3 Northeast Arctic Cod (subareas 1 and 2)

General statement

This year AFWG made two alternative assessments for NEA cod based on the SAM model: SPALY – with the Same model Parameters As Last Year and final run with some changes in the model parameters (see sec. 3.5.1 for details). The final run is proposed by the group to be the basis for advice. Tables in the report with input data and observations are the same for the both runs. The other tables are presented in two parts:

- in the main body of the report section 3 there are tables with final run results;
- in section Annex there are assessment and prediction tables for the SPALY run.

The group notes that following a review (IBPNEACOD 2019) the Advice Drafting Group chose to reject the proposed changes in the "final" run, and that the advice given in 2019 is therefore based on the "SPALY" run described in the Section 3.13.

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 were 778 627 tonnes in 2018. 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 2019 (Tables 3.1-3.4, Figure 3.1)

Reported catch of cod in Subarea 1 and Divisions 2.a and 2.b:

The provisional catch for 2018 reported to the working group is 778 627 t.

Reported catch figures used for the assessment of Northeast Arctic cod:

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 calculated this way for the period 1960—2018 are given in Table 3.2 together with the coastal cod catches calculated based on otolith types (used in the coastal cod assessment as described in Section 2). For 2012–2018 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. By this procedure the amount of Norwegian catches calculated to be coastal cod in 2012, 2013, 2014, 2015, 2016, 2017 and 2018 is 35.2, 25.7, 33.6, 35.8,

54.9, 51.0, and 36.3 thousand tonnes. Table 3.2 includes ECA estimates of coastal cod for the whole period 1984—2018. The plan at the 2015 benchmark was for both stocks to use the ECA estimates for this whole period. As described in the coastal cod section (section 2) these tabulated ECA-results are still considered preliminary, and there is a need for further work on this before the whole time-series is applied. The catch by area, are 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 2018 was similar to 2017. The nominal landings by country are given in Table 3.4.

There is information on cod discards (see section 0.4) but it was not included in the assessment because this 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 450 t of cod in the Jan Mayen EEZ, which is a part of ICES Area 2.a, mostly by long-line. Cod is known to 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 will in 2019 carry out an experimental fishery during four different periods in order to investigate further the occurrence of cod in this area in space and time as well as stock identity. Two Norwegian vessels will participate in this fishery, and a TAC of 400 t has been set aside for each vessel. The 2018 catches in this area were counted against the Norwegian TAC for cod north of 62°N, while the 2019 TAC for this area comes in addition to the Norwegian TAC for cod as agreed by JNRFC.

3.1.3 Unreported catches of Northeast Arctic cod (Tables 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 2018 and 2019

The Joint Norwegian-Russian Fisheries Commission (JNRFC) agreed on a cod TAC of 775 000 t for 2018, and in addition 21 000 t Norwegian coastal cod. The total reported catch of 814 985 t in 2018 was 18 985 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. Norwegian catches in 2018 were about 18 000 t above the TAC, while Russian and third country catches were very close to the TAC (differences of less than 3000 tonnes).

The advice for 2019 given by ACOM in 2018 was 675 000 t based on the agreed harvest control rule. The quota established by JNRFC for 2019 was equal to 725 000 tonnes. Thus, the TAC was not set according to the agreed HCR. In addition, the TAC for Norwegian Coastal Cod was set to the same value for 2019 as for 2018: 21 000 t.

3.2 Status of research

3.2.1 Fishing effort and CPUE (Table A1)

CPUE series of the Norwegian and Russian trawl fisheries are given in Table A1. The data reflect the total trawl effort, both for Norway and Russia. The Norwegian series is given as a total for all areas. Norwegian data for 2011–2018 are not necessarily compatible with data for 2007 and previous years.

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 preliminary swept area estimates and acoustic estimates from the Joint winter survey on demersal fish in the Barents Sea in winter 2019 are given in Tables A2 and A3. More details on this survey are given in WD 04. The total area covered was about the same as in 2014 which is the most extensive coverage in the time series.

Before 2000 this survey was made without participation from Russian vessels, while in 2001—2005, 2008—2016 and 2018–2019 Russian vessels have covered important parts of the Russian zone. In 2006—2007 the survey was carried out only by Norwegian vessels. In 2007 and 2016 the Norwegian vessels were not allowed to cover the Russian EEZ. The method for adjustment for incomplete area coverage in 2007 is described in the 2007 report. 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. In 5 of the 6 adjusted years (including 2017) the adjustments were not based on area ratios, but the "index ratio by age" was used. This means that the index by age for the covered area was scaled by the observed ratio between total index and the index for the same area observed in the years prior to the survey. The adjustments for 2017 were based on average index rations by age for 2014–2016.

Regarding the older part of this time-series it should be noted that the survey prior to 1993 covered a smaller area (Jakobsen *et al*., 1997), and the number of young cod (particularly 1- and 2-year old fish) was probably underestimated. Other changes in the survey methodology through time are described by Jakobsen *et al.* (1997), while the surveys for the years 2007—2012 and 2013—2018 are reported in Mehl *et al.* (2013, 2014, 2015, 2016, 2017a). 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.

The new method for calculating bottom trawl indices is described in Mehl *et al*. (2017b) and revised acoustic indices are given in Mehl *et al*. (2018). Time-series for weight-at-age and maturity-at-age for the years prior to 2018 should be revised accordingly.

With the recent expansion of the cod distribution 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 2014–2019 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 survey estimates within the standard area were used for the tuning data. If a wider coverage is continued in coming years, improved data for tuning and recruitment predictions might be obtained. Figure 3.7 shows the proportion by age of the swept area index which was found in the new northern area (see also Section 0.4).

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 2019 survey results in biomass terms was 663 thousand tonnes, this is almost twice the 2018 level and close to the 2017 level.

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 2.a and 2.b 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 and will likely be 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 2004–2018 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 the coverage was very close to complete.

In 2018, a large area in the eastern part of the Barents Sea was not covered (https://www.imr.no/tokt/okosystemtokt_i_barentshavet/survey_reports/nb-no). It was attempted to adjust for this lack of coverage based on historical data, but those attempts were considered unsuccessful. Thus it was decided not to include 2018 data from this survey, given in WD 01, in the assessment.

Revision of this time-series using the StoX calculation method is in progress (WD 03).

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

Length-at-age is shown in Table A5 for the Norwegian survey in the Barents Sea in winter, in Table A7 for the Lofoten survey and in Table A11 for the Russian survey in October-December. Weight-at-age is shown in Table A6 for the Norwegian survey in the Barents Sea in winter, in Table A8 for the Lofoten survey and in Table A12 for the Russian survey in October-December.

The Joint winter survey in 2019 shows stable size-at-age values (Table A6).

3.2.3 Age reading

The joint Norwegian-Russian work on cod otolith reading has continued, with regular exchanges of otoliths and age readers (see chapter 0.5). 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 2015–2016 exchange was 88.7% (Mjanger and Godiksen, 2018, WD 10). 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 1992–2016 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 used in the assessment

3.3.1 Catch-at-age (Tables 3.6)

For 2018, age compositions from all areas were available from Russia, Norway, Spain, Germany and Poland (Division 1 and 2b only). Unsampled catches were distributed on age by using data from Russian trawl in Subarea 1 and Division 2.a, and by using data from Norwegian trawl in Division 2.b. The catch-at-age data were calculated using InterCatch (Table 3.6).

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.

Length distributions from the Russian fishery were made by observers on board fishing vessels in reasonably sufficient quantity in all areas. Also, length samples of cod taken by Norwegian Coast Guard on board Russian fishing vessels in Norwegian economic zone (NEZ) in first quarter of 2018 were used in calculations of length/age distributions. These data were combined with Russian observers' data. An advantage of adding the Norwegian Coast Guard data is that they were taken in all months of the first quarter and over the whole NEZ area. However, biological sampling from the trawl fishery has been relatively low, especially in Division 2a.

It should be noted that for ages 14 and 15, the catch-at-age in 2018 is the highest since the early 1950s (Table 3.6).

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

Catch weights

For 2018, the mean weight-at-age in the catch (Table 3.8) was obtained from InterCatch as a weighted average of the weight-at-age in the catch for Norway, Russia, Spain, Poland, and Germany (Table 3.7). The weight-at-age in the catch for all countries is given in Table 3.9. From 2000 to 2016, AFWG working group applied 13 as plus group. The weight-at-age 13, 14, and 15 in the catch for 1946–1982, needed due to extended age range, was as last year taken from AFWG 2001 (ICES CM 2001/ACFM:19). For the 2019 assessment, it was decided to use the same, as in the last year, procedure for weight-at-age calculations for the recent period (1983-onwards): Observations were used for ages up to 11. However, because of very noisy values observed for older fish, weight-at-age 12–15 was set to constant values in this period. Weight-at-age 12 was equal to the mean for 1983–2015; the mean increment for ages 12–13, 13–14 and 14–15+ groups in the 1983–2015 period were used to calculate weight-at-age 13, 14, and 15.

Stock weights

For ages 1—11 stock weights-at-age at the start of year y ($W_{a,y}$) for 1983—2018 (Table 3.9) were calculated as follows:

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

where

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

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

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

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

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

Ecosystem survey data on length and weight-at-age are not used because of longer distance between survey time and beginning of the year (assessment using numbers at 1 January).

This year, the same procedure was used for weight-at-age in stock calculations for retro period (1946—1982) assuming that weight-at-age in stock was equal to weight-at-age in catch. Weight-at-age 12—15 was fixed for recent period (1983-onwards). Average values of Fleet 15 (BS-NoRu-Q1 (BTr)) data available at the moment for older age groups (12—15) were used for calculations of average weight-at-age in stock in this period.

Russian data for weight and maturity-at-age in autumn 2018 were not available as the survey was not conducted. In WD 15 to AFWG 2019, correction factors to allow for this when calculating the weight and maturity-at-age in 2019 were updated, based on historical differences between Norwegian and Russian data in the same way as in the 2017 (Yaragina and Bogstad, 2017, WD 10). These correction factors were then applied to the Norwegian data for 2019.

3.3.3 Natural mortality including cannibalism (Table 3.12)

A natural mortality (M) of 0.2 + cannibalism was used. Cannibalism is assumed to only affect natural mortality of ages 3-6. In addition, cannibalism was taken into account.

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 (Table 3.12) 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—2018.

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) were included in assessment during the benchmark to make the VPA 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).

3.3.4 Maturity-at-age (Tables 3.10 and 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 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—2018, 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 approach used is consistent with the approach used to estimate the weight-at-age in the stock (described in Section 3.3.2). The percent mature-at-age for the Russian and Norwegian surveys have been arithmetically averaged for all years, except 1982—1983 when only Norwegian observations were used and 1984 when only Russian observations were used.

Russian data for the autumn survey 2018 were not available as the survey was not conducted. In WD15, 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 2019.

Maturity-at-age for cod has been variable the last five years, particularly for ages 6–9. According to the combined data, maturation at age decreased in 2015–2016 but has now returned to a level close to that in 2010 and previous years.

The proportions of mature cod for age 13–15 was set to 1 for the period 1984–present, while for the period 1946–1983 data were taken from the AFWG 2001 report (ICES CM 2001/ACFM:19).

3.4 Changes of assessment model and data at the latest benchmark

The range of ages in the stock has been expanding and this has caused some problems with the age range used in the stock assessment. One of the basic goals of the Inter-Benchmark meeting in April 2017 (ICES 2017/ ACOM:29) was to investigate if and how information on stock dynamics at older ages (biological, survey, and fishery data) may be included into the analytical stock assessment.

At the inter-benchmark meeting it was decided to use SAM as the main assessment model for this stock and to use an extended age range in the tuning series.

3.5 Assessment using SAM (Tables 3.13, A13)

The following survey dataseries were used:

Fleet code	Name	Place	Season	Age	Years
Fleet 15	Joint bottom-trawl survey	Barents Sea	Feb-Mar	4–12	1981–2019
Fleet 16	Joint acoustic survey	Barents Sea+Lofoten	Feb-Mar	4–12	1985–2019
Fleet 18	Russian bottom-trawl survey	Total area	Oct-Dec	3–12	1982–2017
Fleet 007	Ecosystem survey	Total area	Aug-Sep	3–12	2004–2017

Note that the surveys that are conducted during winter (FLT 15 and 16) are allocated to the time of the year when they are carried out, previously they were allocated the end of the previous year, as that was the only possibility for using them when running XSA.

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 was 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. The Fleet 16 index (Table A13), which is a sum of the index from the Lofoten survey and acoustic index from the winter survey, has not yet been updated for years before 2018 with new data from StoX estimates for the acoustic index from the winter survey (Mehl *et al*., 2018a). For 2018 onwards StoX estimates have been used in the calculations.

3.5.1 Model adjustment and settings (Table 3.14)

At the inter-benchmark it was decided to have the same observation variance at age within each of the 4 tuning series and in the commercial catches, i.e. the simplest possible structure. At the time this seemed reasonable since there were very few fish in the oldest age groups (and note that time at the interbenchmark for checking settings was limited). Since the IBP however, the proportion of the stock and catch in the oldest age groups has increased and can no longer be treated as insignificant (36% of the catch in biomass in 2018 was from age 10+ fish and 14+ from age 12+). The last interbenchmark was held prior to the 2017 stock assessment and thus used 2015 as the last data year for catches. Thus this year's assessment had three more years of available data and the two strong year classes were age 13 and 14 in the last data year compared to

age 10 and 11 in the data set used at the inter-benchmark. At the same time the model diagnostics were indicating that the variance in the data for these oldest fish was (unsurprisingly) different from the younger fish.

The variance structure was thus adjusted at the assessment meeting compared to the benchmark settings. Investigating the residuals (WD 2) proposed age groups which needed separate variance parameters. These parameters were added to the model

The final adjusted variance structure, which is almost identical to the one proposed in WD 2 (the only change is that age 13 was added to the block with ages 14 and 15 for catch data), prescribes the following parameters: Two variance parameters for catches (ages >12 and age 12 and above), three variance parameters for fleet 15 (separate for age four, separate for age 11, and one common for the remaining ages), two variance parameters for fleet 16 (separate for age 11, one common for remaining ages), two variance parameters for fleet 18 (one for ages 9, 11, and 12, and one common for the remaining ages), finally two parameters for fleet 07 (one for age 12 and one common for the remaining ages). These new SAM settings, as well as the SPALY ones, are shown in Table 3.14.

The model diagnostics improved, as shown in the text tables below, as the estimated SD for residuals in the chosen blocks became closer to 1.0 and model diagnostics (AIC values and retrospective measures) were improved.

A comparison of model residuals and retrospective patterns is presented in Figures 3.2a, 3.2b and the influence on assessment results is shown in Figures 3.9a-d.

Standard deviations of residuals by fleets and age groups as a results of SPALY run

Age / Fleet	3	4	5	6	7	8	9	10	11	12	13	14	15
Catch	1.00	0.71	0.68	0.62	0.64	0.55	0.52	0.85	0.79	1.18	1.34	1.69	2.26
Fleet 15		0.38	1.08	0.95	0.91	1.06	0.99	0.90	1.44	1.14			
Fleet 16		0.83	0.81	0.90	0.86	0.92	0.97	0.75	1.27	1.03			
Fleet 18	0.54	0.98	1.00	0.86	0.66	0.70	1.39	0.97	1.35	1.27			
Fleet007	0.92	0.79	0.94	0.96	1.04	1.06	0.56	0.64	1.02	1.61			

Standard deviations of residuals by fleets and age groups as a result of FINAL run, dealing with SD for ages marked in blue as a separate parameters

Age / Fleet	3	4	5	6	7	8	9	10	11	12	13	14	15
Catch	1.02	0.83	0.79	0.72	0.87	0.76	0.72	1.01	1.04	1.51	0.95	1.10	1.46
Fleet 15		0.64	0.84	0.99	0.89	1.06	1.14	1.05	0.95	1.25			
Fleet 16		0.89	0.95	0.80	0.89	0.97	1.06	0.86	1.06	1.04			
Fleet 18	0.76	1.16	1.02	0.82	0.80	0.84	1.01	1.49	1.05	1.11			
Fleet007	1.02	0.83	0.95	1.00	1.04	0.99	0.66	0.76	1.29	1.04			

This adjusted model variance parameterization adds 6 model parameters, but improves the retrospective pattern, and improves the AIC score by 336.

Some criteria for diagnostic of fitting quality (Akaike criteria, Rho for F, R and SSB) for SAM runs with different assumption regarding ages with different variance of observations

	SPALY	WD-09	final run
AIC	2845	2568	2509
Rho(ssb)	8	10	8
Rho R	-27	-19	-20
Rho (F)	-3	-1	-1

3.5.2 SAM diagnostics (Figure 3.2a,b,c)

Residuals for the final SAM run are shown in Fig 3.2a, while retrospective plots of F, SSB and recruitment are shown in Figure 3.2b. The same results from SPALY run are presented in these figures for comparison. Figure 3.2c shows the catchability by survey and age group.

3.5.3 Results (Table 3.15-3.18, Figure 3.1)

The fishing mortalities and population numbers are given in Tables 3.15 and 3.16. 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 M2 since the benchmark meeting in 2015 (WKARCT 2015).

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

3.5.4 SPALY run

For comparison settings and diagnostics are presented together with final run on the same figures and tables. Tables with results and predictions from the SPALY run are given in section 3.13.

3.6 Results of the assessment

3.6.1 Fishing mortalities and stock biomass (Tables 3.18, 3.20, Figure 3.9d)

The estimated $F_{5\text{-}10}$ in 2018 is 0.3992, which is equal to F_{pa} (Table 3.18). Fishing mortality has increased in recent years. The spawning-stock-biomass in 2019 is estimated to be 1755 kt (Table 3.20), which is high but lower than the peak in 2013 (2737 kt). One should bear in mind that in the early part of the time-series the fraction at age of mature fish was considerably lower.

Total stock biomass in 2019 is estimated to 2905 kt which is somewhat above the long-term mean and well below the highest level observed (4478 kt in 2013).

The main difference between this year's assessment and the results from the SPALY run is an increase in abundance of older age groups (Figure 3.9d). The difference in TSB in 2018 is 309 kt of which the difference in SSB accounts for 284 kt. F in 2018 in the SPALY run is 0.02 higher than in this year's assessment.

3.6.2 Recruitment (Table 1.9a)

At the 2008 AFWG meeting it was decided to use a hybrid model, which is a weighted arithmetic mean of different recruitment models (Section 1.4). 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. Prognosis from all the models, including the hybrid is presented in Table 1.9a. Since 2014 the hybrid model is based on objective weighting of different submodels and includes the RCT3 model (see section 1.4 for details). The numbers-at-age 3 calculated by the hybrid method were: 667 million for the 2016 year class, 537 million for the 2017 year class, 644 million for the 2018 year class, and 585 million for the 2019 year class. The same estimates for SPALY SAM were as follows: 660 million for the 2016 year class, 524

million for the 2017 year class, 644 million for the 2018 year class, and 582 million for the 2019 year class.

3.7 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 2020 is based on the agreed harvest control rule.

3.7.1 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).

3.7.2 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).

3.7.3 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 $B_{pa} \leq SSB \leq 2 \times B_{pa}$, 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.

3.8 Prediction

3.8.1 Prediction input (Table 3.19, Figure 3.3-3.6)

The input data to the short-term prediction with management option table (2019—2022) are given in Table 3.19. For 2019 stock weights and maturity were taken from surveys as described in Sections 3.3.2 and 3.3.4, applying the correction factors for missing Russian data in autumn 2018 given in WD15.

Catch weights in 2019 onwards and stock weights in 2020 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)

For age 12 and older constant weights at age in the stock and the catch were used, based on 1983–2015 averages as described in Section 3.3.2.

This method was introduced in the cod prediction in the 2003 working group. Since 2005 working group the 3 most recent values of annual increments have been used for predicting stock weights. For catch weights the last 10-year period for averaging the increments is used. Weight increment for ages older than 9 are fixed to the value calculated for age 9 because of low sampling and high variability observed for older ages. Figures 3.3 and 3.4 show how these predictions perform back in history.

The maturity ogive for the years 2020—2022 was predicted by using the 2017—2019 average. The exploitation pattern in 2019 and later years was set equal to the previous 3 years average according to the benchmark decision (WKARCT 2015).

The method for prediction of weight-at-age in stock and catch and selection pattern for the oldest age groups (10+) should be reviewed at a benchmark, as we have more reliable data for those age groups in recent years and thus long time-series averages are not necessarily the most relevant to use.

The stock number-at-age in 2019 was taken from the final SAM run (Table 3.16) for ages 4 and older. The recruitment at age 3 in the years 2019—2022 was estimated as described in section 3.6.2. Figure 3.5 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—2018. There was no clear trend in natural mortality, and the average M values for the last 3 years are used to predict natural mortality of age groups 3—6 for years 2019—2022 (based on benchmark decision, WKARCT 2015).

The assessment shows an increasing trend in F from 2012 to 2018. The fishing effort also increased, and CPUE decreased, but stabilised in 2016–2018 at a lower level than in previous years (Figure 3.6a,b, Table A1). In accordance with the benchmark decision (WKARCT 2015) and with support from WD 11, the last year's assessment F in terminal year 2018 (*status quo*) is used for F in the intermediate year (2019). Table 3.19 shows input data to the predictions. The results of prediction show that the catch in 2019 predicted using F_{sq} is 4% less than the agreed TAC.

3.8.2 Prediction results (Tables 3.20 - 3.21)

The catches corresponding to F_{sq} in 2019 is 697 kt (Table 3.20). This is somewhat below the TAC for 2019 (725 kt). The resulting SSB in 2020 is 1458 kt, lower than in 2019 but still at a high level.

Table 3.20 shows the short-term consequences over a range of F-values in 2020. The detailed outputs corresponding to F_{sq} in 2019 and the F corresponding to the HCR and F_{pa} in 2020 is given in Table 3.21. Summarised results are shown in the text table below.

Since SSB in 2020 is above $3 \times B_{pa}$ = 1 380 000 t, F = 0.60 is used in the 3-year prediction, giving catches of 886 291, 745 207, and 668 696 tonnes in 2020, 2021, and 2022, respectively. The average of this is 766 732 tonnes.

Basis	Total catch (2020)	F_{total} (2020)	SSB(2021)	% SSB change **	% TAC change ***
ICES advice basis					
Management plan*	766 732	0.50	1 209 867	-17	6
Other options					
MSY approach: F_{MSY}	640 378	0.40	1 312 839	-10	-12
F = 0	0	0	1 860 296	28	-100
$F = F_{2018}$	639 358	0.3992	1 313 678	-10	-12
F_{pa}	640 378	0.40	1 312 839	-10	-12
F_{lim}	1 035 777	0.74	997 575	-32	43

Weights in tonnes.

*** 3 years (2020-2022) average catch**

**** SSB 2021 relative to SSB 2020.**

***** Catch 2020 relative to TAC 2019.**

SPALY SAM run

Since SSB in 2020 is between $2 \times B_{pa}$ = 920 000 t and $3 \times B_{pa}$ = 1 380 000 t, F = 0.4 × (1+0.5 × (1227−920)/460) = 0.533 is used in the 3-year prediction, giving catches of 761 080, 674 767, and 633 166 tonnes in 2020, 2021, and 2022, respectively. The average of this is 689 672 tonnes.

Basis	Total catch (2020)	F_{total} (2020)	SSB(2021)	% SSB change **	% TAC change ***
ICES advice basis					
Management plan*	689 672	0.47	1 056 392	-14	-5
Other options					
MSY approach: F_{MSY}	603 541	0.40	1 127 500	-8	-17
F = 0	0	0	1 652 231	35	-100
$F = F_{2018}$	630 101	0.4215	1 105 457	-10	-13
F_{pa}	603 541	0.40	1 127 500	-8	-17
F_{lim}	971 521	0.74	831 987	-32	34

Weights in tonnes.

*** 3 years (2020-2022) average catch**

**** SSB 2021 relative to SSB 2020.**

***** Catch 2020 relative to TAC 2019.**

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.

3.9 Comparison with last year's assessment

The text tables below compare this year's estimates with last year's estimates for the year 2018 of numbers-at-age (millions), total biomass, spawning biomass (thousand tonnes), as well as reference F for the year 2017.

AFWG 2019
FINAL SAM run

		N(2018)														
Assessment year (specification)	F(2017)	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13	age14	TSB (2018)	SSB (2018)	F (2018)
2018 WG	0.4005	691*	406	130	135	141	80	39	25	11	13	12	7	2624	1486	0.4005**
2019 WG	0.368	498	462	161	146	168	87	46	27	14	15	16	10	3036	1810	0.3992
Ratio 2019 WG/ 2018 WG	0.92	0.72	1.14	1.24	1.08	1.19	1.08	1.18	1.06	1.27	1.20	1.35	1.59	1.16	1.22	1.00

***estimated by recruitment models **assuming F_{sq}**

The number-at-age 3 in 2018 from this year's assessment (FINAL SAM) is considerably below (28%) last year assessment, while the number-at-age 4–12 are above (6–27%) the assessment last year, and ages 13-14 are even further above (35 and 59%). The changes resulted from new SAM settings (Figure 3.9b,d).

AFWG 2019
SPALY SAM
run

		N(2018)														
Assessment year (specification)	F(2017)	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13	age14	TSB (2018)	SSB (2018)	F (2018)
2018 WG	0.4005	691*	406	130	135	141	80	39	25	11	13	12	7	2624	1486	0.4005**
2019 WG	0.387	432	461	159	149	164	87	44	24	11	12	11	6	2727	1526	0.4215
Ratio 2019 WG/ 2018 WG	0.97	0.63	1.14	1.22	1.10	1.16	1.09	1.13	0.96	1.01	0.93	0.95	0.99	1.04	1.03	1.05

***estimated by recruitment models **assuming F_{sq}**

The number-at-age 3 in 2018 from this year's assessment by SPALY SAM shows considerable reduction (37%) in comparison with assessment last year. The number-at-age 4–9 are all above (9–22%) assessment last year, while the number-at-age 10-14 is very close to last year's assessment (7% or less difference). The changes correspond to the observed retrospective pattern of SPALY SAM (Figure 3.2b).

The retrospective patterns for the final run are better and historic stock underestimation is reduced (Figure 3.2b).

3.10 Concerns with the assessment

Since the choice of which age groups should be linked by common parameters will be strongly affected by the changing age structure in a recovering stock, the group believes that this needs evaluating and updating more frequently than at the benchmarks. AFWG (in common with many other groups) used to do something similar with the stock-size dependent catchability in XSA, and for much the same reason. There was considerable debate at the group with some concern raised that this increased the modelled stock size for ages without survey data. However, the final consensus was that the forced linked variances was clearly wrong, and that we should move away from this. This will be examined in more detail at the next benchmark.

The change in assessment settings resulted in an increase in the assessed stock biomass, especially for the oldest ages (13+) for which no tuning data were available. This change is being proposed for the 2019 assessment, with the rationale that this improved the model fitting (including on AIC), reduced most retros and misfits.

The estimated stock numbers for age groups 14 and 15+ in 2019 are the highest in the time series and the 15+ value is twice the previous maximum for that age group. Of the SSB in 2019, 31% consists of age 13+. The model results show that the fishing mortality on these age groups in recent years is much lower than experienced in the late 1940s and early 1950s when catches of these age groups were high (i.e. higher than in recent years). The low recent average selectivity for those age groups used in the prediction implies that the in the years to come, a considerable proportion of the 15+ group will be fish older than 15 years, a situation which has not been experienced before. Stock and fishery dynamics (mortality, selectivity, growth) for older cod, in particular age 15+, is largely unknown.

The model uses single commercial fleet which is estimated to have a dome shaped selectivity, and no survey data on the oldest fish. This leads to the possibility that the model could estimate an artificially low selectivity and artificially high stock for these oldest fish. A simulation study

indicates that the model does reliably estimate the fishing mortality at age over time in the current data situation. The estimation accuracy does naturally decrease for at ages where less data are available. This simulation did not study the potential effect of conflicting data sources.

It was noted that model estimates for age 15+ for the proposed final run are going up faster in the recent years than the 15+ catch data (Table 3.1) suggest, and the short available series of survey estimates for ages 13+ from FLT16 (Table A13, not included in the tuning) also indicates less of an increase in age groups 13+ in 2017–2019 than the assessment indicates. FLT 16 includes coverage of the spawning area and is the one of the two surveys with data from the last year which is considered to cover the largest part of the 10+ and 12+ stock. However, the model results reflect the proportion of age 12+ fish found in the catches of the Norwegian conventional fleet, which catches the major part of those age groups, also in these years. Thus, the data sources show different trends in the last three years.

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

There are some conflicting signals from the different surveys and catch-at-age data. This increases the uncertainty of assessment.

3.11 Additional assessment methods

All models use the same tuning data, but FLT 15 and FLT 16 are shifted one year and one age group in XSA, but not in SAM and TISVPA.

3.11.1 XSA

The same settings as last year used to run XSA this year. The model is run for ages 3–13+, while other models are runs for 3–15+.

3.11.2 TISVPA (Tables 3.22-3.24, Figure 3.8a-c)

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 model was first presented and tested at the ICES Working Group on Methods of Fish Stock Assessments (WGMG 2006) and was used for data exploration and stock assessment for several ICES stocks, including Northeast Atlantic mackerel, blue whiting, Norwegian spring-spawning herring.

To NEA cod stock TISVPA model was applied at AFWG in 1998 and at benchmark group for arctic stocks (WKARCT) in 2015. At Inter-Benchmark protocol working group (IBPArcticCod) in 2017 it was decided to continue to use TISVPA as a supplementary model.

This year the TISVPA model was applied to NEA cod using the same data as SAM except that natural mortality values from cannibalism were taken from the SAM runs. During AFWG 2019 the results of exploratory runs using the TISVPA model were discussed (WD 09). The residuals

of the model approximation of catch-at-age and "fleets" data are presented in Figure 3.8a. Likelihood profiles for different data source are presented in Figure 3.8b. Retrospective run results are shown in Figure 3.8c. The results generally support the results of SAM model giving an estimate of SSB in 2019 of about 1.72 million tonnes.

3.11.3 XSAM

The XSAM (Aanes, 2016) functionality on variances (allowing variances to vary through time, and setting external variance estimates) has now been incorporated into SAM. Work was presented showing that this had the possibility to produce significantly better model fitting. Note that this method of allowing variances to change through time may be a better way of handling the variance-at-age issue outlined above. This could in particular be the case for older age groups which in part of the time series have very low abundance and thus data for those groups are likely to be more uncertain in those periods.

During the meeting SAM was fitted with several XSAM options. Best fit among these runs with respect to likelihood was obtained with usage of external variance structures and with the current benchmark settings. The likelihood increased from -1358.7 to -1132.0 by including external variance estimates. This large increase in the likelihood indicates that model fit is improved by including the external variances. When using all XSAM-options given in Aanes (2016), the likelihood increased to -1213.3.

Leave-out-one residuals obtained using external variance structures and benchmark configurations are shown in Figure 3.10a. Note that there seems to be less structure in the residuals for later years for older ages. Retrospective plots obtained with the same settings are given in Figure 3.10b. Figure 3.10c shows the catch plots with use of both the benchmark configurations and with usage of external covariance structures. We see that the point estimate of the catch is much closer to the observed catch when using the external variance estimates, indicating that the catch observations are given a larger weight. SSB estimates are further given in Figure 3.10d

3.11.4 Model comparisons (Figure 3.9a-d)

Figure 3.9a compares the results of SAM (both runs), XSA and TISVPA, showing F, SSB, TSB, and recruitment. F and TSB is very similar for all models but deviate from each other for the most recent years. TSB and SSB in 2019 is quite similar in all models except SPALY SAM which is lower, around 10% lower TSB than the final SAM run. Recruitment in recent years is higher in XSA than in the other models. TISVPA and SAM demonstrate opposite patterns in catch residuals. TISVPA has a block of negative residuals at the end of time-series for younger age groups, while for older ages residuals are mostly positive (Figure 3.8a). At the same time SAM demonstrates the opposite pattern (Figure 3.2a).

The relatively small difference in total stock and SSB estimation for 2019 between two SAM models do have an effect on the predicted catch calculating according to the management plan. The predictions done using the same settings as for SAM (three years' average fishing pattern, $F_{2019} = F_{2018}$, starting abundance N taken for beginning of 2019) for Final SAM data gives a catch advice for 2020 according to the HCR equal to 767 kt, compared to 690 kt using SPALY SAM data. Such a difference compared to the difference in assessed biomass could be explained by different stock composition in 2019 in the two model sets and differences in fishing pattern (Figures 3.9c-d). In addition, some difference is caused by the fact that in accordance to the HCR the F value used for SPALY SAM in the 3-year prediction (0.53) becomes smaller than for Final SAM (0.60) as SSB for SPALY SAM in 2020 is below $3*B_{pa}$, but for final SAM it is above. For TISVPA SSB in 2020 is also above $3*B_{pa}$ and the catch advice for 2020 according to the HCR is estimated to 866 kt.

3.12 New and revised data sources

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

3.12.1 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 also be ensured. The catch figures used in the coastal cod assessment are not equal to the difference between the total cod catch and the catch used in the NEA cod assessment (Table 3.2). These discrepancies will be adjusted when the ECA-results for the period 1984—2018 are re-evaluated (Table 3.2, and section 2.2.1).

3.12.2 Discard and bycatch data (Tables 3.25-3.26)

Work on updating discard and bycatch data series (Tables 3.25, 3.26) is ongoing, new data on age groups were not available in time for AFWG 2019. Revised bycatch estimates in numbers for the period 2005-2018 are described in Section 0.6. At WKARCT in 2015 it was, however, decided not to include those data in the catch-at-age matrix.

Table 3.26 (taken from Ajiad *et al*., WD2, 2008) presents bycatch in the Norwegian shrimp fishery by cod age (previously this has been given by cod length). 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 1000 million at age 3.

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
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

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
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	272 405	375 328	216 651		864 384
2016	321 347	351 468	176 607		849 422
2017	309 902	360 477	197 898		868 276
2018[1]	249397	321548	207681		778627

Data provided by Working Group members

[1] **Provisional figures**

Table 3.2. Landings of Norwegian Coastal Cod in subareas 1 and 2, 10^3 tonnes

Year	Coastal cod catch used in NCC-assess	Coastal cod catch from ECA-model	Norwegian catches of cod in areas 06+07 whole yr plus q3&4 in areas 00+05	Norwegian catches of cod removed from the NEAC-assessment
Av1960–70			38.6	38.6
1971–79			no data	no data
1980			40	40
1981			49	49
1982			42	42
1983			38	38
1984	74.8	63.5	33	33
1985	75.5	62.5	28	28
1986	68.9	56.0	26	26
1987	61	48.2	31	31
1988	59.3	54.9	22	22
1989	40.3	41.2	17	17
1990	28.1	20.9	24	24
1991	24.8	24.8	25	25
1992	41.7	38.2	35	35
1993	52.6	50.4	44	44
1994	54.6	51.6	48	48
1995	57.2	65.0	39	39
1996	61.8	41.6	32	32
1997	63.3	51.0	36	36
1998	51.6	30.5	29	29
1999	40.7	35.8	23	23
2000	36.7	34.8	19	19
2001	29.7	27.2	14	14
2002	41	36.4	20	20
2003	34.6	35.4	19	19
2004	24.5	33.6	14	14
2005	22.4	29.3	13	13

Year	Coastal cod catch used in NCC-assess	Coastal cod catch from ECA-model	Norwegian catches of cod in areas 06+07 whole yr plus q3&4 in areas 00+05	Norwegian catches of cod removed from the NEAC-assessment
2006	26.1	39.3	15	15
2007	23.8	29.2	13	13
2008	25.8	35.5	13	13
2009	24.8	30.0	15	15
2010	22.9	40.2	13.5	13.5
2011	28.6	36.6	18.8	18.8
2012	31.9	35.5	17.7	35.5
2013	22.5	30.1	16.8	30.1
2014	23.2	33.6	15.5	33.6
2015	39.4	35.8	13.2	35.8
2016	44.6	54.9	10.0	54.9
2017	52.9	51.0	7.6	51.0
2018	-	36.3	7.3	36.3

Table 3.3. Northeast Arctic COD. Total nominal catch ('000 t) by trawl and other gear for each area, data provided by Working Group members.

	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
2018[1]	204.7	44.7	156.7	164.9	192.0	15.6

Data provided by Working Group members

[1] **Provisional figures**

Table 3.4. Northeast Arctic COD. 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	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	United Kingdom	Russia[2]		Others	Total all countries
1961	3 934	13 755	3 921	8 129	268 377	-	158 113	325 780		1 212	783 221
1962	3 109	20 482	1 532	6 503	225 615	-	175 020	476 760		245	909 266
1963	-	18 318	129	4 223	205 056	108	129 779	417 964		-	775 577
1964	-	8 634	297	3 202	149 878	-	94 549	180 550		585	437 695
1965	-	526	91	3 670	197 085	-	89 962	152 780		816	444 930
1966	-	2 967	228	4 284	203 792	-	103 012	169 300		121	483 704
1967	-	664	45	3 632	218 910	-	87 008	262 340		6	572 605
1968	-	-	225	1 073	255 611	-	140 387	676 758		-	1 074 084
1969	29 374	-	5 907	5 543	305 241	7 856	231 066	612 215		133	1 197 226
1970	26 265	44 245	12 413	9 451	377 606	5 153	181 481	276 632		-	933 246
1971	5 877	34 772	4 998	9 726	407 044	1 512	80 102	144 802		215	689 048
1972	1 393	8 915	1 300	3 405	394 181	892	58 382	96 653		166	565 287
1973	1 916	17 028	4 684	16 751	285 184	843	78 808	387 196		276	792 686
1974	5 717	46 028	4 860	78 507	287 276	9 898	90 894	540 801		38 453	1 102 434
1975	11 309	28 734	9 981	30 037	277 099	7 435	101 843	343 580		19 368	829 377
1976	11 511	20 941	8 946	24 369	344 502	6 986	89 061	343 057		18 090	867 463
1977	9 167	15 414	3 463	12 763	388 982	1 084	86 781	369 876		17 771	905 301
1978	9 092	9 394	3 029	5 434	363 088	566	35 449	267 138		5 525	698 715
1979	6 320	3 046	547	2 513	294 821	15	17 991	105 846		9 439	440 538
1980	9 981	1 705	233	1 921	232 242	3	10 366	115 194		8 789	380 434
						Spain					
1981	12 825	3 106	298	2 228	277 818	14 500	5 262	83 000		-	399 037
1982	11 998	761	302	1 717	287 525	14 515	6 601	40 311		-	363 730
1983	11 106	126	473	1 243	234 000	14 229	5 840	22 975		-	289 992
1984	10 674	11	686	1 010	230 743	8 608	3 663	22 256		-	277 651
1985	13 418	23	1 019	4 395	211 065	7 846	3 335	62 489		4 330	307 920
1986	18 667	591	1 543	10 092	232 096	5 497	7 581	150 541		3 505	430 113
1987	15 036	1	986	7 035	268 004	16 223	10 957	202 314		2 515	523 071
1988	15 329	2 551	605	2 803	223 412	10 905	8 107	169 365		1 862	434 939
1989	15 625	3 231	326	3 291	158 684	7 802	7 056	134 593		1 273	332 481
1990	9 584	592	169	1 437	88 737	7 950	3 412	74 609		510	187 000
1991	8 981	975	**Greenland**	2 613	126 226	3 677	3 981	119 427 [3]		3 278	269 158
1992	11 663	2	3 337	3 911	168 460	6 217	6 120	182 315	**Iceland**	1 209	383 234
1993	17 435	3 572	5 389	5 887	221 051	8 800	11 336	244 860	9 374	3 907	531 611
1994	22 826	1 962	6 882	8 283	318 395	14 929	15 579	291 925	36 737	28 568	746 086
1995	22 262	4 912	7 462	7 428	319 987	15 505	16 329	296 158	34 214	15 742	739 999
1996	17 758	5 352	6 529	8 326	319 158	15 871	16 061	305 317	23 005	14 851	732 228
1997	20 076	5 353	6 426	6 680	357 825	17 130	18 066	313 344	4 200	13 303	762 403
1998	14 290	1 197	6 388	3 841	284 647	14 212	14 294	244 115	1 423	8 217	592 624
1999	13 700	2 137	4 093	3 019	223 390	8 994	11 315	210 379	1 985	5 898	484 910
2000	13 350	2 621	5 787	3 513	192 860	8 695	9 165	166 202	7 562	5 115	414 870
2001	12 500	2 681	5 727	4 524	188 431	9 196	8 698	183 572	5 917	5 225	426 471
2002	15 693	2 934	6 419	4 517	202 559	8 414	8 977	184 072	5 975	5 484	445 045
2003	19 427	2 921	7 026	4 732	191 977	7 924	8 711	182 160	5 963	6 149	436 990
2004	19 226	3 621	8 196	6 187	212 117	11 285	14 004	201 525	7 201	6 082	489 445
2005	16 273	3 491	8 135	5 848	207 825	9 349	10 744	200 077	5 874	7 660	475 276
2006	16 327	4 376	8 164	3 837	201 987	9 219	10 594	203 782	5 972	6 271	470 527
2007	14 788	3 190	5951	4619	199 809	9 496	9298	186 229	7316	5 101	445 796
2008	15 812	3 149	5 617	4 955	196 598	9 658	8 287	190 225	7 535	7 336	449 171
2009	16 905	3 908	4 977	8 585	224 298	12 013	8 632	229 291	7 380	7 442	523 431
2010	15 977	4 499	6 584	8 442	264 701	12 657	9 091	267 547	11 299	9 185	609 983
2011	13 429	1 173	7 155	4 621	331 535	13 291	8 210	310 326	12 734	17 354 [4]	719 829
2012 [5]	17523	2841	8520	8 500	315 739	12814	11166	329 943	9536	11 081	727 663
2013	13833	7858	7885	8 010	438 734	15042	12536	432 314	14734	15 263	966 209
2014	33298	8149	10864	6 225	431 846	16378	14762	433 479	18205	13 243	986 449
2015	26568	7480	7055	6 427	377 983	19905	11778	381 188	16120	9 880	864 384
2016	24084	7946	8607	6 336	348 949	14640	13583	394 107	16031	15 139	849 422
2017	28637	9554	13638	5 977	357 419	14414	16731	396 180	11925	13 802	868 276
2018 [1]	26152	6605	12743	9 768	333 539	13143	11533	340 364	10708	14 071	778 627

[1] Provisional figures.
[2] USSR prior to 1991.
[3] Includes Baltic countries.
[4] Includes unspecified EU catches.
[5] Revised figures.

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. In 4 of the 5 adjusted years the adjustments were not based on area ratios, but the "index ratio by age" was used. This 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	143.8		
1995	186.6		
1996	165.3		
1997	87.5	78.0	Index ratio by age
1998	99.2	78.0	Index ratio by age
1999	118.3		
2000	162.4		
2001	164.1		
2002	156.7		
2003	146.6		
2004	164.6		
2005	178.9		
2006	169.1	18.1	Partly covered strata raised to full strata area
2007	122.2	56.7	Index ratio by age
2008	164.4		
2009	170.9		
2010	159.9		
2011	173.1		
2012	150.5	16.7	Index ratio by age
2013	202.1		
2014	207.8		
2015	195.7		
2016	172.8		
2017	146.9	37.5	Index ratio by age
2018	192.1		
2019	207.1		

Table 3.6. Northeast Arctic cod. Catch numbers-at-age (Thous)
SAM
Sun Apr 28 18:53:18 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTALNUM
1946	4008	10387	18906	16596	13843	15370	59845	22618	10093	9573	5460	1927	750	189376
1947	710	13192	43890	52017	45501	13075	19718	47678	31392	9348	9330	4622	4103	294576
1948	140	3872	31054	55983	77375	21482	15237	9815	30041	7945	4491	3899	4205	265539
1949	991	6808	35214	100497	83283	29727	13207	5606	8617	13154	3657	1895	2167	304823
1950	1281	10954	29045	45233	62579	30037	19481	9172	6019	4133	6750	1662	1450	227796
1951	24687	77924	64013	46867	37535	33673	23510	10589	4221	1288	1002	3322	611	329242
1952	24099	120704	113203	73827	49389	20562	24367	15651	8327	3565	647	467	1044	455852
1953	47413	107659	112040	55500	22742	16863	10559	10553	5637	1752	468	173	156	391515
1954	11473	155171	146395	100751	40635	10713	11791	8557	6751	2370	896	268	123	495894
1955	3902	37652	201834	161336	84031	30451	13713	9481	4140	2406	867	355	128	550296
1956	10614	24172	129803	250472	86784	51091	14987	7465	3952	1655	1292	448	166	582901
1957	17321	33931	27182	70702	87033	39213	17747	6219	3232	1220	347	299	173	304619
1958	31219	133576	71051	40737	38380	35786	13338	10475	3289	1070	252	40	141	379354
1959	32308	77942	148285	53480	18498	17735	23118	9483	3748	997	254	161	98	386107
1960	37882	97865	64222	67425	23117	8429	7240	11675	4504	1843	354	102	226	324884
1961	45478	132655	123458	51167	38740	17376	5791	6778	5560	1682	910	280	108	429983
1962	42416	170566	167241	89460	28297	21996	7956	2728	2603	1647	392	280	103	535685
1963	13196	106984	205549	95498	35518	16221	11894	3884	1021	1025	498	129	157	491574
1964	5298	45912	97950	58575	19642	9162	6196	3553	783	172	387	264	131	248025
1965	15725	25999	78299	68511	25444	8438	3569	1467	1161	131	61	79	197	229081
1966	55937	55644	34676	42539	37169	18500	5077	1495	380	403	77	9	70	251976
1967	34467	160048	69235	22061	26295	25139	11323	2329	687	316	225	40	14	352179
1968	3709	174585	267961	107051	26701	16399	11597	3657	657	122	124	70	46	612679
1969	2307	24545	238511	181239	79363	26989	13463	5092	1913	414	121	23	46	574026
1970	7164	10792	25813	137829	96420	31920	8933	3249	1232	260	106	39	35	323792
1971	7754	13739	11831	9527	59290	52003	12093	2434	762	418	149	42	25	170067
1972	35536	45431	26832	12089	7918	34885	22315	4572	1215	353	315	121	40	191622
1973	294262	131493	61000	20569	7248	8328	19130	4499	677	195	81	59	55	547596

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTALNUM
1974	91855	437377	203772	47006	12630	4370	2523	5607	2127	322	151	83	62	807885
1975	45282	59798	226646	118567	29522	9353	2617	1555	1928	575	231	15	37	496126
1976	85337	114341	79993	118236	47872	13962	4051	936	558	442	139	26	53	465946
1977	39594	168609	136335	52925	61821	23338	5659	1521	610	271	122	92	54	490951
1978	78822	45400	88495	56823	25407	31821	9408	1227	913	446	748	48	51	339609
1979	8600	77484	43677	31943	16815	8274	10974	1785	427	103	59	38	45	200224
1980	3911	17086	81986	40061	17664	7442	3508	3196	678	79	24	26	8	175669
1981	3407	9466	20803	63433	21788	9933	4267	1311	882	109	37	3	1	135440
1982	8948	20933	19345	28084	42496	8395	2878	708	271	260	27	5	5	132355
1983	3108	19594	20473	17656	17004	18329	2545	646	229	74	58	20	5	99741
1984	6942	14240	18807	20086	15145	8287	5988	783	232	153	49	12	8	90732
1985	24634	45769	27806	19418	11369	3747	1557	768	137	36	31	32	8	135312
1986	28968	70993	78672	25215	11711	4063	976	726	557	136	28	34	14	222093
1987	13648	137106	98210	61407	13707	3866	910	455	187	227	21	59	20	329823
1988	9828	22774	135347	54379	21015	3304	1236	519	106	69	43	14	5	248639
1989	5085	17313	32165	81756	27854	5501	827	290	41	13	1	11	16	170873
1990	1911	7551	12999	17827	30007	6810	828	179	59	15	6	5	2	78199
1991	4963	10933	16467	20342	19479	25193	3888	428	48	12	1	1	2	101757
1992	21835	36015	27494	23392	18351	13541	18321	2529	264	82	3	9	1	161837
1993	10094	46182	63578	33623	14866	9449	6571	12593	1749	377	63	22	1	199168
1994	6531	59444	102548	59766	32504	10019	6163	3671	7528	995	121	19	4	289313
1995	4879	42587	115329	98485	32036	7334	3014	1725	1174	1920	222	41	1	308747
1996	7655	28782	80711	100509	54590	10545	2023	930	462	230	809	84	1	287331
1997	12827	36491	69633	83017	65768	28392	4651	1151	373	213	144	238	1	302899
1998	31887	88874	48972	40493	34513	26354	6583	965	197	69	42	22	53	279024
1999	7501	77714	92816	31139	15778	15851	8828	1837	195	40	34	8	30	251771
2000	4701	33094	93044	47210	12671	6677	4787	1647	321	71	11	1	14	204249
2001	5044	35019	62139	62456	22794	5266	1773	1163	343	85	6	7	22	196117
2002	2348	31033	76175	67656	42122	11527	1801	529	223	120	21	9	6	233570

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTALNUM
2003	7263	20885	64447	71109	36706	14002	2887	492	142	97	21	43	1	218095
2004	2090	38226	50826	68350	50838	18118	6239	1746	295	127	39	16	8	236918
2005	5815	19768	113144	61665	44777	20553	6285	2348	562	100	21	24	7	275069
2006	8548	47207	33625	78150	31770	15667	7245	1788	737	210	26	45	155	225173
2007	25473	43817	62877	26303	34392	11240	4080	1381	505	285	44	13	35	210445
2008	8459	51704	40656	35072	14037	20676	5503	1794	715	229	42	26	13	178926
2009	4866	38711	83998	46639	20789	8417	8920	1957	872	987	76	21	20	216273
2010	1778	16193	53855	75853	36797	17062	4784	4325	3034	913	189	49	35	214867
2011	1418	8033	32472	70938	73875	21116	11708	5058	3237	600	434	12	0	228901
2012	2695	10462	16646	40372	70014	48315	12326	5214	1926	1124	317	70	24	209505
2013	2903	13659	22752	21020	54231	74451	47124	9143	2963	694	449	89	145	249623
2014	5234	19226	38407	36633	29901	56109	47540	22738	3717	1169	313	210	157	261354
2015	4315	31383	41181	51209	33745	22530	23609	24553	16071	2510	468	134	254	251962
2016	2076	11291	50231	43609	35265	23417	14592	20105	15862	4781	871	249	308	222657
2017	6535	13128	28365	66504	46136	28507	15307	10073	12169	6465	1927	399	285	235800
2018	6120	28569	27128	33816	54328	28323	16208	9722	7132	3740	2295	840	271	218492

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

Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
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

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	12.4		
2008	0.28	0.64	1.16	1.74	2.65	3.58	4.74	5.73	7.32	8.07	9.52	12.5		
2009	0.31	0.64	1.09	1.58	2.11	3.19	4.80	6.58	7.97	9.84	11.51			

Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
2010	0.25	0.57	1.00	1.64	2.28	3.14	4.53	5.98	8.03	9.71	10.70	13.5		
2011	0.25	0.62	1.05	1.56	2.18	2.95	4.33	6.21	8.04	10.13	12.25	15.2		
2012	0.29	0.60	1.07	1.66	2.25	2.95	4.17	6.23	8.58	11.08	12.24	14.1	15.2	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	15.5	17.1	
2014	0.32	0.61	1.05	1.61	2.26	3.15	4.00	5.24	7.13	9.46	11.18	14.5		
2015	0.30	0.60	0.97	1.49	2.11	3.13	4.64	5.78	7.13	9.53	12.12	16.7	17.4	
2016	0.26	0.55	0.97	1.53	2.20	3.19	4.50	6.12	7.97	9.55	10.95	14.3	14.7	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	14.4	16.7	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

Germany (Divisions 2.a and 2.b)

Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994		0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995		0.44	0.84	1.50	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47		
1996		0.84	1.15	1.64	2.53	3.58	4.13	3.90	4.68	6.98	6.43	11.32		
1997		0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.80		
1998	0.23	0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.50	8.57	8.42	11.45	8.79	
1999 [1]		0.85	1.45	2.00	2.65	3.47	4.16	5.45	6.82	5.90		8.01		
2000 [2]	0.26	0.73	1.36	2.04	2.87	3.67	4.88	5.78	7.05	8.45	8.67	9.33	6.88	
2001	0.38	0.80	1.21	1.90	2.74	3.90	4.99	5.69	7.15	7.32	11.72	9.11	6.60	
2002	0.35	1.00	1.31	1.80	2.53	3.64	4.38	5.07	6.82	9.21	7.59	13.18	19.17	19.20
2003	0.22	0.44	1.04	1.71	2.31	3.27	4.93	6.17	7.773	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	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	4.4	5.43	7.18	8.39	10.15	10.03	10.99	14.26
2009 [3]	0.35	0.6	1.19	1.83	2.96	4.08	5.61	6.97	8.55	9.13	10.54	13.34	10.30	17.06

Year		Age													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15+
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	3.3	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	4.5	5.41	6.2	6.39					
2016	[1]		1.38	2.6	3.55	4.81	6.33	7.61	8.9	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

[1] **Division 2.a only**

[2] **2.a and 2.b combined**

[3] **1,2.a and 2.b combined**

[4] **Division 2.b only**

Table 3.7. Northeast Arctic COD. Weights at age (kg) in landings from various countries (continued)
Spain (Division 2.b)

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

Year		Age													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15+
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		

[1] **2.a and 2.b combined**

[2] **1,2.a and 2.b combined**

[3] **1 and 2.b combined**

Iceland (Subarea 1)

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

UK (England & Wales)

Year		Age													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995	[1]			1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.2	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] **Divisions 2.a and 2.b**

[2] **Division 2.a**

Poland (Division 2.b)

Year	Age													
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
2006	0.18	0.51	0.89	1.55	2.23	3.6	5.28	6.95	8.478	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

[1] **Division 2.a**

[2] **Divisions 2.a and 2.b**

[3] **1 and 2.b combined**

Table 3.8. Northeast Arctic COD. Catch weights-at-age (kg)
SAM
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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	4.22	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	4.07	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	4.52	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	4.88	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	5.06	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	5.06	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	5.4	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	4.9	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	5.55	7.28	8	8.35	9.94	10.25	11.56
1957	0.33	0.59	1.02	1.82	2.89	4.28	5.49	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	5.61	7.35	8.67	9.58	11.63	11	13.83
1959	0.35	0.72	1.47	2.68	3.59	4.32	5.45	6.44	7.17	8.63	11.62	11.95	13
1960	0.34	0.51	1.09	2.13	3.38	4.87	6.12	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	6.15	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	6.55	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	6.44	7.91	9.62	11.31	12.74	13.19	14.29
1964	0.33	0.55	0.95	1.86	3.25	4.97	6.41	8.07	9.34	10.16	12.89	13.25	14
1965	0.38	0.68	1.03	1.49	2.41	3.52	5.73	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	5.36	7.27	8.63	10.66	14.15	14	15
1967	0.29	0.81	1.35	2.04	2.81	3.48	4.89	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	5.27	6.65	9.01	9.66	14.85	16.3	17
1969	0.44	0.79	1.23	2.03	2.9	3.81	5.02	6.43	8.33	10.71	14.21	15	17
1970	0.37	0.91	1.34	2	3	4.15	5.59	7.6	8.97	10.99	14.07	14.61	16
1971	0.45	0.88	1.38	2.16	3.07	4.22	5.81	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	5.83	7.62	9.52	12.09	13.67	13.85	16
1973	0.38	0.91	1.54	2.26	3.29	4.61	6.57	8.37	10.54	11.62	13.9	14	15.84

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1974	0.32	0.66	1.17	2.22	3.21	4.39	5.52	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	5.74	8.77	9.92	11.81	13.11	14	14.29
1976	0.35	0.73	1.19	2.01	2.76	4.22	5.88	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	6.46	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	6.54	7.98	10.15	10.85	13.18	14	15
1979	0.35	0.7	1.24	2.14	3.15	4.29	6.58	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	5.84	7.26	8.84	9.28	14.45	15	15.5
1981	0.49	0.98	1.44	2.09	2.98	4.85	6.57	9.16	10.82	10.77	13.93	15	16
1982	0.37	0.66	1.35	1.99	2.93	4.24	6.46	8.51	12.24	10.78	14.04	15	16
1983	0.84	1.37	2.09	2.86	3.99	5.58	7.77	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	6.02	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	7.66	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	6.83	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	8.6	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	8.06	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	7.52	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	7.3	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	6.08	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	6.14	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	6.47	7.19	7.98	11.42	12.8	14.18	15.55
1994	0.82	1.3	2.06	2.89	3.21	5.2	6.8	7.57	8.01	11.42	12.8	14.18	15.55
1995	0.77	1.2	1.78	2.59	3.81	4.99	6.23	8.05	8.74	11.42	12.8	14.18	15.55
1996	0.79	1.11	1.61	2.46	3.82	5.72	6.74	8.04	9.28	11.42	12.8	14.18	15.55
1997	0.67	1.04	1.53	2.22	3.42	5.2	7.19	7.73	8.61	11.42	12.8	14.18	15.55
1998	0.68	1.05	1.62	2.3	3.3	4.86	6.87	9.3	10.3	11.42	12.8	14.18	15.55
1999	0.63	1.01	1.54	2.34	3.21	4.29	6	6.73	10.08	11.42	12.8	14.18	15.55
2000	0.57	1.04	1.61	2.34	3.34	4.48	5.72	7.52	8.02	11.42	12.8	14.18	15.55
2001	0.66	1.05	1.62	2.51	3.51	4.78	6.04	7.54	9	11.42	12.8	14.18	15.55
2002	0.72	1.13	1.56	2.31	3.52	4.78	6.2	7.66	9.14	11.42	12.8	14.18	15.55

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2003	0.67	1.12	1.83	2.5	3.58	5.04	6.36	8.2	10.71	11.42	12.8	14.18	15.55
2004	0.72	1.13	1.61	2.43	3.27	4.72	6.71	7.98	9.19	11.42	12.8	14.18	15.55
2005	0.69	1.08	1.57	2.21	3.26	4.44	6.23	8.19	9.72	11.42	12.8	14.18	15.55
2006	0.72	1.16	1.6	2.39	3.32	4.54	5.47	6.78	7.7	11.42	12.8	14.18	15.55
2007	0.74	1.21	1.83	2.51	3.82	5.04	6.58	8.08	8.94	11.42	12.8	14.18	15.55
2008	0.77	1.27	1.87	2.82	3.79	5.12	6.22	7.75	8.4	11.42	12.8	14.18	15.55
2009	0.75	1.17	1.74	2.42	3.86	5.35	6.43	8.01	8.67	11.42	12.8	14.18	15.55
2010	0.78	1.2	1.74	2.44	3.4	5.04	6.25	7.32	8.53	11.42	12.8	14.18	15.55
2011	0.78	1.31	1.72	2.37	3.2	4.62	6.18	7.47	8.57	11.42	12.8	14.18	15.55
2012	0.67	1.14	1.73	2.34	3.12	4.4	6.28	8.24	10.35	11.42	12.8	14.18	15.55
2013	0.71	1.17	1.67	2.36	3.19	4.22	5.58	7.31	9.08	11.42	12.8	14.18	15.55
2014	0.79	1.2	1.73	2.34	3.28	4.21	5.49	6.98	8.67	11.42	12.8	14.18	15.55
2015	0.78	1.09	1.55	2.18	3.14	4.46	5.61	6.62	7.34	11.42	12.8	14.18	15.55
2016	0.78	1.14	1.66	2.26	3.25	4.5	5.98	7.31	8.54	11.42	12.8	14.18	15.55
2017	0.71	1.15	1.66	2.32	3.32	4.67	6.13	7.15	8.14	11.42	12.8	14.18	15.55
2018	0.86	1.17	1.71	2.5	3.31	4.61	6.03	7.32	8.06	11.42	12.8	14.18	15.55

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

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
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

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
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
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	0.235	0.753	1.42	2.413	3.825	5.416	6.631	7.63	8.112	12.621	14.544	16.466	18.388
1995	0.201	0.485	1.14	2.118	3.47	4.938	7.16	9.119	10.101	12.621	14.544	16.466	18.388
1996	0.195	0.487	0.971	2.054	3.527	5.503	7.767	10.159	10.669	12.621	14.544	16.466	18.388
1997	0.202	0.521	1.079	1.878	3.369	5.263	8.927	12.154	11.204	12.621	14.544	16.466	18.388
1998	0.217	0.533	1.161	1.939	2.945	4.574	7.423	10.367	11.738	12.621	14.544	16.466	18.388
1999	0.203	0.52	1.174	2.031	3.034	4.464	6.482	10.269	10.882	12.621	14.544	16.466	18.388
2000	0.194	0.465	1.208	1.972	3.048	4.096	5.724	7.457	9.582	12.621	14.544	16.466	18.388
2001	0.285	0.522	1.196	2.239	3.313	5.118	6.376	9.241	11.322	12.621	14.544	16.466	18.388
2002	0.251	0.605	1.189	2.138	3.333	4.766	6.859	9.333	10.186	12.621	14.544	16.466	18.388
2003	0.23	0.537	1.31	2.009	3.241	4.971	6.739	8.706	15.026	12.621	14.544	16.466	18.388
2004	0.25	0.546	1.087	2.035	2.921	4.384	6.254	8.543	9.735	12.621	14.544	16.466	18.388
2005	0.231	0.624	1.118	1.932	3.046	3.955	5.811	8.289	13.44	12.621	14.544	16.466	18.388
2006	0.256	0.602	1.201	2.009	3.114	4.427	6.03	8.037	9.928	12.621	14.544	16.466	18.388
2007	0.262	0.699	1.341	2.121	3.167	4.64	6.495	9.123	11.78	12.621	14.544	16.466	18.388
2008	0.286	0.734	1.37	2.367	3.29	4.82	6.548	8.483	8.902	12.621	14.544	16.466	18.388
2009	0.26	0.641	1.343	2.36	3.763	5.111	6.554	9.098	9.432	12.621	14.544	16.466	18.388
2010	0.257	0.589	1.183	2.052	3.181	4.8	6.759	7.859	10.008	12.621	14.544	16.466	18.388
2011	0.224	0.589	1.088	1.915	2.776	4.319	6.495	8.489	10.016	12.621	14.544	16.466	18.388
2012	0.21	0.561	1.108	1.76	2.775	4.056	6.117	8.718	11.676	12.621	14.544	16.466	18.388
2013	0.256	0.589	1.151	2.019	2.857	4.049	5.631	8.146	10.378	12.621	14.544	16.466	18.388
2014	0.22	0.588	1.146	1.827	2.835	3.828	5.142	6.953	9.015	12.621	14.544	16.466	18.388

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2015	0.231	0.546	1.165	1.938	2.853	3.946	5.258	6.821	8.957	12.621	14.544	16.466	18.388
2016	0.229	0.53	1.037	1.805	2.712	3.964	5.537	7.073	8.648	12.621	14.544	16.466	18.388
2017	0.261	0.649	1.168	1.966	2.93	4.627	5.966	7.279	9.3	12.621	14.544	16.466	18.388
2018	0.277	0.631	1.21	1.943	2.742	4.041	5.701	7.485	9.406	12.621	14.544	16.466	18.388
2019	0.274	0.659	1.188	1.95	3.101	4.381	5.928	7.361	9.632	12.621	14.544	16.466	18.388

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

	Percentage mature							
	Age							
Year	3	4	5	6	7	8	9	10
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	100.0

***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

	Percentage mature							
	Age							
Year	3	4	5	6	7	8	9	10
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	0.19	1.05	6.4	28.53	71.3	86.06	98.56
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	0.3	4.0	24.0	68.6	93.1	96.7	99.8

Table 3.11. Northeast Arctic cod. Proportion mature-at-age
SAM
Sun Apr 28 18:53:18 2019

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
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

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
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
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	0.003	0.007	0.119	0.335	0.589	0.862	0.963	0.99	1	1	1	1	1
1995	0	0.003	0.061	0.372	0.624	0.781	0.96	0.979	1	1	1	1	1
1996	0	0	0.019	0.258	0.631	0.82	0.975	1	1	1	1	1	1
1997	0	0	0.012	0.14	0.607	0.83	0.946	1	1	1	1	1	1
1998	0.001	0.003	0.026	0.152	0.472	0.814	0.957	0.98	1	1	1	1	1
1999	0.002	0.002	0.014	0.187	0.544	0.847	0.965	1	1	1	1	1	1
2000	0	0.001	0.071	0.247	0.643	0.83	0.978	1	1	1	1	1	1
2001	0.003	0.003	0.065	0.359	0.624	0.819	0.952	1	1	1	1	1	1
2002	0.002	0.013	0.084	0.388	0.683	0.841	0.951	1	1	1	1	1	1

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2003	0.001	0.001	0.088	0.326	0.672	0.888	0.957	1	1	1	1	1	1
2004	0.001	0.01	0.091	0.442	0.726	0.872	0.976	0.977	1	1	1	1	1
2005	0	0.004	0.068	0.397	0.716	0.892	0.967	0.991	1	1	1	1	1
2006	0	0.001	0.06	0.369	0.647	0.897	0.965	1	1	1	1	1	1
2007	0	0.004	0.072	0.343	0.723	0.876	0.976	1	1	1	1	1	1
2008	0	0.004	0.062	0.282	0.538	0.863	0.928	0.994	1	1	1	1	1
2009	0	0	0.076	0.372	0.755	0.857	0.977	0.997	0.981	1	1	1	1
2010	0	0.003	0.045	0.323	0.573	0.838	0.927	0.97	0.974	0.986	1	1	1
2011	0	0.001	0.037	0.343	0.64	0.817	0.94	0.964	0.991	0.989	1	1	1
2012	0.001	0	0.046	0.215	0.557	0.786	0.909	0.964	0.99	0.989	1	1	1
2013	0	0.002	0.008	0.154	0.486	0.753	0.908	0.981	0.989	1	1	1	1
2014	0	0.002	0.019	0.137	0.513	0.805	0.929	0.981	0.998	1	1	1	1
2015	0	0.001	0.011	0.094	0.281	0.7	0.883	0.967	0.988	0.994	1	1	1
2016	0	0.001	0.006	0.058	0.255	0.577	0.804	0.955	0.986	1	1	1	1
2017	0	0.002	0.004	0.148	0.493	0.781	0.94	0.99	1	0.996	1	1	1
2018	0	0.003	0.027	0.199	0.461	0.702	0.931	0.974	1	0.989	0.991	1	1
2019	0	0.003	0.033	0.199	0.624	0.894	0.947	0.988	0.997	1	1	1	1

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

Age	0	1	2	3	4	5	6
1984	0.000	415.758	21.198	0.228	0.000	0.000	0.000
1985	1555.101	373.360	66.359	0.184	0.000	0.000	0.000
1986	51.176	939.536	385.612	97.691	0.000	0.000	0.000
1987	671.998	180.218	278.630	14.187	0.000	0.000	0.000
1988	29.018	410.532	22.269	1.570	0.000	0.000	0.000
1989	909.916	143.714	0.000	0.000	0.000	0.000	0.000
1990	0.000	126.168	28.076	0.000	0.000	0.000	0.000
1991	122.993	151.311	214.867	1.819	0.000	0.000	0.000
1992	4303.581	1025.534	154.334	4.301	0.000	0.000	0.000
1993	3787.746	20185.712	508.876	51.439	1.382	0.440	0.000

Age	0	1	2	3	4	5	6
1994	7736.962	6682.587	617.760	128.034	51.139	8.178	0.415
1995	8144.974	14913.968	743.249	204.751	64.068	3.608	0.217
1996	9191.479	21039.477	1478.360	142.101	55.525	19.830	1.126
1997	2884.053	15228.549	1827.552	174.311	16.543	1.288	0.228
1998	76.338	4681.534	522.125	210.279	24.735	1.586	0.502
1999	577.347	1797.176	289.814	51.534	4.344	0.005	0.000
2000	1639.380	2183.268	169.731	36.721	14.070	3.953	0.044
2001	90.668	2268.248	114.758	24.467	13.128	2.031	1.131
2002	7628.686	464.289	408.431	42.097	5.555	0.852	0.018
2003	5547.393	4373.454	110.336	24.884	0.000	0.000	0.000
2004	6574.460	2390.806	579.402	21.247	11.460	1.563	0.266
2005	2473.400	2972.940	133.751	82.210	4.691	5.725	0.531
2006	3732.433	2092.722	147.744	6.243	2.032	0.075	0.000
2007	2381.832	1163.180	191.766	75.687	3.503	0.130	0.000
2008	16134.226	789.146	92.849	102.062	33.633	4.472	0.000
2009	10929.329	8222.379	159.788	77.236	23.548	5.801	0.258
2010	4902.355	8230.604	335.563	61.660	32.670	20.380	2.703
2011	14662.972	5083.121	509.812	195.020	48.800	13.444	6.284
2012	24126.530	13957.457	1172.312	121.224	37.904	5.413	0.000
2013	30964.597	5637.282	1858.536	218.117	21.799	9.905	1.502
2014	36435.919	6438.967	867.706	239.532	65.930	6.495	0.080
2015	1671.597	10709.437	345.639	81.164	51.819	22.196	2.188
2016	11920.413	2696.465	521.293	15.201	25.395	37.392	8.826
2017	15905.809	1915.877	465.450	152.035	9.594	4.909	3.581
2018	7565.160	11822.180	207.086	50.267	3.018	0.099	0.000

Table 3.13. Northeast Arctic COD. Tuning data

North-East Arctic cod (Sub-areas I and II) (run name: XSAASA01)									
104									
FLT15: NorBarTrSur									
1981	2019								
1	1	0.085	0.189						
4	12								
1	2330	4000	3840	480	100	30	NA	NA	NA
1	2770	2360	1550	1600	140	20	NA	NA	NA
1	5234	4333	1696	582	321	97	NA	NA	NA
1	2828	2144	1174	407	40	8	NA	NA	NA
1	12598	1992	767	334	21	7	NA	NA	NA
1	14393	6414	830	191	34	4	NA	NA	NA
1	39115	5435	1570	200	45	3	NA	NA	NA
1	8049	17331	2048	358	53	3	NA	NA	NA
1	7586	3779	9019	982	94	10	NA	NA	NA
1	3487	3459	2056	2723	161	38	NA	NA	NA
1	3367	2565	2149	1215	1267	61	NA	NA	NA
1	5771	1782	1283	767	429	272	NA	NA	NA
1	14013	7248	1583	624	389	223	NA	NA	NA
1	30760	15260	4680	813	259	132	55	52	11
1	24210	25230	7710	1790	233	113	55	59	19
1	11670	14070	11120	2480	279	37	16	8	8
1	6920	7500	6070	2680	495	63	68	46	0
1	16740	3170	2640	1750	826	79	52	65	0
1	18190	6130	1280	683	519	98	27	2	3
1	13000	11200	2700	473	182	123	36	10	3
1	19450	8160	3800	958	119	45	19	4	0
1	13770	10860	4650	1450	219	34	19	5	0
1	12540	9520	6660	1790	472	102	16	4	0
1	18610	5360	4320	3090	692	166	29	8	1
1	5480	10270	2240	1640	380	88	30	4	2
1	11400	2810	4330	1400	519	134	22	21	8
1	12730	6890	1370	2360	685	220	40	31	8
1	30000	11560	4080	1800	829	186	35	2	2
1	19610	21800	5820	1750	844	527	50	18	3
1	11490	15550	14450	3980	1120	370	164	57	5
1	5070	12990	13800	10310	1670	434	117	79	20
1	7030	3640	9390	13630	4960	938	233	87	60
1	11980	6400	4100	6500	7620	3360	221	283	41
1	8510	6790	4780	3260	4690	3170	936	101	97
1	17020	13570	9980	7120	2740	5280	1700	286	72
1	11230	15130	10900	6610	2660	1280	1500	643	96
1	3970	4870	5660	2780	1890	763	301	222	349
1	14870	4610	5570	5340	2390	748	541	113	224
1	13200	18860	6640	2700	2880	760	172	34	17
FLT16: NorBarLofAcSur									
1985	2019								
1	1	0.085	0.26						
4	12								
1	1416	204	151	157	33	13	10	5	NA
1	1343	684	116	77	31	3	NA	4	NA
1	2049	502	174	14	30	7	NA	NA	NA
1	355	578	109	40	3	NA	1	NA	NA
1	344	214	670	166	32	5	2	NA	NA
1	206	262	269	668	73	6	3	NA	NA
1	346	293	339	367	500	37	2	2	NA
1	658	215	184	284	254	824	43	17	NA
1	1911	1131	354	255	252	277	442	49	NA
1	4045	2175	895	225	119	94	39	180	NA
1	1598	2166	1040	290	44	43	30	26	NA
1	705	872	891	446	65	11	4	9	NA
1	517	497	422	499	205	22	5	NA	NA
1	1826	424	338	340	247	49	7	2	NA
1	964	454	122	112	187	92	10	2	NA
1	1589	1457	493	129	69	52	12	6	NA
1	1716	816	573	198	24	8	6	3	NA
1	1122	1043	661	345	95	12	5	6	NA
1	1144	1315	1445	643	212	38	5	1	NA
1	928	327	451	468	222	88	22	2	NA
1	337	661	299	432	172	75	18	1	NA
1	591	157	381	169	155	88	24	3	NA
1	371	318	130	427	138	75	33	8	NA
1	3061	1410	754	246	329	58	28	17	NA
1	1783	1405	495	401	133	260	37	17	NA
1	1219	1759	1949	709	375	111	88	17	NA
1	291	824	1587	2843	656	226	61	78	5
1	527	381	828	2244	1547	309	108	48	20
1	850	710	575	1194	2249	1756	209	126	49
1	1178	918	679	529	1354	1751	977	142	66
1	1542	1193	996	965	362	1112	663	300	68
1	583	969	646	587	339	341	481	292	170
1	404	486	766	498	503	285	180	147	172
1	1361	473	546	678	462	186	143	59	59
1	977	1248	563	480	677	264	212	65	29

Table 3.13. Northeast Arctic COD. Tuning data (continued)

FLT18: RusSweptArea										
1982	2018									
1	1	0.9	1							
3	12									
1	1413	1525	721	198	551	174	37	19	15	1
1	520	642	506	358	179	252	94	NA	NA	NA
1	1189	700	489	357	154	69	61	17	15	6
1	1188	1592	1068	365	165	37	8	16	1	21
1	1622	1532	1493	481	189	42	2	6	NA	NA
1	557	3076	900	701	184	60	25	4	1	3
1	993	938	2879	583	260	47	24	NA	NA	NA
1	490	978	1062	1454	1167	299	112	47	18	7
1	167	487	627	972	1538	673	153	49	9	2
1	1077	484	532	583	685	747	98	14	3	NA
1	675	308	239	273	218	175	25	25	4	NA
1	1604	1135	681	416	354	87	3	7	1	1
1	1363	1309	1019	354	128	49	21	11	6	2
1	589	1065	1395	849	251	83	19	18	9	6
1	733	784	1035	773	348	132	19	5	12	2
1	1342	835	613	602	348	116	32	30	NA	NA
1	2028	1363	788	470	259	130	48	5	NA	1
1	1587	2072	980	301	123	94	42	4	NA	NA
1	1839	1286	1786	773	114	52	23	9	4	NA
1	1224	1557	1290	1061	304	50	14	5	25	13
1	980	1473	1473	896	600	182	29	8	1	1
1	1246	1057	1166	1203	535	241	40	9	3	NA
1	329	1576	880	1111	776	279	93	23	4	2
1	1408	631	1832	744	605	244	88	28	6	1
1	927	1613	777	1801	662	342	161	43	17	7
1	2579	1617	1903	846	1525	553	226	86	49	11
1	2203	3088	1635	1472	830	863	291	115	33	17
1	974	2317	3687	2016	1175	620	413	205	65	32
1	334	1070	2505	3715	1817	789	395	299	156	55
1	882	508	1432	3065	3300	917	439	176	175	70
1	815	1114	839	2122	3358	1878	432	195	46	57
1	747	1174	1177	884	2349	3132	1367	306	92	54
1	1399	1368	1725	1483	1111	1929	1297	383	93	35
1	657	1583	1742	1932	1610	925	1158	761	242	65
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	1456	884	1063	1952	1231	567	266	120	120	75
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLT007: Ecosystem_2018										
2004	2018									
1	1	0.65	0.75							
3	12									
1	1477	4215	1502	798	402	101	22	5	1	1
1	2166	558	1009	280	156	57	12	5	1	NA
1	1861	2056	599	698	176	81	26	6	2	NA
1	5862	1592	791	246	269	60	22	9	1	2
1	6526	4834	1323	511	128	175	33	9	2	2
1	2023	2806	2896	1017	319	127	73	26	8	3
1	568	1770	3972	4249	1427	385	105	68	16	3
1	1236	1015	2402	3004	1784	323	77	18	13	6
1	2291	1464	700	1508	1652	845	127	44	16	14
1	2491	1836	1257	632	1182	1302	538	91	33	15
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	1744	2252	1413	726	486	262	353	266	79	17
1	772	937	1216	701	444	272	138	132	54	17
1	3750	1415	1049	1209	626	280	112	64	44	45
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 3.14. SAM model parameter settings used in the Final run and their variant used in the SPALY run (highlighted in grey)

Min Age (should not be modified unless data are modified accordingly)

3

Max Age (should not be modified unless data are modified accordingly)

15

Max Age considered a plus group (0=No, 1=Yes)

1

Coupling of correlation in observations

(NA NA NA NA NA NA NA NA NA NA NA NA)

(-1 0 1 2 3 4 4 4 4 -1 -1 -1)

(-1 5 6 7 8 9 10 10 10 -1 -1 -1)

(11 12 13 14 14 14 14 14 14 -1 -1 -1)

(15 16 17 18 19 20 20 20 20 -1 -1 -1)

Coupling of OBSERVATION VARIANCES

Variant used in the Final SAM run (ages pick upped to be estimated separately highlighted by cyan)

(0 0 0 0 0 0 0 0 0 0 1 1 1)

(-1 2 3 3 3 3 3 3 4 3 -1 -1 -1)

(-1 5 5 5 5 5 5 5 6 5 -1 -1 -1)

(7 7 7 7 7 7 8 7 8 8 -1 -1 -1)

(9 9 9 9 9 9 9 9 9 10 -1 -1 -1)

Variant used in the SPALY SAM run

(0 0 0 0 0 0 0 0 0 0 0 0 0)

(-1 1 1 1 1 1 1 1 1 1 -1 -1 -1)

(-1 2 2 2 2 2 2 2 2 2 -1 -1 -1)

(3 3 3 3 3 3 3 3 3 3 -1 -1 -1)

(4 4 4 4 4 4 4 4 4 4 -1 -1 -1)

Stock recruitment model code (0=RW, 1=Ricker, 2=BH, ... more in time)

0

Years in which catch data are to be scaled by an estimated parameter

0

Define Fbar range

5 10

Table 3.15. Northeast Arctic cod. Fishing mortality
SAM
Sun Apr 28 18:53:19 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1946	0.0021	0.0177	0.062	0.119	0.23	0.2	0.3089	0.2953	0.4381	0.4077	0.4222	0.4997	0.4997	0.2025
1947	0.0015	0.0177	0.0849	0.1959	0.3997	0.3227	0.4826	0.4851	0.7952	0.7259	0.7356	0.8535	0.8535	0.3285
1948	8e-04	0.012	0.0668	0.1847	0.4102	0.3456	0.4842	0.4461	0.7025	0.6656	0.7151	0.8792	0.8792	0.3229
1949	0.0019	0.029	0.1355	0.2987	0.4895	0.3739	0.4656	0.4605	0.742	0.7349	0.7907	0.9854	0.9854	0.3706
1950	0.0025	0.0351	0.1403	0.2712	0.4032	0.3489	0.4828	0.5627	0.9243	0.9556	0.9937	1.2299	1.2299	0.3682
1951	0.0108	0.1128	0.2831	0.3871	0.4562	0.3754	0.471	0.5153	0.695	0.7511	0.8128	1.0376	1.0376	0.4147
1952	0.0159	0.1433	0.353	0.5065	0.5537	0.4667	0.602	0.7562	1.053	1.1392	1.1446	1.3769	1.3769	0.5397
1953	0.0173	0.1212	0.2556	0.3475	0.372	0.3342	0.422	0.5484	0.7178	0.733	0.7374	0.8806	0.8806	0.3799
1954	0.0162	0.111	0.2541	0.3647	0.3829	0.3448	0.4471	0.6228	0.7879	0.7768	0.7531	0.8532	0.8532	0.4027
1955	0.0141	0.0969	0.2691	0.4709	0.5165	0.5198	0.5868	0.7491	0.8867	0.8634	0.7998	0.8538	0.8538	0.5187
1956	0.0198	0.1353	0.3724	0.6316	0.649	0.6542	0.6596	0.804	0.9853	1.0391	0.9273	0.9222	0.9222	0.6285
1957	0.0181	0.1143	0.2699	0.4677	0.5145	0.5451	0.5422	0.6888	0.861	0.9039	0.8057	0.7735	0.7735	0.5047
1958	0.0356	0.2085	0.4038	0.5576	0.5316	0.5067	0.5065	0.6834	0.8064	0.8082	0.6797	0.6305	0.6305	0.5316
1959	0.0359	0.2169	0.4342	0.5477	0.5225	0.5221	0.5302	0.6709	0.717	0.6997	0.6153	0.5828	0.5828	0.5379
1960	0.0333	0.1972	0.3783	0.4634	0.444	0.4742	0.4917	0.6751	0.7733	0.747	0.6742	0.6476	0.6476	0.4878
1961	0.0378	0.2368	0.4903	0.5851	0.5538	0.628	0.6873	0.851	0.926	0.867	0.7965	0.7491	0.7491	0.6326
1962	0.0393	0.2681	0.6333	0.7773	0.6728	0.6988	0.7882	0.9389	0.9381	0.8208	0.7701	0.7119	0.7119	0.7515
1963	0.0276	0.2169	0.6396	0.9017	0.8736	0.9108	1.0437	1.252	1.2951	1.0553	0.9672	0.8516	0.8516	0.9369
1964	0.0187	0.1356	0.3693	0.518	0.5694	0.7016	0.9073	0.965	1.0439	0.8885	0.9077	0.8169	0.8169	0.6718
1965	0.0222	0.1364	0.3346	0.4247	0.4488	0.5539	0.7177	0.7504	0.7212	0.6312	0.7213	0.6808	0.6808	0.5384
1966	0.0255	0.132	0.2792	0.3604	0.4306	0.5568	0.7006	0.6953	0.6096	0.5644	0.6315	0.58	0.58	0.5038
1967	0.0243	0.1275	0.244	0.3071	0.4157	0.6068	0.8315	0.8634	0.8562	0.7447	0.7888	0.6737	0.6737	0.5448
1968	0.0276	0.168	0.3489	0.4163	0.4714	0.5937	0.7559	0.7212	0.6474	0.5187	0.5982	0.5403	0.5403	0.5513
1969	0.0321	0.1971	0.4438	0.5582	0.7013	0.9184	1.1442	1.0945	1.0427	0.7776	0.8201	0.6996	0.6996	0.8101
1970	0.0351	0.1726	0.3925	0.4971	0.619	0.8491	1.0018	0.9156	0.7609	0.5419	0.5993	0.5419	0.5419	0.7125
1971	0.0268	0.1109	0.2436	0.3166	0.4424	0.7205	0.9246	0.8457	0.7329	0.5499	0.5933	0.5322	0.5322	0.5822
1972	0.0504	0.1655	0.3082	0.3718	0.4423	0.7482	1.1111	1.1693	1.082	0.8023	0.8376	0.7217	0.7217	0.6918
1973	0.1148	0.2646	0.4028	0.4308	0.458	0.6754	0.8541	0.8115	0.764	0.6083	0.6554	0.583	0.583	0.6054

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1974	0.1655	0.3751	0.5406	0.5363	0.4969	0.5956	0.6881	0.7924	0.9044	0.761	0.8339	0.7237	0.7237	0.6083
1975	0.1066	0.2636	0.4787	0.5942	0.6211	0.713	0.738	0.7304	0.8874	0.7645	0.8248	0.7104	0.7104	0.6459
1976	0.1329	0.3281	0.5351	0.6146	0.6577	0.7799	0.7753	0.5905	0.6712	0.6145	0.6951	0.6609	0.6609	0.6589
1977	0.1501	0.4206	0.6992	0.754	0.7583	0.9128	1.0551	0.7684	0.8367	0.7684	0.882	0.8901	0.8901	0.8246
1978	0.1105	0.3129	0.6183	0.8018	0.8509	1.0027	1.3069	1.1531	1.6095	1.4921	1.5899	1.5944	1.5944	0.9556
1979	0.0551	0.1841	0.3823	0.5726	0.6649	0.7823	1.0327	0.9904	1.3363	1.2395	1.3699	1.5722	1.5722	0.7375
1980	0.0377	0.1442	0.326	0.5712	0.7033	0.8045	1.0213	1.0278	1.2766	1.1467	1.2225	1.4726	1.4726	0.7424
1981	0.0283	0.1198	0.2694	0.5387	0.7947	0.9976	1.1875	1.0387	1.0535	0.9338	0.8728	1.0098	1.0098	0.8044
1982	0.0408	0.1777	0.3465	0.639	0.8808	1.0005	1.0813	0.8499	0.8295	0.8585	0.7648	0.9519	0.9519	0.7997
1983	0.0268	0.1414	0.2974	0.5448	0.8575	1.0121	0.9835	0.7706	0.6375	0.6278	0.5847	0.819	0.819	0.7443
1984	0.0241	0.13	0.312	0.6124	1.0731	1.2602	1.1944	0.9749	0.817	0.7595	0.6387	0.9304	0.9304	0.9045
1985	0.0362	0.1637	0.3746	0.6445	0.9261	1.0061	0.7755	0.6007	0.471	0.4145	0.3582	0.6007	0.6007	0.7213
1986	0.037	0.1755	0.438	0.7511	0.9957	1.117	0.9492	1.0198	0.8836	0.8646	0.6295	1.0234	1.0234	0.8785
1987	0.0464	0.196	0.5153	0.8806	1.1238	1.1223	0.9777	1.2554	1.1564	1.2301	0.8304	1.3653	1.3653	0.9792
1988	0.0353	0.1367	0.3522	0.668	1.0289	1.1551	1.1651	1.6626	1.5375	1.6828	1.0533	1.6494	1.6494	1.0053
1989	0.0267	0.1044	0.2503	0.4498	0.7014	0.8733	0.8176	0.9698	0.8562	0.9537	0.6751	1.2919	1.2919	0.677
1990	0.0136	0.0579	0.1269	0.2158	0.3099	0.3961	0.4153	0.4956	0.5234	0.6593	0.5292	1.0974	1.0974	0.3266
1991	0.016	0.0805	0.1776	0.2795	0.3577	0.3771	0.3561	0.3317	0.2618	0.3243	0.2881	0.6835	0.6835	0.3133
1992	0.0241	0.1288	0.2904	0.4372	0.5258	0.5285	0.5035	0.4855	0.4041	0.5424	0.481	1.1087	1.1087	0.4618
1993	0.0146	0.0999	0.2879	0.4894	0.6146	0.6273	0.6657	0.7349	0.7202	0.9489	0.8822	1.8371	1.8371	0.57
1994	0.013	0.1024	0.3338	0.6553	0.9831	0.9965	1.0059	1.0903	1.1445	1.4179	1.4324	2.9386	2.9386	0.8441
1995	0.0139	0.1059	0.3226	0.6052	0.8863	0.943	0.96	1.0334	1.0801	1.2367	1.3739	2.8181	2.8181	0.7918
1996	0.0189	0.1308	0.3526	0.576	0.767	0.8579	0.8215	0.9128	0.8482	0.9037	0.9628	1.8908	1.8908	0.7146
1997	0.0249	0.19	0.4979	0.747	0.9309	1.204	1.2595	1.3316	1.2002	1.1188	0.9476	1.379	1.379	0.9952
1998	0.0304	0.2314	0.5507	0.7614	0.8483	1.0806	1.1782	1.2646	1.0501	0.9628	0.7631	0.9746	0.9746	0.9473
1999	0.0175	0.1607	0.479	0.7265	0.8596	1.0931	1.2466	1.2818	0.9139	0.8252	0.6321	0.7477	0.7477	0.9478
2000	0.01	0.0995	0.3367	0.5831	0.7848	1.0124	1.1383	1.1809	0.8597	0.8178	0.5513	0.6258	0.6258	0.8393
2001	0.009	0.0843	0.2798	0.5054	0.7056	0.8731	0.9096	0.9847	0.7004	0.6636	0.4512	0.5606	0.5606	0.7097
2002	0.0081	0.079	0.2721	0.5136	0.7491	0.8586	0.7958	0.7597	0.5733	0.5835	0.3755	0.4656	0.4656	0.6582

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
2003	0.0096	0.082	0.2655	0.4571	0.6468	0.7004	0.6258	0.5823	0.455	0.4621	0.2768	0.3231	0.3231	0.5463
2004	0.0097	0.0839	0.2799	0.508	0.7498	0.8781	0.8641	0.8562	0.7188	0.6842	0.3602	0.373	0.373	0.6893
2005	0.0127	0.111	0.3372	0.5676	0.7821	0.9077	0.9314	0.8623	0.7488	0.7023	0.3612	0.3555	0.3555	0.7314
2006	0.0164	0.1208	0.3103	0.4882	0.6514	0.7729	0.8276	0.7779	0.7546	0.8001	0.4535	0.4575	0.4575	0.638
2007	0.0167	0.1085	0.2529	0.3614	0.4366	0.4955	0.5025	0.4656	0.5473	0.6585	0.3842	0.3665	0.3665	0.4191
2008	0.0089	0.0585	0.1438	0.2426	0.3301	0.3932	0.4042	0.3592	0.4259	0.5483	0.3226	0.2822	0.2822	0.3122
2009	0.0079	0.0501	0.1184	0.1945	0.2693	0.3153	0.3338	0.3082	0.4273	0.6402	0.3687	0.2835	0.2835	0.2566
2010	0.0062	0.0396	0.0934	0.1557	0.24	0.314	0.3399	0.3753	0.5497	0.6266	0.3778	0.2685	0.2685	0.253
2011	0.0048	0.0359	0.0879	0.1417	0.2204	0.3055	0.3698	0.4105	0.4441	0.3747	0.2354	0.1603	0.1603	0.256
2012	0.0055	0.038	0.095	0.1382	0.1946	0.255	0.3027	0.3324	0.3364	0.2638	0.1738	0.1209	0.1209	0.2197
2013	0.0059	0.0404	0.1054	0.1661	0.2342	0.3072	0.3474	0.3641	0.3266	0.2286	0.154	0.1103	0.1103	0.2541
2014	0.0083	0.0539	0.1402	0.2225	0.2908	0.3492	0.3431	0.3536	0.3232	0.2165	0.1414	0.0992	0.0992	0.2832
2015	0.0108	0.0649	0.162	0.2618	0.3096	0.3475	0.3246	0.3799	0.4247	0.2745	0.1632	0.1059	0.1059	0.2976
2016	0.009	0.0525	0.1441	0.2422	0.3076	0.3581	0.3507	0.4101	0.452	0.2648	0.1521	0.0949	0.0949	0.3022
2017	0.0114	0.066	0.1751	0.2965	0.3794	0.441	0.4235	0.4902	0.5641	0.3026	0.162	0.0946	0.0946	0.3676
2018	0.0136	0.0737	0.1928	0.3173	0.4099	0.4661	0.4635	0.5457	0.6762	0.3318	0.1684	0.0934	0.0934	0.3992
FBAR	0.0113	0.064	0.1707	0.2853	0.3656	0.4218	0.4126	0.482	0.5641	0.2997	0.1609	0.0943		

Table 3.16. Northeast Arctic COD Stock number-at-age (Thous)
SAM
Sun Apr 28 18:53:19 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1946	1755794	715330	387863	180013	81351	91103	235341	94459	33749	31570	18669	7951	2344	3635537
1947	656369	928281	529645	306706	138005	55641	60312	137813	56716	18604	17262	10045	5203	2920603
1948	351078	385738	586427	368065	212297	76060	35953	31201	68206	19644	7450	6772	5374	2154264
1949	605332	258667	288587	408032	239760	108235	42889	17866	17135	27883	8154	2990	4110	2029640
1950	815919	383269	222365	200116	225518	116255	58305	22613	9445	6833	11107	2998	2165	2076909
1951	2583494	682927	297361	174298	120833	117622	66226	28868	10648	2917	2126	3410	1227	4091956
1952	2233088	1134739	413394	180084	112861	63083	62974	32788	13861	4752	1126	765	1338	4254853
1953	2957209	1089682	622852	224473	85714	58090	33365	27867	12335	3886	1236	294	428	5117432
1954	832260	1596761	705447	382197	133910	48334	35033	18383	13146	4893	1546	485	245	3772638
1955	359397	540791	1004881	438566	223242	75288	30861	18650	7888	4814	1853	599	254	2707082
1956	725560	234630	395101	583112	215053	110809	35230	14745	7148	2641	1689	687	298	2326705
1957	1454003	397280	147906	208242	239657	92126	46739	14639	5677	2214	739	550	322	2610093
1958	1005575	737698	246645	96426	103607	111464	41463	22146	6138	1988	741	262	331	2374483
1959	1317191	503738	430942	137500	47426	48816	55814	20695	8912	2224	713	313	260	2574545
1960	1550867	634409	256521	208684	68263	23559	23509	25935	8658	3677	911	312	267	2805573
1961	1589071	730335	354289	136795	105411	36919	12045	12589	10422	3181	1443	385	247	2993132
1962	1292322	823748	396661	171420	64791	50137	15772	4836	4651	3331	1069	535	244	2829517
1963	828474	709577	450412	164180	62856	28523	21180	5718	1505	1576	1208	400	313	2275920
1964	428596	402970	372977	173626	51722	20343	9721	6549	1284	326	455	382	250	1469203
1965	873400	237438	265078	208026	83669	23267	7929	3069	2249	351	108	150	232	1704967
1966	2240060	560063	164066	150781	111308	45149	11035	3111	1142	939	156	42	156	3288006
1967	1511690	1454905	400505	106899	84214	57815	21315	4529	1219	552	439	69	88	3644239
1968	169339	1126391	965274	286590	74570	44363	24606	7550	1608	393	213	164	67	2701126
1969	95436	134020	739888	512350	157453	43158	20665	9178	2942	734	195	94	110	1716221
1970	221996	79434	86098	371898	233245	62112	14957	5449	2575	794	274	71	83	1078987
1971	383445	154793	57651	44738	174030	101105	21397	4708	1733	1020	385	123	73	945200
1972	941651	308997	112203	38921	27384	84072	37776	6770	1746	690	484	177	94	1560966
1973	2231117	687328	211599	67095	22110	15768	32452	9793	1625	476	255	171	109	3279898

1974	579419	1440677	483524	121736	36687	11667	6602	10623	3623	638	211	111	129	2695647
1975	570561	354579	705665	244491	60812	19169	5636	3000	3603	1177	247	74	96	1969110
1976	686700	434037	224442	323944	107276	25952	7887	2400	1248	1118	441	88	70	1815602
1977	336354	464436	268213	112001	140365	43927	9060	2990	1214	551	471	179	68	1379828
1978	717515	223555	220251	108058	45668	55631	14206	2353	1121	489	221	155	83	1389306
1979	188057	491187	145637	88594	38673	16413	17448	3130	614	173	90	37	40	990092
1980	120993	145728	317863	87251	39483	16069	6278	5149	954	132	41	19	13	739974
1981	152874	95642	106362	176847	40124	15728	6098	1946	1489	211	35	10	6	597371
1982	200438	129975	77048	62863	83390	15036	4572	1520	555	423	69	12	5	575905
1983	153254	142126	88623	47548	28880	28328	4606	1246	563	193	141	27	5	495540
1984	392799	125732	85914	52556	23269	10898	8347	1382	451	266	87	61	12	701774
1985	623486	359591	89807	47164	23392	5980	2725	2086	417	154	102	38	23	1154966
1986	1046035	462051	256220	48633	20609	7098	1697	1090	977	226	84	59	28	1844805
1987	315985	912262	273483	115143	18258	6661	1764	597	309	334	77	38	25	1644937
1988	293648	225738	575983	119330	33935	5126	1809	570	140	81	78	28	13	1256479
1989	193461	212786	149295	307312	53871	9370	1439	480	86	24	12	22	7	928162
1990	159980	147625	137365	101049	149477	22089	2874	558	138	31	8	5	6	721203
1991	383103	140238	110052	95109	66948	91326	12413	1546	278	59	13	4	3	901091
1992	798991	315197	114772	76275	53775	36569	51869	7040	970	187	34	8	3	1455688
1993	888841	550242	257276	78102	38687	25092	16387	26041	3581	580	88	18	3	1884936
1994	699632	706529	400312	149537	41732	17202	11059	6516	10913	1420	183	29	3	2045066
1995	488242	491444	499216	225636	60002	12663	5266	3248	1839	2915	275	36	1	1790785
1996	445026	293398	317074	277936	102594	19716	4175	1581	958	488	741	56	2	1463745
1997	677708	238263	195708	173577	123367	40360	6566	1647	530	335	165	243	7	1458477
1998	1052482	455261	134970	92174	68905	42204	9912	1524	343	125	89	53	53	1858095
1999	529765	600276	261464	62013	32295	26144	12191	2537	358	94	38	33	34	1527242
2000	629642	391345	375752	119297	24424	11324	7383	2738	595	123	33	16	27	1562698
2001	578837	505977	288612	184237	52219	9335	3386	1864	715	207	42	16	19	1625465
2002	394623	429331	363108	183715	83710	21023	3313	1148	575	288	89	21	16	1480961
2003	743330	306365	295985	233312	83846	31416	7144	1250	445	278	128	52	18	1703569

2004	252623	580469	220931	187626	114735	34911	12517	3142	586	247	148	78	41	1408055
2005	606471	193167	416007	139945	95467	40229	11502	4406	1076	227	104	88	67	1508755
2006	545107	454952	140342	233216	68927	34222	13573	3555	1529	429	91	61	94	1496098
2007	1470329	452623	301006	89736	118930	30894	12517	4646	1248	616	159	47	81	2482833
2008	1185542	1054628	361374	170500	53104	65178	16591	6213	2319	618	254	89	72	2916484
2009	678599	880606	827224	270213	96920	35693	33525	9232	3484	1447	295	148	99	2837485
2010	293867	508187	707088	607260	185761	62471	21706	17929	6104	1939	599	168	153	2413231
2011	448443	226328	437832	588192	424425	97571	38140	13252	10106	2529	896	321	201	2288236
2012	572835	329221	177947	356589	449842	258395	54513	20757	7370	5257	1450	594	363	2235132
2013	625805	395664	251865	148494	274806	311437	166902	30848	12360	4158	3311	1002	715	2227367
2014	771499	426873	310675	198920	118574	193054	180029	87592	16792	7121	2676	2324	1274	2317404
2015	447415	525580	327945	217830	143696	78649	113081	95741	47443	10362	4593	1881	2660	2016875
2016	268554	285807	395649	228740	143053	86286	50417	65468	50642	23738	6406	3155	3319	1611234
2017	750022	215920	205313	269364	152237	85614	49317	28937	32792	26935	14890	4467	4715	1840524
2018	498154	461995	161216	146304	167548	86915	45810	26725	14345	15054	16295	10368	6681	1657410
2019		338158	348666	122712	79018	95191	44464	24333	12504	5742	8845	11273	12714	1601775

Table 3.17. Northeast Arctic COD. Natural mortality used in final run
SAM
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Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.4901	0.3038	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1947	0.5438	0.3246	0.2309	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1948	0.4928	0.3048	0.2263	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1949	0.4338	0.2819	0.2209	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1950	0.3164	0.2364	0.2103	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1951	0.7235	0.3943	0.2471	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1952	0.7148	0.3909	0.2463	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1953	0.5367	0.3219	0.2302	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1954	0.3878	0.264	0.2168	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1955	0.4056	0.271	0.2184	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1956	0.5899	0.3425	0.235	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1957	0.7252	0.395	0.2473	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1958	0.5616	0.3315	0.2325	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1959	0.7131	0.3903	0.2462	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1960	0.7036	0.3866	0.2453	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1961	0.6094	0.35	0.2368	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1962	0.5201	0.3154	0.2287	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1963	0.7882	0.4194	0.253	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1964	0.6027	0.3475	0.2362	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1965	0.4164	0.2752	0.2194	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1966	0.3529	0.2505	0.2136	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1967	0.2707	0.2186	0.2062	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1968	0.2242	0.2006	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1969	0.206	0.2	0.2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1970	0.2927	0.2272	0.2082	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1971	0.2562	0.213	0.2049	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1972	0.3234	0.2391	0.211	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1973	0.2172	0.2	0.2014	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1974	0.2168	0.2	0.2013	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1975	0.2317	0.2035	0.2027	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1976	0.2238	0.2004	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1977	0.2487	0.2101	0.2042	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978	0.2342	0.2045	0.2029	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1979	0.2081	0.2	0.2005	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1980	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1983	0.2031	0.2	0.2001	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1984	0.2	0.2028	0.2174	0.2029	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1985	0.2071	0.2075	0.211	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1986	0.2627	0.226	0.2521	0.2152	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1987	0.2524	0.2188	0.2238	0.2608	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1988	0.2174	0.2033	0.2262	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1989	0.2021	0.2203	0.2	0.2219	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1990	0.2	0.2022	0.2106	0.2002	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1991	0.2	0.2	0.2012	0.2196	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1992	0.2107	0.2	0.2	0.2135	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1993	0.2442	0.2024	0.2151	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1994	0.349	0.2621	0.2171	0.2245	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1995	0.5236	0.3174	0.22	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1996	0.4973	0.3256	0.2353	0.2157	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1997	0.412	0.2699	0.2242	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1998	0.4312	0.2626	0.212	0.2372	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1999	0.262	0.2358	0.2355	0.2067	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2000	0.2489	0.2117	0.2492	0.2172	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2001	0.2372	0.2186	0.2039	0.2318	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2002	0.279	0.2114	0.2	0.2239	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2003	0.2386	0.2	0.2	0.217	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2004	0.2494	0.2139	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2005	0.2942	0.2117	0.2117	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2006	0.202	0.224	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2007	0.2464	0.2	0.2384	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2008	0.2577	0.2149	0.2	0.2236	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.2797	0.213	0.2055	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2010	0.2959	0.2402	0.2128	0.2054	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2011	0.424	0.3232	0.2053	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2012	0.3754	0.3228	0.2218	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.4122	0.2461	0.2165	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2014	0.3975	0.3106	0.217	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.3904	0.278	0.2487	0.203	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2016	0.2244	0.287	0.3093	0.2369	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2017	0.4907	0.2383	0.2053	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2018	0.3286	0.2082	0.2	0.2234	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 3.18. Northeast Arctic COD. Summary table
SAM
Sun Apr 28 18:53:19 2019

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1946	1755794	4332127	990363	706000	0.7129	0.2025
1947	656369	3761772	1016274	882017	0.8679	0.3285
1948	351078	3580230	802790	774295	0.9645	0.3229
1949	605332	3040175	618632	800122	1.2934	0.3706
1950	815919	2780989	556998	731982	1.3142	0.3682
1951	2583494	3692461	497024	827180	1.6643	0.4147
1952	2233088	4011190	501009	876795	1.7501	0.5397
1953	2957209	4190074	388578	695546	1.79	0.3799
1954	832260	4342709	411153	826021	2.009	0.4027
1955	359397	3637959	338366	1147841	3.3923	0.5187
1956	725560	3367213	286427	1343068	4.689	0.6285
1957	1454003	2782457	207204	792557	3.825	0.5047
1958	1005575	2402528	203231	769313	3.7854	0.5316
1959	1317191	2742807	437340	744607	1.7026	0.5379
1960	1550867	2400088	395257	622042	1.5738	0.4878
1961	1589071	2419705	406656	783221	1.926	0.6326
1962	1292322	2218580	324252	909266	2.8042	0.7515
1963	828474	1985989	220684	776337	3.5179	0.9369
1964	428596	1454456	186227	437695	2.3503	0.6718
1965	873400	1458203	102937	444930	4.3224	0.5384
1966	2240060	2415105	122919	483711	3.9352	0.5038
1967	1511690	2975263	135070	572605	4.2393	0.5448
1968	169339	3506567	232121	1074084	4.6273	0.5513
1969	95436	2920202	158166	1197226	7.5694	0.8101
1970	221996	2134168	233195	933246	4.002	0.7125
1971	383445	1637663	322729	689048	2.1351	0.5822
1972	941651	1602778	363707	565254	1.5541	0.6918
1973	2231117	2421731	330673	792685	2.3972	0.6054

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1974	579419	2310174	164090	1102433	6.7185	0.6083
1975	570561	2085787	136580	829377	6.0725	0.6459
1976	686700	1984013	170998	867463	5.0729	0.6589
1977	336354	1971847	347774	905301	2.6031	0.8246
1978	717515	1605995	231975	698715	3.012	0.9556
1979	188057	1123803	169849	440538	2.5937	0.7375
1980	120993	860070	107153	380434	3.5504	0.7424
1981	152874	964259	162493	399038	2.4557	0.8044
1982	200438	752180	320991	363730	1.1331	0.7997
1983	153254	738680	306597	289992	0.9458	0.7443
1984	392799	822886	246469	277651	1.1265	0.9045
1985	623486	1030952	195226	307920	1.5773	0.7213
1986	1046035	1385368	175215	430113	2.4548	0.8785
1987	315985	1224033	120903	523071	4.3264	0.9792
1988	293648	984827	192741	434939	2.2566	1.0053
1989	193461	956726	233586	332481	1.4234	0.677
1990	159980	969795	313138	212000	0.677	0.3266
1991	383103	1515745	701247	319158	0.4551	0.3133
1992	798991	1892878	892347	513234	0.5752	0.4618
1993	888841	2315085	755527	581611	0.7698	0.57
1994	699632	2111183	596545	771086	1.2926	0.8441
1995	488242	1781545	517153	739999	1.4309	0.7918
1996	445026	1655372	546222	732228	1.3405	0.7146
1997	677708	1521544	568920	762403	1.3401	0.9952
1998	1052482	1300557	379755	592624	1.5605	0.9473
1999	529765	1179159	289954	484910	1.6724	0.9478
2000	629642	1185278	247116	414868	1.6788	0.8393
2001	578837	1458292	368598	426471	1.157	0.7097
2002	394623	1607397	510834	535045	1.0474	0.6582

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
2003	743330	1692137	578756	551990	0.9538	0.5463
2004	252623	1608404	686276	606445	0.8837	0.6893
2005	606471	1570869	611913	641276	1.048	0.7314
2006	545107	1551724	590253	537642	0.9109	0.638
2007	1470329	1966329	642292	486883	0.758	0.4191
2008	1185542	2696970	700855	464171	0.6623	0.3122
2009	678599	3400092	1110811	523430	0.4712	0.2566
2010	293867	3735660	1401499	609983	0.4352	0.253
2011	448443	3951490	1997645	719830	0.3603	0.256
2012	572835	4130452	2329091	727663	0.3124	0.2197
2013	625805	4478757	2737085	966209	0.353	0.2541
2014	771499	4091963	2623413	986449	0.376	0.2832
2015	447415	3864872	2229644	864384	0.3877	0.2976
2016	268554	3452059	1927084	849422	0.4408	0.3022
2017	750022	3474026	2114354	868276	0.4107	0.3676
2018	498154	3036166	1810295	778627	0.4301	0.3992
Arith. Mean	773518	2331679	614401	671921	2.0305	0.5905

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

2019								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	667000	0.3479	0	0	0	0.274	0.0113	0.834
4	338158	0.2445	0.003	0	0	0.659	0.0641	1.282
5	348666	0.2382	0.033	0	0	1.188	0.1707	1.671
6	122712	0.2201	0.199	0	0	1.95	0.2853	2.355
7	79018	0.2	0.624	0	0	3.101	0.3656	3.42
8	95191	0.2	0.894	0	0	4.381	0.4217	4.558
9	44464	0.2	0.947	0	0	5.928	0.4126	5.943
10	24333	0.2	0.988	0	0	7.361	0.4820	7.365
11	12504	0.2	0.997	0	0	9.632	0.5641	8.65
12	5742	0.2	1	0	0	12.621	0.2997	11.42
13	8845	0.2	1	0	0	14.544	0.1608	12.8
14	11273	0.2	1	0	0	16.466	0.0943	14.18
15	12714	0.2	1	0	0	18.388	0.0943	15.55

2020								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	537000	0.3479	0	0	0	0.244	0.0113	0.834
4		0.2445	0.003	0	0	0.665	0.0641	1.256
5		0.2382	0.021	0	0	1.244	0.1707	1.789
6		0.2201	0.182	0	0	2.003	0.2853	2.317
7		0.2	0.526	0	0	2.97	0.3656	3.276
8		0.2	0.792	0	0	4.656	0.4217	4.674
9		0.2	0.939	0	0	6.035	0.4126	5.894
10		0.2	0.984	0	0	7.568	0.4820	7.279
11		0.2	0.999	0	0	9.528	0.5641	8.701
12		0.2	0.995	0	0	12.621	0.2997	11.42
13		0.2	1	0	0	14.544	0.1608	12.8
14		0.2	1	0	0	16.466	0.0943	14.18

2020								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
15		0.2	1	0	0	18.388	0.0943	15.55

2021								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	644000	0.3479	0	0	0	0.262	0.0113	0.834
4		0.2445	0.003	0	0	0.635	0.0641	1.256
5		0.2382	0.021	0	0	1.25	0.1707	1.789
6		0.2201	0.182	0	0	2.059	0.2853	2.317
7		0.2	0.526	0	0	3.022	0.3656	3.276
8		0.2	0.792	0	0	4.525	0.4217	4.674
9		0.2	0.939	0	0	6.31	0.4126	5.894
10		0.2	0.984	0	0	7.676	0.4820	7.279
11		0.2	0.999	0	0	9.735	0.5641	8.701
12		0.2	0.995	0	0	12.621	0.2997	11.42
13		0.2	1	0	0	14.544	0.1608	12.8
14		0.2	1	0	0	16.466	0.0943	14.18
15		0.2	1	0	0	18.388	0.0943	15.55

Table 3.20. Northeast Arctic COD. Management option table.

2019					
Biomass (t)	**SSB (t)**	**F_{Mult}**	**F_{Bar}**	**Landings (t)**	
2904828	1754858	1	0.399	697412	
2020				**2021**	
Biomass	**SSB**	**F_{Bar}**	**Landings**	**Biomass**	**SSB**
2733266	1458491	0.00	0	3377091	1860296
		0.05	93143	3268939	1778361
		0.10	182139	3165928	1700742
		0.15	267205	3067780	1627194
		0.20	348546	2974232	1557484
		0.25	426356	2885038	1491392
		0.30	500818	2799964	1428714
		0.35	572104	2718791	1369257
		0.40	640378	2641312	1312839
		0.45	705792	2567333	1259289
		0.50	768492	2496670	1208446
		0.55	828615	2429148	1160160
		0.60	886291	2364604	1114287
		0.65	941641	2302885	1070694
		0.70	994782	2243844	1029255
		0.75	1045822	2187343	989851
		0.80	1094864	2133254	952371
		0.85	1142007	2081452	916708
		0.90	1187342	2031823	882765
		0.95	1230958	1984257	850447
		1.00	1272936	1938651	819666
Tonnes	Tonnes		Tonnes	Tonnes	Tonnes

Table 3.21. Northeast Arctic COD. Detailed prediction output assuming Fsq in 2019 and HCR in 2020.

F_{bar}	age	
range:	5-10	
Year:	2019	
F	multiplier:	1
F_{bar}:	0.3992	

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)
3	0.013	7111	6	667000	183	0	0
4	0.072	20810	27	338158	223	1014	1
5	0.191	54204	91	348666	414	11506	14
6	0.320	30316	71	122712	239	24420	48
7	0.410	24237	83	79018	245	49307	153
8	0.473	32745	149	95191	417	85101	373
9	0.462	15031	89	44464	264	42107	250
10	0.540	9285	68	24333	179	24041	177
11	0.632	5365	46	12504	120	12466	120
12	0.336	1493	17	5742	72	5742	72
13	0.180	1326	17	8845	129	8845	129
14	0.106	1026	15	11273	186	11273	186
15+	0.106	1157	18	12714	234	12714	234
Total	NA	204106	697	1770620	2905	288537	1755
		Thous	Thou.	Thous	Thou.	Thous	Thou.
			tonnes		tonnes		tonnes

F_{bar}	age	
range:	5-10	
Year:	2020	
F	multiplier:	1.25
F_{bar}:	0.4986	

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)
3	0.016	7139	6	537000	131	0	0
4	0.090	35440	45	465072	309	1395	1
5	0.239	46808	84	246468	307	5176	6
6	0.399	67543	156	226942	455	41303	83
7	0.512	26181	86	71525	212	37622	112
8	0.590	17520	82	42949	200	34015	158
9	0.577	19498	115	48587	293	45623	275
10	0.674	10308	75	22929	174	22563	171
11	0.789	5818	51	11609	111	11597	111
12	0.419	1701	19	5441	69	5414	68
13	0.225	616	8	3360	49	3360	49
14	0.132	679	10	6048	100	6048	100
15+	0.132	1984	31	17670	325	17670	325
Total	NA	241235	767	1705599	2733	231787	1458
		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	813202	251608	411969	0.812
1985	990156	199707	583047	0.639
1986	1363640	182247	1015891	0.785
1987	1223679	135359	284049	1.017
1988	1005886	225779	215992	0.987
1989	913903	237312	182324	0.467
1990	996937	334589	211590	0.311
1991	1569125	721825	408357	0.228
1992	1965822	964711	688971	0.411
1993	2455778	853206	1000433	0.624
1994	2232270	643641	728736	0.826
1995	1922693	579860	435074	0.756
1996	1856793	658311	394762	0.719
1997	1718566	721898	608997	1.048
1998	1287720	440631	793938	1.058
1999	1090944	286921	446610	0.97
2000	1062428	230196	557965	0.675
2001	1293487	351235	457530	0.536
2002	1425295	473949	409553	0.522
2003	1516577	532778	654027	0.515
2004	1481568	623001	276911	0.619
2005	1485127	580451	531612	0.625
2006	1523745	597826	552067	0.653
2007	1881561	625058	1368644	0.513
2008	2619874	633097	1360508	0.368
2009	3347953	987173	913069	0.355
2010	3695017	1196468	566554	0.393
2011	3802508	1690494	661291	0.334
2012	3879741	1949245	694998	0.288

Year	B(3+)	SSB	R(3)	F(5-10)
2013	4132734	2220948	801536	0.283
2014	3843732	2171555	990962	0.294
2015	3671185	1850850	447642	0.301
2016	3325412	1638149	307976	0.278
2017	3420527	1958815	760154	0.321
2018	3060426	1731796	668649	0.368

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	411969	139061	72716	41672	24693	12142	9031	1477	697	457	216	39	26
1985	583047	330380	99084	42263	18172	7060	3359	2485	476	404	185	123	31
1986	1015891	459773	230876	56920	20067	6805	2325	1317	1063	223	282	115	47
1987	284049	770659	311592	115323	23465	7158	2196	715	431	371	80	176	60
1988	215992	213745	519539	155444	36581	6232	2088	716	145	146	115	43	15
1989	182324	167846	150484	283707	59066	9080	1504	619	189	34	54	58	85
1990	211590	145761	121659	95349	156221	25788	3483	630	292	109	17	38	15
1991	408357	171671	112179	85629	60730	96049	14419	2020	361	184	72	10	20
1992	688971	330643	132991	79454	54531	35758	58492	8621	1267	243	133	55	6
1993	1000433	546892	245909	88345	44936	28326	17170	30413	4387	716	132	97	4
1994	728736	773315	408791	148380	45562	20319	11546	6693	12358	1781	289	68	14
1995	435074	510456	541471	243402	66668	14633	6112	3263	1805	3862	572	149	4
1996	394762	254975	336244	325503	118830	25532	5192	1897	944	506	1430	302	4
1997	608997	232904	164250	196273	159688	49521	9286	2006	585	307	179	659	3
1998	793938	390105	147310	81142	78757	47764	12972	2097	465	109	61	61	147
1999	446610	498114	237003	71986	31013	24240	10433	3675	496	140	25	24	88
2000	557965	337286	326568	111180	25495	10413	5833	2040	1146	159	55	4	55
2001	457530	429821	242950	172082	48475	9058	3672	1694	590	564	69	34	106
2002	409553	356582	312497	148332	80361	20298	3288	1653	632	246	337	47	31
2003	654027	305973	263507	191691	70741	31541	7725	1294	860	324	116	235	5
2004	276911	507948	231246	166165	97114	30891	12732	3537	596	515	179	76	38
2005	531612	212848	373710	146092	82715	37363	11203	4468	1362	243	287	112	33
2006	552067	388863	155248	218840	72806	33573	12813	4139	1507	580	109	195	673
2007	1368644	443401	272777	96627	108305	31457	12850	4080	1597	523	256	66	179
2008	1360508	1054614	328478	164233	54580	53275	14848	6134	1780	779	208	167	83
2009	913069	1045014	803297	228447	98346	31036	26307	7646	3286	868	432	137	131
2010	566554	684848	806110	567748	142615	57314	17060	13598	4282	1846	209	290	207
2011	661291	417158	516246	583683	365706	79198	29461	9041	6868	1685	877	77	0
2012	694998	426781	293097	379790	399285	219117	43412	14649	4033	3292	915	472	162
2013	801536	472156	297971	217208	265209	257380	128105	24020	7640	1989	1796	552	899
2014	990962	528033	354238	217297	156168	166721	148935	66554	12131	3883	1073	1144	855
2015	447642	658834	367932	247867	145615	102018	91610	82161	33714	6317	2058	654	1239
2016	307976	301749	469848	246795	155035	89009	63312	51657	44562	15285	3051	1285	1589
2017	760154	244223	217284	301657	154696	93021	52840	39519	27109	24123	8170	1852	1323
2018	668649	471549	180507	147182	183834	86526	50168	30203	23854	13510	13745	5031	1623
2019	0	472611	357359	123240	86972	101352	45214	26408	15931	13077	7677	9177	3359

Table 3.24. NEA cod TISVPA estimates of fishing mortality coefficients

F(a,y)	3	4	5	6	7	8	9	10	11	12	13	14	15	F(5-10)
1984	0.0226	0.1381	0.3244	0.5624	1.0246	0.9882	1.0190	0.9539	0.2674	0.8280	0.4149	0.4149	0.4149	0.8121
1985	0.0202	0.1250	0.3151	0.4531	0.6211	0.9217	0.7453	0.7764	0.6621	0.2036	0.3397	0.3397	0.3397	0.6388
1986	0.0211	0.1526	0.4014	0.6484	0.7466	0.8757	1.1290	0.9064	0.8463	0.7143	0.3973	0.3973	0.3973	0.7846
1987	0.0257	0.1585	0.5043	0.8684	1.1553	1.0779	1.0555	1.4410	0.9857	0.9128	0.4640	0.4640	0.4640	1.0171
1988	0.0243	0.1662	0.4333	0.9068	1.2536	1.3342	0.9999	0.9959	1.1657	0.8288	0.4469	0.4469	0.4469	0.9873
1989	0.0135	0.0900	0.2461	0.3775	0.5728	0.6096	0.5435	0.4513	0.4122	0.4582	0.2330	0.2330	0.2330	0.4668
1990	0.0081	0.0593	0.1591	0.2664	0.3225	0.4063	0.3732	0.3408	0.2656	0.2437	0.1551	0.1551	0.1551	0.3114
1991	0.0063	0.0386	0.1135	0.1887	0.2532	0.2617	0.2857	0.2666	0.2260	0.1777	0.1147	0.1147	0.1147	0.2282
1992	0.0094	0.0669	0.1684	0.3225	0.4486	0.5286	0.4726	0.5282	0.4466	0.3717	0.1979	0.1979	0.1979	0.4115
1993	0.0145	0.0847	0.2535	0.4103	0.6726	0.8228	0.8384	0.7457	0.7632	0.6295	0.2897	0.2897	0.2897	0.6239
1994	0.0173	0.1157	0.2812	0.5516	0.7365	1.0854	1.1267	1.1730	0.9067	0.9253	0.3670	0.3670	0.3670	0.8257
1995	0.0163	0.1114	0.3113	0.4726	0.7609	0.8487	1.0430	1.1003	1.0093	0.7917	0.3629	0.3629	0.3629	0.7561
1996	0.0209	0.1065	0.3051	0.5427	0.6584	0.9062	0.8443	1.0544	0.9832	0.9021	0.3672	0.3672	0.3672	0.7185
1997	0.0277	0.1825	0.3922	0.7547	1.1720	1.1850	1.4455	1.3402	1.5442	1.3987	0.5098	0.5098	0.5098	1.0483
1998	0.0308	0.1851	0.5295	0.6965	1.1092	1.4377	1.1501	1.4251	1.1515	1.2958	0.5081	0.5081	0.5081	1.0580
1999	0.0251	0.1958	0.5015	0.9215	0.9186	1.2077	1.2408	1.0303	1.0976	0.9115	0.4720	0.4720	0.4720	0.9701
2000	0.0206	0.1230	0.4004	0.6145	0.8515	0.6925	0.7329	0.7586	0.5950	0.6221	0.3319	0.3319	0.3319	0.6751
2001	0.0147	0.1083	0.2638	0.5360	0.6389	0.7234	0.5108	0.5443	0.5117	0.4106	0.2602	0.2602	0.2602	0.5362
2002	0.0131	0.0881	0.2699	0.4085	0.6748	0.6689	0.6424	0.4647	0.4520	0.4245	0.2403	0.2403	0.2403	0.5215
2003	0.0133	0.0795	0.2198	0.4269	0.5156	0.7234	0.6088	0.5930	0.3960	0.3841	0.2261	0.2261	0.2261	0.5146
2004	0.0144	0.0992	0.2446	0.4329	0.7055	0.7187	0.8765	0.7379	0.6488	0.4274	0.2646	0.2646	0.2646	0.6194
2005	0.0152	0.0945	0.2707	0.4183	0.6029	0.8431	0.7217	0.8939	0.6783	0.5961	0.2695	0.2695	0.2695	0.6251
2006	0.0157	0.1061	0.2746	0.5042	0.6291	0.7770	0.9303	0.8022	0.8946	0.6757	0.2936	0.2936	0.2936	0.6529
2007	0.0125	0.0859	0.2375	0.3804	0.5566	0.5790	0.6035	0.7190	0.5718	0.6259	0.2436	0.2436	0.2436	0.5127
2008	0.0080	0.0635	0.1768	0.3029	0.3855	0.4731	0.4244	0.4461	0.4775	0.3878	0.1892	0.1892	0.1892	0.3682
2009	0.0075	0.0495	0.1615	0.2830	0.3931	0.4269	0.4538	0.4124	0.3972	0.4228	0.1852	0.1852	0.1852	0.3551
2010	0.0060	0.0525	0.1414	0.2954	0.4241	0.5077	0.4769	0.5141	0.4264	0.4090	0.2070	0.2070	0.2070	0.3933
2011	0.0064	0.0346	0.1241	0.2094	0.3562	0.4364	0.4510	0.4294	0.4230	0.3522	0.1896	0.1896	0.0000	0.3344
2012	0.0071	0.0381	0.0832	0.1883	0.2578	0.3781	0.4022	0.4202	0.3676	0.3609	0.1789	0.1789	0.1789	0.2883
2013	0.0077	0.0489	0.1061	0.1447	0.2704	0.3202	0.4129	0.4449	0.4260	0.3711	0.1964	0.1964	0.1964	0.2832
2014	0.0095	0.0555	0.1441	0.1955	0.2162	0.3548	0.3679	0.4838	0.4775	0.4550	0.2268	0.2268	0.2268	0.2937
2015	0.0117	0.0679	0.1614	0.2644	0.2895	0.2750	0.3990	0.4191	0.5070	0.4982	0.2569	0.2569	0.2569	0.3014
2016	0.0105	0.0704	0.1666	0.2465	0.3265	0.3055	0.2541	0.3710	0.3576	0.4279	0.2410	0.2410	0.2410	0.2783
2017	0.0141	0.0749	0.2068	0.3072	0.3682	0.4201	0.3409	0.2857	0.3858	0.3703	0.2720	0.2720	0.2720	0.3215
2018	0.0109	0.0696	0.1816	0.2978	0.3954	0.4491	0.4417	0.4397	0.4011	0.3652	0.2040	0.2040	0.2040	0.3675

Table 3.25. North East arctic cod. Stock numbers-at-age (in thousands) estimated by VPA including discard estimates, and % increase in stock numbers relative to a VPA without discards. From Dingsør (2001). The discard numbers applied correspond to method II (1946–1982) and IIIb (1983–1998) mentioned in Dingsør (2001).

	Estimated stock numbers (thousands)			Percent increase		
Year	Age 3	Age 4	Age 5	Age 3	Age 4	Age 5
1946	875 346	602 579	407 163	20 %	4 %	1 %
1947	531 993	676 806	465 099	27 %	14 %	0 %
1948	570 356	392 309	497 476	29 %	14 %	5 %
1949	589 367	416 668	285 459	26 %	16 %	3 %
1950	799 732	414 016	291 200	13 %	9 %	1 %
1951	1 235 322	586 054	302 346	14 %	2 %	0 %
1952	1 388 731	889 509	401 768	17 %	3 %	0 %
1953	1 801 114	975 004	600 908	13 %	2 %	0 %
1954	830 653	1 321 053	684 303	29 %	5 %	0 %
1955	381 489	615 696	907 875	40 %	19 %	2 %
1956	567 555	274 235	399 344	29 %	25 %	3 %
1957	914 850	387 496	161 710	14 %	10 %	2 %
1958	552 600	672 221	262 135	11 %	4 %	2 %
1959	757 567	391 906	406 694	11 %	3 %	0 %
1960	855 470	534 350	240 047	8 %	1 %	0 %
1961	1 041 570	620 707	347 043	13 %	1 %	0 %
1962	894 728	739 196	382 556	23 %	4 %	0 %
1963	551 938	614 025	429 068	17 %	10 %	0 %
1964	389 151	396 165	361 790	15 %	5 %	0 %
1965	845 469	293 844	266 134	9 %	8 %	0 %
1966	1 618 188	647 435	203 168	2 %	4 %	2 %
1967	1 404 569	1 249 506	465 035	9 %	0 %	1 %
1968	210 875	1 088 071	876 095	24 %	6 %	0 %
1969	143 791	155 947	699 033	28 %	15 %	2 %
1970	222 635	104 415	92 541	13 %	17 %	4 %
1971	462 474	164 397	65 112	14 %	6 %	2 %
1972	1 221 559	358 357	115 892	20 %	10 %	1 %
1973	1 858 123	947 409	249 400	2 %	19 %	11 %
1974	598 555	1 246 499	583 612	14 %	2 %	9 %
1975	654 442	382 692	627 793	5 %	10 %	3 %
1976	622 230	477 390	233 608	1 %	2 %	1 %
1977	397 826	426 386	280 645	14 %	0 %	0 %
1978	653 256	277 410	198 204	2 %	11 %	0 %
1979	225 935	460 104	164 243	14 %	2 %	1 %
1980	152 937	171 954	300 312	11 %	11 %	0 %
1981	161 752	116 964	116 337	7 %	7 %	4 %
1982	151 642	125 307	81 780	0 %	4 %	1 %
1983	166 310	115 423	82 423	0 %	-1 %	3 %
1984	408 525	133 333	77 728	3 %	0 %	0 %
1985	543 828	324 072	96 327	4 %	2 %	0 %
1986	1 114 252	412 683	219 993	7 %	2 %	0 %
1987	307 425	767 656	268 642	7 %	4 %	0 %
1988	222 819	215 720	490 161	9 %	3 %	2 %
1989	180 066	166 955	151 576	4 %	6 %	0 %
1990	249 968	139 922	114 006	3 %	2 %	1 %
1991	418 955	200 700	105 559	2 %	2 %	0 %
1992	748 962	333 517	151 973	4 %	1 %	0 %
1993	1 002 933	576 112	238 980	10 %	2 %	0 %
1994	896 184	744 062	420 039	9 %	8 %	0 %
1995	733 664	584 808	476 048	10 %	6 %	3 %
1996	467 093	341 918	344 124	3 %	7 %	3 %
1997	765 234	238 202	193 102	3 %	0 %	4 %
1998	836 301	429 147	144 629	2 %	1 %	-1 %

Table 3.26. Northeast Arctic cod. Number (thousands) of cod by age groups taken as by-catch in the Norwegian shrimp fishery (1984–2006)

Age\Year	1984	1985	1986	1987	1988	1989	1990	1991
0	322	4537	28	1408	259	717	2971	11651
1	4913	19437	2339	3259	1719	668	13731	34450
2	1624	49334	6952	1961	1534	418	1518	2759
3	1073	2720	5245	499	1380	694	1019	87
4	2200	1891	716	2210	1882	2096	403	64
5	161	9306	737	1715	1124	2281	909	33
6	89	6374	520	411	269	1135	2913	293
7	144	266	92	79	186	184	1434	1138
8	38	1	93	28	178	13	185	316
9	1	2	165	6	1	0	3	29
10	0	3	88	1	0	0	9	0
11	0	0	0	0	0	0	0	0
Total('000)	10564	93872	16976	11576	8532	8206	25095	50819

Age\Year	1992	1993	1994	1995	1996	1997	1998	1999
0	6486	604	1042	1138	519	896	506	651
1	5236	6702	1628	1896	9084	17157	40314	7155
2	2922	4032	410	99	359	1805	5248	245
3	242	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
Total('000)	14886	11339	3080	3133	9962	19858	46068	8052

Age\Year	2000	2001	2002	2003	2004	2005	2006
0	66	1188	478	4253	713	945	1355
1	1572	7187	293	8805	1014	3411	2597
2	3152	1348	893	96	323	1628	218
3	218	0	190	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
Total('000)	5007	9723	1854	13154	2051	5984	4170

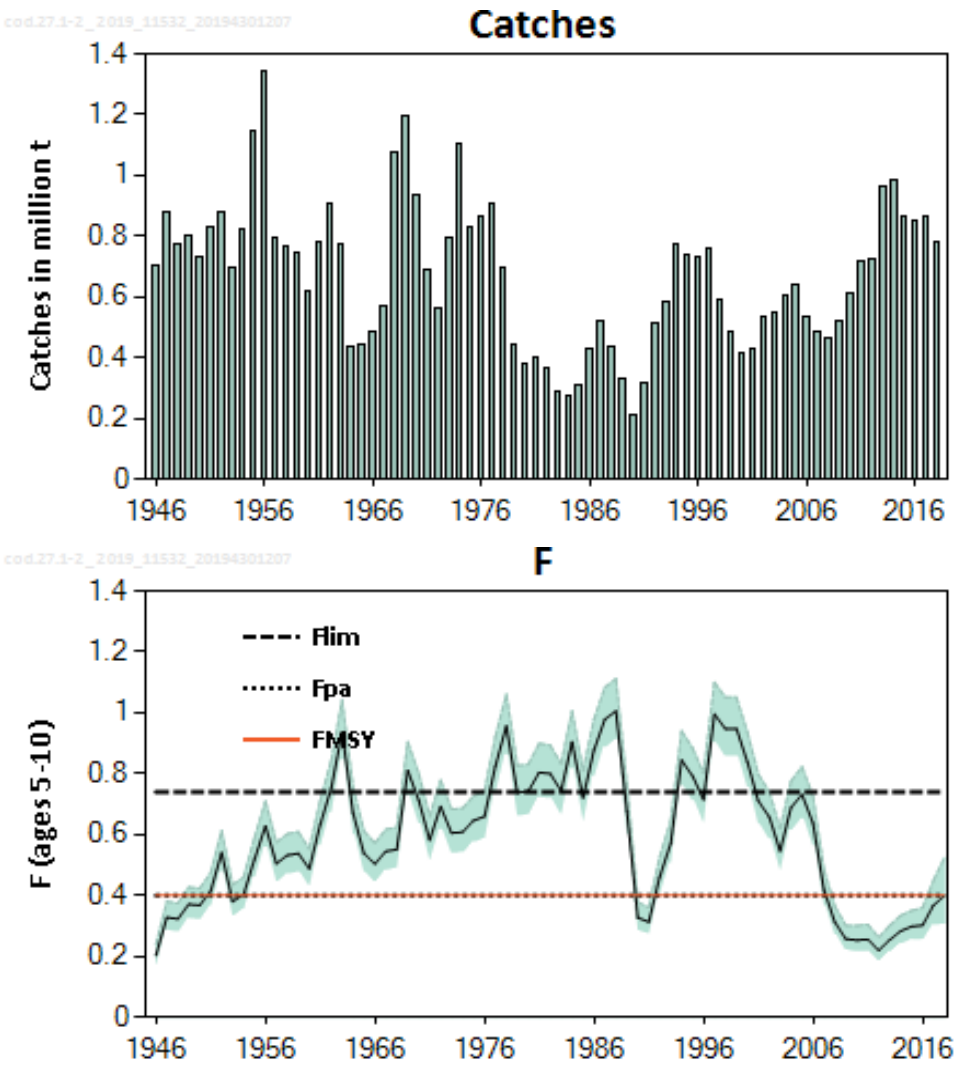

Figure 3.1. ICES Standard plots for Northeast Arctic cod (Subareas 1 and 2)

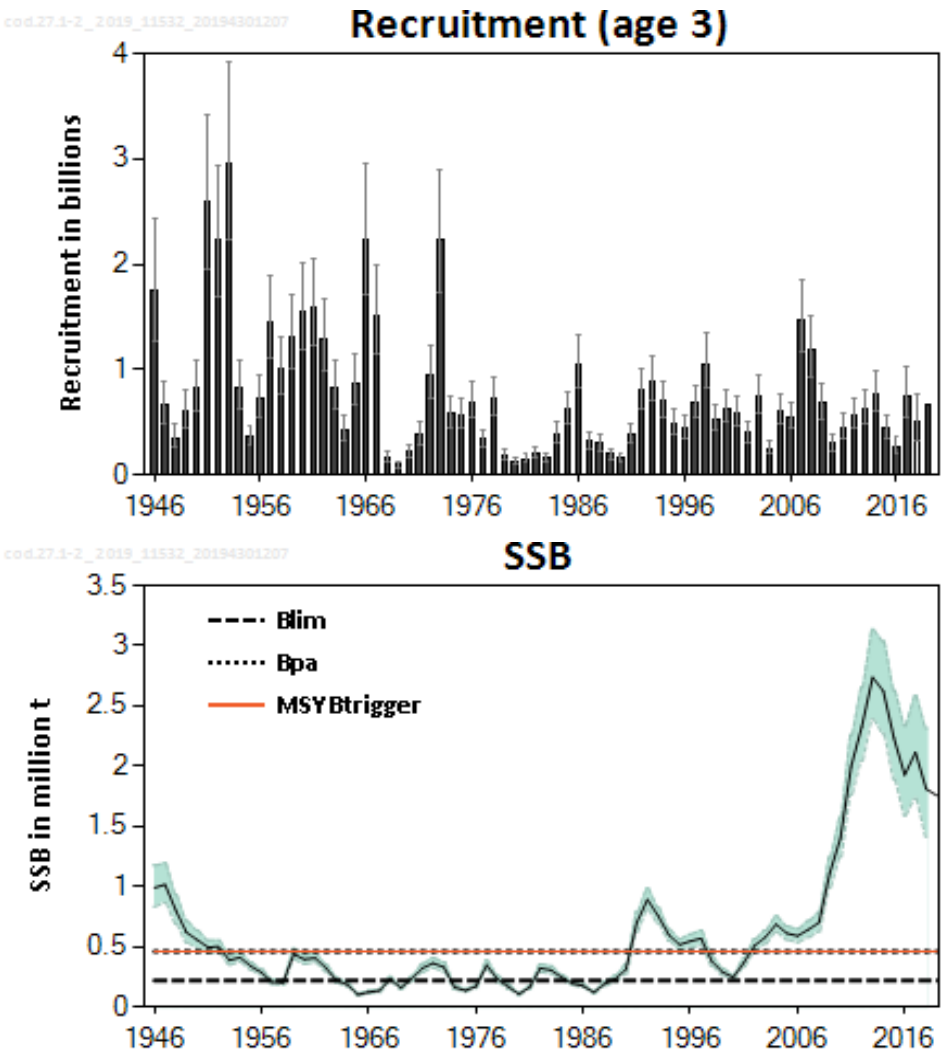

Figure 3.1 (continued). ICES Standard plots for Northeast Arctic cod (Subareas 1 and 2)

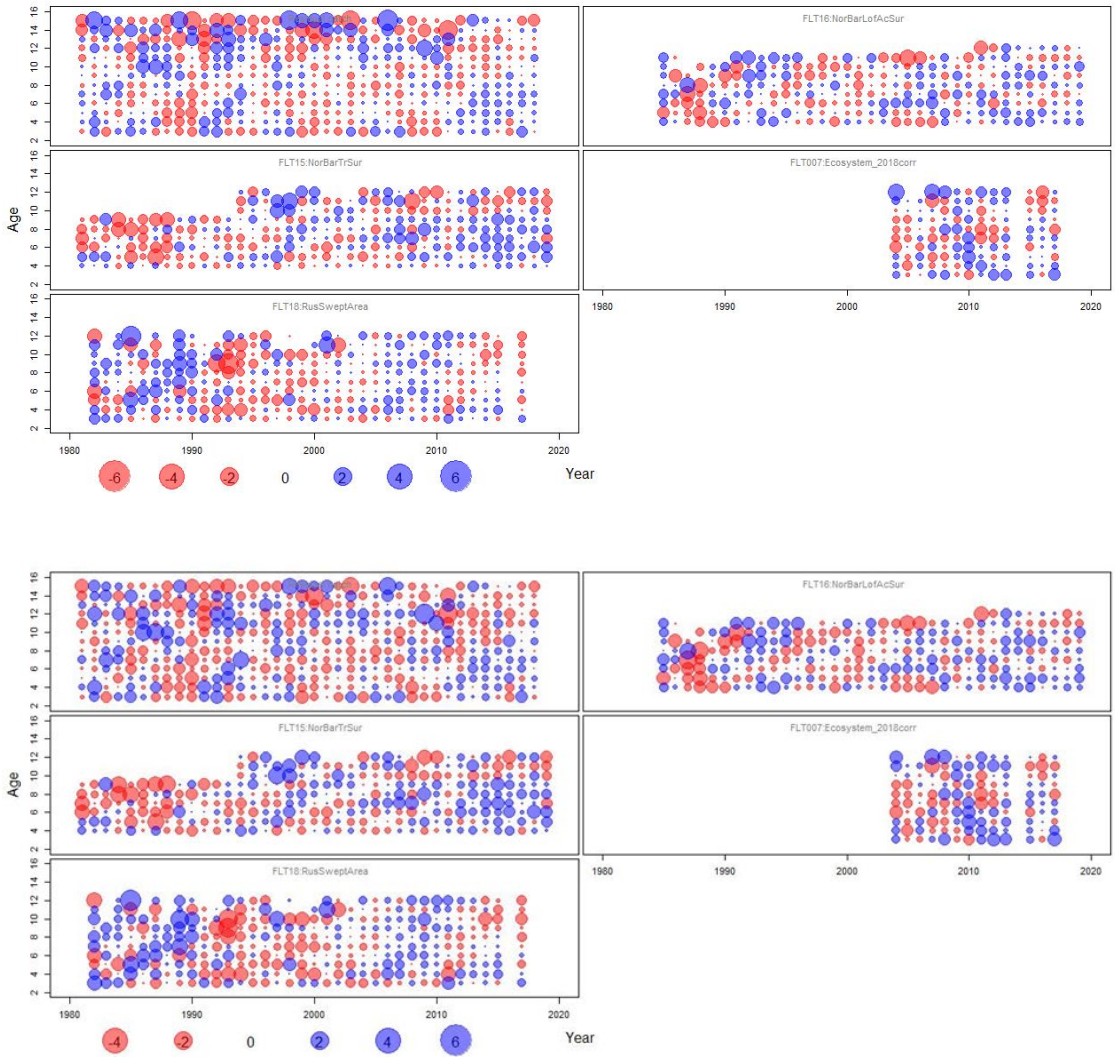

Figure 3.2a. Standardized one-observation-ahead residuals for log-catches and log-indices (Thygesen *et al.*, 2017) in the SPALY SAM run (upper panel) and the final SAM run (lower panel)

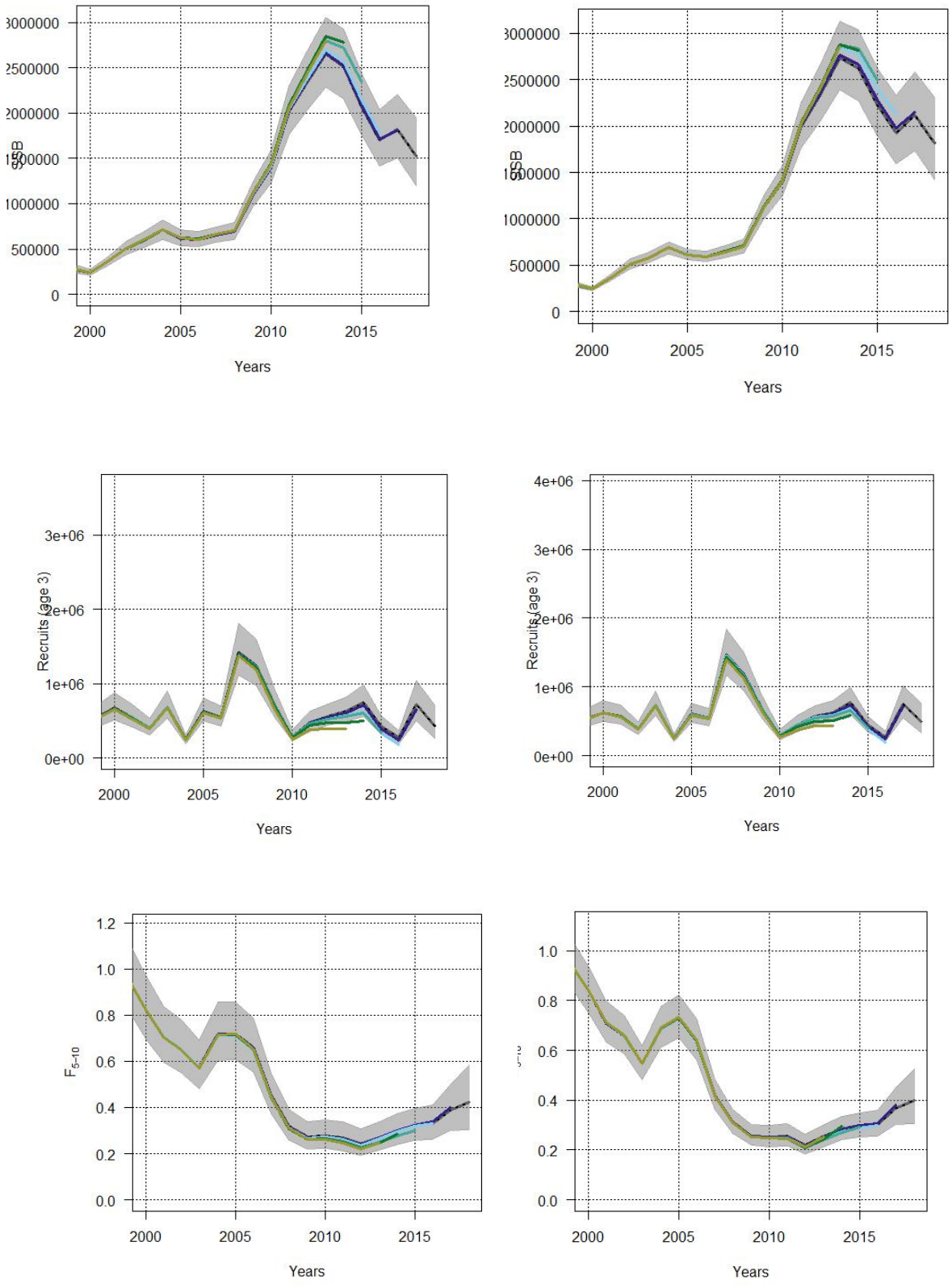

Figure 3.2b. NEA cod SSB, R and F_{bar} retrospective pattern for the SPALY SAM settings (left) and the final SAM run (right).

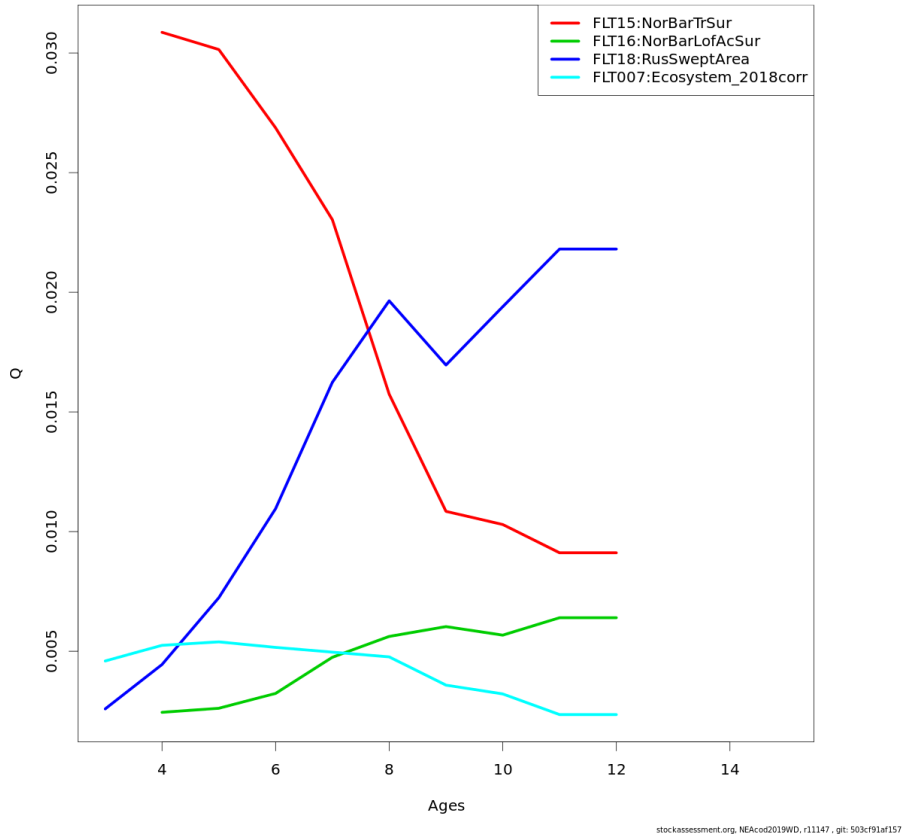

Figure 3.2c. NEA cod. Catchability of different fleets used for final SAM run fit.

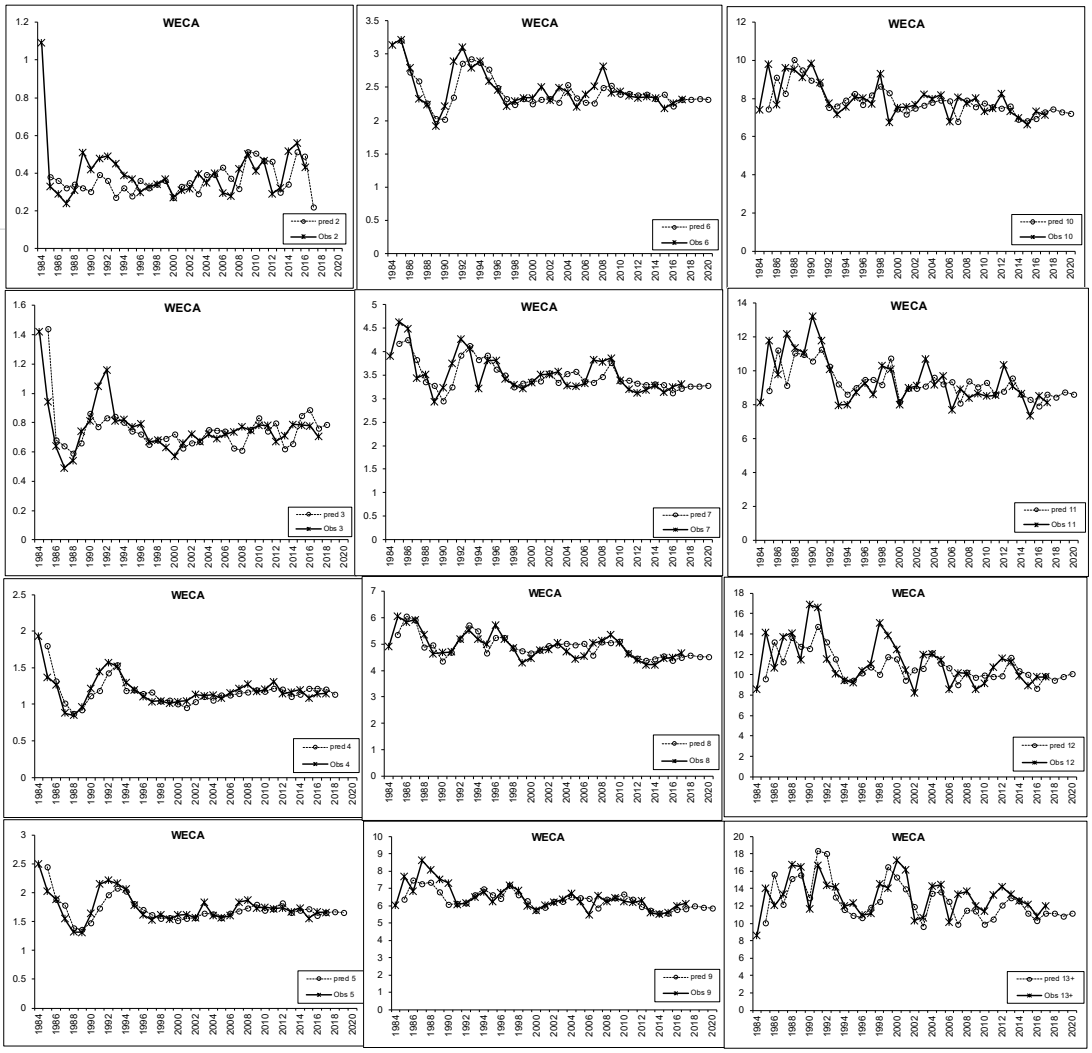

Figure 3.3. Northeast Arctic cod. Weight in catch predictions.

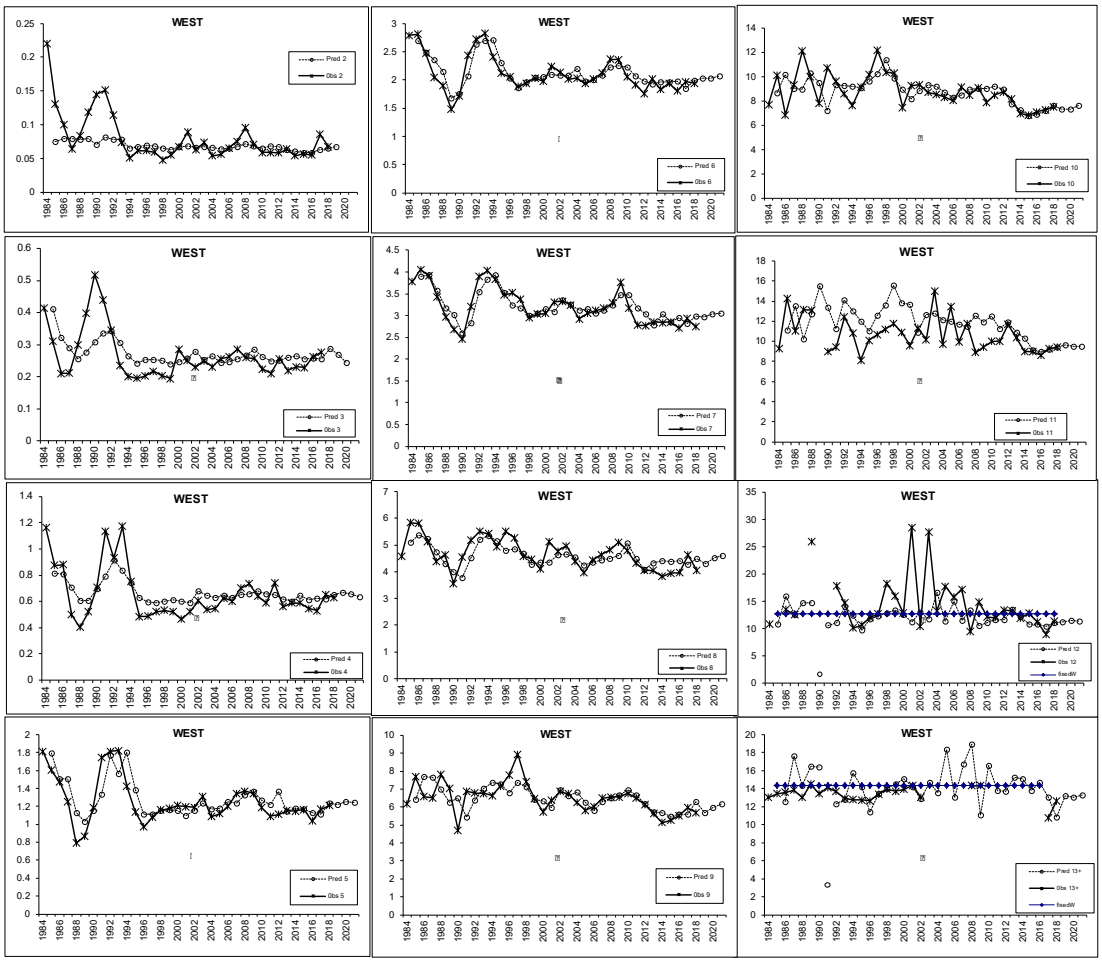

Figure 3.4. Northeast Arctic cod. Weight-in-stock projections.

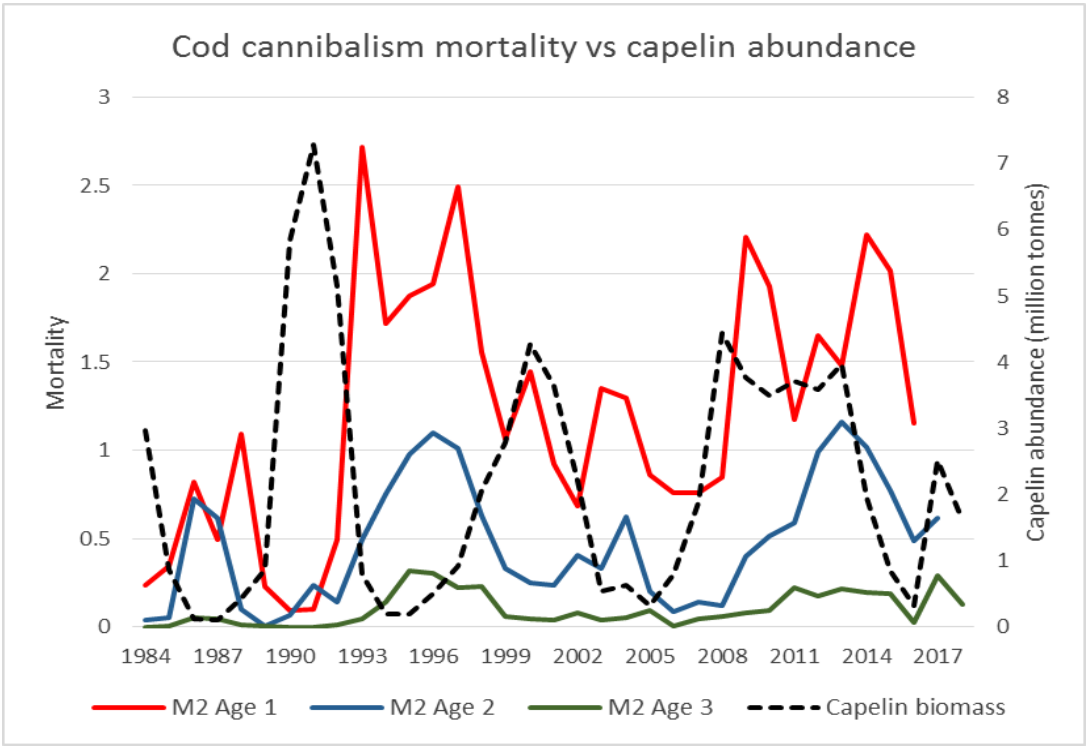

Figure 3.5. NEA cod cannibalism mortality vs. capelin abundance.

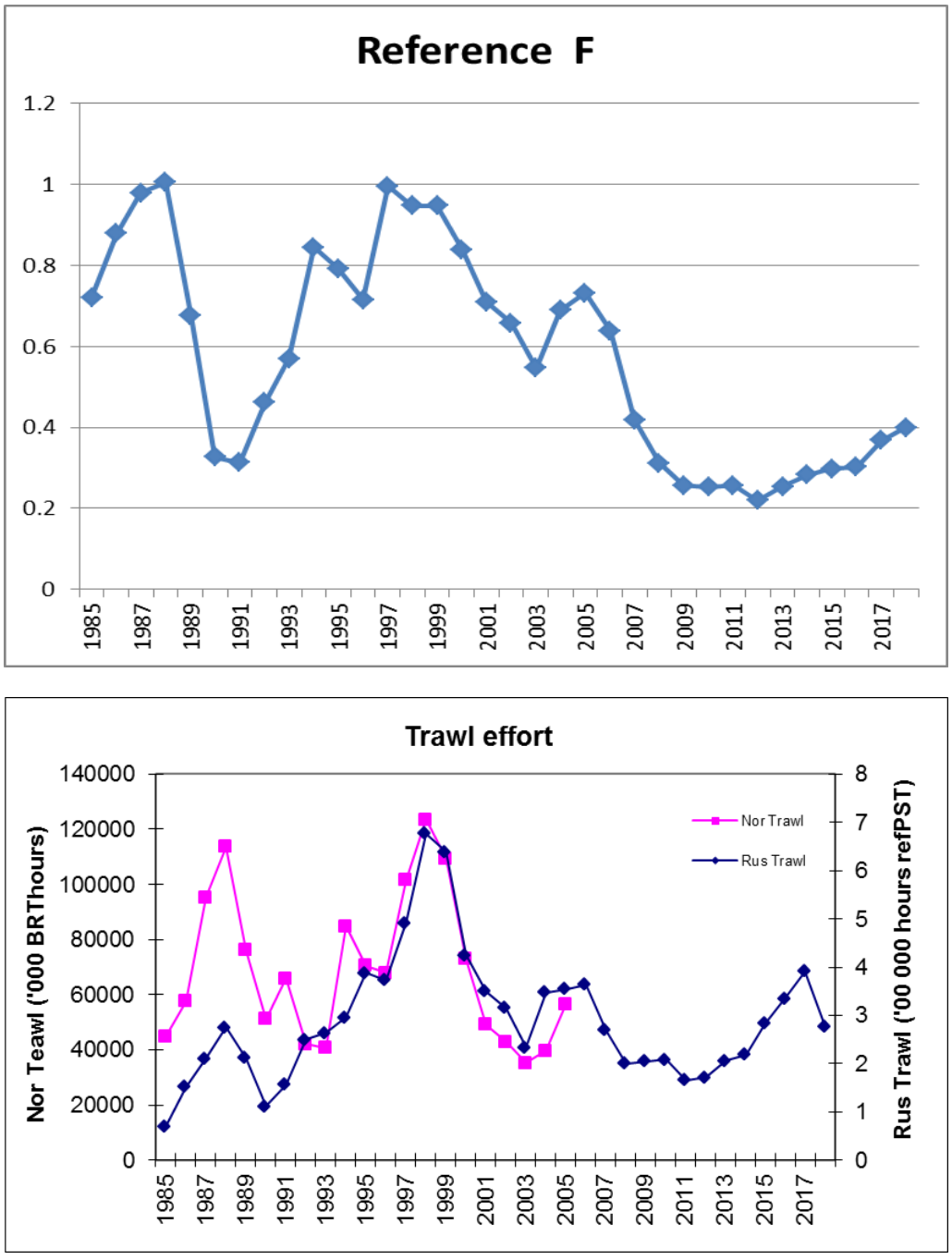

Figure 3.6a. Northeast Arctic cod. Fishing mortality (F5-10) (top panel) and trawl efforts in 1985–2018 (bottom panel).

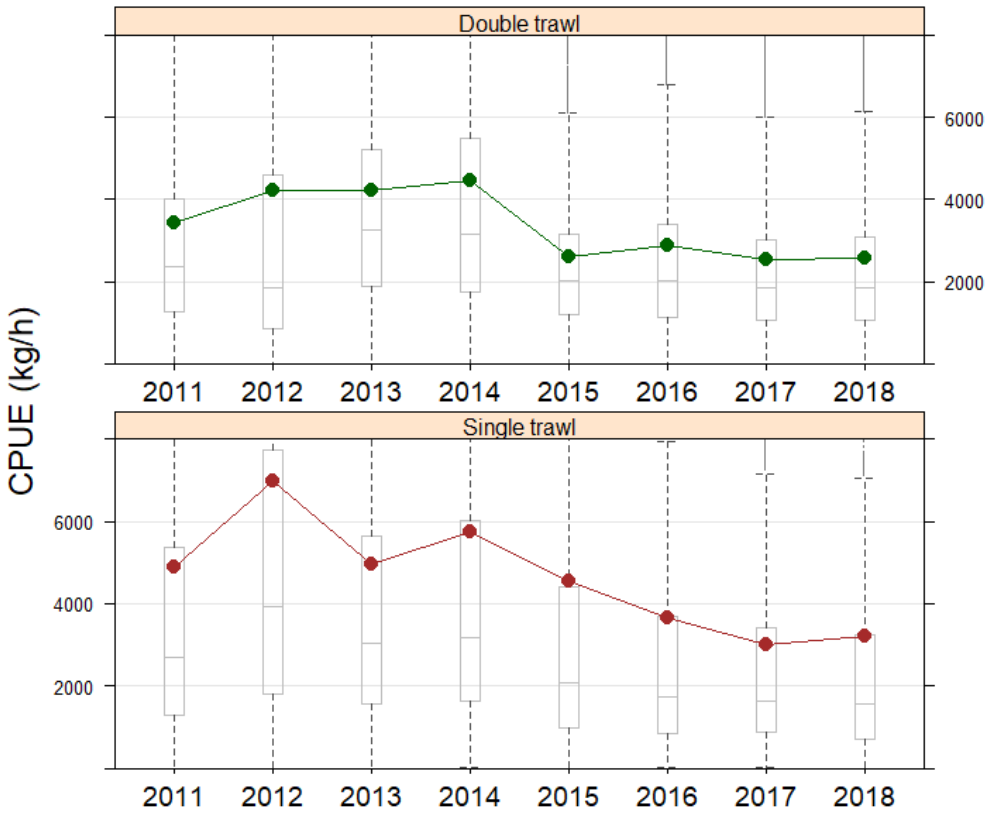

Figure 3.6b. Cod CPUE in Norwegian trawl catches where cod is the main species (double and single trawl). Connected line shows mean, line inside the box shows the median, and the box shows 25 and 75 percentiles.

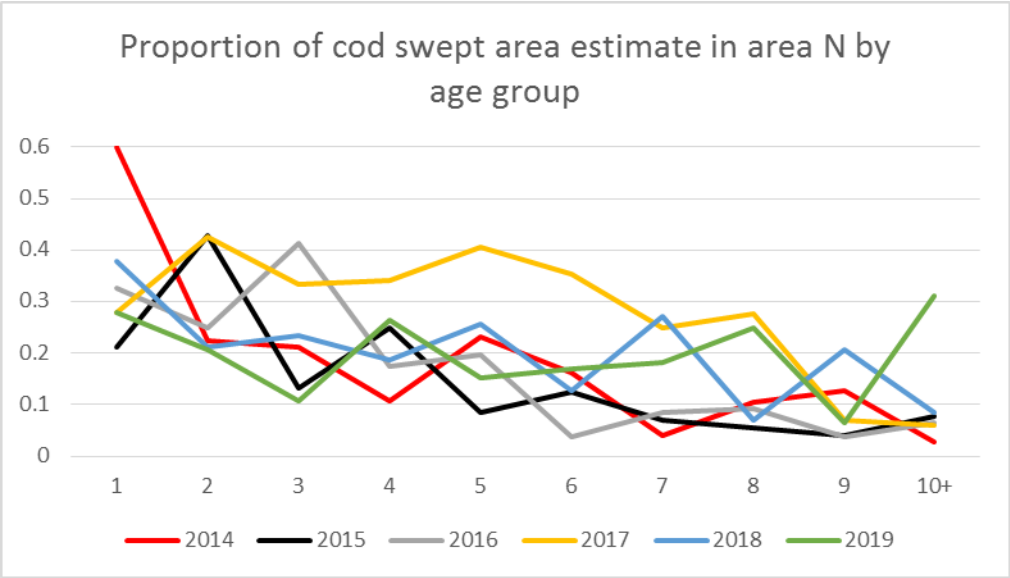

Figure 3.7. Proportion of NEA cod swept area estimate in area N during the Joint winter survey in 2014–2019, by age group.

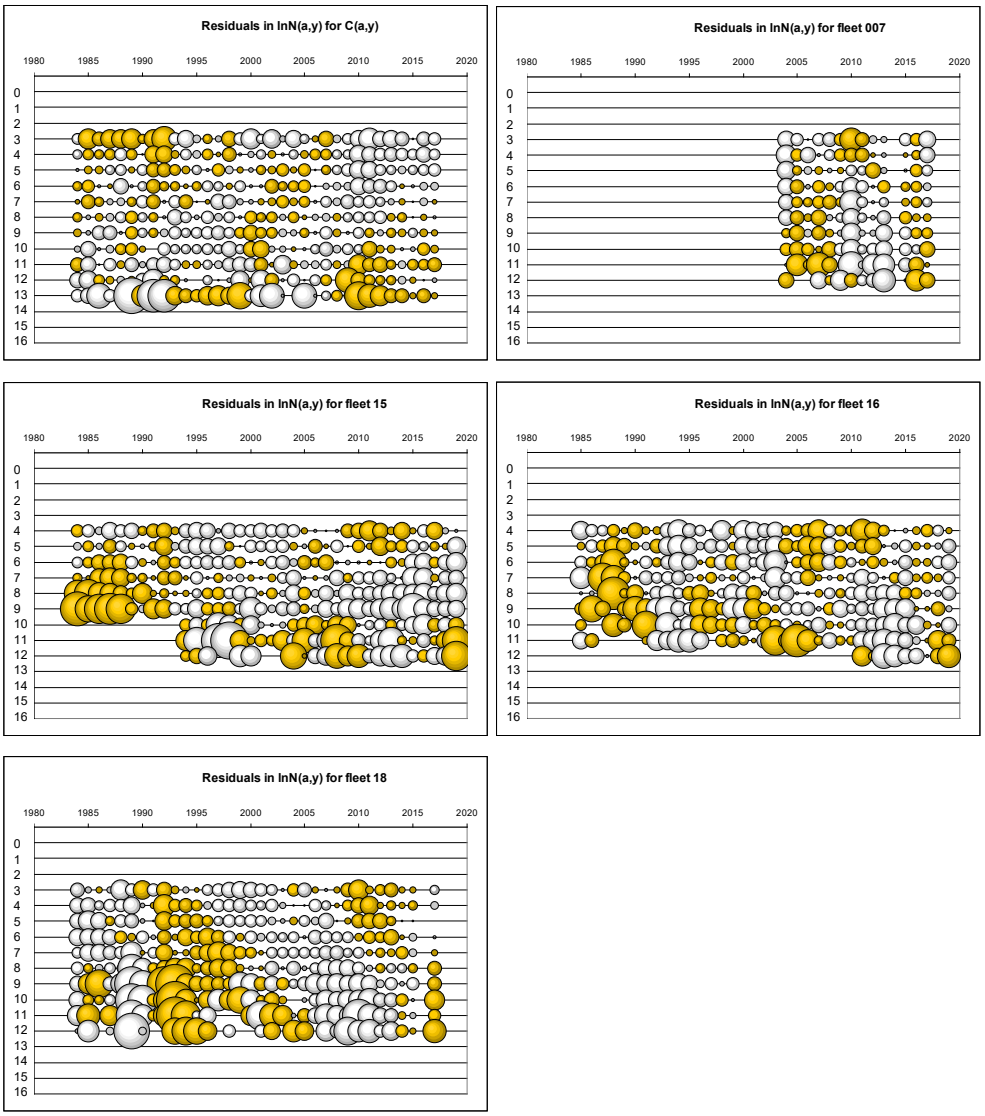

Figure 3.8a. Residuals of the TISVPA data approximation (yellow circles are positive residuals, white – negative, maximum bubble size corresponds to residual = 2.4).

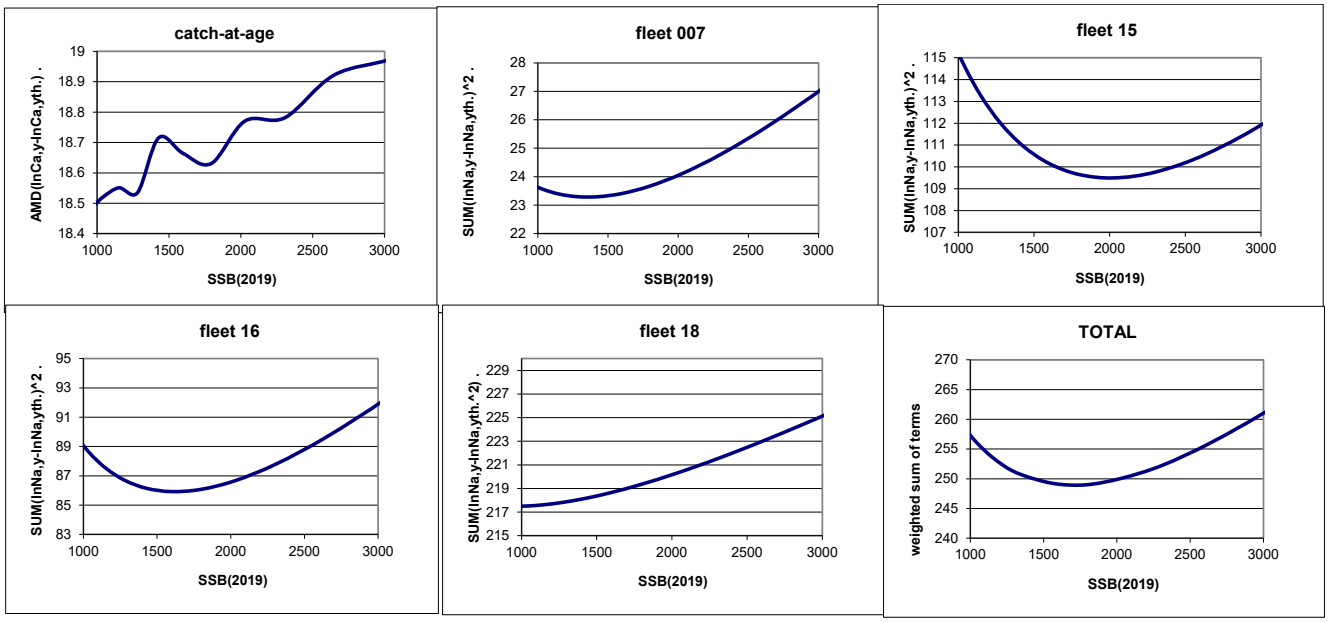

Figure 3.8b. Profiles of the components of the TISVPA objective function.

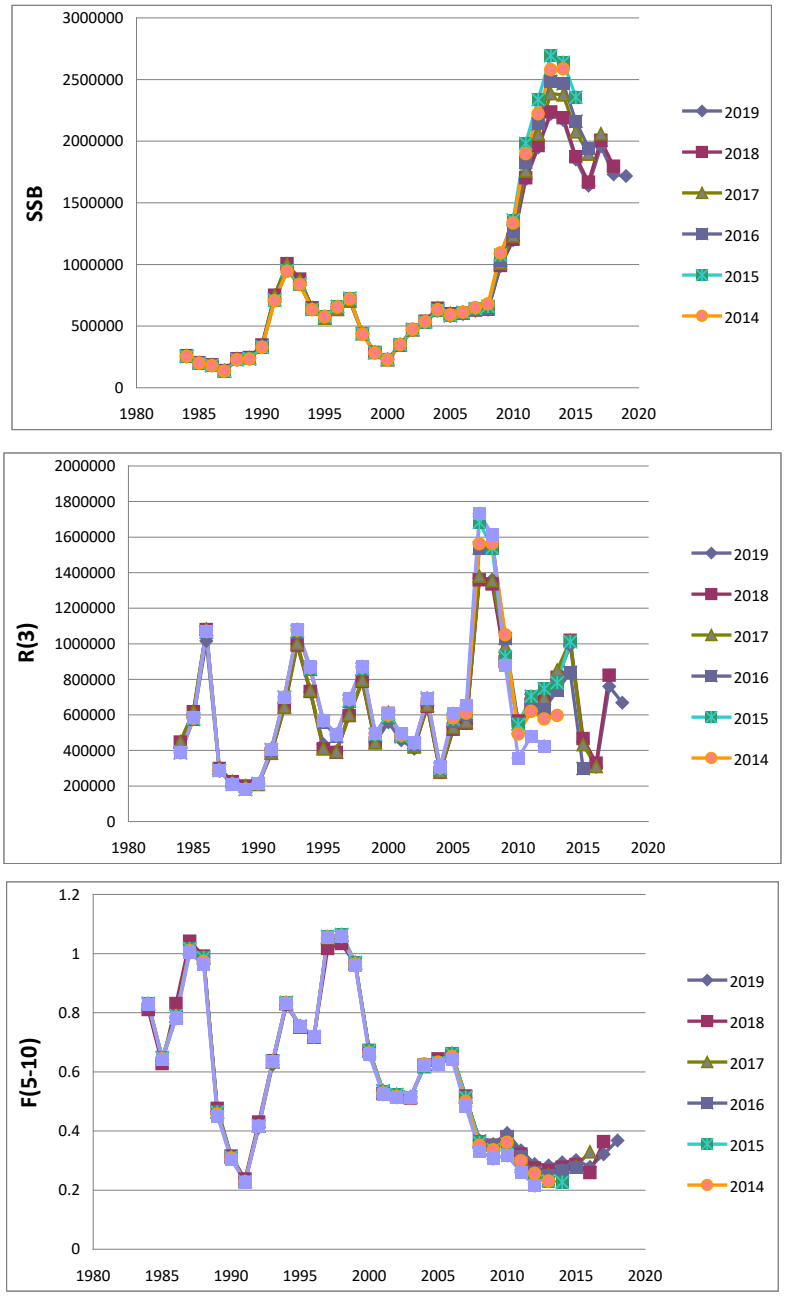

Figure 3.8c. TISVPA retrospective runs.

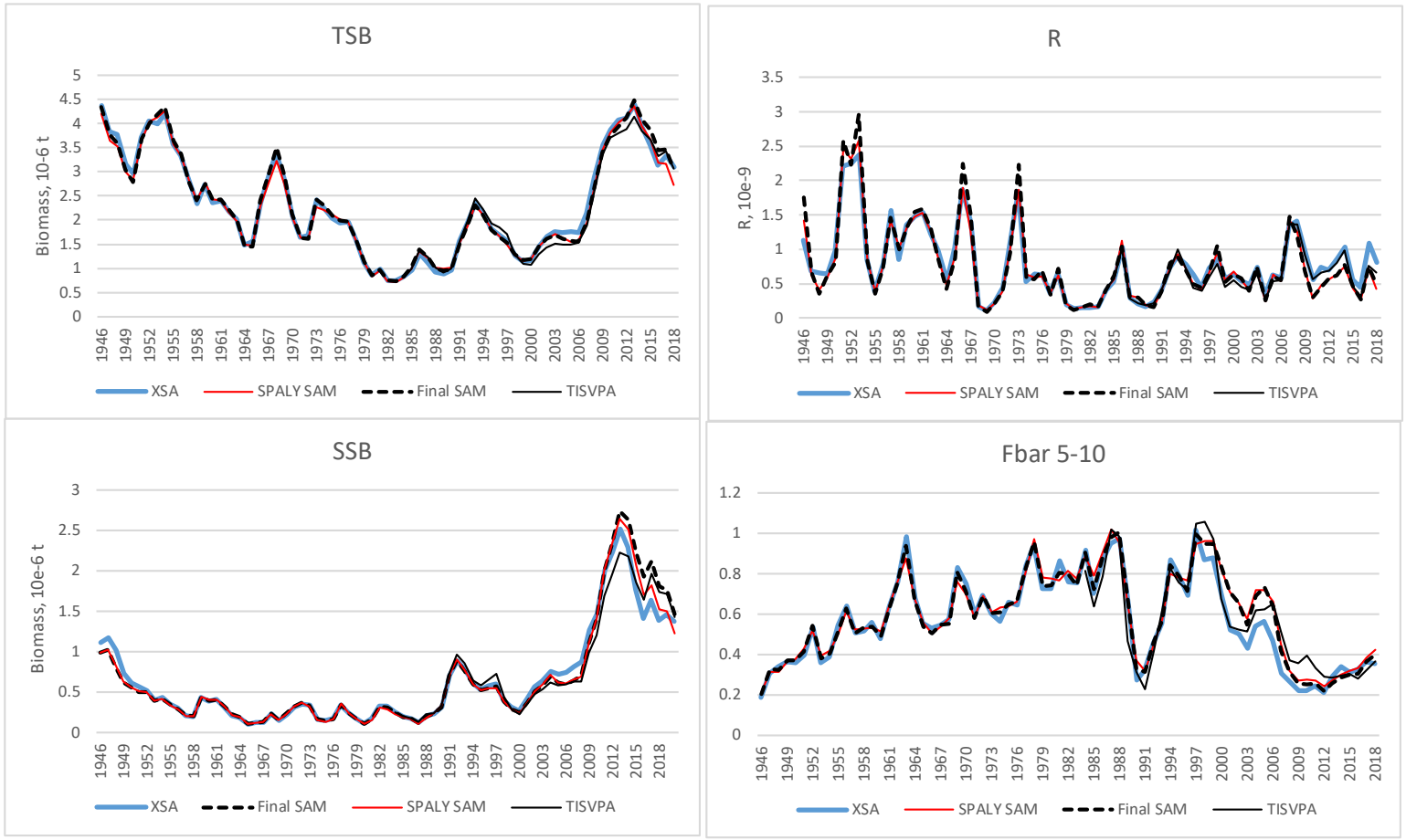

Figure 3.9a. Model comparison. F, SSB, TSB and recruitment in SAM, XSA and TISVPA.

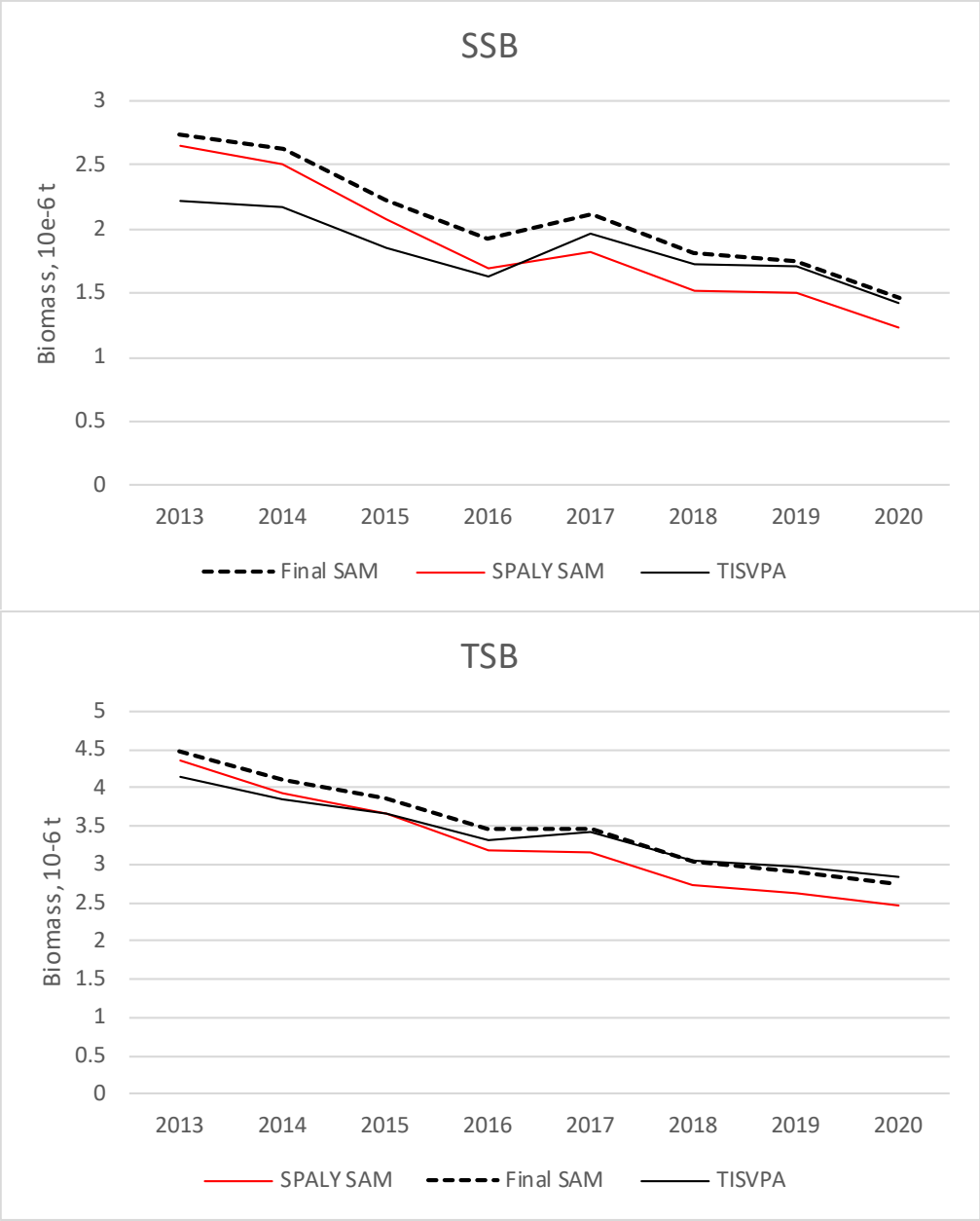

Figure 3.9b. NEA cod biomass dynamic assessed (2012–2018) and predicted (2019–2020) by SAM and TISVPA assuming F status quo in 2019.

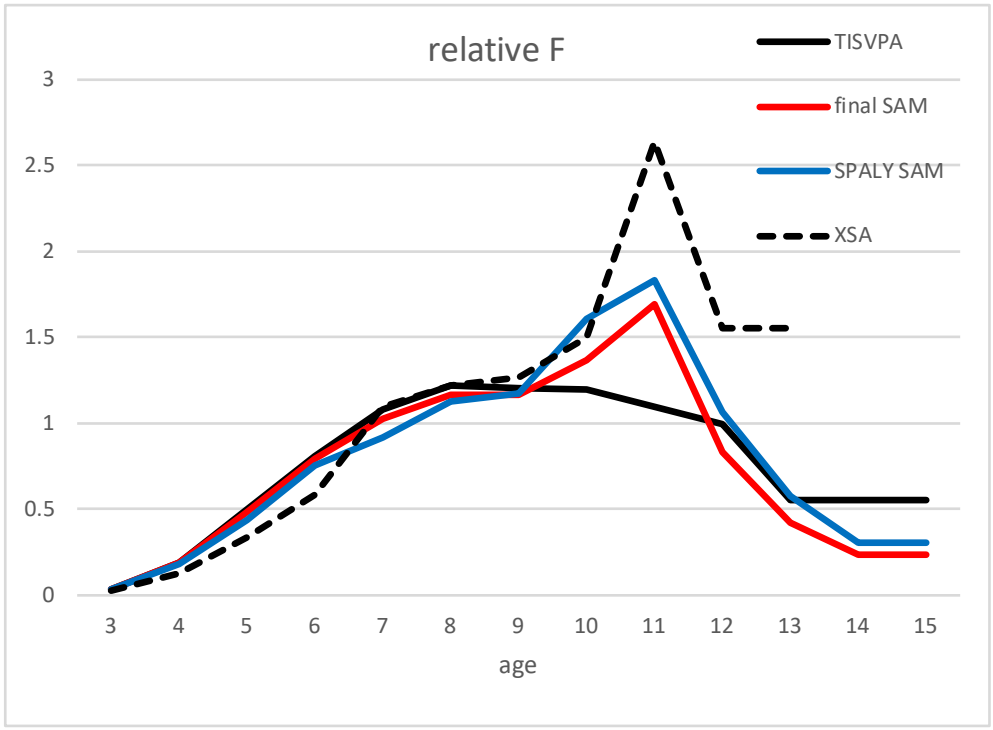

Figure 3.9c. NEA cod average fishing pattern for 2016–2018 from 4 models (SPALY SAM, Final SAM, XSA, and TISVPA).

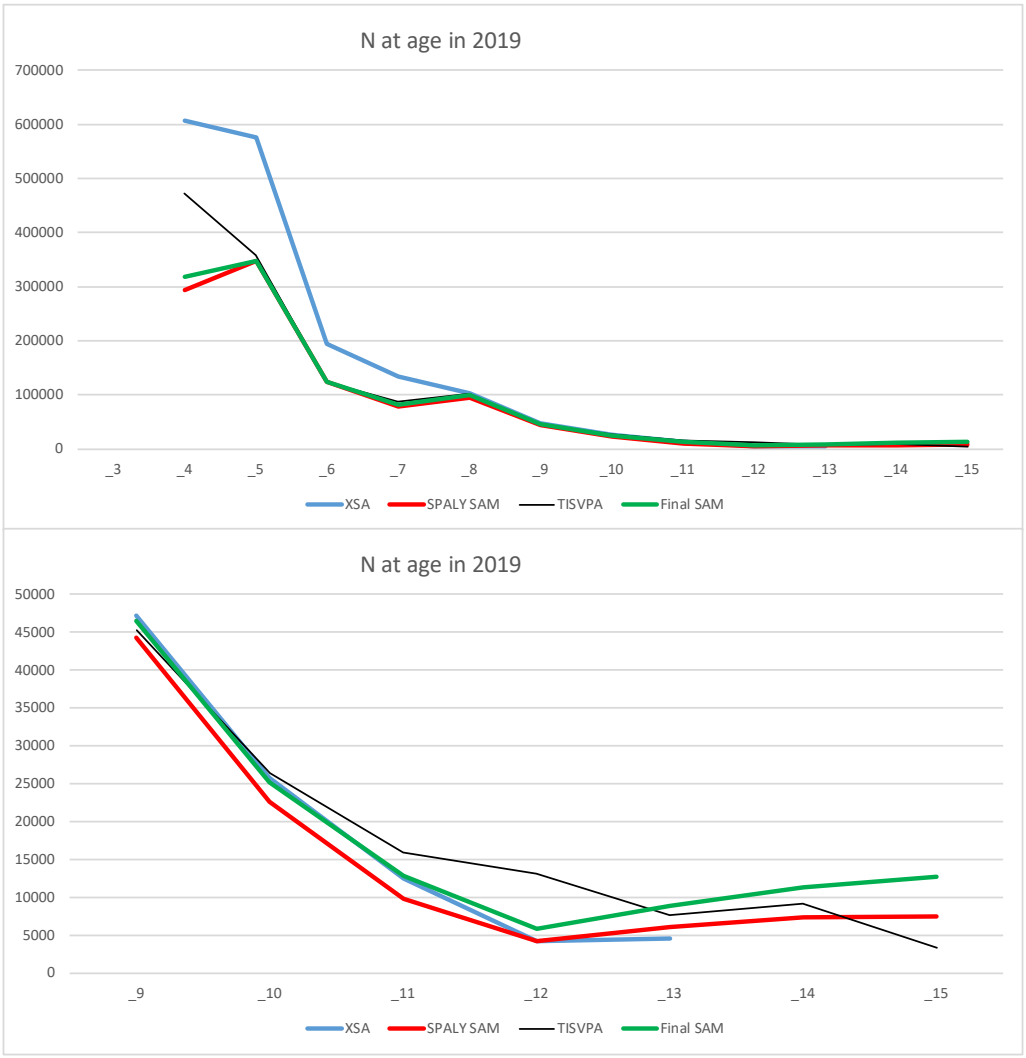

Figure 3.9d. NEA cod stock numbers (thousands) at the beginning of 2019 from 4 models (SPALY SAM, Final SAM, XSA, and TISVPA). Upper panel: Ages 3-15+, lower panel: Ages 9-15+.

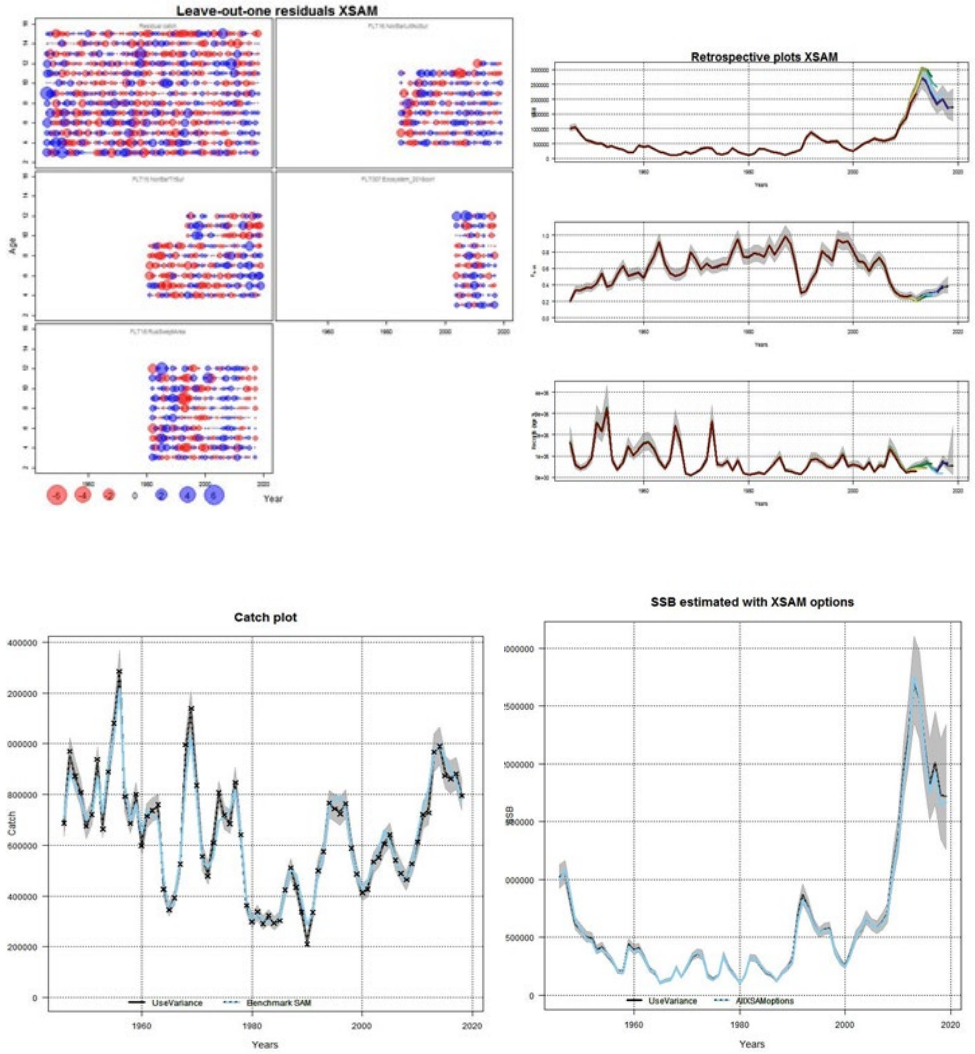

Figure 3.10: a) Leave-out-one residual plots, b) retrospective plots, c) catch plot and D) SSB plot using benchmark settings and variance structures for catch and FLT15. Note that the estimated catch is also provided for the benchmark (SPALY) setting in c), and the SSB estimates are also provided for a run with all XSAM options in d).

Table A1. Northeast 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			1.00		1.05	3.01[6]
2018[1]			1.06			1.40		1.31	3.20[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] 2011-2018 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. Northeast 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 from Mehl *et al.,* 2018a.

Year		Age																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	10+	Total
1981		8.00	82.00	40.00	63.00	106.00	103.00	16.00	3.00	1.00							1.00	423.0
1982		4.00	5.00	49.00	43.00	40.00	26.00	28.00	2.00	+							0.00	197.0
1983		60.49	2.78	5.34	14.27	17.37	11.13	5.58	2.98	0.45							0.06	120.5
1984		745.44	146.11	39.13	13.59	11.26	7.44	2.81	0.19	0.02							0.00	966.0
1985		69.06	446.29	153.04	141.59	19.66	7.58	3.32	0.22	0.09							0.04	840.9
1986		353.63	243.90	499.61	134.27	65.90	8.28	2.15	0.37	0.06							0.02	1308.2
1987		1.62	34.07	62.80	204.93	41.41	10.40	1.22	0.19	0.66							0.00	357.3
1988		1.98	26.25	50.42	35.53	56.20	6.48	1.35	0.15	0.01							0.00	178.4
1989		7.53	7.98	17.00	34.39	21.38	53.82	6.88	0.97	0.10							0.05	150.1
1990		81.13	24.92	14.82	20.63	26.08	24.30	39.78	2.37	0.06							0.03	234.1
1991		181.04	219.51	50.23	34.64	29.33	28.87	16.89	17.33	0.86							0.03	578.7
1992		241.38	562.13	176.48	65.79	18.84	13.23	7.58	4.50	2.78							0.21	1092.9
1993		1074.04	494.68	357.24	191.05	108.24	20.84	8.12	4.98	2.25							2.51	2264.0
1994		823.50	586.90	307.20	384.40	207.00	68.00	12.10	3.53	2.55	0.81	1.11	0.11	0.12	0.00	0.00	2.15	2397.4
1995		2106.60	217.90	143.00	138.00	198.30	67.00	16.10	2.46	0.90	0.32	0.53	0.16	0.00	0.00	0.00	1.01	2891.2
1996		1748.90	261.10	110.00	89.50	115.00	83.30	23.00	2.20	0.27	0.08	0.05	0.05	0.06	0.01	0.00	0.25	2433.4
1997	[1]	2832.90	842.90	209.20	49.20	51.50	43.10	24.90	5.73	1.00	0.23	0.22	0.00	0.00	0.03	0.00	0.48	4060.9
1998	[1]	2633.10	555.80	444.50	210.80	46.60	44.40	28.60	16.90	1.85	0.46	0.16	0.00	0.02	0.00	0.07	0.71	3983.2
1999		351.10	227.00	151.60	133.30	51.80	12.00	7.02	3.98	1.54	0.32	0.02	0.01	0.01	0.00	0.00	0.36	939.6
2000		142.40	248.10	301.10	168.80	147.10	49.00	12.10	4.48	2.85	0.80	0.18	0.12	0.03	0.00	0.00	1.13	1077.0
2001		348.30	50.80	179.00	162.30	81.10	44.00	11.30	1.73	0.47	0.18	0.10	0.00	0.00	0.00	0.01	0.29	879.4
2002		18.40	208.80	62.40	105.50	98.00	53.40	20.20	2.96	0.30	0.53	0.12	0.00	0.00	0.00	0.02	0.67	570.6
2003		1399.70	52.00	307.00	120.60	121.80	118.70	39.10	9.32	1.84	0.33	0.07	0.00	0.07	0.05	0.00	0.52	2170.5
2004		147.10	111.20	33.30	85.20	33.50	28.50	18.00	5.35	1.15	0.36	0.06	0.01	+	0.00	0.00	0.43	463.8
2005		438.20	123.20	129.80	34.90	69.10	21.20	15.00	4.95	0.95	0.27	0.04	0.06	0.05	0.03	0.00	0.45	837.7
2006	[2]	369.50	158.30	64.40	54.50	18.60	29.70	9.57	4.83	1.22	0.19	0.11	0.22	0.00	0.00	0.00	0.52	711.2
2007	[1]	88.90	53.70	63.90	35.70	32.70	9.68	18.80	6.57	2.74	0.51	0.24	0.09	0.04	0.00	0.00	0.88	313.6
2008		48.50	91.90	196.10	292.00	116.00	73.70	21.10	14.10	2.62	0.72	0.05	0.02	0.01	0.00	0.00	0.80	856.8
2009		195.50	23.20	104.60	191.60	139.70	40.90	14.10	4.70	4.38	0.48	0.13	0.02	0.01	0.00	0.00	0.64	719.4
2010		696.10	41.80	21.80	86.90	161.80	153.80	46.20	14.40	3.87	2.86	0.91	0.11	0.14	0.09	0.01	4.12	1230.9
2011		248.50	88.70	39.10	28.70	65.40	106.60	102.40	19.40	6.71	1.49	1.07	0.28	0.13	0.10	0.02	3.09	708.5
2012	[2]	508.10	45.30	87.80	47.60	35.10	70.90	135.80	60.30	8.19	5.19	1.26	0.66	0.45	0.01	0.10	7.67	1006.7
2013		293.30	82.40	59.10	85.40	70.60	50.20	100.00	129.90	57.00	5.37	3.98	1.63	0.70	0.21	0.05	11.94	939.8
2014		582.20	154.20	234.00	115.90	96.00	68.40	37.70	84.70	55.30	24.10	2.46	1.51	0.17	0.04	0.16	28.44	1456.8
2015		1183.00	107.60	110.20	188.00	119.50	130.20	84.90	33.80	51.70	23.00	6.27	0.57	0.14	0.04	0.01	30.03	2038.9
2016		106.20	111.50	35.20	61.60	101.20	64.50	49.20	23.10	11.90	16.30	7.37	2.25	0.69	0.25	0.09	26.95	591.4
2017	[2]	381.50	42.80	80.60	33.00	37.60	58.00	33.00	22.30	10.30	3.81	3.00	3.15	0.59	0.20	0.10	10.85	710.0
2018		1492.00	221.20	93.30	134.00	46.70	51.90	56.10	35.10	10.00	6.65	1.38	2.14	1.55	0.14	0.25	12.11	2152.4
2019		1000.30	287.40	182.10	97.70	124.30	53.40	33.70	31.60	8.70	2.83	0.38	0.33	0.20	0.23	0.16	4.13	1823.3

[1] Survey covered a larger area

[2] Adjusted indices

Table A3. Northeast 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 from Mehl *et al*. 2017b.

				Age														
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	10+	Total
1981		4.60	34.30	16.40	23.30	40.00	38.40	4.80	1.00	0.30							0.00	163.1
1982		0.80	2.90	28.30	27.70	23.60	15.50	16.00	1.40	0.20							0.00	116.4
1983		152.90	13.40	24.95	52.34	43.33	16.96	5.82	3.21	0.97							0.05	313.9
1984		2755.04	379.11	97.49	28.28	21.44	11.74	4.07	0.40	0.08							0.08	3297.7
1985		49.49	660.04	166.79	125.98	19.92	7.67	3.34	0.21	0.07							0.05	1033.6
1986		665.79	399.61	805.00	143.93	64.14	8.30	1.91	0.34	0.04							0.03	2089.1
1987		30.72	444.98	240.38	391.15	54.35	15.70	2.00	0.45	0.03							0.00	1179.8
1988		3.21	72.83	148.03	80.49	173.31	20.48	3.58	0.53	0.03							0.00	502.5
1989		8.24	15.62	46.36	75.86	37.79	90.19	9.82	0.94	0.10							0.07	285.0
1990		207.17	56.72	28.35	34.87	34.59	20.56	27.23	1.61	0.38							0.03	411.5
1991		460.45	220.14	45.85	33.67	25.65	21.49	12.15	12.67	0.61							0.02	832.7
1992		126.56	570.92	158.26	57.71	17.82	12.83	7.67	4.29	2.72							0.22	959.0
1993		534.48	420.40	273.89	140.13	72.48	15.83	6.24	3.89	2.23							2.36	1471.9
1994		1044.50	545.50	296.80	307.60	152.60	46.80	8.13	2.59	1.32	0.55	0.52	0.11	0.05	0.00	0.00	1.23	2407.0
1995		5343.80	540.20	280.40	242.10	252.30	77.10	17.90	2.33	1.13	0.55	0.59	0.19	0.00	0.00	0.00	1.33	6758.7
1996		5908.30	778.60	164.00	116.70	140.70	111.20	24.80	2.79	0.37	0.16	0.08	0.08	0.05	0.02	0.00	0.39	7247.9
1997	[1]	5122.80	1413.70	315.40	69.20	75.00	60.70	26.80	4.95	0.63	0.68	0.46	0.00	0.00	0.00	0.00	1.14	7090.2
1998	[1]	2512.10	492.50	355.20	167.40	31.70	26.40	17.50	8.26	0.79	0.52	0.65	0.00	0.35	0.00	0.04	1.56	3613.4
1999		479.70	353.60	189.60	181.90	61.30	12.80	6.83	5.19	0.98	0.27	0.02	0.03	0.02	0.00	0.00	0.34	1292.2
2000		128.20	242.80	247.50	130.00	112.00	27.00	4.73	1.82	1.23	0.36	0.10	0.03	0.02	0.00	0.00	0.51	895.8
2001		715.80	77.60	182.00	194.50	81.60	38.00	9.58	1.19	0.45	0.19	0.04	0.00	0.00	0.00	0.01	0.24	1300.9
2002		34.20	416.20	118.00	137.70	108.60	46.50	14.50	2.19	0.34	0.19	0.05	0.00	0.00	0.00	0.02	0.26	878.5
2003		3021.40	61.20	380.80	125.40	95.20	66.60	17.90	4.72	1.02	0.16	0.04	0.00	0.02	0.02	0.00	0.24	3774.3
2004		321.30	236.30	65.50	186.10	53.60	43.20	30.90	6.92	1.66	0.29	0.08	0.01	0.01	0.00	0.00	0.39	945.8
2005		846.80	216.40	244.80	54.80	102.70	22.40	16.40	3.80	0.88	0.30	0.04	0.02	0.03	0.04	0.00	0.43	1509.5
2006	[2]	676.90	283.80	115.60	114.00	28.10	43.30	14.00	5.19	1.34	0.22	0.21	0.08	0.00	0.00	0.00	0.51	1282.6
2007	[1]	584.20	369.90	365.80	127.30	68.90	13.70	23.60	6.85	2.20	0.40	0.31	0.08	0.00	0.00	0.00	0.79	1563.2
2008		69.00	103.30	192.50	300.00	115.60	40.80	18.00	8.29	1.86	0.35	0.02	0.02	0.01	0.00	0.00	0.40	850.0
2009		389.40	35.50	124.30	196.10	218.00	58.20	17.50	8.44	5.27	0.50	0.18	0.03	0.03	0.00	0.00	0.74	1053.4
2010		1031.50	96.50	37.00	114.90	155.50	144.50	39.80	11.20	3.70	1.64	0.57	0.05	0.02	0.03	0.02	2.33	1637.0
2011		615.30	225.60	85.40	50.70	129.90	138.00	103.10	16.70	4.34	1.17	0.79	0.20	0.17	0.04	0.02	2.39	1371.4
2012	[3]	728.40	124.80	83.10	70.30	36.40	93.90	136.30	49.60	9.38	2.33	0.87	0.60	0.47	0.02	0.05	4.34	1336.6
2013		439.10	147.20	70.30	119.80	64.00	41.00	65.00	76.20	33.60	2.21	2.83	0.41	0.35	0.06	0.03	5.89	1062.0
2014		499.80	148.80	180.60	85.10	67.90	47.80	32.60	46.90	31.70	9.36	1.01	0.97	0.15	0.04	0.07	11.60	1153.0
2015		1295.00	196.80	125.40	170.20	135.70	99.80	71.20	27.40	52.80	17.00	2.86	0.72	0.10	0.07	0.04	20.79	2194.8
2016		212.30	232.90	53.40	112.30	151.30	109.00	66.10	26.60	12.80	15.00	6.43	0.96	0.50	0.17	0.14	23.20	1000.0
2017	[3]	471.50	71.00	116.10	39.70	48.70	56.60	27.80	18.90	7.63	3.01	2.22	3.49	0.53	0.17	0.06	9.48	867.5
2018		1686.20	394.80	107.60	148.70	46.10	55.70	53.40	23.90	7.48	5.41	1.13	2.24	1.19	0.13	0.39	10.49	2529.3
2019		1291.70	446.00	253.70	132.00	188.60	66.40	27.00	28.80	7.60	1.72	0.34	0.17	0.14	0.13	0.10	2.60	2444.3

1Indices 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

3Indices raised to also represent uncovered parts of the Russian EEZ.

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	13	14+	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	1.22	32.60	26.50	23.68	7.56	6.32	0.81				1.54	100.22
2011	2.02	51.01	178.92	48.47	18.10	4.58	6.98				0.44	310.50
2012	0.37	13.43	98.37	77.69	20.53	7.37	3.18				1.80	222.74
2013	0.22	5.84	33.44	101.10	105.50	15.91	7.01				6.38	275.40
2014	0.25	2.83	15.42	58.13	111.90	75.33	12.25				8.84	284.95
2015	0.96	1.58	16.09	15.66	42.91	44.45	26.80				11.01	159.46
2016	0.15	1.21	7.50	12.00	19.09	32.63	22.84	15.85	7.97	1.89	25.70	121.11
2017	0.18	8.94	12.86	24.07	14.76	12.58	11.58	12.01	3.72	3.51	19.24	104.20
2018	0.62	3.48	11.45	11.21	8.48	7.78	4.44	3.73	2.82	3.06	9.61	57.25
2019	0.54	2.88	14.33	36.09	17.67	18.41	6.10	2.54	2.44	5.03	10.01	106.02

Table A5. COD. Length (cm)-at-age in the Barents Sea from the investigations winter survey in February.

	Age													
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	55.1	65.5	73.8	78.5	87.5	97.9	97.7	100.8	122.1	-
1995	12.2	18.0	28.8	42.1	54.0	63.7	75.7	80.2	83.9	99.1	+	109.0	-	-
1996	12.1	18.9	28.7	40.6	49.3	60.9	71.7	84.8	92.2	92.2	99.5	104.6	108.7	121.0
1997	10.9	15.9	26.8	39.9	49.5	59.2	69.9	81.6	91.8	+	+	-	-	-
1998	9.8	18.0	29.3	40.0	50.9	58.9	67.7	76.7	87.4	+	+	-	+	-
1999	12.0	18.3	29.0	39.9	50.4	59.4	70.4	78.5	88.7	88.4	+	+	+	-
2000	12.9	20.7	28.4	39.7	51.5	61.4	70.5	76.2	84.8	81.8	99.7	+	+	-
2001	11.6	22.6	33.0	41.1	52.2	63.3	70.2	77.7	86.0	96.2	103.8	-	-	-
2002	12.0	19.5	28.6	43.6	52.1	62.0	71.3	79.5	91.0	89.3	102.3	-	-	-
2003	11.4	18.0	28.9	39.4	53.4	61.7	70.6	80.8	89.1	90.6	104.5	-	105.8	111.6
2004	10.6	18.4	31.7	40.6	51.7	61.6	68.6	79.7	90.9	88.5	91.7	+	+	-
2005	11.2	18.3	29.5	43.5	51.1	60.3	71.0	79.6	88.9	96.2	109.4	+	+	+
2006	12.0	19.5	30.9	42.1	53.6	60.2	66.4	76.5	84.5	98.8	93.2	96.3	-	-
2007	13.1	21.0	29.4	40.2	53.1	62.9	68.7	76.6	87.6	94.9	102.4	+	-	-
2008	12.1	22.4	33.1	43.2	51.7	64.1	69.0	81.3	88.4	94.6	108.9	+	+	-
2009	11.2	21.2	32.1	42.6	53.1	61.7	76.5	81.8	89.3	97.9	99.9	+	+	-
2010	11.2	18.2	31.5	42.7	52.4	60.7	70.6	80.4	88.5	96.2	102.7	+	+	+
2011	11.9	19.4	29.5	41.9	51.0	60.7	68.1	78.3	85.9	95.2	101.3	111.1	111.7	119.0
2012	10.6	18.4	29.7	41.0	52.4	58.0	66.5	75.7	86.0	91.4	106.2	113.4	119.7	+
2013	11.2	19.2	31.0	41.0	51.6	62.1	69.7	76.5	81.1	95.2	92.2	110.7	110.7	+
2014	9.8	17.3	29.1	40.1	51.8	59.5	70.3	77.0	81.9	87.1	96.7	98.1	110.5	+
2015	10.5	16.2	30.0	39.9	51.2	60.5	69.0	77.6	80.1	88.9	95.4	101.4	+	+
2016	12.2	18.5	29.9	40.6	50.0	60.6	68.3	76.7	85.6	86.0	90.0	92.6	111.8	122.2
2017	12.4	21.8	31.4	42.3	51.9	60.8	69.7	79.5	85.9	90.6	96.3	91.9	106.9	108.7
2018	11.2	18.6	31.9	42.2	51.1	61.5	68.9	77.6	83.7	87.9	97	98.8	100.1	105.8
2019	11.8	17.2	31.1	41.6	50.8	59.6	69.6	77	83.6	89.6	100.1	102.1	107.3	104.5
In 1997, 1998 and 2012 lengths were adjusted for missing coverage of Russian EEZ.														

Table A6. COD. Weight (g) at-age in the Barents Sea from the investigations winter survey in February.

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	12	55	260	796	1463	2372	3477	4624	6782	8420	8530	13516	20786	-
1995	15	53	239	656	1341	2194	3628	4577	5315	8907	+	12176	-	-
1996	15	62	232	632	1079	1979	3327	5479	7655	8192	9760	13013	13614	14650
1997	13	46	181	592	1097	1785	2917	4928	7290	+	+	-	-	-
1998	8	50	256	608	1184	1749	2601	4040	6383	+	+	-	+	-
1999	14	58	231	588	1178	1827	2994	4123	6343	7326	+	+	+	-
2000	16	74	210	558	1210	1961	3042	3842	5384	5727	9960	+	+	-
2001	14	106	336	642	1288	2233	3090	4332	5727	8571	11022	-	-	-
2002	14	67	233	747	1225	2065	3189	4577	7472	6431	11645	-	-	-
2003	13	59	229	586	1313	2013	2982	4725	6511	7552	12467	-	12885	16112
2004	10	59	276	607	1142	1946	2618	4139	6684	6988	7957	+	+	-
2005	13	61	245	724	1145	1857	2953	4224	6418	8607	12488	+	+	+
2006	13	69	280	663	1413	1965	2599	4244	5783	10131	8620	10735	-	-
2007	17	71	226	638	1370	2270	2918	4254	6556	8727	11130	+	-	-
2008	15	90	336	799	1410	2449	3144	5218	6793	9494	12918	+	+	-
2009	13	84	294	704	1293	2030	4061	5082	6884	9504	9614	+	+	-
2010	11	64	307	702	1297	2031	3165	4736	6501	9016	10417	+	+	+
2011	15	65	247	667	1129	1940	2725	4003	5914	8233	9888	13213	13814	+
2012	13	62	251	609	1278	1673	2480	3772	5923	7783	12298	14876	17868	+
2013	11	65	264	591	1201	2064	2804	3839	4814	8433	8759	15101	14729	+
2014	8	49	238	592	1234	1776	2849	3942	4946	6181	8368	9212	12578	+
2015	10	47	242	574	1250	1971	2760	4077	4621	6901	8096	11366	+	+
2016	13	54	239	602	1063	1952	2701	3855	5553	6034	6963	8061	15330	21950
2017	16	92	297	737	1253	2016	3091	4645	6088	7403	9186	8412	12416	14916
2018	12	66	305	687	1237	2074	2867	4180	5536	6793	9222	10497	11164	12268
2019	12	46	272	652	1157	1883	2916	3994	5303	6926	10034	11535	13243	11926
1987: Estimated weights														
1997, 1998 and 2012: Adjusted weights due to missing coverage of Russian EEZ.														

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	60.6	64.2	75.0	82.8	93.9	93.7	102.8				108.1
2011	56.8	64.5	70.0	79.9	91.1	96.7	101.1				104.8
2012	59.6	65.4	69.9	77.0	85.4	99.0	105.2				106.0
2013	63.6	68.8	73.1	78.2	83.5	90.9	99.1				96.6
2014	57.2	65.8	74.3	77.9	82.8	86.8	93.3				99.0
2015	60.4	67.8	73.0	78.3	83.0	88.3	94.7				99.2
2016	58.2	63.0	74.4	80.1	89.1	92.9	95.7				97.1
2017	57.6	64.9	70.7	80.9	87.3	94.7	98.6	99.3	102.6	106.6	
2018	67.9	66.8	72.8	79.5	89.4	93.6	99.3	104.9	104.3	109.2	
2019	58.8	68.6	74.7	81.4	87.9	93.9	98.1	106.2	111.1	109.6	

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	1.91	2.28	3.60	4.70	7.03	7.11	9.09				12.50
2011	1.61	2.29	2.89	4.51	6.79	8.30	9.46				10.54
2012	2.34	2.46	2.93	3.93	5.39	8.91	11.68				12.56
2013	2.49	3.04	3.51	4.43	5.54	7.56	10.25				11.69
2014	2.00	2.45	3.76	4.05	5.06	5.97	7.34				10.37
2015	2.14	2.66	3.44	3.91	5.06	6.27	7.89				11.32
2016	2.55	2.23	3.65	4.80	6.67	7.74	8.68	8.83	12.63	18.02	10.68
2017	1.96	2.48	2.94	4.80	5.74	7.12	8.16	9.12	10.43	12.31	
2018	3.25	2.72	3.41	4.53	6.51	7.94	9.69	12.06	12.05	13.14	
2019	1.90	2.89	3.72	4.82	6.07	7.43	8.68	11.07	13.87	13.42	

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										Total
		1	2	3	4	5	6	7	8	9	10+	1941
1985	[1]	77	569	400	568	244	51	20	8	1	3	1998
1986	[1]	25	129	899	612	238	69	20	3	2	1	1323
1987	[2]	2	58	103	855	198	82	19	4	1	1	602
1988	[2]	3	23	96	100	305	54	16	3	1	1	332
1989	[1]	1	3	17	45	57	91	75	25	13	5	377
1990	[1]	36	27	8	27	62	74	91	39	10	3	494
1991	[1]	63	65	96	45	50	54	66	49	5	1	1222
1992	[1]	133	399	380	121	56	58	33	29	11	2	783
1993	[1]	20	44	220	234	164	51	19	13	8	10	1335
1994	[1]	105	38	147	275	303	314	100	35	10	8	971
1995	[1]	242	42	111	219	229	97	21	6	2	2	2127
1996	[1,3,5]	424	275	189	316	449	314	126	27	3	4	900
1997	[4,5]	72	160	263	198	112	57	27	9	1	1	672
1998	[1]	26	86	279	186	57	23	10	4	1	0	658
1999	[1]	19	79	166	260	98	20	8	5	2	1	642
2000	[1, rev]	24	82	191	159	127	48	6	3	1	1	656
2001	[1]	38	59	148	204	120	70	14	2	1		672
2002	[1,5,6]	83	2	106	85	140	151	67	30	7	1	908
2003		69	36	25	218	142	167	163	60	23	4	1669
2004		375	35	170	85	345	194	229	167	49	19	803
2005		112	48	65	154	70	214	68	47	17	8	341
2006	[7]	12	20	39	49	78	32	64	23	13	8	1221
2007		13	35	165	372	208	189	74	113	32	20	

[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.

Year				Age												
		0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Sum
				Total (Sub-area I and Division IIa and IIb)												
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	
*	corrected															

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	14.6	20.6	30.6	40.2	51.5	59.3	67.1	76.2	84.9	92.6	97.9	104	110.1
2018	-	-	-	-	-	-	-	-	-	-	-	-	-

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	-	-	-	-	-	-	-	-	-	-	-	-	-

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	858.3	577.2	349.8	404.5	217.5	89.5	22.5	11.9	9.4	3.9	18.0	na	na	2.7
1995	2619.2	292.9	166.2	159.8	216.6	104.0	29.0	4.4	4.3	3.0	2.6	na	na	8.1
1996	2396.0	339.8	92.9	70.5	87.2	89.1	44.6	6.5	1.1	0.4	0.9	na	na	1.4
1997	1623.5	430.5	188.3	51.7	49.7	42.2	49.9	20.5	2.2	0.5	0.0	na	na	0.8
1998	3401.3	632.9	427.7	182.6	42.4	33.8	34.0	24.7	4.9	0.7	0.2	na	na	0.1
1999	358.3	304.3	150.0	96.4	45.4	12.2	11.2	18.7	9.2	1.0	0.2	na	na	0.2
2000	154.1	221.4	245.2	158.9	145.7	49.3	12.9	6.9	5.2	1.2	0.6	na	na	0.2
2001	629.9	63.9	138.2	171.6	81.6	57.3	19.8	2.4	0.8	0.6	0.3	na	na	0.1
2002	18.2	215.5	69.3	112.2	104.3	66.1	34.5	9.5	1.2	0.5	0.6	na	na	0.0
2003	1693.9	61.5	303.4	114.4	131.5	144.5	64.3	21.2	3.8	0.5	0.1	na	na	0.1
2004	157.7	105.2	33.6	92.8	32.7	45.1	46.8	22.2	8.8	2.2	0.2	na	na	0.7
2005	465.3	119.6	123.9	33.7	66.1	29.9	43.2	17.2	7.5	1.8	0.1	na	na	0.2
2006	544.6	216.6	79.8	59.1	15.7	38.1	16.9	15.5	8.8	2.4	0.3	na	na	0.8
2007	125.0	61.7	80.3	37.1	31.8	13.0	42.7	13.8	7.5	3.3	0.8	na	na	0.4
2008	68.8	97.6	210.2	306.1	141.0	75.4	24.6	32.9	5.8	2.8	1.7	na	na	0.8
2009	321.5	30.6	182.6	178.3	140.5	49.5	40.1	13.3	26.0	3.7	1.7	na	na	0.4
2010	485.4	59.4	34.7	121.9	175.9	194.9	70.9	37.5	11.1	8.8	1.7	na	na	1.7
2011	389.3	124.8	47.1	29.1	82.4	158.7	284.3	65.6	22.6	6.1	7.8	0.5	0.6	1.0
2012	950.6	72.7	133.9	52.7	38.1	82.8	224.4	154.7	30.9	10.8	4.8	2.0	0.8	2.7
2013	470.6	110.8	64.1	85.0	71.0	57.5	119.4	224.9	175.6	20.9	12.6	4.9	3.3	8.2
2014	630.1	139.1	220.0	117.8	91.8	67.9	52.9	135.4	175.1	97.7	14.2	6.6	4.0	10.6
2015	1141.0	127.0	94.9	154.2	119.3	99.6	96.5	36.2	111.2	66.3	30.0	6.8	5.2	12.0
2016	142.9	120.7	41.0	58.3	96.9	64.6	58.7	33.9	34.1	48.1	29.2	17.0	11.3	28.1
2017	396.6	48.5	91.2	40.4	48.6	76.6	49.8	50.3	28.5	18.0	14.7	17.2	8.5	25.6
2018	1492.4	221.3	90.0	136.1	47.3	54.6	67.8	46.2	18.6	14.3	5.9	5.9	7.8	13.7
2019	1000.3	287.4	182.1	97.7	124.8	56.3	48.0	67.7	26.4	21.2	6.5	2.9	8.1	10.9

Table A14. Swept area estimates (millions) of Northeast Arctic Cod from the Joint Norwegian- Russian ecosystem survey in August-September (2018 data are taken from WD 01 AFWG 2019).

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***
* not complete coverage, index adjusted but not used in assessment														

3.13 Report tables related to SPALY SAM run which are different from the same tables related to the final run

Table S_3.15. Northeast Arctic cod. Fishing mortality from the SPALY SAM run
SAM
Fri Apr 26 22:22:51 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1946	0.0018	0.0183	0.0683	0.1389	0.2435	0.2152	0.2996	0.3105	0.4384	0.404	0.4062	0.4395	0.4395	0.2127
1947	0.0017	0.0196	0.0858	0.1955	0.3607	0.3203	0.4483	0.4784	0.7205	0.6802	0.703	0.7869	0.7869	0.3148
1948	0.0012	0.0162	0.077	0.1903	0.3623	0.3282	0.449	0.4746	0.7158	0.7209	0.7813	0.9514	0.9514	0.3136
1949	0.0022	0.0283	0.1223	0.2681	0.4379	0.3728	0.4742	0.5059	0.7553	0.7592	0.8182	1.0384	1.0384	0.3635
1950	0.0033	0.0387	0.1442	0.2794	0.4151	0.368	0.4852	0.5598	0.852	0.8948	0.9341	1.2322	1.2322	0.3753
1951	0.0086	0.0861	0.248	0.3802	0.4715	0.3995	0.4966	0.5621	0.7877	0.8412	0.8904	1.1959	1.1959	0.4263
1952	0.0137	0.1231	0.3249	0.4743	0.5382	0.4695	0.5922	0.7188	0.9987	1.0628	1.0761	1.4071	1.4071	0.5196
1953	0.0148	0.1144	0.2699	0.3729	0.4003	0.3531	0.4375	0.5392	0.7136	0.7252	0.7139	0.8952	0.8952	0.3955
1954	0.015	0.1121	0.2701	0.3864	0.4128	0.3731	0.46	0.5961	0.772	0.7752	0.7434	0.8686	0.8686	0.4164
1955	0.0152	0.1115	0.2923	0.4639	0.5099	0.4854	0.5598	0.6998	0.8899	0.8711	0.7902	0.8493	0.8493	0.5019
1956	0.0195	0.1391	0.3622	0.5822	0.6344	0.6122	0.6674	0.8213	1.0394	1.0976	0.9584	0.9204	0.9204	0.6133
1957	0.0198	0.1307	0.3104	0.4842	0.531	0.5335	0.5744	0.7161	0.9022	0.932	0.8256	0.748	0.748	0.5249
1958	0.0293	0.1843	0.3913	0.5338	0.5299	0.5107	0.5386	0.6579	0.767	0.7403	0.594	0.523	0.523	0.527
1959	0.0325	0.2019	0.4205	0.5346	0.517	0.5077	0.544	0.6656	0.7403	0.7012	0.5973	0.5475	0.5475	0.5316
1960	0.0322	0.1974	0.4048	0.4958	0.4731	0.4875	0.5341	0.6797	0.7881	0.7407	0.6609	0.6446	0.6446	0.5125
1961	0.0367	0.2345	0.5089	0.6189	0.581	0.6181	0.7024	0.8501	0.9583	0.9081	0.8279	0.7798	0.7798	0.6466
1962	0.0383	0.257	0.6099	0.7663	0.6995	0.716	0.8103	0.946	0.967	0.8459	0.7877	0.713	0.713	0.758
1963	0.0317	0.2241	0.5962	0.8261	0.8241	0.8758	0.9907	1.1287	1.1576	0.9364	0.8697	0.7497	0.7497	0.8736
1964	0.0223	0.1478	0.3833	0.541	0.5943	0.712	0.872	0.9495	1.0018	0.9027	0.9825	0.8432	0.8432	0.6753
1965	0.0224	0.1327	0.319	0.4278	0.4738	0.5882	0.7385	0.7831	0.7758	0.7099	0.9037	0.8208	0.8208	0.5551
1966	0.0245	0.1304	0.2825	0.369	0.4292	0.5532	0.6949	0.7061	0.6545	0.5713	0.6886	0.6082	0.6082	0.5058
1967	0.0259	0.1346	0.2766	0.3497	0.4282	0.5906	0.7771	0.7962	0.7503	0.6266	0.7225	0.574	0.574	0.5364
1968	0.0294	0.1592	0.3405	0.4212	0.4815	0.6317	0.8048	0.7917	0.7261	0.5928	0.7396	0.6076	0.6076	0.5786
1969	0.0346	0.1834	0.4158	0.5432	0.6514	0.8593	1.0692	1.0172	0.911	0.6876	0.7792	0.6177	0.6177	0.7594
1970	0.0361	0.1656	0.3635	0.4853	0.6016	0.8254	0.9944	0.9112	0.7765	0.5647	0.6494	0.5479	0.5479	0.6969

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1971	0.0323	0.1281	0.2607	0.3423	0.456	0.7041	0.9086	0.8405	0.7324	0.5316	0.5888	0.4917	0.4917	0.5854
1972	0.051	0.1754	0.3198	0.3888	0.477	0.7723	1.0954	1.092	1.0136	0.7469	0.8221	0.6479	0.6479	0.6909
1973	0.0881	0.2543	0.4038	0.4356	0.4615	0.6413	0.8565	0.846	0.8085	0.6142	0.6728	0.5273	0.5273	0.6074
1974	0.1194	0.3361	0.5163	0.5359	0.5204	0.6265	0.7597	0.8488	0.959	0.7917	0.9303	0.6743	0.6743	0.6346
1975	0.1061	0.3016	0.509	0.5816	0.5899	0.6774	0.7322	0.7192	0.8845	0.7678	0.8699	0.5931	0.5931	0.6349
1976	0.1186	0.3367	0.554	0.6338	0.6483	0.7373	0.7556	0.6232	0.6868	0.6394	0.7563	0.5981	0.5981	0.6587
1977	0.1245	0.3815	0.6549	0.7517	0.7707	0.8915	0.9741	0.7936	0.8296	0.7264	0.9353	0.834	0.834	0.8061
1978	0.0998	0.3204	0.6249	0.8125	0.8717	1.0508	1.2792	1.1891	1.4351	1.2951	1.5993	1.4401	1.4401	0.9714
1979	0.0558	0.1949	0.4135	0.6177	0.7095	0.8386	1.0588	1.0524	1.2829	1.2344	1.5177	1.7312	1.7312	0.7818
1980	0.0394	0.1482	0.3477	0.5972	0.7462	0.8668	1.0314	1.0696	1.2554	1.1784	1.3838	1.6737	1.6737	0.7765
1981	0.0319	0.1276	0.3111	0.5857	0.7952	0.9355	1.0249	0.938	1.0138	0.9042	0.8525	0.8792	0.8792	0.7651
1982	0.0374	0.1565	0.3681	0.7036	0.9442	1.0195	1.0064	0.8435	0.8264	0.8371	0.7369	0.8613	0.8613	0.8142
1983	0.03	0.1377	0.3318	0.6208	0.9258	1.0371	0.9599	0.7825	0.6975	0.6918	0.651	0.8846	0.8846	0.7763
1984	0.0293	0.1416	0.3646	0.6893	1.093	1.2075	1.0657	0.9002	0.7533	0.6895	0.5656	0.8571	0.8571	0.8867
1985	0.0347	0.162	0.4036	0.7122	0.9827	1.0738	0.8514	0.7111	0.6149	0.5345	0.4085	0.7354	0.7354	0.7891
1986	0.0379	0.1851	0.4854	0.8129	1.0089	1.157	0.9868	0.9738	0.9178	0.851	0.5307	1.0003	1.0003	0.9041
1987	0.0418	0.2003	0.5419	0.9147	1.1016	1.2125	1.1033	1.2479	1.3169	1.3332	0.7448	1.4668	1.4668	1.0203
1988	0.0328	0.151	0.3915	0.7124	0.9873	1.1101	1.1156	1.4079	1.4334	1.5402	0.7702	1.3866	1.3866	0.9541
1989	0.0238	0.1081	0.2634	0.4795	0.6715	0.8002	0.7625	0.9177	0.9198	0.9782	0.5436	1.3392	1.3392	0.6491
1990	0.0146	0.0671	0.1558	0.267	0.3638	0.4389	0.4523	0.5322	0.6052	0.738	0.4803	1.2329	1.2329	0.3683
1991	0.0154	0.0777	0.1797	0.2894	0.3547	0.3756	0.3572	0.3434	0.3368	0.3929	0.2677	0.8304	0.8304	0.3167
1992	0.0199	0.1108	0.2679	0.429	0.5079	0.5188	0.5043	0.4602	0.4467	0.5177	0.3752	1.1811	1.1811	0.448
1993	0.0161	0.1045	0.2926	0.504	0.6253	0.6603	0.7048	0.6747	0.7207	0.8468	0.7059	1.8166	1.8166	0.5769
1994	0.0155	0.1122	0.3482	0.6602	0.8804	0.9411	0.996	0.9584	1.0497	1.2531	1.2249	3.1384	3.1384	0.7974
1995	0.0155	0.1144	0.3484	0.6356	0.853	0.9213	0.9767	0.9554	1.0046	1.1444	1.292	3.3308	3.3308	0.7817
1996	0.0186	0.1359	0.3871	0.6426	0.7977	0.9134	0.9119	0.9449	0.9657	1.1112	1.1719	2.7926	2.7926	0.7663
1997	0.0238	0.186	0.5114	0.7736	0.9123	1.1233	1.1841	1.1756	1.138	1.1875	0.9513	1.3287	1.3287	0.9467
1998	0.0256	0.2085	0.5529	0.8023	0.8802	1.0887	1.1777	1.2593	1.1141	1.176	0.87	0.9246	0.9246	0.9602
1999	0.0184	0.1652	0.4968	0.757	0.8904	1.1005	1.2333	1.2817	1.0767	1.1582	0.8644	0.8082	0.8082	0.96

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
2000	0.0119	0.1113	0.3633	0.61	0.7876	0.976	1.0829	1.1193	0.8428	0.8829	0.5728	0.5902	0.5902	0.8232
2001	0.0099	0.0904	0.2942	0.5281	0.7206	0.8587	0.8948	0.9464	0.7066	0.7261	0.5143	0.74	0.74	0.7072
2002	0.0092	0.0842	0.2742	0.5035	0.7218	0.8338	0.8021	0.7952	0.5971	0.6196	0.4225	0.6872	0.6872	0.6551
2003	0.0098	0.0841	0.26	0.4532	0.6578	0.7354	0.6917	0.658	0.4699	0.4367	0.2724	0.4059	0.4059	0.576
2004	0.0109	0.0932	0.2869	0.5083	0.7918	0.9277	0.9087	0.8956	0.6495	0.5372	0.2844	0.3601	0.3601	0.7198
2005	0.0131	0.1089	0.3136	0.5126	0.7743	0.9232	0.9188	0.877	0.661	0.5526	0.275	0.3108	0.3108	0.7199
2006	0.0149	0.1136	0.2977	0.4594	0.6608	0.8082	0.8622	0.8657	0.7559	0.7321	0.4396	0.5291	0.5291	0.659
2007	0.0137	0.0964	0.2381	0.3384	0.4598	0.5334	0.5635	0.5818	0.5642	0.5779	0.3594	0.3836	0.3836	0.4525
2008	0.009	0.0608	0.1508	0.2303	0.3249	0.3819	0.4056	0.4195	0.4445	0.4572	0.2898	0.2623	0.2623	0.3188
2009	0.0073	0.0479	0.1167	0.1822	0.2687	0.3247	0.3593	0.3803	0.443	0.4861	0.3139	0.2306	0.2306	0.272
2010	0.0061	0.0395	0.0965	0.1571	0.2488	0.3346	0.3828	0.442	0.529	0.5249	0.376	0.2358	0.2358	0.277
2011	0.0053	0.0355	0.088	0.1431	0.2289	0.3268	0.3841	0.4389	0.47	0.3908	0.2695	0.1461	0.1461	0.2683
2012	0.0056	0.0362	0.089	0.1388	0.2056	0.2875	0.3422	0.3927	0.4064	0.3171	0.2185	0.121	0.121	0.2426
2013	0.0064	0.0409	0.102	0.1623	0.2291	0.3146	0.375	0.4413	0.4426	0.3244	0.2218	0.1332	0.1332	0.2707
2014	0.0084	0.0521	0.1294	0.2049	0.2675	0.3397	0.3828	0.4676	0.4715	0.3333	0.2176	0.1327	0.1327	0.2986
2015	0.0102	0.061	0.1496	0.2405	0.2942	0.3516	0.3795	0.4953	0.5467	0.3697	0.2263	0.1345	0.1345	0.3184
2016	0.0097	0.0568	0.1438	0.2404	0.3005	0.3685	0.3943	0.5307	0.5941	0.3934	0.2374	0.1391	0.1391	0.3297
2017	0.0117	0.0669	0.1678	0.2849	0.3517	0.4402	0.4591	0.6157	0.6925	0.4279	0.2438	0.136	0.136	0.3866
2018	0.0135	0.075	0.1848	0.3161	0.3854	0.4731	0.4935	0.6761	0.7725	0.4493	0.2426	0.1276	0.1276	0.4215
FBAR	0.0116	0.0662	0.1654	0.2805	0.3459	0.4273	0.449	0.6075	0.6864	0.4235	0.2413	0.1342		

Table S_3.16. Northeast Arctic COD Stock number-at-age (Thous) from the SPALY SAM run

SAM, Fri Apr 26 22:22:51 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1946	1416931	680210	383865	180817	85157	89690	241917	85504	36563	32415	18295	8035	2542	3261942
1947	619134	821510	494142	291908	132478	55827	59394	146004	50839	19658	17771	10001	5834	2724499
1948	409903	359212	554131	353389	198426	75886	34137	31132	74202	19464	8253	7124	6007	2131266
1949	578971	275547	268236	396829	234656	109886	44383	17746	16056	30232	7569	3101	4095	1987308
1950	878251	375964	222209	190781	236531	120408	60543	22805	8850	6186	11946	2689	2083	2139246
1951	2464249	675369	291575	170022	117547	123878	67137	30104	10726	3035	2026	3958	1119	3960745
1952	2319857	1154680	417191	179143	104329	60253	66643	32994	14034	4125	1077	673	1257	4356258
1953	2577947	1106242	666739	232937	90210	53350	30955	29938	12971	4219	1158	303	376	4807345
1954	849308	1454583	702709	400710	132397	49889	32273	16324	14306	5168	1692	468	227	3660054
1955	388276	557244	963720	425580	224658	72354	29249	17385	7149	5444	1953	659	239	2693910
1956	745369	251019	386497	563666	213266	111019	36040	13947	7232	2317	1916	737	314	2333338
1957	1420132	406487	155052	211313	248630	90680	49017	15083	5097	2163	600	606	345	2605205
1958	1029039	702429	246389	91831	106463	116385	42016	22725	6099	1690	719	201	372	2366358
1959	1323764	541705	423578	135531	44803	51486	56679	19765	9645	2320	639	341	281	2610538
1960	1478093	625994	286615	216451	66426	21952	25613	26518	8121	3860	950	280	309	2761182
1961	1526684	700467	346204	147718	109092	34581	10973	12820	10864	2919	1545	413	248	2904527
1962	1250450	796560	383401	162994	65748	51210	15272	4360	4676	3407	925	559	246	2739808
1963	842509	707681	442953	161782	60790	27207	21210	5552	1342	1521	1207	337	324	2274416
1964	485216	386388	371506	183774	55760	21103	9328	6698	1450	327	500	430	258	1522737
1965	907526	263551	244644	201557	86699	24645	8262	3134	2220	433	104	152	250	1743177
1966	1899526	586335	179840	144118	107640	44535	11173	3187	1159	870	182	32	141	2978738
1967	1262674	1289825	407405	114183	81898	56888	20974	4558	1268	504	411	79	73	3240738
1968	186334	956300	888344	263049	71294	43820	25358	7822	1678	477	216	164	73	2444927
1969	111350	143418	656691	498619	143661	38714	19421	9231	2898	676	221	81	106	1625087
1970	213861	88637	95700	342946	230336	60742	13975	5474	2737	934	274	84	83	1055782
1971	389450	152690	61396	53054	164640	100238	21538	4360	1792	1044	442	117	78	950837
1972	994529	300452	109953	39887	31620	80720	38878	7010	1575	710	505	209	97	1606146
1973	1862348	703223	203172	65621	22831	17079	29275	10274	1886	464	277	179	132	2916762

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1974	641060	1323978	463609	113656	35379	12236	7725	9532	3555	701	204	122	150	2611906
1975	598801	428966	727575	230318	55253	17597	5671	3247	3089	1092	267	63	115	2072054
1976	609951	434519	257167	341344	104454	24693	7345	2373	1418	950	403	89	85	1784792
1977	373618	423171	258054	122986	145184	44082	9348	2796	1117	650	371	156	81	1381614
1978	627373	249776	220684	108803	49010	54743	14627	2776	1016	425	291	114	84	1329721
1979	209981	449172	148615	91471	39253	17383	15653	3307	693	189	97	47	39	975900
1980	129936	161840	300282	81347	39113	15846	6438	4365	949	159	44	18	12	740350
1981	159985	102093	116849	171928	36336	14817	5544	1985	1179	221	42	9	4	610991
1982	174971	131463	81895	62845	78685	13802	4674	1618	660	328	74	14	5	551033
1983	156432	129911	93507	48169	25536	24719	4165	1404	583	238	109	30	7	484811
1984	413732	123273	85471	55217	21578	8558	7189	1247	533	248	102	43	13	717201
1985	558141	363254	83206	45624	23927	5420	2197	2065	393	207	102	49	19	1084605
1986	1118909	435551	246826	43463	18833	7057	1457	812	854	180	99	56	26	1874123
1987	327381	966880	264980	104606	14967	6071	1718	489	245	283	63	49	25	1687758
1988	297828	241634	624677	115547	29864	4401	1488	467	121	54	59	25	13	1316178
1989	188918	222377	154339	341162	49408	8545	1309	400	90	24	9	21	9	966612
1990	155641	147313	144148	105126	165419	20689	2951	534	126	29	8	4	6	741994
1991	396154	134061	108805	98156	66839	94514	11137	1529	266	53	11	3	3	911531
1992	735643	316583	106964	75309	57438	37875	53004	6500	954	163	29	7	2	1390472
1993	927910	533533	250952	70602	38043	28085	17572	27426	3339	526	80	18	2	1898089
1994	732611	719322	397739	146088	35373	16704	11826	7099	11688	1340	183	31	3	2080006
1995	500001	499327	524736	221745	57359	12108	5330	3527	2266	3512	304	43	1	1830259
1996	410747	297172	331787	290613	97569	18931	4167	1574	1104	650	1036	66	1	1455418
1997	671971	225740	202076	176384	121112	37154	5866	1509	507	333	181	291	3	1443128
1998	956873	438472	130119	94357	69608	41291	9945	1425	393	126	81	57	69	1742816
1999	544727	580878	253279	59312	32762	25564	11481	2580	320	105	30	27	44	1511108
2000	672798	398480	375830	115622	23022	11163	7065	2619	623	89	27	9	28	1607375
2001	551468	527108	293964	183211	50816	8773	3472	1899	690	229	28	12	18	1621687
2002	409501	419714	374943	187160	82000	19991	3127	1192	615	269	95	13	12	1498631

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
2003	694292	304092	296560	244703	86942	32374	6951	1170	444	300	112	55	9	1668004
2004	247602	564525	213079	191287	122603	36494	12708	2824	495	248	172	68	34	1392139
2005	633125	189109	401335	134029	98410	41604	11759	4248	906	208	121	115	56	1515026
2006	542436	460446	136679	234288	70314	36152	13510	3770	1435	407	94	79	119	1499729
2007	1421853	451049	295538	86972	123770	31135	13006	4390	1302	582	164	49	96	2429907
2008	1248669	1059025	365329	165652	52964	65124	15857	6060	1885	666	251	96	79	2981657
2009	710394	925992	847071	264378	95300	35701	34258	8941	3343	1043	346	149	110	2927027
2010	289761	535682	737883	632542	183655	59732	21593	18266	5351	1882	485	211	169	2487212
2011	479622	221072	446817	600952	443711	98594	35488	12030	9474	2498	1025	244	243	2351770
2012	563238	333185	174168	352515	460378	265536	53737	19406	6483	4768	1405	668	337	2235823
2013	628109	388691	246150	146114	267192	311661	160225	28981	10790	3564	2795	914	775	2195961
2014	745585	427963	302272	192068	113175	187946	180526	82350	14774	5537	2035	1827	1223	2257280
2015	426911	501025	323581	211783	139377	75571	113569	95691	39005	7758	3123	1313	2166	1940875
2016	269656	280520	382321	224599	138838	84562	46947	61772	46466	17478	4392	2006	2442	1562000
2017	724455	214015	206656	263753	148082	82858	47227	26185	28242	21379	9846	2828	3017	1778543
2018	431988	461216	159245	148858	163708	87397	43920	24359	11395	11663	11440	6446	3966	1565602
2019		293269	346688	123576	78839	95026	44249	22628	9836	4259	6093	7348	7504	1471304

Table S_3.17 Northeast Arctic COD. Natural mortality from the SPALY SAM run SAM, Fri Apr 26 22:22:51 2019

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.4901	0.3038	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1947	0.5438	0.3246	0.2309	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1948	0.4928	0.3048	0.2263	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1949	0.4338	0.2819	0.2209	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1950	0.3164	0.2364	0.2103	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1951	0.7235	0.3943	0.2471	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1952	0.7148	0.3909	0.2463	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1953	0.5367	0.3219	0.2302	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1954	0.3878	0.264	0.2168	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1955	0.4056	0.271	0.2184	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1956	0.5899	0.3425	0.235	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1957	0.7252	0.395	0.2473	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1958	0.5616	0.3315	0.2325	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1959	0.7131	0.3903	0.2462	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1960	0.7036	0.3866	0.2453	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1961	0.6094	0.35	0.2368	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1962	0.5201	0.3154	0.2287	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1963	0.7882	0.4194	0.253	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1964	0.6027	0.3475	0.2362	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1965	0.4164	0.2752	0.2194	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1966	0.3529	0.2505	0.2136	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1967	0.2707	0.2186	0.2062	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1968	0.2242	0.2006	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1969	0.206	0.2	0.2003	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1970	0.2927	0.2272	0.2082	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1971	0.2562	0.213	0.2049	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1972	0.3234	0.2391	0.211	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1973	0.2172	0.2	0.2014	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1974	0.2168	0.2	0.2013	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1975	0.2317	0.2035	0.2027	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1976	0.2238	0.2004	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1977	0.2487	0.2101	0.2042	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978	0.2342	0.2045	0.2029	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1979	0.2081	0.2	0.2005	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1980	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1983	0.2031	0.2	0.2001	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1984	0.2	0.209	0.2121	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1985	0.2037	0.2137	0.2145	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1986	0.2494	0.2197	0.258	0.2253	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1987	0.2439	0.208	0.2185	0.2611	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1988	0.2143	0.2036	0.2088	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1989	0.2015	0.2166	0.2	0.2153	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1990	0.2	0.2027	0.2074	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1991	0.2012	0.2	0.2019	0.2108	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1992	0.2085	0.2	0.2	0.2166	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1993	0.2445	0.2	0.215	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1994	0.342	0.2523	0.2174	0.2305	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1995	0.5189	0.3103	0.215	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1996	0.5046	0.3167	0.2296	0.2157	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1997	0.4184	0.2688	0.22	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1998	0.4255	0.2624	0.2122	0.2264	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1999	0.2585	0.228	0.2273	0.2013	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2000	0.2458	0.2087	0.245	0.2077	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2001	0.2357	0.2167	0.2004	0.2303	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2002	0.2817	0.208	0.2	0.2214	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2003	0.2398	0.201	0.2	0.2129	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2004	0.2516	0.2133	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2005	0.2987	0.214	0.2069	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2006	0.2027	0.2296	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2007	0.2438	0.2	0.2422	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2008	0.2563	0.2123	0.2	0.2228	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.2809	0.2137	0.2034	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2010	0.3014	0.2426	0.2118	0.2044	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2011	0.4334	0.3241	0.2075	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2012	0.3808	0.3255	0.2249	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2013	0.4114	0.2461	0.2178	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2014	0.4002	0.3117	0.22	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.3829	0.2757	0.2499	0.2068	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2016	0.2235	0.2724	0.294	0.2325	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2017	0.4603	0.233	0.206	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2018	0.3357	0.2077	0.2	0.228	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table S_3.18. Northeast Arctic COD. Summary table from the SPALY SAM run SAM, Fri Apr 26 22:22:51 2019

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1946	1416931	4197431	990849	706000	0.7125	0.2127
1947	619134	3640777	1021359	882017	0.8636	0.3148
1948	409903	3524263	837151	774295	0.9249	0.3136
1949	578971	3004710	624676	800122	1.2809	0.3635
1950	878251	2831042	561970	731982	1.3025	0.3753
1951	2464249	3651356	511078	827180	1.6185	0.4263
1952	2319857	4049077	499222	876795	1.7563	0.5196
1953	2577947	4125663	396048	695546	1.7562	0.3955
1954	849308	4260137	409556	826021	2.0169	0.4164
1955	388276	3564836	331358	1147841	3.4641	0.5019
1956	745369	3333777	284149	1343068	4.7266	0.6133
1957	1420132	2819340	206883	792557	3.8309	0.5249
1958	1029039	2416035	204280	769313	3.766	0.527
1959	1323764	2763014	442991	744607	1.6809	0.5316
1960	1478093	2422153	402990	622042	1.5436	0.5125
1961	1526684	2397619	406033	783221	1.929	0.6466
1962	1250450	2164483	320206	909266	2.8396	0.758
1963	842509	1961230	214441	776337	3.6203	0.8736
1964	485216	1499949	192096	437695	2.2785	0.6753
1965	907526	1473682	106528	444930	4.1767	0.5551
1966	1899526	2280806	121929	483711	3.9671	0.5058

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1967	1262674	2781737	133538	572605	4.288	0.5364
1968	186334	3224154	228937	1074084	4.6916	0.5786
1969	111350	2740734	151312	1197226	7.9123	0.7594
1970	213861	2077956	230628	933246	4.0465	0.6969
1971	389450	1628999	319334	689048	2.1578	0.5854
1972	994529	1621761	365182	565254	1.5479	0.6909
1973	1862348	2274713	324238	792685	2.4448	0.6074
1974	641060	2207965	159552	1102433	6.9096	0.6346
1975	598801	2115748	130574	829377	6.3518	0.6349
1976	609951	2014373	167876	867463	5.1673	0.6587
1977	373618	1976376	352518	905301	2.5681	0.8061
1978	627373	1596211	234824	698715	2.9755	0.9714
1979	209981	1108762	165128	440538	2.6679	0.7818
1980	129936	836842	102622	380434	3.7071	0.7765
1981	159985	956705	151677	399038	2.6308	0.7651
1982	174971	733087	310238	363730	1.1724	0.8142
1983	156432	706868	281458	289992	1.0303	0.7763
1984	413732	810628	227619	277651	1.2198	0.8867
1985	558141	987323	187504	307920	1.6422	0.7891
1986	1118909	1345711	162209	430113	2.6516	0.9041
1987	327381	1204270	110255	523071	4.7442	1.0203
1988	297828	1003447	179367	434939	2.4249	0.9541
1989	188918	997230	234248	332481	1.4194	0.6491
1990	155641	1017098	331888	212000	0.6388	0.3683
1991	396154	1525658	706539	319158	0.4517	0.3167
1992	735643	1872462	908683	513234	0.5648	0.448
1993	927910	2306583	775845	581611	0.7496	0.5769
1994	732611	2104405	591364	771086	1.3039	0.7974
1995	500001	1812051	523318	739999	1.4141	0.7817

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1996	410747	1676724	546404	732228	1.3401	0.7663
1997	671971	1494275	544203	762403	1.401	0.9467
1998	956873	1267417	377854	592624	1.5684	0.9602
1999	544727	1151382	283058	484910	1.7131	0.96
2000	672798	1181840	239037	414868	1.7356	0.8232
2001	551468	1458686	363501	426471	1.1732	0.7072
2002	409501	1615291	505998	535045	1.0574	0.6551
2003	694292	1715991	595218	551990	0.9274	0.576
2004	247602	1624920	709114	606445	0.8552	0.7198
2005	633125	1559230	615647	641276	1.0416	0.7199
2006	542436	1565894	602187	537642	0.8928	0.659
2007	1421853	1957213	653169	486883	0.7454	0.4525
2008	1248669	2702303	688680	464171	0.674	0.3188
2009	710394	3440984	1099774	523430	0.4759	0.272
2010	289761	3812243	1398250	609983	0.4362	0.277
2011	479622	4014603	2012786	719830	0.3576	0.2683
2012	563238	4144546	2334475	727663	0.3117	0.2426
2013	628109	4358560	2645872	966209	0.3652	0.2707
2014	745585	3939370	2507946	986449	0.3933	0.2986
2015	426911	3659453	2071319	864384	0.4173	0.3184
2016	269656	3185130	1700333	849422	0.4996	0.3297
2017	724455	3155230	1821497	868276	0.4767	0.3866
2018	431988	2727210	1525907	778627	0.5103	0.4215
Arith. Mean	749896	2292873	598308	671921	2.0674	0.5956

Table S_3.19. Northeast Arctic COD. Input for the short term prediction from the SPALY SAM run

2019								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	660000	0.3398	0	0	0	0.274	0.0116	0.834
4	293269	0.2377	0.003	0	0	0.659	0.0662	1.282
5	346688	0.2333	0.033	0	0	1.188	0.1655	1.671
6	123576	0.2202	0.199	0	0	1.95	0.2805	2.355
7	78839	0.2	0.624	0	0	3.101	0.3459	3.42
8	95026	0.2	0.894	0	0	4.381	0.4273	4.558
9	44249	0.2	0.947	0	0	5.928	0.4490	5.943
10	22628	0.2	0.988	0	0	7.361	0.6075	7.365
11	9836	0.2	0.997	0	0	9.632	0.6864	8.65
12	4259	0.2	1	0	0	12.621	0.4235	11.42
13	6093	0.2	1	0	0	14.544	0.2413	12.8
14	7348	0.2	1	0	0	16.466	0.1342	14.18
15	7504	0.2	1	0	0	18.388	0.1342	15.55

2020								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	524000	0.3398	0	0	0	0.244	0.0116	0.834
4		0.2377	0.003	0	0	0.665	0.0662	1.256
5		0.2333	0.021	0	0	1.244	0.1655	1.789
6		0.2202	0.182	0	0	2.003	0.2805	2.317
7		0.2	0.526	0	0	2.97	0.3459	3.276
8		0.2	0.792	0	0	4.656	0.4273	4.674
9		0.2	0.939	0	0	6.035	0.4490	5.894
10		0.2	0.984	0	0	7.568	0.6075	7.279
11		0.2	0.999	0	0	9.528	0.6864	8.701
12		0.2	0.995	0	0	12.621	0.4235	11.42
13		0.2	1	0	0	14.544	0.2413	12.8

2020								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
14		0.2	1	0	0	16.466	0.1342	14.18
15		0.2	1	0	0	18.388	0.1342	15.55

2021								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	644000	0.3398	0	0	0	0.262	0.0116	0.834
4		0.2377	0.003	0	0	0.635	0.0662	1.256
5		0.2333	0.021	0	0	1.25	0.1655	1.789
6		0.2202	0.182	0	0	2.059	0.2805	2.317
7		0.2	0.526	0	0	3.022	0.3459	3.276
8		0.2	0.792	0	0	4.525	0.4273	4.674
9		0.2	0.939	0	0	6.31	0.4490	5.894
10		0.2	0.984	0	0	7.676	0.6075	7.279
11		0.2	0.999	0	0	9.735	0.6864	8.701
12		0.2	0.995	0	0	12.621	0.4235	11.42
13		0.2	1	0	0	14.544	0.2413	12.8
14		0.2	1	0	0	16.466	0.1342	14.18
15		0.2	1	0	0	18.388	0.1342	15.55

Table S_3.20. Northeast Arctic COD. Management option table from the SPALY SAM run.

2019					
Biomass (t)	**SSB (t)**	**FMult**	**FBar**	**Landings (t)**	
2612690	1495633	1	0.421	687500	

2020				**2021**	
Biomass	**SSB**	**FBar**	**Landings**	**Biomass**	**SSB**
2464216	1227387	0.00	0	3129014	1652231
		0.05	88412	3026060	1572831
		0.10	172683	2928249	1497886
		0.15	253049	2835280	1427120
		0.20	329729	2746871	1360274
		0.25	402931	2662757	1297107
		0.30	472848	2582693	1237394
		0.35	539661	2506447	1180924
		0.40	603541	2433803	1127500
		0.45	664648	2364557	1076938
		0.50	723131	2298519	1029068
		0.55	779131	2235512	983729
		0.60	832780	2175368	940770
		0.65	884203	2117931	900051
		0.70	933516	2063053	861440
		0.75	980829	2010595	824815
		0.80	1026245	1960429	790060
		0.85	1069861	1912432	757067
		0.90	1111769	1866489	725736
		0.95	1152054	1822493	695970
		1.00	1190798	1780343	667682
Tonnes	Tonnes		Tonnes	Tonnes	Tonnes

Table S_3.21. Northeast Arctic COD. Detailed prediction output assuming Fsq in 2019 and HCR in 2020 from the SPALY SAM run

Fbar	age	
range:	5-10	
Year:	2019	
F	multiplier:	1
Fbar:	0.4215	

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)
3	0.013	7190	6	660000	181	0	0
4	0.074	18549	24	293269	193	880	1
5	0.184	52122	87	346688	412	11441	14
6	0.312	29872	70	123576	241	24592	48
7	0.384	22948	78	78839	244	49196	153
8	0.475	32813	150	95026	416	84953	372
9	0.499	15885	94	44249	262	41904	248
10	0.675	10180	75	22628	167	22356	165
11	0.763	4817	42	9836	95	9806	94
12	0.471	1460	17	4259	54	4259	54
13	0.268	1305	17	6093	89	6093	89
14	0.149	925	13	7348	121	7348	121
15+	0.149	945	15	7504	138	7504	138
Total	NA	199011	688	1699315	2613	270332	1496
		Thous	Thou.	Thous	Thou.	Thous	Thou.
			tonnes		tonnes		tonnes

Fbar	age	
range:	5-10	
Year:	2020	
F	multiplier:	1.12
Fbar:	0.4711	

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)
3	0.014	6376	5	524000	128	0	0
4	0.082	32658	41	463812	308	1391	1
5	0.206	35741	64	214817	267	4511	6
6	0.348	60702	141	228426	458	41573	83
7	0.430	23147	76	72603	216	38189	113
8	0.531	16550	77	43950	205	34808	162
9	0.558	18923	112	48392	292	45440	274
10	0.755	10695	78	21997	166	21645	164
11	0.853	4973	43	9432	90	9422	90
12	0.526	1405	16	3756	47	3737	47
13	0.300	514	7	2178	32	2178	32
14	0.167	533	8	3815	63	3815	63
15+	0.167	1462	23	10475	193	10475	193
Total	NA	213680	690	1647652	2464	217186	1227
		Thous	Thou.	Thous	Thou.	Thous	Thou.
			tonnes		tonnes		tonnes