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

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Editors

Daniel Howell

Authors

Jane Aanestad Godiksen • Erik Berg • Matthias Bernreuther • Bjarte Bogstad • José Miguel Casas Thomas de Lange Wenneck • Elena Eriksen • Johanna Fall • Anatoly Filin • Harald Gjøsæter • Elvar Hallfredsson • Hannes Höffle • Daniel Howell • Edda Johannesen • Yuri Kovalev • Kjell Nedreaas • Holly Ann Perryman • Dmitri Prozorkevich • Alexey Russkikh • Silje Elizabeth Seim • Arved Staby • Ross Tallman • Mikko Juhani Vihtakari • Tone Vollen • Kristin Windsland • Natalia Yaragina

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Section contents

4 Haddock in subareas 1 and 2 (Northeast Arctic)

Melanogrammus aeglefinus – had.27.1-2

4.1 Introductory note

The haddock input data, SAM model configuration and short-term forecast data input were revised during a benchmark in 2020 (WKDEM 2020).

4.2 Status of the fisheries

4.2.1 Historical development of the fisheries

Haddock is mainly fished by trawl as bycatch in the fishery for cod. Also, a directed trawl fishery for haddock is conducted. The proportion of the total catches taken by direct fishery varies between years. On average approximately 30% of the catch is with conventional gears, mostly longline, which in the past was used almost exclusively by Norway. Some of the longline catch are from a directed fishery, which is restricted by national quotas. In the Norwegian management, the quotas are set separately for trawl and other gears. The fishery is also regulated by a minimum landing size, a minimum mesh size in trawls and Danish seine, a maximum bycatch of undersized fish, closure of areas with high density/catches of juveniles and other seasonal and area restrictions.

The exploitation rate of haddock has been variable. The highest fishing mortalities for haddock have occurred at low to intermediate stock levels and historically show little relationship with the exploitation rate of cod, despite haddock being primarily caught as bycatch in the cod fishery. However, the more restrictive quota regulations introduced around 1990 have resulted in a more stable pattern in the exploitation rate.

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

4.2.2 Catches prior to 2021 (Table 4.1–Table 4.3, Figure 4.1)

The highest landings of haddock historically were 322 kt in 1973. Since 1973 the highest catches observed were about 316 kt in 2012. In 2013–2015 the stock biomass started to decline and the landings in 2018, 2019 and 2020 were below 200 kt (Figure 4.1).

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

Provisional official landings for 2020 are about 183 kt, which is 15% below agreed TAC (215 kt).

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

We continue to include the estimates of IUU catches 2002–2008, but the IUU are assumed to be negligible for 2009–2020 and therefore set to zero.

4.2.3 Catch advice and TAC for 2021

The catch advice for 2021 was 233 kt and the Joint Norwegian-Russian Fisheries Commission set the TAC in accordance with the HCR. Furthermore, Russia and Norway can transfer 10% of unused part of own quotas from 2020 to 2021 and 10% of unused part own quotas from 2021 to the quota in 2022.

4.3 Status of research

4.3.1 Survey results

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

The Joint Barents Sea winter survey provides two index series used for tuning and recruitment forecast (bottom trawl: FLT02, NoRu-BTr-Q1 and acoustics: FLT04, NoRu-Aco-Q1). The survey area has been extended from 2014 with additional northern areas (N) covered. The extended area is now included in total and standard survey index calculations for haddock (WKDEM 2020). Overall, this survey tracks both strong and poor year classes well. The indices from the Joint winter survey of cod and haddock in the Barents Sea 1994–2021 are given in WD 2. The spatial survey coverage in 2021 was relatively good. Note that since the AFWG was conducted, minor errors were discovered in the winter survey index for 2021 (both acoustic and bottom trawl). These had minimal (< 1%) impact on the assessment of SSB for NEA haddock. This report is not updated to account for correcting these errors.

Both the acoustic and swept indices of all ages were lower in 2021 compared to 2020.

The Joint Barents Sea ecosystem survey provides indices by age from bottom trawl data (FLT007, Eco-NoRu-Q3 Btr) used for tuning and recruitment forecast. At the benchmark in 2011 it was decided to include this survey as tuning series. Tuning indices by age from the joint ecosystem survey are presented in WD 1 (2004–2020 except 2018). The survey coverage in 2020 was good, but the survey covered the eastern Barents Sea much later than the western Barents Sea (almost three months), which might have influenced the results in an unknown way. The distribution of haddock was reduced in 2020 compared 2019, especially on the Novaya Zemlya bank, where haddock was almost absent. The indices were much lower for the youngest and oldest haddock in 2020 compared to 2019.

4.4 Data used in the assessment

4.4.1 Catch-at-age (Table 4.4)

Age and length composition of the landings in 2020 were available from Norway and Russia in Subarea 1 and Division 2.b, and from Norway, Russia, and Germany in Division 2.a. The biological sampling of NEA haddock catches is considered good for the most important ages in the fisheries (see section 1).

Relevant data of estimated catch-at-age obtained from InterCatch for the period 2008–2020 and historical values from 1950–2007 is listed in Table 4.4.

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

The mean weight-at-age in the catch was obtained from InterCatch as a weighted average of the weight-at-age in the catch for Norway, Russia and Germany.

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

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

4.4.4 Maturity-at-age (Table 4.7)

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

4.4.5 Natural mortality (Table 4.8)

Natural mortality used in the assessment was 0.2. For ages 3–6 mortality predation by cod are added (see stock annex). For the period from 1984 and onwards actual estimates of predation by cod was used. For the years 1950–1983 the average natural mortality for 1984–2020 was used (age groups 3–6). Estimated mortality from predation by cod in this year's assessment is based on the 'final run' cod assessment. The proportion of F and M before spawning was set to zero.

4.4.6 Data for tuning (Table 4.9)

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

Name	ICES Acronym	Place	Season	Age	Year	prior weight
FLT01: Russian bottom trawl	RU-BTr-Q4	Barents Sea	October–December	3–8	1991–2017	1
FLT02: Joint Barents Sea survey–acoustic	BS-NoRU-Q1(Aco)	Barents Sea	February–March	3–9	1993–2021	1
FLT04: Joint Barents Sea survey–bottom trawl	BS-NoRu-Q1 (BTr)	Barents Sea	February–March	3–10	1994–2021	1
FLT007: Joint Russian-Norwegian ecosystem autumn survey in the Barents Sea–bottom trawl	Eco-NoRu-Q3 (Btr)	Barents Sea	August–September	3–9	2004–2020	1

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

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

Natural mortality includes cod predation for the ages 3–6. The data from 1984 and onwards are updated every year after the update of the cod assessment. This year, the change in consumption estimates back to 1984 were larger than usual due to the revision of the cod stock undertaken at the cod benchmark held in early 2021. The averages used for the historic period (1950–1983) were updated and used in the assessment.

4.5 Assessment models and settings (Table 4.10)

At the benchmark in 2020 it was decided to continue using the SAM model as the main model and XSA, with revised settings, will be used as additional model for comparison. This year the TISVPA model is also used as an additional model for comparison.

The SAM configuration was revised during the benchmark in 2020. The main changes were 1) to include age group 3 in the winter survey indices (Fleet 02 and 04), 2) include a plus group in all survey series (new option in SAM), 3) include a prediction variance link for the observation variances (new option in SAM, Breivik *et al.*, in prep) 4) correlation structure in observation variance for the surveys (Berg and Nielsen, 2016).

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

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

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

Fishing mortality has increased since 2013 (Table 4.12). The estimate of fishing mortality of main ages (4–7) in 2020 was 0.43 and above F_{MSY} = 0.35.

The SSB has decreased since the peak in 2013, and the estimate for 2021 201 kt and is still well above MSY $B_{trigger}$ = 80 kt (Figure 4.1).

Most of last year residuals are negative while catch observation close to predicted values, which means survey tends to underestimate stock. Retrospective estimates confirms that stock going down only based on last year surveys data (Figure 4.2 and Figure 4.3)

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

The text table below compares this year's estimates with last year's estimates. Compared to last year's assessment the current estimates by SAM model of the total stock (TSB) and spawning stock (SSB) are lower for 2020. The F in 2019 is estimated a higher. Estimates for all ages except ages 4 and 5 (2015 and 2016 year classes) were reduced.

Year of assessment, model	F (2019)	Numbers 2020 (ages)											SSB (2020)	TSB (2020)
		3	4	5	6	7	8	9	10	11	12	13+		
2020 SAM	0.38	497	532	171	60	29	11	10	4	4	2	5	243	798
2021 SAM	0.43	442	530	164	48	24	9	8	3	3	2	3	205	723
Ratio 2021/2020	1.1	0.9	1.0	1.0	0.8	0.8	0.8	0.8	0.9	0.7	1.0	0.7	0.8	0.9

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

4.8.1 XSA (Figure 4.5)

The Extended Survivors Analysis (XSA) was used to tune the VPA by available index series. As last years, FLR was used for the assessment of haddock (see stock annex), and thus all results concerning XSA are obtained using FLR. The settings used were the same as set in the benchmark in 2015 (WKARCT 2015). The biomass estimates of XSA with these settings significantly deviated from estimates of main model SAM. During the WKDEM 2020 it was found that changing S.E. of the mean survivor estimates shrinkage F from 1.5 to 0.5 gives estimates of biomass dynamics close to SAM estimates. Furthermore, this change improved XSA retrospective pattern. At AFWG 2021 this comparison also done and confirmed that usage of survivor estimates shrinkage 0.5 gave the similar result with SAM estimates.

The estimated consumption of NEA haddock by NEA cod is incorporated into the XSA analysis by first constructing a catch number-at-age matrix, adding the numbers of haddock eaten by cod to the catches for the years where such data are available (1984–2020). The summary of XSA stock estimates with shrinkage value 0.5 are presented in Table 4.15. A retrospective estimate for XSA gave same signals as for main model SAM (Figure 4.5).

4.8.2 TISVPA (Figure 4.6)

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. To NEA haddock stock the TISVPA model was at benchmark group for arctic stocks (WKARCT) in 2015 and this year it was decided to apply to NEA haddock using the same data as SAM except that natural mortality values from cannibalism were taken from the SAM runs. All the input data, including catch-at-age, weight-at-age in stock and in catches, maturity-at-age were taken the same as for stock assessment by means of SAM. During AFWG 2021 the results of runs using the TISVPA model were presented in WD#22. Generally biomass estimates of this model were higher than SAM estimates, which can be explained by different assumptions about indices catchability. A retrospective assessment for TISVPA shows same trends as for both another models (Figure 4.6).

4.8.3 Model comparisons (Figure 4.7)

Results from SAM, XSA and TISVPA are compared in Figure 4.7. Comparison of results of SAM, TISVPA and XSA with previous year settings shows that the models estimate similar trends. The TSVPA model is more flexible for settings than the others and taking in account a possible decreasing in survey data consistency, it was attempted to do tuning of surveys not at abundance but to age proportions because the probable change in effective survey catchability.

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

4.9.1 Recruitment (Table 4.16–Table 4.17)

SAM was used to estimate the recruitment at age 3 of the 2018 year class in 2021. The RCT3 program translation in R was used to estimate the recruiting year classes 2019–2020 in 2022 and 2023 with survey data from the ecosystem survey and winter survey. Input data and results are shown in Tables 4.16 and 4.17, respectively.

The text table below shows the recruitment estimates for the year classes 2000–2018 from assessments and RCT3 (shaded cells). Overall, there is a good agreement with the year-class strength estimate from RCT3 and the assessments, for the year classes 2014–2018, the correlation between the initial estimate from RCT3 and the estimate in SAM is 98%. For the 2004–2017 year classes the estimate from SAM was on average 80% of the initial estimate, whereas the SAM estimate of the recruitment at age 3 of the 2018 year class was less than 50% from the initial estimate from RCT3 calculated in 2019.

Year	Year of assessment, base model (XSA 2005-2014)										XSA	SAM	SAM	SAM	SAM	SAM	SAM	SAM
Class	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015	2016	2017	2018	2019	2020	2021
2000	197	237	236	249	246	222	232	232	232	229	237	179	231	247	244	247	352	340
2001	176	219	224	257	245	237	241	239	239	236	247	184	239	222	218	220	268	260
2002	295	313	339	367	365	371	352	359	359	352	368	275	352	351	349	353	377	366
2003	156	183	135	161	171	185	189	183	186	181	197	169	208	165	161	164	161	158
2004	462	755	672	665	668	610	765	743	725	698	768	687	930	898	869	879	557	543
2005		521	731	943	975	1029	1193	1301	1317	1303	1415	996	1456	1330	1241	1251	1149	1113
2006			463	832	1036	811	1057	1187	1264	1267	1366	827	1254	1083	1027	1030	1063	1025
2007				202	208	212	284	330	370	384	411	211	355	307	305	308	249	241
2008					149	101	120	151	155	169	178	89	157	107	109	110	122	117
2009						303	315	320	345	357	363	230	351	294	291	293	356	340
2010							188	146	137	146	150	100	133	105	105	106	124	119
2011								483	513	482	398	298	397	340	329	332	425	411
2012									124	145	104	78	73	79	70	68	75	72
2013										394	290	197	235	184	174	177	219	213
2014											279	198	247	189	145.96	148	202	194
2015													422	398	333	336	384	368
2016														1067	933	930	875	822
2017															577	629	497	442
2018																344	294	154
2019																	39	31
2020																		95

4.9.2 Prediction data (Table 4.18, Figure 4.8)

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

Stock numbers for 2021–2022 at age 3 are taken from RCT3, and abundance-at-ages 3–13+ in 2020 from the SAM assessment. The average fishing pattern observed in 2018–2020 scaled to F in 2020 was used for distribution of fishing mortality-at-age for 2021–2023 (Figure 4.8). The proportion of M and F before spawning was set to 0.

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

4.9.3 Biomass reference points (Figure 4.1)

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

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

4.9.4 Fishing mortality reference points (Figure 4.1)

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

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

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

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

4.9.5 Harvest control rule

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

- TAC for the next year will be set at level corresponding to F_{MSY}.

- The TAC should not be changed by more than +/- 25% compared with the previous year TAC.
- If the spawning stock falls below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{MSY} at B_{pa} to F = 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year and a year ahead) there should be no limitations on the year-to-year variations in TAC.

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

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

4.9.6 Prediction results and catch options for 2021 (Table 4.19–Table 4.21)

The projection shows a slight increase in SSB from 203 kt in 2021 to 205 kt in 2022 (Table 4.19). TAC constraint F is used for 2021. The TAC for 2022 is established using the current one-year HCR, in accordance of the management plan. F_{MSY} = 0.35 would give a quota for 2022 of 180 kt, this is a 23% decrease from the TAC and advice for 2021. Yield-per-recruit is given in Table 4.21.

Catch options for 2021 are shown in the text table below (weights in tonnes).

Basis	Total catch (2022)	F ages 4–7 (2022)	SSB (2023)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan	180003	0.35	201485	−1.6	−22.6	−22.6
Other scenarios						
MSY approach: F_{MSY}	180003	0.35	201485	−1.6	−22.6	−22.6
F = 0	0	0	309362	51.1	−100.0	−100.0
F = F2021	214185	0.44	181739	−11.2	−7.9	−7.9
F_{pa}	227071	0.47	174372	−14.8	−2.4	−2.4
F_{lim}	320921	0.77	122248	−40.3	38.0	38.0

*** SSB 2023 relative to SSB 2022.**

**** Catch in 2022 relative to TAC in 2021**

***** Catch value for 2022 relative to advice value for 2021**

Detailed information about expected catches by following HCR in 2022 and 2023 is given in Table 4.20. 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.

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

Haddock was benchmarked prior to last year's assessment (WKDEM 2020). The motivation for the benchmark was the poor retrospective (text table below).

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

The one step ahead residuals showed no clear pattern (Figure 4.2). This year, we also used model simulations and jitter analysis, as diagnostics of SAM model performance. No problems were detected.

By adding a new year of data, the analytical retrospective bias increased for SSB and F and decreased for R and TSB (Figure 4.3). The increased bias was mainly due to the low survey indices from the ecosystem survey 2020 and winter survey 2021, pulling the stock estimate down. Compared to last year's assessment, except for the ages 4 and 5, estimates of all ages in 2020 was estimated lower at this year's assessment. This is mainly due to the low survey indices from the ecosystem survey of 2020 and winter survey 2021, but also due to update of the data, especially of the predation from cod, following the benchmark of the cod stock in 2021.

According to this year's assessment, the 2016 year class is the sixth strongest year class in the time-series back to 1950 and the 2017 year class is also above average, whereas the 2018 year class is weak. The 2019–2020 year classes are predicted to be well below average, the 2019 year class as the weakest since 1990.

As for the last two assessments F was above F_{MSY} in 2020 (Figure 4.4). This appears to be due to a too optimistic estimate of the stock in the assessment in 2019, and consequently too high TAC set for 2020. There was less fishing on youngest fish than initially assumed. Also, the weight in the catch in 2020 was considerably lower than was assumed in the forecast, especially for the 4-year olds (Figure 4.9).

The retrospective trend indicates that the catch advice given in 2020 for 2021 is likely biased high. The catch in 2020 was 15% lower than TAC and the catch is expected to be below the TAC also in 2021, especially since the TAC in 2021 was higher than the 2020 TAC.

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

Year	Subarea 1	Division 2.a	Division 2.b	un-reported (2	Total (3	Norw. stat.areas 06 and 07 (4
1960	125026	27781	1844	-	154651	6000
1961	165156	25641	2427	-	193224	4000
1962	160561	25125	1723	-	187409	3000
1963	124332	20956	936	-	146224	4000
1964	79262	18784	1112	-	99158	6000
1965	98921	18719	943	-	118583	6000
1966	125009	35143	1626	-	161778	5000
1967	107996	27962	440	-	136398	3000
1968	140970	40031	725	-	181726	3000
1969	89948	40306	566	-	130820	2000
1970	60631	27120	507	-	88258	-
1971	56989	21453	463	-	78905	-
1972	221880	42111	2162	-	266153	-
1973	285644	23506	13077	-	322227	-
1974	159051	47037	15069	-	221157	10000
1975	121692	44337	9729	-	175758	6000
1976	94054	37562	5648	-	137264	2000
1977	72159	28452	9547	-	110158	2000
1978	63965	30478	979	-	95422	2000
1979	63841	39167	615	-	103623	6000
1980	54205	33616	68	-	87889	5098
1981	36834	39864	455	-	77153	4767
1982	17948	29005	2	-	46955	3335
1983	5837	16859	1904	-	24600	3112
1984	2934	16683	1328	-	20945	3803
1985	27982	14340	2730	-	45052	3583
1986	61729	29771	9063	-	100563	4021
1987	97091	41084	16741	-	154916	3194
1988	45060	49564	631	-	95255	3756

Year	Subarea 1	Division 2.a	Division 2.b	un-reported (2	Total (3	Norw. stat.areas 06 and 07 (4
1989	29723	28478	317	-	58518	4701
1990	13306	13275	601	-	27182	2912
1991	17985	17801	430	-	36216	3045
1992	30884	28064	974	-	59922	5634
1993	46918	32433	3028	-	82379	5559
1994	76748	50388	8050	-	135186	6311
1995	75860	53460	13128	-	142448	5444
1996	112749	61722	3657	-	178128	5126
1997	78128	73475	2756	-	154359	5987
1998	45640	53936	1054	-	100630	6338
1999	38291	40819	4085	-	83195	5743
2000	25931	39169	3844	-	68944	4536
2001	35072	47245	7323	-	89640	4542
2002	40721	42774	12567	18736/5310	114798/101372	6898
2003	53653	43564	8483	33226/9417	138926/115117	4279
2004	64873	47483	12146	33777/8661	158279/133163	3743
2005	53518	48081	16416	40283/9949	158298/127964	5538
2006	51124	47291	33291	21451/8949	153157/140655	5410
2007	62904	58141	25927	14553/3102	161525/150074	7110
2008	58379	60178	31219	5828/-	155604/149776	6629
2009	57723	66045	76293	0	200061	4498
2010	62604	86279	100318	0	249200	3661
2011	86931	99307	123546	0	309785	4169
2012	90141	96807	128679	0	315627	3869
2013	68416	64810	60520	0	193744	4000
2014	61537	58320	57665	0	177522	3433
2015	75195	61567	57993	0	194756	3902
2016	78714	95140	59561	0	233416	3233
2017	94772	75455	57362	0	227589	2987

Year	Subarea 1	Division 2.a	Division 2.b	un-reported (2	Total (3	Norw. stat.areas 06 and 07 (4
2018	80902	58522	51853	0	191276	4437
2019	87446	50967	36989	0	175402	2812
2020[1)]	98341	57397	26730	0	182468	3196

1) Provisional figures

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

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

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

Table 4.2. Northeast Arctic haddock. Total nominal catch ('000 t) by trawl and other gear for each area

	Subarea 1		Division 2.a		Division 2.b		Unreported[2]
Year	Trawl	Others	Trawl	Others	Trawl	Others	
1967	73.7	34.3	20.5	7.5	0.4	-	-
1968	98.1	42.9	31.4	8.6	0.7	-	-
1969	41.4	47.8	33.2	7.1	1.3	-	-
1970	37.4	23.2	20.6	6.5	0.5	-	-
1971	27.5	29.2	15.1	6.7	0.4	-	-
1972	193.9	27.9	34.5	7.6	2.2	-	-
1973	242.9	42.8	14	9.5	13.1	-	-
1974	133.1	25.9	39.9	7.1	15.1	-	-
1975	103.5	18.2	34.6	9.7	9.7	-	-
1976	77.7	16.4	28.1	9.5	5.6	-	-
1977	57.6	14.6	19.9	8.6	9.5	-	-
1978	53.9	10.1	15.7	14.8	1	-	-
1979	47.8	16	20.3	18.9	0.6	-	-
1980	30.5	23.7	14.8	18.9	0.1	-	-
1981	18.8	17.7	21.6	18.5	0.5	-	-
1982	11.6	11.5	23.9	13.5	-	-	-
1983	3.6	2.2	8.7	8.2	0.2	1.7	-
1984	1.6	1.3	7.6	9.1	0.1	1.2	-
1985	24.4	3.5	6.2	8.1	0.1	2.6	-

	Subarea 1		Division 2.a		Division 2.b		Unreported[2]
1986	51.7	10.1	14	15.8	0.8	8.3	-
1987	79	18.1	23	18.1	3	13.8	-
1988	28.7	16.4	34.3	15.3	0.6	0	-
1989	20	9.7	13.5	15	0.3	0	-
1990	4.4	8.9	5.1	8.2	0.6	0	-
1991	9	8.9	8.9	8.9	0.2	0.2	-
1992	21.3	9.6	11.9	16.1	1	0	-
1993	35.3	11.6	14.5	17.9	3	0	-
1994	58.6	18.2	26.1	24.3	7.9	0.2	-
1995	63.9	12	29.6	23.8	12.1	1	-
1996	98.3	14.4	36.5	25.2	3.4	0.3	-
1997	57.4	20.7	44.9	28.6	2.5	0.3	-
1998	26	19.6	27.1	26.9	0.7	0.3	-
1999	29.4	8.9	19.1	21.8	4	0.1	-
2000	20.1	5.9	18.8	20.4	3.7	0.1	-
2001	28.4	6.7	23.4	23.8	7	0.3	-
2002	30.5	10.2	19.5	23.3	12.5	0.1	18.7/5.3
2003	42.7	10.9	21.9	21.7	8.1	0.4	33.2/9.4
2004	52.4	12.5	27	20.5	11.5	0.6	33.8/8.7
2005	38.5	15	24.9	20.9	13	1.6	40.3/9.9
2006	40.1	11	22	25.3	30.1	3.2	21.5/8.9
2007	51.8	11.1	30.5	27.7	20.4	5.5	14.6/3.1
2008	46.8	11.6	30.9	29.3	24.9	6.3	5.8/-
2009	49	8.8	40.1	25.3	67.1	7.8	0
2010	43.6	19	50	35.7	87	10.4	0
2011	55.8	31.1	61.1	38.9	107.7	14.3	0
2012	58.8	31.3	57.5	39.2	103.2	24.8	0
2013	40.1	28.3	37.7	26.9	52.1	8.1	0
2014	35.2	26.3	32.5	25.8	49	8.6	0

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

1) Provisional

2) Figures based on Norwegian/Russian IUU estimates.

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

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

Year	Faroe Islands	France	GDR (–1990) & Green-land (1992–)	Ger-many	Nor-way[4]	Poland	UK	Russia[2]	Others	Total[3]
1977	213	1510	144	4798	40118	-	10878	52210	287	110158
1978	466	1411	369	1521	39955	1	5766	45895	38	95422
1979	343	1198	10	1948	66849	2	6454	26365	454	103623
1980	497	226	15	1365	66501	-	2948	20706	246	92504
1981	381	414	22	2402	63435	Spain	1682	13400	-	81736
1982	496	53	-	1258	43702	-	827	2900	-	49236
1983	428	-	1	729	22364	139	259	680	-	24600
1984	297	15	4	400	18813	37	276	1103	-	20945
1985	424	21	20	395	21272	77	153	22690	-	45052
1986	893	12	75	1079	52313	22	431	45738	-	100563
1987	464	7	83	3105	72419	59	563	78211	5	154916
1988	1113	116	78	1323	60823	72	435	31293	2	95255
1989	1217	-	26	171	36451	1	590	20062	-	58518
1990	705	-	5	167	20621	-	494	5190	-	27182
1991	1117	-	**Green-land**	213	22178	-	514	12177	17	36216
1992	1093	151	1719	387	36238	38	596	19699	1	59922
1993	546	1215	880	1165	40978	76	1802	35071	646	82379
1994	2761	678	770	2412	71171	22	4673	51822	877	135186
1995	2833	598	1097	2675	76886	14	3111	54516	718	142448
1996	3743	6	1510	942	94527	669	2275	74239	217	178128
1997	3327	540	1877	972	103407	364	2340	41228	304	154359
1998	1903	241	854	385	75108	257	1229	20559	94	100630
1999	1913	64	437	641	48182	652	694	30520	92	83195
2000	631	178	432	880	42009	502	747	22738	827	68944
2001	1210	324	553	554	49067	1497	1068	34307	1060	89640
2002	1564	297	858	627	52247	1505	1125	37157	682	114798
2003	1959	382	1363	918	56485	1330	1018	41142	1103	138926

Year	Faroe Islands	France	GDR (–1990) & Green-land (1992–)	Ger-many	Nor-way[4]	Poland	UK	Russia[2]	Others	Total[3]
2004	2484	103	1680	823	62192	54	1250	54347	1569	158279
2005	2138	333	15	996	60850	963	1899	50012	1262	158298
2006	2390	883	1830	989	69272	703	1164	53313	1162	153157
2007	2307	277	1464	1123	71244	125	1351	66569	2511	161525
2008	2687	311	1659	535	72779	283	971	68792	1759	155604
2009	2820	529	1410	1957	104354	317	1315	85514	1845	200061
2010	3173	764	1970	3539	123384	379	1758	111372	2862	249201
2011	1759	268	2110	1724	158202	502	1379	139912	4763	310619
2012	2055	322	3984	1111	159602	441	833	143886	3393	315627
2013	1886	342	1795	500	99215	439	639	85668	3260	193744
2014	1470	198	1150	340	91306	187	355	78725	3791	177522
2015	2459	145	1047	124	95094	246	450	91864	3327	194756
2016	2460	340	1401	170	108718	200	575	115710	3838	233412
2017	2776	108	1810	170	113132	228	372	106714	2279	227588
2018	2333	183	1317	385	93839	169	453	90486	2111	191276
2019	1515	143	1208	204	93860	280	456	76125	1611	175402
2020[1)]	1392	96	910	282	88108	45	320	89030	2286	182468

1) Provisional figures.

2) USSR prior to 1991.

3) Figures based on Norwegian IUU estimates in 2002–2008 (see table 4.1)

4) Included landings in Norwegian statistical areas 06 and 07 (from 1983)

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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950	0	4446	3189	37949	35344	18849	28868	9199	1979	1093	853	867	1257
1951	4069	222	65643	9178	18014	13551	6808	6850	3322	1182	734	178	436
1952	0	13674	6012	151996	13634	9850	4693	3237	2434	606	534	185	161
1953	392	8031	64528	13013	70781	5431	2867	1080	424	315	393	202	410
1954	1726	493	6563	154696	5885	27590	3233	1302	712	319	126	68	349

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1955	0	989	1154	10689	176678	4993	28273	1445	271	100	50	30	20
1956	97	3012	16437	5922	14713	127879	3182	8003	450	200	80	60	45
1957	828	243	2074	24704	7942	12535	46619	1087	1971	356	17	40	119
1958	153	2312	1727	5914	31438	5820	12748	17565	822	1072	226	79	296
1959	169	2425	20318	7826	7243	14040	3154	2237	5918	285	316	71	113
1960	2319	3613	39910	70912	13647	7101	6236	1579	2340	2005	497	70	42
1961	362	5531	15429	56855	63351	8706	3578	4407	788	527	1287	67	80
1962	0	4524	39503	30868	48903	33836	3201	1341	1773	242	247	483	28
1963	3	2143	28466	72736	18969	13579	9257	1239	559	409	80	84	212
1964	149	834	22363	49290	30672	5815	3527	2716	833	104	206	235	190
1965	0	3498	5936	46356	40201	12631	1679	974	897	123	204	123	471
1966	0	2577	26345	22631	63176	29048	5752	582	438	189	186	25	30
1967	0	53	15907	41346	13496	25719	8872	1616	218	175	155	75	41
1968	0	33	657	67632	41267	7748	15599	5292	655	182	101	115	70
1969	0	1061	1524	1968	44634	19002	3620	4937	1628	316	43	43	23
1970	480	281	23444	2454	1906	22417	8100	2012	2016	740	166	26	96
1971	15	3535	1978	24358	1257	918	9279	3056	826	1043	369	130	35
1972	133	9399	230942	22315	42981	3206	1611	6758	2638	900	989	538	120
1973	0	5956	70679	260520	24180	6919	422	426	1692	529	147	339	95
1974	281	3713	9685	41706	88120	5829	4138	382	618	2043	935	276	659
1975	1321	4355	10037	14088	33871	49711	2135	1236	92	131	500	147	287
1976	3475	7499	13994	13454	6810	20796	40057	1247	1350	193	280	652	671
1977	184	18456	55967	22043	7368	2586	7781	11043	311	388	96	101	182
1978	46	2033	47311	18812	4076	1389	1626	2596	6215	162	258	3	139
1979	0	48	17540	35290	10645	1429	812	546	1466	2310	181	87	55
1980	0	0	627	22878	21794	2971	250	504	230	842	1299	111	50
1981	1	68	486	2561	22124	10685	1034	162	162	72	330	564	69
1982	2	29	883	900	3372	12203	2625	344	75	80	91	321	238
1983	3	351	1173	2636	1360	2394	2506	1799	267	37	60	100	132

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1984	7	754	1271	1019	1899	657	950	2619	352	87	2	22	53
1985	4	2952	29624	1695	564	1009	943	886	1763	588	124	64	93
1986	506	650	23113	68429	1565	783	896	393	702	1144	443	130	414
1987	9	83	5031	87170	64556	960	597	376	212	230	419	245	73
1988	7	139	1439	12478	47890	20429	397	178	74	88	168	198	80
1989	611	221	2157	4986	16071	25313	3198	147	1	28	28	53	96
1990	2	446	1015	2580	2142	4046	6221	840	134	42	14	13	44
1991	23	533	4421	3564	2416	3299	4633	3953	461	83	9	18	27
1992	49	2793	11571	11567	4099	2642	2894	3327	3498	486	35	32	18
1993	498	272	13487	19457	13704	4103	1747	1886	2105	1965	201	96	25
1994	95	187	3374	47821	36333	13264	2057	903	1453	2769	1802	259	49
1995	2	85	2003	16109	72644	19145	6417	746	361	770	655	804	116
1996	35	478	1662	6818	36473	73579	13426	2944	573	365	533	598	767
1997	70	94	2280	5633	12603	32832	49478	5636	778	245	126	158	463
1998	547	1476	1701	11304	9258	8633	13801	19469	2113	330	59	54	377
1999	104	568	16839	8039	15365	6073	4466	6355	6204	647	117	109	220
2000	46	692	1520	29986	6496	5149	2406	1657	1570	1744	183	70	184
2001	374	1758	12971	5230	32049	5279	2941	1137	1161	1169	747	169	288
2002	59	603	7132	46335	11084	21985	2602	1602	482	448	581	349	98
2003	123	611	6803	31448	56480	11736	14541	1637	2178	858	411	413	395
2004	58	1295	7993	21116	41310	41226	4939	4914	598	1252	296	139	465
2005	102	865	11452	19369	22887	37067	24461	2393	2997	990	201	263	1059
2006	271	2496	4539	35040	27571	15033	16023	8567	1259	1298	222	175	321
2007	575	3914	30707	15213	45992	18516	10642	7889	2570	678	605	197	185
2008	440	2089	14536	44192	15926	31173	9145	4520	2846	1181	274	214	166
2009	483	1364	15379	55013	52498	13679	15382	3800	1669	887	285	353	321
2010	457	620	6545	52006	80622	50306	9273	5324	1954	1114	533	242	621
2011	909	806	1277	8501	90394	100522	39496	4397	2340	668	437	269	708
2012	268	611	7814	4206	18007	93055	82721	14445	1325	448	217	216	568

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
2013	402	904	1778	12780	3805	12297	58024	29930	4976	957	331	212	535
2014	528	649	6948	4503	14563	6833	16304	39620	16439	2431	619	440	545
2015	303	1334	1645	27317	8526	16624	7950	20538	25534	6677	1556	295	312
2016	294	655	5774	3482	33177	9563	18045	12030	21875	13492	4757	876	248
2017	724	1898	30744	46463	16895	48927	10518	14992	9 485	8447	6640	1872	317
2018	679	1438	9424	16291	34060	8466	18882	5123	8902	4125	3564	4504	1040
2019	797	968	13908	28572	24171	32555	6278	6803	2601	3618	1225	1715	1400
2020	122	1298	10797	62206	46715	18137	10773	3051	2839	1445	996	915	1092

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

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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1969	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1970	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1971	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1972	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1973	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1974	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1975	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1976	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1977	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1978	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1979	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1980	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1981	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1982	0.299	0.519	0.75	1.038	1.321	1.617	1.873	2.147	2.418	2.698	2.931	3.094	3.461
1983	0.188	0.689	1.033	1.408	1.71	2.149	2.469	2.748	3.069	3.687	4.516	3.094	3.461
1984	0.408	0.805	1.218	1.632	2.038	2.852	2.845	3.218	3.605	4.065	4.407	4.734	5.099
1985	0.319	0.383	0.835	1.29	1.816	2.174	2.301	2.835	3.253	3.721	4.084	4.137	4.926
1986	0.218	0.325	0.612	1.064	1.539	1.944	2.362	2.794	3.25	3.643	4.14	4.559	5.927
1987	0.143	0.221	0.497	0.765	1.179	1.724	2.135	2.551	3.009	3.414	3.84	4.415	5.195
1988	0.279	0.551	0.55	0.908	1.097	1.357	1.537	1.704	2.403	2.403	2.486	2.531	2.834
1989	0.258	0.55	0.684	0.84	0.998	1.176	1.546	1.713	1.949	2.14	2.389	2.522	2.797
1990	0.319	0.601	0.793	1.172	1.397	1.624	1.885	2.112	2.653	3.102	3.18	3.438	3.319
1991	0.216	0.616	0.941	1.281	1.556	1.797	2.044	2.079	2.311	2.788	3.408	2.896	3.274
1992	0.055	0.458	0.906	1.263	1.535	1.747	2.043	2.2	2.298	2.494	2.49	2.673	2.923
1993	0.381	0.64	0.94	1.204	1.487	1.748	1.994	2.237	2.417	2.654	2.906	3.184	3.363
1994	0.278	0.521	0.614	0.906	1.287	1.602	1.968	2.059	2.39	2.545	2.881	2.918	3.222
1995	0.258	0.446	0.739	0.808	1.107	1.556	1.838	2.234	2.416	2.602	2.965	3.163	3.786
1996	0.287	0.427	0.683	0.868	1.045	1.363	1.71	1.886	2.214	2.37	2.438	2.707	2.896
1997	0.408	0.575	0.682	1.028	1.151	1.369	1.637	1.856	2.073	2.5	2.279	2.532	2.609

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1998	0.409	0.593	0.748	0.974	1.262	1.433	1.641	1.863	2.069	2.335	2.511	2.8	2.849
1999	0.435	0.695	0.826	1.079	1.261	1.485	1.634	1.798	2.032	2.237	2.339	2.611	2.865
2000	0.378	0.577	0.853	1.186	1.395	1.588	1.808	1.989	2.264	2.415	2.587	2.647	3.098
2001	0.391	0.647	0.751	1.104	1.459	1.709	1.921	2.182	2.331	2.609	2.757	3.376	3.338
2002	0.159	0.407	0.687	1.001	1.363	1.643	1.975	2.086	2.294	2.487	2.612	2.847	3.501
2003	0.198	0.384	0.594	0.875	1.113	1.364	1.361	1.972	1.636	1.877	2.088	2.351	2.842
2004	0.328	0.429	0.636	0.886	1.183	1.508	1.821	2.075	2.339	2.58	2.527	3.153	3.197
2005	0.285	0.492	0.722	0.906	1.121	1.343	1.619	2.036	2.177	2.382	2.527	2.496	2.81
2006	0.311	0.567	0.745	1.041	1.287	1.504	1.72	2.082	2.377	2.738	3.082	3.02	3.43
2007	0.329	0.431	0.652	0.899	1.197	1.435	1.722	1.99	2.309	2.715	2.987	2.947	3.591
2008	0.383	0.484	0.658	0.901	1.242	1.515	1.781	2.18	2.33	2.664	3.019	3.326	3.829
2009	0.378	0.508	0.707	1.024	1.28	1.538	1.806	2.107	2.398	2.531	2.606	3.089	3.541
2010	0.317	0.499	0.642	0.887	1.137	1.396	1.702	1.907	2.095	2.404	2.534	3.064	3.249
2011	0.423	0.513	0.811	0.953	1.093	1.254	1.462	1.715	1.978	2.328	2.305	2.55	2.76
2012	0.271	0.506	0.756	1.004	1.174	1.371	1.514	1.715	2.051	2.444	2.414	2.615	2.932
2013	0.469	0.542	0.821	1.014	1.217	1.401	1.571	1.714	1.914	2.168	2.24	2.516	2.807
2014	0.469	0.645	0.792	1.033	1.253	1.417	1.625	1.793	1.941	2.081	2.479	2.703	3.011
2015	0.473	0.647	0.876	1.054	1.327	1.571	1.777	1.934	2.025	2.216	2.481	2.99	3.455
2016	0.497	0.743	0.882	1.115	1.369	1.662	1.917	2.089	2.301	2.567	3.076	3.286	3.331
2017	0.449	0.608	0.874	1.088	1.378	1.666	1.879	2.146	2.258	2.476	2.72	2.98	3.713
2018	0.443	0.663	0.820	1.051	1.339	1.629	1.927	2.156	2.372	2.588	2.728	2.773	3.175
2019	0.341	0.508	0.729	0.955	1.275	1.581	1.834	2.151	2.378	2.607	2.868	2.934	3.382
2020	0.364	0.523	0.629	0.788	1.131	1.489	1.821	2.126	2.426	2.651	2.771	3.147	3.359

Table 4.6. Northeast Arctic haddock. Stock weights-at-age (kg). The data from 1950–1993 is unchanged AFWG 2019, the data from 1994 and onward have been updated this year. The ages 3–13 are adjusted to account for the lack of the Russian survey as described in the stock annex, age 1–2 are unadjusted smoothed estimates based on winter survey data.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1950	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1951	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1952	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1953	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1954	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1955	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1956	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1957	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1958	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1959	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1960	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1961	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1962	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1963	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1964	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1965	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1966	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1967	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1968	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1969	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1970	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1971	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1972	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1973	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1974	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1975	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1976	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1977	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
1978	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1979	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1980	0.063	0.262	0.454	0.878	1.159	1.675	2.292	3.134	3.31	3.553	3.792	3.792	3.792
1981	0.051	0.274	0.603	0.805	1.315	1.582	2.118	2.728	3.51	3.679	3.904	3.904	3.904
1982	0.036	0.224	0.631	1.049	1.217	1.782	2.017	2.553	3.14	3.853	4.016	4.016	4.016
1983	0.035	0.164	0.524	1.098	1.558	1.663	2.255	2.448	2.97	3.524	4.165	4.165	4.165
1984	0.028	0.158	0.391	0.926	1.632	2.093	2.121	2.718	2.865	3.363	3.878	3.878	3.878
1985	0.03	0.127	0.379	0.700	1.394	2.195	2.626	2.572	3.158	3.261	3.728	3.728	3.728
1986	0.035	0.136	0.311	0.682	1.069	1.898	2.761	3.138	3.005	3.568	3.632	3.632	3.632
1987	0.042	0.161	0.331	0.569	1.047	1.473	2.411	3.307	3.616	3.412	3.946	3.946	3.946
1988	0.039	0.189	0.383	0.603	0.887	1.452	1.895	2.915	3.822	4.054	3.787	3.787	3.787
1989	0.037	0.175	0.445	0.689	0.936	1.248	1.878	2.317	3.395	4.297	4.449	4.449	4.449
1990	0.031	0.169	0.413	0.789	1.054	1.312	1.635	2.308	2.728	3.844	4.73	4.73	4.73
1991	0.025	0.141	0.402	0.737	1.193	1.458	1.714	2.035	2.732	3.122	4.256	4.256	4.256
1992	0.023	0.114	0.34	0.721	1.119	1.63	1.881	2.127	2.437	3.142	3.491	3.491	3.491
1993	0.025	0.107	0.279	0.616	1.100	1.537	2.08	2.308	2.54	2.831	3.531	3.531	3.531
1994	13.8	22.1	0.25	0.502	0.936	1.646	2.17	2.713	2.866	2.817	2.978	3.64	4.181
1995	14.9	22.6	0.261	0.465	0.795	1.311	2.113	2.633	3.166	3.295	3.228	3.163	3.955
1996	14.9	24.3	0.278	0.485	0.744	1.132	1.714	2.568	3.092	3.61	3.719	3.419	3.481
1997	15.2	24.3	0.343	0.512	0.766	1.06	1.49	2.122	3.021	3.546	4.044	3.887	3.738
1998	14	24.8	0.343	0.622	0.813	1.096	1.412	1.873	2.546	3.466	3.957	4.181	4.199
1999	14.2	23	0.363	0.627	0.97	1.154	1.447	1.772	2.263	2.956	3.888	4.111	4.49
2000	13.7	23.3	0.293	0.657	0.976	1.36	1.517	1.822	2.147	2.655	3.365	4.059	4.416
2001	13.2	22.5	0.301	0.538	1.023	1.36	1.774	1.905	2.205	2.539	3.05	3.56	4.361
2002	13.9	21.8	0.273	0.556	0.848	1.428	1.774	2.191	2.299	2.603	2.921	3.252	3.871
2003	13.9	22.8	0.248	0.502	0.873	1.2	1.844	2.191	2.61	2.695	2.993	3.119	3.56
2004	14.1	22.8	0.283	0.461	0.795	1.238	1.572	2.284	2.623	3.043	3.093	3.178	3.434
2005	12.7	23.1	0.283	0.528	0.732	1.132	1.618	1.968	2.702	3.043	3.444	3.282	3.497
2006	12.6	20.9	0.293	0.524	0.831	1.053	1.49	2.023	2.371	3.145	3.46	3.624	3.608

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
2007	13.2	20.9	0.219	0.542	0.831	1.177	1.395	1.873	2.432	2.776	3.555	3.64	3.938
2008	14	21.7	0.219	0.415	0.855	1.177	1.553	1.761	2.263	2.845	3.168	3.738	3.955
2009	14.1	22.9	0.248	0.411	0.664	1.207	1.544	1.936	2.135	2.669	3.242	3.373	4.041
2010	15.3	23.1	0.286	0.461	0.664	0.957	1.581	1.936	2.335	2.526	3.05	3.434	3.689
2011	14.8	24.9	0.295	0.528	0.732	0.951	1.279	1.979	2.335	2.749	2.908	3.252	3.754
2012	15.7	24.3	0.366	0.546	0.836	1.053	1.271	1.626	2.383	2.735	3.137	3.105	3.56
2013	15.1	25.5	0.339	0.667	0.861	1.184	1.395	1.617	1.981	2.79	3.137	3.327	3.419
2014	15.2	24.6	0.391	0.617	1.03	1.215	1.563	1.761	1.97	2.352	3.183	3.327	3.64
2015	14.9	24.8	0.353	0.704	0.962	1.437	1.59	1.946	2.135	2.34	2.728	3.373	3.64
2016	14.2	24.3	0.363	0.642	1.087	1.351	1.865	1.99	2.346	2.513	2.715	2.921	3.689
2017	13.8	23.2	0.343	0.662	0.996	1.516	1.763	2.296	2.395	2.749	2.908	2.907	3.237
2018	13.6	22.7	0.298	0.622	1.023	1.394	1.948	2.179	2.729	2.803	3.153	3.105	3.222
2019	13.4	22.3	0.278	0.55	0.97	1.428	1.804	2.393	2.597	3.159	3.197	3.342	3.419
2020	NA	22.1	0.266	0.516	0.866	1.36	1.854	2.238	2.838	3.028	3.572	3.388	3.656
2021	NA	NA	0.259	0.494	0.813	1.222	1.774	2.284	2.663	3.279	3.444	3.754	3.705

Table 4.7. Northeast Arctic haddock. Proportion mature-at-age. The data from 1950–1993 is unchanged since AFWG 2019, the data from 1994 and onward have been updated this year, ages 11–13+ is set to 1 (not shown)

Year	1	2	3	4	5	6	7	8	9	10
1950	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1951	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1952	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1953	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1954	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1955	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1956	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1957	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1958	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1959	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1960	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1961	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994

Year	1	2	3	4	5	6	7	8	9	10
1962	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1963	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1964	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1965	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1966	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1967	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1968	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1969	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1970	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1971	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1972	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1973	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1974	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1975	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1976	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1977	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1978	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1979	0	0	0.027	0.101	0.311	0.622	0.845	0.944	0.982	0.994
1980	0	0	0.026	0.076	0.243	0.649	0.86	0.95	0.984	0.995
1981	0	0	0.056	0.104	0.303	0.549	0.857	0.948	0.984	0.995
1982	0	0	0.053	0.161	0.332	0.577	0.77	0.947	0.983	0.995
1983	0	0	0.057	0.183	0.472	0.665	0.8	0.906	0.983	0.995
1984	0	0	0.044	0.196	0.51	0.801	0.862	0.921	0.967	0.995
1985	0	0	0.027	0.149	0.522	0.796	0.928	0.953	0.973	0.989
1986	0	0	0.021	0.103	0.454	0.758	0.928	0.977	0.984	0.991
1987	0	0	0.021	0.076	0.294	0.713	0.918	0.976	0.993	0.994
1988	0	0	0.025	0.074	0.24	0.576	0.898	0.975	0.993	0.998
1989	0	0	0.032	0.09	0.25	0.534	0.822	0.966	0.993	0.998
1990	0	0	0.046	0.127	0.305	0.578	0.798	0.937	0.99	0.997

Year	1	2	3	4	5	6	7	8	9	10
1991	0	0	0.041	0.164	0.358	0.623	0.82	0.925	0.98	0.997
1992	0	0	0.03	0.147	0.449	0.704	0.855	0.936	0.976	0.994
1993	0	0	0.018	0.113	0.396	0.741	0.878	0.95	0.979	0.992
1994	0	0	0.028	0.083	0.263	0.627	0.838	0.941	0.958	0.957
1995	0	0	0.029	0.074	0.204	0.49	0.825	0.932	0.975	0.98
1996	0	0	0.031	0.079	0.184	0.408	0.716	0.925	0.972	0.99
1997	0	0	0.042	0.086	0.192	0.373	0.634	0.858	0.968	0.988
1998	0	0	0.042	0.117	0.211	0.391	0.602	0.803	0.931	0.986
1999	0	0	0.046	0.119	0.277	0.418	0.616	0.776	0.898	0.964
2000	0	0	0.033	0.128	0.279	0.512	0.645	0.789	0.88	0.946
2001	0	0	0.035	0.092	0.3	0.512	0.735	0.81	0.889	0.937
2002	0	0	0.03	0.097	0.225	0.542	0.735	0.871	0.902	0.942
2003	0	0	0.027	0.083	0.235	0.44	0.757	0.871	0.937	0.949
2004	0	0	0.032	0.073	0.204	0.457	0.666	0.886	0.938	0.969
2005	0	0	0.032	0.09	0.179	0.408	0.683	0.826	0.945	0.969
2006	0	0	0.033	0.089	0.218	0.37	0.634	0.837	0.911	0.973
2007	0	0	0.023	0.094	0.218	0.429	0.594	0.803	0.919	0.954
2008	0	0	0.023	0.063	0.228	0.429	0.659	0.772	0.898	0.958
2009	0	0	0.027	0.062	0.154	0.443	0.655	0.818	0.878	0.947
2010	0	0	0.032	0.073	0.154	0.325	0.67	0.818	0.907	0.936
2011	0	0	0.035	0.09	0.179	0.322	0.543	0.828	0.907	0.952
2012	0	0	0.046	0.095	0.22	0.37	0.54	0.731	0.913	0.951
2013	0	0	0.041	0.131	0.23	0.433	0.594	0.728	0.851	0.955
2014	0	0	0.051	0.116	0.303	0.447	0.662	0.772	0.848	0.918
2015	0	0	0.043	0.142	0.274	0.545	0.673	0.82	0.878	0.917
2016	0	0	0.046	0.123	0.327	0.509	0.762	0.831	0.908	0.935
2017	0	0	0.042	0.129	0.288	0.578	0.732	0.888	0.914	0.952
2018	0	0	0.035	0.117	0.3	0.527	0.785	0.868	0.947	0.956
2019	0	0	0.031	0.096	0.277	0.542	0.744	0.903	0.936	0.974

Year	1	2	3	4	5	6	7	8	9	10
2020	0	0	0.03	0.087	0.233	0.512	0.76	0.879	0.956	0.968
2021			0.029	0.081	0.211	0.45	0.735	0.886	0.942	0.979

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

Age	0	1	2	3	4	5	6	Biomass
1984	1975.1	990.1	15.3	0.1	0.0	0.0	0.0	51.7
1985	2027.1	1378.0	5.1	0.0	0.0	0.0	0.0	53.5
1986	92.8	624.2	224.5	168.5	0.0	0.0	0.0	109.8
1987	0.0	1058.2	0.0	0.0	0.0	0.0	0.0	5.8
1988	0.0	16.8	0.5	8.7	0.0	0.2	0.0	2.5
1989	21.3	221.3	0.0	0.0	0.0	0.0	0.0	9.9
1990	47.9	135.9	33.9	3.3	0.0	0.0	0.0	13.9
1991	0.0	352.4	12.9	0.0	0.0	0.0	0.0	15.5
1992	132.1	1737.1	123.0	0.9	0.0	0.0	0.0	87.7
1993	824.9	1441.6	143.6	32.2	3.1	2.6	0.0	69.3
1994	1348.5	1483.4	73.6	23.9	6.9	0.8	0.0	48.4
1995	181.8	2868.8	167.3	12.4	28.2	27.8	0.3	113.6
1996	359.6	1549.9	154.2	38.2	5.2	2.5	3.2	66.6
1997	0.0	947.0	38.9	26.4	1.7	0.8	0.5	44.0
1998	0.0	1739.4	27.5	1.7	2.6	0.4	0.0	36.0
1999	0.0	1041.9	25.3	0.4	0.0	0.0	0.0	29.6
2000	813.4	1412.0	71.6	2.2	1.1	0.2	0.1	58.3
2001	1047.9	593.6	53.3	4.7	0.1	0.0	0.0	51.2
2002	456.0	2437.4	240.6	39.5	2.3	0.4	0.2	127.0
2003	1140.2	3568.0	214.3	39.3	12.7	1.2	0.0	165.8
2004	5395.1	2862.8	303.7	39.8	9.9	2.5	0.0	198.1
2005	7703.0	6674.7	276.3	55.4	9.3	2.3	0.9	324.5
2006	12706.3	8410.2	375.2	5.5	4.4	1.2	0.5	360.5
2007	1204.2	10143.7	660.2	71.9	3.9	2.2	0.2	377.6
2008	1354.5	964.7	894.3	227.7	44.3	5.7	3.3	293.3

Age	0	1	2	3	4	5	6	Biomass
2009	5607.2	1854.7	274.1	262.0	69.0	22.3	1.5	252.4
2010	1968.7	5687.7	180.0	66.9	68.5	62.2	11.6	266.8
2011	2316.3	2622.4	451.4	56.1	75.1	86.7	19.4	279.0
2012	231.9	7132.1	134.3	107.3	15.0	6.7	4.3	219.5
2013	2172.4	1581.6	376.4	31.6	22.4	5.5	4.2	200.4
2014	1195.0	1991.3	140.6	27.5	1.8	0.6	0.0	87.6
2015	4931.7	2579.5	131.3	13.6	44.5	1.5	0.2	177.8
2016	8067.8	2654.8	276.8	22.6	2.5	7.7	1.8	222.0
2017	4421.9	7602.9	229.3	22.9	12.7	6.2	13.7	271.8
2018	2348.7	7041.1	583.6	65.0	6.9	0.6	0.0	276.1
2019	542.7	4542.6	411.3	119.2	8.1	0.3	0.0	211.8
2020	2008.8	450.9	72.5	63.7	80.4	4.2	0.1	91.7
Av.1984–2020	**2017.4**	**2713.4**	**199.9**	**44.9**	**14.7**	**6.9**	**1.8**	**142.5**

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

```
Northeast Arctic haddock

104
RU-BTr-Q4                    #Russian trawl and acoustic survey bottom trawl index
1991 2020
1 1 0.9 1.00
3 8
1   62   9   3   6  18  17
1  346  50   4   6   9   9
1 1985 356  48   8   4   4
1  442 1014 116  15   1   6
1   31 123 370  40   5   4
1   28  49 362 334  29   6
1   32  32  10  27  10   8
1   38  46   8   5  15   5
1  196  39  37   8   3  14
1   60 109  26  11   2   5
1  334  40  65  11   4   4
1  399 450  47  24   4   3
1  221 299 231  34  16   3
1  113  94 107  87   5   6
1  240  86  48  57  24   3
1  113 119  57  26  24  13
1  838  73 137  38  14  15
```

1	2557	1051	124	111	17	11
1	1647	1704	631	57	32	9
1	299	1697	1589	466	34	17
1	47	268	1087	783	165	13
1	209	49	160	720	480	70
1	61	175	50	104	374	272
1	250	46	175	56	142	416
1	22	199	40	74	28	171
1	-1	-1	-1	-1	-1	-1
1	71	99	9	38	6	27
1	-1	-1	-1	-1	-1	-1
1	-1	-1	-1	-1	-1	-1
1	-1	-1	-1	-1	-1	-1

BS-NoRU-Q1(Aco) # Joint Barents Sea winter survey acoustic index

1994 2021

1 1 0.077 0.189

3 9

1	348.7	626.6	121.4	8.55	0.7	0.33	2.71
1	41.5	121.5	395.4	47.6	2.8	0.05	0.83
1	30	22.1	68.7	143.7	5.67	0.94	0.07
1	57.3	22.2	15.5	56.1	62.8	4.68	0.19
1	33.8	58.8	24.2	7.7	14.1	20.7	1.62
1	83.7	21.6	22.1	6.17	1.55	3.88	2.77
1	36.4	75.5	14	12.6	1.57	0.53	3.02
1	233.5	40.2	41.4	2.2	1.61	0.16	0.71
1	255.2	201.8	18.5	11.7	1.59	0.29	0.56
1	203.7	184.6	136	12.3	6.01	0.26	0.9
1	151	101.8	107.8	57.7	7.62	1.15	0.55
1	221.3	115.7	57.4	56.7	12.7	0.38	0.33
1	56.3	123.8	47.4	19.3	13.6	3.23	0.35
1	209.3	46.1	80.6	28.9	10	5.05	2.79
1	812.4	303	90	74.1	7.41	12.8	2.11
1	883.7	630	266.6	38.9	14.6	1.26	1.71
1	128.1	631	604	167	12.1	2.94	2.11
1	54.2	84.2	313	292.2	54.9	1.72	1.47
1	191.6	48.8	88.1	310.6	172.5	30.1	1.01
1	67.3	146.8	35.4	53	223.8	102.7	14.35
1	334.8	39.12	108.71	23.2	34.76	86.34	38.8
1	24.31	189.4	26.6	46.17	9.22	22.41	31.97
1	71.82	12.06	59.67	12.5	17.31	7.48	33.27
1	81.13	65.08	4.8	34.8	6.24	7.93	17.73
1	170.4	62.87	64.18	6.88	15.77	2.75	14.52
1	507.61	146.22	31.73	21.88	4.9	3.27	4.11
1	290.483	302.908	81.912	23.057	11.49	1.804	6.219
1	43.1	114.3	173.8	17.1	6.28	0.48	1.12

BS-NoRu-Q1 (BTr) # Joint Barents Sea winter survey bottom trawl index

1994 2021

1 1 0.077 0.189

3 10

1	314.533	436.251	46.176	3.54	0.163	0.13	0.2	0.651
1	54.857	167.104	343.38	29.623	1.441	0.025	0.043	0.404
1	55.843	31.334	150.768	238.108	16.131	1.15	0	0.069
1	79.632	39.855	18.255	61.566	88.411	3.277	0.082	0.043
1	21.681	36.749	11.844	1.294	9.203	7.212	0.648	0.092
1	56.92	15.874	9.418	2.831	0.807	1.282	0.771	0.034
1	24.08	35.241	6.789	4.134	0.684	0.083	0.802	0.288
1	293.996	26.252	22.997	1.634	0.752	0.058	0.06	0.329
1	312.87	185.453	12.417	8.04	0.846	0.218	0.009	0.325
1	352.236	174.452	72.708	5.104	1.682	0.119	0.104	0.217
1	173.132	100.516	77.021	51.281	7.409	0.912	0.133	0.228
1	317.889	141.058	50.664	61.191	10.082	0.249	0.08	0.009
1	78.798	130.76	46.048	20.874	16.208	3.184	0.094	0.265
1	443.266	81.784	84.667	26.279	5.411	2.197	1.376	0.896
1	1591.031	583.606	53.079	54.732	6.794	10.248	0.23	0.167
1	1230.426	751.012	368.33	25.414	12.437	0.851	0.09	0.363
1	102.451	510.449	443.759	139.316	7.988	1.016	0.386	0.574
1	52.883	123.634	469.482	290.036	65.236	1.416	1.121	0.184
1	316.077	28.785	74.714	267.945	154.601	24.766	3.115	0.391
1	57.444	143.984	22.019	33.624	191.145	69.385	6.114	0.076
1	381.173	32.729	104.397	23.257	50.035	97.536	38.692	2.425
1	30.615	187.035	43.601	39.44	14.668	18.735	30.744	10.2
1	163.385	34.342	115.597	22.406	41.948	12.437	32.396	33.161
1	134.9	105.5	7.553	55.338	9.692	15.6	2.527	23.861
1	336.307	86.656	65.764	7.771	15.59	3.621	2.564	11.931
1	1075.552	187.224	49.399	16.996	4.038	2.948	0.736	1.91
1	424.225	586.985	99.123	22.08	6.057	2.605	1.042	2.827
1	118.428	194.033	302.978	20.677	4.628	0.848	0.204	0.93

FLT007: Eco-NoRu-Q3 (Btr) # Joint Barents Sea ecosystem survey bottom trawl index

2004 2020

1 1 0.65 0.75

3 9

1	123.368	70.303	69.118	31.482	2.989	1.721	0.22
1	324.56	89.531	30.44	32.246	15.035	0.472	1.116
1	107.467	124.64	41.597	18.98	17.482	7.289	1.384
1	1282.94	88.498	90.369	19.227	5.881	7.102	3.209
1	1154.869	405.999	43.133	35.517	4.94	2.514	2.539
1	650.742	619.088	305.883	21.045	6.549	0.87	0.576
1	184.001	865.318	666.439	147.72	15.84	2.73	0.589
1	40.446	73.802	392.93	301.368	37.357	2.972	0.514
1	92.468	20.348	67.607	214.052	152.03	12.739	2.003

1	25.779	65.228	19.575	50.846	150.131	76.427	7.561
1	261.631	40.768	70.161	25.781	60.452	85.771	19.646
1	42.148	213.636	25.132	37.111	20.577	47.868	42.903
1	209.303	34.43	184.09	47.965	56.787	40.367	125.907
1	70.313	70.306	11.47	20.537	3.963	4.025	15.265
1	-1	-1	-1	-1	-1	-1	-1
1	896.982	160.736	38.067	15.133	5.303	5.037	11.56
1	204.059	341.372	58.813	4.918	1.959	0.802	1.483

Table 4.10 Northeast Arctic haddock. SAM model configuration used. Updated at WKDEM 2020

```
#Configuration saved: Wed Feb 12 12:57:09 2020
# Where a matrix is specified rows corresponds to fleets and columns to ages.
# Same number indicates same parameter used
# Numbers (integers) starts from zero and must be consecutive
$minAge
# The minimum age class in the assessment
 3
$maxAge
# The maximum age class in the assessment
 13
$maxAgePlusGroup
# Is last age group considered a plus group for each fleet (1 yes, or 0 no).
 1 1 1 1 1
$keyLogFsta
# Coupling of the fishing mortality states (nomally only first row is used).
  0  1  2  3  4  5  5  5  5  5  5
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$corFlag
# Correlation of fishing mortality across ages (0 independent, 1 compound symmetry, 2 AR(1), 3
separable AR(1).
 2
$keyLogFpar
# Coupling of the survey catchability parameters (nomally first row is not used, as that is covered
by fishing mortality).
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
  0  1  1  1  1  1 -1 -1 -1 -1 -1
  2  3  3  3  3  4  4 -1 -1 -1 -1
  5  6  6  6  6  7  7  7 -1 -1 -1
  8  9  9  9  9  9  9 -1 -1 -1 -1
$keyQpow
# Density dependent catchability power parameters (if any).
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
  0  0  0  0  0  0 -1 -1 -1 -1 -1
  1  1  1  1  1  2  2 -1 -1 -1 -1
  3  3  3  3  3  4  4  4 -1 -1 -1
  5  5  5  5  5  5  5 -1 -1 -1 -1
```

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

```
$fixVarToWeight
# If weight attribute is supplied for observations this option sets the treatment (0 relative weight,
1 fix variance to weight).
 0
$fracMixF
# The fraction of t(3) distribution used in logF increment distribution
 0
$fracMixN
# The fraction of t(3) distribution used in logN increment distribution
 0
$fracMixObs
# A vector with same length as number of fleets, where each element is the fraction of t(3) distri-
bution used in the distribution of that fleet
 0 0 0 0 0
$constRecBreaks
# This option is only used in combination with stock-recruitment code 3)
  $predVarObsLink
# Coupling of parameters used in a mean-variance link for observations.
   0  1  2  2  2  2  2  2  2  2  2
   3  3  3  3  3  3 -1 -1 -1 -1 -1
   4  4  4  4  4  4  4 -1 -1 -1 -1
   5  5  5  5  5  5  5  5 -1 -1 -1
   6  6  6  6  6  6  6 -1 -1 -1 -1
```

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

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4–7)	Low	High	TSB	Low	High
1950	72387	46062	113757	214451	191896	239657	0.755	0.637	0.894	387984	347732	432897
1951	657549	421933	1024740	126198	111962	142244	0.683	0.574	0.812	433412	338704	554603
1952	88651	56447	139228	101722	88677	116687	0.712	0.595	0.851	425163	337716	535254
1953	1235085	805743	1893203	120624	103993	139915	0.536	0.443	0.650	733145	558302	962743
1954	133361	85029	209168	174452	147488	206344	0.430	0.353	0.524	826557	650141	1050844
1955	58610	36972	92912	313927	267217	368803	0.445	0.368	0.537	849059	713766	1009997
1956	229244	145866	360280	368382	313148	433358	0.470	0.390	0.567	690111	591624	804993
1957	60266	38168	95158	253706	217108	296473	0.425	0.353	0.512	435085	377199	501855
1958	72860	46450	114287	182036	157918	209837	0.517	0.428	0.623	315294	277030	358844
1959	389171	254295	595585	125360	108680	144599	0.445	0.366	0.540	333166	273423	405963
1960	320748	208438	493573	112847	99388	128128	0.540	0.450	0.648	418829	348061	503987
1961	145185	94620	222773	124852	111078	140333	0.663	0.560	0.786	402474	349320	463715
1962	294861	192640	451325	125250	111167	141117	0.791	0.670	0.933	376991	323928	438745
1963	315359	207593	479068	94365	82948	107352	0.757	0.634	0.905	353624	295169	423655
1964	353500	231399	540029	84511	74143	96329	0.632	0.523	0.763	386037	318642	467687
1965	126853	81897	196486	103153	89857	118418	0.524	0.432	0.635	386407	325823	458256
1966	313477	203773	482241	145776	126683	167746	0.557	0.463	0.671	451214	384496	529509

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4–7)	Low	High	TSB	Low	High
1967	341190	221107	526492	151263	130129	175829	0.441	0.363	0.535	464389	389441	553759
1968	18013	11107	29212	168174	145329	194610	0.482	0.397	0.586	426984	361320	504581
1969	20599	12799	33151	167949	143974	195917	0.411	0.335	0.504	316968	270836	370956
1970	209787	134801	326485	155435	131552	183655	0.383	0.309	0.474	286902	241277	341154
1971	109545	69787	171952	127588	107314	151692	0.327	0.261	0.409	263556	223617	310629
1972	1052876	667948	1659631	128490	111420	148176	0.653	0.533	0.799	601810	452127	801049
1973	310449	202458	476042	125203	107368	146001	0.534	0.435	0.655	637223	507838	799570
1974	66135	42760	102289	153690	133714	176650	0.504	0.415	0.612	462911	398743	537405
1975	59421	38424	91892	194817	166555	227875	0.497	0.414	0.597	378920	328264	437393
1976	61869	39371	97225	196331	168410	228881	0.721	0.606	0.857	296386	259233	338863
1977	120514	75884	191393	118795	99987	141140	0.735	0.606	0.893	201315	172466	234989
1978	214589	140083	328722	81208	67119	98254	0.623	0.505	0.768	199556	164222	242492
1979	161504	105201	247938	62610	52588	74542	0.580	0.466	0.722	206831	171527	249400
1980	22094	13599	35894	62985	53381	74317	0.471	0.377	0.589	213487	177892	256205
1981	10280	6095	17337	73069	61627	86634	0.432	0.345	0.540	168620	141915	200351
1982	16749	10277	27298	68801	56759	83398	0.379	0.301	0.479	122917	102645	147193
1983	8656	5087	14729	58364	47816	71239	0.351	0.275	0.449	87932	73504	105192
1984	13271	8149	21611	53199	43258	65423	0.315	0.244	0.406	71822	59820	86232

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4–7)	Low	High	TSB	Low	High
1985	358813	233153	552199	49169	40822	59223	0.395	0.309	0.504	191524	140182	261671
1986	478572	311663	734868	54924	46468	64919	0.535	0.425	0.675	374796	293890	477975
1987	90214	57751	140923	77959	66517	91369	0.628	0.504	0.783	356744	297363	427982
1988	38984	24377	62344	80099	67250	95402	0.509	0.407	0.637	253948	214793	300241
1989	28853	17865	46599	84610	69520	102976	0.372	0.294	0.470	193201	161348	231341
1990	37125	23767	57992	85901	69709	105854	0.211	0.165	0.270	153622	127998	184377
1991	111048	77956	158188	100647	84303	120159	0.239	0.190	0.300	186699	159043	219165
1992	328727	233077	463631	111090	95809	128808	0.294	0.237	0.365	291322	243904	347959
1993	848769	613008	1175203	125741	110626	142922	0.316	0.257	0.389	526073	433781	638001
1994	396614	318970	493159	153834	137161	172532	0.371	0.306	0.451	650312	566914	745978
1995	100060	77811	128671	186134	165514	209324	0.298	0.250	0.356	643113	566516	730065
1996	99507	77719	127404	215730	192019	242370	0.366	0.310	0.431	557155	495314	626717
1997	119084	93193	152169	186891	166282	210055	0.445	0.376	0.527	400459	358952	446765
1998	63240	48775	81995	130850	115668	148025	0.452	0.378	0.541	266478	238448	297802
1999	151245	120741	189455	94816	83809	107270	0.462	0.383	0.557	233978	208477	262597
2000	83258	65021	106611	78075	68910	88460	0.341	0.279	0.417	214801	189585	243371
2001	367666	300041	450533	91259	81229	102526	0.366	0.303	0.442	318048	280668	360407
2002	395448	321892	485812	108683	96817	122003	0.351	0.292	0.423	436563	384807	495280

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4–7)	Low	High	TSB	Low	High
2003	340113	272564	424403	136879	122623	152791	0.424	0.358	0.503	506909	450642	570201
2004	260359	212216	319424	155689	139461	173805	0.387	0.328	0.456	493539	441891	551224
2005	366492	300172	447466	166962	149621	186313	0.404	0.344	0.476	510380	457657	569177
2006	157564	127155	195244	151329	135466	169050	0.369	0.312	0.437	439168	393891	489649
2007	543223	441281	668715	153562	137718	171230	0.384	0.323	0.455	504466	450324	565117
2008	1112513	913961	1354200	163092	145133	183272	0.314	0.262	0.377	738154	647137	841971
2009	1025284	845638	1243094	183533	163348	206213	0.260	0.216	0.311	996702	871947	1139306
2010	240955	195431	297083	248053	220499	279050	0.244	0.206	0.291	1130768	991062	1290169
2011	117224	92480	148588	355613	315855	400375	0.255	0.217	0.301	1178847	1040816	1335183
2012	340386	276667	418780	475908	419566	539815	0.220	0.186	0.260	1175999	1040560	1329067
2013	119057	94420	150121	523943	460492	596137	0.148	0.124	0.177	1005601	890548	1135517
2014	411335	336043	503497	523619	463357	591718	0.154	0.128	0.185	983944	880258	1099843
2015	72464	56494	92950	497402	444871	556135	0.190	0.159	0.227	874947	787488	972120
2016	212760	170769	265075	489847	438583	547104	0.261	0.219	0.310	803199	722937	892372
2017	194179	156196	241399	410620	369903	455820	0.351	0.296	0.416	702033	634303	776994
2018	367841	295751	457503	303265	271126	339214	0.404	0.339	0.481	617524	553251	689263
2019	821773	668831	1009689	234446	206986	265549	0.433	0.355	0.527	695945	612581	790655
2020	441844	354723	550361	204484	175372	238429	0.438	0.347	0.554	722596	623367	837621

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4–7)	Low	High	TSB	Low	High
2021	153680	110687	213373	200849	162390	248417				648860	532298	790945

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

Year age	3	4	5	6	7	8	9	10	11	12	13
1950	0.096	0.412	0.706	0.849	1.052	0.886	0.886	0.886	0.886	0.886	0.886
1951	0.086	0.359	0.617	0.773	0.981	0.884	0.884	0.884	0.884	0.884	0.884
1952	0.092	0.380	0.641	0.797	1.029	0.933	0.933	0.933	0.933	0.933	0.933
1953	0.067	0.282	0.473	0.588	0.802	0.737	0.737	0.737	0.737	0.737	0.737
1954	0.048	0.207	0.357	0.468	0.689	0.648	0.648	0.648	0.648	0.648	0.648
1955	0.046	0.199	0.368	0.502	0.710	0.600	0.600	0.600	0.600	0.600	0.600
1956	0.050	0.210	0.389	0.549	0.733	0.621	0.621	0.621	0.621	0.621	0.621
1957	0.047	0.198	0.367	0.492	0.643	0.547	0.547	0.547	0.547	0.547	0.547
1958	0.058	0.235	0.450	0.601	0.781	0.690	0.690	0.690	0.690	0.690	0.690
1959	0.059	0.228	0.409	0.521	0.620	0.566	0.566	0.566	0.566	0.566	0.566
1960	0.089	0.317	0.537	0.633	0.672	0.616	0.616	0.616	0.616	0.616	0.616
1961	0.117	0.406	0.682	0.782	0.783	0.694	0.694	0.694	0.694	0.694	0.694
1962	0.147	0.502	0.853	0.941	0.867	0.722	0.722	0.722	0.722	0.722	0.722
1963	0.133	0.471	0.805	0.909	0.845	0.681	0.681	0.681	0.681	0.681	0.681
1964	0.097	0.360	0.634	0.769	0.765	0.647	0.647	0.647	0.647	0.647	0.647
1965	0.077	0.292	0.513	0.635	0.656	0.566	0.566	0.566	0.566	0.566	0.566
1966	0.090	0.328	0.563	0.667	0.670	0.555	0.555	0.555	0.555	0.555	0.555
1967	0.072	0.268	0.446	0.515	0.535	0.465	0.465	0.465	0.465	0.465	0.465
1968	0.084	0.297	0.490	0.554	0.588	0.513	0.513	0.513	0.513	0.513	0.513
1969	0.079	0.267	0.428	0.469	0.481	0.416	0.416	0.416	0.416	0.416	0.416
1970	0.082	0.262	0.402	0.428	0.439	0.381	0.381	0.381	0.381	0.381	0.381
1971	0.073	0.233	0.351	0.355	0.366	0.324	0.324	0.324	0.324	0.324	0.324
1972	0.193	0.503	0.759	0.696	0.654	0.545	0.545	0.545	0.545	0.545	0.545
1973	0.199	0.486	0.641	0.530	0.477	0.381	0.381	0.381	0.381	0.381	0.381
1974	0.179	0.431	0.547	0.515	0.522	0.460	0.460	0.460	0.460	0.460	0.460
1975	0.195	0.459	0.548	0.494	0.487	0.417	0.417	0.417	0.417	0.417	0.417
1976	0.289	0.647	0.785	0.723	0.728	0.640	0.640	0.640	0.640	0.640	0.640
1977	0.322	0.713	0.852	0.719	0.658	0.559	0.559	0.559	0.559	0.559	0.559

Year age	3	4	5	6	7	8	9	10	11	12	13
1978	0.223	0.546	0.726	0.644	0.576	0.505	0.505	0.505	0.505	0.505	0.505
1979	0.160	0.443	0.670	0.652	0.557	0.502	0.502	0.502	0.502	0.502	0.502
1980	0.101	0.316	0.525	0.563	0.481	0.459	0.459	0.459	0.459	0.459	0.459
1981	0.085	0.273	0.472	0.538	0.444	0.428	0.428	0.428	0.428	0.428	0.428
1982	0.075	0.244	0.411	0.477	0.385	0.380	0.380	0.380	0.380	0.380	0.380
1983	0.077	0.247	0.388	0.428	0.342	0.341	0.341	0.341	0.341	0.341	0.341
1984	0.069	0.226	0.347	0.376	0.308	0.293	0.293	0.293	0.293	0.293	0.293
1985	0.075	0.257	0.412	0.481	0.429	0.412	0.412	0.412	0.412	0.412	0.412
1986	0.088	0.315	0.541	0.666	0.619	0.588	0.588	0.588	0.588	0.588	0.588
1987	0.097	0.359	0.644	0.786	0.724	0.658	0.658	0.658	0.658	0.658	0.658
1988	0.071	0.278	0.511	0.655	0.592	0.537	0.537	0.537	0.537	0.537	0.537
1989	0.055	0.219	0.388	0.466	0.414	0.362	0.362	0.362	0.362	0.362	0.362
1990	0.029	0.126	0.214	0.255	0.248	0.231	0.231	0.231	0.231	0.231	0.231
1991	0.031	0.136	0.243	0.291	0.285	0.262	0.262	0.262	0.262	0.262	0.262
1992	0.032	0.146	0.291	0.367	0.372	0.341	0.341	0.341	0.341	0.341	0.341
1993	0.026	0.128	0.291	0.407	0.439	0.398	0.398	0.398	0.398	0.398	0.398
1994	0.024	0.124	0.305	0.476	0.579	0.544	0.544	0.544	0.544	0.544	0.544
1995	0.019	0.099	0.231	0.366	0.497	0.489	0.489	0.489	0.489	0.489	0.489
1996	0.024	0.123	0.286	0.439	0.614	0.620	0.620	0.620	0.620	0.620	0.620
1997	0.032	0.158	0.374	0.534	0.716	0.683	0.683	0.683	0.683	0.683	0.683
1998	0.038	0.178	0.402	0.552	0.677	0.676	0.676	0.676	0.676	0.676	0.676
1999	0.045	0.203	0.432	0.560	0.652	0.624	0.624	0.624	0.624	0.624	0.624
2000	0.033	0.159	0.325	0.412	0.468	0.438	0.438	0.438	0.438	0.438	0.438
2001	0.034	0.162	0.355	0.455	0.491	0.449	0.449	0.449	0.449	0.449	0.449
2002	0.031	0.151	0.321	0.453	0.481	0.423	0.423	0.423	0.423	0.423	0.423
2003	0.036	0.169	0.366	0.531	0.629	0.570	0.570	0.570	0.570	0.570	0.570
2004	0.034	0.158	0.329	0.483	0.578	0.547	0.547	0.547	0.547	0.547	0.547
2005	0.037	0.163	0.336	0.494	0.624	0.603	0.603	0.603	0.603	0.603	0.603
2006	0.036	0.159	0.316	0.443	0.558	0.549	0.549	0.549	0.549	0.549	0.549

Year age	3	4	5	6	7	8	9	10	11	12	13
2007	0.037	0.158	0.319	0.465	0.592	0.572	0.572	0.572	0.572	0.572	0.572
2008	0.025	0.112	0.230	0.383	0.532	0.524	0.524	0.524	0.524	0.524	0.524
2009	0.020	0.088	0.178	0.307	0.465	0.479	0.479	0.479	0.479	0.479	0.479
2010	0.020	0.084	0.168	0.287	0.438	0.489	0.489	0.489	0.489	0.489	0.489
2011	0.021	0.088	0.184	0.303	0.446	0.489	0.489	0.489	0.489	0.489	0.489
2012	0.020	0.082	0.159	0.264	0.373	0.400	0.400	0.400	0.400	0.400	0.400
2013	0.015	0.061	0.108	0.171	0.252	0.311	0.311	0.311	0.311	0.311	0.311
2014	0.017	0.069	0.121	0.178	0.249	0.345	0.345	0.345	0.345	0.345	0.345
2015	0.022	0.089	0.160	0.223	0.288	0.396	0.396	0.396	0.396	0.396	0.396
2016	0.029	0.115	0.224	0.312	0.392	0.509	0.509	0.509	0.509	0.509	0.509
2017	0.037	0.150	0.305	0.439	0.511	0.590	0.590	0.590	0.590	0.590	0.590
2018	0.037	0.155	0.348	0.523	0.590	0.640	0.640	0.640	0.640	0.640	0.640
2019	0.035	0.155	0.374	0.596	0.604	0.600	0.600	0.600	0.600	0.600	0.600
2020	0.035	0.156	0.385	0.598	0.615	0.579	0.579	0.579	0.579	0.579	0.579
2021											

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

Year age	3	4	5	6	7	8	9	10	11	12	13
1950	72387	101009	76017	37150	46935	16676	4880	2688	1381	1458	2057
1951	657549	47705	46081	27475	12803	12509	5437	1943	1014	446	1091
1952	88651	438929	30695	19192	9000	4349	3848	1638	740	358	506
1953	1235085	52138	209525	14008	6354	2642	1334	1051	533	255	309
1954	133361	913544	26058	91355	6875	2330	1091	550	387	198	228
1955	58610	84501	631189	14601	52376	3092	919	454	237	160	168
1956	229244	40701	55883	324913	7240	17802	1441	402	215	114	153
1957	60266	151466	27728	36033	111034	3106	6150	704	168	100	131
1958	72860	39770	92930	15488	20893	40149	1644	2509	354	84	120
1959	389171	51295	26037	40026	7337	7294	14884	731	899	148	88
1960	320748	266359	35741	15664	16981	3484	3678	6151	365	369	109

Year age	3	4	5	6	7	8	9	10	11	12	13
1961	145185	192859	145259	17681	6976	8042	1598	1508	2792	158	204
1962	294861	86481	92421	59752	6747	2709	3285	659	610	1159	139
1963	315359	177692	37947	26417	17576	2650	1088	1226	273	244	536
1964	353500	199644	75558	12273	7678	5842	1227	440	508	123	346
1965	126853	240169	115011	30342	4168	2789	2265	536	199	218	212
1966	313477	82668	159195	62307	12375	1706	1278	942	273	92	187
1967	341190	201060	43604	72639	24821	4868	791	602	450	133	132
1968	18013	248132	118431	21878	36202	12529	2349	410	314	233	138
1969	20599	11699	142453	55382	10694	15788	5755	1164	197	157	175
1970	209787	12601	7442	70596	25187	5928	8046	3010	645	106	186
1971	109545	135078	7121	4480	33447	12303	3367	4542	1695	372	163
1972	1052876	80012	82395	4549	3103	17570	6739	2020	2777	1031	316
1973	310449	611103	46689	23226	1698	1550	7634	2898	926	1381	612
1974	66135	168872	250030	16572	10670	885	1018	4471	1685	549	1231
1975	59421	37507	90353	140384	6794	4948	449	564	2145	815	939
1976	61869	33814	16493	44274	79181	3147	2774	247	336	1149	973
1977	120514	31955	13774	6432	17629	30320	1281	1184	103	150	807
1978	214589	55473	9805	4432	2903	7738	15125	627	564	45	431
1979	161504	118148	23372	3261	2038	1408	4103	7088	338	273	226
1980	22094	103045	58844	8328	1152	1050	718	2169	3494	175	240
1981	10280	15556	63778	26434	3456	551	560	381	1144	1721	215
1982	16749	6731	11059	31900	10551	1721	278	308	219	627	960
1983	8656	11414	4623	6826	13527	5614	984	146	178	128	805
1984	13271	5143	6723	2738	3892	8834	2874	577	80	105	519
1985	358813	8928	2896	3609	1787	2574	5370	1840	369	51	399
1986	478572	277557	5190	1600	1853	994	1477	2795	1027	206	263
1987	90214	251326	157099	2536	656	793	470	680	1205	471	209
1988	38984	69536	135665	46741	1070	233	319	205	302	507	280
1989	28853	25825	49166	71076	12181	553	95	152	99	146	365

Year age	3	4	5	6	7	8	9	10	11	12	13
1990	37125	21055	17098	26048	32816	5474	358	59	87	57	277
1991	111048	25165	13652	14116	20258	20295	3130	252	40	57	205
1992	328727	84057	16045	10130	10434	12634	12657	1883	167	26	158
1993	848769	223913	57735	10760	5933	6253	7669	7276	1047	103	107
1994	396614	587436	154930	31942	4717	3143	3765	4809	4340	594	117
1995	100060	226590	435698	78166	14754	2118	1430	1880	2211	2156	341
1996	99507	61789	169995	248671	32136	7295	1100	713	945	1113	1277
1997	119084	55471	38253	96439	103120	13962	2515	500	315	419	1105
1998	63240	80491	34945	18197	36788	39134	5215	991	213	133	718
1999	151245	48598	47807	17437	8943	15880	13968	1913	411	95	395
2000	83258	120846	31027	21381	6915	4355	6581	5478	813	189	237
2001	367666	68635	94932	16897	10167	3556	2621	3527	2687	439	242
2002	395448	300091	52067	48539	9168	5544	1920	1468	1939	1411	359
2003	340113	261408	196328	34543	25078	4620	3530	1249	843	1100	1007
2004	260359	172273	166036	112867	16305	11103	2162	1680	629	400	1083
2005	366492	171572	94829	110334	51502	6674	5666	1165	744	318	809
2006	157564	219442	109811	52161	45104	21091	3242	2875	569	352	551
2007	543223	121375	168189	61734	26885	19538	8239	1776	1508	293	455
2008	1112513	468268	98184	105061	22152	14209	7305	3341	914	737	371
2009	1025284	728429	383448	62880	40729	10451	5495	3239	1485	513	620
2010	240955	691017	611521	237174	32624	15444	4886	2807	1654	800	679
2011	117224	194409	563046	432721	124025	14466	6299	2164	1383	855	862
2012	340386	73679	139426	404212	273255	55692	6248	2614	1060	724	988
2013	119057	202072	58279	96150	278419	130583	24094	3248	1443	609	1036
2014	411335	74058	147167	50176	89044	149208	62995	11011	1919	910	1046
2015	72464	289943	66054	93229	40823	70958	75588	26121	5433	1045	1069
2016	212760	49328	170881	46203	62182	33887	50649	38657	13022	2602	1031
2017	194179	178302	34064	111000	28140	36803	19145	22167	18206	5675	1498
2018	367841	136644	126603	24863	44110	14515	18040	9062	9354	8647	3170

Year age	3	4	5	6	7	8	9	10	11	12	13
2019	821773	245167	89266	64306	16672	17748	6762	7639	3760	3946	4324
2020	441844	529584	163506	48047	23575	8750	7624	3230	3185	1816	3452
2021	153680	259641	362981	65434	24257	9282	3972	3483	1479	1459	2410

Table 4.14. Northeast Arctic haddock. SAM model. Natural mortality estimated.

Year	3	4	5	6	7	8	9	10	11	12	13
1950	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1951	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1952	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1953	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1954	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1955	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1956	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1957	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1958	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1959	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1960	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1961	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1962	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1963	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1964	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1965	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1966	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1967	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1968	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1969	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1970	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1971	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1972	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1973	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Year	3	4	5	6	7	8	9	10	11	12	13
1974	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1975	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1976	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1977	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1978	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1979	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1980	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1981	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1982	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1983	0.347	0.258	0.245	0.242	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1984	0.216	0.224	0.214	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1985	0.209	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1986	0.640	0.262	0.200	0.210	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1987	0.200	0.207	0.421	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1988	0.379	0.200	0.200	0.393	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1989	0.200	0.200	0.200	0.232	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1990	0.328	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1991	0.202	0.216	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1992	0.216	0.205	0.203	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1993	0.253	0.248	0.274	0.260	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1994	0.289	0.216	0.295	0.227	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1995	0.379	0.341	0.319	0.291	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1996	0.724	0.319	0.253	0.283	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1997	0.503	0.267	0.255	0.284	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1998	0.230	0.291	0.265	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1999	0.200	0.207	0.278	0.260	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2000	0.214	0.200	0.215	0.245	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2001	0.210	0.200	0.226	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2002	0.323	0.213	0.200	0.204	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Year	3	4	5	6	7	8	9	10	11	12	13
2003	0.417	0.250	0.208	0.203	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2004	0.414	0.301	0.201	0.228	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2005	0.396	0.302	0.231	0.270	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2006	0.223	0.214	0.275	0.211	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2007	0.297	0.200	0.239	0.320	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2008	0.371	0.279	0.266	0.338	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2009	0.402	0.248	0.284	0.256	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2010	0.358	0.249	0.273	0.285	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2011	0.529	0.468	0.310	0.227	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2012	0.593	0.313	0.204	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2013	0.460	0.340	0.248	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2014	0.283	0.206	0.219	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2015	0.344	0.402	0.211	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2016	0.305	0.200	0.248	0.229	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2017	0.330	0.296	0.233	0.412	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2018	0.442	0.250	0.265	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2019	0.361	0.269	0.200	0.276	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2020	0.412	0.360	0.323	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
2021	0.412	0.360	0.323	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200

Table 4.15. Northeast Arctic haddock. Summary XSA (p-shrinkage not applied, F shrinkage= 0.5). Thu Apr 23 16:16:08 2020.

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1950	82517	242696	134602	132125	0.9816	1.5897	0.8305
1951	669592	356206	101130	120077	1.1874	1.2272	0.6238
1952	76993	235716	57527	127660	2.2191	1.7404	0.7243
1953	1276811	512541	82624	123920	1.4998	1.4279	0.5157
1954	152912	538732	117456	156788	1.3349	1.474	0.3802
1955	68791	486182	178951	202286	1.1304	1.536	0.5112
1956	208993	475286	243778	213924	0.8775	1.2623	0.4328
1957	66305	326559	186324	123583	0.6633	1.2455	0.4322

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1958	87212	277194	157018	112672	0.7176	1.1252	0.5185
1959	398937	365304	133348	88211	0.6615	0.9405	0.3672
1960	289884	401516	114703	154651	1.3483	1.0411	0.484
1961	130882	391762	130068	193224	1.4856	0.9942	0.6362
1962	291125	346736	118945	187408	1.5756	1.0518	0.8
1963	341475	311066	82694	146224	1.7683	1.1458	0.8645
1964	398845	302301	63902	99158	1.5517	1.3572	0.6522
1965	124503	358459	95547	118578	1.241	1.1507	0.4935
1966	294241	388088	127654	161778	1.2673	1.1621	0.583
1967	362769	468419	154643	136397	0.882	0.9984	0.4147
1968	23990	421753	169593	181726	1.0715	0.9976	0.503
1969	21471	342797	184231	130820	0.7101	0.882	0.3972
1970	202641	286838	156150	88257	0.5652	0.9762	0.3575
1971	122645	345853	168613	78905	0.468	0.7638	0.2465
1972	1252757	619817	123068	266153	2.1626	1.0883	0.6918
1973	342252	604302	114785	322226	2.8072	1.1656	0.5362
1974	69287	604427	200945	221157	1.1006	0.8946	0.4315
1975	60222	493447	256440	175758	0.6854	0.8957	0.4268
1976	66905	307480	206755	137264	0.6639	1.12	0.5705
1977	134417	229040	141828	110158	0.7767	1.09	0.6832
1978	213614	256138	130603	95422	0.7306	0.9219	0.5112
1979	176286	318567	129566	103623	0.7998	0.7684	0.5515
1980	34826	343544	133268	87889	0.6595	0.7568	0.3978
1981	13441	293155	148313	77153	0.5202	0.7174	0.4012
1982	17394	212027	127285	46955	0.3689	0.7224	0.3093
1983	9563	104393	71491	24600	0.3441	1.0373	0.2715
1984	13434	83502	64118	20945	0.3267	1.0547	0.2498
1985	288300	182799	62012	45052	0.7265	0.9761	0.32
1986	529936	343817	62309	100563	1.6139	1.0484	0.4388

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1987	109761	333920	75055	154916	2.064	0.992	0.5958
1988	54817	260029	78423	95255	1.2146	0.9955	0.499
1989	26591	212726	91989	58518	0.6361	0.9774	0.3892
1990	36885	170781	95306	27182	0.2852	1.0159	0.1562
1991	104289	195374	110525	36216	0.3277	1.0374	0.2082
1992	207573	269180	125749	59922	0.4765	0.9797	0.2838
1993	661827	442193	130412	82379	0.6317	1.0031	0.359
1994	292252	542649	144884	135186	0.9331	1.0056	0.425
1995	97799	538481	158892	142448	0.8965	1.0247	0.3825
1996	102077	472118	184556	178128	0.9652	1.0175	0.4235
1997	115566	349254	162754	154359	0.9484	1.0519	0.4862
1998	58271	249707	124288	100630	0.8097	1.0113	0.4235
1999	230876	252735	93038	83195	0.8942	1.021	0.4212
2000	89446	250625	85299	68944	0.8083	1.026	0.2802
2001	366245	356725	110567	89640	0.8107	0.9903	0.2795
2002	342709	443325	128727	114798	0.8918	1.011	0.3173
2003	224429	474128	150713	138926	0.9218	1.019	0.4292
2004	225230	455037	157794	158279	1.0031	1.0192	0.3795
2005	347443	471039	168020	158298	0.9421	1.0029	0.49
2006	157072	415213	142651	153157	1.0736	0.9938	0.405
2007	668942	496479	140120	161525	1.1528	0.9916	0.4228
2008	1339631	738745	146275	155604	1.0638	0.9928	0.3902
2009	1454218	1075831	168600	200061	1.1866	1.0019	0.3525
2010	526318	1253906	233140	249200	1.0689	0.9994	0.293
2011	245890	1275393	336181	309785	0.9215	0.9978	0.3175
2012	381957	1158133	419440	315627	0.7525	0.9994	0.266
2013	156234	988402	465852	193744	0.4159	0.9967	0.134
2014	389701	993569	511632	177522	0.347	0.9968	0.111
2015	103379	934929	524799	194756	0.3711	0.9953	0.1558

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
2016	260916	846474	496913	233183	0.4693	1.0006	0.2208
2017	200597	729410	417225	227588	0.5455	0.994	0.3318
2018	368406	618897	307333	191276	0.6224	0.9943	0.3915
2019	871151	709103	236928	175402	0.7403	0.9963	0.4545
2020	415726	760305	214036	182468	0.8525	0.9962	0.4345

Table 4.16. Northeast Arctic haddock. Input data for recruitment prediction (RCT3)- recruits as 3 year-olds. Recr: recruitment estimate from SAM 2020 NT1: Norwegian Russian winter bottom trawl survey age 1 NT2: Norwegian Russian winter bottom trawl survey age 2 NT3: Norwegian Russian winter bottom trawl survey age 3 NAK1: Norwegian Russian winter acoustic survey age 1 NAK2: Norwegian Russian winter acoustic survey age 2 NAK3: Norwegian Russian winter acoustic survey age 3 ECO1: Ecosystem survey age 1. ECO2: Ecosystem survey age 2. The Russian survey (RT) was discontinued in 2017 and has not been used for recruitment.

Year class	Recr.	NT1	NT2	NT3	NAK1	NAK2	NAK3	EC01	ECO2
1990	848769	NA	NA	NA	NA	NA	NA	NA	NA
1991	396614	NA	NA	315	NA	NA	349	NA	NA
1992	100060	NA	225	55	NA	188	42	NA	NA
1993	99507	604	200	56	888	89	30	NA	NA
1994	119084	1429	265	80	1198	95	57	NA	NA
1995	63240	301	91	22	133	27	34	NA	NA
1996	151245	1118	197	57	509	151	84	NA	NA
1997	83258	248	83	24	211	30	36	NA	NA
1998	367666	1208	437	294	653	405	234	NA	NA
1999	395448	832	447	313	1063	266	255	NA	NA
2000	340113	1231	475	352	753	268	204	NA	NA
2001	260359	1700	472	173	1315	362	151	NA	NA
2002	366492	3327	707	318	2744	467	221	NA	268
2003	157564	701	386	79	529	144	56	189	114
2004	543223	4473	1310	443	2277	625	209	604	929
2005	1112513	4945	1685	1591	2091	954	812	2270	1819
2006	1025284	3731	2042	1230	2016	1754	884	988	1292
2007	240955	853	317	103	778	209	128	322	144
2008	117224	563	80	53	444	86	54	135	65
2009	340386	1635	354	316	1559	288	192	274	114

Year class	Recr.	NT1	NT2	NT3	NAK1	NAK2	NAK3	EC01	ECO2
2010	119057	676	137	57	429	95	67	105	42
2011	411335	1867	490	381	1583	407	335	591	223
2012	72464	345	124	31	293	110	24	156	75
2013	212760	1281	342	163	1839	247	72	265	145
2014	194179	1134	562	135	1593	107	81	320	145
2015	367841	2299	770	336	1276	331	170	794	189
2016	821773	5065	1676	1076	3344	806	508	936	NA
2017	441844	3823	1125	424	2931	688	286	NA	585
2018	153680	1898	268	118	1545	261	43	379	58
2019	NA	111	31	NA	273	32	NA	27	NA
2020	NA	462	NA	NA	435	NA	NA	NA	NA

Table 4.17. Northeast Arctic haddock Analysis by RCT3 ver3.1 - R translation

Analysis by RCT3 ver3.1 - R translation

Data for 8 surveys over 31 year classes : 1990 - 2020
Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied
Final estimates shrunk towards mean
Estimates with S.E.'S greater than that of mean included
Minimum S.E. for any survey taken as 0.2
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

yearclass:2018

index	slope	intercept	se	rsquare	n	indices	prediction	se.pred
NT1	0.9691	5.441	0.2604	0.9137	20	7.549	12.76	0.2972
NT2	0.8716	7.198	0.3445	0.8606	20	5.594	12.07	0.3981
NT3	0.6869	8.867	0.1120	0.9830	20	4.783	12.15	0.1292
NAK1	1.1972	4.034	0.5124	0.7322	20	7.343	12.83	0.5854
NAK2	0.9353	7.276	0.3050	0.8873	20	5.568	12.48	0.3476
NAK3	0.8015	8.550	0.1825	0.9560	20	3.786	11.59	0.2206
EC01	1.0586	6.267	0.3663	0.8532	14	5.941	12.56	0.4250
ECO2	0.8087	8.248	0.3967	0.8071	15	4.074	11.54	0.4843
VPA Mean	NA	NA	NA	NA	28	NA	12.58	0.8028

WAP.weights
0.13206
0.07360
0.29163
0.03404
0.09653
0.23972
0.06460
0.04973
0.01810

yearclass:2019

index	slope	intercept	se	rsquare	n	indices	prediction	se.pred
NT1	1.0341	4.886	0.3606	0.8393	20	4.715	9.762	0.5627
NT2	0.8802	7.128	0.3358	0.8594	20	3.455	10.170	0.4915
NT3	NA	NA	NA	NA	NA	NA	NA	NA
NAK1	1.2736	3.396	0.5859	0.6643	20	5.612	10.543	0.7771
NAK2	0.9857	6.947	0.3531	0.8468	20	3.490	10.388	0.4971
NAK3	NA	NA	NA	NA	NA	NA	NA	NA
EC01	1.1232	5.823	0.4206	0.8056	15	3.326	9.558	0.6831
ECO2	NA	NA	NA	NA	NA	NA	NA	NA
VPA Mean	NA	NA	NA	NA	29	NA	12.518	0.7822

WAP.weights
0.18821
0.24677

```
      NA
 0.09871
 0.24116
      NA
 0.12772
      NA
 0.09743

yearclass:2020
   index slope intercept     se rsquare  n indices prediction se.pred
    NT1 1.031     4.895 0.3624  0.8374 19   6.137      11.22  0.4597
    NT2    NA        NA     NA      NA NA      NA         NA      NA
    NT3    NA        NA     NA      NA NA      NA         NA      NA
   NAK1 1.257     3.489 0.5814  0.6667 19   6.078      11.13  0.7321
   NAK2    NA        NA     NA      NA NA      NA         NA      NA
   NAK3    NA        NA     NA      NA NA      NA         NA      NA
   EC01    NA        NA     NA      NA NA      NA         NA      NA
   ECO2    NA        NA     NA      NA NA      NA         NA      NA
VPA Mean    NA        NA     NA      NA 29      NA      12.51  0.7770
WAP.weights
    0.5733
      NA
      NA
    0.2260
      NA
      NA
      NA
      NA
    0.2006

                WAP logWAP  int.se
yearclass:2018 188877  12.15 0.09103
yearclass:2019  30736  10.33 0.24414
yearclass:2020  94702  11.46 0.34806
```

Table 4.18. Northeast Arctic haddock. Prediction with management option table: Input data (based on SAM estimates

"MFDP version 1a"

"Run: 2021"

"Time and date: 22:28 19.04.2021"

"Fbar age range: 4-7"

""

2021

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	153680	0.405	0.029	0	0	0.259	0.0368	0.693
4	259641	0.293	0.081	0	0	0.494	0.1603	0.919
5	362981	0.263	0.211	0	0	0.813	0.3808	1.180
6	65434	0.225	0.45	0	0	1.222	0.5906	1.475
7	24257	0.2	0.735	0	0	1.774	0.6223	1.843
8	9282	0.2	0.886	0	0	2.284	0.6257	1.920
9	3972	0.2	0.942	0	0	2.663	0.6257	2.150
10	3483	0.2	0.979	0	0	3.279	0.6257	2.413
11	1479	0.2	1	0	0	3.444	0.6257	2.489
12	1459	0.2	1	0	0	3.754	0.6257	2.863
13	2410	0.2	1	0	0	3.705	0.6257	3.453

2022

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	30736	0.405	0.03	0	0	0.273	0.0368	0.708
4	.	0.293	0.078	0	0	0.481	0.160	0.905
5	.	0.263	0.199	0	0	0.784	0.3808	1.154
6	.	0.225	0.418	0	0	1.154	0.5906	1.414
7	.	0.2	0.679	0	0	1.609	0.6223	1.745
8	.	0.2	0.871	0	0	2.191	0.6257	1.931
9	.	0.2	0.946	0	0	2.716	0.6257	2.066
10	.	0.2	0.971	0	0	3.085	0.6257	2.314
11	.	0.2	1	0	0	3.686	0.6257	2.379
12	.	0.2	1	0	0	3.624	0.6257	2.799
13	.	0.2	1	0	0	4.059	0.6257	3.468

2023

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
3	94702	0.405	0.03	0	0	0.315	0.0368	0.753
4	.	0.293	0.082	0	0	0.497	0.160	0.922
5	.	0.263	0.192	0	0	0.766	0.3808	1.138
6	.	0.225	0.401	0	0	1.117	0.5906	1.380
7	.	0.2	0.649	0	0	1.526	0.6223	1.696
8	.	0.2	0.833	0	0	2.000	0.6257	1.884
9	.	0.2	0.937	0	0	2.610	0.6257	2.070
10	.	0.2	0.973	0	0	3.145	0.6257	2.283
11	.	0.2	1	0	0	3.507	0.6257	2.334

12	.	0.2	1	0	0	3.854	0.6257	2.775
13	.	0.2	1	0	0	3.938	0.6257	3.471

Table 4.19. Northeast Arctic haddock. Prediction with management option table for 2021–2023 (TAC constraint applied for intermediate year

MFDP version 1a

Run: 2021

2021MFDP Index file 19.04.2021

Time and date: 22:28 19.04.2021

Fbar age range: 4-7
202
1

Biomass	SSB	FMult	FBar	Landings
648860	200849	0.9932	0.4355	232537

	2022					2023	
Biomass		SSB	FMult	FBar	Landings	Biomass	SSB
	507632	204751	0	0	0	569679	309362
.		204751	0.1	0.0439	26690	544131	293022
.		204751	0.2	0.0877	52064	519923	277586
.		204751	0.3	0.1316	76192	496979	263004
.		204751	0.4	0.1754	99141	475232	249226
.		204751	0.5	0.2193	120972	454615	236208
.		204751	0.6	0.2631	141745	435068	223906
.		204751	0.7	0.307	161515	416531	212280
.		204751	0.8	0.3508	180334	398951	201292
.		204751	0.9	0.3947	198253	382274	190906
.		204751	1	0.4385	215319	366452	181089
.		204751	1.1	0.4824	231576	351439	171807
.		204751	1.2	0.5262	247065	337192	163032
.		204751	1.3	0.5701	261828	323667	154734
.		204751	1.4	0.6139	275901	310828	146888
.		204751	1.5	0.6578	289320	298636	139467
.		204751	1.6	0.7016	302119	287058	132448
.		204751	1.7	0.7455	314329	276060	125808
.		204751	1.8	0.7893	325981	265612	119527
.		204751	1.9	0.8332	337103	255683	113583
.		204751	2	0.877	347723	246247	107960

Table 4.20. Northeast Arctic haddock. Prediction single option table for 2020–2022 based on HCR

MFDP version 1a

Run: Fhcr

Time and date: 22:38 19.04.2021

Fbar age range: 4-7

Year:	2021	F multiplier:	0.9932	Fbar:	0.4355				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0366	4541	3147	153680	39803	4457	1154	4457	1154
4	0.1592	33255	30561	259641	128263	21031	10389	21031	10389
5	0.3782	101347	119589	362981	295104	76589	62267	76589	62267
6	0.5866	26289	38776	65434	79960	29445	35982	29445	35982
7	0.6181	10240	18872	24257	43032	17829	31628	17829	31628
8	0.6215	3934	7553	9282	21200	8224	18783	8224	18783
9	0.6215	1683	3619	3972	10577	3742	9964	3742	9964
10	0.6215	1476	3562	3483	11421	3410	11181	3410	11181
11	0.6215	627	1560	1479	5094	1479	5094	1479	5094
12	0.6215	618	1770	1459	5477	1459	5477	1459	5477
13	0.6215	1021	3527	2410	8929	2410	8929	2410	8929
Total		185031	232537	888078	648860	170074	200849	170074	200849

Year:	2022	F multiplier:	0.7982	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0294	732	518	30736	8391	922	252	922	252
4	0.128	10320	9340	98822	47533	7708	3708	7708	3708
5	0.304	38324	44226	165188	129507	32872	25772	32872	25772
6	0.4714	64912	91785	191163	220602	79906	92212	79906	92212
7	0.4967	10397	18142	29062	46761	19733	31751	19733	31751

8	0.4994	3846	7426	10704	23452	9323	20427	9323	20427
9	0.4994	1467	3030	4082	11087	3862	10488	3862	10488
10	0.4994	628	1452	1747	5389	1696	5233	1696	5233
11	0.4994	550	1309	1532	5646	1532	5646	1532	5646
12	0.4994	234	654	650	2357	650	2357	650	2357
13	0.4994	611	2120	1702	6906	1702	6906	1702	6906
Total		132021	180003	535387	507632	159906	204751	159906	204751

Year:	2023	F multiplier:	0.7982	Fbar:	0.35				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
3	0.0294	2256	1699	94702	29831	2841	895	2841	895
4	0.128	2079	1917	19907	9894	1632	811	1632	811
5	0.304	15050	17127	64869	49690	12455	9540	12455	9540
6	0.4714	31818	43909	93703	104666	37575	41971	37575	41971
7	0.4967	34082	57803	95269	145381	61830	94352	61830	94352
8	0.4994	5202	9800	14479	28958	12061	24122	12061	24122
9	0.4994	1911	3955	5318	13881	4983	13007	4983	13007
10	0.4994	729	1664	2028	6379	1973	6207	1973	6207
11	0.4994	312	728	868	3044	868	3044	868	3044
12	0.4994	273	759	761	2933	761	2933	761	2933
13	0.4994	420	1457	1169	4602	1169	4602	1169	4602
Total		94131	140817	393074	399259	138149	201485	138149	201485

Table 4.21. Northeast Arctic haddock. Yield-per-recruit. Input data and results.

MFYPR version 2a

Run: 2021YPR

Time and date: 22:25 19.04.2021

Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	4.2321	6.4432	1.9203	5.0608	1.9203	5.0608
0.1	0.0495	0.1087	0.2095	3.7039	4.7588	1.4293	3.4316	1.4293	3.4316
0.2	0.099	0.1778	0.3169	3.3732	3.7718	1.1326	2.4938	1.1326	2.4938
0.3	0.1485	0.2264	0.3785	3.1444	3.1343	0.9353	1.9004	0.9353	1.9004
0.4	0.198	0.2629	0.417	2.9753	2.6943	0.7954	1.5002	0.7954	1.5002
0.5	0.2475	0.2917	0.4427	2.8442	2.3754	0.6914	1.2172	0.6914	1.2172
0.6	0.297	0.3153	0.4607	2.7389	2.1352	0.6114	1.0098	0.6114	1.0098
0.7	0.3465	0.3351	0.4739	2.6519	1.9487	0.5482	0.8532	0.5482	0.8532
0.8	0.396	0.3521	0.4839	2.5784	1.8001	0.497	0.7322	0.497	0.7322
0.9	0.4455	0.367	0.4917	2.5152	1.6793	0.4549	0.6367	0.4549	0.6367
1	0.495	0.3802	0.4979	2.4601	1.5791	0.4196	0.56	0.4196	0.56
1.1	0.5445	0.392	0.5029	2.4114	1.4948	0.3897	0.4974	0.3897	0.4974
1.2	0.594	0.4028	0.5071	2.3679	1.4229	0.3641	0.4458	0.3641	0.4458
1.3	0.6435	0.4126	0.5105	2.3287	1.3608	0.3419	0.4026	0.3419	0.4026
1.4	0.693	0.4216	0.5135	2.2931	1.3066	0.3226	0.3661	0.3226	0.3661
1.5	0.7425	0.4299	0.516	2.2605	1.2588	0.3055	0.3349	0.3055	0.3349
1.6	0.792	0.4377	0.5182	2.2306	1.2164	0.2903	0.3081	0.2903	0.3081
1.7	0.8415	0.445	0.5201	2.2029	1.1784	0.2768	0.2849	0.2768	0.2849
1.8	0.891	0.4519	0.5218	2.1771	1.1442	0.2647	0.2646	0.2647	0.2646
1.9	0.9405	0.4583	0.5234	2.1531	1.1131	0.2538	0.2468	0.2538	0.2468
2	0.99	0.4644	0.5247	2.1306	1.0848	0.2439	0.2311	0.2439	0.2311

F multiplier Absolute F

Reference point		
Fbar(3-13)	1	0.495
FMax	>=1000000	
F0.1	0.4082	0.2021
F35%SPR	0.3284	0.1626

Weights in kilograms

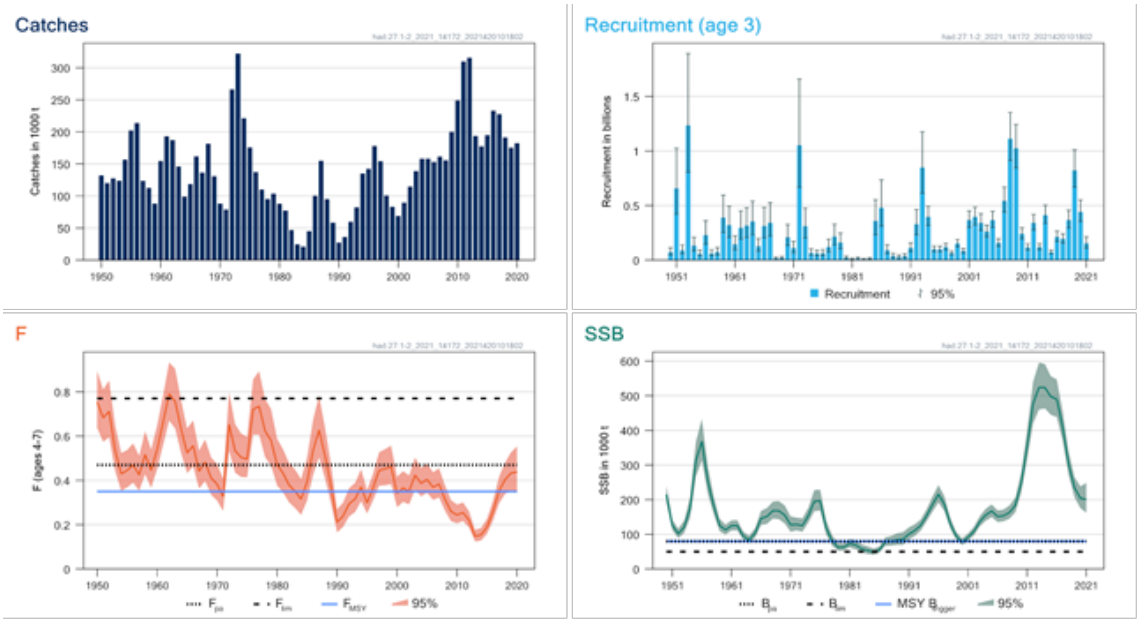

Figure 4.1 Landings, fishing mortality, recruitment, and spawning-stock biomass of Northeast Arctic haddock 1950–2021. Fishing mortality and spawning-stock biomass are given with point wise 95% confidence intervals (shaded areas).

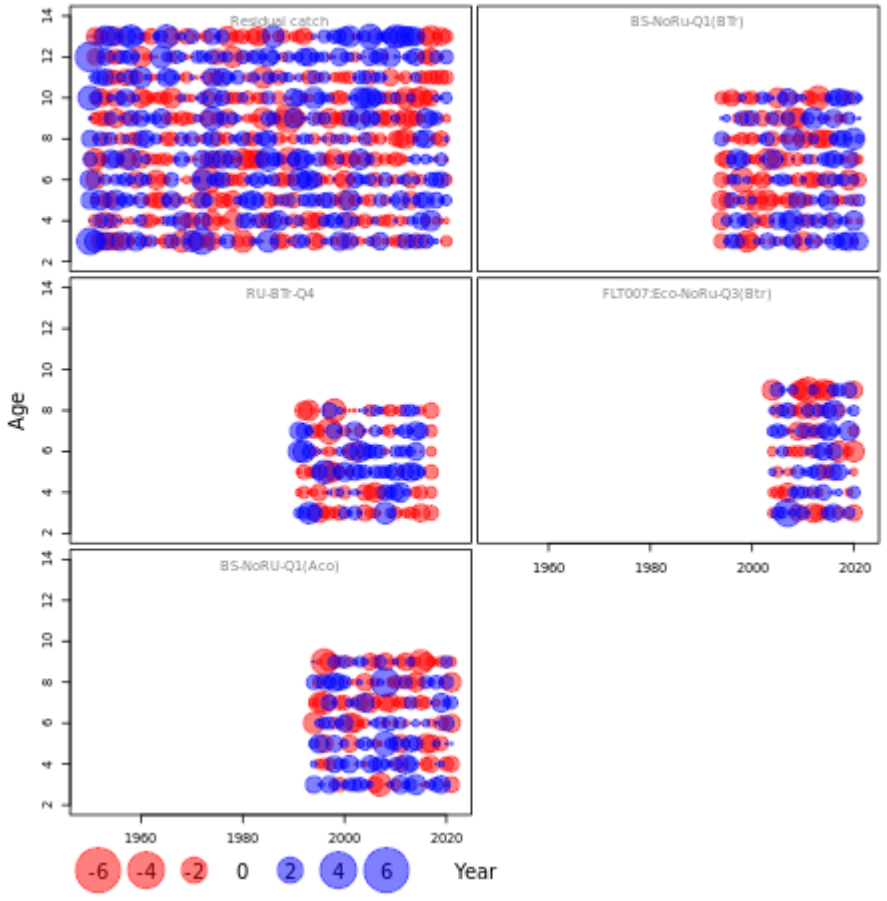

Figure 4.2. Northeast Arctic haddock; on step ahead residuals for the final SAM run. Blue circles indicate positive residuals (observations larger than predicted) and red circles indicate negative residuals.

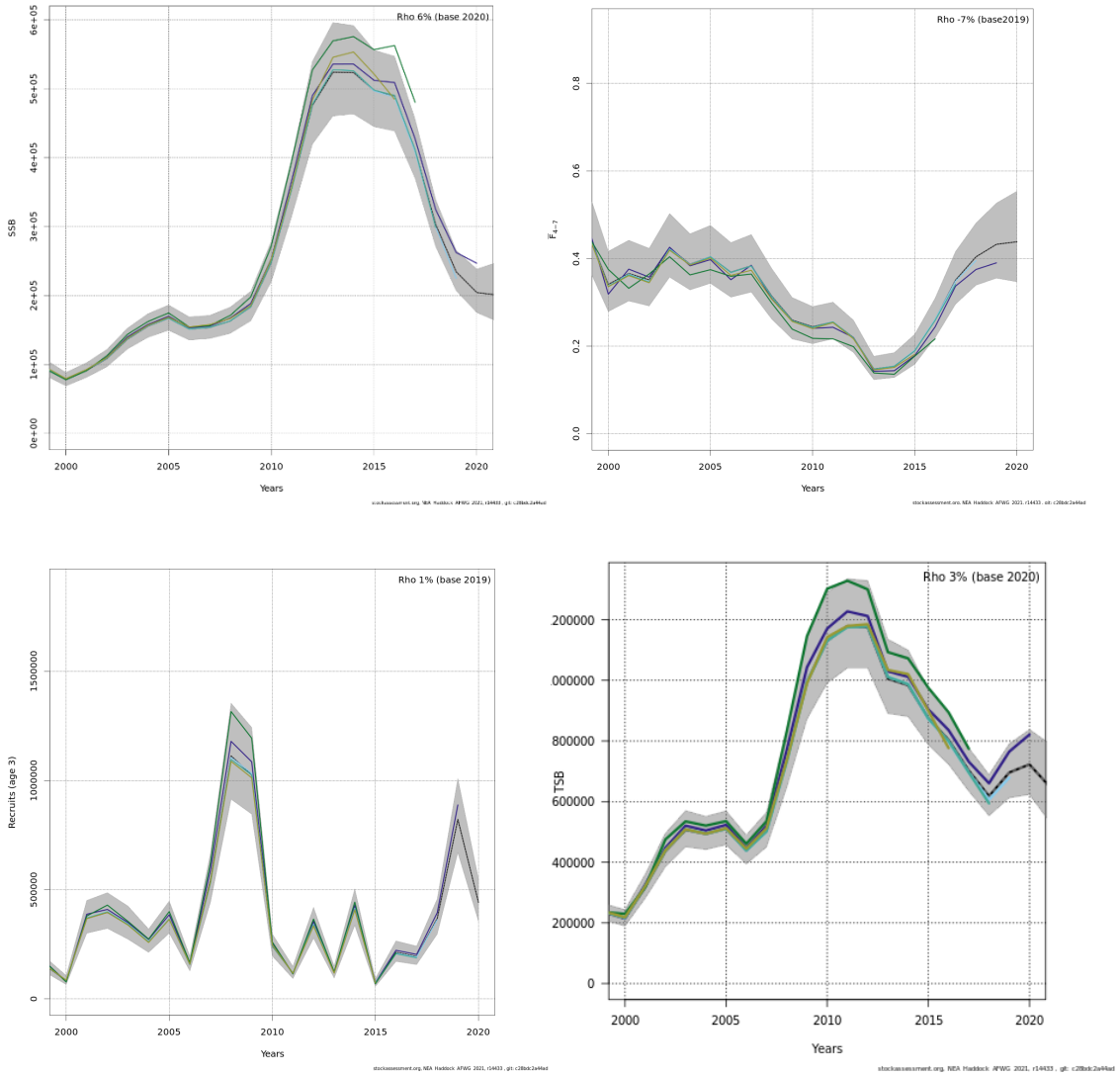

Figure 4.3. Northeast Arctic haddock. 5 year retrospective plots of SSB (top right), fishing mortality (top left), TSB (bottom left), and recruitment (bottom right) for years 2000–2021 (SAM with 95% confidence intervals).

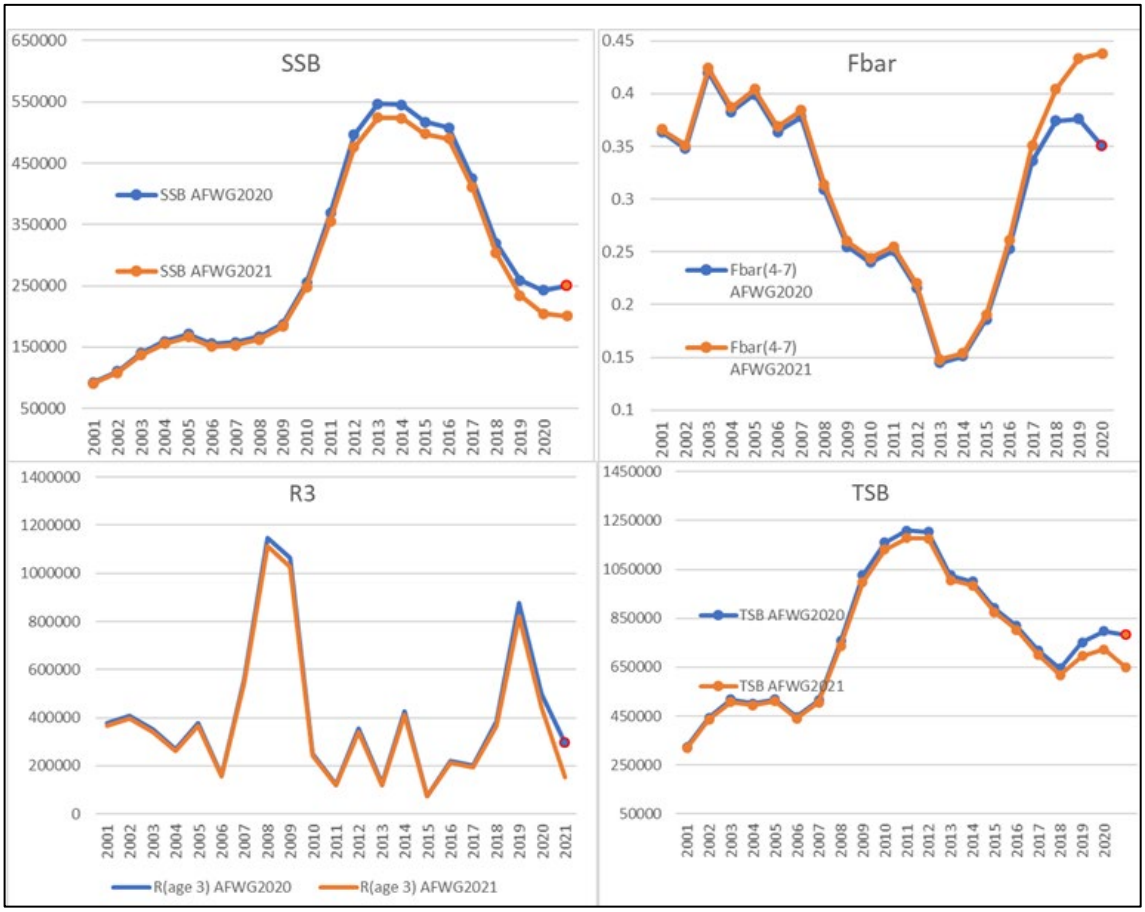

Figure 4.4. Results of assessment of NEA haddock. Fbar, TSB, recruits and SSB from AFWG 2020 (last year) and AFWG 2021 from 2001 and onwards. The last red points on the blue lines are forecasts from last year.

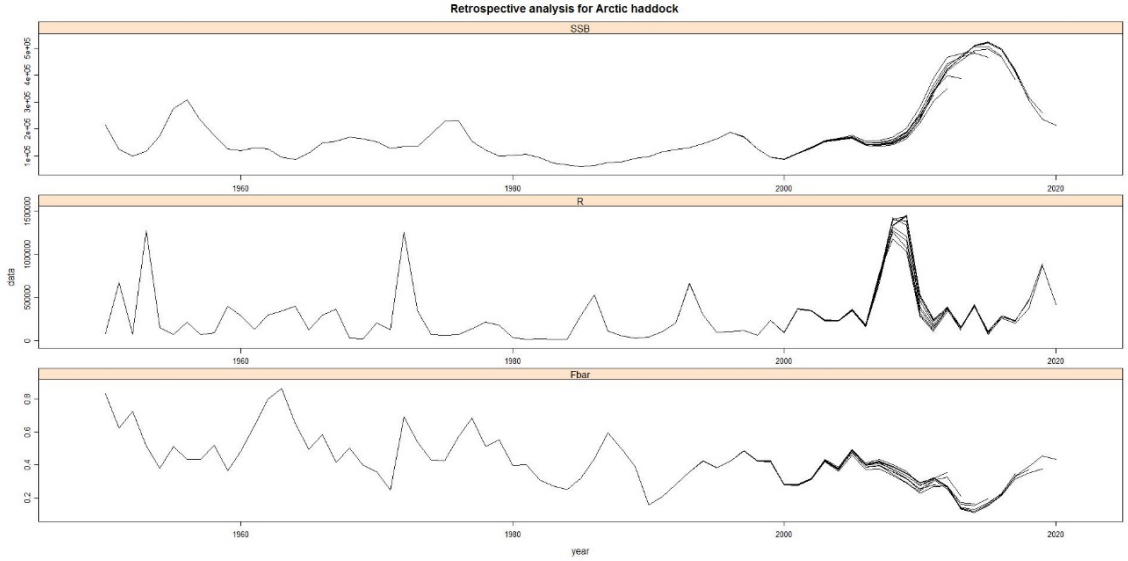

Figure 4.5. Northeast Arctic haddock. Retrospective plots of SSB, fishing mortality and recruitment for assessment years 1950–2020 (XSA without P shrinkage, F shrinkage= 0.5)

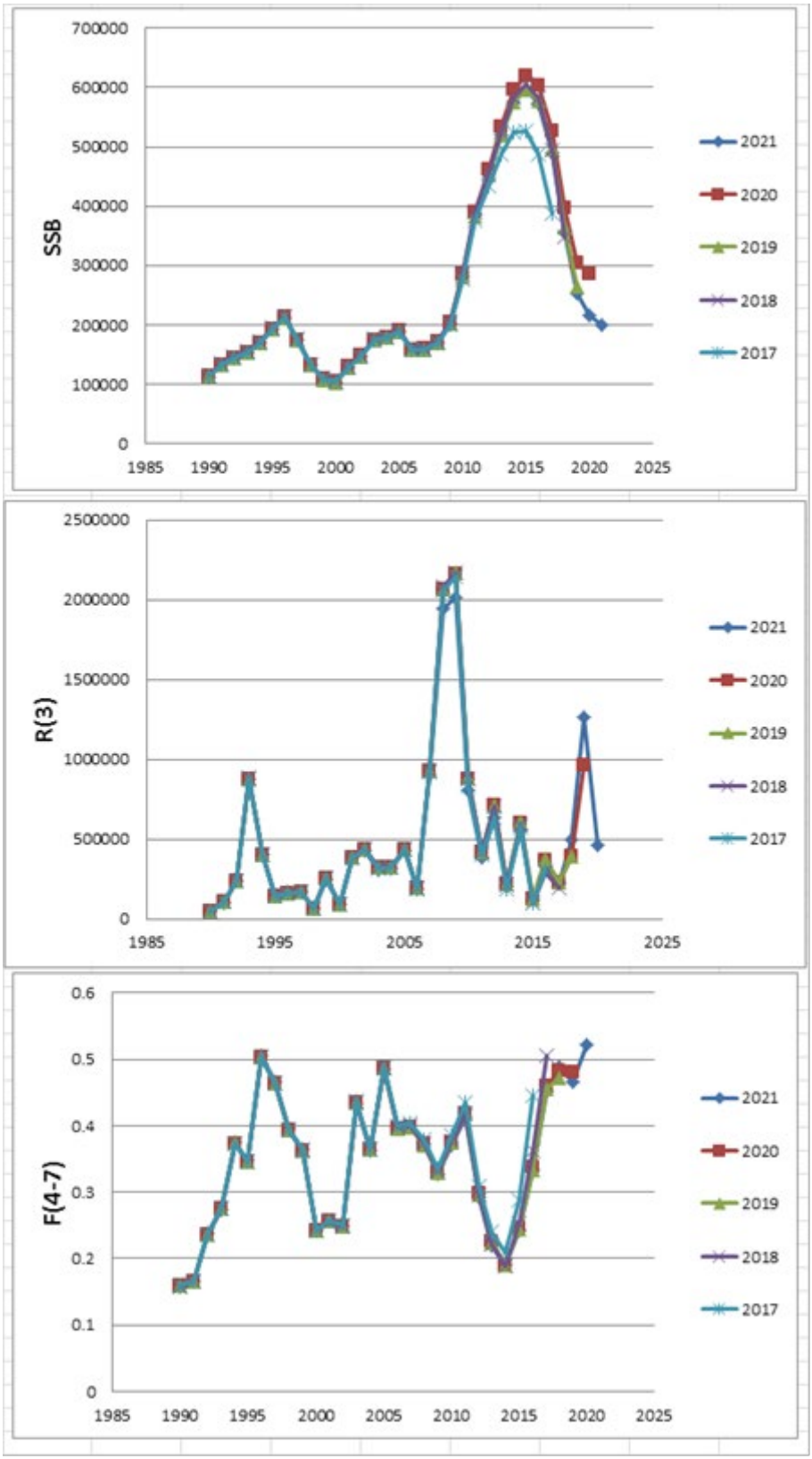

Figure 4.6. Northeast Arctic haddock. Retrospective plots of SSB, fishing mortality and recruitment for assessment years 1990–2020 from TSVPA model (see WD 22).

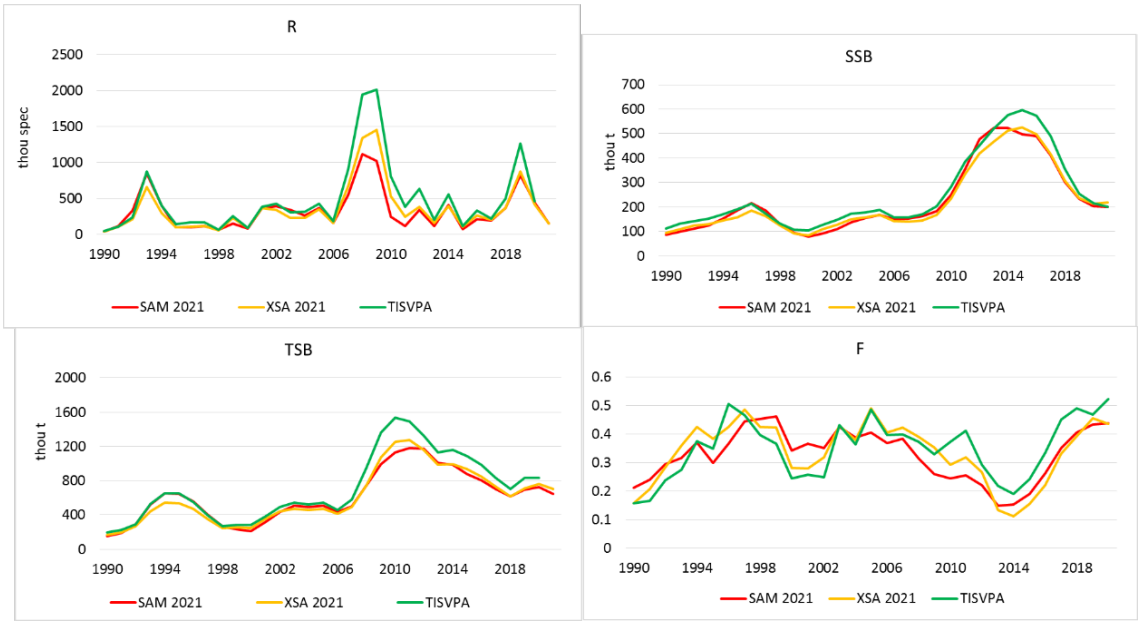

Figure 4.7. Comparison of results of assessment of NEA haddock. Recruits, biomass, spawning biomass and F in 1990–2020 by different models: medium SAM estimates, XSA with setting mentioned at section 4.9 and TISVPA with settings as mentioned at WDXX.

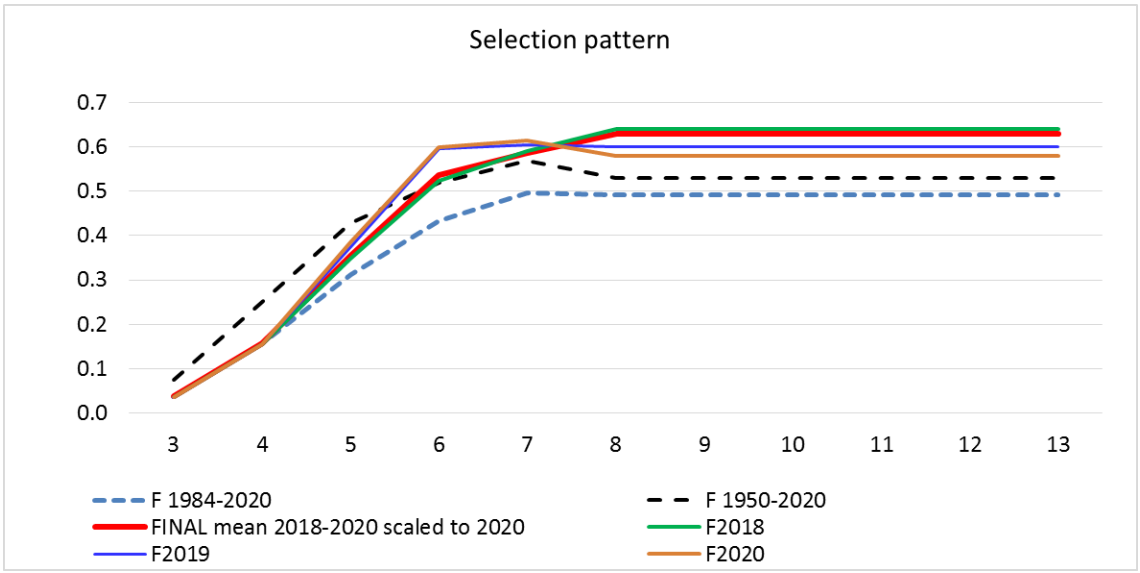

Figure 4. 8 Standard selection pattern model (red) used for short-term forecasts at AFWG 2021.

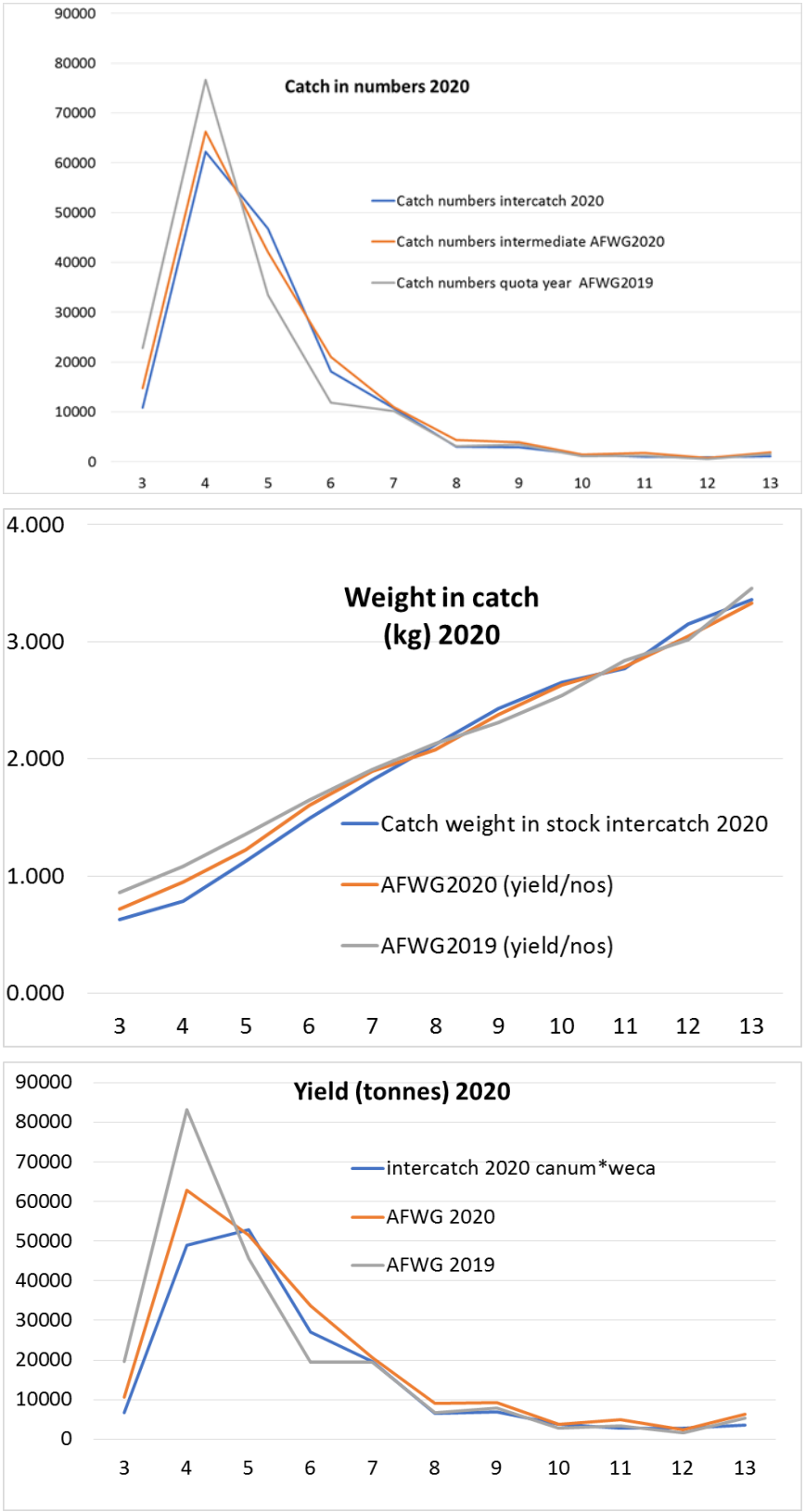

Figure 4.9 Comparisons of catch data by age 2020 from InterCatch with forecasts from AFWG 2019 and 2020. Top: catch number of individuals, middle: catch weights, bottom: yield.