.45	5.96	2.95	20.72	2.70	2.02	1.66	0.71	37.17
2009	3.42	14.48	27.64	8.10	22.31	3.07	1.56	0.37	80.95
2010	0.96	20.06	16.98	16.84	6.89	9.61	3.05	2.60	76.96
2011	2.01	51.73	170.09	44.72	17.16	5.12	6.54	0.40	297.76
2012	0.46	12.56	91.58	67.75	17.30	5.98	2.59	1.53	199.76
2013	0.22	5.89	33.69	101.76	106.39	16.08	7.05	6.48	277.56
2014	0.25	2.82	15.49	58.75	112.10	75.33	12.07	8.82	285.62
2015	0.87	1.40	15.42	14.73	42.98	44.20	24.62	11.75	155.97
2016	0.24	1.46	9.05	14.53	22.06	38.65	27.06	25.45	138.51
2017	0.17	7.51	12.84	21.94	14.79	12.70	11.67	18.84	100.46
2018	0.61	3.28	11.11	11.21	8.44	7.82	4.42	9.60	56.50
2019	0.25	2.35	13.34	36.00	17.68	18.35	5.96	9.93	103.87
2020	0.58	3.17	7.75	24.37	28.05	13.28	6.66	5.29	89.15
2021	0.34	1.68	6.13	3.90	5.04	9.68	5.99	2.77	35.53
2022	0.31	3.34	4.58	6.70	3.77	4.39	3.75	2.53	29.37
20 23	0.08	0.72	4.01	5.73	6.45	1.66	1.40	1.28	21.34

Table A5. North East Arctic COD. Length (cm) at-age in the Barents Sea from the investigations winter survey in February. Data for ages 1-11 from 1994 and onwards - WD 1, WKBarFar 2021.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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	11.3	17.9	30.2	44.6	55.2	65.7	73.9	78.9	87.4	97.2	97.6	104.7	122.4	
1995	12.2	18.1	29.0	42.2	53.9	63.9	75.4	80.4	85.9	99.1	90.1	109.0		
1996	12.1	18.8	28.8	40.5	49.4	60.9	71.8	85.1	92.4	94.9	96.1	104.2	103.9	121.0
1997	10.8	16.9	29.7	41.0	50.6	59.4	69.6	81.2	92.3	80.4	103.2			
1998	10.5	17.8	30.8	40.9	50.9	58.5	67.7	76.7	87.2	103.0	111.4		105.9	
1999	12.0	18.4	29.0	40.0	50.4	59.4	70.4	78.4	88.5	87.6	117.0	62.0	108.0	
2000	12.8	20.7	28.4	39.7	51.5	61.4	70.4	76.3	84.9	84.3	100.0	116.2	90.0	
2001	11.6	22.6	33.0	41.2	52.2	63.3	70.4	78.3	86.0	95.7	104.7			
2002	12.0	19.6	28.9	43.6	52.1	61.9	71.4	79.5	91.2	89.7	103.7			
2003	11.4	18.1	29.1	39.7	53.4	61.7	70.6	80.8	89.1	90.1	105.4		104.3	110.5
2004	10.6	18.4	31.7	40.6	51.7	61.6	68.6	79.7	90.9	90.4	92.2	116.0	112.0	
2005	11.2	18.3	29.5	43.4	51.1	60.4	71.0	79.6	89.0	96.4	109.3	113.7	129.6	107.0
2006	12.0	19.4	30.9	42.1	53.8	60.3	66.7	76.7	84.9	98.9	95.4	84.9		
2007	13.2	20.7	29.6	41.1	52.8	62.5	70.4	78.2	87.5	92.7	101.8	121.6	110.0	
2008	12.1	22.3	33.0	43.2	51.8	64.0	69.9	81.3	88.7	95.3	108.9	103.0	102.0	
2009	11.2	21.1	32.1	42.6	53.2	61.9	76.6	81.8	89.5	97.8	99.5	94.2	110.0	
2010	11.2	18.4	31.4	42.7	52.4	60.7	70.5	80.4	88.8	96.3	102.2	99.8	100.8	126.0
2011	11.9	19.5	29.4	41.9	51.0	60.7	68.1	78.3	86.1	95.4	102.2	110.4	114.3	116.9
2012	10.6	18.4	29.7	41.0	52.4	58.1	66.5	75.6	86.0	91.8	105.9	114.0	119.0	115.5
2013	11.2	19.3	31.1	41.1	51.7	62.0	69.7	76.5	81.2	95.3	93.7	110.7	110.8	145.0
2014	9.7	17.1	29.5	40.5	52.0	59.6	70.2	76.8	81.8	87.1	97.4	98.9	107.8	91.1
2015	10.5	15.9	30.0	40.3	51.1	60.2	68.8	77.5	81.2	88.7	94.0	101.9	127.5	121.1
2016	12.2	18.3	27.7	40.6	49.8	60.5	68.3	76.6	85.5	86.5	90.5	94.1	112.0	122.5
2017	12.3	22.2	31.2	42.5	51.2	60.5	69.6	75.5	85.2	90.9	96.0	92.6	108.6	108.7
2018	11.2	19.1	32.7	42.4	51.2	61.6	69.0	77.5	83.4	87.6	97.0	99.3	101.8	106.8
2019	11.7	17.5	31.2	42.4	51.0	59.6	69.7	77.0	84.1	87.1	99.3	103.4	104.6	109.8
2020	12.0	17.5	25.5	39.5	50.2	58.6	66.7	74.8	83.0	90.0	93.9	92.4	111.2	113.9
2021	11.6	19.9	26.5	37.4	48.0	58.5	66.7	74.9	84.0	91.7	97.7	102.1	105.8	115.0

2022	10.8	20.4	32.4	39.1	49.3	58.4	68.7	75.3	84.1	92.5	98.2	102.6	113.2	
2023	11.4	19.7	32.3	42.2	50.0	59.1	67.6	75.9	81.7	86.8	104.2	104.1	115.6	

Table A6. North East Arctic COD. Weight (g) at-age in the Barents Sea from the investigations winter survey in February. Data for ages 1-11 from 1994 and onwards - WD 1, WKBarFar 2021.

Year \ Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1983	20	190	372	923	1597	2442	3821	4758						
1984	23	219	421	1155	1806	2793	3777	4566						
1985	20	171	576	1003	2019	3353	5015	6154						
1986	20	119	377	997	1623	2926	3838	7385						
1987	21	65	230	490	1380	2300	3970	6000						
1988	24	114	241	492	892	1635	3040	4373						
1989	16	158	374	604	947	1535	2582	4906	10943	5226				
1990	26	217	580	1009	1435	1977	2829	4435	10772	11045	9615			
1991	18	196	805	1364	2067	2806	3557	4502	7404	13447				
1992	20	136	619	1118	1912	2792	3933	5127	6420	8103	17705	22060		
1993	9	71	415	1179	1743	2742	3977	5758	7068	7515	7521	10744		
1994	13	56	262	796	1470	2386	3481	4603	6777	8195	8516	13972		
1995	15	54	240	658	1336	2207	3570	4715	5712	8816	6817	12331		
1996	15	62	232	627	1084	1980	3343	5514	7722	8873	9613	12865	12556	
1997	13	52	230	638	1175	1797	2931	4875	7529	5739	10194			
1998	11	52	280	635	1182	1728	2588	4026	6076	11257	14391			
1999	14	59	231	592	1178	1829	2991	4128	6321	7342				
2000	16	74	210	558	1210	1963	3036	3867	5401	6154	10023			
2001	14	106	336	646	1288	2233	3088	4439	5732	8442	11429			
2002	14	67	238	747	1229	2063	3199	4578	7525	6598	12292			
2003	13	61	234	597	1316	2014	2989	4715	6517	7500	12812			
2004	11	59	275	608	1143	1947	2623	4137	6673	7368	8109			
2005	13	61	246	723	1146	1866	2949	4226	6436	8646	12537		24221	11640
2006	13	69	280	669	1420	1970	2641	4260	5914	10179	9439	8328		
2007	19	73	235	639	1302	2190	3039	4411	6394	8056	10826	20104		
2008	15	90	335	798	1399	2442	3235	5210	6981	9641				
2009	13	83	294	704	1302	2065	4067	5087	6874	9460	9511			
2010	12	64	304	700	1296	2033	3162	4743	6562	8984	10315			22766
2011	15	66	246	668	1131	1940	2726	4013	5969	8275	10309	13159	14868	
2012	13	62	252	609	1276	1681	2489	3764	5920	7809	12199	15006	17582	
2013	11	65	269	602	1208	2055	2809	3843	4822	8447	9101	15108	14743	
2014	8	50	246	603	1226	1780	2866	3930	4927	6203	8570	9566	12239	

2015	10	44	242	602	1221	1929	2741	4043	4804	6817	7759	11544	21652	
2016	13	53	200	593	1049	1928	2674	3830	5540	6129	7110	8272	15256	21945
2017	15	102	292	720	1178	1972	3056	3962	5901	7429	9301	8599	12958	14894
2018	12	69	320	688	1228	2062	2803	4154	5409	6632	9156	10510	11810	12443
2019	12	48	273	685	1164	1870	2916	3974	5394	6068	9637	11507	12371	13993
2020	14	44	153	548	1077	1692	2476	3625	5074	6758	8040	8107	14892	15793
2021	14	68	164	462	910	1682	2484	3620	5379	7160	9313	10923	12410	
2022	11	77	311	535	1052	1716	2885	3855	5321	7751	9538	11432	14940	
2023	12	71	316	694	1111	1757	2802	4097	5119	6443	10937	10668	14732	

Table A7. Northeast Arctic COD. Length at age in cm in the Lofoten survey.

Year/age	5	6	7	8	9	10	11	12	13	14	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
2008	63.8	69.1	73.6	80.9	90.0	94.9	94.9				96.5
2009	60.5	69.3	76.5	82.7	88.7	98.8	92.9				111.6
2010	59.9	64.9	73.6	83.3	89.2	96.3	100.8	103.1	118.2	123.0	

2011	57.1	64.3	70.0	79.9	91.2	98.3	101.6	103.6	110.0	102.0	
2012	65.3	65.1	69.9	76.6	85.3	98.7	104.6	103.9	116.2	89.0	
2013	63.6	68.7	73.0	78.4	83.5	90.9	99.1	96.6	103.0	116.8	
2014	55.9	66.0	74.5	77.9	82.8	86.8	93.4	99.1	109.2	116.0	
2015	61.0	66.5	72.9	78.6	83.4	89.0	95.4	99.5	106.1	114.5	
2016	64.0	63.0	74.3	81.1	88.8	93.2	95.5	97.1	103.2	117.1	
2017	58.0	64.8	70.7	81.6	87.3	94.8	98.7	99.4	102.7	106.1	
2018	67.9	67.3	72.9	79.5	89.4	93.6	99.3	104.9	104.3	107.9	
2019	59.9	69.4	74.7	81.4	87.9	93.9	98.1	106.2	111.1	109.8	
2020	66.1	68.3	75.1	81.8	88.9	95.1	96.3	106.0	109.5	109.1	
2021	63.3	66.3	74.3	78.6	89.4	93.3	96.9	103.7	103.1	108.4	
2022	61.4	67.9	72.9	81.0	88.4	96.5	100.1	98.3	99.3	104.0	
2023	60.0	69.1	76.7	80.5	87.1	93.1	99.3	107.2	114.0	120.6	

Table A8. Northeast Arctic COD. Mean weight-at-age (kg) in the Lofoten survey.

Year	5	6	7	8	9	10	11	12	13	14+	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
2008	2.21	2.97	3.63	4.88	6.74	8.18	7.70				9.07
2009	2.04	2.98	4.10	5.19	6.56	9.38	8.58				15.67
2010	1.90	2.46	3.47	5.13	6.26	7.83	9.59	10.77	18.31	20.84	
2011	1.66	2.28	2.89	4.52	6.82	8.82	9.55	9.08	13.38	10.70	
2012	3.07	2.47	2.93	3.89	5.37	8.79	11.53	12.28	15.04	5.41	
2013	2.49	3.05	3.52	4.46	5.54	7.56	10.26	10.23	11.49	16.61	
2014	1.90	2.52	3.80	4.04	5.06	5.96	7.36	9.01	12.20	16.95	
2015	2.16	2.62	3.42	3.95	5.21	6.53	8.32	9.95	12.45	14.21	
2016	2.53	2.31	3.72	5.05	6.79	8.03	8.93	9.02	12.12	18.46	
2017	2.01	2.52	2.94	4.91	5.75	7.16	8.18	9.10	10.49	11.59	
2018	3.25	2.77	3.41	4.53	6.51	7.94	9.65	12.05	12.04	12.85	
2019	2.12	3.02	3.76	4.81	6.07	7.44	8.71	11.06	13.86	13.40	
2020	2.75	2.79	3.64	4.69	6.06	7.78	8.70	10.86	12.93	13.95	
2021	2.30	2.62	3.76	4.40	6.59	7.39	8.56	10.15	11.821	14.79	
2022	2.61	3.00	3.59	5.01	7.15	8.34	9.34	9.35	9.41	11.63	
2023	1.86	2.94	4.16	4.84	6.00	7.19	9.36	11.88	15.31	17.69	

Table A9. Northeast Arctic COD. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent waters in the autumn. Stock number in millions.

Year					Age								
		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	
2007		13	35	165	372	208	189	74	113	32	20	1221	
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. Northeast Arctic COD. Abundance indices (millions) from the Russian bottom trawl survey in the Barents Sea. Total (Sub-area I and Division IIa and IIb).

Year			Age												
	0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Sum
1982	849.3	1905.3	33.2	141.3	152.5	72.1	19.8	55.1	17.4	3.7	1.9	1.5	0.1	0.0	3253.3
1983	1872.2	2003.4	73.2	52.0	64.2	50.6	35.8	17.9	25.2	9.4	0	0	0	0	4203.9
1984	363.3	180.5	104.4	118.9	70.0	48.9	35.7	15.4	6.9	6.1	1.7	1.5	0.6	0.2	954.0
1985	284.6	15.6	129.0	118.8	159.2	106.8	36.5	16.5	3.7	0.8	1.6	0.1	2.1	0.0	875.3
1986	329.9	7.6	31.7	162.2	153.2	149.3	48.1	18.9	4.2	0.2	0.6	0.0	0.0	0.0	905.9
1987	7.7	1.3	46.9	55.7	307.6	90.0	70.1	18.4	6.0	2.5	0.4	0.1	0.3	0.0	607.0
1988	92.5	2.9	31.3	99.3	93.8	287.9	58.3	26.0	4.7	2.4	0.1	0.0	0.0	0.0	699.2
1989	355.8	3.0	14.7	49.0	97.8	106.2	145.4	116.7	29.9	11.2	4.7	1.8	0.7	0.5	937.4
1990	1248.4	31.1	51.0	16.7	48.7	62.7	97.2	153.8	67.3	15.3	4.9	0.9	0.2	0.0	1798.2
1991	974.0	64.0	91.1	107.7	48.4	53.2	58.3	68.5	74.7	9.8	1.4	0.3	0.0	0.0	1551.4
1992	1204.8	157.7	151.1	67.5	30.8	23.9	27.3	21.8	17.5	2.5	2.5	0.4	0.0	0.0	1707.8
1993	484.8	38.0	158.6	160.4	113.5	68.1	41.6	35.4	8.7	0.3	0.7	0.1	0.1	0.0	1110.3
1994	1606.6	833.2	69.9	136.3	130.9	101.9	35.4	12.8	4.9	2.1	1.1	0.6	0.2	0.0	2935.9
1995	5703.5	471.9	36.9	58.9	106.5	139.5	84.9	25.1	8.3	1.9	1.8	0.9	0.6	0.0	6640.8
1996	2660.3	396.5	128.5	73.3	78.4	103.5	77.3	34.8	13.2	1.9	0.5	1.2	0.2	0.0	3569.6
1997	1371.4	353.9	135.3	134.2	83.5	61.3	60.2	34.8	11.6	3.2	3.0	0.0	0.0	0.0	2252.4
1998	304.8	276.8	89.6	202.8	136.3	78.8	47.0	25.9	13.0	4.8	0.5	0.0	0.1	0.0	1180.4
1999	266.9	40.1	118.4	158.7	207.2	98.0	30.1	12.3	9.4	4.2	0.4	0.0	0.0	0.0	945.7
2000	1436.5	37.7	103.6	183.9	128.6	178.6	77.3	11.4	5.2	2.3	0.9	0.4	0.0	0.0	2166.4

2001	321.6	233.8	77.3	122.4	155.7	129.0	106.1	30.4	5.0	1.4	0.5	2.5	1.3	0.0	1187.1
2002	1797.9	26.7	135.6	98.0	147.3	147.3	89.6	60.0	18.2	2.9	0.8	0.1	0.1	0.0	2524.4
2003	489.5	517.5	26.8	124.6	105.7	116.6	120.3	53.5	24.1	4.0	0.9	0.3	0.0	0.1	1583.9
2004	1770.4	158.4	87.5	32.9	157.6	88.0	111.1	77.6	27.9	9.3	2.3	0.4	0.2	0.0	2523.6
2005	2298.0	323.9	61.7	140.8	63.1	183.2	74.4	60.5	24.4	8.8	2.8	0.6	0.1	0.0	3242.4
2006	427.4	52.4	63.2	92.7	161.3	77.7	180.1	66.2	34.2	16.1	4.3	1.7	0.7	0.0	1178.1
2007	177.5	37.0	148.6	257.9	161.7	190.3	84.6	152.5	55.3	22.6	8.6	4.9	1.1	0.7	1303.3
2008	1468.6	45.2	86.3	220.3	308.8	163.5	147.2	83.0	86.3	29.1	11.5	3.3	1.7	0.2	2654.9
2009	1877.7	287.8	21.9	97.4	231.7	368.7	201.6	117.5	62.0	41.3	20.5	6.5	3.2	0.9	3338.7
2010*	2210.4	214.9	47.0	33.4	107.0	250.5	371.5	181.7	78.9	39.5	29.9	15.6	5.5	2.0	3587.7
2011	2296.1	125.9	80.0	88.2	50.8	143.2	306.5	330.0	91.7	43.9	17.6	17.5	7.0	3.5	3602.1
2012	1096.0	196.2	45.1	81.5	111.4	83.9	212.2	335.8	187.8	43.2	19.5	4.6	5.7	1.9	2424.8
2013	297.1	654.0	107.6	74.7	117.4	117.7	88.4	234.9	313.2	136.7	30.6	9.2	5.4	4.5	2191.5
2014	909.7	211.0	72.1	139.9	136.8	172.5	148.3	111.1	192.9	129.7	38.3	9.3	3.5	2.0	2277.1
2015	572.9	465.4	51.5	65.7	158.3	174.2	193.2	161.0	92.5	115.8	76.1	24.2	6.5	4.9	2162.0
2016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2017	4325.9	5257.4	94.5	145.6	88.4	106.3	195.2	123.1	56.7	26.6	12.0	12.0	7.5	2.8	10454.0
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

***revised**

Table A11. Northeast Arctic COD. Length-at-age (cm) from Russian surveys in November-December.

Year	Age												
	0	1	2	3	4	5	6	7	8	9	10	11	12
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	104.2	-	-
2001	10.6	19.4	29.8	37.3	50.4	61.9	71.9	81.4	91.0	98.7	103.8	-	-
2002	10.7	19.2	29.9	38.2	52.5	60.4	70.6	82.2	91.3	97.2	104.1	-	-
2003	9.8	18.9	28.3	34.9	49.2	62.2	71.0	81.5	92.3	100.9	104.3	-	-
2004	9.8	19.6	29.3	38.4	49.1	60.0	70.5	80.0	91.0	98.0	106.0	-	-
2005	11.2	19.4	29.7	38.5	48.7	59.3	69.3	79.2	87.7	96.1	104.4	-	-
2006	13.0	21.9	31.6	42.7	53.2	60.1	70.2	79.1	88.3	95.2	107.7	-	-
2007	10.7	21.5	30.8	42.2	53.6	63.7	71.0	79.6	87.3	95.9	-	-	-
2008	10.2	20.0	30.3	40.2	53.7	64.5	74.6	82.7	89.5	98.2	102.3	110.2	111.9
2009	12.9	19.3	29.5	38.4	50.7	61.5	70.7	81.7	89.9	94.7	101.8	105.9	109.4
2010	11.1	19.3	28.7	38.5	48.9	59.1	68.0	78.4	88.2	97.3	102.5	108.4	117.7
2011	11.2	20.3	29.2	38.5	49.5	58.6	68.7	78.2	90.0	97.9	106.9	109.3	116.0
2012	11.0	20.3	31.1	40.8	50.8	60.7	68.4	77.6	87.4	97.7	105.2	111.7	116.6
2013	9.5	19.5	29.0	40.3	50.4	59.3	67.3	75.3	84.4	95.3	104.5	111.9	119.4
2014	10.1	20.1	29.8	39.2	50.7	60.9	69.4	77.9	85.1	93.6	102.7	113.3	122.8
2015	11.5	19.0	28.5	37.5	48.0	58.4	67.4	76.3	83.5	91.0	98.8	107.1	117.9
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	15	21	31	40	52	59	67	76	85	92.6	97.9	104	110.1
2018	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A12. Northeast 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	11	12
1984	26	90	250	746	1187	2234	3422	5027	6479	9503	-	-	-
1985	26	80	245	762	1296	1924	3346	5094	7360	6833	11167	-	-
1986	25	63	191	506	1117	1940	2949	4942	7406	9300	-	-	-
1987	-	54	182	316	672	1691	2688	3959	8353	10583	13107	-	-
1988	15	78	223	435	789	1373	2609	4465	5816	-	-	-	-
1989	-	73	216	401	928	1427	2200	3133	4649	6801	8956	-	-
1990	28	106	230	908	1418	2092	2897	4131	6359	10078	13540	-	-
1991	26	93	260	743	1629	2623	3816	4975	7198	11165	15353	-	-
1992	10	76	273	1165	1895	2971	4377	5596	7319	9452	12414	-	-
1993	11	46	211	717	1280	2293	3509	4902	6621	7339	8494	-	-

1994	12	69	153	316	919	1670	2884	4505	6520	8207	9812	-	-
1995	11	61	180	337	861	1987	3298	5427	7614	9787	10757	-	-
1996	7	64	191	436	1035	1834	3329	5001	8203	10898	11358	-	-
1997	6	48	203	487	1176	2142	3220	4805	6925	10823	12426	-	-
1998	11	55	187	435	1186	2050	3096	4759	7044	11207	12593	-	-
1999	10	58	177	371	1214	1925	3064	4378	6128	7843	11543	-	-
2000	8	74	232	379	1101	2128	3341	5054	6560	8497	12353	-	-
2001	9	58	221	459	1125	2078	3329	4950	7270	9541	11672	-	-
2002	8	65	232	505	1299	1964	3271	5325	7249	9195	11389	-	-
2003	6	49	205	492	972	1993	2953	4393	6638	9319	11085	-	-
2004	6	55	231	543	1079	1798	2977	4110	5822	8061	12442	-	-
2005	10	59	223	521	1034	1910	3036	4619	6580	9106	12006	-	-
2006	13	72	270	707	1332	1953	2969	4340	6410	8622	12436	-	-
2007	10	96	252	669	1344	2277	3140	4691	6178	8567	10014	-	-
2008	7	58	228	558	1332	2305	3527	5001	6519	8848	10339	13276	15196
2009	15	54	214	495	1116	2024	3090	4876	6592	8087	10262	11472	13268
2010	9	54	191	794	989	1784	2719	4246	6384	8747	10499	12117	14199
2011	10	63	206	486	1037	1691	2827	4312	6698	8979	11557	12915	15694
2012	9	62	237	561	1087	1877	2688	3974	5930	8495	11000	13377	14826
2013	5	55	202	546	1062	1718	2541	3667	5258	7821	10509	13161	16581
2014	7	64	221	508	1079	1849	2734	3994	5418	7480	10100	14163	18404
2015	11	55	198	452	947	1735	2588	3728	5081	6827	8877	11623	15626
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	22	69	248	571	1150	1771	2539	3819	5426	7554	9236	11220	13536
2018	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A13. Northeast Arctic COD. 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	13+	12+
1985	69.1	446.3	153.0	141.6	20.4	15.1	15.7	3.3	1.3	1.0	0.5	na	na	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	na	na	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	na	na	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	na	na	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	na	na	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	na	na	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	na	na	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	na	na	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	na	na	0.8
1994	902.6	624.4	323.9	374.5	229.3	96.1	23.4	11.8	10.3	4.2	18.7	na	na	2.9
1995	2175.3	212.3	137.7	139.5	203.6	101.6	28.1	4.7	4.5	2.9	2.6	na	na	8.1
1996	1826.3	271.7	99.4	89.6	112.8	97.4	46.2	5.9	1.1	0.4	0.9	na	na	1.5
1997	1698.5	565.3	158.6	44.2	50.3	45.9	51.0	21.5	2.3	0.7	0.1	na	na	0.8
1998	2523.6	475.2	391.2	189.8	44.9	41.5	34.9	27.1	5.1	1.0	0.2	na	na	0.1
1999	364.8	231.5	147.6	130.3	52.3	13.9	11.8	18.7	9.9	1.0	0.2	na	na	0.1
2000	153.4	262.8	294.8	167.3	149.2	54.6	14.6	6.9	5.0	1.3	0.6	na	na	0.2
2001	363.6	51.5	177.4	160.6	85.1	62.1	19.1	2.7	0.8	0.6	0.3	na	na	0.1
2002	19.2	209.1	61.4	106.2	101.1	71.3	36.6	9.4	1.2	0.8	0.6	na	na	0.0
2003	1505.0	52.5	306.7	116.8	127.1	146.1	67.7	23.5	3.8	0.4	0.1	na	na	0.2
2004	161.2	117.2	33.4	85.2	34.9	45.6	48.0	21.7	8.8	2.4	0.2	na	na	0.7
2005	499.7	138.7	125.0	33.3	69.3	34.1	43.8	18.0	7.5	1.8	0.1	na	na	0.3
2006	411.2	158.0	64.8	53.8	18.6	42.0	17.6	15.9	8.7	2.3	0.3	na	na	1.0
2007	85.1	47.1	58.5	30.4	30.8	12.9	46.6	15.1	8.0	3.3	0.9	na	na	0.4
2008	50.9	94.2	199.9	288.7	116.6	78.9	24.8	35.2	5.5	2.8	1.7	na	na	0.7
2009	204.9	25.5	107.8	182.5	141.5	56.0	41.5	12.8	26.6	3.6	1.7	na	na	0.4
2010	620.3	43.6	22.8	88.0	161.4	175.0	61.8	31.4	10.8	12.5	4.0	2.0	0.9	2.9
2011	266.0	91.0	40.4	28.3	67.4	159.5	272.7	64.5	23.3	6.8	7.5	0.4	0.5	0.9
2012	496.5	40.2	82.8	49.4	34.4	89.5	226.6	133.5	25.7	10.4	3.8	1.8	1.0	2.8
2013	313.1	89.2	60.6	84.5	72.4	54.1	133.6	233.8	161.7	21.5	11.1	5.5	3.2	8.8
2014	1758.6	211.0	286.9	124.2	111.5	77.7	55.3	149.0	173.9	98.0	14.6	6.8	3.8	10.5
2015	1903.5	211.4	138.7	235.6	130.0	144.2	96.4	49.8	96.9	68.6	32.5	6.6	6.1	12.7
2016	240.8	201.9	56.3	76.9	119.9	66.4	59.4	40.9	35.6	56.5	34.4	17.6	11.0	28.6
2017	439.4	73.3	111.5	42.4	44.4	74.2	48.6	48.4	26.8	16.7	14.6	15.1	7.8	23.0
2018	2057.6	280.3	109.0	149.9	54.0	58.4	77.5	45.6	19.3	14.1	6.1	6.0	7.8	13.7
2019	1437.2	362.4	203.6	125.4	144.6	63.9	49.3	73.9	27.3	21.8	6.5	2.9	8.1	11.1
2020	92.7	157.9	117.3	117.3	81.9	94.3	50.6	50.9	49.5	19.5	8.4	2.6	5.4	8.0
2021*	45.9	28.5	64.9	59.1	55.8	40.2	36.9	16.3	11.4	14.3	8.2	1.9	1.6	3.4
2022	524.7	43.4	29.4	53.0	57.0	50.4	47.5	34.5	11.6	6.8	5.3	2.2	1.8	3.9
2023	244.4	103.2	28.7	26.5	33.6	34.6	27.8	18.3	13.5	3.2	1.7	0.8	0.7	1.5

* revised

Table A14. Swept area estimates (millions) of Northeast Arctic Cod from the Joint Norwegian- Russian ecosystem survey in August-September (2020 data are taken from WD 01 AFWG 2021).

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2004	543.0	330.6	329.7	147.7	421.5	150.2	79.8	40.2	10.1	2.2	0.5	0.1	0.1	0.1

2005	180.2	440.7	146.6	216.6	55.8	100.9	28.0	15.6	5.7	1.2	0.5	0.1	0.0	0.1
2006	276.0	479.0	509.7	186.1	205.6	59.9	69.8	17.6	8.1	2.6	0.6	0.2	0.0	0.0
2007	101.0	333.3	505.4	586.2	159.2	79.1	24.6	26.9	6.0	2.2	0.9	0.1	0.2	0.0
2008	483.4	130.9	372.6	652.6	483.4	132.3	51.1	12.8	17.5	3.3	0.9	0.2	0.2	0.2
2009	903.3	569.7	93.5	202.3	280.6	289.6	101.7	31.9	12.7	7.3	2.6	0.8	0.3	0.2
2010	652.6	310.3	84.2	56.8	177.0	397.2	424.9	142.7	38.5	10.5	6.8	1.6	0.3	0.3
2011	2083.0	509.8	160.0	123.6	101.5	240.2	300.4	178.4	32.3	7.7	1.8	1.3	0.6	0.3
2012	1412.7	1454.3	255.9	229.1	146.4	70.0	150.8	165.2	84.5	12.7	4.4	1.6	1.4	0.6
2013	2281.8	914.2	659.0	249.1	183.6	125.7	63.2	118.2	130.2	53.8	9.1	3.3	1.5	0.9
2014	2445.2	308.2	155.1	190.0	108.6	93.9	52.8	30.4	50.2	36.3	12.1	3.4	1.0	1.4
2014 *	***2445.2***	***339.0***	***184.0***	***226.3***	***122.2***	***103.4***	***67.7***	***42.1***	***81.3***	***78.9***	***28.1***	***4.7***	***1.3***	***1.5***
2015	350.9	725.3	154.0	174.4	225.2	141.3	72.6	48.6	26.2	35.3	26.6	7.9	1.7	1.0
2016	1164.8	350.8	341.3	77.2	93.7	121.6	70.1	44.4	27.2	13.8	13.2	5.4	1.7	1.4
2017	2316.3	757.5	260.6	375.0	141.5	104.9	120.9	62.6	28.0	11.2	6.4	4.4	4.5	2.7
2018*	***1841.2***	***2100.3***	***413.8***	***183.6***	***148.9***	***60.0***	***37.6***	***57.1***	***20.2***	***14.4***	***5.8***	***3.6***	***3.5***	***2.8***
2019	313.4	560.2	475.2	416.6	232.3	215.1	76.6	42.2	44.4	16.1	4.9	2.2	1.1	1.8
2020**	115.6	63.5	106.3	139.5	135.6	93.4	82.9	30.8	14.2	10.7	3.1	1.0	0.5	1.0
2021	749.1	62.1	51.2	84.7	99.8	81.1	45.7	33.6	12.4	4.7	5.0	2.4	1.0	0.7
2022***	399.2	218.2	39.6	25.6	32.8	34.4	33.8	18.6	9.8	2.5	0.8	0.5	0.1	0.2

*data adjusted taking into account not complete area coverage

** revised

*** incomplete and unsynoptic coverage

Table A15. Mean weight at age of cod (g), data from bottom trawls Barents Sea Ecosystem survey. StoX calculations.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2004		30	127	415	823	1464	2448	3266	4608	6323	9444	18331	13830	-	15924			
2005		37	162	428	985	1723	2553	3697	4808	5958	8583	7662	-	8799	-			
2006		39	155	473	1068	1759	2723	3725	5220	6798	10769	8904	9520	-	-			
2007		52	173	523	1237	2078	3004	4163	5860	7638	11251	-	12683	-	15529			
2008		39	193	511	1154	1958	3187	4262	5793	7741	9563	12039	11149	16320	-			
2009		29	164	462	989	1614	2453	4034	5313	6334	7595	8221	12001	12040	-			
2010		37	152	470	946	1634	2551	3801	5381	6921	7986	9063	8868	13406	19217			
2011		35	143	419	991	1672	2523	3500	4812	6826	9403	12623	10379	10945	-			
2012		34	149	418	904	1634	2388	3276	4344	6466	8459	9798	11181	14621	10895			
2013		28	129	429	918	1553	2249	3230	4443	5805	8454	9817	12531	14308	17723			
2014		28	148	374	897	1684	2244	3501	4511	5933	7183	7894	11979	7602	13250			
2015		28	149	414	823	1483	2297	3219	4490	5635	6962	8478	12148	10385	15370			

2016		45	162	527	914	1563	2308	3324	4492	6472	7476	8689	10939	7485	16645			
2017		37	185	441	953	1660	2414	3398	4821	5876	7173	8345	9968	12765	12445			
2018		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2019		28	103	386	899	1458	2208	3369	4508	6355	7734	9351	9147	11394	11403			
2020*		38	125	343	864	1514	2311	3204	4609	6020	7589	8685	10474	12242	13537	10724	14504	19800
2021		41	200	359	714	1278	2224	3196	4482	6355	7527	9165	10910	12089		15930	17193	
2022		33	169	499	828	1451	2415	3688	5088	7184	7581	12774					17880	

*revised

Table A 16. Mean weight at age of cod (kg), combined data from winter survey and Lofoten survey.

Year/age	1	2	3	4	5	6	7	8	9	10	11
1985	0.02	0.171	0.576	1.003	2.018	3.386	4.696	6.636	8.245	10.321	14.290
1986	0.02	0.119	0.377	0.997	1.645	3.010	4.488	6.518	4.218	0.000	13.480
1987	0.021	0.065	0.23	0.49	1.390	2.155	3.913	5.438	0.322		12.550
1988	0.024	0.114	0.241	0.492	0.907	2.116	3.269	4.937	3.635	13.640	
1989	0.016	0.158	0.374	0.604	0.948	1.581	2.762	4.791	8.835	8.582	
1990	0.026	0.217	0.58	1.009	1.436	2.010	2.716	3.995	5.425	8.992	
1991	0.018	0.196	0.805	1.364	2.067	2.764	3.532	4.945	7.401	11.645	5.350
1992	0.02	0.136	0.619	1.118	1.994	2.808	3.975	5.376	6.352	8.034	9.500
1993	0.009	0.071	0.415	1.179	1.745	2.675	3.686	5.399	6.280	7.680	9.280
1994	0.013	0.056	0.262	0.796	1.557	2.624	4.181	5.846	6.675	7.966	7.778
1995	0.015	0.054	0.24	0.658	1.364	2.565	4.124	5.326	7.379	9.895	9.738
1996	0.015	0.062	0.232	0.627	1.098	2.094	3.742	5.586	7.866	10.057	10.502
1997	0.013	0.052	0.23	0.638	1.185	1.918	3.433	5.515	8.889	10.408	12.405
1998	0.011	0.052	0.28	0.635	1.183	1.731	2.667	4.362	7.259	10.577	11.657
1999	0.014	0.059	0.231	0.592	1.180	1.964	2.978	4.200	5.980	8.848	9.642
2000	0.016	0.074	0.21	0.558	1.222	2.001	3.064	3.862	5.365	6.471	8.379
2001	0.014	0.106	0.336	0.646	1.319	2.371	3.257	5.078	6.186	10.084	10.558
2002	0.014	0.067	0.238	0.747	1.244	2.199	3.344	4.669	6.554	8.078	9.277
2003	0.013	0.061	0.234	0.597	1.335	2.080	3.207	4.643	6.206	7.649	17.062
2004	0.011	0.059	0.275	0.608	1.177	2.083	2.870	4.411	5.889	7.752	9.310
2005	0.013	0.061	0.246	0.723	1.166	2.068	3.114	3.852	5.877	8.538	14.573
2006	0.013	0.069	0.28	0.669	1.421	2.083	3.009	4.212	5.501	6.881	7.646
2007	0.019	0.073	0.235	0.639	1.351	2.334	3.340	4.923	6.598	9.649	11.132
2008	0.015	0.09	0.335	0.798	1.402	2.482	3.282	5.015	6.863	8.598	7.822
2009	0.013	0.083	0.294	0.704	1.320	2.302	4.089	5.152	6.611	9.391	8.657
2010	0.012	0.064	0.304	0.7	1.300	2.082	3.251	4.951	6.366	8.095	9.757

2011	0.015	0.066	0.246	0.668	1.146	2.050	2.830	4.367	6.592	8.681	9.647
2012	0.013	0.062	0.252	0.609	1.295	1.792	2.664	3.827	5.551	8.373	11.741
2013	0.011	0.065	0.269	0.602	1.212	2.163	2.988	4.103	5.292	7.782	9.842
2014	0.008	0.05	0.246	0.603	1.228	1.804	3.121	3.975	5.015	6.018	7.575
2015	0.01	0.044	0.242	0.602	1.227	1.936	2.849	4.015	4.981	6.630	8.187
2016	0.013	0.053	0.2	0.593	1.051	1.936	2.835	4.240	6.315	7.431	8.541
2017	0.015	0.102	0.292	0.72	1.181	2.024	3.026	4.363	5.817	7.223	8.405
2018	0.012	0.069	0.32	0.688	1.251	2.099	2.890	4.246	5.893	7.356	9.512
2019	0.012	0.048	0.273	0.685	1.165	1.908	3.139	4.384	5.833	7.221	8.788
2020	0.014	0.044	0.153	0.548	1.089	1.729	2.650	4.133	5.633	7.455	8.566
2021	0.014	0.068	0.164	0.462	0.918	1.721	2.696	3.807	5.916	7.314	8.762
2022	0.011	0.077	0.311	0.535	1.061	1.801	2.953	4.079	5.915	8.126	9.399
2023	0.012	0.071	0.316	0.694	1.113	1.782	2.997	4.330	5.537	6.824	9.661

4 - Haddock in subareas 1 and 2 (Northeast Arctic)

4.1 - Introductory note

On 30th March 2022 all Russian participation in ICES was suspended. The AFWG report 2023 chapter on haddock was therefore not updated.

In the present report, we have kept the main structure of the NEA haddock chapters in AFWG reports from the last years.

4.2 - Status of the fisheries

4.2.1 - Historical development of the fisheries

Haddock is mainly fished by trawl as bycatch in the fishery for cod. Also, a directed trawl fishery for haddock is conducted. The proportion of the total catches taken by direct fishery varies between years. On average approximately 70% of the catches are taken by trawl. Norway takes about half of the quota with other gear, in particular long line and Danish seine. Danish seine has become more important in the Norwegian fisheries the last 10 years. Some of the longline catches 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 (40 cm), a minimum mesh size in trawls and Danish seine, a maximum bycatch 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 low to intermediate stock levels and historically show little relationship with the exploitation rate of cod, despite haddock being primarily caught as bycatch in the cod fishery. However, the more restrictive quota regulations introduced around 1990 have resulted in a more stable pattern in the exploitation rate.

The exceptionally strong year classes 2005–2006 contributed to the strong increase to all-time high stock levels and high catch levels in the last decade. Their importance in the catches is currently minimal. Currently, the 2017 and 2016 year-classes are dominating the catches.

4.2.2 - Catches prior to 2023 (Table 4.1–Table 4.3, Figure 4.1)

The highest landings of haddock historically were 322 kt in 1973. Since 1973 the highest catches observed was 316 kt in 2012. The landings in 2018-2021were below 200 kt (Figure 4.1).

Provisional official landings for 2022 are about 177 kt, which is 1% below agreed TAC (178 kt).

In 2006 it was decided to include reported Norwegian landings of haddock from the Norwegian statistical areas 06 and 07 (i.e. between 62°N and Lofoten Islands). These areas were not previously included in the total landings of NEA haddock as input for this stock assessment (ICES CM 2006/ACFM:19; ICES CM 2006/ACFM:25).

Estimates of unreported catches (IUU catches) of haddock have been added to reported landings for the years from 2002 to 2008. Two estimates of IUU catches were available, one Norwegian and one Russian. At the benchmark in 2011 it was decided to base the final assessment on the Norwegian IUU estimates (ICES CM 2011/ACOM:38; Table 4.1).

We continue to include the estimates of IUU catches 2002–2008. The IUU catches are assumed to be negligible for the period 2009–2022 and therefore set to zero.

4.2.3 - Catch advice and TAC for 2023

The catch advice for 2023 was 170 kt and the Joint Norwegian-Russian Fisheries Commission set the TAC in accordance with the HCR. Furthermore, Russia and Norway can transfer the unused part of their own quota, restricted to a maximum of 10% of own quotas from 2022 to 2023.

4.3 - Status of research

4.3.1 - Survey results

Russia provided indices for 1982–2015 and 2017 for the Barents Sea trawl and acoustic survey (TAS) which was carried out in October–December (FLT01, RU-BTr-Q4). The survey was discontinued in 2018.

The Joint Barents Sea winter survey provides two index series used for tuning and recruitment forecast (bottom trawl: FLT02, NoRu-BTr-Q1 and acoustics: FLT04, NoRu-Aco-Q1). The survey area has been extended from 2014 with additional northern areas (N) covered. The extended area is now included in total and standard survey index calculations for haddock (WKDEM 2020) and is done using the StoX software (Johnsen et al. 2019). Overall, this survey tracks both strong and poor year classes well. The indices from the Joint winter survey of cod and haddock in the Barents Sea are provided in the annual survey reports from this survey (e.g., Fall et al. 2023). The spatial survey coverage in 2023 was relatively good, but more restricted compared to 2022, especially in the Northeast.

The Joint Barents Sea ecosystem survey provides indices by age from bottom trawl data (FLT007, Eco-NoRu-Q3 Btr) used for tuning and recruitment forecast. At the benchmark in 2011 it was decided to include this survey as tuning series. Tuning indices by age from the Joint ecosystem survey is calculated using the BIOFOX programme (Prozorkevich and Gjøsæter 2014). The coverage in 2022 was not synoptic since the eastern Barents Sea was covered more than month later then the western Barents Sea. The problems with the survey were also evident when plotting internal consistency especially for the older ages, which could be explained by migration of older fish during the survey period. Therefore the 2022 indices from this survey were not used in the 2023 assessment. The indices for age 1 and 2 was used in the forecast, since younger fish migrate less and there were no apparent problems detected from the consistency plots for these ages.

The survey indices for ages used in tuning can be found in Table 4.9, and the survey indices used in recruitment forecast can be found in Table 4.16.

4.4 - Data used in the assessment

4.4.1 - Catch-at-age (Table 4.4)

Age and length composition of the landings in 2022 were available from Norway and Russia in Subarea 1 and Division 2.b, and from Norway, Russia, and Germany in Division 2.a. The biological sampling of NEA haddock catches is considered good for the most important ages in the fisheries .

Relevant data of estimated catch-at-age was obtained from InterCatch for the period 2008–2020 and is presented together with historical values from 1950–2007 in Table 4.4. For the 2021 and 2022 catch data allocation, instead of InterCatch, the same algorithm was realized in Excel. Excel was used for comparison with InterCatch in 2008-202 0 , and no differences between InterCatch and Excel allocations were detected.

4.4.2 - Catch-weight-at-age (Table 4.5)

The mean weight-at-age in the catch was obtained as a weighted average of the weight-at-age in the catch from

Norway, Russia and Germany.

4.4.3 - Stock-weight-at-age (Table 4.6)

Since 1983 the stock weights-at-age (Table 4.6) are calculated using the average of the weight-at-age estimate from the Joint Barents Sea winter survey and the Russian bottom trawl survey. These averages are assumed to give representative values for the beginning of the year (see stock annex for details). However, the Russian bottom trawl survey has been discontinued and therefor stock weights-at-age were calculated using a correction factor (WKDEM 2020). Since the benchmark in 2006 stock weight at age has been smoothed (ICES 2006, see stock annex for details).

4.4.4 - Maturity-at-age (Table 4.7)

Since the benchmark 2006, smoothed estimates were produced separately for the Russian autumn survey and the Joint winter survey and then combined using arithmetic average. These averages are assumed to give representative values for the beginning of the year. However, the Russian bottom trawl survey has been discontinued and therefore stock weights-at-age were calculated using a correction factor (see WKDEM 2020 and stock annex).

4.4.5 - Natural mortality (Table 4.8)

Natural mortality used in the assessment was 0.2. For ages 3–6 mortality predation by cod is added (see stock annex). For the period from 1984 and onwards actual estimates of predation by cod was used. For the years 1950–1983 the average natural mortality for 1984–202 2 was used (age groups 3–6). Estimated mortality from predation by cod in this year’s assessment is based on the ‘final run’ cod assessment. The proportion of F and M before spawning was set to zero.

4.4.6 - Data for tuning (Table 4.9)

The following survey series are included in the data for tuning, the last age for all surveys is the plus group. Data are lacking (no survey) for FLT01 in 2016, and for FLT007 in 2018 and 2022 (not included due to poor/not synoptic coverage).

Name	Acronym	Place	Season	Age	Year	prior weight
FLT01: Russian bottom trawl	RU-BTr-Q4	Barents Sea	October–December	3–8+	1991–2017	1
FLT02: Joint Barents Sea survey–acoustic	BS-NoRU-Q1(Aco)	Barents Sea	February–March	3–9+	1993–2023	1
FLT04: Joint Barents Sea survey–bottom trawl	BS-NoRu-Q1 (BTr)	Barents Sea	February–March	3–10+	1994–2023	1
FLT007: Joint Russian-Norwegian ecosystem autumn survey in the Barents Sea–bottom trawl	Eco-NoRu-Q3 (Btr)	Barents Sea	August–September	3–9+	2004–2021	1

4.4.7 - Changes in data from last year (Table 4.6–Table 4.7, Table 4.9)

At the benchmark (WKDEM 2020) it was decided that historic values (1950–1993) of stock weight and maturity should not be updated in the following years. Due to the smoothing procedure (see stock annex) the stock weight and maturity at age back to 1994 are updated every year.

Natural mortality includes cod predation for the ages 3–6. The data from 1984 and onwards are updated every year after the update of the cod assessment. The averages used for the historic period (1950–1983) were updated and used in the assessment.

4.5 - Assessment models and settings (Table 4.10)

At the benchmark in 2020 it was decided to continue using the SAM model as the main model.

The SAM configuration was revised during the benchmark in 2020. The main changes to the configuration were to include:

1) age group 3 in the winter survey indices (Fleet 02 and 04),

2) plus group in all survey series (new option in SAM),

3) prediction variance link for the observation variances (new option in SAM, Breivik *et al.,* 2021) 4) correlation structure in observation variance for the surveys (Berg and Nielsen, 2016).

The configuration, settings and tuning of SAM that were decided on during the benchmark (WKDEM 2020) were used in the current assessment. The configuration file is given in Table 4.10 and in the stock annex.

XSA, with revised settings, and TISVPA are both used as additional models for comparison.

4.6 - Results of the assessment (Table 4.11–Table 4.14 and Figure 4.1–Figure 4.3)

The dominating feature of the assessment is that the stock reached an all-time high level around 2011 due to the strong 2004–2006 year-classes, and since declined (Table 4.11; Figure 4.1)

Fishing mortality increased from 2013 to 2020 (Table 4.12), has been above F_{MSY} = 0.35 since 2018 and reached 0.45 in 2020, but decreased to 0.351 in 2022. The SSB declined from an all-time high in the period 2012-2016 to an intermediate level in 2020 and then stabilized. The estimate of SSB for 2023 is 210 kt which is above MSY $B_{trigger}$ = 80 kt (Figure 4.1).

The residuals and retrospective patterns are shown in Figure 4.2 and 4.3.

4.7 - Comparison with last year's assessment (Figure 4.4)

The text table below compares this year's estimates with last year's estimates. Compared to last year the current estimates of the total stock (TSB) in 2022 is 6% lower, whereas the spawning stock (SSB) estimate is 9% lower. The Fbar in 2021 is estimated as higher compared to last year's assessment. Estimates for 2022 for all ages except age 3 and 4 were lower or identical to last year's assessment. Ratios are calculated on original numbers (not rounded as shown in table)

Assessment year, model	F (2021)	Numbers 2022 (ages)											SSB (2022)	TSB (2022)
		3	4	5	6	7	8	9	10	11	12	13+		
2022 SAM	0.42	38	138	193	201	35	9	4	2	2	1	2	217	566
2023 SAM	0.44	45	144	191	178	33	8	4	2	1	1	2	197	533
Ratio 2023/2022	1.05	1.17	1.04	0.99	0.88	0.93	0.85	0.87	0.89	0.81	1.01	0.88	0.91	0.94

4.8 - Additional assessment methods (Table 4.15, Figure 4.5–Figure 4.6)

4.8.1 - XSA (Figure 4.5)

The Extended Survivors Analysis (XSA) was used to tune the VPA by available index series. As last years, FLR was used for the assessment of haddock (see stock annex), and thus all results concerning XSA are obtained using FLR. The settings used were the same as set in the benchmark in 2015 (WKARCT 2015). At this meeting the comparison confirmed that usage XSA with survivor estimate shrinkage 0.5 gave similar result to the estimates from SAM.

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 (1984–2022). The summary of XSA stock estimates with shrinkage value 0.5 are presented in Table 4.15. A retrospective estimate for XSA gave same signals as for the main model SAM (Figure 4.5).

4.8.2 - TISVPA (Figure 4.5)

The TISVPA (Triple Instantaneous Separable VPA) model (Vasilyev 2005, 2006) represents fishing mortality coefficients (more precisely – exploitation rates) as a product of three parameters: f(year)*s(age)*g(cohort). The generation-dependent parameters, which are estimated within the model, are intended to adapt traditional separable representation of fishing mortality to situations when several year classes may have peculiarities in their interaction with fishing fleets caused by different spatial distribution, higher attractiveness of more abundant schools to fishers, or by some other reasons. The TISVPA model was presented at benchmark groups for haddock stock (WKARCT 2015, WKDEM, 2020) and it was decided to apply to NEA haddock using the same data as SAM except that natural mortality values from cannibalism were taken from the SAM runs. All the input data, including catch-at-age, weight-at-age in stock and in catches, maturity-at-age were the same as used in SAM. Generally, the biomass estimates of this model were higher than SAM estimates, which can be explained by different assumptions about catchability of indices. The retrospective pattern for TISVPA shows the same trends as both the SAM and XSA models (Figure 4.5).

4.8.3 - Model comparisons (Figure 4.6)

Results from SAM, XSA and TISVPA are compared in Figure 4.6. Comparison of results of SAM, TISVPA and XSA with previous year settings shows that the models estimate similar trends. The TISVPA model is more flexible for settings than the others and taking into account a possible decrease in survey data consistency, it was attempted to do tuning of surveys not at abundance but to age proportions because of the probable change in effective survey catchability.

4.9 - Predictions, reference points and harvest control rules (Table 4.16–Table 4.21)

4.9.1 - Recruitment (Table 4.16–Table 4.17)

SAM was used to estimate the recruitment at age 3 of the 2020 year-class in 2023. The RCT3 program (R version) was used to estimate the recruiting year classes 2021–2022 in 2024 and 2023 with survey data from the ecosystem survey and winter survey (acoustics and bottom trawl). Input data and results are shown in Tables 4.16 and 4.17, respectively.

The text table below shows the recruitment estimates for the year classes 2004–2022 from assessments and RCT3 forecasts (shaded cells). Overall, there is good agreement with the year-class strength estimates from RCT3 and the assessments (r=0.96), and the estimate the first year the year-class was assessed was on average 89% of the initial RCT3 estimate (year-classes 2005-2020). In the most recent years, it is noticeable that the 2018 year-class was less than 50% of the initial RCT3 estimate, whereas the 2020 year-class was estimated by SAM 66% higher than the initial RCT3 estimate.

Year Cl...	Year of assessment, base model

Class	2008 XSA	2009 XSA	2010 XSA	2011 XSA	2012 XSA	2013 XSA	2014 XSA	2015 XSA	2015 SAM	2016 SAM	2017 SAM	2018 SAM	2019 SAM	2020 SAM	2021 SAM	2022 SAM	202 3 SAM
2004	665	668	610	765	743	725	698	768	687	930	898	869	879	557	543	546	534
2005	943	975	1029	1193	1301	1317	1303	1415	996	1456	1330	1241	1251	1149	1113	1118	1085
2006	832	1036	811	1057	1187	1264	1267	1366	827	1254	1083	1027	1030	1063	1025	1032	998
2007	202	208	212	284	330	370	384	411	211	355	307	305	308	249	241	242	238
2008		149	101	120	151	155	169	178	89	157	107	109	110	122	117	119	118
2009			303	315	320	345	357	363	230	351	294	291	293	356	340	344	335
2010				188	146	137	146	150	100	133	105	105	106	124	119	120	118
2011					483	513	482	398	298	397	340	329	332	425	411	415	407
2012						124	145	104	78	73	79	70	68	75	72	73	73
2013							394	290	197	235	184	174	177	219	213	215	212
2014								279	198	247	189	146	148	202	194	198	195
2015										422	398	333	336	384	368	370	363
2016											1067	933	930	875	822	831	808
2017												577	629	497	442	449	432
2018													344	294	154	164	161
2019														39	31	38	47
2020															95	89	158
2021																303	372
2022																	231

4.9.2 - Prediction data (Table 4.18, Figure 4.7)

The input data for the prediction are presented in Table 4.18.

Stock numbers for 2024–2025 at age 3 are taken from RCT3, and abundance-at-ages 3–13+ in 2023 from the SAM assessment.

The average fishing pattern observed in 2020–2022 scaled to F in 2022 was used for distribution of fishing mortality-at-age for 2023–2025 (Figure 4.7). The proportion of M and F before spawning was set to 0.

Input data to projection of weight at age in the stock, weight at age in the catch, maturity and mortality followed the stock annex (WKDEM, 2020).

4.9.3 - Biomass reference points (Figure 4.1)

Biological and fisheries reference points for NEA haddock were last set following a thorough analysis as part of the WKNEAMP-2 (ICES, 2016) Harvest Control Rule evaluation in 2016. The revised model developed during the 2020 benchmark produced better fits to the data but only a small change in the reconstructed stock (WKDEM, 2020). A brief analysis at WKDEM 2020 indicated that the reference points from the current model are very similar to the previously estimated values. Given the more thorough analysis at WKNEAMP-2 (ICES, 2016), this is taken as indicating that there was no evidence to deviate from the reference points set in 2016.

At the last benchmark (WKDEM 2020) it was proposed to keep B_{lim} = 50 000 t and B_{pa} = 80 000 t with the rationale that B_{lim} is equal to B_{loss}, and $B_{pa} = B_{lim}*\exp(1.645*\sigma)$, where $\sigma = 0.3$. This gives a 95% probability of maintaining SSB above B_{lim} taking into account the uncertainty in the assessments and stock dynamics. B_{MSY} trigger was proposed equal B_{pa}, $B_{trigger}$ was then selected as a biomass that is encountered with low probability if F_{MSY} is implemented, as recommended by WKFRAME2 (ICES CM 2011/ACOM:33). Values of reference points compared with current stock values are reflected in Figure 4.1.

4.9.4 - Fishing mortality reference points (Figure 4.1)

Biological and fisheries reference points for NEA haddock were last set following a thorough analysis as part of the WKNEAMP-2 (ICES, 2016) Harvest Control Rule evaluation in 2016. The revised model developed during the 2020 benchmark produced better fits to the data but only a small change in the reconstructed stock (ICES WKDEM 2020). A brief analysis at WKDEM 2020 indicated that the reference points from the current model are very similar to the previously estimated values. Given the more thorough analysis at WKNEAMP-2 (ICES, 2016), this is taken as indicating that there was no evidence to deviate from the reference points set in 2016.

There is no standard method of estimating F_{lim} nor F_{pa}, and ACOM accepted to use geometric mean recruitment (146 million) and B_{lim} as basis for the F_{lim} estimate. F_{lim} is then based on the slope of line from origin at SSB = 0 to the geometric mean recruitment (146 million) and SSB = B_{lim}. The SPR value of this slope give F_{lim} value on SPR curve; F_{lim} = 0.77 (found using Pasoft). Using the same approach as for B_{pa}; $F_{pa} = F_{lim} *\exp(-1.645* \sigma$
$) = 0.47$.

F_{MSY} = 0.35 has been estimated by long-term stochastic simulations. Values of reference points compared with current stock values are reflected in Figure 4.1.

The estimates of cod's consumption of haddock were revised following the cod benchmark in early 2021. At the AFWG 2021 meeting, the haddock F_{MSY} was checked with the new updated mortality estimates and found to still be valid and precautionary.

4.9.5 - Harvest control rule

The harvest control rule (HCR) was evaluated by ICES in 2007 (ICES CM 2007/ACFM:16) and found to be in agreement with the precautionary approach. The agreed HCR for haddock with last modifications is as follows (Protocol of the 40th Session of The Joint Norwegian Russian Fisheries Commission (JNRFC), 14 October 2011):

- TAC for the next year will be set at level corresponding to F_{MSY}.
- The TAC should not be changed by more than +/- 25% compared with the previous year 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_{MSY} 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 and a year ahead) there should be no limitations on the year-to-year variations in TAC.

As mentioned above F_{lim} and F_{pa} were revised in 2011. The new values of F_{lim} = 0.77 and F_{pa} = 0.47 are higher than the previous values (0.49 and 0.35, respectively). In the 2012 meeting of the JNRFC the proposals of ICES were accepted, and the current HCR management is based on F_{MSY} instead of $F_{pa.}$ This corresponds to the goal of the management strategy for this stock and should provide maximum sustainable yield.

In 2014, JNRFC decided that from 2015 onwards, Norway and Russia can transfer to next year or borrow from last year maximum 10% of the country's quota. At its 45th session in October 2015, the Joint Norwegian-Russian Fisheries Commission (JNRFC) decided that a number of alternative harvest control rules (HCRs) for Northeast Arctic haddock should be evaluated by ICES. This was done by WKNEAMP (ICES 2015/ACOM:60, ICES C. M. 2016/ACOM:47). Six HCRs for NEA haddock including the existing one were tested. At its 46th session in October 2016, the JNRFC decided not to change the HCR.

4.9.6 - Prediction results and catch options for 2024 (Table 4.19–Table 4.20)

The projection shows a decrease in SSB from 210 kt in 2023 to 189 kt in 2024 (Table 4.19). TAC constraint F is used for 2023. The TAC for 2024 is established using the current one-year HCR, in accordance with the management plan. F_{MSY} = 0.35 would give a quota for 2024 of 122 465 kt, this is a 28% decrease from the TAC. Following the harvest control rule, the TAC should not be changed with more than 25% compared to the previous year, therefor the TAC advice for 2024 is a quota of 127 550 tonnes.

Catch options for 2024 are shown in the text table below (weights in tonnes).

Basis	Total catch (2024)	F ages 4−7 (2024)	SSB (2025)	% SSB change *	% TAC change **	% Advice change ***
Advice basis						
Management plan	127 550	0.3681	159 292	-16	-25	-25
Other scenarios						
MSY approach: F_{MSY}	122 465	0.35	162 753	-14	-28	-28
F = 0	0	0.00	249 327	32	-100	-100
F = F2023	130 057	0.3771	157 591	-17	-24	-24
F_{pa}	154 413	0.47	141 245	-25	-9	-9
F_{lim}	218 207	0.77	100 344	-47	28	28

*** SSB 2025 relative to SSB 2024.**

**** Catch in 2024 relative to TAC in 2023 (170 067 t)**

***** Catch value for 2024 relative to advice value for 2023 (170 067 t)**

Detailed information about expected catches by following the HCR in 2024 and 2025 is given in Table 4.20. The forecast covers all catches. It is then implied that all types of catches are to be counted against this TAC.

4.9.7 - Comments to the assessment and predictions (Figure 4.2-4.4 and Figure 4.8- Figure 4.9)

The one step ahead residuals showed no clear pattern (Figure 4.2). Haddock was benchmarked in 2020 (WKDEM 2020). The motivation for the benchmark was the poor retrospective (text table below). The retrospective biases were greatly improved after the benchmark. The retrospective biases for F, SSB, TSB and R (absolute values) are <8% (Figure 4.3). To conclude, no obvious problems with the 2023 assessment were detected. The results from this year’s assessment agreed well with the results from last year (Figure 4.4).

Retrospective bias (Mohn’s Rho), 5-year peel	R	SSB	F	TSB
AFWG 2018	−3%	24%	−7%	14%
AFWG 2019	−5%	18%	−7%	7%
WKDEM 2020	−2%	3%	−3%	1%
AFWG 2020	−4%	−3%	0%	−5%
AFWG 2021	1%	6%	−7%	3%

JRN_AFWG 2022	-2%	5%	-6%	1%
JRN_AFWG 2023	0%	7%	-6%	3%

According to this year’s assessment, the 2016 year-class is the sixth strongest year class in the time-series back to 1950. The 2017 year-class is above average (average 1950-2023, R3=258 million individuals). The 2018 and 2020 year-classes are weak, and the 2019 year-class is the weakest since the 1987 year-class. The 2021 year-class is predicted to be above average, whereas the 2022 year-class is predicted to be close to average.

Fishing mortality (F_{bar4-7}) has been above F_{msy} in 2018, 2019, 2020 and 2021, meaning that the quotas for 2018-2021 have been set too high because the stock biomass was overestimated. The assessments from 2017 to 2019 on which the TAC advice for 2018-2020 were based, had large positive retrospective biases for TSB and SSB (see text table above), implying that the stock sizes were overestimated. The retrospective bias was reduced after the revision at the 2020 benchmark (WKDEM 2020).

The quota in 2021 was not taken, but F_{bar} was still larger than F_{msy} . One possible reason is that the advice and quota was set too high, due to lower catch weights of ages 3-7 compared to the forecast, e.g. the catch weight at age 5 (2016 year-class) was 16% lower than predicted by AFWG in 2020. The 2016 year-class accounted for more than half of the individuals caught in 2021 (54%) and thus the weight of this year-class in the catches had the greatest impact on the yield. As a result, a given catch in tons required more individuals had to be caught, and hence a higher effort from the fishing fleet. In 2022, the difference between the catch weight at age 5 (year-class 2017 and age 6 (year-class 2016), and the predictions from AFWG 2021 was much smaller (5% lower).

The strong 2016 year-class and the 2017 year-class is dominating the catches (73% in biomass). In 2022 99% of the quota was taken, but more of the quota was taken from the 2017-year class than assumed in the predictions (Figure 4.8, 2016-year class: prediction 50%, catches: 42%, 2017-year-class: 26% in prediction vs 31% in catches).

The spawning stock will decline from 2023 to 2024 and is expected to decline in the next years, since the incoming year-classes 2018-2020 are weak. The age composition will change in the coming years as the 2016 and 2017 year-classes are fished out of the stock and the 2021 and 2022 -year-classes start recruited to the fishery (Figure 4.9).

4.10 - References

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Table 4.1. Northeast Arctic haddock. Total nominal catch (t) by fishing areas.

Year	Subarea 1	Division 2.a	Division 2.b	un-reported[2)]	Total[3)]	Norw. stat.areas 06 and 07[4)]
1960	125026	27781	1844	-	154651	6000
1961	165156	25641	2427	-	193224	4000
1962	160561	25125	1723	-	187409	3000
1963	124332	20956	936	-	146224	4000
1964	79262	18784	1112	-	99158	6000
1965	98921	18719	943	-	118583	6000
1966	125009	35143	1626	-	161778	5000
1967	107996	27962	440	-	136398	3000
1968	140970	40031	725	-	181726	3000
1969	89948	40306	566	-	130820	2000
1970	60631	27120	507	-	88258	-
1971	56989	21453	463	-	78905	-

Year	Subarea 1	Division 2.a	Division 2.b	un-reported	Total	Norw. stat.areas 06 and 07
1972	221880	42111	2162	-	266153	-
1973	285644	23506	13077	-	322227	-
1974	159051	47037	15069	-	221157	10000
1975	121692	44337	9729	-	175758	6000
1976	94054	37562	5648	-	137264	2000
1977	72159	28452	9547	-	110158	2000
1978	63965	30478	979	-	95422	2000
1979	63841	39167	615	-	103623	6000
1980	54205	33616	68	-	87889	5098
1981	36834	39864	455	-	77153	4767
1982	17948	29005	2	-	46955	3335
1983	5837	16859	1904	-	24600	3112
1984	2934	16683	1328	-	20945	3803
1985	27982	14340	2730	-	45052	3583
1986	61729	29771	9063	-	100563	4021
1987	97091	41084	16741	-	154916	3194
1988	45060	49564	631	-	95255	3756
1989	29723	28478	317	-	58518	4701
1990	13306	13275	601	-	27182	2912
1991	17985	17801	430	-	36216	3045
1992	30884	28064	974	-	59922	5634
1993	46918	32433	3028	-	82379	5559
1994	76748	50388	8050	-	135186	6311
1995	75860	53460	13128	-	142448	5444
1996	112749	61722	3657	-	178128	5126
1997	78128	73475	2756	-	154359	5987
1998	45640	53936	1054	-	100630	6338
1999	38291	40819	4085	-	83195	5743
2000	25931	39169	3844	-	68944	4536
2001	35072	47245	7323	-	89640	4542
2002	40721	42774	12567	18736/5310	114798/101372	6898
2003	53653	43564	8483	33226/9417	138926/115117	4279
2004	64873	47483	12146	33777/8661	158279/133163	3743
2005	53518	48081	16416	40283/9949	158298/127964	5538
2006	51124	47291	33291	21451/8949	153157/140655	5410
2007	62904	58141	25927	14553/3102	161525/150074	7110

Year	Subarea 1	Division 2.a	Division 2.b	un-reported	Total	Norw. stat.areas 06 and 07
2008	58379	60178	31219	5828/-	155604/149776	6629
2009	57723	66045	76293	0	200061	4498
2010	62604	86279	100318	0	249200	3661
2011	86931	99307	123546	0	309785	4169
2012	90141	96807	128679	0	315627	3869
2013	68416	64810	60520	0	193744	4000
2014	61537	58320	57665	0	177522	3433
2015	75195	61567	57993	0	194756	3902
2016	78714	95140	59561	0	233416	3233
2017	94772	75455	57362	0	227589	2987
2018	80902	58522	51853	0	191276	4437
2019	87446	50967	36989	0	175402	2812
2020	98341	57397	26730	0	182468	3196
2021	109914	5800 6	36823	0	204743	2363
2022[1)]	85887	63415	27604	0	176906	2151

1) Provisional figures

2) Figures based on Norwegian/Russian IUU estimates. From 2009, IUU estimates are made by a Joint Russian-Norwegian analysis group under the Russian-Norwegian Fisheries Commission.

3) In 2002–2008, the Norwegian IUU estimates were used in final assessment.

4) Included in total landings and in landings in region 2.a.

Table 4.2. Northeast Arctic haddock. Total nominal catch (‘000 t) by trawl and other gear for each area.

	Subarea 1		Division 2.a		Division 2.b		Unreported[2]
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	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	-	-

	Subarea 1		Division 2.a		Division 2.b		Unreported
1979	47.8	16	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	15.8	0.8	8.3	-
1987	79	18.1	23	18.1	3	13.8	-
1988	28.7	16.4	34.3	15.3	0.6	0	-
1989	20	9.7	13.5	15	0.3	0	-
1990	4.4	8.9	5.1	8.2	0.6	0	-
1991	9	8.9	8.9	8.9	0.2	0.2	-
1992	21.3	9.6	11.9	16.1	1	0	-
1993	35.3	11.6	14.5	17.9	3	0	-
1994	58.6	18.2	26.1	24.3	7.9	0.2	-
1995	63.9	12	29.6	23.8	12.1	1	-
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	19.6	27.1	26.9	0.7	0.3	-
1999	29.4	8.9	19.1	21.8	4	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	0.3	-
2002	30.5	10.2	19.5	23.3	12.5	0.1	18.7/5.3
2003	42.7	10.9	21.9	21.7	8.1	0.4	33.2/9.4
2004	52.4	12.5	27	20.5	11.5	0.6	33.8/8.7
2005	38.5	15	24.9	20.9	13	1.6	40.3/9.9
2006	40.1	11	22	25.3	30.1	3.2	21.5/8.9
2007	51.8	11.1	30.5	27.7	20.4	5.5	14.6/3.1
2008	46.8	11.6	30.9	29.3	24.9	6.3	5.8/-
2009	49	8.8	40.1	25.3	67.1	7.8	0
2010	43.6	19	50	35.7	87	10.4	0
2011	55.8	31.1	61.1	38.9	107.7	14.3	0
2012	58.8	31.3	57.5	39.2	103.2	24.8	0
2013	40.1	28.3	37.7	26.9	52.1	8.1	0
2014	35.2	26.3	32.5	25.8	49	8.6	0

	Subarea 1		Division 2.a		Division 2.b		Unreported
2015	49.1	26.1	34.6	27	48.5	9.4	0
2016	56.4	22.3	62.5	32.5	45.4	14.1	0
2017	65	29.8	50.7	24.7	47.1	10.3	0
2018	51.7	29.2	36.9	21.6	43.2	8.6	0
2019	53.9	33.5	30.4	20.4	31.0	5.9	0
2020	66.7	31.6	35.1	22.3	23.2	3.5	0
2021	81.4	28.5	41.0	17.0	31.0	5.8	0
2022[1)]	63.4	22.5	44.7	18.7	22.1	5.5	0

1) Provisional

2) Figures based on Norwegian/Russian IUU estimates.

Table 4.3 Northeast Arctic haddock. Nominal catch (t) by countries. Subarea 1 and divisions 2.a and 2.b combined. (Data provided by Working Group members).

Year	Faroe Islands	France	GDR (–1990) & Greenland (1992–)	Germany	Norway[4]	Poland	UK	Russia[2]	Others	Total[3]
1960	172	-	-	5597	46263	-	45469	57025	125	154651
1961	285	220	-	6304	60862	-	39650	85345	558	193224
1962	83	409	-	2895	54567	-	37486	91910	58	187408
1963	17	363	-	2554	59955	-	19809	63526	-	146224
1964	-	208	-	1482	38695	-	14653	43870	250	99158
1965	-	226	-	1568	60447	-	14345	41750	242	118578
1966	-	1072	11	2098	82090	-	27723	48710	74	161778
1967	-	1208	3	1705	51954	-	24158	57346	23	136397
1968	-	-	-	1867	64076	-	40129	75654	-	181726
1969	2	-	309	1490	67549	-	37234	24211	25	130820
1970	541	-	656	2119	37716	-	20423	26802	-	88257
1971	81	-	16	896	45715	43	16373	15778	3	78905
1972	137	-	829	1433	46700	1433	17166	196224	2231	266153
1973	1212	3214	22	9534	86767	34	32408	186534	2501	322226
1974	925	3601	454	23409	66164	3045	37663	78548	7348	221157
1975	299	5191	437	15930	55966	1080	28677	65015	3163	175758
1976	536	4459	348	16660	49492	986	16940	42485	5358	137264
1977	213	1510	144	4798	40118	-	10878	52210	287	110158
1978	466	1411	369	1521	39955	1	5766	45895	38	95422
1979	343	1198	10	1948	66849	2	6454	26365	454	103623
1980	497	226	15	1365	66501	-	2948	20706	246	92504

Year	Faroe Islands	France	GDR (–1990) & Greenland (1992–)	Germany	Norway	Poland	UK	Russia	Others	Total
1981	381	414	22	2402	63435	Spain	1682	13400	-	81736
1982	496	53	-	1258	43702	-	827	2900	-	49236
1983	428	-	1	729	22364	139	259	680	-	24600
1984	297	15	4	400	18813	37	276	1103	-	20945
1985	424	21	20	395	21272	77	153	22690	-	45052
1986	893	12	75	1079	52313	22	431	45738	-	100563
1987	464	7	83	3105	72419	59	563	78211	5	154916
1988	1113	116	78	1323	60823	72	435	31293	2	95255
1989	1217	-	26	171	36451	1	590	20062	-	58518
1990	705	-	5	167	20621	-	494	5190	-	27182
1991	1117	-	**Greenland**	213	22178	-	514	12177	17	36216
1992	1093	151	1719	387	36238	38	596	19699	1	59922
1993	546	1215	880	1165	40978	76	1802	35071	646	82379
1994	2761	678	770	2412	71171	22	4673	51822	877	135186
1995	2833	598	1097	2675	76886	14	3111	54516	718	142448
1996	3743	6	1510	942	94527	669	2275	74239	217	178128
1997	3327	540	1877	972	103407	364	2340	41228	304	154359
1998	1903	241	854	385	75108	257	1229	20559	94	100630
1999	1913	64	437	641	48182	652	694	30520	92	83195
2000	631	178	432	880	42009	502	747	22738	827	68944
2001	1210	324	553	554	49067	1497	1068	34307	1060	89640
2002	1564	297	858	627	52247	1505	1125	37157	682	114798
2003	1959	382	1363	918	56485	1330	1018	41142	1103	138926
2004	2484	103	1680	823	62192	54	1250	54347	1569	158279
2005	2138	333	15	996	60850	963	1899	50012	1262	158298
2006	2390	883	1830	989	69272	703	1164	53313	1162	153157
2007	2307	277	1464	1123	71244	125	1351	66569	2511	161525
2008	2687	311	1659	535	72779	283	971	68792	1759	155604
2009	2820	529	1410	1957	104354	317	1315	85514	1845	200061
2010	3173	764	1970	3539	123384	379	1758	111372	2862	249201
2011	1759	268	2110	1724	158202	502	1379	139912	4763	310619
2012	2055	322	3984	1111	159602	441	833	143886	3393	315627
2013	1886	342	1795	500	99215	439	639	85668	3260	193744
2014	1470	198	1150	340	91306	187	355	78725	3791	177522
2015	2459	145	1047	124	95094	246	450	91864	3327	194756

Year	Faroe Islands	France	GDR (–1990) & Greenland (1992–)	Germany	Norway	Poland	UK	Russia	Others	Total
2016	2460	340	1401	170	108718	200	575	115710	3838	233412
2017	2776	108	1810	170	113132	228	372	106714	2279	227588
2018	2333	183	1317	385	93839	169	453	90486	2111	191276
2019	1515	143	1208	204	93860	280	456	76125	1611	175402
2020	1392	96	910	282	88108	45	320	89030	2286	182468
2021	1722	105	1101	365	100673	13	78	98296	2390	204743
2022[1)]	1831	164	1101	268	89044	99	138	82364	1897	176906

1) Provisional figures., 2) USSR prior to 1991. , 3) Figures based on Norwegian IUU estimates in 2002–2008 (see table 4.1), 4) Included landings in Norwegian statistical areas 06 and 07 (from 1983)

Table 4.4. Northeast Arctic haddock. Catch numbers-at-age (numbers, ´000).

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950	0	4446	3189	37949	35344	18849	28868	9199	1979	1093	853	867	1257
1951	4069	222	65643	9178	18014	13551	6808	6850	3322	1182	734	178	436
1952	0	13674	6012	151996	13634	9850	4693	3237	2434	606	534	185	161
1953	392	8031	64528	13013	70781	5431	2867	1080	424	315	393	202	410
1954	1726	493	6563	154696	5885	27590	3233	1302	712	319	126	68	349
1955	0	989	1154	10689	176678	4993	28273	1445	271	100	50	30	20
1956	97	3012	16437	5922	14713	127879	3182	8003	450	200	80	60	45
1957	828	243	2074	24704	7942	12535	46619	1087	1971	356	17	40	119
1958	153	2312	1727	5914	31438	5820	12748	17565	822	1072	226	79	296
1959	169	2425	20318	7826	7243	14040	3154	2237	5918	285	316	71	113
1960	2319	3613	39910	70912	13647	7101	6236	1579	2340	2005	497	70	42
1961	362	5531	15429	56855	63351	8706	3578	4407	788	527	1287	67	80
1962	0	4524	39503	30868	48903	33836	3201	1341	1773	242	247	483	28
1963	3	2143	28466	72736	18969	13579	9257	1239	559	409	80	84	212
1964	149	834	22363	49290	30672	5815	3527	2716	833	104	206	235	190
1965	0	3498	5936	46356	40201	12631	1679	974	897	123	204	123	471
1966	0	2577	26345	22631	63176	29048	5752	582	438	189	186	25	30
1967	0	53	15907	41346	13496	25719	8872	1616	218	175	155	75	41
1968	0	33	657	67632	41267	7748	15599	5292	655	182	101	115	70
1969	0	1061	1524	1968	44634	19002	3620	4937	1628	316	43	43	23
1970	480	281	23444	2454	1906	22417	8100	2012	2016	740	166	26	96
1971	15	3535	1978	24358	1257	918	9279	3056	826	1043	369	130	35
1972	133	9399	230942	22315	42981	3206	1611	6758	2638	900	989	538	120
1973	0	5956	70679	260520	24180	6919	422	426	1692	529	147	339	95

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1974	281	3713	9685	41706	88120	5829	4138	382	618	2043	935	276	659
1975	1321	4355	10037	14088	33871	49711	2135	1236	92	131	500	147	287
1976	3475	7499	13994	13454	6810	20796	40057	1247	1350	193	280	652	671
1977	184	18456	55967	22043	7368	2586	7781	11043	311	388	96	101	182
1978	46	2033	47311	18812	4076	1389	1626	2596	6215	162	258	3	139
1979	0	48	17540	35290	10645	1429	812	546	1466	2310	181	87	55
1980	0	0	627	22878	21794	2971	250	504	230	842	1299	111	50
1981	1	68	486	2561	22124	10685	1034	162	162	72	330	564	69
1982	2	29	883	900	3372	12203	2625	344	75	80	91	321	238
1983	3	351	1173	2636	1360	2394	2506	1799	267	37	60	100	132
1984	7	754	1271	1019	1899	657	950	2619	352	87	2	22	53
1985	4	2952	29624	1695	564	1009	943	886	1763	588	124	64	93
1986	506	650	23113	68429	1565	783	896	393	702	1144	443	130	414
1987	9	83	5031	87170	64556	960	597	376	212	230	419	245	73
1988	7	139	1439	12478	47890	20429	397	178	74	88	168	198	80
1989	611	221	2157	4986	16071	25313	3198	147	1	28	28	53	96
1990	2	446	1015	2580	2142	4046	6221	840	134	42	14	13	44
1991	23	533	4421	3564	2416	3299	4633	3953	461	83	9	18	27
1992	49	2793	11571	11567	4099	2642	2894	3327	3498	486	35	32	18
1993	498	272	13487	19457	13704	4103	1747	1886	2105	1965	201	96	25
1994	95	187	3374	47821	36333	13264	2057	903	1453	2769	1802	259	49
1995	2	85	2003	16109	72644	19145	6417	746	361	770	655	804	116
1996	35	478	1662	6818	36473	73579	13426	2944	573	365	533	598	767
1997	70	94	2280	5633	12603	32832	49478	5636	778	245	126	158	463
1998	547	1476	1701	11304	9258	8633	13801	19469	2113	330	59	54	377
1999	104	568	16839	8039	15365	6073	4466	6355	6204	647	117	109	220
2000	46	692	1520	29986	6496	5149	2406	1657	1570	1744	183	70	184
2001	374	1758	12971	5230	32049	5279	2941	1137	1161	1169	747	169	288
2002	59	603	7132	46335	11084	21985	2602	1602	482	448	581	349	98
2003	123	611	6803	31448	56480	11736	14541	1637	2178	858	411	413	395
2004	58	1295	7993	21116	41310	41226	4939	4914	598	1252	296	139	465
2005	102	865	11452	19369	22887	37067	24461	2393	2997	990	201	263	1059
2006	271	2496	4539	35040	27571	15033	16023	8567	1259	1298	222	175	321
2007	575	3914	30707	15213	45992	18516	10642	7889	2570	678	605	197	185
2008	440	2089	14536	44192	15926	31173	9145	4520	2846	1181	274	214	166
2009	483	1364	15379	55013	52498	13679	15382	3800	1669	887	285	353	321

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
2010	457	620	6545	52006	80622	50306	9273	5324	1954	1114	533	242	621
2011	909	806	1277	8501	90394	100522	39496	4397	2340	668	437	269	708
2012	268	611	7814	4206	18007	93055	82721	14445	1325	448	217	216	568
2013	402	904	1778	12780	3805	12297	58024	29930	4976	957	331	212	535
2014	528	649	6948	4503	14563	6833	16304	39620	16439	2431	619	440	545
2015	303	1334	1645	27317	8526	16624	7950	20538	25534	6677	1556	295	312
2016	294	655	5774	3482	33177	9563	18045	12030	21875	13492	4757	876	248
2017	724	1898	30744	46463	16895	48927	10518	14992	9 485	8447	6640	1872	317
2018	679	1438	9424	16291	34060	8466	18882	5123	8902	4125	3564	4504	1040
2019	797	968	13908	28572	24171	32555	6278	6803	2601	3618	1225	1715	1400
2020	122	1298	10797	62206	46715	18137	10773	3051	2839	1445	996	915	1092
2021	263	641	2882	31573	99086	31202	7412	3595	1985	1161	814	802	966
2022	49	752	2836	18050	50522	55469	11172	2368	1016	544	285	335	479

Table 4.5. Northeast Arctic haddock. Catch weights-at-age (kg).

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1951	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1952	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1953	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1954	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1955	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1956	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1957	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1958	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1959	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1960	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1961	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1962	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1963	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1964	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1965	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1966	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1967	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1968	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1969	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1970	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1971	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1972	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1973	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1974	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1975	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1976	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1977	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1978	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1979	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1980	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1981	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1982	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1983	0.188	0.689	1.033	1.408	1.71	2.149	2.469	2.748	3.069	3.687	4.516	3.094	3.461
1984	0.408	0.805	1.218	1.632	2.038	2.852	2.845	3.218	3.605	4.065	4.407	4.734	5.099
1985	0.319	0.383	0.835	1.29	1.816	2.174	2.301	2.835	3.253	3.721	4.084	4.137	4.926
1986	0.218	0.325	0.612	1.064	1.539	1.944	2.362	2.794	3.25	3.643	4.14	4.559	5.927
1987	0.143	0.221	0.497	0.765	1.179	1.724	2.135	2.551	3.009	3.414	3.84	4.415	5.195
1988	0.279	0.551	0.55	0.908	1.097	1.357	1.537	1.704	2.403	2.403	2.486	2.531	2.834
1989	0.258	0.55	0.684	0.84	0.998	1.176	1.546	1.713	1.949	2.14	2.389	2.522	2.797
1990	0.319	0.601	0.793	1.172	1.397	1.624	1.885	2.112	2.653	3.102	3.18	3.438	3.319
1991	0.216	0.616	0.941	1.281	1.556	1.797	2.044	2.079	2.311	2.788	3.408	2.896	3.274
1992	0.055	0.458	0.906	1.263	1.535	1.747	2.043	2.2	2.298	2.494	2.49	2.673	2.923
1993	0.381	0.64	0.94	1.204	1.487	1.748	1.994	2.237	2.417	2.654	2.906	3.184	3.363
1994	0.278	0.521	0.614	0.906	1.287	1.602	1.968	2.059	2.39	2.545	2.881	2.918	3.222
1995	0.258	0.446	0.739	0.808	1.107	1.556	1.838	2.234	2.416	2.602	2.965	3.163	3.786
1996	0.287	0.427	0.683	0.868	1.045	1.363	1.71	1.886	2.214	2.37	2.438	2.707	2.896
1997	0.408	0.575	0.682	1.028	1.151	1.369	1.637	1.856	2.073	2.5	2.279	2.532	2.609
1998	0.409	0.593	0.748	0.974	1.262	1.433	1.641	1.863	2.069	2.335	2.511	2.8	2.849
1999	0.435	0.695	0.826	1.079	1.261	1.485	1.634	1.798	2.032	2.237	2.339	2.611	2.865
2000	0.378	0.577	0.853	1.186	1.395	1.588	1.808	1.989	2.264	2.415	2.587	2.647	3.098
2001	0.391	0.647	0.751	1.104	1.459	1.709	1.921	2.182	2.331	2.609	2.757	3.376	3.338
2002	0.159	0.407	0.687	1.001	1.363	1.643	1.975	2.086	2.294	2.487	2.612	2.847	3.501
2003	0.198	0.384	0.594	0.875	1.113	1.364	1.361	1.972	1.636	1.877	2.088	2.351	2.842
2004	0.328	0.429	0.636	0.886	1.183	1.508	1.821	2.075	2.339	2.58	2.527	3.153	3.197

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
2005	0.285	0.492	0.722	0.906	1.121	1.343	1.619	2.036	2.177	2.382	2.527	2.496	2.81
2006	0.311	0.567	0.745	1.041	1.287	1.504	1.72	2.082	2.377	2.738	3.082	3.02	3.43
2007	0.329	0.431	0.652	0.899	1.197	1.435	1.722	1.99	2.309	2.715	2.987	2.947	3.591
2008	0.383	0.484	0.658	0.901	1.242	1.515	1.781	2.18	2.33	2.664	3.019	3.326	3.829
2009	0.378	0.508	0.707	1.024	1.28	1.538	1.806	2.107	2.398	2.531	2.606	3.089	3.541
2010	0.317	0.499	0.642	0.887	1.137	1.396	1.702	1.907	2.095	2.404	2.534	3.064	3.249
2011	0.423	0.513	0.811	0.953	1.093	1.254	1.462	1.715	1.978	2.328	2.305	2.55	2.76
2012	0.271	0.506	0.756	1.004	1.174	1.371	1.514	1.715	2.051	2.444	2.414	2.615	2.932
2013	0.469	0.542	0.821	1.014	1.217	1.401	1.571	1.714	1.914	2.168	2.24	2.516	2.807
2014	0.469	0.645	0.792	1.033	1.253	1.417	1.625	1.793	1.941	2.081	2.479	2.703	3.011
2015	0.473	0.647	0.876	1.054	1.327	1.571	1.777	1.934	2.025	2.216	2.481	2.99	3.455
2016	0.497	0.743	0.882	1.115	1.369	1.662	1.917	2.089	2.301	2.567	3.076	3.286	3.331
2017	0.449	0.608	0.874	1.088	1.378	1.666	1.879	2.146	2.258	2.476	2.72	2.98	3.713
2018	0.443	0.663	0.820	1.051	1.339	1.629	1.927	2.156	2.372	2.588	2.728	2.773	3.175
2019	0.341	0.508	0.729	0.955	1.275	1.581	1.834	2.151	2.378	2.607	2.868	2.934	3.382
2020	0.364	0.523	0.629	0.788	1.131	1.489	1.821	2.126	2.426	2.651	2.771	3.147	3.359
2021	0.257	0.445	0.570	0.773	0.997	1.351	1.716	2.150	2.388	2.682	3.073	3.201	4.139
2022	0.175	0.436	0.642	0.808	1.093	1.329	1.651	2.031	2.473	2.727	3.000	3.278	4.297

Table 4.6a. Northeast Arctic haddock. Smoothed stock weights-at-age (kg). The data from 1950–1993 is unchanged since AFWG 2019, the data from 1994 and onward have been updated this year.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950-1979	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1980	0.063	0.262	0.454	0.878	1.159	1.675	2.292	3.134	3.31	3.553	3.792	3.792	3.792
1981	0.051	0.274	0.603	0.805	1.315	1.582	2.118	2.728	3.51	3.679	3.904	3.904	3.904
1982	0.036	0.224	0.631	1.049	1.217	1.782	2.017	2.553	3.14	3.853	4.016	4.016	4.016
1983	0.035	0.164	0.524	1.098	1.558	1.663	2.255	2.448	2.97	3.524	4.165	4.165	4.165
1984	0.028	0.158	0.391	0.926	1.632	2.093	2.121	2.718	2.865	3.363	3.878	3.878	3.878
1985	0.03	0.127	0.379	0.700	1.394	2.195	2.626	2.572	3.158	3.261	3.728	3.728	3.728
1986	0.035	0.136	0.311	0.682	1.069	1.898	2.761	3.138	3.005	3.568	3.632	3.632	3.632
1987	0.042	0.161	0.331	0.569	1.047	1.473	2.411	3.307	3.616	3.412	3.946	3.946	3.946
1988	0.039	0.189	0.383	0.603	0.887	1.452	1.895	2.915	3.822	4.054	3.787	3.787	3.787
1989	0.037	0.175	0.445	0.689	0.936	1.248	1.878	2.317	3.395	4.297	4.449	4.449	4.449
1990	0.031	0.169	0.413	0.789	1.054	1.312	1.635	2.308	2.728	3.844	4.73	4.73	4.73
1991	0.025	0.141	0.402	0.737	1.193	1.458	1.714	2.035	2.732	3.122	4.256	4.256	4.256
1992	0.023	0.114	0.34	0.721	1.119	1.63	1.881	2.127	2.437	3.142	3.491	3.491	3.491

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1993	0.025	0.107	0.279	0.616	1.100	1.537	2.08	2.308	2.54	2.831	3.531	3.531	3.531

Table 4.6b Northeast Arctic haddock. Smoothed stock weights-at-age (kg), updated from 1994 and onwards this year.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1994	0.025	0.106	0.251	0.504	0.939	1.65	2.162	2.704	2.856	2.822	2.969	3.612	4.168
1995	0.032	0.113	0.262	0.471	0.797	1.314	2.107	2.625	3.156	3.284	3.217	3.168	3.926
1996	0.032	0.141	0.279	0.487	0.746	1.135	1.718	2.573	3.083	3.599	3.707	3.393	3.47
1997	0.034	0.144	0.344	0.517	0.769	1.062	1.494	2.126	3.025	3.518	4.014	3.858	3.71
1998	0.026	0.151	0.344	0.624	0.815	1.099	1.416	1.877	2.538	3.455	3.944	4.168	4.168
1999	0.027	0.12	0.364	0.629	0.972	1.157	1.45	1.776	2.267	2.96	3.875	4.081	4.458
2000	0.025	0.124	0.294	0.659	0.979	1.364	1.521	1.825	2.151	2.659	3.355	4.029	4.384
2001	0.021	0.111	0.306	0.539	1.026	1.364	1.767	1.898	2.198	2.543	3.04	3.533	4.329
2002	0.026	0.101	0.274	0.562	0.851	1.431	1.778	2.195	2.291	2.595	2.912	3.242	3.858
2003	0.026	0.118	0.249	0.504	0.882	1.203	1.848	2.195	2.602	2.686	2.982	3.109	3.549
2004	0.027	0.116	0.288	0.463	0.804	1.242	1.575	2.277	2.614	3.032	3.084	3.168	3.424
2005	0.019	0.121	0.285	0.53	0.741	1.135	1.622	1.972	2.706	3.032	3.432	3.271	3.486
2006	0.019	0.088	0.297	0.53	0.833	1.056	1.503	2.027	2.363	3.134	3.432	3.612	3.581
2007	0.021	0.088	0.224	0.544	0.833	1.18	1.398	1.877	2.424	2.767	3.544	3.612	3.926
2008	0.026	0.101	0.22	0.416	0.857	1.18	1.557	1.765	2.267	2.835	3.157	3.71	3.926
2009	0.027	0.118	0.249	0.416	0.671	1.211	1.548	1.94	2.128	2.659	3.232	3.347	4.029
2010	0.035	0.121	0.291	0.467	0.666	0.96	1.584	1.94	2.339	2.518	3.055	3.408	3.661
2011	0.032	0.155	0.297	0.535	0.741	0.96	1.282	1.983	2.327	2.74	2.898	3.242	3.726
2012	0.037	0.141	0.371	0.548	0.845	1.056	1.275	1.63	2.375	2.726	3.128	3.095	3.549
2013	0.033	0.164	0.341	0.669	0.863	1.195	1.398	1.62	1.986	2.78	3.128	3.317	3.408
2014	0.033	0.147	0.392	0.624	1.04	1.218	1.567	1.765	1.974	2.356	3.172	3.317	3.629
2015	0.033	0.149	0.354	0.706	0.972	1.44	1.594	1.95	2.14	2.344	2.72	3.362	3.629
2016	0.025	0.146	0.361	0.644	1.09	1.356	1.869	1.994	2.351	2.518	2.706	2.911	3.677
2017	0.024	0.114	0.35	0.654	0.999	1.51	1.767	2.301	2.388	2.753	2.898	2.911	3.227
2018	0.024	0.107	0.279	0.639	1.013	1.397	1.942	2.184	2.72	2.794	3.143	3.095	3.212
2019	0.025	0.11	0.265	0.517	0.993	1.414	1.808	2.385	2.602	3.149	3.188	3.332	3.408
2020	0.027	0.116	0.271	0.492	0.815	1.389	1.827	2.229	2.815	3.018	3.56	3.377	3.645
2021	0.019	0.124	0.282	0.5	0.781	1.157	1.797	2.253	2.654	3.254	3.432	3.742	3.693
2022	NA	0.088	0.302	0.526	0.792	1.106	1.529	2.218	2.68	3.076	3.658	3.596	4.046
2023	NA	NA	0.22	0.558	0.827	1.128	1.467	1.908	2.64	3.105	3.481	3.825	3.909

Table 4.7a. Northeast Arctic haddock. Proportion mature at age. The data from 1950-1993 is unchanged since AFWG 2019. Age 1-2 are 0, and ages 11-13+ set to 1 (not shown)

Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1950-1979	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1980	0.026	0.076	0.243	0.649	0.86	0.95	0.984	0.995
1981	0.056	0.104	0.303	0.549	0.857	0.948	0.984	0.995
1982	0.053	0.161	0.332	0.577	0.77	0.947	0.983	0.995
1983	0.057	0.183	0.472	0.665	0.8	0.906	0.983	0.995
1984	0.044	0.196	0.51	0.801	0.862	0.921	0.967	0.995
1985	0.027	0.149	0.522	0.796	0.928	0.953	0.973	0.989
1986	0.021	0.103	0.454	0.758	0.928	0.977	0.984	0.991
1987	0.021	0.076	0.294	0.713	0.918	0.976	0.993	0.994
1988	0.025	0.074	0.24	0.576	0.898	0.975	0.993	0.998
1989	0.032	0.09	0.25	0.534	0.822	0.966	0.993	0.998
1990	0.046	0.127	0.305	0.578	0.798	0.937	0.99	0.997
1991	0.041	0.164	0.358	0.623	0.82	0.925	0.98	0.997
1992	0.03	0.147	0.449	0.704	0.855	0.936	0.976	0.994
1993	0.018	0.113	0.396	0.741	0.878	0.95	0.979	0.992

Table 4.7b. Northeast Arctic haddock. Smoothed proportion mature at age. Data 1994-2022, Age 1-2 set to 0, and ages 11-13+ set to 1 (not shown)

Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1994	0.03	0.09	0.275	0.638	0.842	0.943	0.959	0.959
1995	0.031	0.081	0.215	0.505	0.829	0.934	0.976	0.981
1996	0.035	0.085	0.194	0.422	0.726	0.929	0.972	0.99
1997	0.046	0.093	0.203	0.388	0.648	0.864	0.969	0.988
1998	0.046	0.125	0.222	0.405	0.616	0.811	0.933	0.986
1999	0.049	0.126	0.289	0.433	0.63	0.785	0.902	0.966
2000	0.037	0.136	0.292	0.526	0.658	0.799	0.886	0.948
2001	0.039	0.099	0.313	0.526	0.742	0.816	0.893	0.94
2002	0.033	0.106	0.237	0.554	0.745	0.876	0.905	0.944
2003	0.03	0.09	0.251	0.454	0.765	0.876	0.939	0.95
2004	0.036	0.079	0.217	0.472	0.678	0.889	0.94	0.97
2005	0.036	0.097	0.192	0.422	0.695	0.833	0.948	0.97
2006	0.037	0.097	0.229	0.385	0.651	0.844	0.914	0.974
2007	0.026	0.101	0.229	0.444	0.609	0.811	0.922	0.955
2008	0.026	0.068	0.239	0.444	0.672	0.782	0.902	0.959

2009	0.03	0.068	0.166	0.457	0.668	0.826	0.882	0.948
2010	0.037	0.08	0.164	0.339	0.681	0.826	0.911	0.938
2011	0.037	0.098	0.192	0.339	0.559	0.835	0.91	0.954
2012	0.05	0.103	0.234	0.385	0.555	0.742	0.915	0.953
2013	0.045	0.139	0.242	0.451	0.609	0.739	0.858	0.956
2014	0.055	0.125	0.319	0.461	0.675	0.782	0.856	0.922
2015	0.048	0.151	0.289	0.558	0.684	0.829	0.885	0.921
2016	0.049	0.131	0.34	0.522	0.771	0.838	0.913	0.938
2017	0.047	0.134	0.301	0.586	0.742	0.894	0.918	0.955
2018	0.035	0.129	0.307	0.541	0.79	0.875	0.949	0.957
2019	0.032	0.093	0.298	0.547	0.754	0.905	0.939	0.976
2020	0.033	0.086	0.222	0.536	0.76	0.882	0.957	0.969
2021	0.035	0.089	0.208	0.433	0.751	0.886	0.943	0.979
2022	0.038	0.095	0.213	0.409	0.661	0.88	0.946	0.971
2023	0.026	0.105	0.227	0.419	0.637	0.818	0.942	0.973

Table 4.8. Northeast Arctic haddock. Consumption of Haddock by NEA Cod (mln. spec) age 0–6, and total biomass ages 0–6 consumed.

Age	0	1	2	3	4	5	6	Biomass
1984	2226.13	1021.95	15.33	0.09	0.00	0.00	0.00	55.68
1985	2013.22	1368.22	5.08	0.00	0.00	0.00	0.00	53.17
1986	92.25	596.62	223.55	167.55	0.00	0.00	0.00	108.79
1987	0.00	1056.52	0.00	0.00	0.00	0.00	0.00	5.81
1988	0.00	16.71	0.48	8.69	0.00	0.20	0.00	2.50
1989	21.19	220.73	0.00	0.00	0.00	0.00	0.00	9.86
1990	48.44	137.39	34.24	3.32	0.00	0.00	0.00	14.08
1991	0.00	355.55	12.99	0.00	0.00	0.00	0.00	15.68
1992	132.30	1745.90	123.72	0.93	0.00	0.00	0.00	88.19
1993	825.58	1442.59	143.72	32.19	3.11	2.63	0.00	69.40
1994	1346.87	1483.77	73.44	23.88	6.92	0.82	0.01	48.31
1995	181.57	2868.54	167.10	12.37	28.14	27.78	0.32	113.53
1996	358.39	1535.66	154.31	38.20	5.18	2.46	3.18	66.35
1997	0.00	940.21	38.69	26.34	1.70	0.76	0.51	43.68
1998	0.00	1724.31	27.47	1.74	2.56	0.44	0.00	35.73
1999	0.00	1036.23	25.20	0.35	0.00	0.00	0.00	29.44
2000	811.66	1409.01	71.51	2.21	1.15	0.19	0.08	58.21
2001	1049.25	594.35	53.33	4.70	0.07	0.00	0.00	51.31

Age	0	1	2	3	4	5	6	Biomass
2002	456.38	2440.14	240.81	39.53	2.28	0.36	0.17	127.16
2003	1142.87	3575.15	214.44	39.30	12.69	1.21	0.00	166.11
2004	5394.22	2865.22	303.83	39.71	9.88	2.46	0.00	198.07
2005	7717.83	6687.34	276.26	55.14	9.29	2.25	0.88	324.85
2006	12797.81	8422.29	375.09	5.49	4.39	1.17	0.48	361.21
2007	1212.36	10191.31	660.13	71.71	3.84	2.20	0.22	378.44
2008	1368.88	969.68	896.66	228.03	43.89	5.64	3.22	293.25
2009	5657.49	1871.32	275.94	262.40	68.85	22.22	1.53	253.38
2010	1988.14	5732.79	180.16	66.60	67.96	61.64	11.49	266.97
2011	2331.46	2639.28	451.51	56.01	74.85	86.03	18.99	278.41
2012	234.60	7143.05	134.50	107.34	15.03	6.71	4.27	219.69
2013	2161.36	1587.29	376.23	31.36	22.13	5.49	4.16	199.40
2014	1173.98	1991.03	139.52	27.17	1.80	0.62	0.00	87.05
2015	4921.63	2560.70	129.58	13.37	43.55	1.43	0.22	176.32
2016	8073.55	2648.78	277.37	22.11	2.40	7.53	1.74	221.40
2017	4604.25	7660.46	228.98	22.74	12.56	6.17	13.48	272.62
2018	2303.31	6919.23	579.58	64.59	6.82	0.59	0.02	272.99
2019	531.00	4445.71	402.63	118.12	8.10	0.31	0.00	207.81
2020	1867.44	496.40	76.62	55.52	70.59	3.67	0.13	85.24
2021	1015.79	300.91	80.75	5.52	4.58	0.83	0.12	25.73
2022	4221.66	2201.10	219.24	8.30	1.26	0.06	0.00	78.77
Average 1984-2022	2058.54	2638.55	197.18	42.63	13.73	6.51	1.67	137.55

Table 4.9. Northeast Arctic haddock. Survey indices for SAM tuning (see section 4.4.6). The last age is a plus group.

Survey	Year\Age	3	4	5	6	7	8	9	10
RU-BTr-Q4	1991	62	9	3	6	18	17		
RU-BTr-Q4	1992	346	50	4	6	9	9		
RU-BTr-Q4	1993	1985	356	48	8	4	4		
RU-BTr-Q4	1994	442	1014	116	15	1	6		
RU-BTr-Q4	1995	31	123	370	40	5	4		
RU-BTr-Q4	1996	28	49	362	334	29	6		
RU-BTr-Q4	1997	32	32	10	27	10	8		
RU-BTr-Q4	1998	38	46	8	5	15	5		
RU-BTr-Q4	1999	196	39	37	8	3	14		
RU-BTr-Q4	2000	60	109	26	11	2	5		

RU-BTr-Q4	2001	334	40	65	11	4	4		
RU-BTr-Q4	2002	399	450	47	24	4	3		
RU-BTr-Q4	2003	221	299	231	34	16	3		
RU-BTr-Q4	2004	113	94	107	87	5	6		
RU-BTr-Q4	2005	240	86	48	57	24	3		
RU-BTr-Q4	2006	113	119	57	26	24	13		
RU-BTr-Q4	2007	838	73	137	38	14	15		
RU-BTr-Q4	2008	2557	1051	124	111	17	11		
RU-BTr-Q4	2009	1647	1704	631	57	32	9		
RU-BTr-Q4	2010	299	1697	1589	466	34	17		
RU-BTr-Q4	2011	47	268	1087	783	165	13		
RU-BTr-Q4	2012	209	49	160	720	480	70		
RU-BTr-Q4	2013	61	175	50	104	374	272		
RU-BTr-Q4	2014	250	46	175	56	142	416		
RU-BTr-Q4	2015	22	199	40	74	28	171		
RU-BTr-Q4	2016	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2017	71	99	9	38	6	27		
RU-BTr-Q4	2018	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2019	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2020	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2021	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2022	-1	-1	-1	-1	-1	-1		
BS-NoRU-Q1(Aco)	1994	348.73	626.65	121.38	8.55	0.7	0.33	2.71	
BS-NoRU-Q1(Aco)	1995	41.47	121.49	395.37	47.61	2.8	0.05	0.83	
BS-NoRU-Q1(Aco)	1996	29.97	22.09	68.65	143.69	5.67	0.93	0.07	
BS-NoRU-Q1(Aco)	1997	57.27	22.22	15.47	56.13	62.77	4.68	0.19	
BS-NoRU-Q1(Aco)	1998	33.78	58.79	24.2	7.7	14.06	20.69	1.62	
BS-NoRU-Q1(Aco)	1999	83.67	21.64	22.1	6.17	1.55	3.88	2.77	
BS-NoRU-Q1(Aco)	2000	36.39	75.53	14.01	12.61	1.57	0.53	3.02	
BS-NoRU-Q1(Aco)	2001	233.45	40.2	41.38	2.2	1.61	0.15	0.71	
BS-NoRU-Q1(Aco)	2002	255.2	201.84	18.47	11.7	1.59	0.29	0.56	
BS-NoRU-Q1(Aco)	2003	203.68	184.57	136.04	12.26	6.01	0.26	0.9	
BS-NoRU-Q1(Aco)	2004	151.01	101.85	107.82	57.68	7.61	1.15	0.55	
BS-NoRU-Q1(Aco)	2005	221.33	115.67	57.43	56.71	12.69	0.38	0.33	
BS-NoRU-Q1(Aco)	2006	56.32	123.84	47.37	19.26	13.64	3.23	0.35	
BS-NoRU-Q1(Aco)	2007	209.28	46.14	80.57	28.92	10	5.05	2.79	
BS-NoRU-Q1(Aco)	2008	812.41	303.04	90.02	74.12	7.41	12.77	2.11	

BS-NoRU-Q1(Aco)	2009	883.68	629.98	266.65	38.87	14.57	1.26	1.05	
BS-NoRU-Q1(Aco)	2010	128.07	631.03	603.99	166.96	12.07	2.94	2.11	
BS-NoRU-Q1(Aco)	2011	54.16	84.23	313.02	292.21	54.91	1.71	1.46	
BS-NoRU-Q1(Aco)	2012	191.63	48.84	88.12	310.6	172.52	30.09	1.01	
BS-NoRU-Q1(Aco)	2013	67.29	146.77	35.41	53.03	223.77	102.68	14.37	
BS-NoRU-Q1(Aco)	2014	334.82	39.12	108.72	23.18	34.77	86.36	38.82	
BS-NoRU-Q1(Aco)	2015	24.35	189.4	26.63	46.13	9.22	22.45	31.99	
BS-NoRU-Q1(Aco)	2016	71.81	12.08	59.62	12.52	17.28	7.48	33.24	
BS-NoRU-Q1(Aco)	2017	81.15	65.05	4.81	34.81	6.24	7.93	17.72	
BS-NoRU-Q1(Aco)	2018	171.03	62.74	64.4	6.77	15.57	2.75	14.69	
BS-NoRU-Q1(Aco)	2019	507.61	146.22	31.73	21.88	4.72	3.46	4.19	
BS-NoRU-Q1(Aco)	2020	286.32	306.38	79.18	22.38	11.59	1.84	6.33	
BS-NoRU-Q1(Aco)	2021	50.76	130.37	181.8	19.35	5.44	0.94	1.77	
BS-NoRU-Q1(Aco)	2022	11.35	63.4	95.3	101.24	11.79	0.82	1.08	
BS-NoRU-Q1(Aco)	2023	76.99	9.02	51.28	53.25	38.07	2.69	0.49	
BS-NoRu-Q1 (BTr)	1994	314.533	436.251	46.176	3.54	0.163	0.13	0.2	0.651
BS-NoRu-Q1 (BTr)	1995	54.857	167.104	343.38	29.623	1.441	0.025	0.043	0.404
BS-NoRu-Q1 (BTr)	1996	55.843	31.334	150.768	238.108	16.131	1.15	0	0.069
BS-NoRu-Q1 (BTr)	1997	79.632	39.855	18.255	61.566	88.411	3.277	0.082	0.043
BS-NoRu-Q1 (BTr)	1998	21.681	36.749	11.844	1.294	9.203	7.212	0.648	0.092
BS-NoRu-Q1 (BTr)	1999	56.92	15.874	9.418	2.831	0.807	1.282	0.771	0.034
BS-NoRu-Q1 (BTr)	2000	24.08	35.241	6.789	4.134	0.684	0.083	0.802	0.288
BS-NoRu-Q1 (BTr)	2001	293.996	26.252	22.997	1.634	0.752	0.058	0.06	0.329
BS-NoRu-Q1 (BTr)	2002	312.87	185.453	12.417	8.04	0.846	0.218	0.009	0.325
BS-NoRu-Q1 (BTr)	2003	352.236	174.452	72.708	5.104	1.682	0.119	0.104	0.217
BS-NoRu-Q1 (BTr)	2004	173.132	100.516	77.021	51.281	7.409	0.912	0.133	0.228
BS-NoRu-Q1 (BTr)	2005	317.889	141.058	50.664	61.191	10.082	0.249	0.08	0.009
BS-NoRu-Q1 (BTr)	2006	78.798	130.76	46.048	20.874	16.208	3.184	0.094	0.265
BS-NoRu-Q1 (BTr)	2007	443.266	81.784	84.667	26.279	5.411	2.197	1.376	0.896
BS-NoRu-Q1 (BTr)	2008	1591.031	583.606	53.079	54.732	6.794	10.248	0.23	0.167
BS-NoRu-Q1 (BTr)	2009	1230.426	751.012	368.33	25.414	12.437	0.851	0.09	0.363
BS-NoRu-Q1 (BTr)	2010	102.451	510.449	443.759	139.316	7.988	1.016	0.386	0.574
BS-NoRu-Q1 (BTr)	2011	52.883	123.634	469.482	290.036	65.236	1.416	1.121	0.184
BS-NoRu-Q1 (BTr)	2012	316.077	28.785	74.714	267.945	154.601	24.766	3.115	0.391
BS-NoRu-Q1 (BTr)	2013	57.444	143.984	22.019	33.624	191.145	69.385	6.114	0.076
BS-NoRu-Q1 (BTr)	2014	381.173	32.729	104.397	23.257	50.035	97.536	38.692	2.425
BS-NoRu-Q1 (BTr)	2015	30.615	187.035	43.601	39.44	14.668	18.735	30.744	10.2

BS-NoRu-Q1 (BTr)	2016	163.385	34.342	115.597	22.406	41.948	12.437	32.396	33.161
BS-NoRu-Q1 (BTr)	2017	134.9	105.5	7.553	55.338	9.692	15.6	2.527	23.861
BS-NoRu-Q1 (BTr)	2018	336.307	86.656	65.764	7.771	15.59	3.621	2.564	11.931
BS-NoRu-Q1 (BTr)	2019	1075.552	187.224	49.399	16.996	4.038	2.948	0.736	1.91
BS-NoRu-Q1 (BTr)	2020	424.225	586.985	99.123	22.08	6.057	2.605	1.042	2.827
BS-NoRu-Q1 (BTr)	2021	111.35	176.57	265.49	19.32	3.57	0.68	0.19	0.72
BS-NoRu-Q1 (BTr)	2022	12.226	86.54	121.699	113.566	9.099	0.617	0.113	0.44
BS-NoRu-Q1 (BTr)	2023	82.055	8.058	50.201	49.022	33.313	2.168	0.096	0.318
FLT007: Eco-NoRu-Q3 (Btr)	2004	123.368	70.303	69.118	31.482	2.989	1.721	0.22	
FLT007: Eco-NoRu-Q3 (Btr)	2005	324.56	89.531	30.44	32.246	15.035	0.472	1.116	
FLT007: Eco-NoRu-Q3 (Btr)	2006	107.467	124.64	41.597	18.98	17.482	7.289	1.384	
FLT007: Eco-NoRu-Q3 (Btr)	2007	1282.94	88.498	90.369	19.227	5.881	7.102	3.209	
FLT007: Eco-NoRu-Q3 (Btr)	2008	1154.869	405.999	43.133	35.517	4.94	2.514	2.539	
FLT007: Eco-NoRu-Q3 (Btr)	2009	650.742	619.088	305.883	21.045	6.549	0.87	0.576	
FLT007: Eco-NoRu-Q3 (Btr)	2010	184.001	865.318	666.439	147.72	15.84	2.73	0.589	
FLT007: Eco-NoRu-Q3 (Btr)	2011	40.446	73.802	392.93	301.368	37.357	2.972	0.514	
FLT007: Eco-NoRu-Q3 (Btr)	2012	92.468	20.348	67.607	214.052	152.03	12.739	2.003	
FLT007: Eco-NoRu-Q3 (Btr)	2013	25.779	65.228	19.575	50.846	150.131	76.427	7.561	
FLT007: Eco-NoRu-Q3 (Btr)	2014	261.631	40.768	70.161	25.781	60.452	85.771	19.646	
FLT007: Eco-NoRu-Q3 (Btr)	2015	42.148	213.636	25.132	37.111	20.577	47.868	42.903	
FLT007: Eco-NoRu-Q3 (Btr)	2016	209.303	34.43	184.09	47.965	56.787	40.367	125.907	
FLT007: Eco-NoRu-Q3 (Btr)	2017	70.313	70.306	11.47	20.537	3.963	4.025	15.265	
FLT007: Eco-NoRu-Q3 (Btr)	2018	-1	-1	-1	-1	-1	-1	-1	
FLT007: Eco-NoRu-Q3 (Btr)	2019	896.982	160.736	38.067	15.133	5.303	5.037	11.56	
FLT007: Eco-NoRu-Q3 (Btr)	2020	204.059	341.372	58.813	4.918	1.959	0.802	1.483	
FLT007: Eco-NoRu-Q3 (Btr)	2021	129.533	345.768	330.627	32.25	5.446	0.885	1.41	
FLT007: Eco-NoRu-Q3 (Btr)	2022	-1	-1	-1	-1	-1	-1	-1	

Table 4.10 SAM model configuration used. Updated at WKDEM 2020

#Configuration saved: Wed Feb 12 12:57:09 2020
Where a matrix is specified rows corresponds to fleets and columns to ages.
Same number indicates same parameter used
Numbers (integers) starts from zero and must be consecutive
$minAge
The minimum age class in the assessment
3

$maxAge
The maximum age class in the assessment
13
$maxAgePlusGroup
Is last age group considered a plus group for each fleet (1 yes, or 0 no).
1 1 1 1 1
$keyLogFsta
Coupling of the fishing mortality states (nomally only first row is used).
0 1 2 3 4 5 5 5 5 5 5
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$corFlag
Correlation of fishing mortality across ages (0 independent, 1 compound symmetry, 2 AR(1), 3 separable AR(1).
2
$keyLogFpar
Coupling of the survey catchability parameters (nomally first row is not used, as that is covered by fishing mortality).
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
0 1 1 1 1 1 -1 -1 -1 -1 -1
2 3 3 3 3 4 4 -1 -1 -1 -1
5 6 6 6 6 7 7 7 -1 -1 -1
8 9 9 9 9 9 9 -1 -1 -1 -1
$keyQpow
Density dependent catchability power parameters (if any).
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
0 0 0 0 0 0 -1 -1 -1 -1 -1
1 1 1 1 1 2 2 -1 -1 -1 -1
3 3 3 3 3 4 4 4 -1 -1 -1
5 5 5 5 5 5 5 -1 -1 -1 -1
$keyVarF
Coupling of process variance parameters for log(F)-process (nomally only first row is used)
0 1 1 1 1 1 1 1 1 1 1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarLogN
Coupling of process variance parameters for log(N)-process
0 1 1 1 1 1 1 1 1 1 1
$keyVarObs
Coupling of the variance parameters for the observations.
0 1 2 2 2 2 2 2 2 2 2
3 3 3 3 3 3 -1 -1 -1 -1 -1
4 4 4 4 4 4 4 -1 -1 -1 -1
5 5 5 5 5 5 5 5 -1 -1 -1
6 6 6 6 6 6 6 -1 -1 -1 -1
$obsCorStruct
Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for unstructured). | Possible values are: "ID" "AR" "US"
"ID" "AR" "AR" "AR" "AR"
$keyCorObs
Coupling of correlation parameters can only be specified if the AR(1) structure is chosen above.
NA's indicate where correlation parameters can be specified (-1 where they cannot).
#V1 V2 V3 V4 V5 V6 V7 V8 V9 V10
NA NA NA NA NA NA NA NA NA NA
0 1 1 1 2 -1 -1 -1 -1 -1
3 3 3 3 3 4 -1 -1 -1 -1
5 5 5 5 5 6 6 -1 -1 -1
7 7 7 7 7 7 -1 -1 -1 -1
$stockRecruitmentModelCode
Stock recruitment code (0 for plain random walk, 1 for Ricker, 2 for Beverton–Holt, and 3 piece-wise constant).
0
$noScaledYears
Number of years where catch scaling is applied.
0
$keyScaledYears
A vector of the years where catch scaling is applied.
$keyParScaledYA
A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).
$fbarRange
lowest and higest age included in Fbar
4 7
$keyBiomassTreat

To be defined only if a biomass survey is used (0 SSB index, 1 catch index, 2 FSB index, 3 total catch, 4 total landings and 5 TSB index).
-1 -1 -1 -1 -1
$obsLikelihoodFlag
Option for observational likelihood | Possible values are: "LN" "ALN"
"LN" "LN" "LN" "LN" "LN"
$fixVarToWeight
If weight attribute is supplied for observations this option sets the treatment (0 relative weight, 1 fix variance to weight).
0
$fracMixF
The fraction of t(3) distribution used in logF increment distribution
0
$fracMixN
The fraction of t(3) distribution used in logN increment distribution
0
$fracMixObs
A vector with same length as number of fleets, where each element is the fraction of t(3) distribution used in the distribution of that fleet
0 0 0 0 0
$constRecBreaks
This option is only used in combination with stock-recruitment code 3)
$predVarObsLink
Coupling of parameters used in a mean-variance link for observations.
0 1 2 2 2 2 2 2 2 2 2
3 3 3 3 3 3 -1 -1 -1 -1 -1
4 4 4 4 4 4 4 -1 -1 -1 -1
5 5 5 5 5 5 5 5 -1 -1 -1
6 6 6 6 6 6 6 -1 -1 -1 -1

Table 4.11. Northeast Arctic haddock. SAM model. Estimated recruitment, spawning-stock biomass (SSB), and average fishing mortality (Fbar ages 4.-7).

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4-7)	Low	High	TSB	Low	High
1950	109623	69719	172368	213220	191156	237830	0.792	0.672	0.934	397004	356438	442186
1951	631600	419651	950595	124921	110924	140684	0.681	0.574	0.808	426981	341432	533963
1952	84773	54716	131341	100892	88188	115426	0.702	0.587	0.839	414536	331663	518118
1953	1185570	788600	1782370	120474	104198	139293	0.531	0.440	0.642	714903	552489	925061
1954	131072	84429	203482	173396	147339	204060	0.430	0.354	0.521	810761	643156	1022044

1955	59015	37632	92549	310699	265693	363330	0.448	0.372	0.539	839986	709844	993988
1956	224093	143883	349018	365196	311618	427984	0.473	0.394	0.569	683432	588380	793838
1957	60604	38656	95014	253014	217173	294769	0.427	0.356	0.512	432917	376615	497637
1958	73937	47720	114558	181479	157787	208730	0.517	0.431	0.622	314741	277314	357219
1959	385837	255412	582864	125376	108965	144258	0.444	0.367	0.538	332385	274589	402346
1960	316609	207861	482251	112820	99557	127849	0.540	0.451	0.646	416093	347620	498055
1961	142992	94247	216948	124521	110996	139694	0.663	0.561	0.784	399847	348322	458994
1962	290838	193209	437798	124755	110917	140319	0.793	0.674	0.932	373918	322982	432887
1963	312452	209219	466621	93953	82727	106701	0.759	0.637	0.903	350254	294071	417171
1964	352527	234648	529623	84272	74117	95818	0.633	0.526	0.761	384525	319428	462887
1965	126418	82446	193844	103006	90021	117864	0.525	0.435	0.634	385699	326833	455168
1966	311649	205173	473380	145159	126569	166479	0.559	0.466	0.670	448964	384402	524368
1967	339662	223233	516817	150924	130293	174822	0.442	0.366	0.534	462635	390044	548737
1968	18632	11581	29976	167460	145218	193109	0.484	0.400	0.586	424534	360952	499316
1969	20419	12678	32884	167225	143902	194328	0.414	0.338	0.506	315395	270631	367564
1970	207491	134384	320370	154939	131625	182383	0.385	0.312	0.475	285433	241116	337894
1971	111175	72211	171164	127393	107531	150922	0.327	0.262	0.407	263185	224203	308944
1972	1070502	702592	1631067	128356	111626	147594	0.657	0.540	0.801	607473	464904	793764
1973	313265	207865	472108	124981	107671	145074	0.537	0.440	0.656	636571	512649	790447
1974	65486	42670	100502	153799	134217	176238	0.502	0.415	0.608	463526	400797	536073
1975	59189	38540	90901	194901	167177	227223	0.496	0.414	0.593	378744	329157	435801
1976	60684	38901	94664	195998	168532	227941	0.719	0.606	0.852	295485	258996	337114
1977	121979	76877	193541	118883	100338	140857	0.736	0.608	0.890	201169	172504	234598
1978	214424	142356	322979	80977	67141	97665	0.626	0.510	0.769	198729	164562	239989
1979	160926	106383	243435	62345	52497	74039	0.582	0.470	0.722	205414	171253	246389
1980	23213	14499	37164	62642	53262	73674	0.474	0.381	0.590	212528	177897	253901
1981	10753	6412	18033	72614	61489	85753	0.435	0.349	0.542	168102	142110	198848
1982	16720	10242	27295	68575	56806	82784	0.381	0.303	0.479	122827	103001	146468
1983	8149	4776	13902	58539	48137	71188	0.348	0.273	0.445	87910	73704	104855
1984	12959	7947	21134	53258	43476	65242	0.314	0.244	0.405	71641	59861	85740
1985	359312	236221	546544	49122	40892	59009	0.397	0.312	0.505	191609	141398	259649
1986	475093	314149	718492	54736	46432	64525	0.536	0.427	0.673	372994	294625	472209
1987	91356	59208	140957	77455	66308	90476	0.630	0.508	0.782	354567	296956	423354
1988	39791	25056	63192	79718	67210	94553	0.512	0.411	0.637	253803	215631	298733
1989	28136	17461	45338	84374	69643	102221	0.372	0.296	0.468	192610	161616	229549
1990	36625	23539	56987	86094	70227	105547	0.211	0.165	0.268	153642	128637	183508
1991	109109	76849	154913	100514	84514	119543	0.239	0.191	0.299	185561	158658	217025

1992	322033	229560	451758	110630	95699	127889	0.296	0.239	0.366	287771	242054	342123
1993	826301	602336	1133542	124712	110048	141329	0.319	0.260	0.391	516687	429018	622272
1994	393766	319529	485252	156442	139995	174822	0.375	0.310	0.453	640827	561985	730730
1995	100598	78995	128108	190422	170029	213262	0.302	0.254	0.359	637221	564547	719251
1996	100245	79110	127026	220324	196959	246461	0.369	0.314	0.433	553666	494787	619551
1997	120223	95102	151980	191369	170872	214324	0.448	0.380	0.529	400900	360744	445527
1998	63423	49360	81492	133091	118110	149971	0.454	0.381	0.541	266552	239365	296826
1999	149058	119876	185343	96283	85445	108497	0.463	0.385	0.558	232836	208217	260366
2000	83495	65831	105898	79739	70662	89982	0.342	0.281	0.417	213699	189394	241123
2001	364169	299709	442494	93068	83120	104206	0.369	0.307	0.444	317315	281258	357995
2002	391892	321807	477240	111070	99298	124238	0.354	0.295	0.425	433151	383747	488916
2003	338236	273815	417813	140482	126288	156272	0.428	0.362	0.505	503391	449690	563505
2004	259668	213462	315874	159092	143041	176944	0.392	0.334	0.461	491520	442065	546507
2005	362149	299324	438161	170323	153202	189358	0.408	0.348	0.478	507710	457400	563553
2006	156383	127361	192018	154878	139215	172302	0.372	0.316	0.439	437455	394265	485375
2007	529730	435759	643965	156349	140853	173550	0.389	0.330	0.460	499998	449165	556584
2008	1082898	900454	1302306	165612	148176	185101	0.320	0.268	0.382	722543	638944	817079
2009	1006157	838256	1207688	188052	168383	210019	0.266	0.223	0.317	979507	864231	1110158
2010	238242	194758	291435	253718	226928	283670	0.250	0.212	0.296	1107953	978842	1254094
2011	118425	94405	148557	365658	326967	408928	0.262	0.224	0.307	1160931	1033094	1304588
2012	338277	277459	412427	480739	426855	541425	0.225	0.192	0.265	1155519	1029885	1296479
2013	119004	95182	148787	527223	466340	596054	0.151	0.126	0.179	990749	882849	1111837
2014	408463	336651	495592	526488	469008	591013	0.156	0.131	0.187	974511	877083	1082763
2015	72818	57371	92425	499967	449971	555517	0.191	0.160	0.228	865793	784065	956039
2016	211215	171518	260100	491826	443504	545413	0.262	0.222	0.310	796459	722086	878493
2017	195172	158817	239849	411777	373750	453673	0.351	0.298	0.414	697005	634732	765387
2018	361715	294755	443888	304028	275111	335985	0.406	0.345	0.477	605919	549120	668592
2019	803698	664905	971462	233785	211128	258874	0.437	0.368	0.519	666438	597228	743667
2020	432773	355823	526363	196925	176888	219231	0.449	0.377	0.535	684255	609425	768272
2021	162387	129606	203461	188827	167976	212267	0.439	0.366	0.526	628726	557559	708976
2022	44865	32747	61469	196492	168994	228465	0.351	0.284	0.434	532782	460835	615961
2023	157204	117650	210057	210340	169939	260346				454403	373476	552864

Table 4.12. Northeast Arctic haddock. SAM model estimated fishing mortality-at-age. SAM model.

Year Age	3	4	5	6	7	8	9	10	11	12	13

1950	0.196	0.478	0.750	0.873	1.069	0.895	0.895	0.895	0.895	0.895	0.895
1951	0.131	0.369	0.614	0.766	0.975	0.881	0.881	0.881	0.881	0.881	0.881
1952	0.125	0.376	0.627	0.784	1.021	0.930	0.930	0.930	0.930	0.930	0.930
1953	0.081	0.277	0.467	0.582	0.798	0.737	0.737	0.737	0.737	0.737	0.737
1954	0.055	0.206	0.357	0.467	0.689	0.650	0.650	0.650	0.650	0.650	0.650
1955	0.051	0.200	0.371	0.505	0.716	0.605	0.605	0.605	0.605	0.605	0.605
1956	0.055	0.210	0.392	0.554	0.738	0.626	0.626	0.626	0.626	0.626	0.626
1957	0.050	0.198	0.369	0.494	0.646	0.550	0.550	0.550	0.550	0.550	0.550
1958	0.061	0.235	0.451	0.601	0.782	0.692	0.692	0.692	0.692	0.692	0.692
1959	0.061	0.228	0.409	0.521	0.619	0.567	0.567	0.567	0.567	0.567	0.567
1960	0.096	0.318	0.538	0.633	0.671	0.615	0.615	0.615	0.615	0.615	0.615
1961	0.127	0.406	0.684	0.782	0.782	0.694	0.694	0.694	0.694	0.694	0.694
1962	0.160	0.501	0.858	0.944	0.867	0.722	0.722	0.722	0.722	0.722	0.722
1963	0.140	0.468	0.808	0.912	0.846	0.682	0.682	0.682	0.682	0.682	0.682
1964	0.098	0.358	0.635	0.771	0.766	0.648	0.648	0.648	0.648	0.648	0.648
1965	0.076	0.292	0.514	0.637	0.657	0.567	0.567	0.567	0.567	0.567	0.567
1966	0.091	0.330	0.565	0.669	0.671	0.556	0.556	0.556	0.556	0.556	0.556
1967	0.072	0.269	0.447	0.516	0.536	0.465	0.465	0.465	0.465	0.465	0.465
1968	0.085	0.300	0.493	0.556	0.589	0.514	0.514	0.514	0.514	0.514	0.514
1969	0.080	0.270	0.431	0.471	0.483	0.417	0.417	0.417	0.417	0.417	0.417
1970	0.083	0.265	0.404	0.429	0.441	0.382	0.382	0.382	0.382	0.382	0.382
1971	0.072	0.234	0.351	0.355	0.366	0.324	0.324	0.324	0.324	0.324	0.324
1972	0.213	0.509	0.765	0.698	0.656	0.546	0.546	0.546	0.546	0.546	0.546
1973	0.219	0.491	0.646	0.532	0.479	0.382	0.382	0.382	0.382	0.382	0.382
1974	0.190	0.430	0.545	0.513	0.521	0.460	0.460	0.460	0.460	0.460	0.460
1975	0.208	0.457	0.546	0.493	0.486	0.417	0.417	0.417	0.417	0.417	0.417
1976	0.321	0.644	0.782	0.721	0.727	0.640	0.640	0.640	0.640	0.640	0.640
1977	0.364	0.713	0.854	0.718	0.657	0.559	0.559	0.559	0.559	0.559	0.559
1978	0.243	0.549	0.731	0.646	0.577	0.505	0.505	0.505	0.505	0.505	0.505
1979	0.168	0.444	0.674	0.654	0.558	0.502	0.502	0.502	0.502	0.502	0.502
1980	0.102	0.318	0.529	0.567	0.483	0.460	0.460	0.460	0.460	0.460	0.460
1981	0.085	0.276	0.476	0.542	0.447	0.430	0.430	0.430	0.430	0.430	0.430
1982	0.074	0.246	0.413	0.478	0.387	0.381	0.381	0.381	0.381	0.381	0.381
1983	0.075	0.245	0.385	0.424	0.340	0.339	0.339	0.339	0.339	0.339	0.339
1984	0.067	0.226	0.347	0.376	0.308	0.292	0.292	0.292	0.292	0.292	0.292
1985	0.075	0.259	0.415	0.484	0.431	0.413	0.413	0.413	0.413	0.413	0.413

1986	0.088	0.315	0.542	0.667	0.619	0.587	0.587	0.587	0.587	0.587	0.587
1987	0.100	0.359	0.647	0.789	0.726	0.659	0.659	0.659	0.659	0.659	0.659
1988	0.072	0.278	0.514	0.660	0.595	0.539	0.539	0.539	0.539	0.539	0.539
1989	0.055	0.219	0.387	0.467	0.414	0.363	0.363	0.363	0.363	0.363	0.363
1990	0.027	0.127	0.214	0.255	0.247	0.231	0.231	0.231	0.231	0.231	0.231
1991	0.030	0.136	0.243	0.291	0.285	0.262	0.262	0.262	0.262	0.262	0.262
1992	0.031	0.148	0.294	0.368	0.373	0.341	0.341	0.341	0.341	0.341	0.341
1993	0.025	0.131	0.295	0.411	0.440	0.400	0.400	0.400	0.400	0.400	0.400
1994	0.023	0.127	0.309	0.481	0.582	0.547	0.547	0.547	0.547	0.547	0.547
1995	0.018	0.101	0.235	0.371	0.500	0.493	0.493	0.493	0.493	0.493	0.493
1996	0.024	0.126	0.290	0.444	0.617	0.624	0.624	0.624	0.624	0.624	0.624
1997	0.032	0.160	0.377	0.538	0.718	0.686	0.686	0.686	0.686	0.686	0.686
1998	0.038	0.180	0.404	0.554	0.678	0.680	0.680	0.680	0.680	0.680	0.680
1999	0.047	0.205	0.434	0.562	0.653	0.627	0.627	0.627	0.627	0.627	0.627
2000	0.033	0.160	0.327	0.414	0.468	0.440	0.440	0.440	0.440	0.440	0.440
2001	0.035	0.165	0.359	0.459	0.493	0.451	0.451	0.451	0.451	0.451	0.451
2002	0.031	0.153	0.324	0.456	0.483	0.424	0.424	0.424	0.424	0.424	0.424
2003	0.037	0.172	0.371	0.536	0.632	0.573	0.573	0.573	0.573	0.573	0.573
2004	0.035	0.161	0.334	0.489	0.583	0.551	0.551	0.551	0.551	0.551	0.551
2005	0.038	0.166	0.339	0.499	0.627	0.606	0.606	0.606	0.606	0.606	0.606
2006	0.037	0.161	0.319	0.448	0.562	0.553	0.553	0.553	0.553	0.553	0.553
2007	0.039	0.161	0.324	0.472	0.599	0.581	0.581	0.581	0.581	0.581	0.581
2008	0.025	0.115	0.234	0.390	0.541	0.536	0.536	0.536	0.536	0.536	0.536
2009	0.020	0.091	0.183	0.314	0.474	0.490	0.490	0.490	0.490	0.490	0.490
2010	0.020	0.087	0.174	0.294	0.447	0.499	0.499	0.499	0.499	0.499	0.499
2011	0.022	0.091	0.190	0.312	0.457	0.500	0.500	0.500	0.500	0.500	0.500
2012	0.021	0.084	0.163	0.271	0.383	0.410	0.410	0.410	0.410	0.410	0.410
2013	0.014	0.062	0.109	0.173	0.257	0.318	0.318	0.318	0.318	0.318	0.318
2014	0.016	0.070	0.122	0.180	0.253	0.353	0.353	0.353	0.353	0.353	0.353
2015	0.022	0.090	0.161	0.224	0.289	0.402	0.402	0.402	0.402	0.402	0.402
2016	0.029	0.116	0.226	0.314	0.392	0.514	0.514	0.514	0.514	0.514	0.514
2017	0.038	0.150	0.307	0.441	0.508	0.592	0.592	0.592	0.592	0.592	0.592
2018	0.037	0.156	0.353	0.527	0.588	0.641	0.641	0.641	0.641	0.641	0.641
2019	0.035	0.156	0.382	0.607	0.603	0.604	0.604	0.604	0.604	0.604	0.604
2020	0.035	0.157	0.398	0.617	0.624	0.598	0.598	0.598	0.598	0.598	0.598
2021	0.034	0.153	0.388	0.597	0.618	0.622	0.622	0.622	0.622	0.622	0.622
2022	0.031	0.137	0.330	0.462	0.474	0.474	0.474	0.474	0.474	0.474	0.474

Table 4.13. Northeast Arctic haddock. SAM model. Estimated stock numbers-at-age.

Year Age	3	4	5	6	7	8	9	10	11	12	13
1950	109623	99515	73946	36861	46641	16609	4900	2693	1380	1454	2052
1951	631600	55863	45199	26869	12660	12380	5398	1921	1001	444	1088
1952	84773	422627	32356	19106	8994	4308	3835	1643	729	354	507
1953	1185570	50064	209430	14435	6404	2655	1333	1060	535	250	306
1954	131072	889554	25847	91806	6993	2344	1091	548	391	200	225
1955	59015	84026	623259	14553	51921	3113	925	454	236	161	168
1956	224093	40838	55764	321772	7224	17672	1442	403	213	112	153
1957	60604	149066	27687	35841	110868	3084	6149	697	168	98	128
1958	73937	40105	92201	15498	20678	40168	1623	2516	348	84	117
1959	385837	51762	26132	40054	7328	7278	14901	718	906	145	86
1960	316609	264126	35758	15636	17097	3472	3648	6190	356	374	107
1961	142992	190773	144816	17679	6966	8027	1593	1508	2803	155	205
1962	290838	85322	91871	59513	6759	2704	3279	658	611	1162	140
1963	312452	174643	37745	26397	17531	2638	1086	1229	272	244	536
1964	352527	198348	75316	12255	7694	5828	1214	440	509	121	344
1965	126418	239839	114736	30289	4177	2797	2268	531	198	218	209
1966	311649	82240	158397	61955	12357	1710	1281	949	268	91	187
1967	339662	199815	43537	72456	24781	4869	792	603	452	131	132
1968	18632	245726	117726	21891	36059	12463	2357	411	314	234	137
1969	20419	12004	141328	55071	10677	15754	5749	1166	198	156	175
1970	207491	12565	7544	70208	25122	5889	8057	3012	644	106	185
1971	111175	133807	7132	4514	33401	12287	3348	4546	1694	371	163
1972	1070502	80551	81578	4518	3097	17569	6743	2010	2775	1028	315
1973	313265	609383	46109	23259	1694	1534	7653	2911	924	1375	612
1974	65486	168837	251149	16511	10675	880	999	4454	1683	545	1217
1975	59189	37029	90428	140453	6825	4965	447	553	2147	818	930
1976	60684	33566	16530	44304	78976	3167	2772	245	327	1149	966
1977	121979	30693	13743	6449	17664	30350	1292	1184	103	145	812
1978	214424	54722	9660	4446	2891	7748	15067	630	563	45	432

1979	160926	116800	23166	3236	2033	1399	4093	7080	337	273	227
1980	23213	102283	58300	8304	1154	1042	713	2155	3484	174	240
1981	10753	16073	63188	26202	3457	552	554	378	1134	1718	214
1982	16720	7005	11187	31651	10536	1724	278	305	215	619	961
1983	8149	11334	4726	6844	13601	5608	984	147	176	125	807
1984	12959	4960	6715	2782	3900	8812	2897	578	81	103	521
1985	359312	8881	2854	3616	1794	2567	5356	1845	368	52	398
1986	475093	276662	5201	1574	1848	994	1468	2791	1026	205	261
1987	91356	249222	155831	2542	646	792	469	676	1207	470	208
1988	39791	70206	135366	46356	1063	231	320	204	299	507	280
1989	28136	26115	49172	70655	12224	545	95	152	98	144	365
1990	36625	20735	17302	26218	32801	5514	350	58	87	56	277
1991	109109	24790	13634	14134	20183	20285	3159	246	39	57	205
1992	322033	82805	15932	10079	10383	12604	12643	1898	162	26	158
1993	826301	221025	56917	10585	5914	6226	7641	7271	1055	99	107
1994	393766	572759	152794	31377	4664	3146	3737	4744	4308	596	115
1995	100598	224101	428082	77772	14595	2088	1430	1856	2184	2128	339
1996	100245	61795	167529	246266	32037	7266	1079	709	929	1093	1253
1997	120223	55556	38088	95697	103026	13997	2526	490	312	411	1083
1998	63423	80159	35203	18059	36783	38928	5244	995	208	131	698
1999	149058	48420	47439	17478	8872	15850	13861	1922	412	92	380
2000	83495	118561	30873	21467	6897	4301	6600	5451	816	188	226
2001	364169	69036	93286	16779	10213	3519	2579	3523	2683	439	234
2002	391892	294294	51864	47700	9142	5508	1893	1444	1932	1409	354
2003	338236	257652	193472	34354	24646	4595	3471	1218	827	1092	999
2004	259668	170475	164074	111001	16400	10905	2145	1647	610	391	1064
2005	362149	170200	94356	109327	50823	6652	5559	1139	733	306	782
2006	156383	215933	108515	52020	44900	20854	3216	2821	554	345	529
2007	529730	120423	164703	61199	26744	19335	8222	1748	1474	283	439
2008	1082898	452799	97021	102901	21815	14087	7194	3317	885	714	353
2009	1006157	704569	372586	62189	40083	10345	5338	3155	1462	484	582
2010	238242	668207	593168	231950	32390	15223	4822	2730	1609	780	624
2011	118425	191334	545119	421278	122220	14345	6229	2135	1342	827	802
2012	338277	73590	137008	392916	265836	54954	6207	2591	1040	696	922
2013	119004	198814	58125	94933	272212	127779	23887	3195	1416	591	966
2014	408463	73709	145482	50016	87912	146010	62030	10947	1881	886	984
2015	72818	283525	65858	92635	40753	69890	74091	25930	5400	1025	1026

2016	211215	49652	167859	46340	61953	33696	49712	38248	12937	2595	1008
2017	195172	175360	34021	110016	28306	36698	18879	22005	18099	5665	1499
2018	361715	135419	124971	24834	43862	14742	17957	8956	9322	8556	3162
2019	803698	238352	87983	62961	16612	17572	6986	7674	3716	3910	4306
2020	432773	513996	157212	45875	22832	8832	7199	3475	3278	1773	3409
2021	162387	269777	347368	70355	19576	8636	4129	2977	1687	1538	2308
2022	44865	143622	190956	177748	32764	7624	3506	1791	1228	772	1652
2023	157204	28014	107132	112780	88935	17075	3594	1770	908	624	1227

Table 4.14. Northeast Arctic haddock. SAM model. Natural mortality estimated age 3-6 from 0.20 + consumption from cod, ages 7-13+ natural mortality set to 0.2

+											
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1950	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1951	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1952	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1953	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1954	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1955	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1956	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1957	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1958	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1959	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1960	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1961	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1962	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1963	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1964	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1965	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1966	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1967	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1968	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1969	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1970	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1971	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200

1972	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1973	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1974	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1975	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1976	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1977	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1978	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1979	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1980	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1981	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1982	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1983	0.345	0.255	0.241	0.239	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1984	0.215	0.220	0.214	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1985	0.209	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1986	0.638	0.262	0.200	0.210	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1987	0.200	0.206	0.417	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1988	0.380	0.200	0.200	0.388	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1989	0.200	0.200	0.200	0.231	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1990	0.330	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1991	0.202	0.215	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1992	0.215	0.204	0.203	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1993	0.252	0.247	0.274	0.259	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1994	0.288	0.213	0.292	0.224	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1995	0.379	0.340	0.315	0.291	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1996	0.722	0.320	0.249	0.280	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1997	0.502	0.266	0.256	0.280	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1998	0.231	0.291	0.267	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1999	0.200	0.207	0.274	0.262	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2000	0.214	0.200	0.215	0.244	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2001	0.210	0.200	0.225	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2002	0.323	0.212	0.200	0.203	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2003	0.417	0.249	0.206	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2004	0.414	0.300	0.200	0.225	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2005	0.397	0.302	0.230	0.268	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2006	0.223	0.214	0.274	0.211	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2007	0.296	0.200	0.236	0.321	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2008	0.373	0.276	0.263	0.335	0.200	0.200	0.200	0.200	0.200	0.200	0.200

2009	0.405	0.247	0.281	0.254	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2010	0.358	0.248	0.271	0.283	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2011	0.528	0.467	0.307	0.225	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2012	0.595	0.312	0.203	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2013	0.458	0.338	0.246	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2014	0.283	0.206	0.218	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2015	0.342	0.398	0.209	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2016	0.305	0.200	0.244	0.227	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2017	0.340	0.296	0.231	0.409	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2018	0.430	0.265	0.266	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2019	0.371	0.255	0.217	0.278	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2020	0.366	0.355	0.271	0.213	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2021	0.224	0.215	0.227	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2022	0.434	0.201	0.200	0.210	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Table 4.15. Northeast Arctic haddock. Summary XSA (p-shrinkage not applied, F shrinkage= 0.5). FLR Thu Jun 01 17:00:23 2023

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1950	82358	242532	134570	132125	0.9818	1.5897	0.8312
1951	668654	355818	101096	120077	1.1878	1.2272	0.6238
1952	76856	235382	57487	127660	2.2207	1.7404	0.7245
1953	1274412	511708	82542	123920	1.5013	1.4279	0.516
1954	152568	537772	117340	156788	1.3362	1.474	0.3805
1955	68638	485566	178791	202286	1.1314	1.536	0.5117
1956	208621	474931	243678	213924	0.8779	1.2623	0.4332
1957	66162	326310	186283	123583	0.6634	1.2455	0.4328
1958	87032	276967	156973	112672	0.7178	1.1252	0.519
1959	398300	364900	133304	88211	0.6617	0.9405	0.3672
1960	289536	401027	114646	154651	1.3489	1.0411	0.4842
1961	130728	391342	129987	193224	1.4865	0.9942	0.6365
1962	290785	346439	118893	187408	1.5763	1.0518	0.8005
1963	340884	310688	82659	146224	1.769	1.1458	0.8648
1964	398106	301821	63852	99158	1.5529	1.3572	0.6525
1965	124286	357905	95458	118578	1.2422	1.1507	0.4935
1966	293747	387627	127564	161778	1.2682	1.1621	0.5835

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1967	362150	467845	154565	136397	0.8825	0.9984	0.415
1968	23934	421264	169508	181726	1.0721	0.9976	0.5032
1969	21428	342515	184144	130820	0.7104	0.882	0.3972
1970	202340	286651	156116	88257	0.5653	0.9762	0.358
1971	122446	345537	168580	78905	0.4681	0.7638	0.2465
1972	1251170	619134	123021	266153	2.1635	1.0883	0.6922
1973	341754	603399	114691	322226	2.8095	1.1656	0.5365
1974	69192	603583	200749	221157	1.1017	0.8946	0.4322
1975	60153	493085	256310	175758	0.6857	0.8957	0.427
1976	66858	307383	206727	137264	0.664	1.12	0.571
1977	134320	228964	141815	110158	0.7768	1.09	0.684
1978	213354	255968	130588	95422	0.7307	0.9219	0.5115
1979	175982	318219	129532	103623	0.8	0.7684	0.552
1980	34745	343110	133215	87889	0.6598	0.7568	0.398
1981	13415	292881	148243	77153	0.5204	0.7174	0.4012
1982	17379	211908	127246	46955	0.369	0.7224	0.3093
1983	9564	104361	71477	24600	0.3442	1.0373	0.2715
1984	13434	83502	64118	20945	0.3267	1.0547	0.2498
1985	288300	182799	62012	45052	0.7265	0.9761	0.32
1986	528864	343499	62303	100563	1.6141	1.0484	0.4388
1987	109761	333919	75055	154916	2.064	0.992	0.5958
1988	54833	260035	78422	95255	1.2146	0.9955	0.499
1989	26591	212726	91989	58518	0.6361	0.9774	0.3892
1990	36926	170796	95307	27182	0.2852	1.0159	0.1562
1991	104297	195376	110524	36216	0.3277	1.0374	0.2082
1992	207580	269187	125750	59922	0.4765	0.9797	0.2838
1993	661753	442178	130414	82379	0.6317	1.0031	0.359
1994	292144	544170	148802	135186	0.9085	1.0056	0.425
1995	97778	540469	164106	142448	0.868	1.0247	0.3828
1996	102089	473273	189927	178128	0.9379	1.0175	0.4235
1997	115475	350171	167002	154359	0.9243	1.0519	0.4862
1998	58292	250224	126742	100630	0.794	1.0113	0.4235
1999	230833	253282	95021	83195	0.8755	1.021	0.4212
2000	89100	251156	87595	68944	0.7871	1.026	0.2802
2001	365921	358557	113453	89640	0.7901	0.9903	0.2795
2002	342184	445166	132555	114798	0.866	1.011	0.3175

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
2003	223322	475695	155730	138926	0.8921	1.019	0.4302
2004	224464	456645	162309	158279	0.9752	1.0192	0.382
2005	346167	471225	172007	158298	0.9203	1.0029	0.493
2006	155997	415409	146117	153157	1.0482	0.9938	0.4088
2007	666658	497187	142876	161525	1.1305	0.9916	0.4282
2008	1338413	736952	149223	155604	1.0428	0.9928	0.3948
2009	1454803	1079714	173982	200061	1.1499	1.0019	0.357
2010	525518	1259213	241741	249200	1.0309	0.9994	0.2968
2011	244116	1283336	351185	309785	0.8821	0.9978	0.319
2012	383756	1160965	431556	315627	0.7314	0.9994	0.266
2013	150464	988307	477516	193744	0.4057	0.9967	0.1335
2014	378223	989466	521615	177522	0.3403	0.9968	0.1115
2015	100899	926753	532292	194756	0.3659	0.9953	0.1588
2016	254252	833858	500288	233183	0.4661	1.0006	0.2262
2017	175193	704814	413802	227588	0.55	0.994	0.3555
2018	337402	574493	297367	191276	0.6432	0.9943	0.4328
2019	780289	619341	217111	175402	0.8079	0.9963	0.511
2020	408527	644060	177067	182468	1.0305	0.9962	0.557
2021	210752	595739	169237	204743	1.2098	0.9981	0.5058
2022	61285	513996	175534	176906	1.0078	0.998	0.379

Table 4.16. Northeast Arctic haddock. Input data for recruitment prediction (RCT3)- recruits as 3 year-olds. Recr: recruitment estimate from SAM 2023 NT1: Norwegian Russian winter bottom trawl survey age 1 NT2: Norwegian Russian winter bottom trawl survey age. NAK1: Norwegian Russian winter acoustic survey age 1 NAK2: Norwegian Russian winter acoustic survey age 2. ECO1: Ecosystem survey age 1. ECO2: Ecosystem survey age 2. The Russian survey (RT) was discontinued in 2017 and has not been used for recruitment forecast since.

Year class	Recr.	NT1	NT2	NAK1	NAK2	EC01	ECO2
1990	826301	NA	NA	NA	NA	NA	NA
1991	393766	NA	NA	NA	NA	NA	NA
1992	100598	NA	224.785	NA	187.96	NA	NA
1993	100245	604.198	199.523	887.82	88.59	NA	NA
1994	120223	1429.036	265.083	1198.18	94.52	NA	NA
1995	63423	300.778	90.806	132.6	26.51	NA	NA
1996	149058	1117.83	196.698	508.87	150.99	NA	NA
1997	83495	248.274	83.201	210.96	30.11	NA	NA
1998	364169	1207.984	437.224	653.4	404.77	NA	NA
1999	391892	832.297	446.843	1063.01	266.12	NA	NA

Year class	Recr.	NT1	NT2	NAK1	NAK2	EC01	ECO2
2000	338236	1230.979	475.308	753.01	267.9	NA	NA
2001	259668	1700.188	471.677	1315.15	362.35	NA	NA
2002	362149	3327.315	706.61	2743.74	466.54	NA	268.462
2003	156383	700.861	386.388	528.97	143.98	188.987	114.244
2004	529730	4473.159	1310.216	2276.46	624.78	603.787	929.118
2005	1082898	4944.605	1684.829	2091.11	953.5	2270.189	1818.927
2006	1006157	3731.194	2042.009	2015.71	1753.54	988.391	1291.864
2007	238242	853.093	317.051	778.39	209.05	322.015	143.819
2008	118425	562.606	79.895	443.93	86.03	134.833	65.087
2009	338277	1634.823	353.866	1559.42	288.27	274.353	113.561
2010	119004	676.315	137.384	428.46	94.54	105.263	41.529
2011	408463	1866.965	490.28	1583.44	407.16	591.096	222.994
2012	72818	344.585	123.954	292.71	109.92	155.943	75.054
2013	211215	1281.405	342.024	1838.71	246.59	264.813	145.248
2014	195172	1133.967	561.956	1593.12	107.18	319.963	144.86
2015	361715	2299.365	770	1276	331.42	793.772	189.253
2016	803698	5065.427	1675.638	3343.93	810.16	935.791	NA
2017	432773	3823.293	1125.267	2925.9	687.8	NA	585.3
2018	162387	1898.2	267.785	1544.96	260.72	379.389	57.781
2019	44865	110.624	24.99	272.94	15.69	26.825	35.878
2020	157204	405.82	110.312	431.68	70.15	107.622	106.849
2021	NA	1662.107	583.238	1797.09	511.05	691.821	NA
2022	NA	1337.385	NA	1032.67	NA	NA	NA

Table 4.17. Northeast Arctic haddock Analysis by RCT3 ver3.1 - R translation. Data for 6 surveys over 32 year classes : 1990 – 2021 Regression type = C, Tapered time weighting applied, power = 3 over 20 years, Survey weighting not applied, Final estimates shrunk towards mean, Estimates with S.E.'S greater than that of mean included, Minimum S.E. for any survey taken as 0.2, Minimum of 3 points used for regression, Forecast/Hindcast variance correction used.

yearclass	:2020								
index	**slope**	**intercept**	**se**	**rsquare**	**n**	**indices**	**prediction**	**se.pred**	**WAP.weights**
NT1	0.8625	6.178	0.3367	0.8847	20	6.008	11.36	0.4008	0.20097
NT2	0.7666	7.845	0.3159	0.8973	20	4.712	11.46	0.3733	0.23174
NAK1	1.1983	3.912	0.5191	0.7635	20	6.053	11.17	0.6241	0.0829
NAK2	0.8199	7.923	0.3494	0.8772	20	4.265	11.42	0.4138	0.18854
EC01	0.9149	7.099	0.4026	0.8543	16	4.688	11.39	0.4825	0.13868
ECO2	0.9	7.798	0.4553	0.7987	17	4.679	12.01	0.5267	0.11639

yearclass	:2021								
index	slope	intercept	se	rsquare	n	indices	prediction	se.pred	WAP.weights
NT1	0.8282	6.461	0.3572	0.864	20	7.416	12.6	0.4088	0.22589
NT2	0.7431	8.017	0.3276	0.883	20	6.37	12.75	0.3769	0.26565
NAK1	1.14	4.36	0.5227	0.748	20	7.494	12.9	0.6046	0.10327
NAK2	0.7968	8.089	0.3681	0.8567	20	6.238	13.06	0.4309	0.20326
EC01	0.8883	7.293	0.4182	0.8344	17	6.541	13.1	0.5	0.15098
ECO2	NA	NA	NA	NA	NA	NA	NA	NA	NA
yearclass	:2022								
index	slope	intercept	se	rsquare	n	indices	prediction	se.pred	WAP.weights
NT1	0.8122	6.566	0.3581	0.865	19	7.199	12.41	0.4135	0.5843
NT2	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAK1	1.1179	4.494	0.5162	0.7551	19	6.941	12.25	0.5955	0.2817
NAK2	NA	NA	NA	NA	NA	NA	NA	NA	NA
EC01	NA	NA	NA	NA	NA	NA	NA	NA	NA
ECO2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	WAP	logWAP	int.se						
2020 YC	98498	11.5	0.1797						
2021 YC	371852	12.83	0.1943						
2022YC	230976	12.35	0.3161						

Table 4.18. Northeast Arctic haddock. Prediction with management option table: Input data (based on SAM estimates and forecast estimates according to stock annex).

2023								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWt**	**Sel**	**CWt**
3	157204	0.341	0.026	0	0	0.22	0.028	0.641
4	28014	0.257	0.105	0	0	0.558	0.127	0.975
5	107132	0.233	0.227	0	0	0.827	0.316	1.182
6	112780	0.208	0.419	0	0	1.128	0.475	1.383
7	88935	0.2	0.637	0	0	1.467	0.486	1.654
8	17075	0.2	0.818	0	0	1.908	0.48	1.927
9	3594	0.2	0.942	0	0	2.64	0.48	2.273
10	1770	0.2	0.973	0	0	3.105	0.48	2.704
11	908	0.2	1	0	0	3.481	0.48	2.901
12	624	0.2	1	0	0	3.825	0.48	3.144
13	1227	0.2	1	0	0	3.909	0.48	3.641

2024								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	371852	0.341	0.033	0	0	0.318	0.028	0.75
4	.	0.257	0.068	0	0	0.416	0.127	0.822
5	.	0.233	0.247	0	0	0.876	0.316	1.227
6	.	0.208	0.44	0	0	1.173	0.475	1.424
7	.	0.2	0.644	0	0	1.485	0.486	1.665
8	.	0.2	0.801	0	0	1.836	0.48	1.929
9	.	0.2	0.907	0	0	2.303	0.48	2.176
10	.	0.2	0.971	0	0	3.061	0.48	2.546
11	.	0.2	1	0	0	3.512	0.48	2.882
12	.	0.2	1	0	0	3.661	0.48	3.078
13	.	0.2	1	0	0	4.133	0.48	3.533
2025								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	230976	0.341	0.032	0	0	0.304	0.028	0.733
4	.	0.257	0.089	0	0	0.5	0.127	0.912
5	.	0.233	0.164	0	0	0.666	0.316	1.035
6	.	0.208	0.469	0	0	1.234	0.475	1.48
7	.	0.2	0.665	0	0	1.539	0.486	1.697
8	.	0.2	0.806	0	0	1.856	0.48	1.939
9	.	0.2	0.896	0	0	2.22	0.48	2.178
10	.	0.2	0.951	0	0	2.7	0.48	2.47
11	.	0.2	1	0	0	3.481	0.48	2.748
12	.	0.2	1	0	0	3.693	0.48	3.065
13	.	0.2	1	0	0	3.977	0.48	3.48

Table 4.19. Northeast Arctic haddock. Prediction with management option table for 2023-2025 (TAC constraint applied for intermediate year) MFDP R version. Run22 data from file fhcr_fmgmt.xls. Input units are thousands and kg - output in tonnes

year	Biomass	SSB	FMult	FBar	Landings
2023	**454405**	**210343**	**1.0745**	**0.3771**	**170067**
year	**Biomass**	**SSB**	**FMult**	**FBar**	**Landings**
2024	444781	189420	0	0	0
			0.1	0.0351	14648
			0.2	0.0702	28704
			0.3	0.1053	42193
			0.4	0.1404	55141

			0.5	0.1755	67573
			0.6	0.2106	79510
			0.7	0.2457	90976
			0.8	0.2808	101991
			0.9	0.3159	112576
			1	0.351	122749
			1.1	0.3861	132529
			1.2	0.4212	141933
			1.3	0.4563	150977
			1.4	0.4914	159678
			1.5	0.5265	168051
			1.6	0.5616	176110
			1.7	0.5967	183869
			1.8	0.6318	191341
			1.9	0.6669	198539
			2	0.702	205475

Table 4.20. Northeast Arctic haddock. Prediction single option table for 2023-2025 based on HCR MFDP R version Run22 data from file fhcr_fmgmt.xls Fbar age range: 4-7. Input units are thousands and kg - output in tonnes

Year:	**2023**	**F multiplier:**	**1.0745**	**Fbar:**	**0.3771**	
age	**CatchN**	**CatchYield**	**F**	**SSB (Jan)**	**StockBiomass (Jan)**	**StockN (Jan)**
3	3951	2533	0.0301	899	34585	157204
4	3160	3081	0.1365	1641	15632	28014
5	27694	32734	0.3395	20112	88598	107132
6	41060	56786	0.5104	53303	127216	112780
7	33073	54703	0.5222	83108	130468	88935
8	6289	12119	0.5157	26650	32579	17075
9	1324	3009	0.5157	8938	9488.2	3594
10	652	1763	0.5157	5347	5495.9	1770
11	334	970	0.5157	3161	3160.7	908
12	230	723	0.5157	2387	2386.8	624
13	452	1646	0.5157	4796	4796.3	1227
TOTAL	118220	170067		210343	454405	519263
Year:	2024	F multiplier:	1.0486	Fbar:	0.3681	
age	CatchN	CatchYield	F	SSB (Jan)	StockBiomass (Jan)	StockN (Jan)
3	9124	6843	0.0294	3902	118249	371852
4	11960	9831	0.1332	3068	45123	108468

5	4786	5873	0.3314	4090	16558	18902
6	21589	30743	0.4981	31191	70888	60433
7	20067	33411	0.5096	52585	81654	54986
8	15612	30116	0.5033	63524	79306	43195
9	3017	6565	0.5033	17435	19223	8346.8
10	635	1617	0.5033	5222	5377.7	1756.9
11	313	901	0.5033	3039	3038.7	865.23
12	160	494	0.5033	1625	1625	443.86
13	327	1155	0.5033	3740	3739.6	904.83
TOTAL	87591	127550		189420	444781	670153
Year:	2025	F multiplier:	0.9972	Fbar:	0.35	
age	CatchN	CatchYield	F	SSB (Jan)	StockBiomass (Jan)	StockN (Jan)
3	5393	3953	0.0279	2247	70217	230976
4	27005	24629	0.1266	11426	128379	256758
5	17812	18435	0.3151	8020	48902	73427
6	3692	5464	0.4736	6221	13265	10750
7	10467	17762	0.4846	30527	45905	29828
8	9397	18222	0.4786	40456	50193	27044
9	7429	16180	0.4786	42525	47461	21379
10	1436	3546	0.4786	10607	11154	4131.1
11	302	830	0.4786	3027	3027	869.53
12	149	456	0.4786	1581	1581	428.23
13	232	807	0.4786	2655	2655	667.51
TOTAL	83313	110283		159292	422739	656258

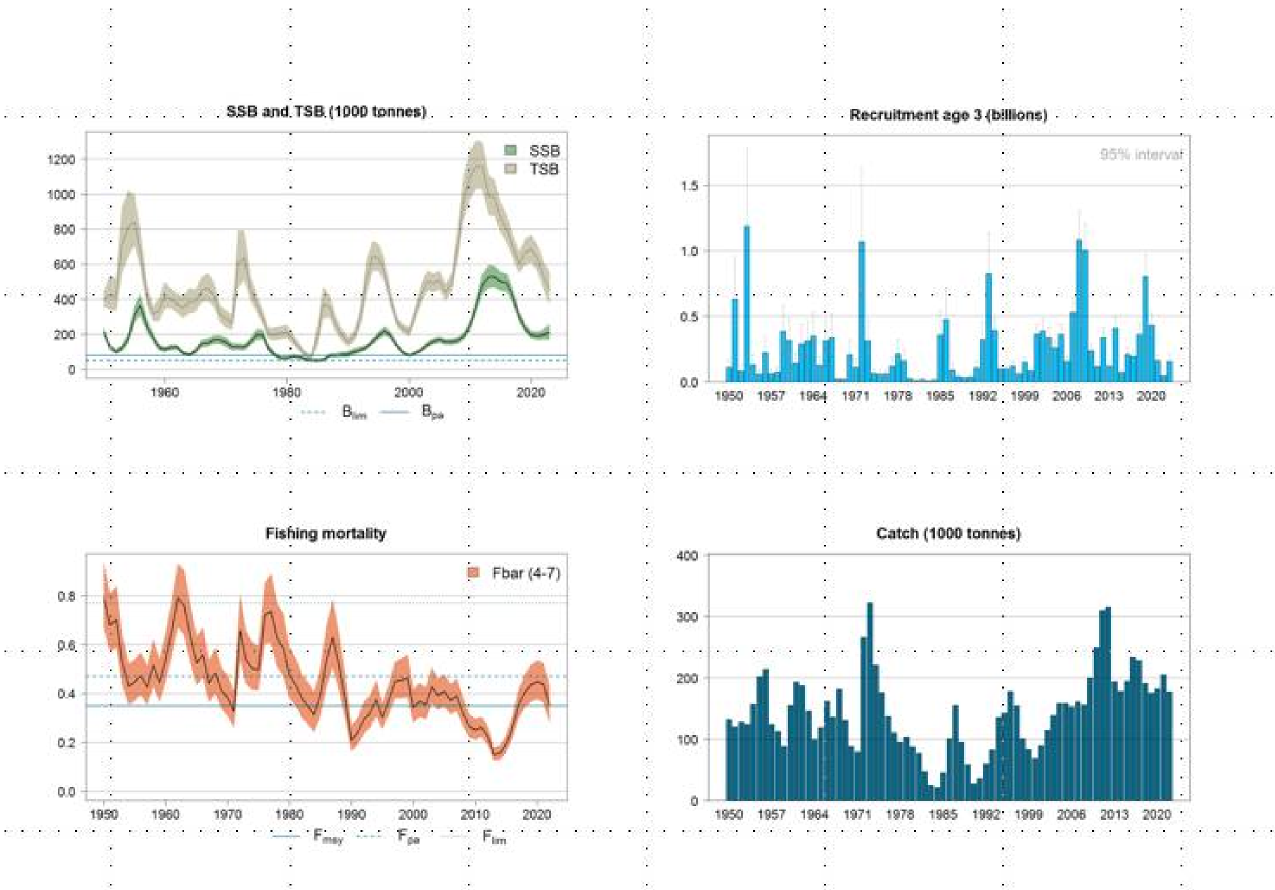

Figure 4.1 Northeast Arctic haddock landings (top left 1950-2022), fishing mortality (top right 1950-2022), recruitment (bottom left 1950-2023), and total stock biomass for ages 3+ (TSB) and spawning-stock biomass (SSB) (bottom right 1950–2023). The reference points in the SSB and TSB plot refers to the spawning stock biomass. Fishing mortality and total and spawning stock biomass are given with point wise 95% confidence intervals (shaded areas), recruitment is given with upper 95% confidence interval (bar).

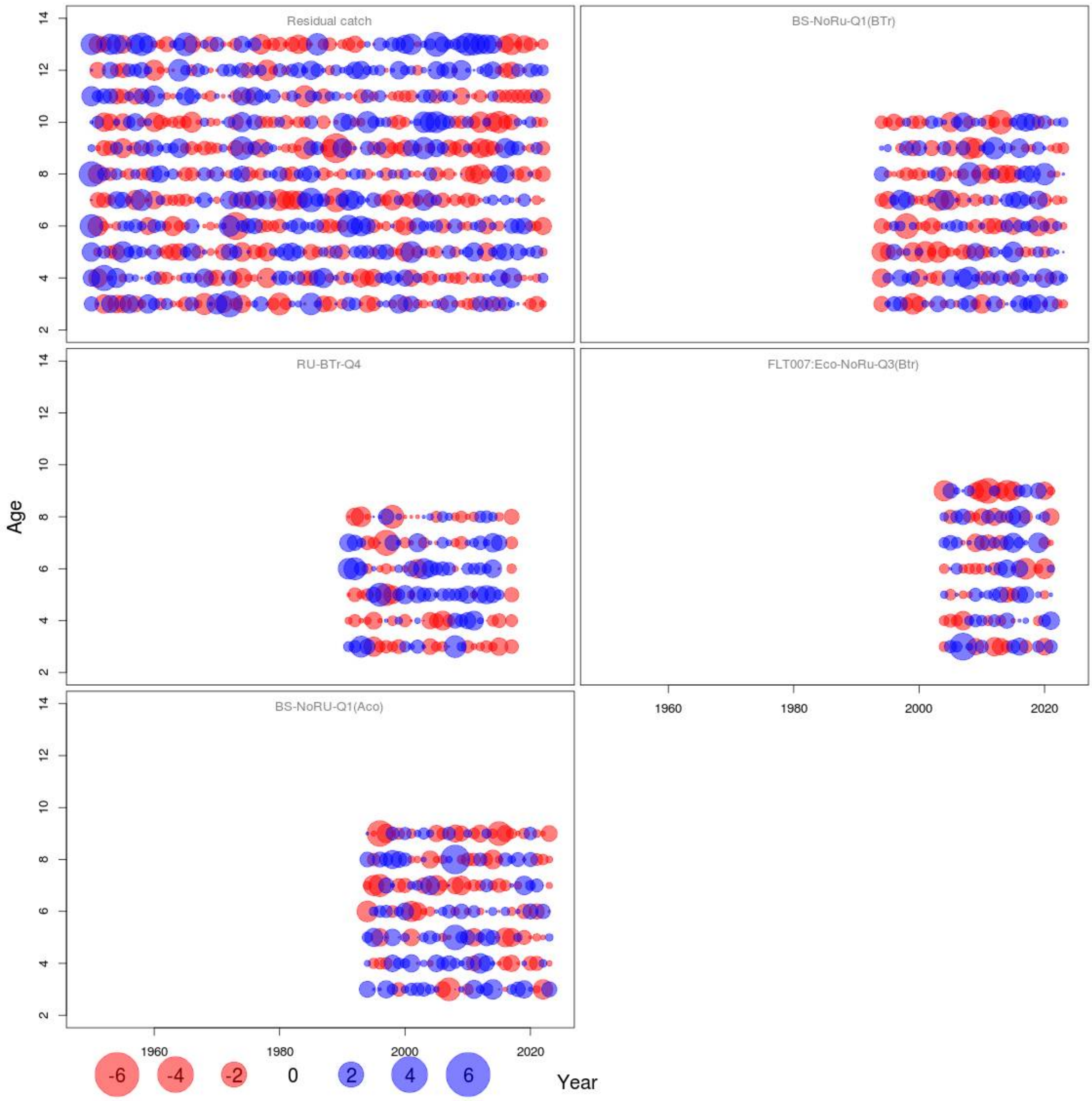

Figure 4.2. Northeast Arctic haddock; one step ahead residuals for the final SAM run 2023. Blue circles indicate positive residuals (observations larger than predicted) and red circles indicate negative residuals.

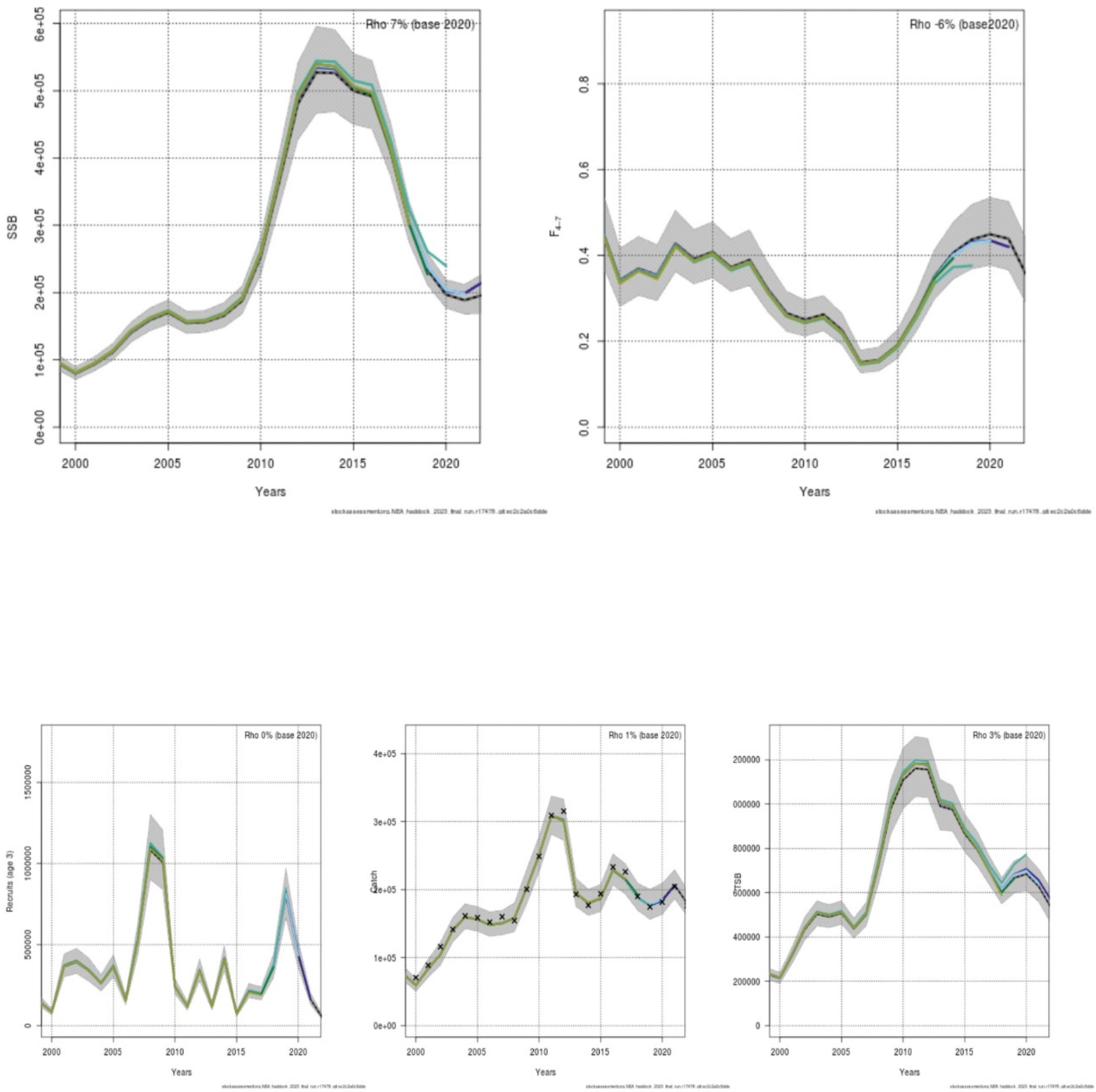

Figure 4.3. Northeast Arctic haddock. 5 year retrospective plots of SSB (top left), fishing mortality (top right), recruitment (bottom left), catches (bottom middle) and TSB (bottom right) for years 2000–2022 (SAM with 95% confidence intervals).

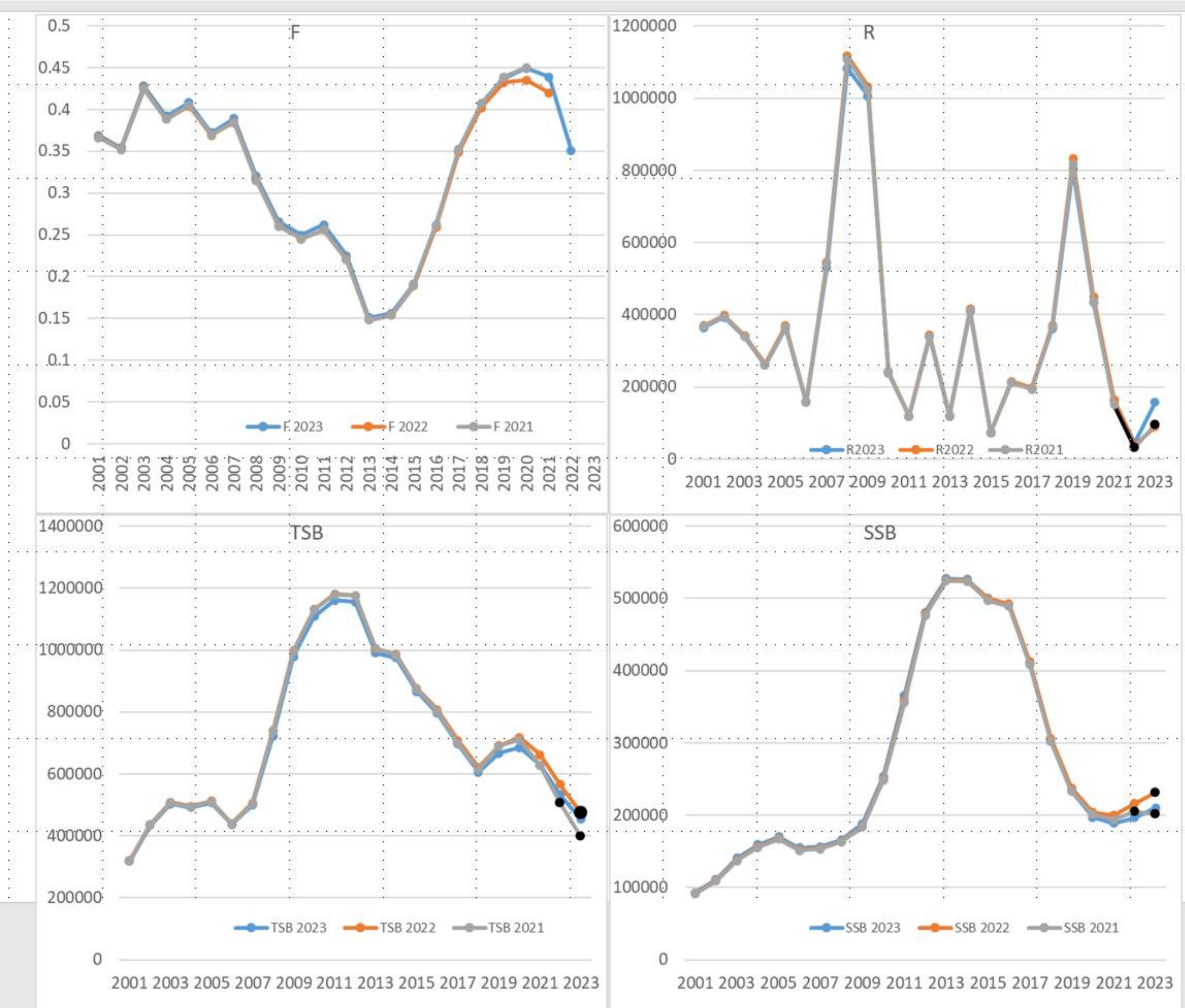

Figure 4.4. Results of assessment of NEA haddock. Fbar(4-7), TSB, recruits and SSB from AFWG 2021 (grey), JRN-AFWG 2022(orange) and this year's (2023) assessment (blue) from 2001 and onwards. The last black circles on the lines for AFWG 2021 and JRN-AFWG 2022 are forecasts for 2022 and 2023.

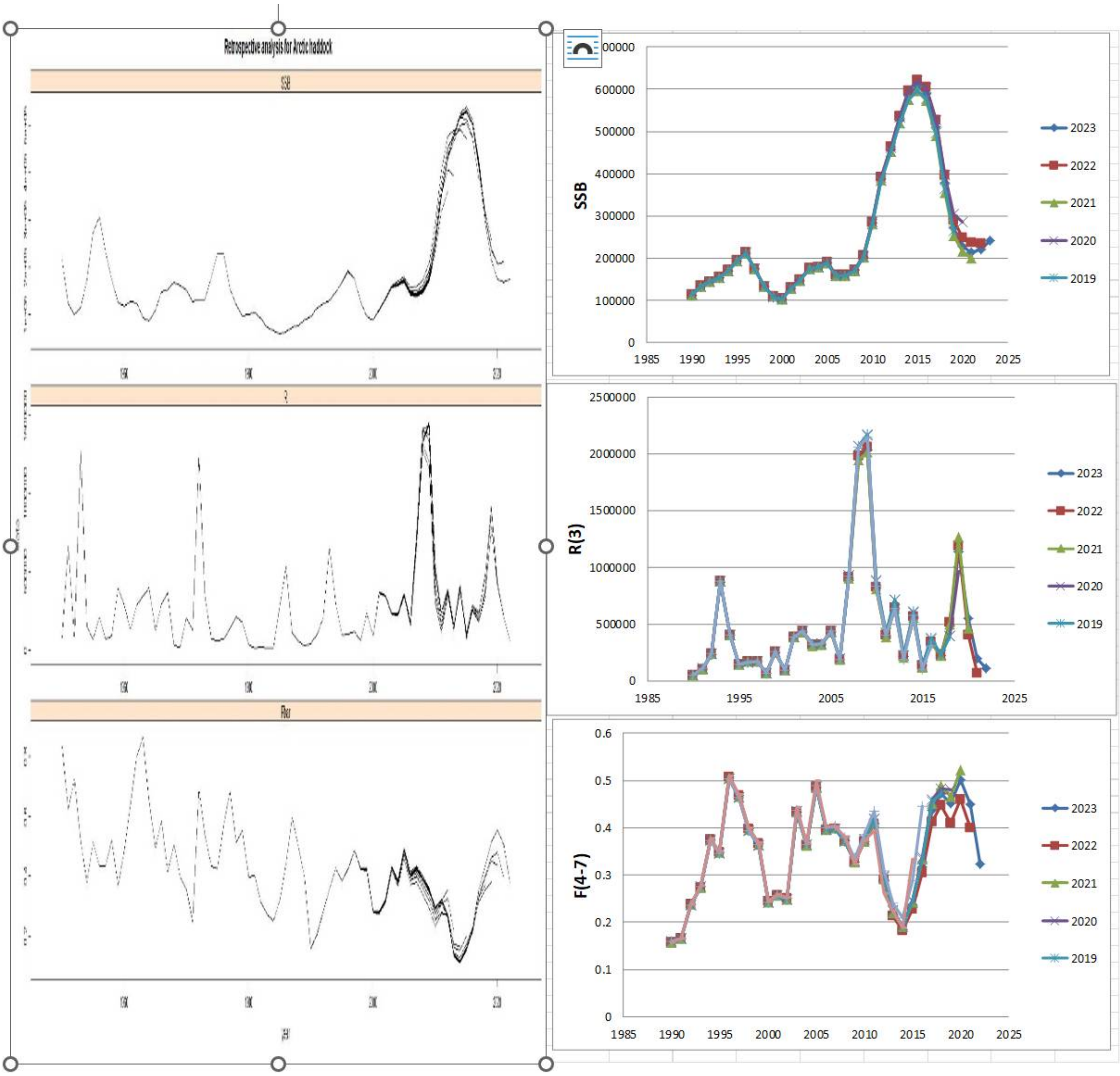

Figure 4.5. Northeast Arctic haddock. Retrospective plots of SSB, fishing mortality and recruitment for assessment years 1950–2022 (left - XSA without P shrinkage, F shrinkage= 0.5) and right - for assessment years 1990–2022 from the TSVPA model.

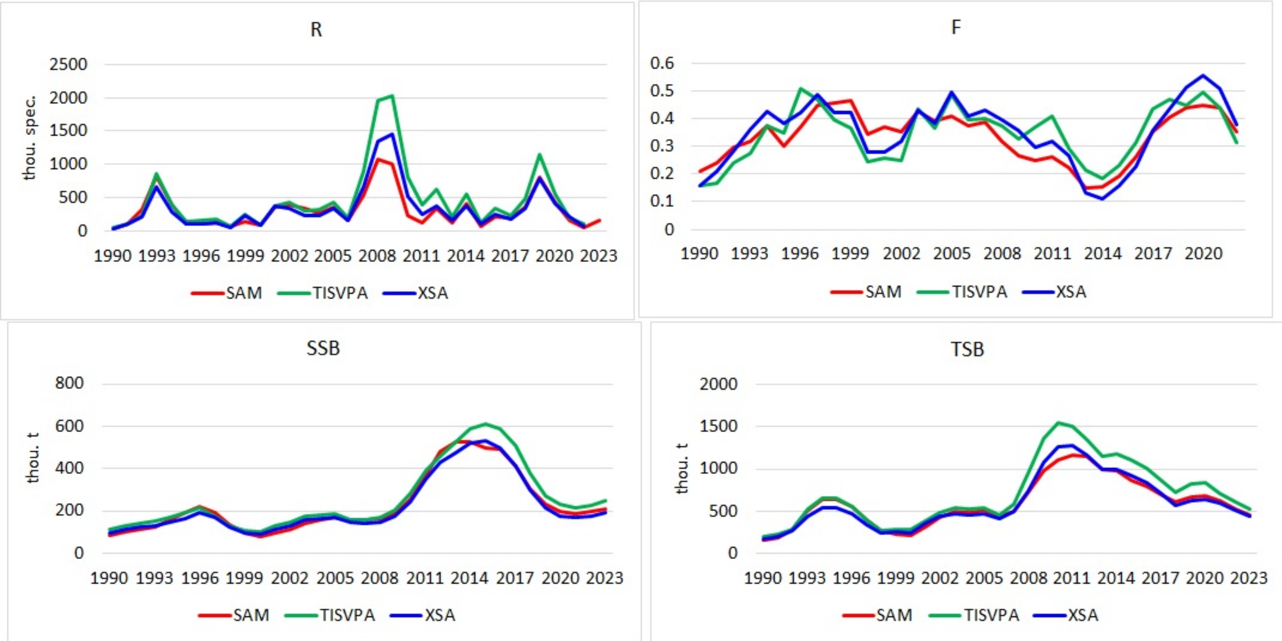

Figure 4.6. Comparison of results of assessment of NEA haddock. Recruits, biomass, spawning biomass and F in 1990–2022 by different models: median SAM estimates, XSA with setting mentioned at section 4.9 and TISVPA with settings established in WKDEM 2020.

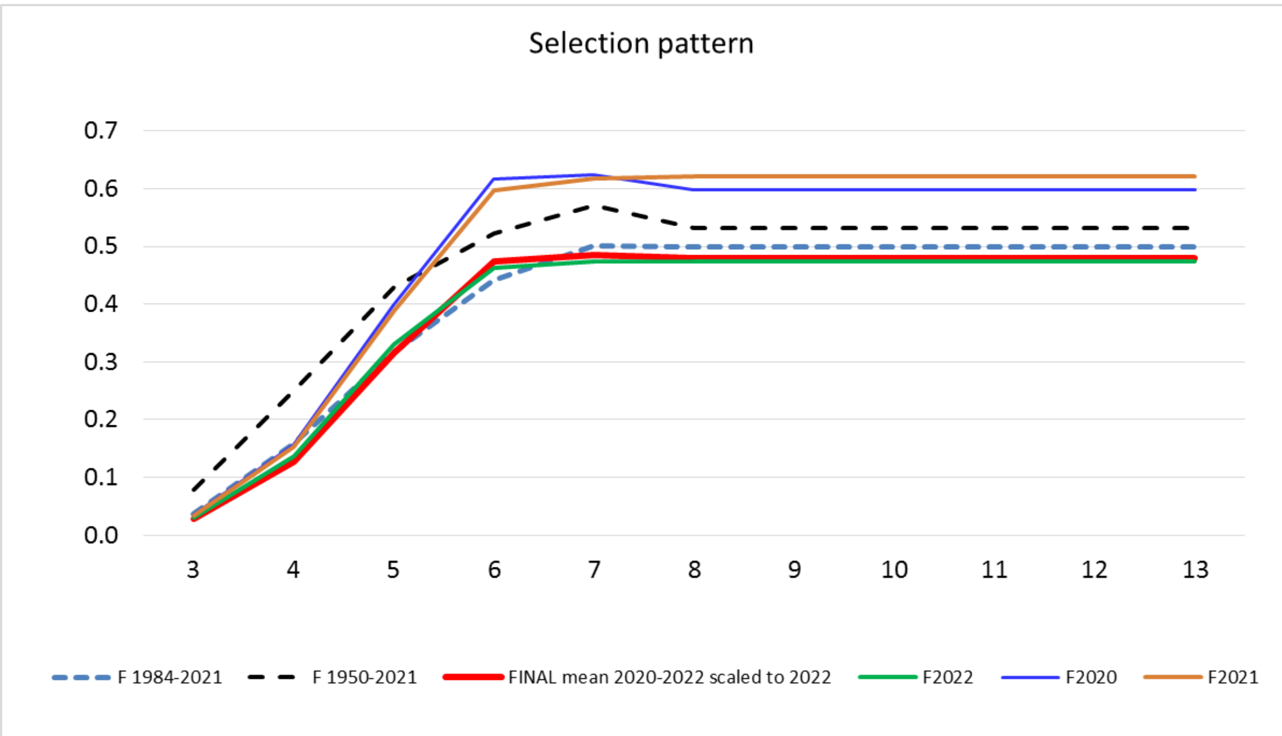

Figure 4.7 Standard selection pattern model (red) used for short-term forecasts at the current meeting.

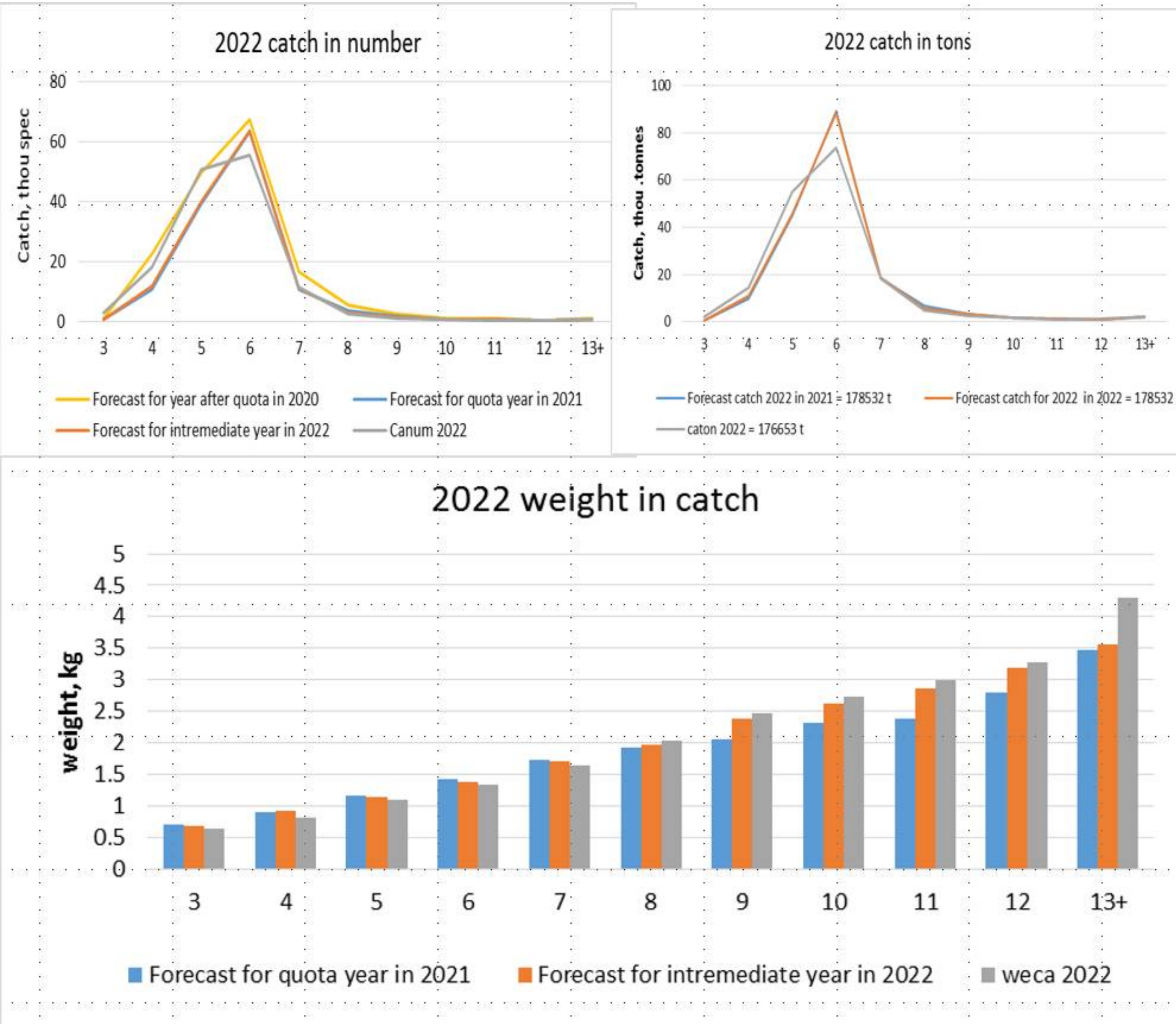

Figure 4.8 Catch composition in 2022 compared to predictions in 2020, 2021 and 2022 (intermediate year). Higher catches, both in individuals (upper left) and biomass (upper right) of 5-year haddock (2017 year-class) than predicted. The weight in the catch (weca) was lower than predicted for ages 3-7 and higher than predicted for ages 8-13+.

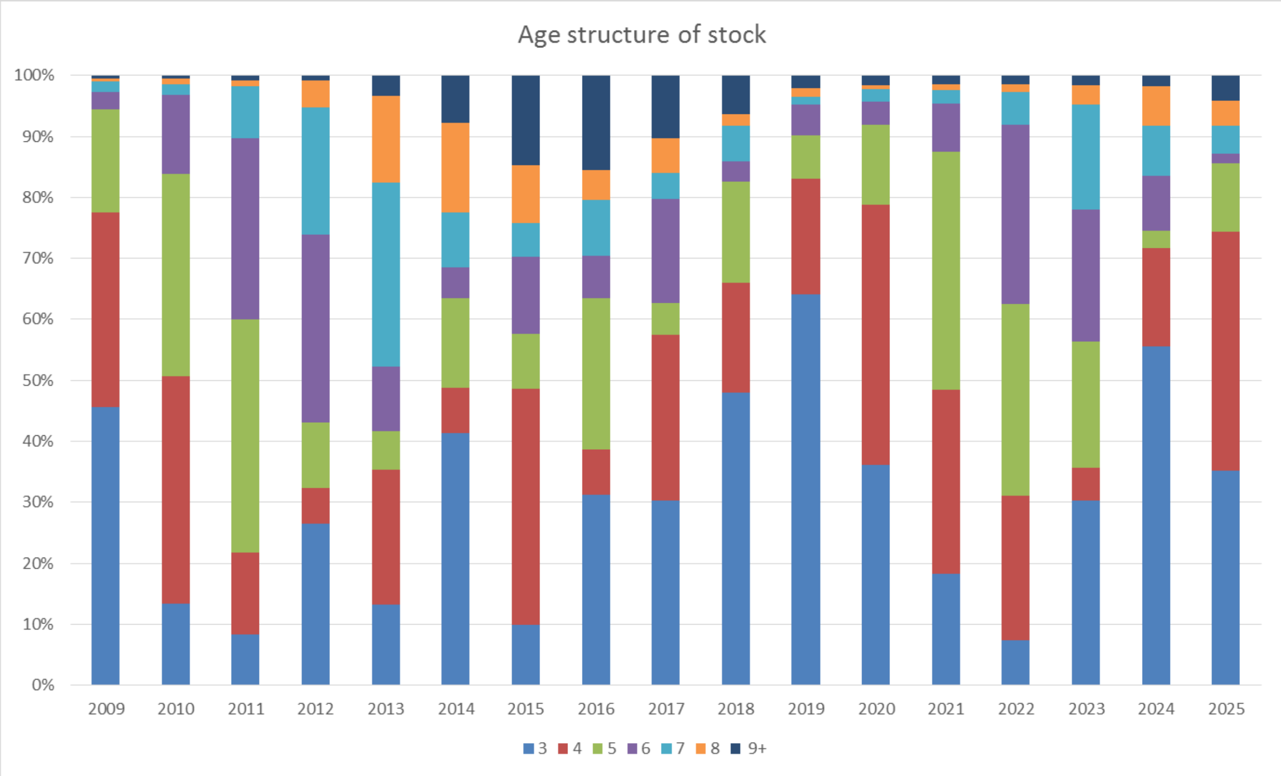

Figure 4.9. Age structure from assessment (2009-2023) and prediction (2024-2025).

8 - Northeast Arctic Greenland halibut (Subareas 1 and 2)

8.1 - Status of the fisheries

8.1.1 - Landings prior to 2023 (Tables 8.1–8.8, Figures 8.1–8.3)

Nominal landings by country for subareas 1 and 2 combined are presented in Table 8.1. Tables 8.2 to 8.4 give the landings for Subarea 1 and divisions 2.a and 2.b separately, and landings separated by gear type are presented in Table 8.5. For most countries, the landings 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 represent those presented to the Working Group by the members. Catch per unit effort is presented in Table 8.6 and total catch from 1935 to now in Table 8.7 and Figure 8.1.

The preliminary estimate of the total landings for 2022 is 26 997 t. This is 1 434 t less than the landings in 2021 and 7903 t more than the ICES advised maximum catch for 2022 (19094 t). The catches from most countries remained stable, compared to 2021. Combined landings exceeded the quotas set by the Joint Russian-Norwegian Fisheries Commission for 2022 by 1997 t (total TAC 25 000 t). Catches in the report include all landings in ICES 1 and 2, and thus include catches in EU waters in the southern part of ICES 2.

Some fishing for Greenland halibut has taken place in the northern part of Division 4.a during the past 20–30 years, varying between a few tonnes and up to 1668 t in 1995 and 2577 in 1999. From 2005 to 2011 this catch was mostly below 200 t, taken mostly by Norway, France, and the UK. Preliminary numbers show 892 t in 2022, an increase from 144 t the year before mainly due to that the Norwegian trawl fleets having access to British waters which they did not have in 2021 (Table 8.8, Figures 8.2 and 8.3). Although there is a continuous distribution of this species from the southern part of Division 2a along the continental slope towards the Shetland area, the stock structure is unclear in this area and these landings have therefore not been added to the total from subareas 1 and 2. Recent mark-recapture and genetic investigations indicate that the stock might have a more south and westward distribution than the current ICES definition of the stock boundaries (Albert and Vollen, 2015; Westgaard *et al.,* 2016).

8.1.2 - ICES advice applicable to 2021–2023

The roll over advice from ICES for 2021 was as follows:

ICES advises that when the precautionary approach is applied, catches in 2020 should be no more than 23 000 tonnes. This corresponds to a harvest rate of ≈0.036. All catches are assumed to be landed.

Last advice:

ICES advises that when the precautionary approach is applied, catches in the year 2022 should be no more than 19 094 tonnes and catches in the year 2023 should be no more than 18 494 tonnes.

8.1.3 - Additional considerations

A benchmark and data workshop process led to an agreed ICES analytic assessment in 2023. The JRN-AFWG approved the use of this assessment method to generate advice for 2024. Since the assessment is now out of sync with the Norwegian slope survey, that is conducted every other year, this assessment will provide advice for 2024 only. After that we will revert to a two-year schedule.

A benchmark meeting was held in February 2023 with associated data workshop in November 2022. The assessment is described in the ICES stock annex, and in the benchmark report (ICES 2023).

8.1.4 - Management

The 38th JRNFC's (Joint Norwegian-Russian Fisheries Commissions) session in 2009 decided to cancel the ban against targeted Greenland halibut fishery and established the TAC at 15 000 t for the next three years (2010–2012). The 40th JRNFC Session in 2011 decided to increase the TAC for 2012 up to 18 000 t, and at the 42nd JRNFC Session in 2012, the TAC for 2013 was increased to 19 000 t. The 43rd and 44th sessions kept the same TAC for 2014 and 2015. For 2016 and 2017 TAC was set to 22 and 24 thousand tonnes, respectively. The TAC for 2018 was 27 thousand tonnes and the same for 2019, 2020 and 2021. The TAC for 2022 and 2023 was 25 thousand tonnes.

The TAC for Greenland halibut set by JNRFC applies to catches in ICES areas 1, 2a and 2b, except the Jan Mayen EEZ and the part of the UK EEZ which is north of 62°N.

In 2022 no catches were takin in the Jan Mayen area (within ICES Subarea 2), where Greenland halibut fisheries are not regulated by TAC.

Norway previously had a quota for Greenland halibut in the EU EEZ which could be fished in ICES areas 2a and 6. Thus this TAC was given partly within and partly outside the stock boundary. This area is now in UK EEZ and there was no agreement for quota to Norway in this area for 2021. Norway and UK agreed on 600 t quota to Norway in area 2a, 4, 5b, 6 in 2022, with only longline fisheries allowed in area 6. TAC in the UK part of area 2a allocated to Norway was 700 tonnes in 2023. There is no ICES separate advice for the fishery in this area.

The TAC sat by EU for 2020 applied to "Union waters of 2a and 4; Union and international waters of 5b and 6" were allocated to Norway with the footnote "To be taken in Union waters of 2a and 6. In 6, this quantity may only be fished with longlines (GHL/*2A6-C)." Additionally, EU had sat another TAC in "International waters of 1 and 2(GHL/1/2INT)" and a minor quota in "Norwegian waters of 1 and 2 (GHL/1N2AB.)", both with the footnote "Exclusively for bycatches [2] .

EU has sat a TAC of 629 t for 2021 to be taken in Union waters of 2a and 6. In 6, this quantity may only be fished with longlines. EU has sat 1800 t TAC in international waters of ICES 1 and 2, exclusively for bycatches. No directed fisheries are permitted under this [3] .

EU has sat a TAC of 2571 t for 2022 in area6; United Kingdom and Union waters of 4; United Kingdom waters of 2a and United Kingdom and international waters of 5b (GHL/2A-C46) [3] .

For the Greenland halibut stock in area 1 and 2, the EU/UK TAC in the part of area 2a that is within UK EEZ is of most interest. Further investigations need to be conducted to reveal historical catches in this area.

Further information on regulations is found in the Stock Annex.

8.1.5 - Expected landings in 2023

Catches in 2022 were 26 997 t, which exceeded the TAC sat by JRNFC and the official advice. The total Greenland halibut landings in the Barents Sea and adjacent waters (ICES Subarea 1 and divisions 2a and 2b) in 2023 may thus be higher than the JRNFC TAC of 25 000 t. Discards are not regarded as a problem.

8.2 - Status of research

8.2.1 - Survey results (Tables 8.9–8.12, Figures 8.4–8.10)

Survey indices from the Russian autumn survey (Figures 8.4–8.6), the Norwegian slope survey (Figures 8.4–8.5

and 8.7) and the Joint Norwegian-Russian Ecosystem survey (A5216) (Figures 8.8–8.9). Length distributions from these surveys are presented in Tables 8.9–8.12.

The Russian bottom-trawl surveys in October-December (ICES acronym: G5348) are important since they usually cover large parts of the total known distribution area of the Greenland halibut within 100–900 m depth. A working document with a revision of the Russian index was provided to the 2021 meeting (Russkikh et al. 2021, WD12). Revised and recalculated length distributions were implemented in the 2023 assessment. Length distributions by year for this survey are given in Table 8.9. The biomass indices for this survey increased steeply from 2005 to 2011, decreased until 2015 after which the biomass level flattened out (Figures 8.4 and 8.5).

Total biomass indices from the Norwegian autumn slope survey (G1165) showed an upward trend in biomass estimates between 1994 and 2003, then a downward trend until 2008 until it increased again in 2009 but levelled out again in 2011, 2013, and 2015 (Figures 8.4–8.5, and 8.7). Since then, there has been a downward trend until 2020 when the index was at its lowest since the start of the survey. In 2021 there was an increase in the index, but it is still among the lowest estimates in the time series. The length distributions from this survey (Figure 8.10, Tables 8.10 and 8.11) show modes that can be followed through the years and indicate new recruitment to the adult stock in 2007. Since then, no such large recruit events are apparent in the length distributions, and since 2009 abundance of fish in adult lengths has been declining as well. This survey was conducted every year during 1994–2009 and biennially since then.

The Joint ecosystem Survey in autumn (A5216) covers a large part of the Barents Sea down to 500 m and concerning Greenland halibut it can be regarded to be in the areas where mainly juveniles and immature fish are found. Three indices for Greenland halibut are based on the Joint Ecosystem Survey in the Barents Sea, one for fish between 10-17 cm, denoted Eco_SI_1, (Figure 8.8), one for fish between 17-27 cm, denoted Eco_SI_2 (Figure 8.8) and on for fish between 28 and 65 cm, denoted EcoS (Figure 8.9). The juvenile indices (Eco_SI_1 and Eco_Si_2), indicates a highly variable recruitment success with years between good year classes. The EcoS index for both females and males showed an increasing trend until 2007, followed by a mainly decreasing trend since then.

The joint winter survey in the Barents Sea (A6996) has been run from 1986 to the present (jointly with Russia since 2000, except 2006 and 2007). The survey mainly covers depths of 100–500 m and does not cover the deeper slope areas. Spatially, the survey focuses on the central Barents Sea, and west of Svalbard for some years. The northward coverage is limited by sea ice in some years. It is conducted in February and can thus give information on the stock at a different time of the year, as the other surveys are run in autumn. The biomass index has shown an increasing trend since 2004 with large variations in recent years. From the winter survey, only length distributions are used in the assessment model (Table 8.12).

Norwegian slope survey in spring (G5678) is a trawl acoustic survey conducted in 2009, 2012 and biennially since then, along the continental slope in Norwegian EEZ from 62–74°N (subareas 1 and 2). Only length distributions used in the assessment.

8.2.2 - Commercial catch-per-unit-effort (Table 8.6)

The CPUE series (Table 8.6) for the stock was subject to the 2015 benchmark and associated data workshops (see reports from WKBUT 2013, DCWKNGHD 2014 and IBPHALI 2015, and working documents by Bakanev (WD14 WKBUT 2013) and Nedreaas (WD 2 DCWKNGHD 2014). An alternative CPUE series for the Russian fisheries for the years 2004–2015 was presented at the 2016 meeting (Mikhaylov, WD14 AFWG 2016). It shows some discrepancies compared to the previous CPUE series used for the Russian fisheries for the same years. In the CPUE series values before 1992, when the partial moratorium was implemented, are not comparable with values after 1992 due to reduced effort leading to increased catchability. See the Stock Annex for further comments. The CPUE series are not currently used in the assessment.

8.2.3 - Age readings

Based on the scientific understanding that the species is slower growing and more vulnerable than the previous age readings suggest, the Norwegian age reading methods were changed in 2006. The new Norwegian age readings are not comparable with older data or the Russian age readings.

The report from Workshop on Age Reading of Greenland Halibut (WKARGH) 14–17 February 2011 (ICES CM 2011/ACOM:41) described and evaluated several age reading methods for Greenland halibut.

The different methods can be classified into two groups: A) Those that produce age–length relationships that broadly compare with the traditional methods described by the joint NAFO-ICES workshop in 1996 (ICES CM 1997 /G:1); and B) Several recently developed techniques that show much higher longevity and approximately half the growth rate from 40–50 cm onwards compared to the traditional method.

A second workshop on age reading of Greenland halibut (WKARGH2) was conducted in August 2016 and worked on further validation on new age reading methods. The workshop recommended that two of the new methods can be used to provide age estimations for stock assessments. Further, recognizing some bias and low precision in methods, the WKARGH2 suggested that an aging error matrix or growth curve with error be provided for use in future stock assessments (WKARGH2 report, ICES 2016).

WKARGH2 recommends regular inter-lab calibration exercises to improve precision (i.e. exchange of digital images between readers for each method and between methods).

AFWG suggests that Russian and Norwegian scientists and age readers meet to work out issues of disagreements on Greenland halibut aging.

8.3 - Data used in the assessment

At the 2023 benchmark all input data were scrutinised and revised (Windsland et al. 2023, WD 2 ICES WKBNORTH), with the exception of the Russian slope survey that was revised by Russkikh et al. (ICES 2021, AFWG WD12), and in preparation for the 2023 JRN AFWG.

In the assessment, the catch data are split into five aggregated fleets by gear and countries. Longline/gillnet fleets include landings from gillnet, longline, and handline. Trawl fleets include landings from bottom trawl, purse-seine (very minor catches, can be bycatch or misreporting) and Danish seine. Catch in tonnes and length distributions per quarter per fleet and sex from 1992–2020 are used in the assessment. Fleets are split between Norwegian catches, Russian catches, and catches from 3rd countries. Selectivities are allowed to vary by sex to account for sexual dimorphism influencing vulnerability to fishing. Catches are aggregated into following fleets:

- Russian, trawl and minor gears
- Russian, gillnet and longline
- Norwegian, trawl and minor gears
- Norwegian, gillnet and longline
- 3rd countries

No survey covers the whole stock distribution area. The model uses length distributions and biomass indices from three surveys. From these surveys the following indices go into the current assessment:

- EggaN_S– based on the Norwegian slope survey.
- Eco_SI_1 and Eco_SI_2 - juvenile indicies based on 10-17 cm and 18-27 cm fish in the Joint Ecosystem survey.
- EcoS_SI - an index for fish 28-65 cm, based on data from the Joint Ecosystem survey.
- RussianS_SI - Russian bottom-trawl survey in the Barents Sea in autumn.

In addition, length distributions from the Norwegian Slope Survey South and the Joint Winter Survey are used in the assessment.

Age data from the Norwegian slope survey was used in the tuning. The age data was provided using the frozen whole right otolith method recommended by WKARGH2 (ICES 2017).

No CPUE indices are used in the tuning.

8.4 - Methods used in the assessment (Table 8.13)

A new assessment method with a length and age-based GADGET model was benchmarked in 2023. The assessment is further described in the Stock Annex.

At the meeting the revision of the Russian Slope Survey was implemented in the assessment. This required recalculation of reference points that are given in table 8.13.

Advice for the stock has been given biennially. Due to the assessment being out of sync with the Norwegian slope survey, that is conducted every other year, this assessment will provide advice for 2024 only. After that we will revert to a two-year schedule.

8.4.1 - Model settings

Model used: Gadget3 (Lentin et al. 2022)

- Start year 1980.
- One year time-step.
- Single area model, with variable distributions handled through fleet selectivity (“fleets as areas” approach)
- Two sexes, split into mature and immature stock components
- Logistic maturity estimated for each sex
- 1 cm length classes and 1-year age classes
    - Lengths: females; immature 1-100 cm, mature 1-120 cm - males; immature 1-65 cm, mature 1-90 cm
    - Age: immature 1-25+, mature 3-25+
- Von Bertanlanffy growth estimated separately for males and females, with L_{inf} for males fixed to 68 cm. Length at age one fixed.
- Natural mortality set to 0.12 for females and 0.16 for males

- Initial size of recruits fixed at 14 cm (model has proved unable to estimate this)
- Recruitment modelled as annual numbers, no relationship with SSB (estimated directly), assumed equal recruitment of male and female
- Initial population follows a simplifying assumption of constant recruitment, M and F, giving an exponential decay by age. A fixed maturity ogive is used to split immature and mature proportions. Standard deviations of lengths at age is externally fixed.
- Fisheries and surveys are modelled with fixed catch in tonnes per fleet, and sex-specific selectivity estimated using length distribution data and sex-at-length data.
- Five aggregated commercial fleets (as described above), each with sex-specific logistic selectivity
- Three surveys used for indices (EcoS, EggaN and RussianS), with logistic selectivity (but with a min:max length range to avoid bias in indices on fish suspected to be poorly selected)
- Only length distributions used from Winter and EggaS surveys

More detailed model description, as well as outputs and diagnostics are shown in ICES stock annex and in Vihtakari et al. 2023 (WD 17, WKBNORTH) .

8.5 - Results of the assessment (Figure 8.11-8.14)

Model results, retrospective pattern, jitter, and short-term projections are shown in Figures 8.11-8.14. Reference point and catch scenarios are shown in table 8.13 and 8.14. The stock biomass is presented for the total 45+ cm (minimum legal landing size) population and the spawning stock (Figure 8.11). Biomass peaks around 2013–2014 and shows a clear downward trend since then. This trend is broadly in line with all three tuning series (Figures 8.4,8.7 and 8.9). SSB was above B_{PA} in 2022 but is expected to go below it in 2023. The harvest rate has been steadily increasing since 2009 and is now above HR_{PA} and HR_{MSY} . The retrospective analysis for model biomass has negative Mohn’s rho values (Figure 8.12). The retrospective patterns by year got lumped following the availability of survey data, with the Norwegian slope survey run every other year and missing years in the Russian autumn survey. As a result of this pattern, it is recommended that the assessment be run every other year rather than annually. There is a retrospective trend to increase the stock estimate over time. Peaks in recruitment were most likely exaggerated in the assessment model used before the benchmark, while in the present model they are probably underestimated. Large uncertainties in the age reading probably smooths out the peaks, distributing the recruitment over multiple years. The recruitment peak in the latest years is based on little data and is unreliable. Even though the assessment most likely smooths out the recruitment, the modelled peaks show reasonably good agreement to the data from the juvenile survey indices. This stock is dominated by sporadic recruitment events, and the model does a reasonable job of capturing this.

8.5.1 - Biological reference points

Estimates of trends and biomass levels in stock dynamics are stable in the revised assessment. Therefore, the suggested reference points are for ICES category 1 stock (ICES, 2021).

The HR_{TARGET} is set to HR_{MSY} which equals 0.139. As recommended at the recent Benchmark (ICES 2023), this value was calculated during the present meeting following the revision of the Russian survey index (Russkikh et al. WD12, AFWG 2021). The fishable biomass is taken to be the 45+ cm biomass. The $B_{TRIGGER}$ in the ICES Advice Rule is set to be B_{PA}, which equals 46747 t. B_{MSY} has not been calculated.

8.5.2 - Exploratory assessments; surplus production models and TSVPA.

Results of the assessment of the Barents Sea Greenland halibut stock based on a Bayesian surplus production model was provided by Bakanev in 2013, (WKBUT WD 14). Different sets of abundance indices were used for tuning the model. The analysis of model run results has shown that K is estimated within the range of 810 to 1139 kt, B_{MSY} of 405 to 570 kt and MSY of 23 to 47 kt. However, the model was sensitive to the choice of prior on K. Taking into consideration a high probability of the stock size being at the level, which was quite a bit above BMSY, the risk of the biomass being below this optimal one was very small in 2002–2012 (<1%). The risk analysis of the stock size in the prediction years (2013–2020) under the catch of 0 to 30 kt indicated that the probability of the stock size being under the threshold levels (B_{MSY}, B_{LIM}) was also minor (less than 1%). It was concluded that further work was needed on the historical CPUE series. Based on scrutiny of the CPUE series it was recommended to examine runs with the surplus production model for the period 1964-1991 and 1964-2005, in addition to runs for the whole 1964–2013 period. Fisheries CPUE series were considered less reliable to reflect stock dynamics than survey indices in the period after regulations of the fishery were introduced in 1992. The Bayesian surplus model was not updated for presentation at the current meeting.

A production model was presented at the 2016 meeting (Mikhaylov, 2016, WD 14), although this model has not been reviewed at a benchmark, nor were biomass trends presented at this meeting. The model has been proposed as a possible method for the estimation of long-term reference points. An update was presented at the 2019 meeting (Mikhaylov 2019, AFWG 2019 WD21). In the current version, the MSY would be around 34 kt, the B_{MSY} around 500 kt and F_{MSY} on the level 0.069. It should be noted that these values are not directly transferable to a different model with different biomass levels and in any case a long-term average. The WD concluded that, in general, the stock can withstand the fishing pressure in 2016 and the fishing regime was approaching optimum, indicating that the results of the exploratory surplus production model were in general alignment with the assessment.

F_{MSY} is not appropriate to this stock given the recent extended run of poor recruitment, and such values have not been evaluated for precautionarity. In a plenary, it was concluded that it would be useful for further development of the production model to conduct separate exploratory runs for CPUE split into before and after 1992 and run with CPUE only before 1992 and survey data after 1992. This production model was not updated for presentation at the current meeting.

At the 2018 meeting, AFWG results from SPiCT production model were presented (AFWG report 2018). In the run that is presented in this report, all available data up to 2016 were used. For run with default, priors applied K = 995 421 t and deterministic reference points were B_{MSY} = 419 955 t, F = 0.07 and MSY = 29 742 t. Stochastic reference points for this run were in a similar range. Run with default priors deactivated gives similar MSY estimates but otherwise, rather different estimates; K = 2 504 006 t, B_{MSY} = 609 410 t, F = 0.05 and MSY = 28 097 t. Further utilization of this approach demands closer scrutiny of model settings in relation to diagnostics. The SPiCT model can be a flexible tool to examine the production model approach to Greenland halibut, however, concerns highlighted below still apply.

In principle, a production model could be used in conjunction with the GADGET assessment model to extend the simulations back in time and provide better estimates for B_{LIM} . However, the inability of production models to follow variable recruitment, and especially runs of above or below average recruitment, limits their ability to advise on this stock. In the benchmark report (IBPHALI 2015) Table 3.3 gives CPUE series and survey estimates that can be helpful for this task.

A working document (Bulatov et al. 2023, WD1 JNR-AFWG 2023) presents a comparison of two types of models: several different formulations of production models for Greenland halibut and age-structured TSVPA mode alongside a production model (the “combi” model) tuned to an index constructed from the TSVPA results. Tuning data for production model included catch in tonnes, Norwegian CPUE, Russian Survey and Winter survey indices. The biomass models showed F_{MSY} (in a biomass model context) of around 0.05 to 0.07 and Bmsy of 437-620 kt, giving long term MSY yields of between 32.3kt and 37.47kt. A TSVPA model was constructed, and the overall trend (with F_{MSY} at age 9 at 0.14, and MSY yield of between 28.2kt and 31.5kt) was presented. A biomass model tuned to TSVPA as a relative index of abundance gave a F_{MSY} (again in production model context) of 0.15 and long term MSY yield of 28.4kt. The use of TISVPA results allowed us to build a recruitment model (Beverton-Holt and “hockey stick” models) that predicts an approximately constant replenishment level (25 million at age 5), which justifies the assumptions accepted in new version of GADGET. However, given difficulties in the tuning indices noted below, the group does not feel that reliance can be placed on the absolute level of these results.

The group notes that there are two key problems in tuning data used in this WD, one is that the CPUE has an artificial step-change (increase) after the reduction in effort due to the partial moratorium in 1992 and will thus likely drive the hypothetical artificial fast rise in population from that point. The other is that the winter survey has had a trend to expand coverage area over time, and therefore the increasing trend in the swept area index is, at least partially, driven by this rather than any stock trends. Therefore, neither the full time series of CPUE nor the simple winter survey estimate should be used for model tuning. Furthermore, the new age reading methods imply considerably slower growth rate and increased longevity, compared to the traditional method used for age data in the TSVPA model (ICES WKARGH 2011, ICES WKARGH2 2016), and the old age readings should not be used in model tuning. It is also questionable if a biomass model is able to track the trends of this stock (where the population seems to be driven by variability in recruitment success).

In terms of trends, the TSVPA and the “Combi” biomass model tuned to a TSVPA-derived index were broadly similar to each other and to the new Gadget model. Key differences were that the TSVPA rose more steeply than Gadget after the 1992 low point, and the Combi model more steeply again. It seems likely that this could be explained by the use of CPUE tuning data (with its artificial rise post 1992) in the Combi and TSVPA models. The other key point of difference is that the Gadget model shows a downturn starting in c. 2012, while the other models only turn down in 2021. One possible reason for this is that the Gadget model uses Ecosystem and Norwegian slope survey indices alongside the Russian index, while the models presented here use the Winter Survey (which has an artificial increasing trend due to increasing coverage).

The group felt that the TSVPA model was worth continuing developing, with a potential use as an auxiliary model (as for NEA cod and haddock), although its accuracy would continue to be hampered by the limited age reading on this species with new age reading methods. Using different tuning series and the more modern age reading method should result in a TSVPA model which could be used as an auxiliary model and could then be compared with the Gadget assessment. Effort should also be placed into continuing the age reading work, as an improved age data series would benefit both Gadget and age-based models such as TSVPA.

8.6 - Comments to the assessment

An overview of model exploration before, and at, the benchmark is given in the benchmark report (Vihtakari et al. WD 17, ICES 2023). At the JRN-AFWG in 2023 the assessment was updated by adding the revised Russian survey index.

Between the end of the physical benchmark meeting and completion of the final model the following adjustments were made: Recalculation of data weighting, and flat top selectivity applied to all fleets. In addition the Russian survey was revised as noted previously.

Within the fisheries in the Barents Sea and associated slope, fish tend to move to the slope as they mature. This means that fisheries on the shelf tend to fewer of the large mature fish. The Barents Sea Greenland halibut Gadget model was designed to be a “fleets as areas model”, where fleet selectivity would take care of the issue of the larger fish moving out of the areas covered by some fleets and surveys. However, the dome shaped selectivity required for this was problematic. The model employing the dome shaped selectivity was unstable, with a large pattern in the jitter analysis indicating that the model was unable to converge to a single solution. The reasons for this are unclear, but it was clear that the dome-shaped selectivity model cannot be used at present as the basis for advice. The model presented here therefore uses exponential (“flat topped”, “S-shaped”) selectivity curves for all fleets and surveys. The ecosystem survey index is expected to be affected by this issue, and the survey index has been computed over a range of sizes (28-65cm) to avoid this and ensure that the movement of fish does not cause undue bias. It is clear in the data, that the trawl fleets catch fewer large fish than the other gears (which are more concentrated along the slope) and there is therefore a slight mismatch here between model and data. The fits to the length distributions are otherwise good for these fleets, and the issue of dome shaped selectivity is therefore a research recommendation for future improvements in the model.

According to jitter analysis the model trends can be considered stable (figure 8.13)

8.6.1 - Future work

Efforts to improve stock assessment in the future should include:

- Experimenting with changing the likelihood component weights may further improve the model stability
- Gather age data over more years.
- Further examine consequences of using of dome-shaped versus logistic selectivity in the Gadget model.
- Examine further Norwegian and joint Norwegian/Russian survey indices using VAST (mixed models) or similar statistical analysis.
- Develop a harvest control rule.
- Review stock structure for Greenland halibut in the North Atlantic, reflecting the results from an ongoing international project (NORSUTAIN).

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8.7 - Tables and figures

Table 8.1. Greenland halibut in subareas 1 and 2. Nominal Catch (t) by countries (Subarea 1, divisions 2a, and 2b combined) as officially reported to ICES.

Year	Denmark	Estonia	Faroe Islands	France	Fed. Rep. Germany	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
1984	0	0	0	138	2165	0	0	0	0	0	4376	0	0	15181	0	0	23	0	21883
1985	0	0	0	239	4000	0	0	0	0	0	5464	0	0	10237	0	0	5	0	19945
1986	0	0	42	13	2718	0	0	0	0	0	7890	0	0	12200	0	0	10	2	22875
1987	0	0	0	13	2024	0	0	0	0	0	7261	0	0	9733	0	0	61	20	19112
1988	0	0	186	67	744	0	0	0	0	0	9076	0	0	9430	0	0	82	2	19587
1989	0	0	67	31	600	0	0	0	0	0	10622	0	0	8812	0	0	6	0	20138
1990	0	0	163	49	954	0	0	0	0	0	17243	0	0	4764	0	0	10	0	23183
1991	11	2564	314	119	101	0	0	0	0	0	27587	0	0	2490	132	0	0	2	33320
1992	0	0	16	111	13	13	0	0	0	0	7667	0	31	718	23	0	10	0	8602
1993	2	0	61	80	22	8	56	0	0	30	10380	0	43	1235	0	0	16	0	11933
1994	4	0	18	55	296	3	15	5	0	4	8428	0	36	283	1	0	76	2	9226
1995	0	0	12	174	35	12	25	2	0	0	9368	0	84	794	1106	0	115	7	11734
1996	0	0	2	219	81	123	70	0	0	0	11623	0	79	1576	200	0	317	57	14347
1997	0	0	27	253	56	0	62	2	0	0	7661	12	50	1038	157	0	67	25	9410
1998	0	0	57	67	34	0	23	2	0	0	8435	31	99	2659	259	0	182	45	11893
1999	0	0	94	0	34	38	7	2	0	0	15004	8	49	3823	319	0	94	45	19517
2000	0	0	0	45	15	0	16	1	0	0	9083	3	37	4568	375	0	111	43	14297
2001	0	0	0	122	58	0	9	1	0	0	10896	2	35	4694	418	0	100	30	16365
2002	0	219	0	7	42	22	4	6	0	0	7143	5	14	5584	178	0	41	28	13293
2003	0	0	459	2	18	14	0	1	0	0	8216	5	19	4384	230	0	41	58	13447
2004	0	0	0	0	9	0	9	0	0	0	13939	1	50	4662	186	0	43	0	18899

Year	Denmark	Estonia	Faroe Islands	France	Fed. Rep. Germany	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
2005	0	170	0	32	8	0	0	0	0	0	13011	0	23	4883	660	0	29	18	18834
2006	0	0	204	44	7	0	7	0	0	196	11119	201	24	6055	2	12	0	0	17871
2007	0	0	203	39	6	198	15	0	0	0	8230	200	50	6484	10	17	0	0	15452
2008	0	0	663	40	4	0	28	0	0	0	7393	200	46	5294	112	26	0	0	13806
2009	0	0	422	16	19	16	15	1	0	0	8446	203	237	3335	202	67	0	0	12979
2010	0	0	272	102	14	15	15	0	0	0	770	2	11	6888	188	25	0	0	8302
2011	0	0	538	46	80	4	7	0	0	234	8270	169	21	7053	144	39	0	0	16605
2012	0	0	563	39	38	12	13	0	0	0	9331	21	1	10041	185	33	0	0	20277
2013	0	0	783	167	48	22	106	0	0	0	10403	29	7	10310	11	91	0	0	21977
2014	0	0	887	268	33	24	86	0	0	0	11232	17	0	10061	22	210	0	0	22840
2015	0	0	721	228	30	16	98	0	0	0	10874	13	0	12953	23	113	0	0	25069
2016	2	353	1076	226	8	17	75	0	0	0	12932	26	17	10576	27	54	0	0	25389
2017	0	523	993	175	21	25	10	0	3	72	13741	25	10	10714	36	82	0	0	26430
2018	2	574	400	148	50	19	24	0	0	204	14874	25	4	12072	59	132	0	0	28587
2019	0	587	350	103	44	21	8	0	0	347	14845	122	7	12198	86	74	0	0	28792
2020	1	579	512	37	70	47	19	0	0	260	14532	96	8	12266	96	43	0	0	28566
2021*	1	382	756	138	88	14	40	0	96	160	14008	15	46	12394	125	177	0	0	28440
2022*	0	253	1055	85	94	48	27	0	75	136	13140	0	60	11746	164	114	0	0	26997

*** Provisional figures.**

Table 8.2. Greenland halibut in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1 as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (England & Wales)	UK (Scot land)	Total
1984	0	0	0	0	0	0	0	0	0	593	0	0	81	0	0	17	0	691

Year	Estonia	Faroe Islands	Fed. Rep. Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (England & Wales)	UK (Scot land)	Total
1985	0	0	0	0	0	0	0	0	0	602	0	0	122	0	0	1	0	725
1986	0	0	1	0	0	0	0	0	0	557	0	0	615	0	0	5	1	1179
1987	0	0	2	0	0	0	0	0	0	984	0	0	259	0	0	10	0	1255
1988	0	9	4	0	0	0	0	0	0	978	0	0	420	0	0	7	0	1418
1989	0	0	0	0	0	0	0	0	0	2039	0	0	482	0	0	0	0	2521
1990	0	7	0	0	0	0	0	0	0	1304	0	0	321	0	0	0	0	1632
1991	164	0	0	0	0	0	0	0	0	2029	0	0	522	0	0	0	0	2715
1992	0	0	0	0	0	0	0	0	0	2349	0	0	467	0	0	0	0	2816
1993	0	32	0	0	0	56	0	0	0	1754	0	0	867	0	0	0	0	2709
1994	0	17	217	0	0	15	0	0	0	1165	0	0	175	0	0	0	0	1589
1995	0	12	0	0	0	25	0	0	0	1352	0	0	270	84	0	0	0	1743
1996	0	2	0	0	0	70	0	0	0	911	0	0	198	0	0	0	0	1181
1997	0	15	0	0	0	62	0	0	0	610	0	0	170	0	0	0	0	857
1998	0	47	0	0	0	23	0	0	0	859	0	0	491	0	0	2	0	1422
1999	0	91	0	0	13	7	0	0	0	1101	0	0	1203	0	0	0	0	2415
2000	0	0	0	0	0	16	0	0	0	1021	0	0	1169	0	0	0	0	2206
2001	0	0	0	0	0	9	0	0	0	925	0	0	951	0	0	2	0	1887
2002	0	0	3	0	0	0	0	0	0	834	0	0	1167	0	0	0	0	2004
2003	0	48	0	0	2	0	1	0	0	962	1	0	735	0	0	0.3	0	1749
2004	0	0	0	0	0	0.3	0	0	0	866	0	0	633	0	0	3	0	1502
2005	0	0	0	1	0	0	0	0	0	572	0	0	595	0	0	3	0	1171
2006	0	17	1	0	0	1	0	0	0	575	0	0	626	0	2	0	0	1222
2007	0	18	0	1	198	3	0	0	0	514	0	3	438	0	4	0	0	1179
2008	0	13	0	1	0	5	0	0	0	599	0	0	390	0	0	0	0	1008
2009	0	33	0	0	16	5	0	0	0	734	0	0	483	0	0	0	0	1271

Year	Estonia	Faroe Islands	Fed. Rep. Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (England & Wales)	UK (Scot land)	Total
2010	0	15	0	0	0	15	0	0	0	659	0	0	708	0	0	0	0	1397
2011	0	63	0	0	0	6	0	0	0	867	0	0	782	0	0	0	0	1718
2012	0	8	4	0	0	7	0	0	0	921	0	0	1368	0	7	0	0	2315
2013	0	39	0	8	0	100	0	0	0	1055	4	0	1442	1	7	0	0	2656
2014	0	143	8	10	19	38	0	0	0	1270	6	0	1261	0	13	0	0	2768
2015	0	107	13	5	14	47	0	0	0	1424	5	0	1681	7	10	0	0	3313
2016	353	87	2	2	3	38	0	0	0	1265	12	0	1172	0	20	0	0	2954
2017	519	133	4	4	2	8	0	3	72	1389	9	0	1124	3	21	0	0	3291
2018	574	103	9	15	1	20	0	0	198	1008	4	0	894	1	96	0	0	2923
2019	587	116	27	9	5	5	0	0	347	939	119	0	32	15	49	0	0	2250
2020	579	123	36	2	14	18	0	0	257	1388	96	0	787	36	2	0	0	3338
2021*	382	207	17	1	10	35	0	96	160	1617	9	14	713	25	1	0	0	3287
2022*	253	120	21	24	5	0	0	75	136	1151	0	5	494	18	0	0	0	2302

*** Provisional figures.**

Table 8.3. Greenland halibut in subareas 1 and 2. Nominal catch (t) by countries in Division 2a as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germ.	France	Greenland	Ireland	Iceland	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot-land)	Total
1984	0	0	265	138	0	0	0	0	3703	0	0	5459	0	0	1	0	9566
1985	0	0	254	239	0	0	0	0	4791	0	0	6894	0	0	2	0	12180
1986	0	6	97	13	0	0	0	0	6389	0	0	5553	0	0	5	1	12064
1987	0	0	75	13	0	0	0	0	5705	0	0	4739	0	0	44	10	10586
1988	0	177	150	67	0	0	0	0	7859	0	0	4002	0	0	56	2	12313
1989	0	67	104	31	0	0	0	0	8050	0	0	4964	0	0	6	0	13222
1990	0	133	12	49	0	0	0	0	8233	0	0	1246	0	0	1	0	9674

Year	Estonia	Faroe Islands	Fed. Rep. Germ.	France	Greenland	Ireland	Iceland	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot-land)	Total
1991	1400	314	21	119	0	0	0	0	11189	0	0	305	0	0	0	1	13349
1992	0	16	1	108	13	0	0	0	3586	0	15	58	0	0	1	0	3798
1993	0	29	14	78	8	0	0	0	7977	0	17	210	0	0	2	0	8335
1994	0	0	33	47	3	4	0	0	6382	0	26	67	0	0	14	0	6576
1995	0	0	30	174	12	2	0	0	6354	0	60	227	0	0	83	2	6944
1996	0	0	34	219	123	0	0	0	9508	0	55	466	4	0	278	57	10744
1997	0	0	23	253	0	0	0	0	5702	0	41	334	1	0	21	25	6400
1998	0	0	16	67	0	1	0	0	6661	0	80	530	5	0	74	41	7475
1999	0	0	20	0	25	2	0	0	13064	0	33	734	1	0	63	45	13987
2000	0	0	10	43	0	0	0	0	7536	0	18	690	1	0	65	43	8406
2001	0	0	49	122	0	1	9	0	8740	0	13	726	5	0	56	30	9751
2002	0	0	9	7	22	0	4	0	5877	0	3	849	0	0	12	28	6811
2003	0	390	5	2	12	0	0	0	6713	0	10	1762	14	0	5	58	8971
2004	0	0	4	0	0	0	9	0	11704	0	24	810	4	0	1	0	12556
2005	0	0	3	31	0	0	0	0	11216	0	11	1406	0	0	5	18	12690
2006	0	175	0	37	0	0	6	0	8897	0	5	950	0	8	0	0	10078
2007	0	162	1	36	0	0	12	0	6761	0	2	489	0	9	0	0	7472
2008	0	646	3	37	0	0	23	0	5566	0	1	1170	3	16	0	0	7465
2009	0	379	0	13	0	0	10	0	6456	0	9	1531	0	60	0	0	8458
2010	0	255	0	102	15	0	0	0	6426	0	0	4757	0	21	0	0	11576
2011	0	467	0	45	4	0	1	0	6637	0	0	3643	0	3	0	0	10800
2012	0	553	0	37	12	0	6	0	7934	0	0	3878	0	13	0	0	12433
2013	0	739	0	149	22	0	6	0	8215	0	2	4143	0	75	0	0	13351
2014	0	741	0	255	1	0	48	0	8640	0	0	4800	0	184	0	0	14669
2015	0	613	1	220	2	0	51	0	8166	0	0	3691	0	79	0	0	12823
2016	0	985	6	215	14	0	37	0	10073	6	6	1797	0	18	0	0	13157

Year	Estonia	Faroe Islands	Fed. Rep. Germ.	France	Greenland	Ireland	Iceland	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot-land)	Total
2017	0	841	0	160	20	0	2	0	10122	0	6	1852	0	16	0	0	13019
2018	0	296	1	104	9	0	4	1	11226	1	4	695	0	6	0	0	12347
2019	0	232	15	94	16	0	3	0	12122	3	7	2754	3	11	0	0	15260
2020	0	384	20	33	28	0	1	0	11437	0	7	2691	0	2	0	0	14603
2021*	0	529	20	123	4	0	5	0	9647	0	5	842	5	109	0	0	11289
2022*	0	888	10	26	14	0	27	0	9753	0	11	740	1	25	0	0	11495

*** Provisional figures.**

Table 8.4. Greenland halibut in subareas 1 and 2. Nominal catch (t) by countries in Division 2b as officially reported to ICES.

Year	Denmark	Estonia	Faroe Islands	Fed. rep. Germ.	France	Greenland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
1984	0	0	0	1900	0	0	0	0	0	80	0	0	9641	0	0	5	0	11626
1985	0	0	0	3746	0	0	0	0	0	71	0	0	3221	0	0	2	0	7040
1986	0	0	36	2620	0	0	0	0	0	944	0	0	6032	0	0	0	0	9632
1987	0	0	0	1947	0	0	0	0	0	572	0	0	4735	0	0	7	10	7271
1988	0	0	0	590	0	0	0	0	0	239	0	0	5008	0	0	19	0	5856
1989	0	0	0	496	0	0	0	0	0	533	0	0	3366	0	0	0	0	4395
1990	0	0	23	942	0	0	0	0	0	7706	0	0	3197	0	0	9	0	11877
1991	11	1000	0	80	0	0	0	0	0	14369	0	0	1663	132	0	0	1	17256
1992	0	0	0	12	3	0	0	0	0	1732	0	16	193	23	0	9	0	1988
1993	2	0	0	8	2	0	0	0	30	649	0	26	158	0	0	14	0	889
1994	4	0	1	46	8	0	1	0	4	881	0	10	41	1	0	62	2	1061
1995	0	0	0	5	0	0	0	0	0	1662	0	24	297	1022	0	32	5	3047
1996	0	0	0	47	0	0	0	0	0	1204	0	24	912	196	0	39	0	2422
1997	0	0	12	33	0	0	2	0	0	1349	12	9	534	156	0	46	0	2153

Year	Denmark	Estonia	Faroe Islands	Fed. rep. Germ.	France	Greenland	Ireland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	GB	UK (Engl. & Wales)	UK (Scot land)	Total
1998	0	0	10	18	0	0	1	0	0	915	31	19	1638	254	0	106	4	2996
1999	0	0	3	14	0	0	0	0	0	839	8	16	1886	318	0	31	0	3115
2000	0	0	0	5	2	0	1	0	0	526	3	19	2709	374	0	46	0	3685
2001	0	0	0	9	0	0	0	0	0	1231	2	22	3017	413	0	42	0	4736
2002	0	219	0	30	0	0	6	0	0	432	5	11	3568	178	0	29	0	4478
2003	0	0	21	13	0	0	0	0	0	541	4	9	1887	216	0	35	0	2726
2004	0	0	0	5	0	0	0	0	0	1369	1	26	3219	182	0	39	0	4841
2005	0	170	0	5	0	0	0	0	0	1223	0	12	2882	660	0	21	0	4973
2006	0	0	12	6	7	0	0	0	196	1647	201	19	4479	2	2	0	0	6571
2007	0	0	23	5	2	0	0	0	0	955	200	45	5557	10	4	0	0	6801
2008	0	0	4	1	2	0	0	0	0	1228	200	45	3734	109	10	0	0	5333
2009	0	0	10	19	3	0	1	0	0	1256	203	228	1321	202	7	0	0	3250
2010	0	0	2	14	0	0	0	0	0	615	2	11	1423	188	4	0	0	2259
2011	0	0	8	80	1	0	0	0	234	766	169	21	2628	144	36	0	0	4087
2012	0	0	2	34	2	0	0	0	0	476	21	1	4795	185	13	0	0	5529
2013	0	0	5	48	10	0	0	0	0	1133	25	5	4725	10	9	0	0	5970
2014	0	0	3	25	3	4	0	0	0	1321	11	0	4000	22	13	0	0	5402
2015	0	0	1	16	3	0	0	0	0	1284	8	0	7581	16	24	0	0	8933
2016	2	0	4	0	9	0	0	0	0	1594	8	11	7608	27	16	0	0	9279
2017	0	4	19	17	11	3	0	0	0	2230	16	4	7737	33	45	0	0	10119
2018	2	0	1	40	29	9	0	0	5	2477	20	0	10483	58	30	0	0	13154
2019	0	0	2	2	0	0	0	0	0	1784	0	0	8512	68	14	0	0	10382
2020	1	0	5	14	2	5	0	0	3	1708	0	1	8788	60	39	0	0	10626
2021*	1	0	19	51	13	0	0	0	0	2744	5	27	10839	106	57	0	0	13862
2022*	0	0	47	63	35	28	0	0	0	2236	0	44	10512	145	89	0	0	13199

*** Provisional figures.**

Table 8.5. Greenland halibut in subareas 1 and 2. Landings by gear (tonnes). Approximate figures, the total may differ slightly from Table 8.1.

Year	Gillnet	Longline	Trawl	Danish seine	Other
1980	1189	336	11759	-	-
1981	730	459	13829	-	-
1982	748	679	15362	-	-
1983	1648	1388	19111	-	-
1984	1200	1453	19230	-	-
1985	1668	750	17527	-	-
1986	1677	497	20701	-	-
1987	2239	588	16285	-	-
1988	2815	838	15934	-	-
1989	1342	197	18599	-	-
1990	1372	1491	20325	-	-
1991	1904	4552	26864	-	-
1992	1679	1787	5787	-	-
1993	1497	2493	7889	-	-
1994	1403	2392	5353	-	-
1995	1500	4034	5494	-	-
1996	1480	4616	7977	-	-
1997	998	3378	5198	-	-
1998	1327	7395	6664	-	-
1999	2565	6804	10177	-	-
2000	1707	5029	7700	-	-
2001	2041	6303	7968	-	-
2002	1737	5309	6115	-	-
2003	2046	5483	6049	-	-
2004	2290	7135	8778	599	-
2005	1842	7539	9420	447	-
2006	1503	6146	10042	205	-
2007	997	4503	9618	119	-
2008	901	3575	9285	9	8
2009	1409	4952	6583	34	18
2010	1449	5427	8165	170	10
2011	1583	5039	9351	239	15
2012	1929	5602	12130	413	5
2013	2398	5805	13791	176	0
2014	2647	6166	13673	183	0

Year	Gillnet	Longline	Trawl	Danish seine	Other
2015	2508	6287	15445	489	18
2016	2646	7290	14333	650	304
2017	2677	7221	15774	679	29
2018	3021	6542	17367	842	20
2019	3323	7028	17046	1119	0
2020	2976	6989	17675	1044	28
2021*	2930	7385	17203	866	50
2022*	2996	6391	16605	989	16

*** Provisional figures.**

Table 8.6. Greenland halibut in subareas 1 and 2. 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	-

Year		USSR catch/hour trawling (t)				Norway catch/hour trawling (t)		Average CPUE		Total effort (in '000 hrs trawling)	CPUE 7+	GDR (catch/day tonnage (kg)
		RT		PST		A	B	A	B			
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	-	-	-	-	-
2007		0.64	12	-		-	-	-	-	-	-	-
2008		0.48	12	-		-	-	-	-	-	-	-
2009		0.77	13	-		-	-	-	-	-	-	-
2010				1.57	12	-	-	-	-	-	-	-
2011				2.32	12							
2012				2.06	12							
2013				2.25	12							
2014				2.52	12							

[1] Side trawlers, 800–1000 hp. From 1983 onwards, stern trawlers (SRTM), 1000 hp. From 1997 based on research fishing.

[2] Stern trawlers, up to 2000 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 S IV, 1943 BRT (FAO Code 090).

[8] Norwegian trawlers, ISSC-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. Greenland halibut in subareas 1 and 2. Catch history back to 1935.

Year	Norway	Russia	Others	Total	Year	Norway	Russia	Others	Total
1935	1534	n/a	-	1534	1979	2843	10311	4088	17242
1936	830	n/a	-	830	1980	3157	7670	2457	13284
1937	616	n/a	-	616	1981	4201	9276	1541	15018
1938	329	n/a	-	329	1982	3206	12394	1189	16789
1939	459	n/a	-	459	1983	4883	15152	2112	22147
1940	846	n/a	-	846	1984	4376	15181	2326	21883
1941	1663	n/a	-	1663	1985	5464	10237	4244	19945
1942	955	n/a	-	955	1986	7890	12200	2785	22875
1943	824	n/a	-	824	1987	7261	9733	2118	19112
1944	678	n/a	-	678	1988	9076	9430	1081	19587
1945	1148	n/a	-	1148	1989	10622	8812	704	20138
1946	1337	25	-	1362	1990	17243	4764	1176	23183
1947	1409	28	-	1437	1991	27587	2490	3243	33320
1948	1877	110	-	1987	1992	7667	718	217	8602
1949	198	177	-	375	1993	10380	1235	318	11933
1950	1853	221	-	2074	1994	8428	283	515	9226
1951	2438	423	-	2861	1995	9368	794	1572	11734
1952	2576	377	-	2953	1996	11623	1576	1148	14347

Year	Norway	Russia	Others	Total	Year	Norway	Russia	Others	Total
1953	2208	393	-	2601	1997	7661	1038	711	9410
1954	3674	416	-	4090	1998	8435	2659	799	11893
1955	3010	290	-	3300	1999	15004	3823	690	19517
1956	3493	446	-	3939	2000	9083	4568	646	14297
1957	4130	505	-	4635	2001	10896	4694	775	16365
1958	2931	1261	-	4192	2002	7143	5584	566	13293
1959	4307	3632	-	7939	2003	8216	4384	847	13447
1960	6662	4299	-	10961	2004	13939	4662	298	18899
1961	7977	3836	-	11813	2005	13011	4883	940	18834
1962	11600	1760	-	13360	2006	11119	6055	697	17871
1963	11300	3240	-	14540	2007	8230	6484	738	15452
1964	14200	26191	-	40391	2008	7393	5294	1119	13806
1965	18000	16682	-	34682	2009	8446	3335	1198	12979
1966	16434	9768	119	26321	2010	770	6888	644	8302
1967	17528	5737	1002	24267	2011	8270	7053	1282	16605
1968	22514	3397	257	26168	2012	9331	10041	905	20277
1969	14856	19760	9173	43789	2013	10403	10310	1264	21977
1970	15871	35578	38035	89484	2014	11232	10061	1547	22840
1971	9466	54339	15229	79034	2015	10874	12953	1242	25069
1972	15983	16193	10872	43048	2016	12932	10576	1881	25389
1973	13989	8561	7349	29899	2017	13741	10714	1975	26430
1974	8791	16958	11972	37721	2018	14874	12072	1641	28587
1975	4858	20372	12914	38144	2019	14845	12198	1749	28792
1976	6005	16580	13469	36054	2020	14532	12266	1768	28566
1977	4217	15045	9613	28875	2021*	14008	12394	2038	28440
1978	4082	14651	5884	24617	2022*	13140	11746	2111	26997

*** Provisional figures.**

Table 8.8. Greenland halibut in ICES Division 4.a (North Sea). Nominal catch (t) by countries as officially reported to ICES. Not included in the assessment.

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	GB	UK England & Wales	UK Scotland	Netherlands	T
1973	0	0	0	4	0	0	9	8	0	28	0	0	
1974	0	0	0	2	0	0	2	0	0	30	0	0	
1975	0	0	0	1	0	0	4	0	0	12	0	0	

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	GB	UK England & Wales	UK Scotland	Netherlands	T
1976	0	0	0	1	0	0	2	0	0	18	0	0	
1977	0	0	0	2	0	0	2	0	0	8	0	0	
1978	0	0	2	30	0	0	0	0	0	1	0	0	
1979	0	0	2	16	0	0	2	0	0	1	0	0	
1980	0	177	0	34	0	0	5	0	0	0	0	0	
1981	0	0	0	0	0	0	7	0	0	0	0	0	
1982	0	0	2	26	0	0	17	0	0	0	0	0	
1983	0	0	1	64	0	0	89	0	0	0	0	0	
1984	0	0	3	50	0	0	32	0	0	0	0	0	
1985	0	1	2	49	0	0	12	0	0	0	0	0	
1986	0	0	30	2	0	0	34	0	0	0	0	0	
1987	0	28	16	1	0	0	35	0	0	0	0	0	
1988	0	71	62	3	0	0	19	0	0	1	0	0	
1989	0	21	14	1	0	0	197	0	0	5	0	0	
1990	0	10	30	3	0	0	29	0	0	4	0	0	
1991	0	48	291	1	0	0	216	0	0	2	0	0	
1992	1	15	416	3	0	0	626	0	0	+	1	0	1
1993	1	0	78	1	0	0	858	0	0	10	+	0	
1994	+	103	84	4	0	0	724	0	0	6	0	0	
1995	+	706	165	2	0	0	460	0	0	52	283	0	1
1996	+	0	249	1	0	0	1496	0	0	105	159	0	
1997	+	0	316	3	0	0	873	0	0	1	162	0	1
1998	+	0	71	10	0	10	804	0	0	35	435	0	1
1999	+	0		1	0	18	2157	0	0	43	358	0	2
2000	+		41	10	0	19	498	0	0	67	192	0	
2001	+		43	0	0	10	470	0	0	122	202	0	
2002	+		8	+	0	2	200	0	0	10	246	0	
2003	0	0	1	+	+	+	453	0	0	+	122	0	
2004	0	0	0	0	0	0	413	0	0	90	0	0	
2005	0	0	2	0	0	0	58	0	0	4	0	0	
2006	0	0	3	0	0	0	90	0	0	0	7	0	
2007	0	1	0	0	0	0	133	0	0	1	6	0	
2008	0	0	0	0	0	0	14	0	0	0	22	0	
2009	0	9	22	0	0	0	5	0	0	0	129	0	
2010	+	1	38	0	0	0	10	0	0	0	49	0	

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	GB	UK England & Wales	UK Scotland	Netherlands	T
2011	0	1	39	0	0	0	94	0	0	0	44	0	
2012	0	0	14	0	0	0	788	0	0	0	43	0	
2013	0	0	25	0	0	0	122	0	0	0	174	0	
2014	0	2	27	0	0	0	723	0	0		104	0	
2015	0	0	34	1	0	0	1151	0	0	0	127	0	1
2016	0	0	31	0	0	0	983	0	0	0	120	0	1
2017	0	0	20	0	0	0	753	0	0	0	73	0	
2018	0	0	15	0	0	0	472	0	42	0	0	0	
2019	0	0	21	0	0	0	241	0	14	0	0	1	
2020	0	0	10	0	0	0	663	0	45	0	0	1	
2021*	0	4	19	0	0	0	0	0	121	0	0	0	
2022*	0	207	13	0	0	0	522	0	150	0	0	0	

*** Provisional figures.**

Table 8.9. Abundance indices of different length groups in Russian autumn survey.

Year/ Length (cm)	≤30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	>80	Total
1984	955	2194	4608	8790	7770	6128	2847	1624	1594	1168	687	350	38713
1985	5399	1779	4704	6840	7312	4746	2608	1226	1187	999	540	248	37587
1986	1845	2856	6312	7298	7883	7083	3376	1309	1272	1038	550	214	41034
1987	1279	2303	3941	4324	3512	1940	901	510	380	185	191	31	19496
1988	1125	1394	2859	2140	1498	1433	383	236	233	102	121	77	11599
1989	354	1418	4987	6506	4255	2500	890	402	654	266	41	45	22318
1990	176	1296	3720	3979	3686	3107	1257	325	253	194	72	43	18107
1991	280	693	2851	5405	3764	2454	969	611	168	112	61	50	17417
1992	16	464	6630	15337	13600	10643	6080	2163	1562	675	212	83	57464
1993	0	52	928	5159	9231	6067	2419	1287	1070	534	333	153	27231
1994	101	50	449	4694	7153	6005	2997	1151	690	324	81	43	23736
1995	0	12	383	7525	13851	6180	2043	1188	655	458	190	32	32516
1996	0	0	579	12804	30605	20922	7610	2188	1225	666	161	83	76844
1997	69	53	609	5486	16005	12008	4504	1177	1008	533	150	52	41653
1998	22	92	1081	5036	18596	17089	7215	2334	903	478	104	67	53018
1999	206	82	595	3634	15099	16481	8084	3083	1809	505	240	84	49902
2000	749	550	1727	6027	16638	18489	10558	3857	2341	1057	330	125	62448
2001	376	976	3734	9210	20824	22882	11509	4814	2794	1440	625	369	79553

Year/ Length (cm)	≤30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	76–80	>80	Total
2002	229	895	3555	6656	9427	6074	3009	1485	815	247	75	30	32494
2003	36	839	3012	5565	8993	6294	3113	2978	3212	787	366	207	35403
2004	218	991	5279	8597	12754	12071	8664	5533	4509	1973	818	711	62117
2005	43	1156	3431	7326	8938	8308	6104	3988	2797	1063	318	543	44013
2006	73	966	11173	25138	26005	20288	11027	5174	3739	1979	730	559	106850
2007	387	1781	9683	15010	15387	13046	8410	4516	2547	1036	380	187	72369
2008	245	1548	7657	16345	21733	23003	21343	9291	8299	4279	2180	1122	117045
2009	20	1699	17514	31415	29067	25527	18885	7433	4089	2780	903	798	140130
2010	110	1923	24818	48545	44198	31754	20806	8970	7018	4280	1517	1536	195474
2011	198	629	11519	41842	53112	50416	38685	19082	8917	7173	3188	1561	236322
2012	4	211	5765	34616	42618	34595	25428	11845	5323	3755	1924	1162	167248
2013	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	9	762	6150	25687	38692	29358	18332	7111	3787	1887	694	495	132964
2015	37	689	7523	25534	35328	27096	14453	7570	3146	1289	522	231	123416
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	4	523	4388	11781	24279	30347	19697	8133	4282	1790	687	430	106339
2018	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	101	1196	10530	25051	28518	23866	15836	7728	3476	2037	843	559	119742

Table 8.10. Abundance indices of different length groups in Norwegian autumn slope survey (in thousands).

Year	<30	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-80	>80	SUM
1996	2	29	1018	10753	20084	11301	3816	1535	1005	401	136	59	50139
1997	2	80	1421	10690	19311	10802	3807	1837	1052	484	184	95	49766
1998	9	74	957	5762	14474	12655	5262	2241	1306	521	192	114	43568
1999	3	57	550	4629	13893	15236	6684	3356	2305	922	393	176	48203
2000	9	169	1121	4495	9538	11646	5816	2590	1347	590	220	111	37651
2001	30	355	1955	5980	11835	12829	6680	3084	1863	694	317	131	45753
2002	48	449	1897	5234	9620	11161	6319	2987	1571	636	239	126	40286
2003	48	748	3515	6958	10931	13029	8279	4769	2547	928	469	222	52444
2004	27	1014	3674	5504	8941	11044	6255	4019	2176	968	402	232	44256
2005	118	2128	5859	8307	8145	6792	4108	2866	1724	670	294	199	41210
2006	36	1214	5140	7416	8448	8047	5092	3315	2022	809	370	253	42163
2007	185	4034	18450	16416	10410	6954	4086	2026	1125	414	163	110	64372
2008	505	6041	12820	11714	7884	5978	3023	1743	1110	440	149	176	51585
2009	54	2645	13634	16937	11488	8487	4864	2456	1841	714	284	211	63615

Year	<30	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-80	>80	SUM
2011	0	377	5536	14368	13765	10668	5352	1793	1612	881	440	330	55123
2013	4	134	2420	11053	12859	7408	3880	1389	688	357	213	115	40520
2015	9	774	3982	13688	15619	9195	4165	1859	867	440	194	151	50943
2017	19	342	2259	6006	9796	8924	5035	1841	832	259	132	125	35571
2019	0	677	4192	8117	9053	5738	3064	1215	570	222	73	84	33005
2021	109	1645	4635	10264	12302	9064	4643	2445	917	275	112	32	46442

Table 8.11. Abundance indices of females of different length groups in Norwegian autumn slope survey (in thousands).

Year	<30	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-80	>80	SUM
1996	0	12	337	2154	4284	2889	1918	1340	933	394	136	59	14456
1997	1	42	657	2052	3711	2902	1897	1643	1008	484	182	95	14672
1998	4	26	353	1036	2784	3983	2861	2047	1279	518	192	114	15198
1999	1	11	207	880	2367	4214	3510	2996	2235	906	385	176	17889
2000	5	64	435	1083	1377	2012	2428	2109	1292	589	220	111	11726
2001	17	159	758	1407	1648	1905	2556	2595	1838	694	317	131	14026
2002	34	207	733	1243	1297	1749	2297	2352	1528	632	239	126	12439
2003	33	345	1649	2009	1670	2340	3434	4121	2493	925	469	222	19710
2004	11	445	1534	1550	1436	2113	3029	3675	2145	950	401	232	17519
2005	40	737	1910	1925	1254	1341	2093	2576	1703	668	294	199	14740
2006	19	542	2096	2163	1789	1587	2158	2890	1971	801	369	249	16634
2007	110	2111	8639	6230	2667	1620	1897	1735	1106	405	163	107	26790
2008	278	3159	5536	3703	2137	1456	1463	1577	1095	440	149	175	21167
2009	28	1047	5255	5506	3126	2227	2198	2063	1752	704	268	201	24374
2011	0	149	1623	2757	2367	1578	1063	1354	1553	875	440	330	14088
2013	0	35	492	1632	2023	1421	1004	1035	679	354	213	115	9003
2015	5	308	1385	1954	2623	2502	1694	1374	854	440	194	151	13484
2017	16	169	864	1435	1863	1725	1908	1270	820	259	132	125	10588
2019	0	321	1714	2004	1867	1530	1379	952	531	222	73	84	10678
2021	42	852	1775	1793	2203	1798	2152	2066	880	275	112	32	13980

Table 8.12. Abundance indices (numbers in thousands) from bottom-trawl surveys in the Barents Sea standard area winter (Mehl et al., WD4 AFWG 2019).

Year	Length group (cm)																Biomass (tonnes)
	≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	≥80	Total	
1994	0	0	21	76	148	1117	3139	4740	3615	1941	889	541	21	0	0	16248	19228
1995	298	0	0	0	90	129	2877	7182	5739	2027	1622	839	489	86	0	21378	27459
1996	4121	0	0	0	62	124	1214	4086	4634	1871	1112	638	337	74	12	18285	20256
1997[1]	0	68	0	0	55	163	949	4313	5629	2912	1609	643	300	65	21	16727	24214
1998[1]	68	220	945	578	481	487	1088	4016	6591	3076	1798	707	326	93	44	20518	27248
1999	43	84	241	436	566	269	784	1701	3097	1669	1094	491	89	75	0	10639	14681
2000	140	184	344	836	1722	3857	2253	1560	2144	1714	1191	615	249	76	0	16885	17246
2001	68	49	147	179	737	1525	3716	3271	2302	2010	1088	529	160	50	39	15870	18224
2002	271	0	70	34	382	1015	1916	3803	3250	2279	1138	976	242	159	114	15649	21198
2003	51	0	74	19	304	715	1842	3008	4765	2235	714	561	245	146	0	14679	19635
2004	106	104	15	0	319	1253	1229	1717	2277	1227	798	298	148	94	26	9611	11872
2005	263	70	159	1139	2235	2621	4206	3782	3847	2037	917	585	336	118	0	22315	22293
2006[2]	0	72	94	414	1968	5149	4613	5743	4283	2132	891	449	258	34	18	26118	25579
2007[1]	0	18	146	1869	1418	3114	5710	5947	4287	2205	963	658	391	80	89	26895	28006
2008	0	0	0	243	1708	5974	4654	6136	5198	3403	827	638	174	82	50	29087	30153
2009	55	0	0	26	1044	4327	8133	4551	4084	2266	996	627	442	253	154	26958	28919
2010	0	0	0	99	678	3648	5729	6560	4897	2467	1064	552	229	128	41	26092	25979
2011	51	0	0	0	216	4396	5864	5498	5237	3698	699	936	327	252	97	27271	31552
2012[3]	77	0	0	0	51	1145	4524	5366	4517	2774	1147	195	73	0	48	19917	22656
2013	0	0	0	0	0	511	5368	4868	5374	3687	1944	939	348	131	154	23324	31748
2014	0	0	46	92	156	368	2271	5587	5903	3555	2251	1369	154	260	79	22091	31112
2015	367	0	61	0	284	1612	3187	6452	7249	6752	3350	1936	587	334	0	32171	46828
2016	205	0	124	511	950	1953	3486	4539	5479	5613	1999	1973	646	98	80	27656	35831
2017[4]	52	0	0	78	592	1328	1885	3850	4852	4550	1721	1455	317	190	23	20893	29756
2018	0	0	62	0	383	1333	2049	3445	4258	3573	1904	1366	736	196	20	19325	28688
2019	0	0	0	375	272	1671	3285	4034	5177	4265	3570	2526	1328	535	137	27175	45912
2020[3]	80	91	2464	442	790	2272	4391	5136	4929	4613	3278	1803	894	384	250	29599	43631
2021[3]	0	154	927	927	2370	2976	3869	4265	3516	2991	2378	1649	670	682	238	27612	37090
2022[3]	0	0	822	2165	3696	1831	3365	5322	5672	3621	2230	1543	799	432	135	31633	39548
2023[3]	0	0	59	746	6480	8816	5302	5792	7284	351	2065	1369	1001	57	338	43260	47623

[1] Indices raised to also represent the Russian EEZ

[2] Not complete coverage in southeast due to restrictions, strata 7 area set to default and strata 13 as in 2005

[3] Indices not raised to also represent uncovered parts of the Russian EEZ.

[4] Indices raised to also represent uncovered parts of the Russian EEZ

Table 8.13. Reference points, values, and their technical basis for NEA G. halibut.

Framework	Reference point	Value	Technical basis
MSY approach	MSY	19142 t	Maximum sustainable yield
	HR_{MSY}	0.139	HR (>=45cm) leading to MSY
Precautionary approach	B_{lim}	33391 t	Lowest modelled mature female substock biomass
	B_{pa}	46747 t	B_{lim} x 1.4
	$B_{trigger}$	46747 t	B_{pa}
	HR_{lim}	0.165	HR (>=45cm) leading to P(SSB<B_{lim})=0.5
	HR_{pa}	0.145	HR(>=45cm), when ICES AR is applied, leading to P(SSB > Blim) = 0.05

Table 8.14. Greenland halibut in ICES subareas 1 and 2 (Northeast Arctic). Annual catch scenarios for 2024. All weights are in tonnes. Harvest rate (HR) for >= 45 cm fish, spawning stock biomass (SSB) in the beginning of 2025.

Basis	Total catch (2024)	HR (2024)	SSB (2025)	% Biomass change *	% TAC change **	% Advice change ***
ICES advice basis						
MSY approach: HRmsy x SSB2024/Btrigger	15560	0.134	46054	+1.5	-37.8	-15.9
Other scenarios						
MSY approach ex. 2019 recruitment spike	14012	0.129	43282	-1.2	-44.0	-24.2
HR=0	0	0	53142	+14.6	-100	-100
Catch s.q.	26997	0.233	40844	-11.1	+8.0	+46.0

*** SSB 2025 relative to 2024.**

**** Advice value for 2024 relative to the TAC value in 2023 (25000 tonnes).**

***** Advice value for 2024 relative to the advice value for 2023 (18494 tonnes**

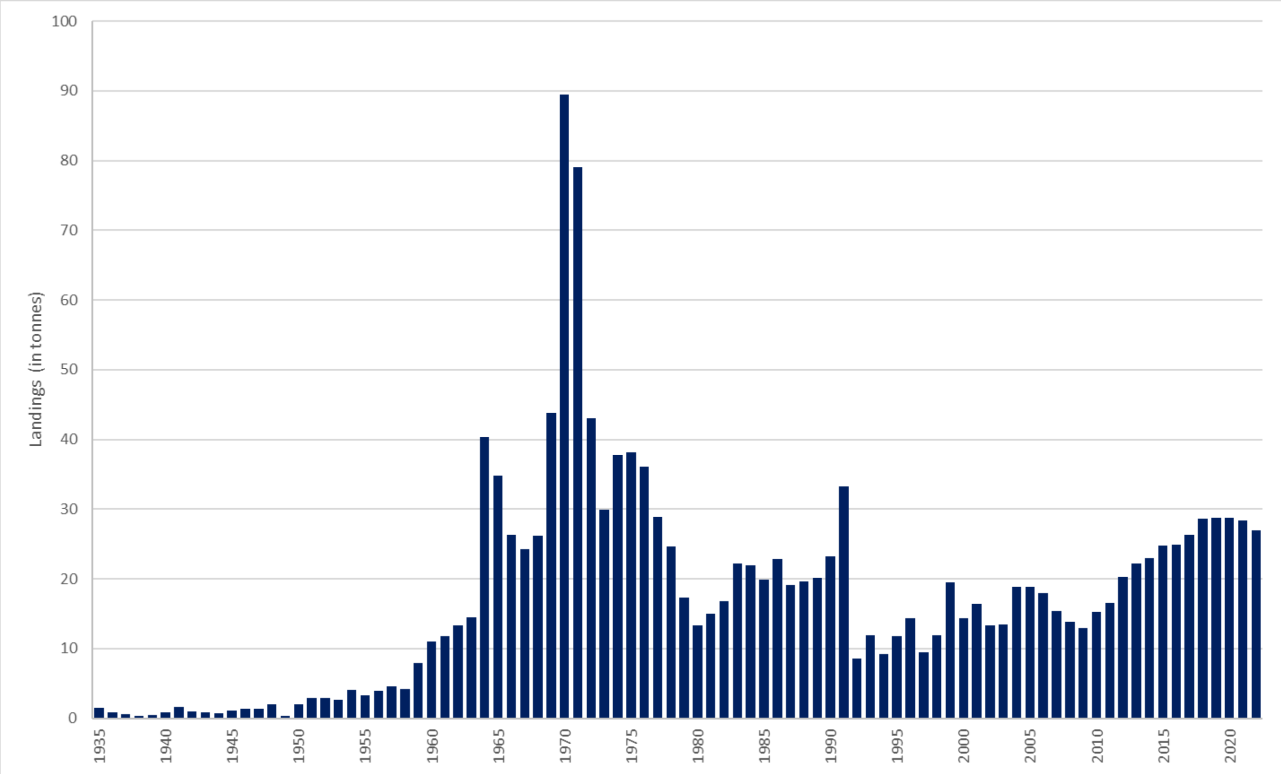

Figure 8.1. NEA Greenland halibut landings. Historical landings (Nedreaas and Smirnov 2003 and AFWG).

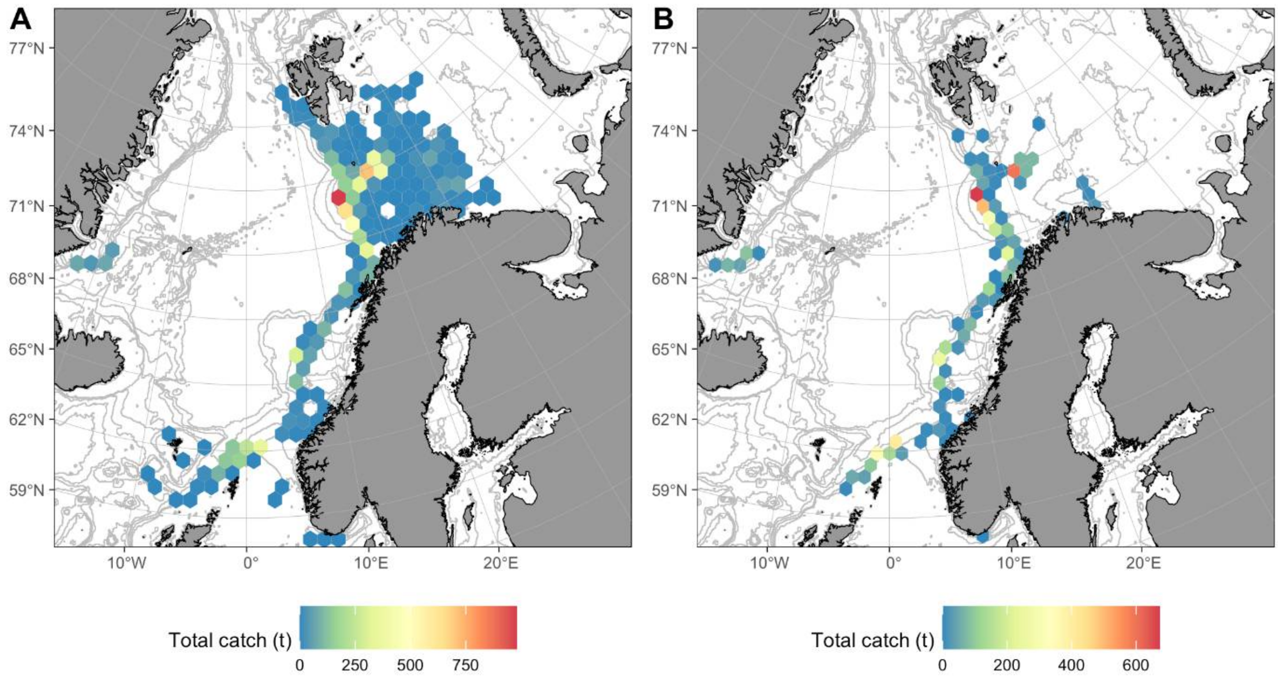

Figure 8.2. Spatial distribution of Greenland halibut catches in 2022 according to Norwegian electronic logbooks, in all registered fisheries including bycatch (A), and catches where G. halibut make more than 50% of the total catches (B).

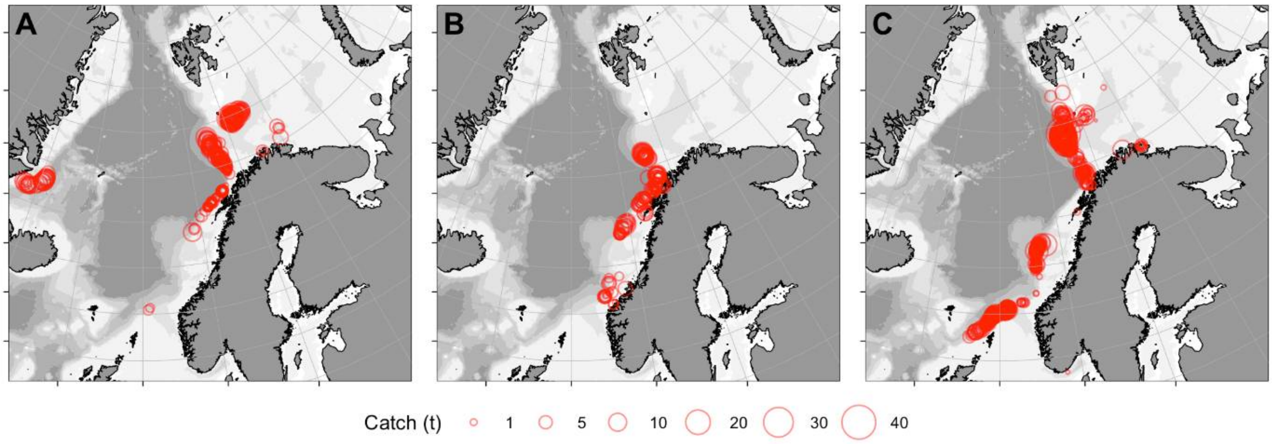

Figure 8.3. Spatial distribution of catches where Greenland halibut make more than 50% of the total catches, according to Norwegian electronic logbooks from 2022. Bubble area is proportional to the size of single catches expressed in metric tonnes. The panels show longline (A), gillnet (B) and trawl (C) catches.

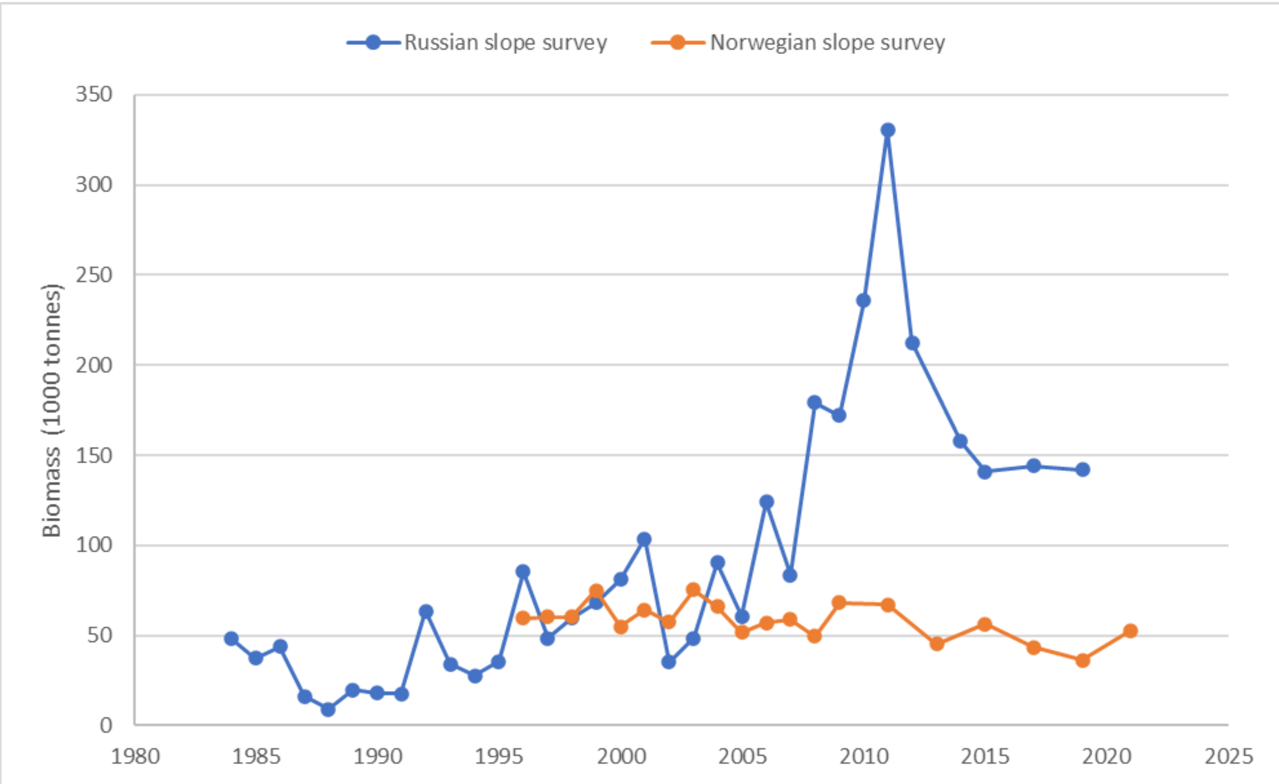

Figure 8.4. NEA Greenland halibut. Total biomass estimates from Russian autumn survey and the Norwegian slope survey. Note that the Norwegian survey is run every other year since 2009. Uncertain estimate for 2013 from the Russian survey. Russian data from 1992 and onwards are revised in 2021 (Russkikh WD12). No Russian data for 2016, 2018 and 2020.

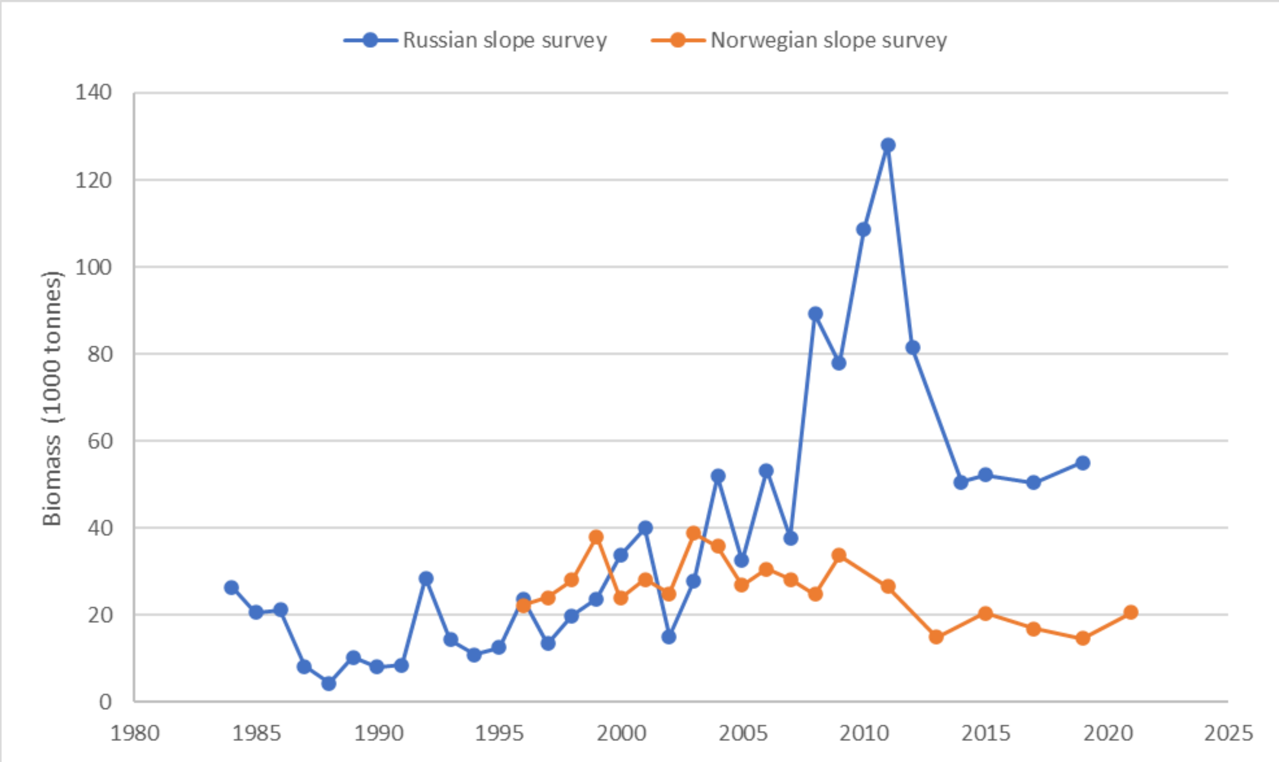

Figure 8.5. NEA Greenland halibut. Swept–area estimate of the female biomass based on the data from the Norwegian slope survey in August (every other year since 2009) and the Russian trawl survey in October–December (compared to previous reports, . Russian data from 1992 and onwards are revised in 2021 (Russkikh WD12)). Uncertain estimate for 2013 from the Russian survey.

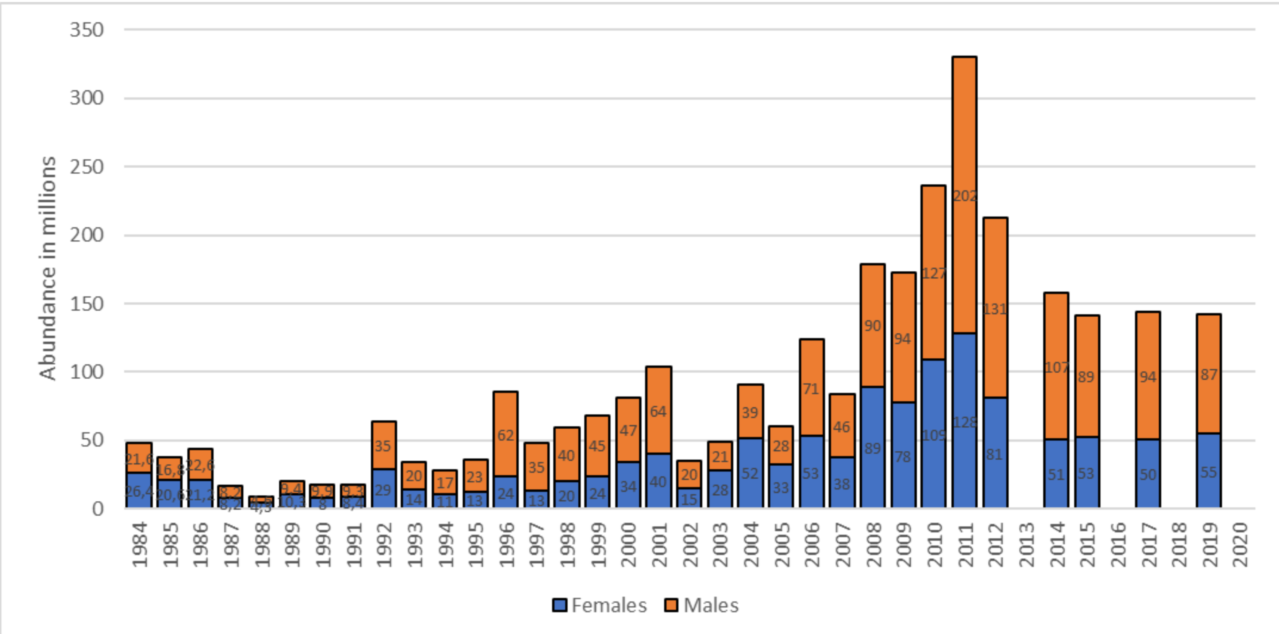

Figure 8.6. Russian autumn survey; Greenland halibut abundance by sex (Russkikh and Smirnov, WD16 AFWG 2016). Russian data from 1992 and onwards are revised in 2021 (Russkikh WD12). In this figure the 1992, 1996, 2002, 2017 and 2019 indices were not raised to also represent uncovered parts of the standard survey area.

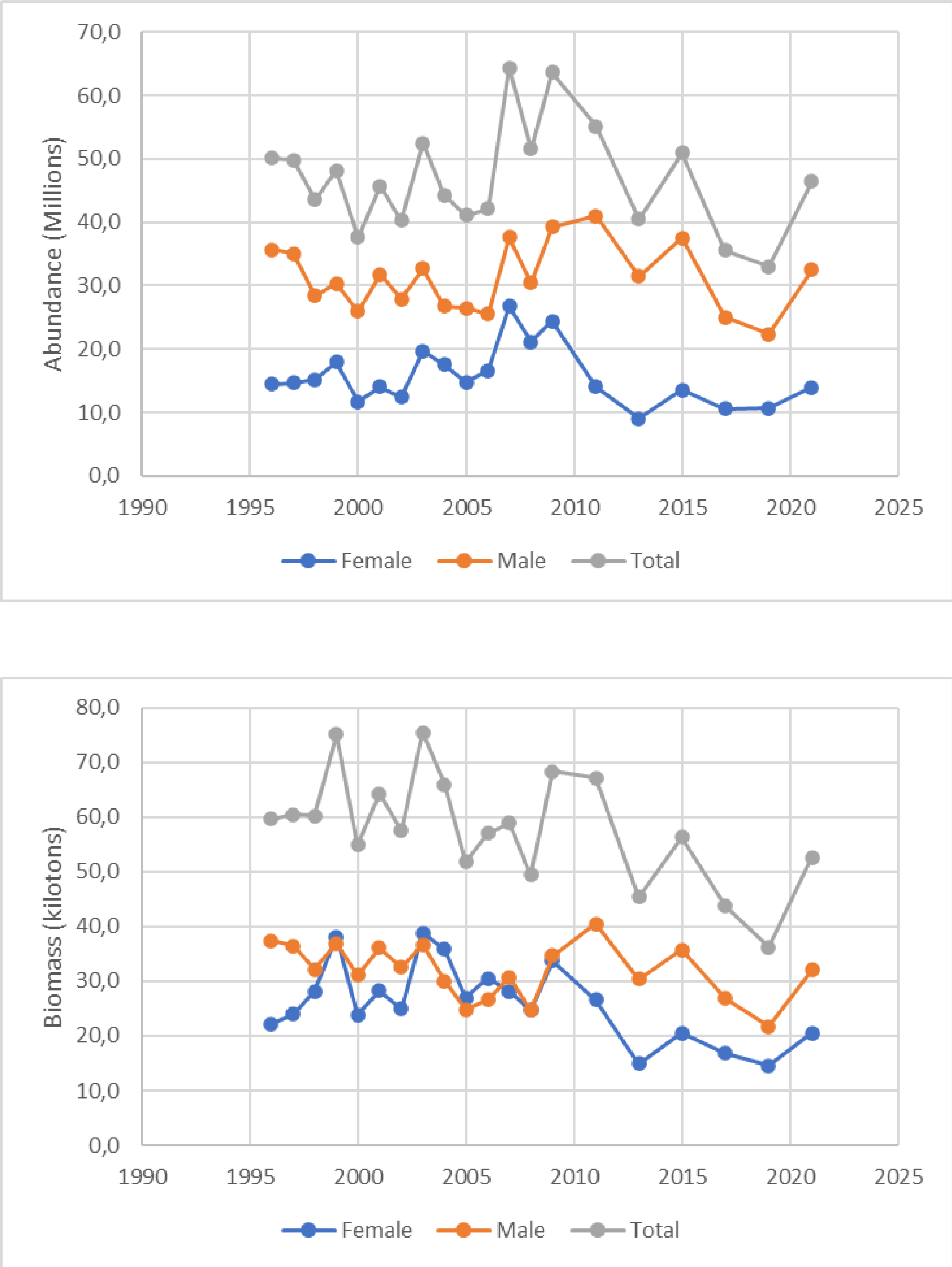

Figure 8.7. Estimated Greenland halibut abundance (upper panel) and biomass (lower panel), by sex, from the Norwegian autumn slope survey.

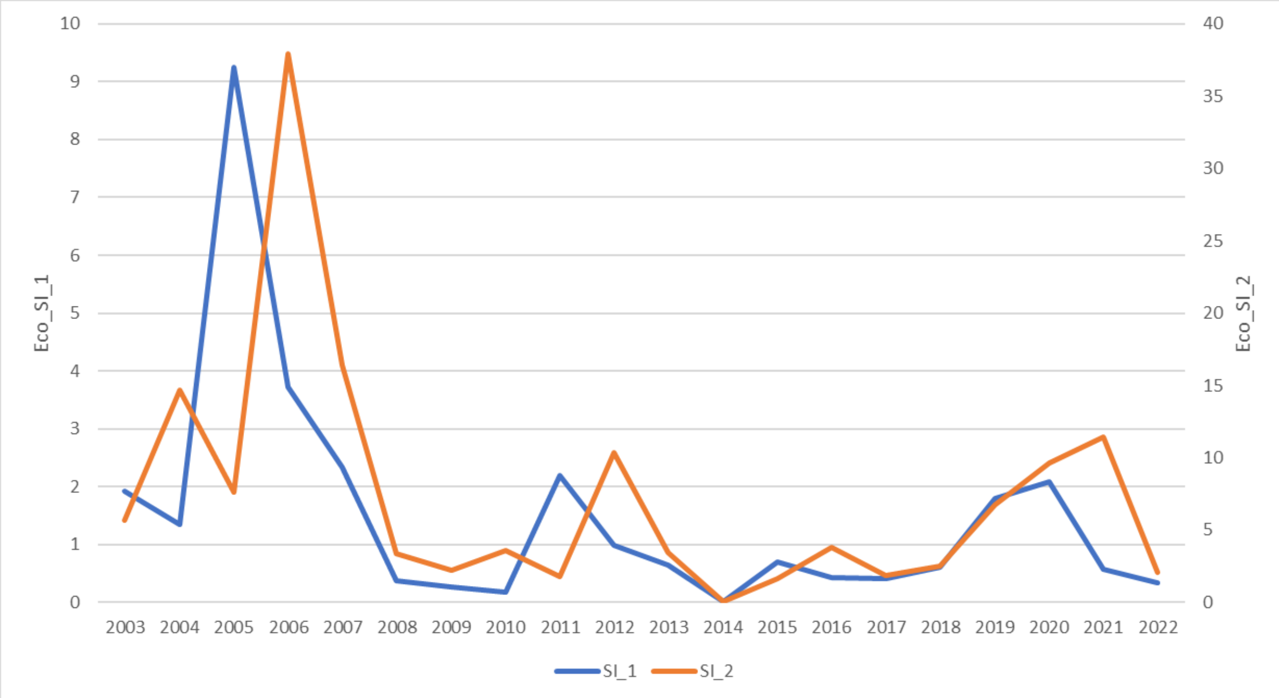

Figure 8.8. Total juvenile biomass indices Eco_SI_1 (10-17cm) and Eco_SI_2(18-27cm) (sex distribution is assumed 50/50 in the juvenile area) for Greenland halibut based on the Barents Sea Ecosystem Survey (A5216) (2014 not included due to poor survey coverage in the juvenile area) and the juvenile survey 1996−2002 (for area see Hallfredsson and Vollen, WD20 AFWG 2015).

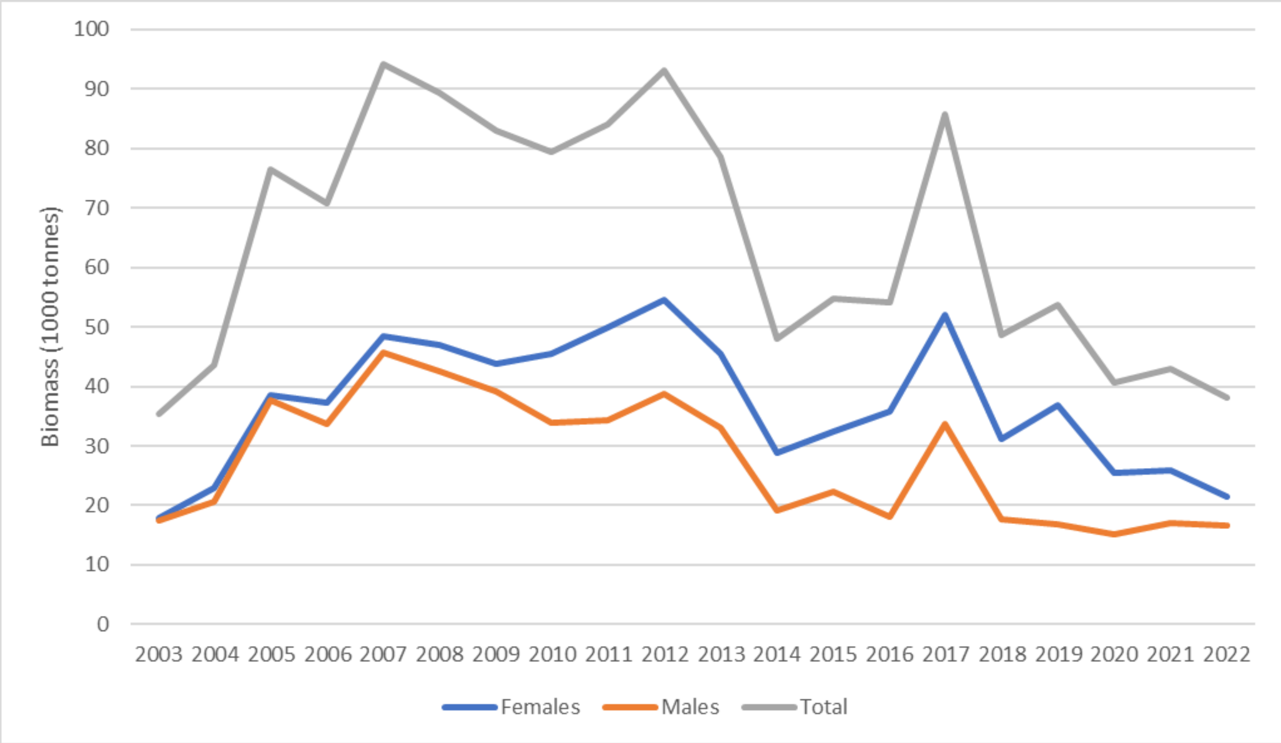

Figure 8.9. EcoS biomass index by sex for Greenland halibut in the Barents Sea Ecosystem Survey (A5216)

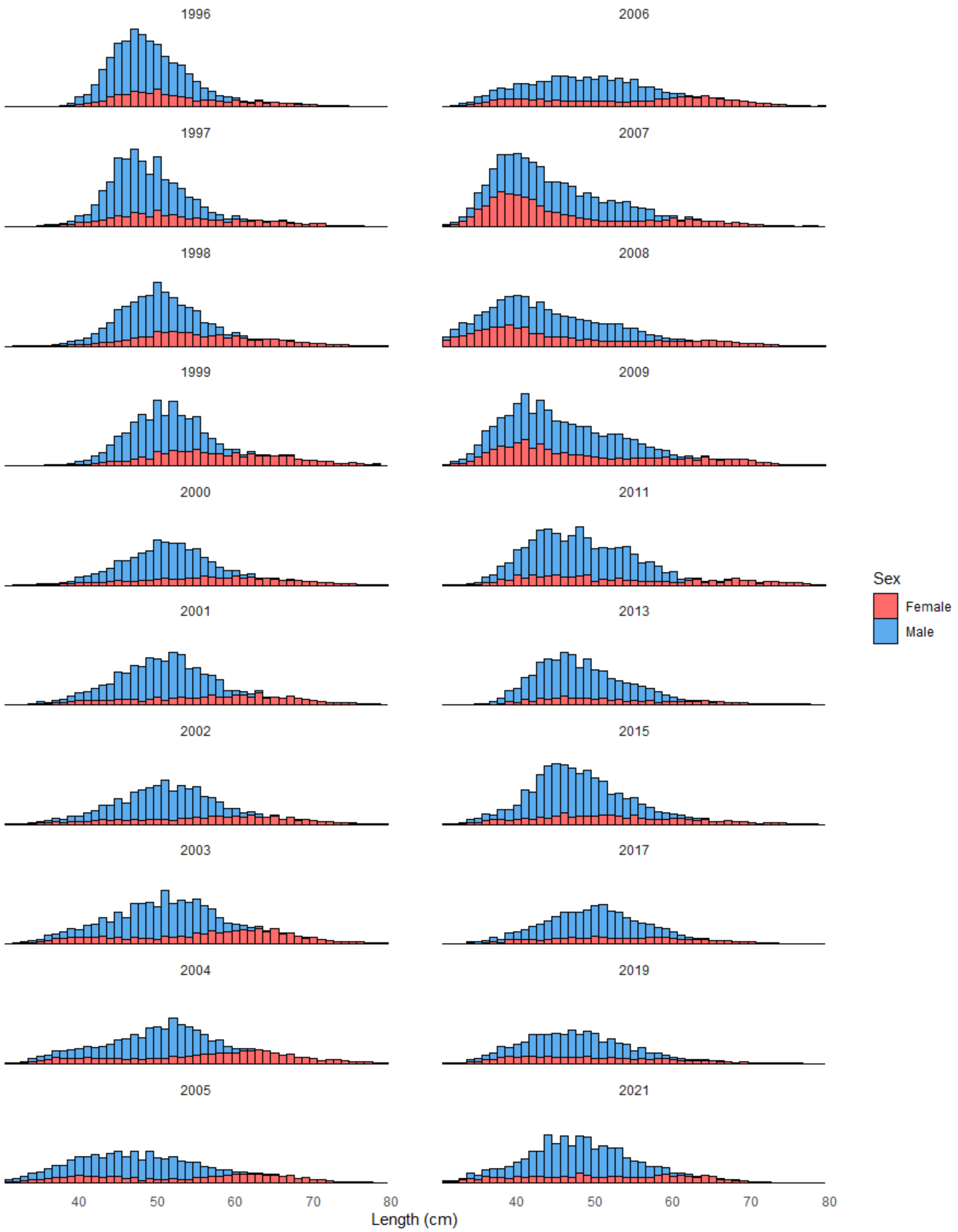

Figure 8.10. Length frequency distribution estimates for the entire area covered by the Norwegian Slope survey during autumn. Note biennial surveys after 2009.

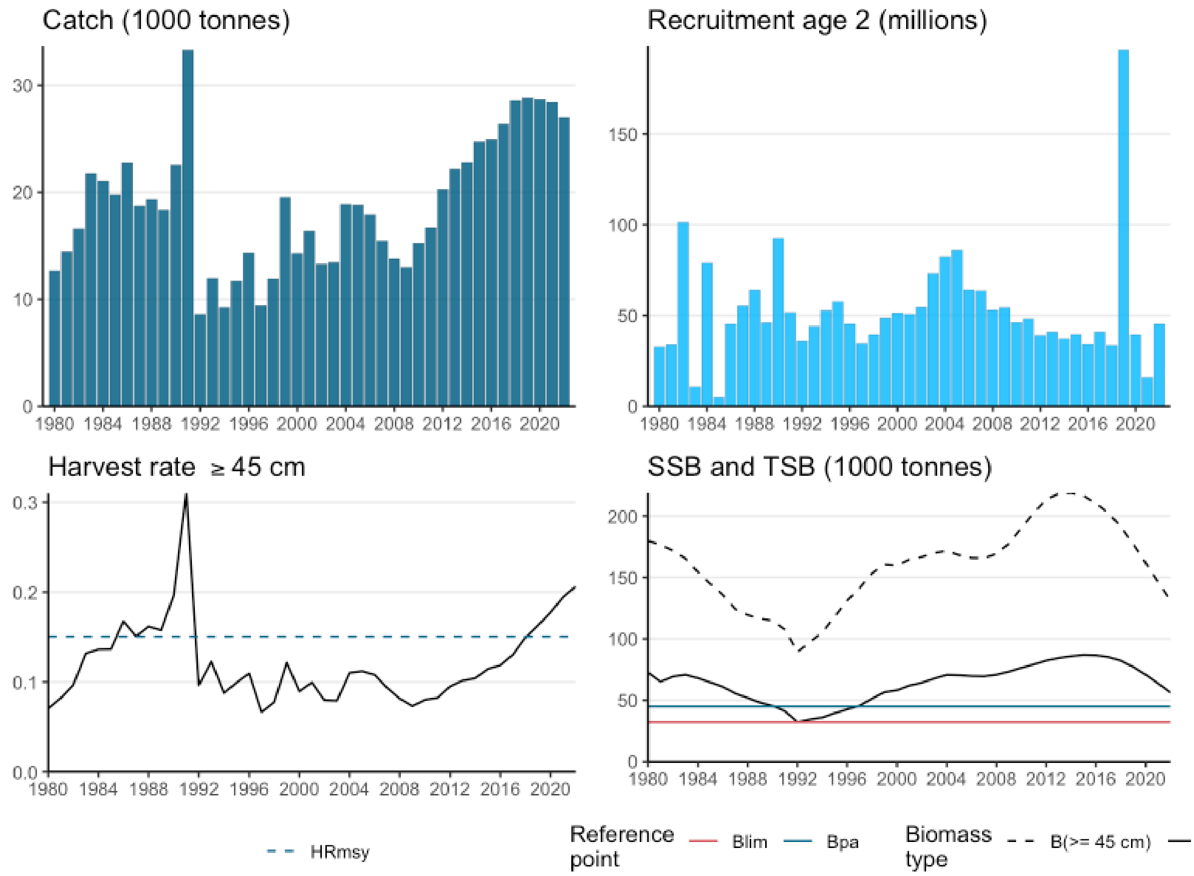

Figure 8.11. From top left to bottom right: Catch (1000 tonnes), recruitment estimate (in millions) for 1 year olds, harvest rate and Spawning stock biomass (SSB) and total stock biomass (TSB) for Greenland halibut as estimated by the GADGET model. Note that the recruitment spike in 2019 is uncertain.

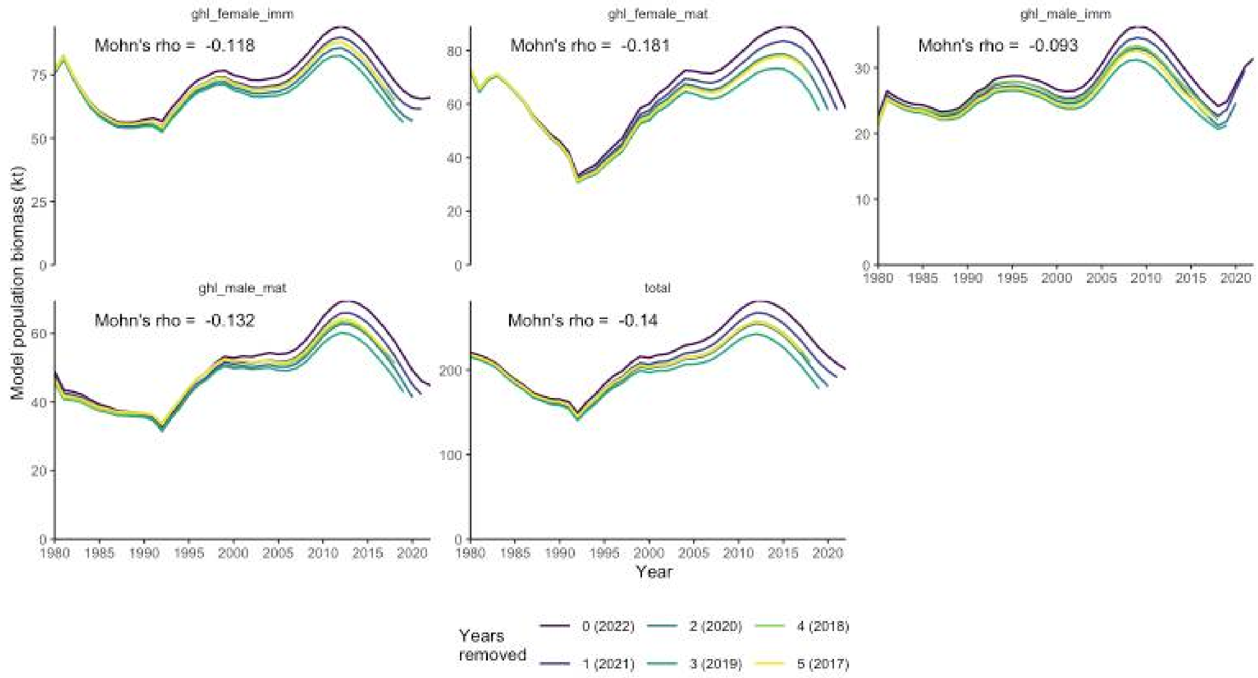

Figure 8.12 Retrospective analysis using model biomass for each sub-stock and total biomass. Colors are scaled to the number of years removed.

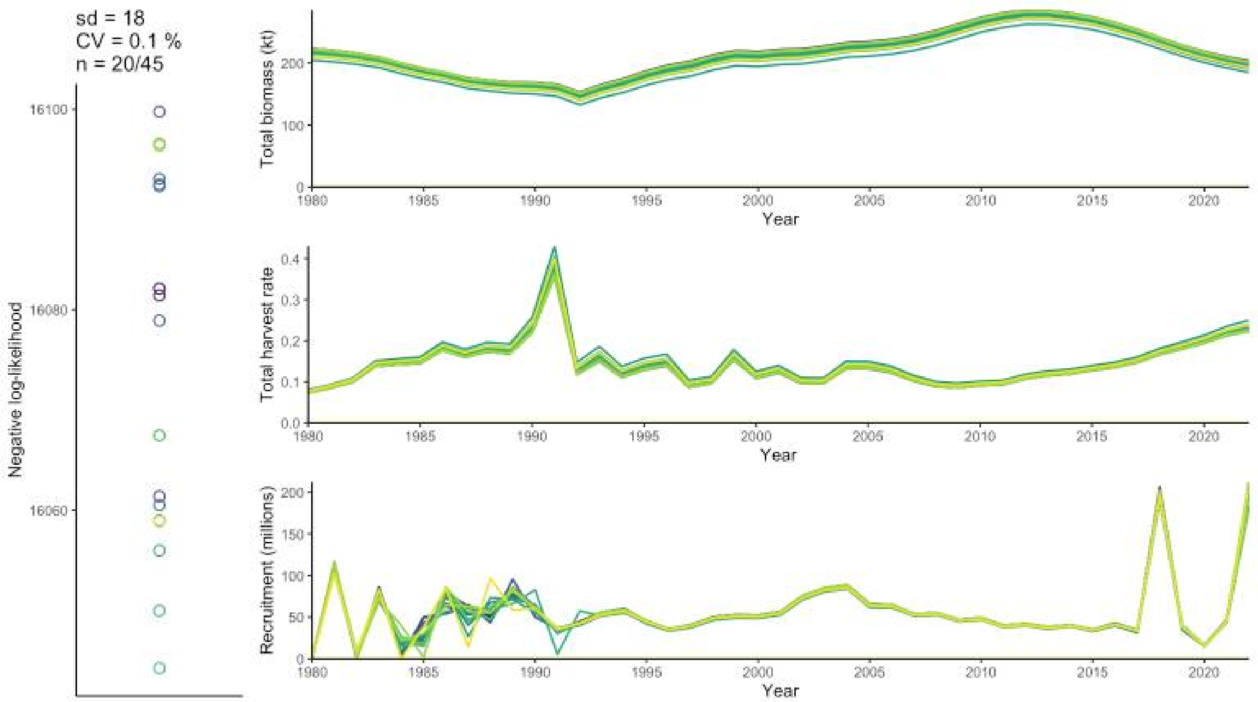

Figure 8. 13. Jitter results for the model. Negative log-likelihood scores of jitter runs are shown on the left together with standard deviation and CV (in percentage). Total biomass, harvest rate and recruitment are on top of each other on the right. Colour indicates the run number and is standardized across all panels.

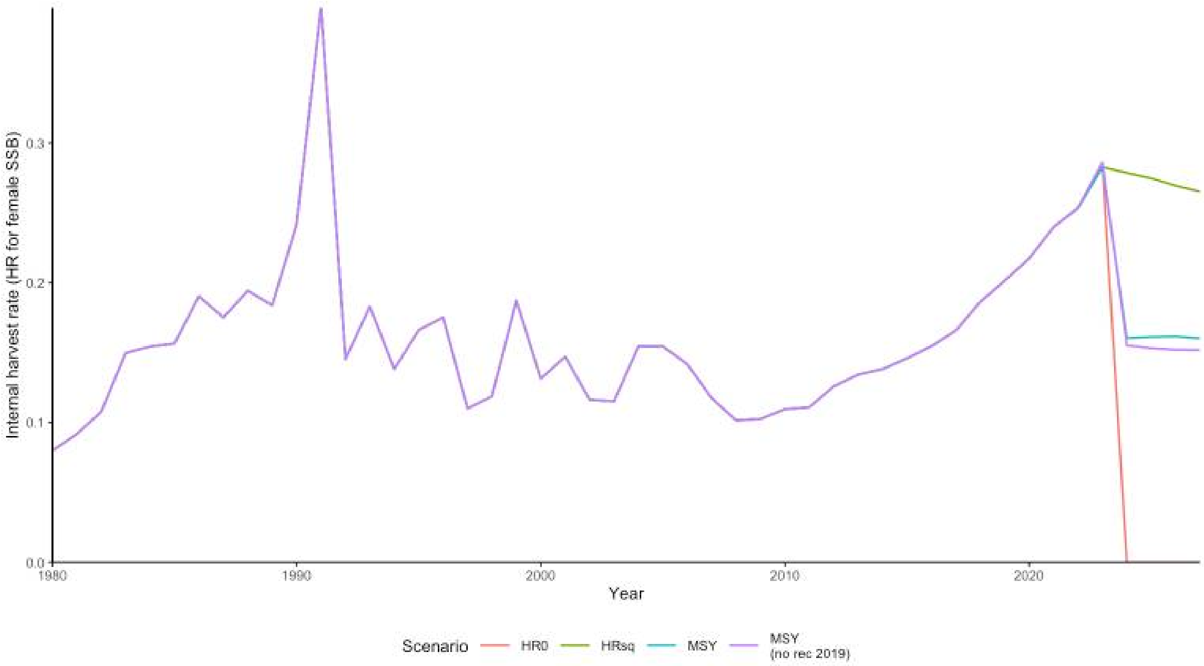

Figure 8. 14. Internal harvest rates (HR for female SSB) of short-term projection scenarios. Harvest rates are influenced by B TRIGGER .

1 Greenland halibut (*Reinhardtius hippoglossoides*) in subareas 1 and 2 (Northeast Arctic); ghl.27.1-2.

2 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0123&from=EN

3 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0092&from=EN

3 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R0515&qid=1650982320384&from=en

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