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Joint Russian Norwegian Arctic Fisheries Working Group (JRN-AFWG) Report 2025

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Summary (English):

On 30th March 2022 all Russian participation in ICES was temporally suspended. Although the announcement of the suspension stressed the role of ICES as a “multilateral science organization”, this suspension applied not only to research activities but also to the ICES work providing fisheries advice for the sustainable management of fish stocks and ecosystems. On 9th December 2024 Russia announced its intention to leave ICES by 9th December 2025. As a result, since 2022 the ICES AFWG has provided advice only for saithe, coastal cod north, coastal cod south, and golden redfish. Northeast Arctic (NEA) cod, haddock, beaked redfish, Greenland halibut, and capelin assessments have been conducted outside of ICES in a bilateral Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG). Although this work has been conducted independently of ICES, the methodologies agreed at ICES benchmarks and agreed HCRs (Harvest Control Rules) have been followed in providing this advice.

The chapter numbering in this report is not continuous (Chapter 2,5 and 7 are missing). This is

done in order to be consistent with the chapter numbering in ICES AFWG reports.

In 2025 we are giving advice for NEA cod and haddock. There is a 2-year advice for both Greenland halibut and beaked redfish, with the next advice release planned for 2026. The capelin advice is conducted and released in the autumn via a separate report. The beaked redfish model is planned for a method revision prior to the next advice.

We would note that both cod and haddock had TAC quota set above advice in 2025. Both stocks are projected to increase provided the HCRs are followed. However, any further fishing above scientific advice would imperil the improvements for these stocks, and for NEA cod in particular would increase the risk of the stock falling below Blim.

Advice on fishing opportunities for NEA cod

The NEA cod stock is continuing to decline following a prolonged period of moderate to poor recruitment, and is currently below B_{pa} but above B_{lim}. Revisions in the weight at age and maturity have resulted in a downward revision of the stock, and quota set above advice for 2025 has resulted in a lower projected stock development.

Following the agreed HCR, the advice for 2026 is that catches should be no more than 269 440 tonnes, down from an advice of 311 587 tonnes and a quota of 340 000 tonnes in 2025. Provided that this advice is followed, then projections indicate that at current recruitment levels the stock should stabilize and start to rise slightly. Further quota above advice could be expected to delay any recovery for this stock, and potentially lead to further decline.

Advice on fishing opportunities for NEA haddock

Following a period of low recruitment the stock is rising as a result of a relatively good yearclass in 2021, and a further good yearclass in 2022 is predicted to enter the fishery in 2026.

Following the agreed HCR, the advice is that catches in 2026 should not exceed 153 293 tonnes, up from an advice of 106 912 tonnes and a quota of 130 000 tonnes in 2025. Provided that this yearclass is not heavily caught at small sizes then then this should lead to a continued increase in stock and catches as long as the advice is followed. In recent

years there has been a rise in the catch of small haddock, and if this is not curtailed then there is a risk that a large part of the incoming yearclass could be fished before reaching a size to give optimum yield.

Content

Chapter 1. Ecosystem considerations

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

The Barents Sea ecosystem survey (BESS):

The aim of the Barents Sea ecosystem survey (BESS) in August-October is to monitor the status and changes in the Barents Sea ecosystem. In 2018, and 2022, BESS coverage was incomplete, and in 2020 it was delayed, making the evaluation of the ecosystem status more uncertain. The 2024 BESS was carried out during the period from 17-th August 2024 to 12th October by three Norwegian and one Russian research vessels. The temporal and spatial progression during the survey was good, despite technical problems and bad weather (Figure 1.1a and b).

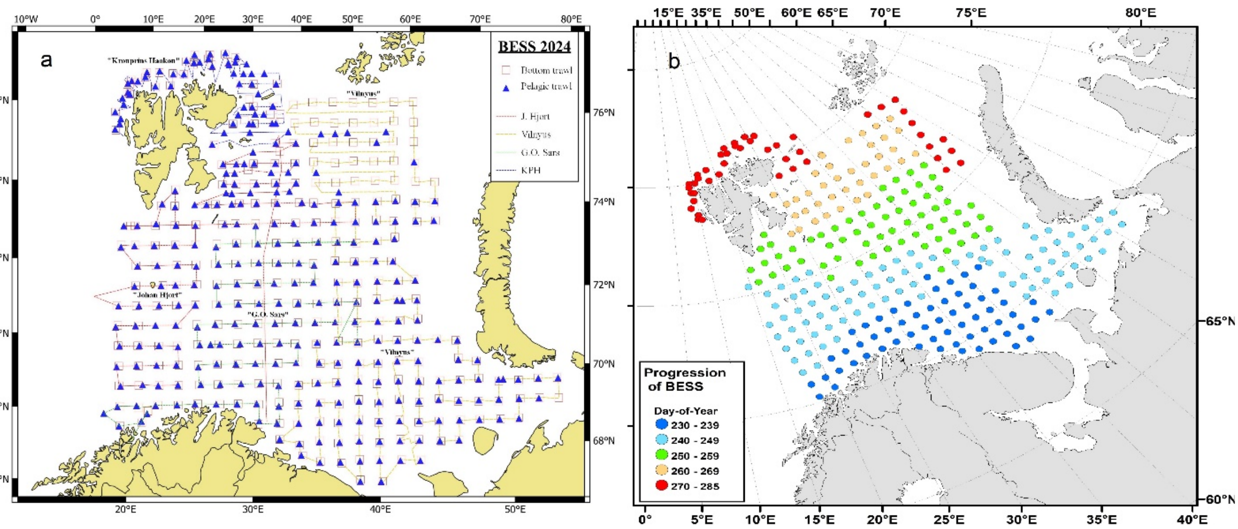

Figure 1.1. The spatial (a, left) and temporal (b, right) progression during the survey.

Current state and changes

Abiotic conditions

Sea Surface Temperature (SST) in both the southern and northern Barents Sea were at, or slightly below, the long-term mean (1991-2020) for the first half of 2024. However, the SSTs rapidly increased in late June/early

July reaching 3-3.5^{o}C above the seasonal mean in August-September. These conditions were associated with a marine heatwave. The sea surface stayed warmer than the long-term mean for the rest of 2024 and at least to the end of February 2025. Despite a strong marine heat wave at the surface, it did not reach deeper waters at the time. Observations from the full water column in August-October reveal that the heat wave was present only in the upper 30 m of the water column. Below, most of the ocean had temperatures 0-1^{o} C above the long-term mean. The exception was some patches with higher anomalies around Svalbard.

The southwestern Barents Sea is strongly affected by the varying characteristics of the inflowing Atlantic Water (AW). The long-term time series from standard sections reveal an increasing temperature trend in the Atlantic Water since the late 1970s. Temperatures in the inflowing water decreased from 2015-2019/2021 . The last 4-5 years the temperatures in summer have increased, but the winter temperatures do not show the same pattern (Figure 1.2).

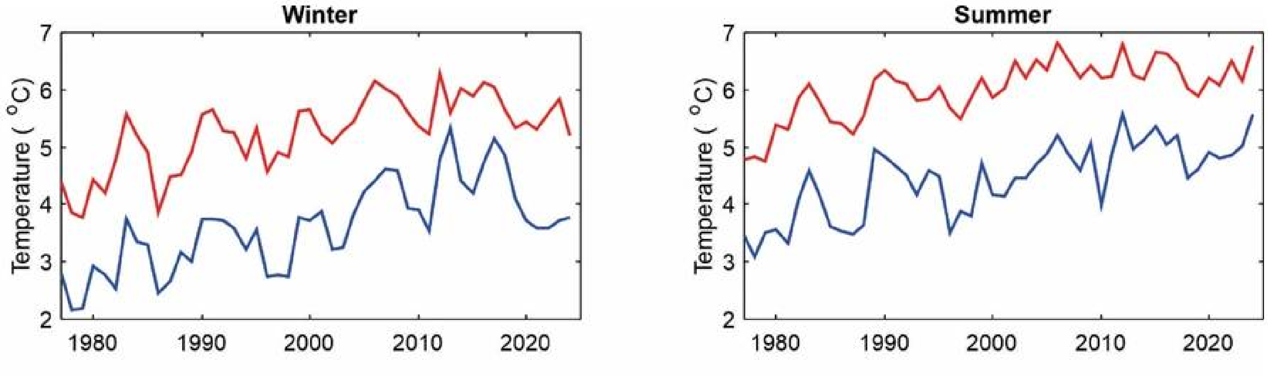

Figure 1.2. Temperature in the AW flowing into the Barents Sea in Fugløya-Bear Island (red) and Vardø-North (blue). Left panels show winter while right panels show summer.

Sea ice conditions in the northern Barents Sea in early winter 2024 were highly fluctuating with more sea ice than the long-term mean for about two weeks in January followed by small amounts of sea ice in February and then increasing SIA to levels above the long-term mean during late March to April. SIA was close to normal during May and the first half of June, and well below the long-term mean for the rest of 2024 and in January-February 2025.

The area of the Barents Sea occupied by bottom waters with a temperature < 0°C amounted to 31%, which was substantially higher compared to 2023 and somewhat below the level of 2019-2022 (Fig. 1.3). According to the expert evaluation, Atlantic water temperature in the Murman Current in 2025 is expected to remain typical of warm years. Due to high temperatures and low sea-ice extent in recent years, the ice coverage of the Barents Sea is expected to remain below normal. Lower-than-average ice coverage and longer duration of ice-free season increase the primary productivity of the Barents Sea.

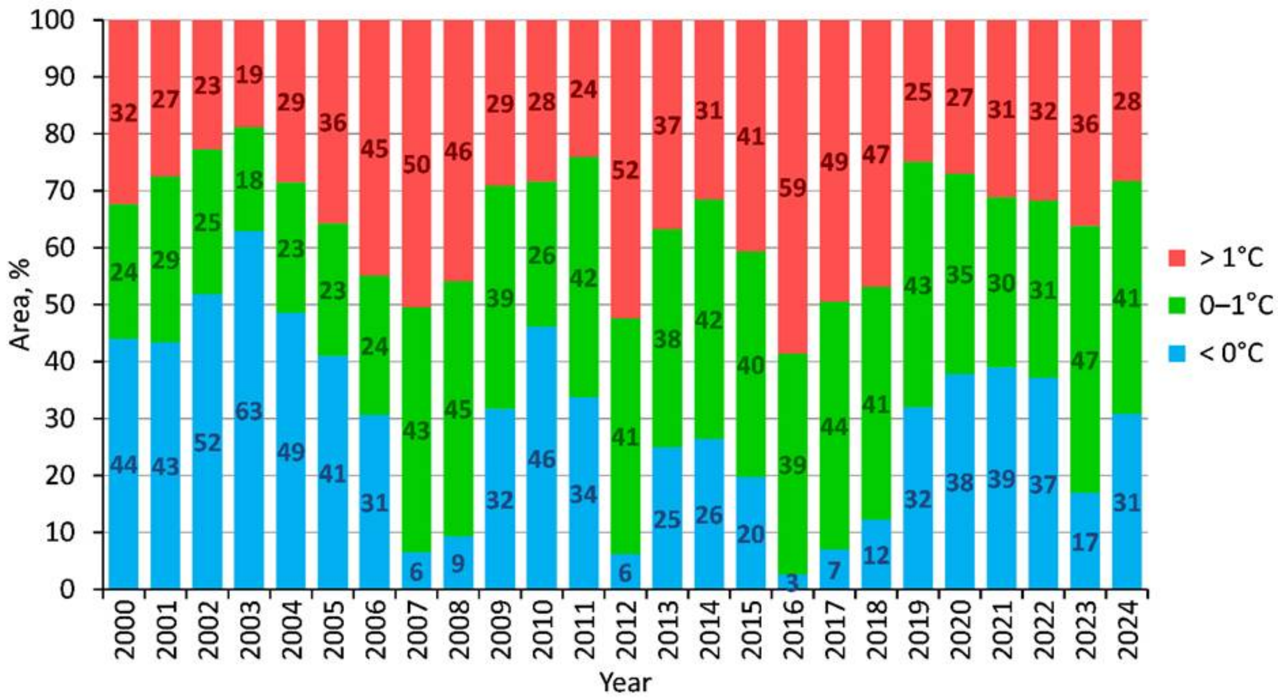

Figure 1.3. Area of bottom waters with different temperature ranges in the Barents Sea in September-October 2000-2024.

There is no trend in the volume transport across the Barents Sea Opening when investigating the full time series. However, there appear to be shifts between periods. The period 1997-2006 had highly varying volume transports. The period 2007-2020, on the other hand, was more stable, with the exception of the extreme years of 2015-2016. From 2021 and onwards, the volume transport has been rather weak compared to before, in particular in spring/early summer and fall.

Mesozooplankton

The total mesozooplankton biomass in autumn 2024 was similar to preceding years in most of the Barents Sea. However, in several subareas of the Norwegian sector, where size-fractioned biomass data are available, the biomass of the mid-size fraction (typically representing older stages of large copepods like *Calanus* spp.) has been very low since 2020. During the same period, the biomass of the smallest size-fraction (typically representing young stages of intermediately sized copepods, as well as smaller species) has displayed a strong increase.

The changes in the biomasses of the intermediate and small zooplankton size-fractions may reflect a combination of factors including the predation pressure from the large fish stocks, possibly a lower advection of mesozooplankton with inflowing waters into the BS in recent years, as well as variability in local production rates.

Krill indices of biomass have shown increasing trends over recent decades to the increased contribution from *M. norvegica* in the BS.

Prey stocks

Euphausiids, amphipods and shrimp are important prey for most commercial fish in the Barents Sea. In 2023 the total biomass of euphausiids was slightly less than long term mean (1980-2023). In recent years, the northern shrimp stock has remained stable, showing fluctuations but without a clear trend. Indices were not updated in 2024.

Capelin, polar cod and young herring are the main forage pelagic fish in the Barents Sea, which are important prey for most predators in the area, including commercial demersal species. These species are very sensitive to various changes in the ecosystem, the influence of predators, fishing, or the plankton . Total biomass of the main pelagic species during 1986–2024 has fluctuated between ca. 0.5 and 9 million tonnes; largely driven by fluctuations in the capelin stock (Figure 1.4). During 2020-2024 (except for the year 2022 with poor survey coverage), the combined biomass of capelin, herring, polar cod, and blue whiting has been above the long-term average after a low-biomass period from 2014-2019. The biomass during this latter period has been dominated first by capelin from the 2019 and 2020 year-classes, and in the last two years by herring from the 2021 and 2022 year-classes.

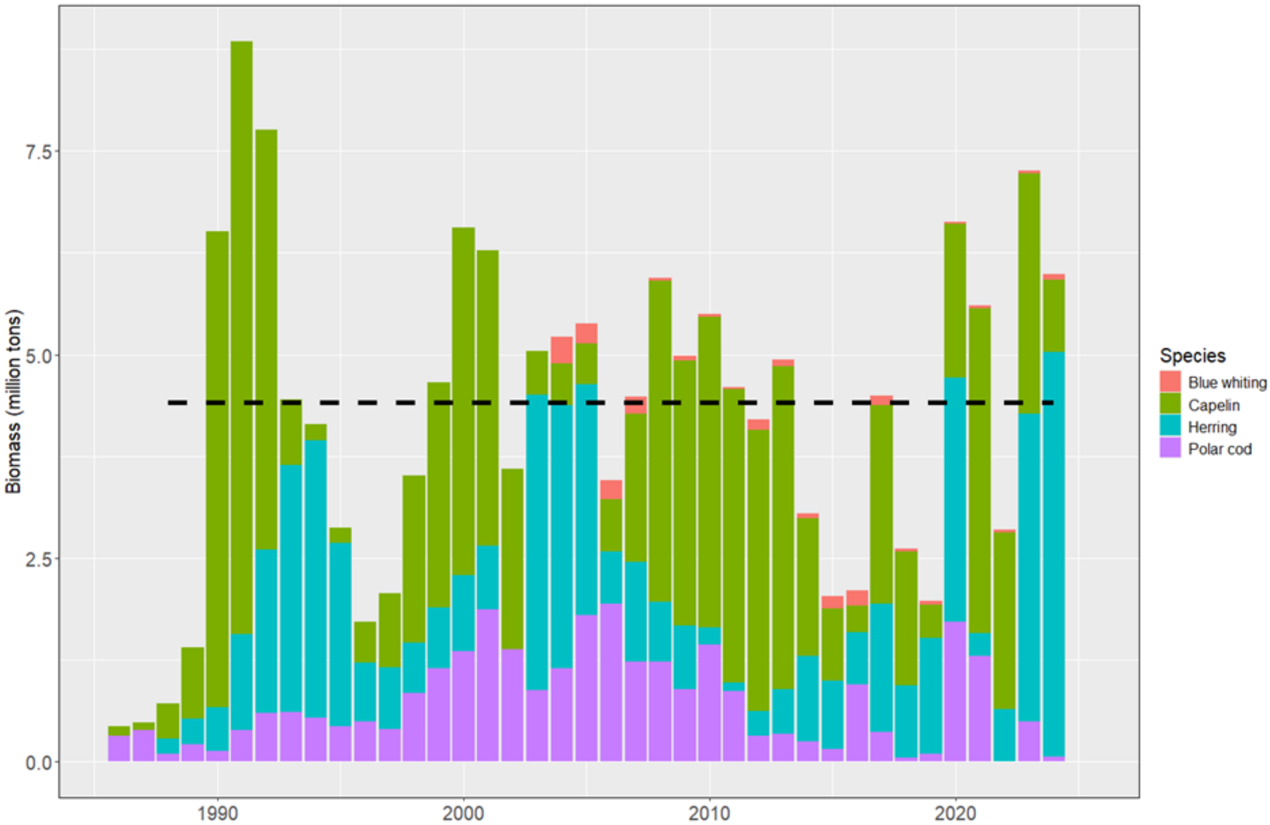

Figure 1.4. Total biomass of pelagic fish (excluding 0-group) in the Barents Sea in 1986-2024. Note that herring survey estimates are available from 1999 and blue whiting estimates from 2004. Biomass estimates for herring between 1988 and 1998 are derived from the NSS-herring assessment (age 1-3). The dashed line denotes average biomass summed over all the included pelagic species for 1988-2024.

The recent strong recruitment to the polar cod stock in 2016 and 2020 led to sudden increases in stock size, but the stock sizes decreased again rapidly (Figure 1.4). Polar cod are predicted to experience decrease in habitat and abundance with a warmer and more ice-free Barents Sea, and t here is also a high probability that polar cod are now distributed outside the standard survey area in the Barents Sea.

Specification of the ecosystem impact on the assessed species:

Cod

The cod stock has been decreasing, but predictions indicate that it will stabilize on a low level. The main effect of the ecosystem impact on cod stock dynamics is manifested in the change in the abundance of its recruitment. There have not been any strong year-classes of cod since 2005 despite high cod SSB and above average sea temperatures. Recruitment has previously been shown to be positively correlated with both those factors, but in recent years this is no longer the case. Meso-zooplankton is important for survival of larvae and 0-group cod, so their distribution must overlap with areas of relatively high plankton biomasses. Despite a large number of studies (see e.g. summary in Ottersen et al., 2014), the underlying mechanism of the impact of the Barents Sea ecosystem on cod recruitment is still not well understood.

Cod diet

Cod is a main predator among fishes in the Barents Sea. Its diet was relatively stable in recent years; capelin was the main prey. The diet composition of cod in 2024 was rather similar to that in 2023 (Figure 1.5). Since 2013 the importance of snow crab in cod diet considerably increased and has since then consisted of 3-7 % by weight (Figure 1.6). It should be noted that in 2022-2023 an unexpected increase of red king crab, up to 3-5 % by weight in the diet was observed (Figure 1.6), but cod consume only crab legs, empty carapaxes after molting or individuals with soft carapax immediately after molting. Figure 1.7 shows the consumption by cod in the period 1984-2024. Consumption of most prey has decreased in recent years due to decreasing cod abundance. Total prey consumption in 2024 was very close to that in 2023.

Figure 1.8 and 1.9 show the proportion of cod and haddock in the diet of cod. Predation of cod on juvenile cod and haddock was relatively low in 2020-2023, but the proportion of haddock in cod diet increased considerably from 2023 to 2024, which is consistent with the increased abundance of young haddock in recent years. The proportion of cod in cod diet also increased somewhat from 2023 to 2024.

Individual growth of cod now seems to have stabilized. Feeding conditions for cod are expected to be adequate in the near future, as the cod likely will be able to feed on other prey despite the present low capelin stock level (see Gjøsæter et al. 2009 for a discussion of ecosystem effects of capelin collapses). Also, the cod stock is low so there will be less competition for food.

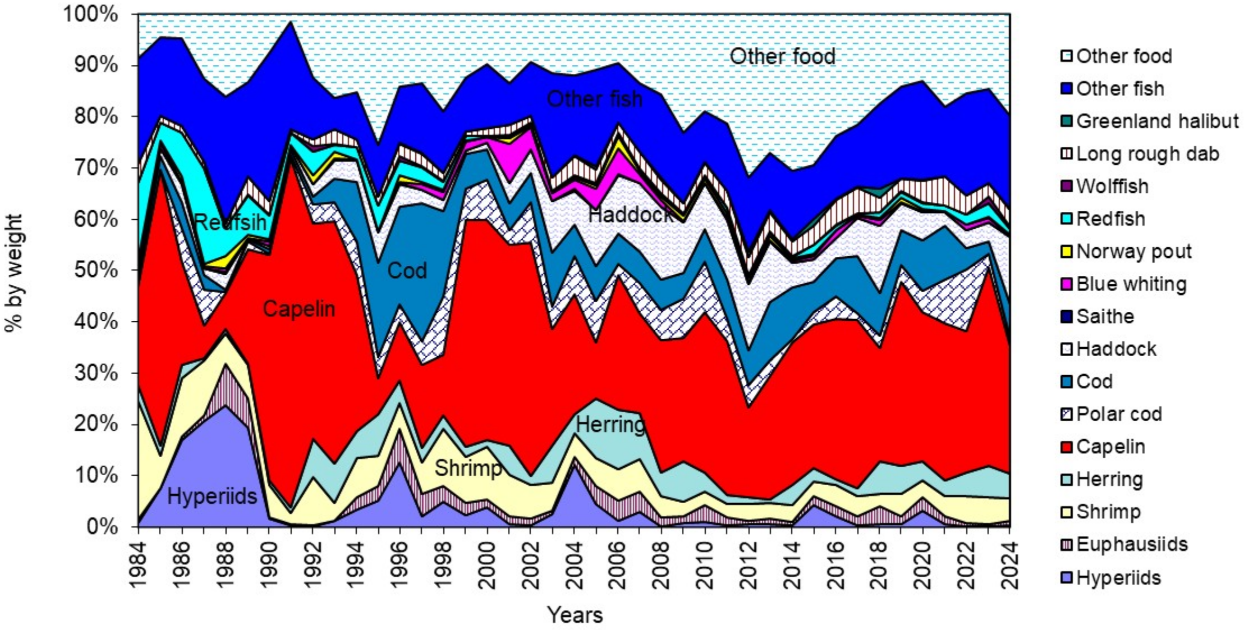

Figure 1.5. Diet consumption of cod in the Barents Sea in 1984-2024, % by weight

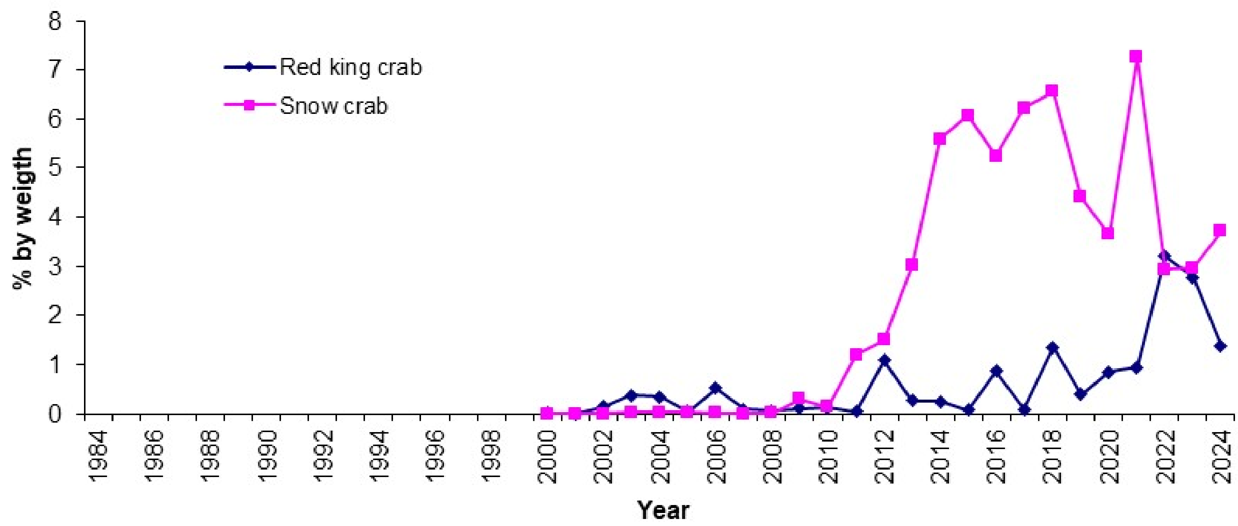

Figure 1.6. Importance of snow crab and red king crab in diet of cod in 1984-2024, % by weight

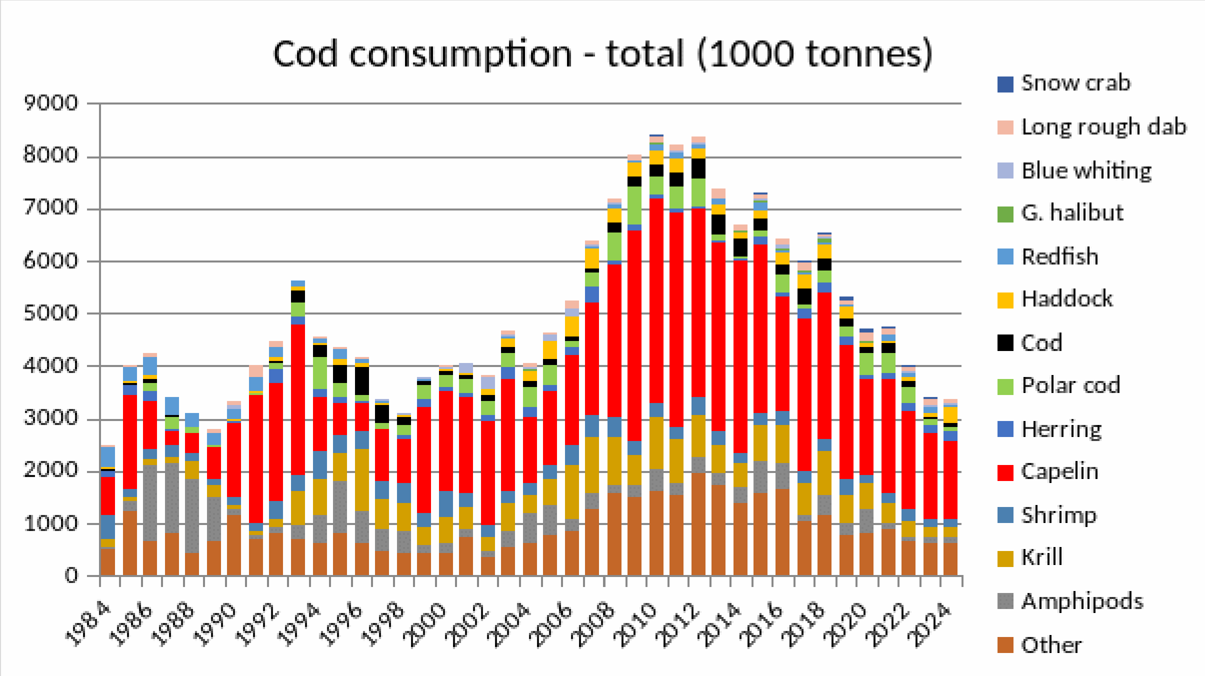

Figure 1.7. Consumption of various prey items by cod in 1984-2024. Norwegian calculations.

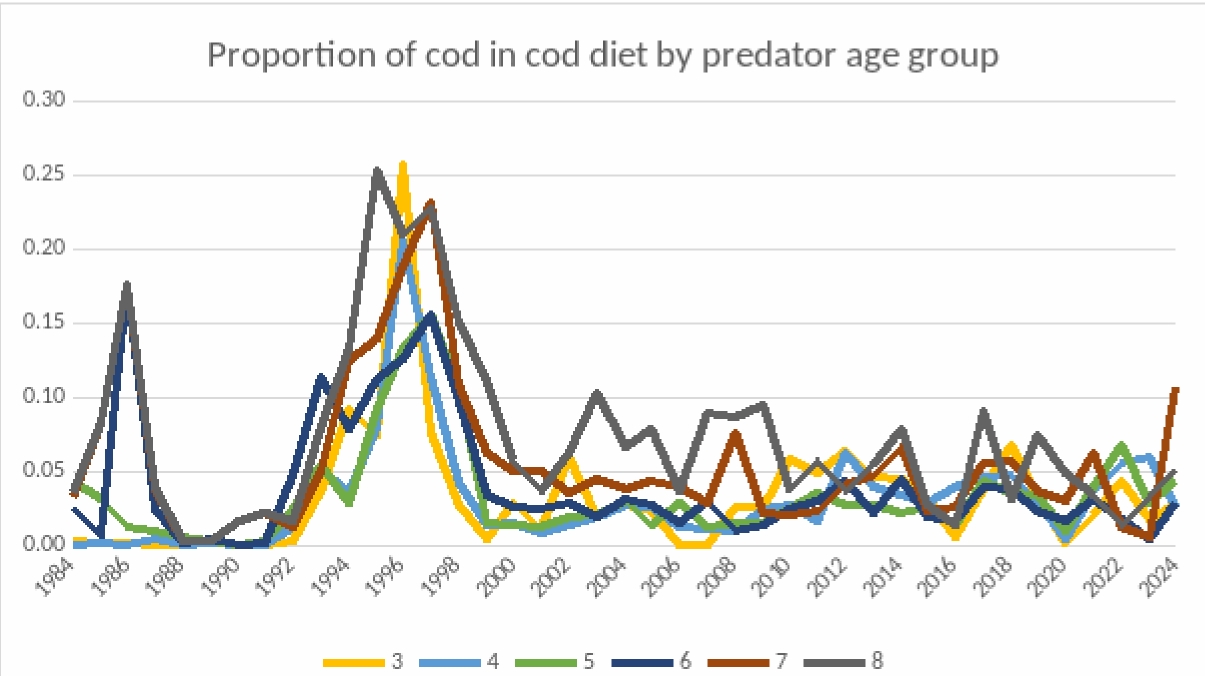

Figure 1.8. Proportion of cod in cod diet by predator age group.

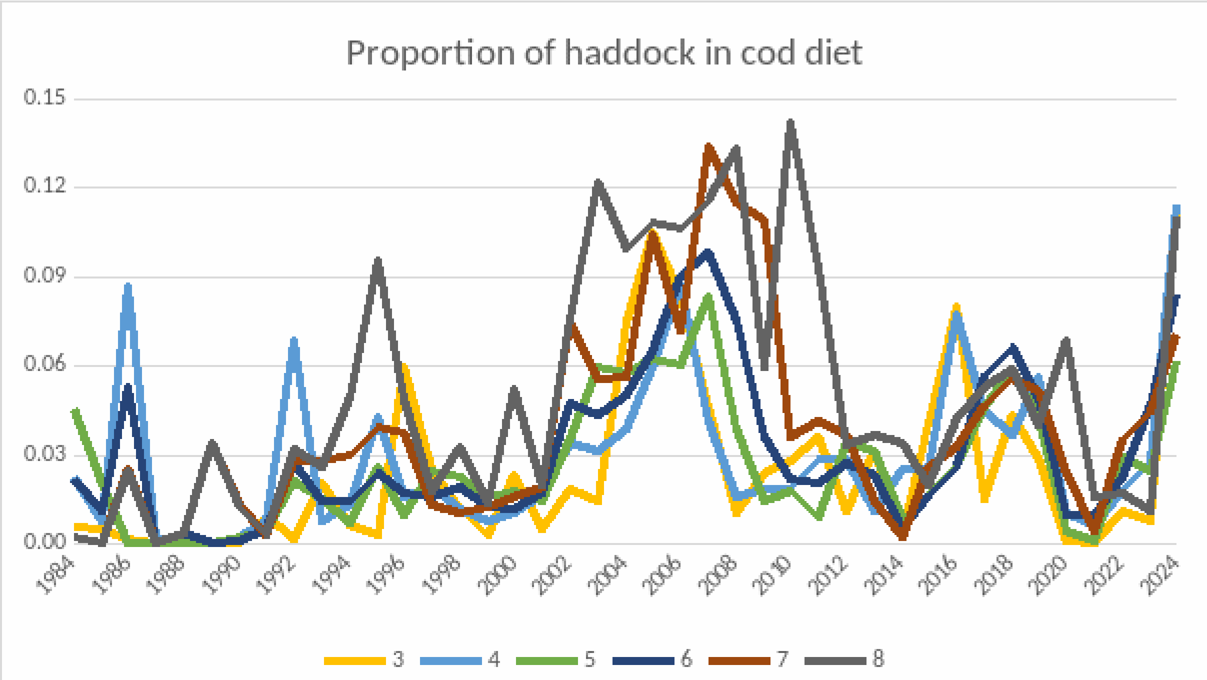

Figure 1.9. Proportion of haddock in cod diet by predator age group.

Haddock

Warm conditions are necessary, but not sufficient conditions to ensure good recruitment and growth. Plankton bloom (timing and strength) and influx are important for year-class formation. The year classes 2018-2020 were poor, but the reasons are not fully explored. The year-classes 2021-2024 appear to be average, or above average. There is no clear recent trend in the condition factor of haddock (Figure 1.10). Older haddock includes a high proportion of benthic invertebrates in their diet, but the availability of this prey group is not known. The low cod stock should lead to less predation on haddock by cod, and therefore lower mortality on both pre-recruits and younger haddock recruited into the fishery.

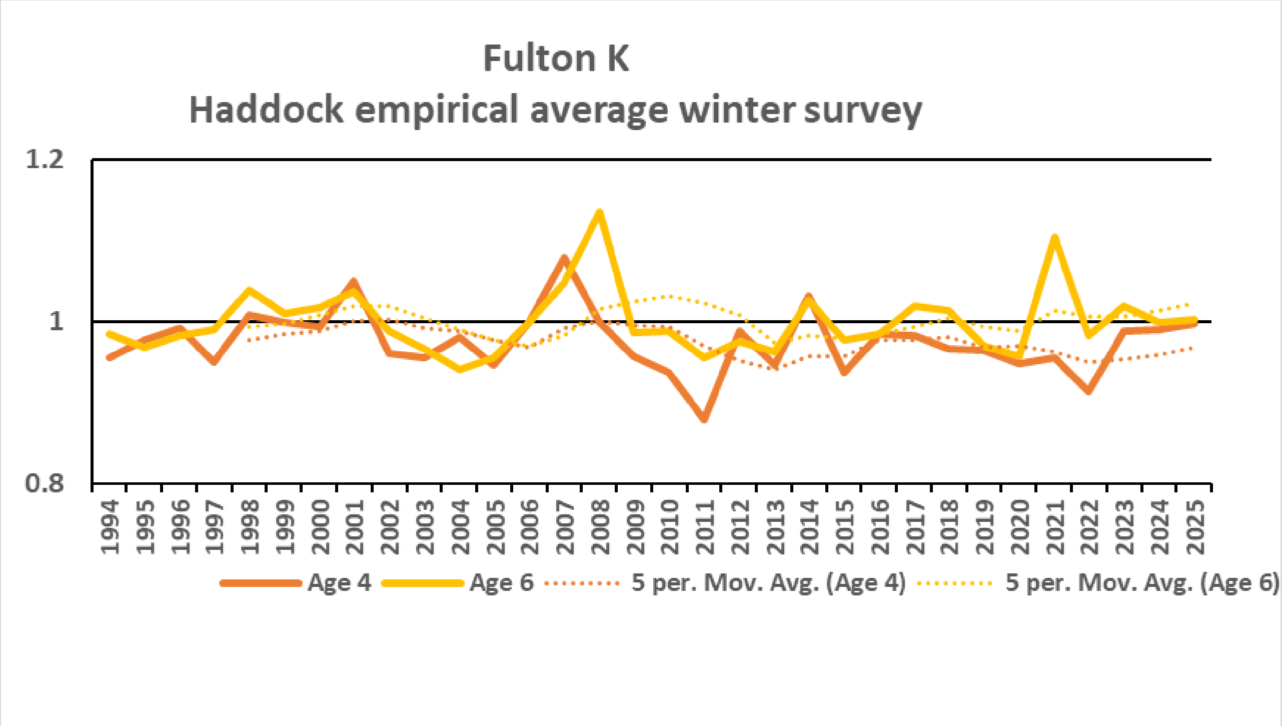

*Figure 1.10. Fulton's K (100*weight (g) /length (cm)^3) calculated from average weights and lengths from the winter survey 1994-2025 (Godiksen et al. 2025)*

Haddock diet

The diet composition of haddock is presented in Figure 1.11. Haddock is a benthivorous species and feeds mainly on polychaets, echinoderms and molluscs (on average up to 43 % by weight). However, euphausiids and fish (including capelin and herring) can be important prey items (on average up to 13 % and 17 % by weight respectively).

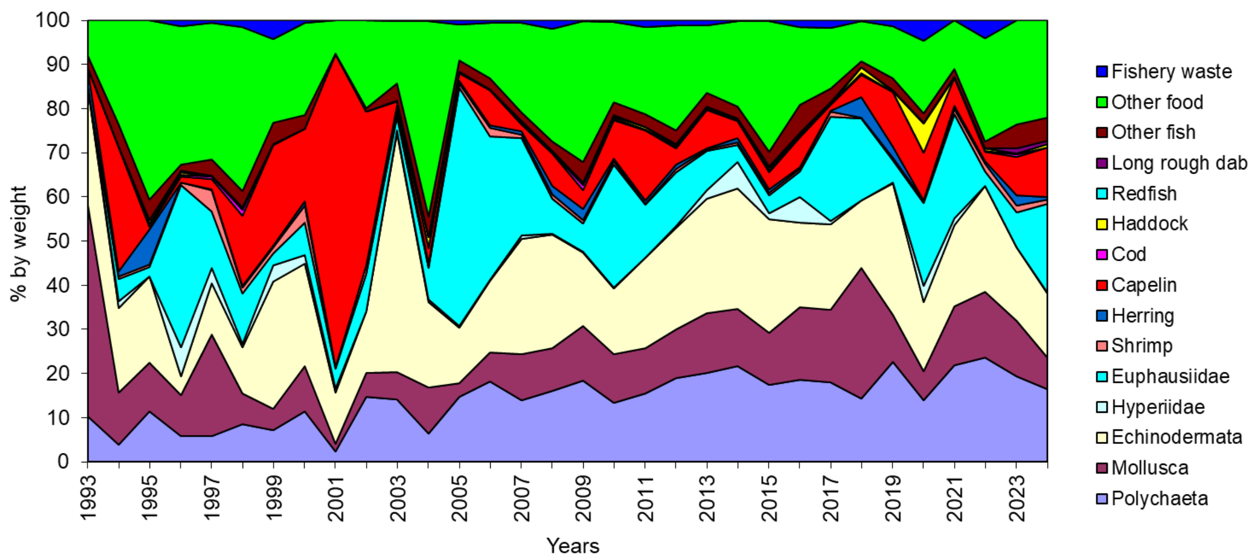

Figure 1.11. Diet composition of haddock in the Barents Sea in 1993-2024, % by weight

Greenland halibut

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

The Greenland halibut stock has experienced notable changes over the past two decades. In the early 2000s, the stock was considered relatively stable, supported by moderate fishing pressure. From 2009, fishing activity has increased significantly, which has contributed to a gradual decline in both harvestable biomass and spawning stock biomass (SSB). By 2024, stock indicators suggested increased pressure on the population, as the SSB had fallen below precautionary reference points and the harvest rate exceeded sustainable levels. These developments highlight the importance of continued monitoring and adaptive management to support the long-term sustainability of the stock.

Beaked redfish

As a boreal species, it is benefiting from the warming in the Barents Sea. Its stock has increased in recent years, but stock assessment of this species is characterized by high uncertainty. Feeding condition for beaked redfish, which feeds on zooplankton and small fish (capelin), in 2022-2023 were likely to be relatively stable. Cod and Greenland halibut are main predators for the beaked redfish. However, as abundance of these species is declining and abundance of capelin, herring and polar cod is increased, the predation pressure on redfish is probably relatively low. In recent years, the total number of redfish juveniles, mostly *S. mentella* , caught as bycatch in the international shrimp fishery has increased (see text and figure below). This strongly depends on the overlap between the distribution areas of redfish juveniles and shrimp fishery areas. The stock size and distribution of shrimp as well as currents and temperature affect this.

Marine mammals

In the Barents Sea, about 15 cetacean species, 7 seal species and the polar bear can potentially be observed. The white-beaked dolphin is the most common cetacean species to be seen within the Barents Sea as it is distributed all over the area. Among the large baleen whales, especially minke whales, but also fin whales, are distributed over large parts of the Barents Sea, and are seasonally present at relatively high numbers. Humpback whales have much more aggregated distributions north and west of Hopen and around Bear Island, and these locations are also shared by the other baleen whale species.

In 2024, white-beaked dolphins were the most frequently observed, although lower in numbers than in previous years. Dominant species in the group of baleen whales were humpback whales and fin whales. Aggregations of humpback whales in areas East of Svalbard commonly overlap with capelin distribution.

Food web and species interactions

The Barents Sea food web is a relatively well-studied, cold-water marine ecosystem characterized by strong seasonal productivity and top-down control by predators (Blanchard et al. 2002, Wassmann and Reigstad 2011 **)** . At its base, the food web starts with phytoplankton, which bloom in spring and are grazed by zooplankton such as *Calanus finmarchicus* . These in turn support a variety of pelagic fish like capelin (*Mallotus villosus*), herring, polar cod and the early life-stages of demersal fish. Demersal fish (e.g., cod, *Gadus morhua*) feed on both pelagic and benthic prey, while marine mammals (such as harp seals and whales) and seabirds (e.g., auks) act as apex predators. The web is influenced by climate-driven changes in ice cover and inflow of Atlantic waters, affecting species composition and productivity.

A model for assessing the food web of marine mammals and fish in Barents Seas developed by Planque et al. (2024) is shown in Figure 1.12. Marine mammals consume large quantities of food, comprised of fish, including cod and lower trophic level species that support commercial fish stocks.

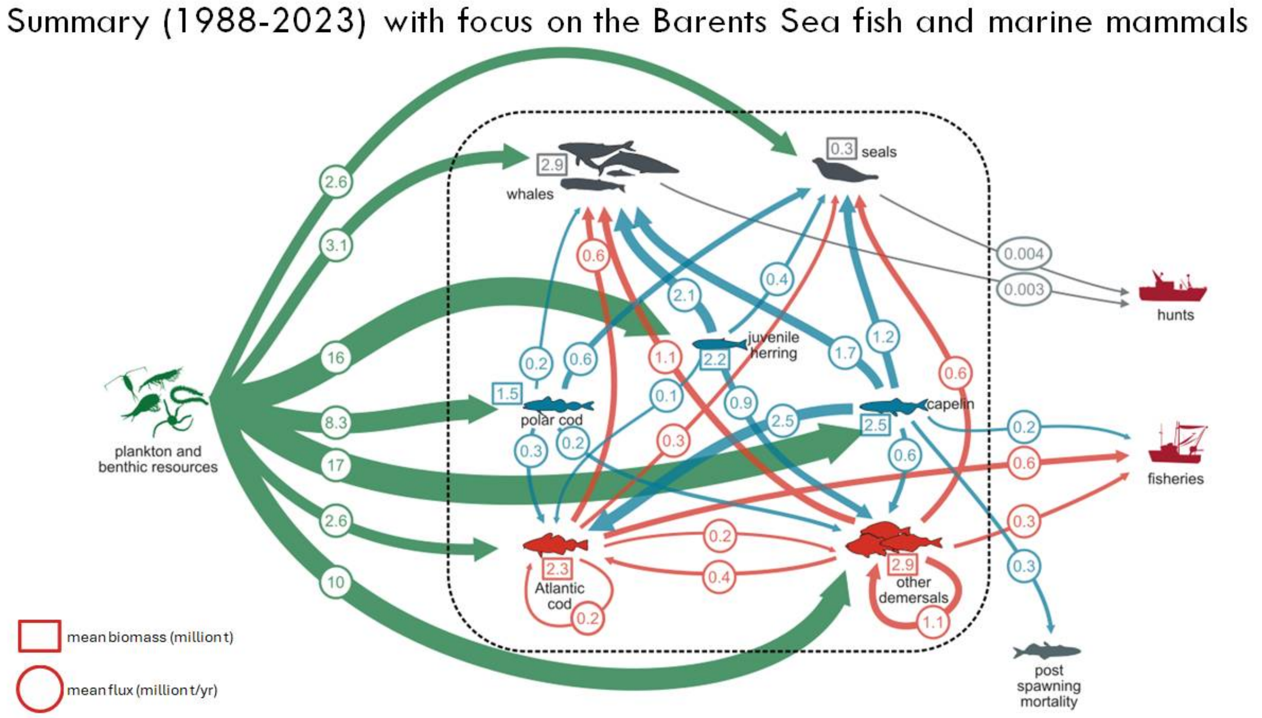

Figure 1.12. Results from a food-web assessment model for marine mammals, fish, and fisheries in the Barents and Norwegian Seas (Planque et al. 2024). Note the legends in lower left corner of the figure.

According to Mauritzen et al. (2022) marine mammals consume about 535 000 tons of gadoid species annually in the Barents Sea. We should get more information about the gadoid species composition and size of this prey in their diet to better evaluate the mortality caused by marine mammals compared to cannibalism, fishing mortality and other natural mortalities. For Northeast Arctic cod, total cannibalism during the record high spawning stock biomasses (SSB) during 2011-2015 was up to 370 000 tons (2013), while cannibalism in 2024 was estimated to 112 000 tons (Table 1.1).

Table 1.1. The North-east arctic COD stock's consumption of various prey species in 1984-2024 (1000 tonnes) based on Norwegian consumption calculations. Same data as for Figs. 5 and 7.

Year	Other	Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Blue whiting	Long rough dab	Snow crab

1984	522	30	140	459	747	83	16	23	55	376	0	0	25	
1985	1239	185	63	177	1765	212	3	31	53	242	0	2	48	
1986	675	1424	136	163	948	161	155	74	108	339	0	0	66	
1987	804	1356	88	231	292	38	223	26	6	337	1	0	11	
1988	445	1415	337	150	381	8	98	11	2	258	0	5	6	
1989	671	822	235	123	591	3	37	8	10	222	0	0	67	
1990	1154	124	77	162	1411	7	5	16	14	190	0	82	87	
1991	699	65	73	164	2455	7	10	23	16	266	7	8	242	
1992	822	94	151	352	2261	275	91	46	88	172	23	2	94	
1993	710	242	645	304	2865	155	268	260	69	91	2	2	27	
1994	610	553	694	507	1056	146	599	222	48	76	0	1	43	
1995	830	980	530	359	606	117	245	366	113	194	2	0	36	
1996	604	627	1182	346	539	46	100	528	66	94	0	10	36	
1997	477	421	564	348	974	5	114	347	44	33	0	33	15	
1998	450	415	527	375	825	102	172	161	36	9	0	14	18	
1999	429	168	314	296	2024	149	256	66	29	18	1	34	8	
2000	424	187	499	500	1923	61	217	83	58	8	0	40	21	
2001	723	178	393	292	1834	75	263	68	51	6	1	157	31	
2002	375	95	257	240	1996	86	279	108	127	1	0	238	16	
2003	547	286	542	238	2152	216	276	110	166	3	0	74	52	
2004	624	559	346	246	1247	214	356	126	197	3	11	56	64	
2005	772	568	514	271	1388	131	386	117	324	2	4	114	52	
2006	860	220	1047	352	1736	167	106	79	360	12	2	162	123	
2007	1255	308	1077	429	2145	284	263	87	376	46	0	44	73	
2008	1579	158	920	388	2873	105	513	186	290	59	12	18	92	
2009	1492	240	586	267	3987	121	732	194	250	28	3	5	115	
2010	1607	415	997	282	3901	52	333	240	263	138	10	14	132	
2011	1533	247	842	219	4068	81	418	280	274	114	0	26	120	
2012	1953	305	788	343	3613	50	513	370	217	50	33	8	123	
2013	1716	252	528	260	3573	50	134	367	195	107	1	21	162	1
2014	1368	321	468	199	3634	70	30	350	85	31	10	18	103	
2015	1583	622	662	246	3205	126	142	206	172	138	40	58	81	3
2016	1652	512	698	294	2158	93	340	188	218	56	5	85	115	
2017	1040	127	588	249	2891	192	87	309	267	44	4	24	135	5
2018	1161	373	854	220	2778	195	233	236	267	32	67	45	51	4
2019	774	245	529	302	2549	173	159	178	201	44	0	2	97	4
2020	815	463	470	158	1837	104	400	98	81	26	11	12	149	8

2021	883	139	372	196	2182	96	393	186	25	111	0	13	94	3
2022	680	66	310	196	1893	145	299	116	76	81	4	30	73	4
2023	622	109	181	182	1614	165	101	55	67	105	0	58	112	2
2024	613	113	215	137	1499	176	64	112	293	33	6	23	71	2
Sum	37790	16029	20439	11224	82416	4744	9433	6656	5656	4194	260	1538	3086	45

Concerns have been raised, and questions asked why the number of Northeast Arctic cod surviving to age 3 did not increase despite the record high SSBs producing these year-classes in 2011-2015, and the evidence of strong new year-classes being produced at the 0-group stage (Figure 1. 13a-c). Possible explanations for the low survival to age 3 are fishing (e.g., bycatch of juveniles in shrimp fishery), climate, food, predation, cannibalism and random effects. All these explanations should be further investigated to see if one in the future could gain more long-lasting effects of keeping high SSBs although cannibalism and predations by marine mammals are likely the main reasons.

A: B: C:

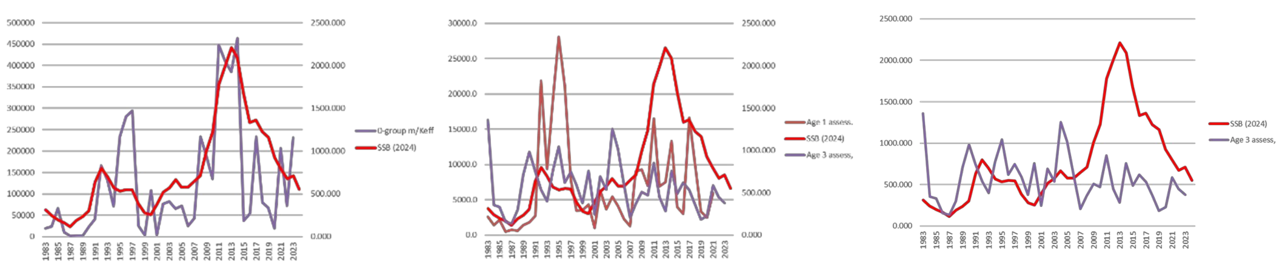

Figure. 1.13. Illustrating the low survival of promising year-classes of cod produced by record high SSBs during 2011-2015. A - comparing SSB with corresponding year-classes at age 0, B - comparing SSB with corresponding year-classes at age 2 and 3 and C- comparing SSB with corresponding year-classes at age 3.

Discards and young fish bycatch in mixed fishery

In this report, the terms ‘landings’ and ‘catches’ are, somewhat incorrectly, used as synonyms, as discards are in no cases used in the assessments. This does not mean, however, that discards have not occurred, but the WG has no information on the likely extent. Available information indicates low discard rates at present (less than 5% of catch), and it therefore is assumed that discards are negligible in the context of the precision of the advice.

We would note that there have been historical periods with significant mis-reporting, and for further information on under- and misreporting, we refer to the 2016 and 2022 AFWG reports.

Bycatch estimates (1994–2024) of redfish, cod, haddock, Greenland halibut and polar cod juveniles in the commercial shrimp fishery in the Barents Sea are presented in Figure 1. 14 . These estimates are obtained with a spatio-temporal model based on a procedure elaborated in Breivik et al. (2017). In Breivik et al. (2017) an extensive validation study indicates that the procedure obtains bycatch estimates with approximately correct uncertainty. The bycatch estimates illustrated in Figure 1. 14 are available for each quarter in each main statistical area (not shown in report). Note the increase in bycatch of redfish juveniles in recent years. In the Barents Sea , genetic analyses of redfish juveniles collected from bycatches in the shrimp fishery some years ago showed that 97% of the redfish juveniles were *S. mentella* (K. Nedreaas, *pers.com* .). Most of the redfish bycatch are 8-15 cm and 1-3 years old *S. mentella* with an average weight of about 22 g. A bycatch of 30 million redfish hence corresponds to 650 tons bycatch compared to 33 000 tons eaten by cod in 2024. On the other hand, 10 million 2-year-old redfish bycatch (i.e., 1/3 of the total bycatch) is about 4% of the assessed total stock number of 2 year olds (Howell et al. 2024). The current stock assessment of *S. mentella* is less accurate with regards to small fish since it mainly focuses on the fished part of the stock. The natural mortality of the smallest redfish caught as bycatch is also likely higher than M=0.05 used in the current stock assessment.

The time-series in Figure 1.14 are obtained by scaling the estimated bycatch in the Norwegian shrimp fishery with the international fishery in e.g., each season and ICES area. The scaling procedure assumes that the Norwegian fishery is representative of the international shrimp fishery with regards to bycatch. This assumption is necessary because the international catch data are available only to a low spatio-temporal resolution. If the international vessels to a relatively high degree trawl at locations not trawled by Norwegian vessels, the bycatch estimates illustrated in Figure 1. 14 may be biased. The estimated bycatches do not include larger fish kept in escapement bags in some countries’ shrimp fisheries in international waters (the “Loop-hole”).

The same spatio-temporal model may also be used as a tool to open closed areas.

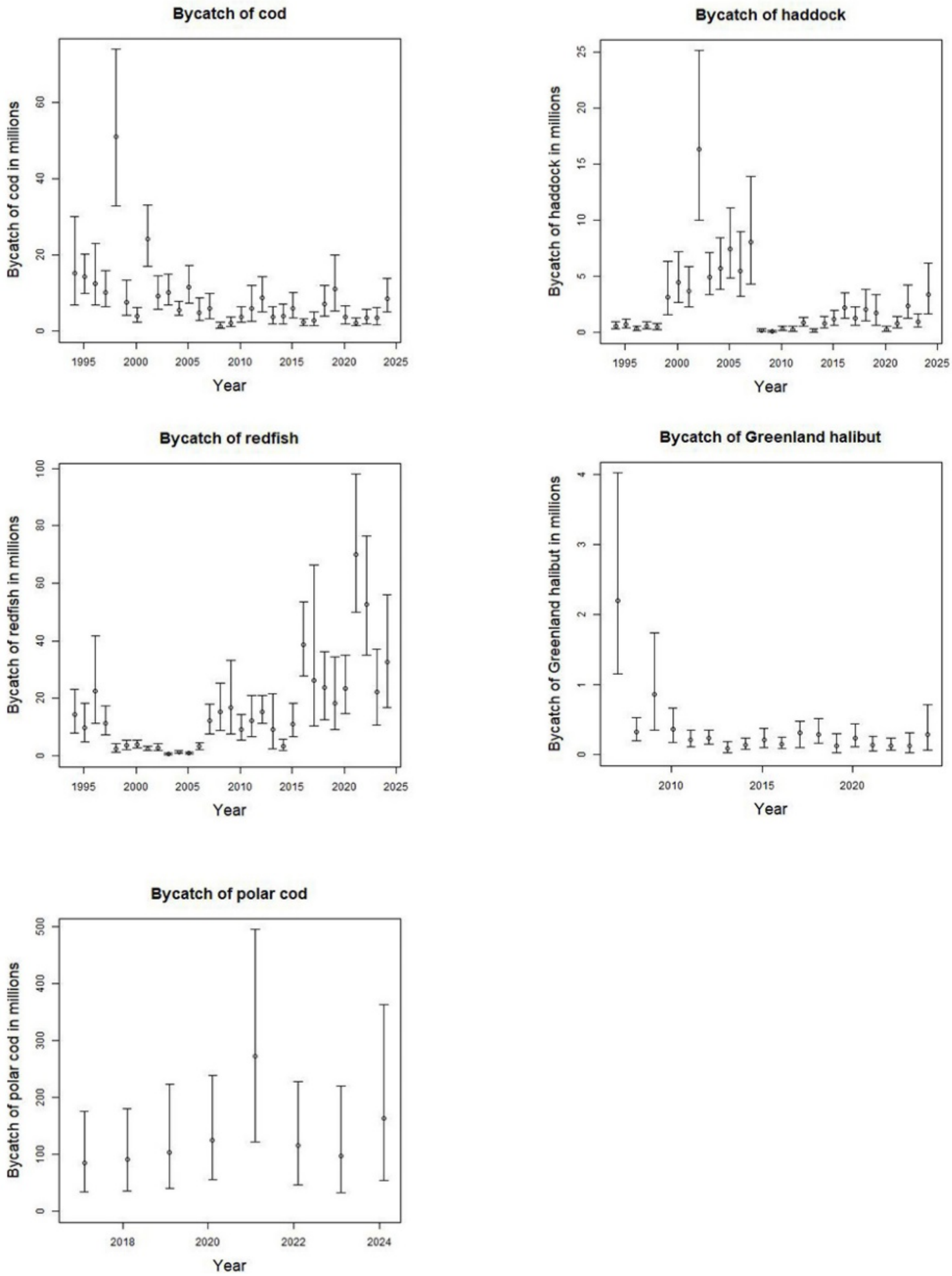

Figure. 1.14. Estimated bycatch of cod, haddock, redfish, Greenland halibut and polar cod (Boreogadus saida) in the Barents Sea international shrimp fishery. Intervals are 90% confidence intervals.

Sampling of commercial catches – age and length sampling

Tables 1.2–1.5 show the development of the Norwegian, Russian, Spanish and German sampling of commercial catches in the period 2008–2024. The tables show the total sampling effort, but do not show how well the sampling covers the fishery. Indices of coverage should be developed to indicate this. The main reason for the general strong decrease in numbers of Norwegian samples in the first part of this period is the termination of the port sampling program in northern Norway. This program is now up and running again. It should be considered whether catch sampling carried out by different countries fishing by trawl for the same time and area could be coordinated and data shared on a detailed level to a greater extent than is done today. It is also possible for Norway to provide stock coordinators in other countries with samples collected by the Norwegian Coastguard during their inspections of foreign vessels.

Table 1.2 . Age and length sampling by Norway of commercial catches in 2008–202 4 . Number of samples and average number of fish per sample. Also, number of age samples and aged individuals per 1 000 t caught. For comparison, also the EU DCF requirements are shown.

Year	No of unique vessels	No of length samples	No of length-measured individuals	No of unique vessels (***)	No of age samples	No of aged individuals	Landing tonnes	Length-samples per 1000 t	Age samples per 1000 t	Aged individuals per 1000 t	EU co pe
NEA-cod + coastal cod											
2008	336	2526	51263		464	16026	196067	12.9	2.4	81.7	12
2009	272	2669	53350		417	14170	224816	11.9	1.9	63.0	12
2010	175	2542	39733		338	7671	263816	9.6	1.3	29.1	12
2011	273	2305	46227		434	10043	331535	7.0	1.3	30.3	12
2012	356	3132	57954		618	14710	363207	8.6	1.7	40.5	12
2013	266	2917	81583	84	1275	13940	464258	6.3	2.7	30.0	12
2014	556	2063	254627	306	1170	14815	465554	4.4	2.5	31.8	12
2015	498	1654	130514	89	1392	16500	413741	4.0	3.4	39.9	12
2016	482	2500	91590	401	1398	17027	403907	6.2	3.5	42.2	12
2017	413	2615	91366	348	1458	15471	408423	6.4	3.6	37.9	12
2018	873	3163	122788	346	1545	15535	369897	8.6	4.2	42.0	12
2019	842	3093	135375	337	1457	12519	322233	9.6	4.5	38.9	12
2020	389	1869	53587	259	653	12431	334773	5.6	2.0	37.1	12
2021											
2022											
2023											
2024											
NEA-haddock											
2008	285	2177	45038		281	9474	72553	30.0	3.9	130.6	12
2009	233	2255	41481		206	6010	104882	21.5	2.0	57.3	12
2010	154	2155	38045		232	5458	123517	17.4	1.9	44.2	12
2011	227	2028	39663		312	7225	158293	12.8	2.0	45.6	12
2012	258	2609	47995		386	8191	159008	16.4	2.4	51.5	12
2013	89	2142	62193	86	965	5718	99127	21.6	9.7	57.7	12

Year	No of unique vessels	No of length samples	No of length-measured individuals	No of unique vessels (***)	No of age samples	No of aged individuals	Landing tonnes	Length-samples per 1000 t	Age samples per 1000 t	Aged individuals per 1000 t	EU co pe
2014	425	1479	114560	126	825	7297	91333	16.2	9.0	79.9	12
2015	397	1380	76574	47	967	8394	95086	14.5	10.2	88.3	12
2016	237	1986	47032	208	391	8202	108718	18.3	3.6	75.4	12
2017	215	2108	57461	150	1084	8805	113206	18.6	9.6	77.8	12
2018	536	2435	85303	130	1088	8397	93839	25.9	11.6	89.5	12
2019	497	2269	83378	123	1003	7652	93860	24.2	10.7	81.5	12
2020	142	1055	32009	70	342	6589	88108	12.0	3.9	74.8	12
2021											
2022											
2023											
2024											
Beaked redfish (*S. mentella*) **											
2008	13	178	1038		0	0	2214	80.4	0.0	0.0	12
2009	12	319	1841		2	40	2567	124.3	0.8	15.6	12
2010	11	284	3664		11	320	2245	126.5	4.9	142.5	12
2011	9	255	3210		11	298	2690	94.8	4.1	110.8	12
2012	13	166	2187		13	241	2098	79.1	6.2	114.9	12
2013	14	184	383	5	13	390	1361	135.2	9.6	286.6	12
2014	11	36	4664	12	49	5	13402	2.7	3.7	0.4	12
2015	22	295	8324	5	19	174	19433	15.2	1.0	9.0	12
2016	23	285	5470	9	23	169	18191	15.7	1.3	9.3	12
2017	22	234	3507	7	29	177	17077	13.7	1.7	10.4	12
2018	26	407	7295	8	41	374	18594	21.9	2.2	20.1	12
2019	21	345	5884	6	38	329	23844	14.5	1.6	13.8	12
2020	29	475	10796	9	75	686	32950	14.4	2.3	20.8	12
2021	27	623	17001	6	53	970	43794	14.2	1.2	22.1	12
2022	27	488	10658	7	71	1238	40716	12.0	1.7	30.4	12
2023											
2024											
Greenland halibut											
2008	56	622	20307				7394	84.1			12
2009	35	753	17233				8446	89.2			12
2010	44	541	9222				7685	70.4			12
2011	52	504	9239				8273	60.9			12

Year	No of unique vessels	No of length samples	No of length-measured individuals	No of unique vessels (***)	No of age samples	No of aged individuals	Landing tonnes	Length-samples per 1000 t	Age samples per 1000 t	Aged individuals per 1000 t	EU co pe
2012	51	637	9765				10074	63.2			12
2013	53	523	10554	1	2		12613	41.5	0.16	0.0	12
2014	52	391	5140				10876	36.0			12
2015	92	440	11200	21	22	944	10704	41.1	2.1	88.9	12
2016	120	415	8040	22	29	1128	12573	33.0	2.3	89.7	12
2017	107	486	10385	24	28	1128	13194	36.8	2.1	85.5	12
2018	98	505	9083	5	27	629	14876	33.9	1.8	42.3	12
2019	93	455	9286	47	86	697	14813	30.7	5.8	47.0	12
2020	89	509	9110	52	80		14532	35.0	5.5	0.0	12
2021	73	590	10804	40	66	979	14008	42.1	4.7	69.9	12
2022	64	502	8164	40	59	0	13138	38.2	4.5	0.0	12
2023	76	335	7290	38	48	0	13919	23.1	3.5	0.0	12
2024											
Capelin											
2008	4	3	150		0	0	5000	0.6	0.0	0.0	12
2009	18	97	7039		39	1039	233000	0.4	0.2	4.5	12
2010	75	230	6191		47	1291	246000	0.9	0.2	5.2	12
2011	115	315	8346		48	1313	273000	1.2	0.2	4.8	12
2012	84	308	9337		29	843	181328	1.7	0.2	4.6	12
2013	12	213	12215	47	47	773	156340	1.4	0.3	4.9	12
2014	27	113	9054	1	8	1086	40021	2.8	0.2	27.1	12
2015	65	722	83776	65	722	5393	71435	10.1	10.1	75.5	12
2016	7	27	1863	7	27	649	0				12
2017	21	43	2294	14	25	305	0				12
2018	68	207	15022	33	76	823	123461	1.7	0.6	6.7	12
2019	4	26	260	2	13	0	0				12
2020							0				12
2021							0				12
2022	23		2256			673	42597				12
2023	16		1539			480	37652				12
2024											

****In addition to age the otoliths are also used for identification of coastal cod.**

****Age samples from surveys with commercial trawl come in addition.**

*****From 2013 No. of unique vessels are split by length and age samples.**

******Only from large, meshed gillnets as basis for assessment.**

Table 1.3 . Age and length sampling by Russia of commercial catches and age sampling of surveys in 2008–202 4 . Also, length-measured individuals and aged individuals per 1000 t caught. For comparison also the EU DCF requirements are shown.

	Year	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total aged individuals per 1000 t	E c p
NEA-cod*										
	2008	380592	3097	7565	10662	190225	2001	16.3	56.0	1:
	2009	178038	1075	7426	8501	229291	776	4.7	37.1	1:
	2010	126502	1828	7670	9498	267547	473	6.8	35.5	1:
	2011	122623	2376	5783	8159	310326	395	7.7	26.3	1:
	2012***	140028	2040	7742	9782	329943	424	6.2	29.6	1:
	2013	131455	1999	8103	10102	432314	304	4.6	23.4	1:
	2014	114538	3110	7154	10264	433479	264	7.2	23.7	1:
	2015***	105721	2486	6095	8581	381188	277	6.5	22.5	1:
	2016	158006	5090	2704	7794	394107	401	12.9	19.8	1:
	2017	161192	4918	6121	11039	396195	407	12.4	27.9	1:
	2018	157048	3129	1982	5111	340364	461	9.2	15.0	1:
	2019***	83018	2093	3737	5830	316813	262	6.6	18.4	1:
	2020***	112950	3105	3858	6963	312683	361	9.9	22.3	1:
	2021									
	2022									
	2023									
	2024									
NEA-haddock										
	2008	216959	2498	5677	8175	68792	3154	36.3	118.8	1:
	2009	43254	489	5421	5910	85514	506	5.7	69.1	1:
	2010	85445	834	5060	5894	111372	767	7.5	52.9	1:
	2011	61990	1570	3584	5154	139912	443	11.2	36.8	1:
	2012***	87880	1545	5034	6579	143886	611	10.7	45.7	1:
	2013	42927	1205	4021	5226	85668	501	14.1	61.0	1:
	2014	45447	899	3796	4695	78725	577	11.4	59.6	1:
	2015***	31009	914	2972	3886	91864	338	9.9	42.3	1:
	2016	55598	2691	1884	4575	115710	480	23.3	39.5	1:
	2017	74297	3554	2614	6168	106714	696	33.3	57.8	1:

	Year	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total aged individuals per 1000 t	E c p
	2018	61360	2274	1136	3410	90486	678	25.1	37.7	1:
	2019***	44728	1923	1778	3701	76125	588	25.3	48.6	1:
	2020***	69301	2356	1575	3931	89030	778	26.5	44.2	1:
	2021									
	2022									
	2023									
	2024									
S. mentella										
	2008	21446	471	3379	3850	7117	3013	66.2	541.0	1:
	2009	29435	761	1447	2208	3843	7659	198.0	574.6	1:
	2010	2776	100	2295	2395	6414	433	15.6	373.4	1:
	2011	917	7	640	647	5037	182	1.4	128.4	1:
	2012	7802	422	1146	1568	4101	1902	102.9	382.3	1:
	2013	19092	1253	1625	2878	3677	5192	340.8	782.7	1:
	2014	817	25	1297	1322	1704	479	14.7	775.8	1:
	2015	771		1818	1818	1142	675	0.0	1591.9	1:
	2016	27765	1076	85	1161	8419	3298	127.8	137.9	1:
	2017	958	99	1000	1099	4952	193	20.0	221.9	1:
	2018	21004	845	39	884	10497	2001	80.5	84.2	1:
	2019	6881	400	469	869	13164	523	30.4	66.0	1:
	2020	8718	340	612	952	13997	623	24.3	68.0	1:
	2021									
	2022									
	2023									
	2024									
Greenland halibut										
	2008	106411	1519	3366	4885	5294	20100	286.9	922.7	1:
	2009	77554	819	2282	3101	3335	23255	245.6	929.8	1:
	2010	32090	416	2784	3200	6888	4659	60.4	464.6	1:
	2011	9892	115	1541	1656	7053	1403	16.3	234.8	1:
	2012	82943	2140	2506	4646	10041	8260	213.1	462.7	1:
	2013	12608	555	2756	3311	10310	1223	53.8	321.1	1:
	2014	24346	633	2106	2739	10061	2420	62.9	272.2	1:

	Year	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total aged individuals per 1000 t	E c p
	2015	22116	575	2489	3064	12953	1707	44.4	236.5	1:
	2016	11818	574	221	795	10576	1117	54.3	75.2	1:
	2017	24061	1205	1579	2784	10713	2246	112.5	259.9	1:
	2018	21893	954	308	1262	12072	1814	79.0	104.5	1:
	2019	861	125	1552	1677	12198	71	10.2	137.5	1:
	2020	1387	165	1853	2018	12266	113	13.5	164.5	1:
	2021									
	2022									
	2023									
	2024									
Capelin										
	2008**	82625	1644	2341	3985	5000	16525	328.8	797.0	1:
	2009	94541	900	2511	3411	73000	1295	12.3	46.7	1:
	2010	67265	1072	4043	5115	77000	874	13.9	66.4	1:
	2011	63784	1273	2271	3544	86531	737	14.7	41.0	1:
	2012	20023	1130	1783	2913	68182	294	16.6	42.7	1:
	2013	54708	1565	1007	2572	60413	906	25.9	42.6	1:
	2014	13206	850	1249	2099	25720	513	33.0	81.6	1:
	2015	27200	1000	1004	2004	115				1:
	2016	8669	3954	1047	5001	0				1:
	2017			4115	4115	6				1:
	2018	14491	250	1050	1300	65934	220	3.8	19.7	1:
	2019			1498	1498	34				1:
	2020			1245	1245	19				1:
	2021									
	2022									
	2023									
	2024									

***In addition, also used long-term mean age–length keys.**

****Age samples from surveys with commercial trawl come in addition.**

*****In addition, used samples from Russian vessels, sampled by the Norwegian Coast Guard in 2012, 2015, 2019, and 2020.**

Table 1.4 . Age and length sampling by Spain 0F 1 of commercial catches and length sampling of surveys in 2008–202 4 . Also,

length-measured individuals and aged individuals per 1000 t caught. For comparison also the EU DCF requirements are shown.

Stock	Year	No of vessels	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total indivi per 10
NEA-cod										
	2008	2	10108	610		610	9658	1047	63	63
	2009	2	8733	1834		1834	12013	727	153	153
	2010	2	28297	1735		1735	12657	2236	137	137
	2011	2	11633	964		964	13291	875	73	73
	2012	2	9849	998		998	12814	769	78	78
	2013	2	30295	2381		2381	15041	2014	158	158
	2014	2	27828	2306		2306	16479	1689	140	140
	2015	2	18568	1445		1445	18772	989	77	77
	2016	2	27937	1246		1246	14640	1908	85	85
	2017	2	33984	2018		2018	14414	2358	140	140
	2018	1	25933	911		911	14415	1799	63	63
	2019	1	5781	1117		1117	13939	415	80	80
	2020						11403			
	2021	2	23891	1314		1314	11080	2156	119	119
	2022	2	22791	345		345	12214	1866	28	28
	2023									
	2024									
NEA-haddock*										
	2009	1	2561				240			
	2010	1	3243				379			
	2011	1	1796				408			
	2012	2	3198				647			
	2013	1	660				413			
	2014	1	2460				370			
	2015	1	702				418			
	2016	2	701				357			
	2017	1	710				156			
	2018	1	154				169			

Stock	Year	No of vessels	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total a indivi per 10
	2019						280			
	2020						45			
	2021						131			
	2022						187			
	2023									
	2024									
S. mentella										
	2008**	1	2275	28			987	2304	28	0
	2011*	1	86				1237			
	2012**	2	11579	476			1612	7183	295	0
	2014**	1	6177				1146	5390		
	2015**	1	6117				2371	2580		
	2016**	1	11806				3133	3768		
	2017**	1	5015				2624	1911		
	2018**	1	11638				2399	4851		
	2019**	1	11952				1908	6265		
	2020**						737			
	2021**	1	2074	157			280	7396		
	2022						277			
	2023									
	2024									
Greenland halibut										
	2008	2	11662				112	103826		
	2009	1	3383				210	16143		
	2010	1	5783				182	31800		
	2011	1	8541				169	50600		
	2012	1	4809				186	25907		
	2013	1	11988				190	63019		
	2014	1	12002				206	58262		
	2015	1	17552				111	158126		
	2016	1	15031				218	68837		
	2017									

Stock	Year	No of vessels	No of length-measured individuals (commercial catches)	No of aged individuals (commercial catches)	No of aged individuals (surveys)	Total no of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Aged individuals per 1000 t (commercial catches)	Total indivi per 10
	2018									
	2019	1					49			
	2020						96			
	2021						125			
	2022						164			
	2023						72			
	2024									

***Sampling from bycatch in cod fishery.**

****Sampling from pelagic redfish fishery.**

*****Sampling from Spanish Greenland halibut survey.**

Table 1.5 . Age and length sampling by Germany of commercial catches and age sampling of surveys in 2008–202 4 . Also, length-measured individuals and aged individuals per 1 000 t caught. For comparison also the EU DCF requirements are shown.

	Year	No of unique vessels	No of length samples	No of length-measured individuals	No of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Age-sampled individuals per 1000 t	EU DCF for comparison
NEA cod									
	2008	5	3	65800	2033	4955	13280	410	125
	2009	5	2	43107	2419	8585	5021	282	125
	2010	5	2	51923	3075	8442	6151	364	125
	2011	4	1	7318	769	4621	1584	166	125
	2012	4	2	16315	1924	8500	1919	226	125
	2013	4	2	29281	2043	7939	3688	257	125
	2014	4	1	23137	1291	6225	3717	207	125
	2015	4	1	39335	886	6427	6120	138	125
	2016	3	1	22109	1060	6636	3332	160	125
	2017	4	1	19942	785	5969	3341	132	125
	2018	4	2	43371	2283	7774	5579	294	125
	2019	2	1	17954	1444	8535	2104	169	125
	2020	2	1	21716	1021	9786	2219	104	125
	2021	2	1	21548	1393	5470	3939	255	125
	2022	2	1	14795	986	7171	2063	137	125
	2023								

	Year	No of unique vessels	No of length samples	No of length-measured individuals	No of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Age-sampled individuals per 1000 t	EU DCF for comparison
	2024								
NEA haddock									
	2008	5	3	5548	442	535	10370	826	125
	2009	5	2	23348	958	1957	11931	490	125
	2010	5	2	54704	1039	3539	15457	294	125
	2011	4	1	1925	160	1724	1117	93	125
	2012	4	2	4088	502	1111	3680	452	125
	2013	4	1	7040	478	501	14052	954	125
	2014	4	1	3113	261	340	9156	768	125
	2015	4	1	616	325	124	4968	2621	125
	2016	3	1	4807	544	170	28276	3200	125
	2017	4	1	3464	527	155	22348	3400	125
	2018	4	2	4345	497	391	11113	1271	125
	2019	2	1	5031	393	208	24188	1889	125
	2020	2	1	2979	356	283	10527	1258	125
	2021	2	1	2808	344	368	7630	935	125
	2022	2	1	3270	399	271	12066	1472	125
	2023								
	2024								
Redfish									
	2008	5	3	330	0	46	7174	0	125
	2009	8	2	0	0	100	0	0	125
	2010	6	2	0	0	52	0	0	125
	2011	6	1	7937	0	844	9404	0	125
	2012	9	2	4036	0	584	6911	0	125
	2013	4	1	1315	0	81	16235	0	125
	2014	4	1	571	0	451	1266	0	125
	2015	4	1	76	0	266	286	0	125
	2016	3	1	6095	0	497	12264	0	125
	2017	4	1	977	0	770	1269	0	125
	2018	4	2	3438	0	2508	1371	0	125
	2019	2	1	8958	0	1741	5145	0	125
	2020	3	1	4248	0	1998	2126	0	125
	2021	2	1	2261	0	743	3043	0	125

	Year	No of unique vessels	No of length samples	No of length-measured individuals	No of aged individuals	Landings tonnes	Length-measured individuals per 1000 t	Age-sampled individuals per 1000 t	EU DCF for comparison
	2022	2	1	8525	0	896	9515	0	125
	2023								
	2024								
Greenland halibut									
	2008	5	2	0	0	5	0	0	125
	2009	3	2	0	0	19	0	0	125
	2010	2	2	0	0	14	0	0	125
	2011	3	1	0	0	81	0	0	125
	2012	4	2	0	0	40	0	0	125
	2013	3	1	1298	0	49	26544	0	125
	2014	4	1	1076	0	34	31647	0	125
	2015	4	1	658	0	32	20563	0	125
	2016	3	1	365	0	9	40556	0	125
	2017	4	1	0	0	21	0	0	125
	2018	4	1	257	0	52	4942	0	125
	2019	2	1	511	0	45	11356	0	125
	2020	2	1	305	0	74	4122	0	125
	2021	2	1	160	0	88	2222	0	125
	2022	2	1	672	0	95	7074	0	125
	2023	2	1	161	0	76	2118	0	125
	2024								

References

Blanchard, A. L., et al. (2002). "The structure of a community strongly affected by top predators: The Barents Sea." Polar Biology, 25(5), 310–320.

Breivik, O.N, Storvik, G. and Nedreaas, K. 2017. Latent Gaussian models to predict historical bycatch in commercial fishery, Fisheries Research, Volume 185, Pages 62-72, ISSN 0165-7836, https://doi.org/10.1016/j.fishres.2016.09.033.

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

Howell et al. 2024. Report of the Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG). IMR PINRO 2024-7. https://www.hi.no/hi/nettrapporter/imr-pinro-en-2024-7

Mette Skern-Mauritzen , Ulf Lindstrøm , Martin Biuw , Bjarki Elvarsson , Thorvaldur Gunnlaugsson , Tore Haug , Kit M Kovacs , Christian Lydersen , Margaret M McBride , Bjarni Mikkelsen , Nils Øien , Gísli Víkingsson 2022. Marine mammal consumption and fisheries removals in the Nordic and Barents Seas. ICES Journal of Marine Science, Volume 79, Issue 5, July 2022, Pages 1583–1603, https://doi.org/10.1093/icesjms/fsac096

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

Planque, B., Bas, L., Biuw, M., Blanchet M.A., Bogstad, B., Eriksen, E., et al. .2024. A food-web assessment model for marine mammals, fish, and fisheries in the Norwegian and Barents Seas. Progress in Oceanography, https://doi.org/10.1016/j.pocean.2024.103361

The state of biological resources of the Barents, White and Kara Seas and the North Atlantic in 2025. / Murmansk, PINRO 2025, 183 p.

van der Meeren, G. and Prozorkevitch, D. (eds.) 2024. Survey report from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August- December 2024. IMR/PINRO-report series x/2023 (in prep)

Wassmann, P., & Reigstad, M. (2011). "Future Arctic Ocean seasonal ice zones and implications for pelagic-benthic coupling." Oceanography, 24(3), 220–231.

Chapter 3. Cod in subareas 1 and 2 (Northeast Arctic)

Status of the fisheries

Historical development of the fisheries (Table 3.1)

From a level of about 900 000 t in the mid-1970s, total catch declined steadily to around 300 000 t in 1983—1985 (Table 3.1). Catches increased to above 500 000 t in 1987 before dropping to 212 000 t in 1990, the lowest level recorded in the post-war period. The catches increased rapidly from 1991 onwards, stabilizing at around 750 000 t in 1994—1997 but decreased to about 414 000 t in 2000. From 2000—2009, the reported catches were between 400 000 and 520 000 t. In addition, there were unreported catches (see below). Catches decreased from a peak of 986 000 t in 2014 to 693 000 t in 2019-2020 before increasing to 767 000 t in 2021 and decreasing again to 582 552 t in 2023 and 453 040 t in 2024.

The fishery is conducted both with an international trawler fleet and with coastal vessels using traditional fishing gears. Quotas were introduced in 1978 for the trawler fleets and in 1989 for the coastal fleets. In addition to quotas, the fishery is regulated by a minimum catch size, a minimum mesh size in trawls and Danish seines, a maximum bycatch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

Reported catches prior to 2025 (Tables 3.1-3.4, Figure 3.1)

The provisional catch of cod in Subarea 1 and divisions 2.a and 2.b for 2024 reported to the working group is 483 867 t (including both NEA cod and NCC catches).

The historical practice (considering catches between 62°N and 67°N for the whole year and catches between 67°N and 69°N for the second half of the year to be Norwegian coastal cod) has been used for estimating the Norwegian landings of Northeast Arctic cod up to and including 2011 (Table 3.2). The catches of coastal cod subtracted from total cod catches in Subarea 1 and divisions 2.a and 2.b for the period 1960—2024 are given in Table 3.2. For 2012–2024 the Norwegian catches have been analyzed by an ECA-version designed for simultaneously providing estimates of catch numbers-at-age for each of the two stocks.

Coastal cod catches in 2024 for the southern and northern area combined were 30 827 tonnes and this amount was as in previous years subtracted from the total cod catch north of 62° N to get the figure for NEA cod used in that assessment (Table 3.1 and 3.2).

The time series for coastal cod catches are now inconsistent with the coastal cod catches presented in ICES AFWG 2025 Chapter 2, as the coastal cod catch time series were revised at WKBarFar (ICES 2021a), but not the NEA cod time series. At WKBarFar, the proposal for revision of NEA cod catch data series was rejected, as Norwegian data for many years and age groups (especially ages 12+ in years prior to 2013) were changed considerably and the reason for this was not sufficiently explained. WKBarFar recommended that when the revision of the historical Norwegian catch data is ready it should be submitted to ICES for review, ideally by a review attached to the AFWG.

The catch by area is shown in Table 3.1 and further split into trawl and other gears in Table 3.3. The distribution of catches by gears in 2024 was similar to 2023, while the proportion of catches taken in area 2a increased markedly. The nominal landings by country are given in Table 3.4.

There is information on cod discards (see ICES AFWG 2021 section 0.4, ICES 2021b) but it was not included in the assessment because these data are fragmented and different estimates are in contradiction with each other.

Moreover, the level of discards is relatively small in the recent period and including these estimates in the assessment should not change our perception of NEA cod stock size.

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

Quotas, catches and advice for the period 2019-2025 for cod in the Jan Mayen area are given in Table 3.1a. These catches are not included in the catch statistics for Northeast Arctic cod. No directed fishery for cod was allowed in 2024, but 6 t were caught as bycatch in the Greenland halibut fishery.

Unreported catches of Northeast Arctic cod (Table 3.1)

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

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

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

TACs and advised catches for 2024 and 2025

The Joint Norwegian-Russian Fisheries Commission (JNRFC) agreed on a cod TAC of 453 427 t for 2024, and in addition 21 000 t Norwegian coastal cod. The total reported catch of 453 040 t in 2024 was 387 t below the agreed TAC. Since 2015, JNRFC has decided that Norway and Russia can transfer to next year or borrow from last year 10% of the cod country’s quota. That may lead to some deviation between agreed TAC and reported catch. As an extraordinary measure due to expected underfishing of the TAC in 2021, JNRFC decided that it should be possible to transfer 15% of the TAC between 2021 and 2022, but thereafter the maximum transfer was reset back to the agreed 10%.

The advice for 2025 given by JRN-AFWG in 2024 was 311 587 t based on the agreed harvest control rule. The quota established by JNRFC for 2025 was set to 340 000 t. In addition, the TAC for Norwegian Coastal Cod was set to the same value for 2025 as for 2024: 21 000 t.

Status of research

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

CPUE series of the Russian and Norwegian trawl fisheries are given in Table A1 and described in Kovalev (WD1) and Gundersen et al. (WD2). The Russian series have been combined by area and vessel type since last year (WD1). The data reflect the total trawl effort (Figure 3.4 and 3.5), both for Norway and Russia. Norwegian data for 2011–2024 are not compatible with data for 2007 and previous years. Norwegian CPUE (double trawl) has declined from 2020 to 2021 and has then stabilized (Figure 3.5). Russian CPUE has declined in a similar way as total stock biomass has decreased in recent years (Figure 3.4).

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

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

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

Before 2000 this survey was made without participation from Russian vessels, while in 2001—2005, 2008—2016 and 2018-2025, Russian vessels have covered important parts of the Russian zone. In 2006—2007 the survey was carried out only by Norwegian vessels. In 2007, 2016, and 2021-2025 the Norwegian vessels did not cover any part of the Russian EEZ. The methods for adjustment for incomplete area coverage are described in detail in Fall et al. (2024) and references therein. Table 3.5 shows areas covered in the time-series and the additional areas implied in the method used to adjust for missing coverage in the Russian Economic Zone.

Regarding the older part of this time-series it should be noted that the survey prior to 1993 covered a smaller area (Jakobsen *et al* . 1997), and the number of young cod (particularly 1- and 2-years old fish) was probably underestimated. Changes in the survey methodology through time are described in Appendix 2 in Fall et al. (2024). Note that the change from 35 to 22 mm mesh size in the codend in 1994 is not corrected for in the time-series. This mainly affects the age 1 indices.

It is likely that in recent years the coverage in the February survey (BS-NoRu-Q1 (BTr) and BS-NoRu-Q1 (Aco)) has been incomplete, in particular for the younger ages. This could cause a bias in the assessment, but the magnitude is unknown. The 2014–2025 surveys covered considerably larger areas than earlier winter surveys and showed that most age groups of cod (particularly ages 1 and 2) were distributed far outside the standard survey area. The bottom trawl survey estimates including the extended area for 2014-2025 were used in the tuning data separately from the same index before 2014, as decided at WKBarFar 2021 (ICES 2021a).

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

The estimated abundance indices from the Norwegian acoustic survey off Lofoten and Vesterålen (the main spawning area for this stock) in March/April are given in Table A4. A description of the survey, sampling effort and details of the estimation procedure can be found in Korsbrekke (1997). The 2025 survey result in biomass terms was 32 thousand tonnes, this is 30 % of the 2024 level and the lowest since 1988.

A pilot survey on spawning grounds north of the area covered by the Lofoten survey was carried out in 2023 (Korsbrekke 2024), at about the same time and in the same way as the Lofoten survey. The total abundance in that area was about 17% of that in the Lofoten area. The area covered by this pilot survey is mostly covered also by the winter survey, but with much larger distance between transects at that time. Such a survey was not carried out in 2024 or 2025. Extra coverage of this area in the winter survey should be considered as the fishery on spawning cod has shifted northwards in recent years.

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

Swept area bottom trawl estimates from the joint Norwegian-Russian Ecosystem survey (BESS) in August-September for the period 2004–2024 are given in Table A14. This survey normally covers the entire distribution area of cod at that time of the year.

In 2014 this survey had an essential problem with area coverage in the north-west region because of difficult ice conditions. During the 2013 survey, a substantial part of population was distributed in the area covered by ice in 2014. Based on those observations AFWG decided in 2015 to exclude 2014 year from that tuning series in current assessment. In 2016 there was incomplete coverage in the international waters and close to the

Murman coast. An adjustment for this incomplete coverage was made based on interpolation from adjacent areas (Kovalev *et al* 2017, WD 12). At this time of the year, usually a relatively small part of the cod stock is found in the area which was not covered in 2016. In 2017 and 2019 the coverage was close to complete, although the far northeastern part of the survey area (west of the north island of Novaya Zemlya) was not covered due to military restrictions. In 2018, a large area in the eastern part of the Barents Sea was not covered. Thus, it was decided not to include 2018 data from this survey in the assessment.

The coverage in 2020 was less synoptic than usual, but it was decided to keep the results in the assessment. The 2021 and 2023 coverages were adequate. In 2024 the coverage was somewhat incomplete west of Svalbard (van der Meeren and Prozorkevitch, 2025).

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

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

Russian autumn survey Acronym: RU-BTr-Q4

Abundance estimates from the Russian autumn survey (November-December) are given in Table A9 (acoustic estimates) and Table A10 (bottom trawl estimates). The entire bottom trawl time-series was in 2007 revised backwards to 1982 (Golovanov *et al* ., 2007, WD3), using the same method as in the revision presented in 2006, which went back to 1994. The new swept area indices reflect Northeast Arctic cod stock dynamics more precisely compared to the previous one - catch per hour trawling. The Russian autumn survey in 2006 was carried out with reduced area coverage. Divisions 2a and 2b were adequately investigated in the survey in contrast to Subarea 1, where the survey covered approximately 40% of the long-term average area coverage. The Subarea 1 survey indices were calculated based on actual covered area (40 541 sq. miles). The 2007 AFWG decided to use the “final" year class indices without any correction because of satisfactory internal correspondence between year class abundances at age 2—9 years according to the 2006 survey and ones due to the previous surveys.

This survey was not conducted in 2016, but was carried out in 2017, when 79% of the standard survey area was covered (Sokolov *et al* 2018, WD 11). The index shows a reliable internal consistency, and it was decided to use it in the assessment. This survey was not carried out in 2018-2024 and is discontinued.

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

Length-at-age is shown in Table A5 for the Joint Barents Sea winter survey, in Table A7 for the Lofoten survey and in Table A11 for the Russian survey in October-December. Weight-at-age is shown in Table A6 for the Joint Barents Sea winter survey, in Table A8 for the Lofoten survey, Table A12 for the Russian survey in October-December and Table A15 for the Ecosystem survey (calculated using StoX). Table A16 presents combined data on Weight-at-age from Joint Barents Sea winter survey and Lofoten survey.

Length and weight at age in the Joint Barents Sea winter survey was fairly stable from 2024 to 2025, with some decrease noted for ages 1-4. Weight at age in the Lofoten survey was similar to 2024. The size at age in the Ecosystem survey in 2024 decreased for ages 1-3 and increased for ages 4-7 compared to 2023.

Age reading

The joint Norwegian-Russian work on cod otolith reading has for many years included regular exchanges of otoliths and age readers (see ICES2021b chapter 0.7). The results of fifteen years of annual comparative age readings are described in Yaragina *et al*. (2009). Zuykova *et al*. (2009) re-read old otoliths and found no significant difference in contemporary and historical age determination and subsequent length at age. However, age at first maturation in the historical material as determined by contemporary readers is somewhat younger (from -0.6 years for the 1940-1950s to -0.28-0 years for the 1970-1980s) than that determined by historical readers. Taking this difference into account would thus affect the spawning stock-recruitment relationship and thus the biological reference points.

The overall percentage agreement for the 2017–2018 exchange was 87.7% (Zuykova et al. 2020). The main reason for cod ageing discrepancies between Russian and Norwegian specialists remains the same, representing the latest summer growth zone, and different interpretations of the false zones. The general trend is that the Russian readers assign slightly lower ages than the Norwegian readers compared to the modal age for age groups 7 years and older. This is opposite of what we have seen in previous readings, where the Russian readers have tended to be slightly overestimating the age compared to the Norwegian readers for younger fish (1-5 years), underestimating for older fish (>10 years) and reading without significant difference for ages 6-9 years.

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

Cod and haddock otoliths from 2019-2024 have not yet been exchanged between the parties. A system for transferring otoliths between IMR and the Polar Branch of VNIRO needs to be set up to resume regular calibration of age readings. At present, in the absence of a system for transferring otolith samples between IMR and the Polar Branch of VNIRO, the scientists have exchanged images of cod and haddock otoliths (100 and 110 specimens) for the first time. Images of otoliths will temporarily be used instead of a physical exchange of otoliths until a system for exchange is in place. Norwegian otoliths collected in 2024 have been embedded in epoxy, cut and photographed by Norwegian specialists, and images have been shared with the Polar Branch of VNÌRO according to the agreed plans of the long-term cooperation. Each reader estimated fish age and annotated the corresponding zones in a single-blind approach (without access to any other annotation). In addition to the dataset containing reader-specific ages, the exchange coordinator then also generated for each fish a single image representing all readers and their annotations, to facilitate discussion and comparison of age estimates.

Online workshops were conducted on May 19th and 26th 2025. The principal objectives were to assess the general results of the exchange (agreement, bias, etc.), but more importantly to go through the annotated materials for as many samples as possible, starting with the more difficult / least agreed upon otoliths. The cod exchange results were encouraging but the overall percentage agreement was initially somewhat low at around 67%, with most age classes showing agreement over 70% (Denechaud et al., WD7). Differences in age estimates were, however, mostly restrained to deviations of one year and rarely more than 2, indicating no strong bias among age reading practices. Initial results indicated a potential small “positive” bias from the Russian reader for most age classes, suggesting a tendency to estimate older ages than the Norwegian readers as in previous exchange. During discussion with the annotations of everyone available, the group reached consensus on a single age for most samples. The necessary use of images from sectioned otoliths means that the results were not directly comparable to previous exchanges nor to actual age estimates from broken otoliths. More data is needed to assess the statistical power of these biases given the wide age distribution of samples (age groups 2-14) and moderate amounts of otoliths for comparison of each separate age group. It was noted that due to the higher resolution and static nature of annotating images, readers found it easier to count more rings than while actively reading under a binocular.

Data available for use in assessment

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

Catch-at-age (Table 3.6)

For 2024, age compositions from all areas were available from Norway, Russia and Spain. German age compositions were also available but were not used due to inadequate sampling.

There is a concern about the biological sampling from parts of both the Norwegian and Russian fishery that may be too low or missing. Also, the split between NEA cod and coastal cod may be affected by the sampling coverage. Data from Norwegian Coast Guard vessels' length measurements onboard Russian vessels in some quarters of 2024 were used for calculation of age composition of Russian catches in Division 1, 2a and 2b.

Survey indices available for use in assessment (Table 3.13, A13)

The following survey data series were available:

Fleet code	Name	Place	Season	Age	Years
Fleet 15*	Joint bottom trawl survey	Barents Sea	Feb-Mar	3–12+	1981–2013, 2014-2025
Fleet 16	Joint acoustic survey	Barents Sea+Lofoten	Feb-Mar	3–12+	1985–2025
Fleet 18	Russian bottom trawl surv.	Barents Sea	Oct-Dec	3–12+	1982–2017
Fleet 007	Ecosystem surv.	Barents Sea	Aug-Sep	3–12+	2004–2024**

*Survey indices for Fleet 15 were divided by two series (before and after 2014) in model tuning as decided at WKBarFar 2021.

**2014, 2018 and 2022 data not used in the assessment

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

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

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

Catch weights

For 2024, weight-at-age in the catch for areas 1, 2a and 2b was provided by Norway, Russia and Spain (Table 3.7). For ages up to and including 11, observations are used. Following the WKBarFar 2021 decision, weight at age in catch for the years 1983-present for ages 12-15+ are calculated by a cohort-based von Bertalanffy approach used to replace previous fixed values.

Stock weights

For ages 1—11 stock weights-at-age at the start of year y ($W_{a,y}$) for 1983—2024 are calculated combining, when available, weight at age from the Winter, Lofoten, Russian autumn and Ecosystem surveys. The details are given in the Stock Annex. For ages 12-15+ a similar approach as for weight at age in the catch was used.

Natural mortality including cannibalism (Table 3.12, Table 3.17)

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

2024 data are available, and 2023 data have been updated.

The method used for calculation of prey consumption by cod described by Bogstad and Mehl (1997) is used to calculate the consumption of cod by cod for use in cod stock assessment. The consumption is calculated based on cod stomach content data taken from the joint PINRO-IMR stomach content database (methods described in Mehl and Yaragina 1992). On average about 9000 cod stomachs from the Barents Sea have been analyzed annually in the period 1984—2024.

These data are used to calculate the per capita consumption of cod by cod for each half-year (by prey age groups 0—6 and predator age groups 1–11+). It was assumed that the mature part of the cod stock is found outside the Barents Sea for three months during the first half of the year. Thus, consumption by cod in the spawning period was omitted from the calculations.

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

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

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

Maturity-at-age (Tables 3.10-3.11)

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

Since 1982 Russian and Norwegian survey data have been used (Table 3.10). For the years 1985—2024, Norwegian maturity-at-age ogives have been obtained by combining the Barents Sea winter survey and the Lofoten survey. Russian maturity ogives from the autumn survey as well as from commercial fishery for November-February are available from 1984 until present. The Norwegian maturity ogives tend to give a higher percent mature-at-age compared to the Russian ogives, which is consistent with the generally higher growth rates observed in cod sampled by the Norwegian surveys. The percent mature-at-age for the Russian and Norwegian surveys have been arithmetically averaged for all years, except 1982—1983 when only Norwegian observations were used and 1984 when only Russian observations were used.

Russian data for the autumn survey for 2018 and later years were not available as the survey was not conducted. In WD15, 2019, updated correction factors to allow for this when calculating the combined maturity-at-age in 2019 were calculated, based on historical differences between Norwegian and Russian data. These correction factors were then applied to the Norwegian data for 2020-2025.

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

Maturity-at-age for cod has been variable the last years, particularly for ages 6–9. According to the combined data, maturity at age decreased from 2024 to 2025 for age groups 6-10 (Table 3.11).

Assessment using SAM

SAM settings (Table 3.14)

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

SAM diagnostics (Figure 3.2 a-e)

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

The retrospective pattern is generally adequate (Figure 3.2b), with absolute values of Mohn's rho < 18% for SSB, R and F.

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

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

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

The estimated $F_{5\text{-}10}$ in 2024 is 0.627, which is above F_{pa} and also above the F_{msy} range (Table 3.18). Fishing mortality has been increasing steadily from 2012-2022 but seems to have levelled off since 2022. The spawning stock biomass in 2025 is estimated to be 330 kt (Table 3.20), which is the lowest since 2000, and much lower than the peak in 2013 (2,186 kt). When comparing it farther back in time, one should bear in mind that in the early part of the time-series (before the 1980s) the fraction at age of mature fish was considerably lower.

Total stock biomass in 2025 is estimated to 1,133 kt, which is below the long-term mean and well below the highest level observed after 1955 (3,662 kt in 2013).

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

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

Reference points and harvest control rules

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

At the 46th session of JNRFC a new version of the management rule was adopted (see section 3.5.3) . The TAC advice for 2026 is based on the agreed harvest control rule.

Biomass reference points

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

Fishing mortality reference points

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

Harvest control rule

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

The current rule reads as follows:

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

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

- *if $SSB < B_{pa}$, then $F_{tr} = SSB / B_{pa} \times F_{msy}$;*
- *if $B_{pa} \leq SSB \leq 2\times B_{pa}$, then $F_{tr} = F_{msy}$;*
- *if $2\times B_{pa} < SSB < 3\times B_{pa}$, then $F_{tr} = F_{msy} \times (1 + 0.5 \times (SSB - 2\times B_{pa}) / B_{pa})$;*
- *if $SSB \geq 3\times B_{pa}$, then $F_{tr} = 1.5 \times F_{msy}$;*

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

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

Prediction

Prediction input (Tables 3.19a)

The input data to the short-term prediction with management option table (2025—2028) are given in Table 3.19a. For 2025 stock weights and maturity were calculated from surveys as described in Sections 3.3.2 and 3.3.4.

Catch weights in 2025 onwards and stock weights in 2026 and onwards for age 3–11 are predicted by the method described by Brander (2002), where the latest observation of weights by cohort are used together with average annual increments to predict the weight of the cohort the following year. The method is given by the equation

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

This method was introduced in the cod prediction in the 2003 working group (ICES 2003b). Since the 2005 working group (ICES 2005) an average of the 3 most recent values of annual increments have been used for predicting stock weights. For catch weights the last 5-year period for averaging the increments is used (changed from 10-year period at the 2021 benchmark).

The maturity ogive for the years 2026—2028 was predicted by using the 2022-2024 average. The fishing pattern in 2025 and later years was set equal to the average of the previous 3 years. The stock annex prescribes average over 5 years, but as there has been a clear shift in the fishing pattern in recent years towards exploiting younger fish, a 3-year average was considered to be more appropriate. A 3-year average was also used in last year’s assessment.

The stock number-at-age in 2025 was taken from the final SAM run (Table 3.16) for ages 4 and older. Recruitment at age 3 in the years 2025—2028 was estimated as described in section 3.7.2. Figure 3.3 shows the development in natural mortality due to cannibalism for cod (prey) age groups 1-3 together with the abundance of capelin in the period 1984—2024. Although natural mortality increased from 2023 to 2024, there is no clear time trend in natural mortality. Thus, the average M values for the last 3 years are used to predict natural mortality of age groups 3—6 for years 2025—2028 (based on benchmark decision, WKARCT 2015 and unchanged at WKBarFar 2021).

The catch in 2025 is expected to be close to the TAC when taking into account transfers of quota between years and the expected level of the coastal cod catch. It was found to be more appropriate to use TAC constraint than F_{sq} (which is the usual choice) in the intermediate year, as F_{sq} would imply a catch in 2025 of 398 000 t, i. e. 58 000 t above the TAC.

Recruitment prediction (Table 3.19b-c)

At the 2008 AFWG meeting (ICES 2008) it was decided to use a hybrid model, which is a weighted arithmetic mean of different recruitment models. This model has not performed well in recent years (as shown e.g. in Fig. 3.2c for the prediction of age 3 abundance in the assessment (intermediate) year. A thorough analysis of existing recruitment models and five proposed new models, as well as using recent averages of recruitment values was carried out in 2024 (Kovalev and Chetyrkin, WD6, 2024) and updated this year. Based on the model performance, the RCT3 model was, as in 2024, chosen for predicting 1-3 years ahead.

This gave recruitment values of 537 million for 2025, 378 million for 2026, 322 million for 2027 and 356 million for 2028. For the age 3 recruitment in 2025, the results of running RCT3 with/without the Ecosystem survey and SAM (456 million) were all very similar. An average of the recent 4 years was chosen to predict 4 years ahead (i.e. the recruitment at age 3 for 2028 being calculated as the 2022-2025 average).

It is suggested to rerun an analysis of various recruitment models each year.

Issues to be considered for the future:

Including the Ecosystem survey in the RCT3 analysis.

Evaluate the performance of the SAM model for the 1-year-ahead prediction. The Mohn's rho for recruitment in SAM is currently quite good (12% for the last 5 years), but the retrospective performance of SAM has not been compared to the models proposed in Kovalev and Chetyrkin (WD6, 2024).

Prediction results (Tables 3.20-3.21)

The resulting SSB in 2026 is 325 kt, which is 2 % lower than the SSB in 2025. Table 3.20 shows the short-term consequences over a range of F-values in 2026. The detailed outputs corresponding to a catch equal to the TAC in 2025 and the F corresponding to the HCR and F_{pa} in 2026 are given in Table 3.21. Summarized results are shown in the text table below.

Basis	Total catch (2026)	F (2026)	SSB (2027)	% SSB change *	% TAC change **	% Advice change ***
Management plan^	269 440	0.3 67	359 319	1 0	- 21	- 14
Other options						
MSY approach: F_{MSY} ****	289 647	0.40	347 646	7	- 15	- 7
F = 0	0	0	527 732	6 2	-100	-100
F = 0.283 ^^	214 765	0.283	391 622	20	-31	-37
$F = F_{2025}$	354 709	0. 511	311 083	- 4	4	14
F_{pa}	289 647	0.40	347 646	7	- 15	- 7
F_{lim}	472 332	0.74	249 215	-2 3	39	52

* SSB 2027 relative to SSB 2026.

** Advice for 2026 relative to TAC for 2025 (340 000 tonnes).

*** Advice for 2026 relative to advice for 2025 (311 587 tonnes)

**** F = 0.40 corresponds to the lower bound of the F_{MSY} range (0.40-0.60), F not reduced for SSB being below B_{pa}.

^ Since SSB in 2026 is below B_{pa} = 460 000 t, F = 0.40*SSB_{2026}/B_{pa} = 0.283 is used in the 3-year prediction, giving catches of 214 765, 270 953 and 322 601 t in 2026, 2027 and 2028, respectively. The average of this is 269 440 tonnes. As SSB is below B_{pa} in 2026, the 20% limit on annual change in TAC does not apply.

^^F=0.283 corresponds to applying the harvest control rule without a 3-year prediction.

The advice for 2026 is 14% lower than the advice for 2025. The downward adjustment of spawning stock size since last year's assessment and the declining spawning stock trend both contribute to the reduction in advice.

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.

Exploratory analysis of one possible formulation of an HCR which is S-shaped when SSB is below B_{pa} (see formula below) was presented at JRN-AFWG. Using that particular formulation with a three-year prediction as in the existing HCR would give an F_{target} of 0.36, giving catches of 264 832, 317 555 and 362 712 tonnes in 2026, 2027 and 2028, respectively. The average of this is 315 033 tonnes. Note that this is not the agreed HCR and is not being presented as the basis for current management but is presented here to facilitate further exploration of such a rule. In particular, the precise formulation of such a rule (especially the degree to which it deviates from the current straight line) would need to be explored by JRN-AFWG before it could be recommended for use in management.

Formula for S-shaped reduction of F_{target} below B_{pa} : (in the example described above the exponent p=3 was used, but other exponents could be explored)

$F_{target}=a*SSB^p$ for $SSB<=0.5*B_{pa}$

$F_{target}=F_{pa}-a*(B_{pa}-SSB)^p$ for $0.5*B_{pa} < SSB < B_{pa}$

where

$a=0.5*F_{pa}/((0.5*B_{pa})^p)$

Medium-term predictions (Figure 3.8)

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

The stock size has been decreasing in recent years due to low incoming recruitment, downward adjustment of the stock size (due to model modifications at the benchmark in 2021) and high fishing mortality. The increase in fishing mortality was partly due to the 20% limit on annual reduction of TAC. Recruitment in coming years (2022-2025 year classes) is also estimated to be below average. The reasons for the low recent recruitment are not known, but investigation on this topic is ongoing. Previous periods of low recruitment have mainly occurred when temperature is below average, which is not the case at present.

The predictions for 2026 and following years indicate that catches, SSB and total stock biomass will increase after 2026, and that SSB will remain below B_{pa} until 2028 (Figure 3.8).

Comparison to 2024 assessment

The text table below compares this year’s estimates with the 2024 JRN-AFWG estimates for numbers at age (millions), total biomass, spawning biomass (thousand tonnes) in 2024, as well as reference F for the year 2023.

		N (2024) by age												
Assessment year	F (2023)	3	4	5	6	7	8	9	10	11	12+	TSB (2024)	SSB (2024)	F (2024)
2024	0.589	587.0*	167.2	101.6	91.9	80.1	55.6	29.3	12.9	2.6	1.9	1289	552	0.589**
2025	0.631	632.5	183.3	105.6	94.8	77.4	48.0	27.7	10.4	2.3	1.1	1244	490	0.627
Ratio 2025/2024	1.07	1.08	1.10	1.04	1.03	0.97	0.86	0.95	0.81	0.88	0.58	0.97	0.89	1.06

*estimated by recruitment models

**assuming Fsq

In the current assessment, the number of age 3-6 in 2024 was adjusted upwards compared to the 2024 JRN-AFWG assessment, while the older age groups were adjusted downwards.

Comparison to prediction

The change in the advice is large compared to last year. The advice for 2026 is 269 440 t, while the advice for 2025 given by JRN-AFWG was 311 587 t. The 2025 assessment adjusted the spawning stock size in recent years downwards. The main tendency for stock decrease in recent years was similar to last year's assessment.

Concerns with the assessment and management advice

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

Given the decline of the stock in recent years, the 20% limit on annual TAC change led to fishing pressure well above the target in the HCR for several years. The SSB has now fallen below B_{pa}, and it is thus critical for future stock development to ensure that the TAC is set equal to the scientific advice. The allowed 10% quota transfer between years compounds the risk arising from the TAC being set above the advice in the current situation with the spawning stock being below B_{pa} .

Based on the predicted SSB in 2026, F= 0.283 is used for the advice. Applying F= 0.283 to the projected stock in 2026 would give a quota advice of 214 765 t . The three-year look ahead component in the HCR results in the actual advice being higher (at 269 440 t) because the HCR accounts for signs that the stock is expected to increase in 2026-2028, assuming the catch advice is followed.

It is also a concern whether the current harvest control rule is precautionary in view of the recent below average recruitment (no strong year classes after 2005). Preliminary results (Kovalev et al., WD10) indicate that the current harvest control rule is precautionary also for a stock-recruitment relationship based on the year classes 2006-2019.

A separate document describing evaluation of the existing harvest control rules and some alternative rules will be presented to the JNRFC meeting in October 2025.

Additional assessment methods

All models use the same tuning data.

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

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

Model comparisons (Figures 3.2a, 3.6c, 3.7)

Figure 3.7 compares the results of SAM and TISVPA, showing F, SSB, TSB and recruitment. Trends are similar in all models, but TISVPA gives a slightly lower F in 2024 and higher biomass in 2025 than SAM. Also, TISVPA gives a different trend in F in recent years with a peak in 2022, while SAM gives an almost constant F in 2022-2024. Recruitment in 2024 is higher in TISVPA than in SAM. Both models show a reasonable retrospective pattern (Figures 3.2a, 3.6c).

New and revised data sources

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

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

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

Discard and bycatch data

Work on updating discard and bycatch data series is ongoing. Revised bycatch estimates in numbers for the period 2005-2024 are shown in Fig. 1.14. At WKARCT in 2015 it was, however, decided not to include those data in the catch-at-age matrix.

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

References

Bogstad, B. 2023. Jan Mayen—a new spawning and fishing area for Atlantic cod *Gadus morhua* . Polar Biology 46: 103-109. https://doi.org/10.1007/s00300-022-03102-8

Bogstad, B. and Mehl, S. 1997. Interactions Between Cod (*Gadus morhua*) and Its Prey Species in the Barents Sea. Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01: 591-615. University of Alaska Fairbanks.

Brander, K. 2002. Predicting weight at age. Internal ICES note to assessment working groups. 2003. Software implementation of process models. Working Document No. 2 to the Arctic Fisheries Working Group, San Sebastian, Spain, 23 April- 2 May 2003.

Denechaud, C., et al. IMR – PINRO cod otolith exchange 2025 . WD7, JRN-AFWG 2025.

Fall, J., Wenneck, T. de Lange, Bogstad, B., Eidset, E., Fuglebakk, E., Godiksen, J. A., Høines, Å., Johannesen, E., Midtun, H. Aa., Moksness, I., Skage, M. L., Skaret, G., Staby, A., Tranang, C. Aa., Windsland, K., Russkikh, A. A., and Kharlin, S. 2024. Fish investigations in the Barents Sea winter 2024. IMR-PINRO Joint Report Series 8-2024, 156 pp.

Golovanov S.E., Sokolov A.M., and Yaragina, N.A. 2007. Revised indices of the Northeast Arctic cod abundance according to the 1982-2006 data from Russian trawl-acoustic survey (TAS). Working Document #3 for AFWG 2007.

Gundersen, S., Otterå, H. and Nedreaas, K. 2025. Effort and catch-per-unit-effort (CPUE) for Norwegian trawlers fishing **cod** north of 67˚N in 2011-2024. WD2, JRN_AFWG 2025.

ICES 2001. Report of the Arctic Fisheries Working Group. Bergen, Norway, 24 April – 3 May 2001. ICES CM 2001/ACFM:19. 380 pp.

ICES 2003a. Study Group on Biological Reference Points for Northeast Arctic Cod. Svanhovd, Norway 13-17 January 2003. ICES CM 2003/ACFM:11.

ICES 2003b. Report of the Arctic Fisheries Working Group, San Sebastian, Spain 23 April – 2 May 2003. ICES C.M. 2003/ACFM:22, 448 pp.

ICES 2004. Report of the Arctic Fisheries Working Group, Copenhagen 4-13 May 2004. ICES C.M. 2004/ACFM:28, 475 pp.

ICES 2005. Report of the Arctic Fisheries Working Group, Murmansk, Russia 19-28 April 2005. ICES C.M. 2005/ACFM:20, 564 pp.

ICES 2008. Report of the Arctic Fisheries Working Group, Copenhagen, 21-29 April 2008. ICES C.M. 2008/ACOM:01, 531 pp.

ICES. 2015a. Report of the Benchmark Workshop on Arctic Stocks (WKARCT), 26-30 January 2015, ICES Headquarters, Denmark. ICES CM 2015\ACOM:31. 126 pp.

ICES 2015b. Report of the first Workshop on Management Plan Evaluation on Northeast Arctic cod and haddock and Barents Sea capelin (WKNEAMP-1) , , . ICES CM 2015/ACOM:60, 27 pp.

ICES 2016. Report of the second Workshop on Management Plan Evaluation on Northeast Arctic cod and haddock and Barents Sea capelin (WKNEAMP-2) , 25-28 January 2016, Kirkenes, Norway. ICES CM 2016/ACOM:47, 76 pp.

ICES 2017. Report of the Arctic Fisheries Working Group, Copenhagen, 19-25 April 2017. ICES C.M. 2017/ACOM:06,486 pp.

ICES. 2021a. Benchmark Workshop for Barents Sea and Faroese Stocks (WKBARFAR 2021). ICES Scientific Reports. 3:21. 205 pp. https://doi.org/10.17895/ices.pub.7920

ICES. 2021b. Arctic Fisheries Working Group (AFWG). ICES Scientific Reports 3:58. 817 pp. https://doi.org/10.17895/ices.pub.8196

ICES. 2025. Arctic Fisheries Working Group (AFWG). ICES Scientific Reports. 7:66. https://doi.org/10.17895/ices.pub.29234186

Jakobsen, T., Korsbrekke, K., Mehl, S., and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES CM 1997/Y:17.

Korsbrekke, K. 1997. Norwegian acoustic survey of Northeast Arctic cod on the spawning grounds off Lofoten. ICES C.M 1997/Y:18.

Korsbrekke, K. 2024. Acoustic survey targeting spawning NEA cod north of Vesterålsbankene 2023 (In Norwegian). https://www.hi.no/hi/nettrapporter/toktrapport-2024-1.

Kovalev, Yu. 2025. Russian trawl fleet CPUE on NEA cod fishery. WD1, JRN-AFWG 2025.

Kovalev, Y., Prozorkevich, D., and Chetyrkin, A. 2017. Estimation of Ecosystem survey 2016 index in situation of not full area coverage. Working Document No. 12 to the Arctic Fisheries Working Group, Copenhagen, 18-25 April 2017.

Kovalev, Y., and Chetyrkin, A. 2019. What does NEA cod want for prediction - Fsq or TAC constraint? Working Document No. 11 to the Arctic Fisheries Working Group. ICES. 2019. Arctic Fisheries Working Group (AFWG). ICES Scientific Reports. 1:30. 934 pp.

Kovalev, Y., and Chetyrkin, A. 2024. Analysis of the NEA Cod recruitment prediction quality. WD6, AFWG 2024.

Kovalev, Y., Yaragina, N. A., and Vasilyev, D. 2025. Evaluation of the NEA cod HCRs. WD10, JRN-AFWG 2025.

Mehl, S., and Yaragina, N. A. 1992. Methods and results in the joint PINRO-IMR stomach sampling program. In: Bogstad, B. and Tjelmeland, S. (eds.), Interrelations between fish populations in the Barents Sea. Proceedings of the fifth PINRO-IMR Symposium. Murmansk, 12–16 August 1991. Institute of Marine Research, Bergen, Norway, 5–15.

Sokolov A., Russkikh A., Kharlin S., Kovalev Yu. A., and Yaragina N.A. 2018. Results of the Russian trawl-acoustic survey on cod and haddock in the Barents Sea and adjacent waters in October-December 2017. Working Document no. 11. ICES Arctic Fisheries Working Group, ICES CM 2018/ACOM:06.

Thygesen, U. H., Albertsen, C. M., Berg, C. W., Kristensen, K., and Nielsen, A. 2017. Validation of ecological state space models using the Laplace approximation Environmental and Ecological Statistics 24 (2): 317-339.

van der Meeren, G. and Prozorkevitch, D. (eds.) 2023. Survey report from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August-October 2024. IMR/PINRO-report series 10/2023.

van der Meeren, G. and Prozorkevitch, D. (eds.) 2025. Survey report from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August-October 2024. IMR/PINRO-report series 3/2025.

WD 15. 2019. Updated mean ratios between the combined and Norwegian data on weight at age and maturity at age in Northeast Arctic cod. Working document no 15, AFWG 2019.

Yaragina N.A. Nedreaas K.H., Koloskova V., Mjanger H., Senneset H., Zuykova N. and Ågotnes P. 2009. Fifteen years of annual Norwegian-Russian cod comparative age readings. Marine Biology Research 5(1): 54-65.

Yaragina N. A., Kovalev Yu. A., and Chetyrkin A. 2018. Extrapolating predation mortalities back in time: an example from North-east Arctic cod cannibalism, Marine Biology Research 14(2): 203-216. https://doi.org/10.1080/17451000.2017.1396342

Zuykova N.V., Koloskova V.P., Mjanger H., Nedreaas K.H., Senneset H., Yaragina N.A., Ågotnes P., and Aanes S. 2009. Age determination of Northeast Arctic cod otoliths through 50 years of history. Marine Biology Research 5(1): 66-74.

Zuykova N.V., et al. 2020. Report on the meeting between Norwegian and Russian age reading specialists at Polar Branch of FSBSI “VNIRO” Murmansk, 20-24 May 2019. Working document no 8 in: ICES. 2020c.Arctic Fisheries Working Group (AFWG). ICES Scientific Reports. 2:52. 577 pp. http://doi.org/10.17895/ices.pub.6050 .

Table 3. 1 . Northeast Arctic cod. Total catch (t) by fishing areas and unreported catch .

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
1961	409 694	153 019	220 508		783 221
1962	548 621	139 848	220 797		909 266
1963	547 469	117 100	111 768		776 337
1964	206 883	104 698	126 114		437 695

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
1965	241 489	100 011	103 430		444 983
1966	292 253	134 805	56 653		483 711
1967	322 798	128 747	121 060		572 605
1968	642 452	162 472	269 254		1 074 084
1969	679 373	255 599	262 254		1 197 226
1970	603 855	243 835	85 556		933 246
1971	312 505	319 623	56 920		689 048
1972	197 015	335 257	32 982		565 254
1973	492 716	211 762	88 207		792 685
1974	723 489	124 214	254 730		1 102 433
1975	561 701	120 276	147 400		829 377
1976	526 685	237 245	103 533		867 463
1977	538 231	257 073	109 997		905 301
1978	418 265	263 157	17 293		698 715
1979	195 166	235 449	9 923		440 538
1980	168 671	199 313	12 450		380 434
1981	137 033	245 167	16 837		399 037
1982	96 576	236 125	31 029		363 730
1983	64 803	200 279	24 910		289 992
1984	54 317	197 573	25 761		277 651
1985	112 605	173 559	21 756		307 920
1986	157 631	202 688	69 794		430 113
1987	146 106	245 387	131 578		523 071
1988	166 649	209 930	58 360		434 939
1989	164 512	149 360	18 609		332 481
1990	62 272	99 465	25 263	25 000	212 000
1991	70 970	156 966	41 222	50 000	319 158
1992	124 219	172 532	86 483	130 000	513 234
1993	195 771	269 383	66 457	50 000	581 611
1994	353 425	306 417	86 244	25 000	771 086
1995	251 448	317 585	170 966		739 999
1996	278 364	297 237	156 627		732 228
1997	273 376	326 689	162 338		762 403
1998	250 815	257 398	84 411		592 624
1999	159 021	216 898	108 991		484 910
2000	137 197	204 167	73 506		414 870

Year	Subarea 1	Division 2.a	Division 2.b	Unreported catches	Total catch
2001	142 628	185 890	97 953		426 471
2002	184 789	189 013	71 242	90 000	535 045
2003	163 109	222 052	51 829	115 000	551 990
2004	177 888	219 261	92 296	117 000	606 445
2005	159 573	194 644	121 059	166 000	641 276
2006	159 851	204 603	104 743	67 100	537 642
2007	152 522	195 383	97 891	41 087	486 883
2008	144 905	203 244	101 022	15 000	464 171
2009	161 602	207 205	154 623		523 431
2010	183 988	271 337	154 657		609 983
2011	198 333	328 598	192 898		719 829
2012	247 938	331087	148 638		727 663
2013	360 673	421678	183 858		966 209
2014	320 347	468 934	197 168		986 449
2015	272405	375328	216651		864384
2016	321347	351468	176607		849422
2017	309902	360477	197898		868276
2018	249397	321548	207681		778627
2019	234985	318539	139084		692609
2020	234029	298707	160166		692903
2021	281198	268942	217144		767284
2022	236173	256394	226644		719211
2023	260853	202358	119341		582552
2024[1]	188045	183109	81886		453040

Data provided by Working Group members

[1] Provisional figure

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

Year	Advice		TAC	CATCH
2018	-		-	441
2019	-		800	628
2020	-		800	522
2021	600		600	146
2022	347		347	276
2023	315		315	181
2024	0		0	6

2025	0		0	

Table 3. 2 . Catches of Norwegian Coastal Cod in subareas 1 and 2, 1000 t, which are removed from the NEA cod assessment.

Year	Norwegian catches of cod removed from the nea cod-assessment.
v1960–70	38.6
1971–79	no data
1980	40
1981	49
1982	42
1983	38
1984	33
1985	28
1986	26
1987	31
1988	22
1989	17
1990	24
1991	25
1992	35
1993	44
1994	48
1995	39
1996	32
1997	36
1998	29
1999	23
2000	19
2001	14
2002	20
2003	19
2004	14
2005	13
2006	15
2007	13
2008	13
2009	15
2010	13.5
2011	18.8

Year	Norwegian catches of cod removed from the nea cod-assessment.
2012	35.5
2013	30.1
2014	33.6
2015	35.8
2016	54.9
2017	51.0
2018	36.3
2019	40.1
2020	45.3
2021	42.0
2022	40.3
2023	48.1
2024	30.8

Table 3. 3 . Northeast Arctic COD. Total nominal catch ('000 t) by trawl and other gear for each.

		subarea 1		division 2.a		division 2.b	
year		trawl	others	trawl	others	trawl	others
1967		238	84.8	38.7	90	121.1	-
1968		588.1	54.4	44.2	118.3	269.2	-
1969		633.5	45.9	119.7	135.9	262.3	-
1970		524.5	79.4	90.5	153.3	85.6	-
1971		253.1	59.4	74.5	245.1	56.9	-
1972		158.1	38.9	49.9	285.4	33	-
1973		459	33.7	39.4	172.4	88.2	-
1974		677	46.5	41	83.2	254.7	-
1975		526.3	35.4	33.7	86.6	147.4	-
1976		466.5	60.2	112.3	124.9	103.5	-
1977		471.5	66.7	100.9	156.2	110	-
1978		360.4	57.9	117	146.2	17.3	-
1979		161.5	33.7	114.9	120.5	8.1	-
1980		133.3	35.4	83.7	115.6	12.5	-
1981		91.5	45.1	77.2	167.9	17.2	-
1982		44.8	51.8	65.1	171	21	-
1983		36.6	28.2	56.6	143.7	24.9	-
1984		24.5	29.8	46.9	150.7	25.6	-
1985		72.4	40.2	60.7	112.8	21.5	-

1986		109.5	48.1	116.3	86.4	69.8	-
1987		126.3	19.8	167.9	77.5	129.9	1.7
1988		149.1	17.6	122	88	58.2	0.2
1989		144.4	19.5	68.9	81.2	19.1	0.1
1990		51.4	10.9	47.4	52.1	24.5	0.8
1991		58.9	12.1	73	84	40	1.2
1992		103.7	20.5	79.7	92.8	85.6	0.9
1993		165.1	30.7	155.5	113.9	66.3	0.2
1994		312.1	41.3	165.8	140.6	84.3	1.9
1995		218.1	33.3	174.3	143.3	160.3	10.7
1996		248.9	32.7	137.1	159	147.7	6.8
1997		235.6	37.7	150.5	176.2	154.7	7.6
1998		219.8	31	127	130.4	82.7	1.7
1999		133.3	25.7	101.9	115	107.2	1.8
2000		111.7	25.5	105.4	98.8	72.2	1.3
2001		119.1	23.5	83.1	102.8	95.4	2.5
2002		147.4	37.4	83.4	105.6	69.9	1.3
2003		146	17.1	107.8	114.2	50.1	1.8
2004		154.4	23.5	100.3	118.9	88.8	3.5
2005		132.4	27.2	87	107.7	115.4	5.6
2006		141.8	18.1	91.2	113.4	100.1	4.6
2007		129.6	22.9	84.8	110.6	91.6	6.3
2008		123.8	21.1	94.8	108.4	95.3	5.7
2009		130.1	31.5	102	105.2	142.1	11.4
2010		151.1	32.9	130	141.4	149.2	5.4
2011		158.1	38.4	163.5	167	181	11.9
2012		212.1	35.9	172.7	158.4	133.8	14.9
2013		308.5	52.2	216.9	204.7	159.7	24.1
2014		268.8	51.5	246.8	222.1	177.9	19.3
2015		224.3	48.1	192.2	183.2	197.7	19.0
2016		285.5	35.8	181.7	169.8	156.3	20.3
2017		265.4	44.5	189.5	171.0	180.0	17.9
2018		204.7	44.7	156.7	164.9	192.0	15.6
2019		199.4	35.6	177.8	140.7	128.9	10.1
2020		199.4	34.6	157.2	141.5	153.5	6.7
2021		220.8	60.4	120.2	148.7	202.1	15.1
2022		192.9	43.3	108.9	147.4	212.9	13.7

2023		218.5	42.4	90.9	111.5	112.6	6.8
2024	1	166.2	21.8	88.2	94.9	75.1	6.8

Data provided by Working Group members

[1] Provisional figures

Table 3. 4 . Northeast Arctic COD. Nominal catch(t) by countries. (Subarea 1 and divisions 2a and 2b combined, data provided by Working group members.

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep.Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain
1961	3934	13755	3921	8129			268377	-	158113	325780	
1962	3109	20482	1532	6503			225615	-	175020	476760	
1963	-	18318	129	4223			205056	108	129779	417964	
1964	-	8634	297	3202			149878	-	94549	180550	
1965	-	526	91	3670			197085	-	89962	152780	
1966	-	2967	228	4284			203792	-	103012	169300	
1967	-	664	45	3632			218910	-	87008	262340	
1968	-	-	225	1073			255611	-	140387	676758	
1969	29374	-	5907	5543			305241	7856	231066	612215	
1970	26265	44245	12413	9451			377606	5153	181481	276632	
1971	5877	34772	4998	9726			407044	1512	80102	144802	
1972	1393	8915	1300	3405			394181	892	58382	96653	
1973	1916	17028	4684	16751			285184	843	78808	387196	
1974	5717	46028	4860	78507			287276	9898	90894	540801	
1975	11309	28734	9981	30037			277099	7435	101843	343580	
1976	11511	20941	8946	24369			344502	6986	89061	343057	
1977	9167	15414	3463	12763			388982	1084	86781	369876	
1978	9092	9394	3029	5434			363088	566	35449	267138	
1979	6320	3046	547	2513			294821	15	17991	105846	
1980	9981	1705	233	1921			232242	3	10366	115194	
1981	12825	3106	298	2228			277818		5262	83000	14500
1982	11998	761	302	1717			287525		6601	40311	14515
1983	11106	126	473	1243			234000		5840	22975	14229
1984	10674	11	686	1010			230743		3663	22256	8608
1985	13418	23	1019	4395			211065		3335	62489	7846
1986	18667	591	1543	10092			232096		7581	150541	5497
1987	15036	1	986	7035			268004		10957	202314	16223
1988	15329	2551	605	2803			223412		8107	169365	10905
1989	15625	3231	326	3291			158684		7056	134593	7802

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep.Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain
1990	9584	592	169	1437			88737		3412	74609	7950
1991	8981	975		2613			126226		3981	119427***	3677
1992	11663	2		3911	3337		168460		6120	182315	6217
1993	17435	3572		5887	5389	9374	221051		11336	244860	8800
1994	22826	1962		8283	6882	36737	318395		15579	291925	14929
1995	22262	4912		7428	7462	34214	319987		16329	296158	15505
1996	17758	5352		8326	6529	23005	319158		16061	305317	15871
1997	20076	5353		6680	6426	4200	357825		18066	313344	17130
1998	14290	1197		3841	6388	1423	284647		14294	244115	14212
1999	13700	2137		3019	4093	1985	223390		11315	210379	8994
2000	13350	2621		3513	5787	7562	192860		9165	166202	8695
2001	12500	2681		4524	5727	5917	188431		8698	183572	9196
2002	15693	2934		4517	6419	5975	202559		8977	184072	8414
2003	19427	2921		4732	7026	5963	191977		8711	182160	7924
2004	19226	3621		6187	8196	7201	212117		14004	201525	11285
2005	16273	3491		5848	8135	5874	207825		10744	200077	9349
2006	16327	4376		3837	8164	5972	201987		10594	203782	9219
2007	14788	3190		4619	5951	7316	199809		9298	186229	9496
2008	15812	3149		4955	5617	7535	196598		8287	190225	9658
2009	16905	3908		8585	4977	7380	224298		8632	229291	12013
2010	15977	4499		8442	6584	11299	264701		9091	267547	12657
2011	13429	1173		4621	7155	12734	331535		8210	310326	13291
2012	17523	2841		8500	8520	9536	315739		11166	329943	12814
2013	13833	7858		8010	7885	14734	438734		12536	432314	15042
2014	33298	8149		6225	10864	18205	431846		14762	433479	16378
2015	26568	7480		6427	7055	16120	377983		11778	381778	19905
2016	24084	7946		6336	8607	16031	348949		13583	394107	14640
2017	28637	9554		5977	13638	11925	357419		16731	396180	14414
2018	26152	6605		9768	12743	10708	333539		11533	340364	13143
2019	22270	6371		8470	7553	12294	282120		11214	316813	13939
2020	21679	5796		9725	7391	9734	289472		12113	312683	11403
2021	21767	4459		6190	8246	8933	337931		5426	352064	11080
2022	21530	4988		7134	7688	6214	310145		7024	333697	12214
2023	17556	4632		5630	3994	5157	242117		5972	276923	8030
2024*	15938	4677		5632	4000	3756	171480		4832	222661	6417

* Provisional figures

** USSR prior to 1991.

*** Includes Baltic countries.

^ Includes unspecified EU catches.

^^ In 2022-2025 assessment and advice was carried out by the Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG) which compiled catches for 2021-2024 and gave advice for 2023-2026.

Table 3. 5 . Barents Sea winter survey. Area covered ('000 square nautical miles) and areas implied in the method used to adjust for missing coverage in Russian EEZ. "Index ratio by age" means that the index by age (for the area outside Russian EEZ) was scaled by the observed ratio between total index and the index outside Russian EEZ observed in the years prior to the survey.

Year	Area covered	Additional area implied in adjustment	Adjustment method
1981-92	88.1		
1993	137.6		
1994	161.1		
1995	191.9		
1996	166.1		
1997	88.4	56.2	Index ratio by age
1998	100.4	51.1	Index ratio by age
1999	118.5		
2000	163.2		
2001	164.7		
2002	157.4		
2003	147.4		
2004	164.4		
2005	179.9		
2006	170.1	18.1	Partly covered strata raised to full strata area
2007	123.9	56.7	Index ratio by age
2008	165.2		
2009	171.8		
2010	160.5		
2011	174.3		
2012	151.3	16.7	Index ratio by age
2013	203.6		
2014	266.8		
2015	243.3		
2016	228.0		
2017	184.4	37.5	Index ratio by age
2018	236.3		

2019	241.2		
2020	203.2	25.1	Index ratio by age
2021	232.0	10.9	Index ratio by age
2022	232.7		
2023	253.3		
2024	253.4		
2025	232.1		

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Table 3. 6 . Northeast Arctic cod. Catch numbers-at-age (Thous).

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

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	
1972	35536	45431	26832	12089	7918	34885	22315	4572	1215	353	315	121	40	
1973	294262	131493	61000	20569	7248	8328	19130	4499	677	195	81	59	55	
1974	91855	437377	203772	47006	12630	4370	2523	5607	2127	322	151	83	62	
1975	45282	59798	226646	118567	29522	9353	2617	1555	1928	575	231	15	37	
1976	85337	114341	79993	118236	47872	13962	4051	936	558	442	139	26	53	
1977	39594	168609	136335	52925	61821	23338	5659	1521	610	271	122	92	54	
1978	78822	45400	88495	56823	25407	31821	9408	1227	913	446	748	48	51	
1979	8600	77484	43677	31943	16815	8274	10974	1785	427	103	59	38	45	
1980	3911	17086	81986	40061	17664	7442	3508	3196	678	79	24	26	8	
1981	3407	9466	20803	63433	21788	9933	4267	1311	882	109	37	3	NA	
1982	8948	20933	19345	28084	42496	8395	2878	708	271	260	27	5	5	
1983	3108	19594	20473	17656	17004	18329	2545	646	229	74	58	20	5	
1984	6942	14240	18807	20086	15145	8287	5988	783	232	153	49	12	8	
1985	24634	45769	27806	19418	11369	3747	1557	768	137	36	31	32	8	
1986	28968	70993	78672	25215	11711	4063	976	726	557	136	28	34	14	
1987	13648	137106	98210	61407	13707	3866	910	455	187	227	21	59	20	
1988	9828	22774	135347	54379	21015	3304	1236	519	106	69	43	14	5	
1989	5085	17313	32165	81756	27854	5501	827	290	41	13	NA	11	16	
1990	1911	7551	12999	17827	30007	6810	828	179	59	15	6	5	2	
1991	4963	10933	16467	20342	19479	25193	3888	428	48	12	NA	NA	2	
1992	21835	36015	27494	23392	18351	13541	18321	2529	264	82	3	9	NA	
1993	10094	46182	63578	33623	14866	9449	6571	12593	1749	377	63	22	NA	
1994	6531	59444	102548	59766	32504	10019	6163	3671	7528	995	121	19	4	
1995	4879	42587	115329	98485	32036	7334	3014	1725	1174	1920	222	41	NA	
1996	7655	28782	80711	100509	54590	10545	2023	930	462	230	809	84	NA	
1997	12827	36491	69633	83017	65768	28392	4651	1151	373	213	144	238	NA	
1998	31887	88874	48972	40493	34513	26354	6583	965	197	69	42	22	53	
1999	7501	77714	92816	31139	15778	15851	8828	1837	195	40	34	8	30	
2000	4701	33094	93044	47210	12671	6677	4787	1647	321	71	11	NA	14	
2001	5044	35019	62139	62456	22794	5266	1773	1163	343	85	6	7	22	
2002	2348	31033	76175	67656	42122	11527	1801	529	223	120	21	9	6	
2003	7263	20885	64447	71109	36706	14002	2887	492	142	97	21	43	NA	
2004	2090	38226	50826	68350	50838	18118	6239	1746	295	127	39	16	8	
2005	5815	19768	113144	61665	44777	20553	6285	2348	562	100	21	24	7	
2006	8548	47207	33625	78150	31770	15667	7245	1788	737	210	26	45	155	
2007	25473	43817	62877	26303	34392	11240	4080	1381	505	285	44	13	35	

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	
2008	8459	51704	40656	35072	14037	20676	5503	1794	715	229	42	26	13	
2009	4866	38711	83998	46639	20789	8417	8920	1957	872	987	76	21	20	
2010	1778	16193	53855	75853	36797	17062	4784	4325	3034	913	189	49	35	
2011	1418	8033	32472	70938	73875	21116	11708	5058	3237	600	434	12	0	
2012	2695	10462	16646	40372	70014	48315	12326	5214	1926	1124	317	70	24	
2013	2903	13659	22752	21020	54231	74451	47124	9143	2963	694	449	89	145	
2014	5234	19226	38407	36633	29901	56109	47540	22738	3717	1169	313	210	157	
2015	4315	31383	41181	51209	33745	22530	23609	24553	16071	2510	468	134	254	
2016	2076	11291	50231	43609	35265	23417	14592	20105	15862	4781	871	249	308	
2017	6535	13128	28365	66504	46136	28507	15307	10073	12169	6465	1927	399	285	
2018	6120	28569	27128	33816	54328	28323	16208	9722	7132	3740	2295	840	271	
2019	4389	21405	48422	29849	26548	39759	17395	8883	4606	2109	715	564	322	
2020	3992	22446	37649	52454	31009	20904	23618	11768	6130	1572	591	310	278	
2021	2983	17935	54005	59732	59136	22397	14744	13589	4919	1737	678	228	344	
2022	5725	23486	53467	68112	47067	30569	11776	6046	3797	1489	575	164	107	
2023	11046	15493	30653	37250	38616	28163	16233	5885	1995	984	195	56	94	
2024	10389	21050	21148	26784	28564	23911	14331	5597	1133	263	105	33	12	

Table 3. 7 . Northeast Arctic COD. Weights-at-age (kg) in landings from various countries.

Norway														
Year			**Age**											
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1983	0.41	0.82	1.32	2.05	2.82	3.94	5.53	7.70	9.17	11.46	16.59	16.42	16.96	24.46
1984	1.16	1.47	1.97	2.53	3.13	3.82	4.81	5.95	7.19	7.86	8.46	7.99	9.78	10.64
1985	0.34	0.99	1.43	2.14	3.27	4.68	6.05	7.73	9.86	11.87	14.16	14.17	13.52	15.33
1986	0.30	0.67	1.34	2.04	3.14	4.60	5.78	6.70	7.52	9.74	10.68	12.86	9.59	16.31
1987	0.24	0.48	0.88	1.66	2.72	4.35	6.21	8.78	9.78	12.50	13.75	15.12	10.43	19.95
1988	0.36	0.56	0.83	1.31	2.34	3.84	6.50	8.76	9.97	11.06	14.43	19.02	12.89	10.16
1989	0.53	0.75	0.90	1.17	1.95	3.20	4.88	7.82	9.40	11.52	11.47		19.47	14.68
1990	0.40	0.81	1.22	1.59	2.14	3.29	4.99	7.83	10.54	14.21	17.63	7.97	14.64	
1991	0.63	1.37	1.77	2.31	3.01	3.68	4.63	6.06	8.98	12.89	17.00		14.17	16.63
1992	0.41	1.10	1.79	2.45	3.22	4.33	5.27	6.21	8.10	10.51	11.59		15.81	6.52
1993	0.30	0.83	1.70	2.41	3.35	4.27	5.45	6.28	7.10	7.82	10.10	16.03	19.51	17.68
1994	0.30	0.82	1.37	2.23	3.35	4.27	5.56	6.86	7.45	7.98	9.53	12.16	11.45	19.79
1995	0.44	0.78	1.26	1.87	2.80	4.12	5.15	5.96	7.90	8.67	9.20	11.53	17.77	21.11
1996	0.29	0.90	1.15	1.67	2.58	4.08	6.04	6.62	7.96	9.36	10.55	11.41	9.51	24.24

1997	0.35	0.78	1.14	1.56	2.25	3.48	5.35	7.38	7.55	8.30	11.15	8.64	12.80	
1998	0.38	0.68	1.03	1.64	2.23	3.24	4.85	6.88	9.18	9.84	15.78	14.37	13.77	15.58
1999	0.46	0.88	1.16	1.65	2.40	3.12	4.26	6.00	6.52	10.64	14.05	12.67	9.20	17.22
2000	0.31	0.65	1.23	1.80	2.54	3.58	4.49	5.71	7.54	7.86	12.71	14.71	15.40	20.26
2001	0.30	0.77	1.18	1.83	2.75	3.64	4.88	5.93	7.43	8.90	10.22	11.11	13.03	18.85
2002	0.31	0.90	1.40	1.90	2.60	3.55	4.60	5.80	7.40	9.56	8.71	12.92	8.42	17.61
2003	0.55	0.88	1.39	2.01	2.63	3.59	4.83	5.57	7.262	9.36	9.52	9.52	10.68	21.66
2004	0.54	1.08	1.41	1.95	2.69	3.46	4.77	6.72	7.90	8.66	12.21	14.02	16.50	11.37
2005	0.58	0.92	1.38	1.86	2.61	3.54	4.57	6.41	8.24	9.89	11.04	14.08	11.81	20.08
2006	0.51	0.97	1.45	2.06	2.71	3.56	4.57	5.53	6.61	7.53	8.55	8.44	9.82	12.31
2007	0.53	1.07	1.70	2.37	3.26	4.36	5.45	6.71	8.08	8.56	9.75	11.72	12.72	15.58
2008	0.65	1.12	1.70	2.44	3.32	4.41	5.61	6.84	8.25	9.31	10.54	12.45	13.59	21.15
2009	0.56	0.98	1.47	2.10	2.83	3.90	5.06	5.76	7.31	7.79	7.81	10.68	11.83	14.76
2010	0.55	0.95	1.46	2.06	2.93	4.02	5.40	6.44	7.19	8.43	9.11	10.46	11.39	15.55
2011	0.53	1.09	1.50	2.06	2.85	3.70	5.01	6.26	7.33	8.34	9.87	13.23		
2012		0.83	1.32	1.92	2.65	3.52	4.71	6.34	8.11	9.92	11.31	13.45	15.75	
2013	0.43	0.95	1.40	2.00	2.64	3.44	4.51	5.67	7.29	8.80	10.33	11.38	12.56	
2014	0.59	1.07	1.55	2.15	2.80	3.70	4.57	5.78	6.97	8.35	9.46	10.99	12.28	15.49
2015	0.64	0.96	1.42	1.96	2.57	3.30	4.13	5.49	6.46	7.18	8.63	10.37	12.24	14.60
2016	0.59	0.96	1.46	1.99	2.71	3.57	4.56	5.78	6.82	8.08	9.33	10.01	11.68	14.79
2017	0.55	0.99	1.53	2.06	2.69	3.64	4.72	5.91	6.91	7.88	9.41	10.93	11.78	15.07
2018	0.62	1.05	1.51	2.11	2.80	3.48	4.54	5.80	6.97	7.64	9.11	10.29	11.35	14.05
2019	0.51	0.96	1.43	2.02	2.72	3.60	4.51	5.80	6.91	7.94	8.89	10.94	11.55	14.49
2020	0.58	0.94	1.42	2.01	2.66	3.50	4.59	5.77	7.03	8.46	9.78	10.97	12.74	16.08
2021	0.39	0.75	1.27	1.86	2.55	3.42	4.52	5.86	7.13	8.55	10.09	11.79	12.98	15.75
2022	0.32	0.71	1.15	1.73	2.42	3.36	4.47	5.79	7.18	8.65	10.09	11.45	12.93	16.43
2023	0.38	0.80	1.23	1.79	2.51	3.39	4.47	5.80	7.23	8.74	9.86	11.79	13.66	15.78
2024	0.38	0.74	1.21	1.84	2.58	3.50	4.59	5.90	7.34	8.95	10.77	12.17	13.51	20.81

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

Russia (trawl only)															
Year				**Age**											
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1983		0.65	1.05	1.58	2.31	3.39	4.87	6.86	8.72	10.40	12.07	14.43			
1984		0.53	0.88	1.45	2.22	3.21	4.73	6.05	8.43	10.34	12.61	14.95			
1985		0.33	0.77	1.31	1.84	2.96	4.17	5.94	6.38	8.58	10.28				
1986		0.29	0.61	1.14	1.75	2.45	4.17	6.18	8.04	9.48	11.33	12.35	14.13		
1987		0.24	0.52	0.88	1.42	2.07	2.96	5.07	7.56	8.93	10.80	13.05	18.16		

1988		0.27	0.49	0.88	1.32	2.06	3.02	4.40	6.91	9.15	11.65	12.53	14.68		
1989		0.50	0.73	1.00	1.39	1.88	2.67	4.06	6.09	7.76	9.88				
1990		0.45	0.83	1.21	1.70	2.27	3.16	4.35	6.25	8.73	10.85	13.52			
1991		0.36	0.64	1.05	2.03	2.85	3.77	4.92	6.13	8.36	10.44	15.84	19.33		
1992		0.55	1.20	1.44	2.07	3.04	4.24	5.14	5.97	7.25	9.28	11.36			
1993		0.48	0.78	1.39	2.06	2.62	4.07	5.72	6.79	7.59	11.26	14.79	17.71		
1994		0.41	0.81	1.24	1.80	2.55	2.88	4.96	6.91	8.12	10.28	12.42	16.93		
1995		0.37	0.77	1.21	1.74	2.37	3.40	4.71	6.73	8.47	9.58	12.03	16.99		
1996		0.30	0.64	1.09	1.60	2.37	3.42	5.30	7.86	8.86	10.87	11.80			
1997		0.30	0.57	1.00	1.52	2.18	3.30	4.94	7.15	10.08	11.87	13.54			
1998		0.33	0.68	1.06	1.60	2.34	3.39	5.03	6.89	10.76	12.39	13.61	14.72		
1999		0.24	0.58	0.98	1.41	2.17	3.26	4.42	5.70	7.27	10.24	14.12			
2000		0.18	0.48	0.85	1.44	2.16	3.12	4.44	5.79	7.49	9.66	10.36			
2001		0.12	0.31	0.62	1.00	1.53	2.30	3.31	4.57	6.55	8.11	9.52	11.99		
2002		0.20	0.60	1.05	1.46	2.14	3.27	4.47	6.23	8.37	10.06	12.37			
2003		0.23	0.63	1.06	1.78	2.40	3.41	4.86	6.28	7.55	11.10	13.41	12.12	14.51	
2004		0.30	0.57	1.09	1.55	2.37	3.20	4.73	6.92	8.41	9.77	11.08			
2005		0.33	0.65	0.98	1.50	2.10	3.08	4.31	5.81	8.42	10.37	13.56	14.13		
2006		0.27	0.68	1.05	1.49	2.25	3.16	4.54	5.90	8.59	10.31	12.31			
2007		0.23	0.67	1.12	1.66	2.25	3.31	4.57	6.27	8.20	10.02	12.36	12.42		
2008		0.28	0.64	1.16	1.74	2.65	3.58	4.74	5.73	7.32	8.07	9.52	12.52		
2009		0.31	0.64	1.09	1.58	2.11	3.19	4.80	6.58	7.97	9.84	11.51			
2010		0.25	0.57	1.00	1.64	2.28	3.14	4.53	5.98	8.03	9.71	10.70	13.53		
2011		0.25	0.62	1.05	1.56	2.18	2.95	4.33	6.21	8.04	10.13	12.25	15.18		
2012		0.29	0.60	1.07	1.66	2.25	2.95	4.17	6.23	8.58	11.08	12.24	14.07	15.22	16.39
2013		0.33	0.63	1.05	1.54	2.26	3.09	4.08	5.47	7.37	9.59	12.57	15.54	17.05	
2014		0.32	0.61	1.05	1.61	2.26	3.15	4.00	5.24	7.13	9.46	11.18	14.47		
2015		0.30	0.60	0.97	1.49	2.11	3.13	4.64	5.78	7.13	9.53	12.12	16.71	17.37	
2016		0.26	0.55	0.97	1.53	2.20	3.19	4.50	6.12	7.97	9.55	10.95	14.35	14.74	17.25
2017		0.33	0.63	1.03	1.56	2.24	3.24	4.67	6.34	7.74	9.40	11.12	14.43	16.67	11.91
2018		0.33	0.68	1.06	1.62	2.40	3.22	4.66	6.23	7.79	8.91	10.26	11.26	13.41	10.14
2019		0.29	0.62	1.10	1.60	2.33	3.22	4.44	6.45	8.10	9.60	11.02	13.83	10.65	10.65
2020		0.27	0.47	0.93	1.44	2.05	2.95	4.28	5.73	7.59	8.45	10.66	12.26	12.18	12.23
2021		0.19	0.44	0.76	1.35	2.02	2.81	4.25	6.26	7.81	9.59	10.67	10.86	13.62	12.31
2022		0.39	0.62	0.91	1.42	2.21	3.22	4.45	6.15	8.16	9.91	10.83	11.96		10.33
2023		0.36	0.63	1.03	1.55	2.29	3.27	4.49	5.81	7.05	8.92	9.99	10.77		
2024		0.38	0.73	1.10	1.57	2.19	2.97	4.24	5.10	6.44	8.60	11.40	15.47		

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

Germany (Division IIa and IIb)															
Year				**Age**											
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1994			0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995			0.44	0.84	1.5	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47		
1996			0.84	1.15	1.64	2.53	3.58	4.13	3.9	4.68	6.98	6.43	11.32		
1997			0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.8		
1998		0.23	0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.5	8.57	8.42	11.45	8.79	
1999	1		0.853	1.448	1.998	2.65	3.473	4.156	5.447	6.82	5.902		8.01		
2000	2	0.26	0.73	1.36	2.04	2.87	3.67	4.88	5.78	7.05	8.45	8.67	9.33	6.88	
2001		0.38	0.80	1.21	1.90	2.74	3.90	4.99	5.69	7.15	7.32	11.72	9.11	6.60	
2002		0.35	1.00	1.31	1.80	2.53	3.64	4.38	5.07	6.82	9.21	7.59	13.18	19.17	19.20
2003		0.22	0.44	1.04	1.71	2.31	3.27	4.93	6.17	7.77	9.61	9.99	12.29	13.59	
2004	2	0.22	0.73	1.01	1.75	2.58	3.33	4.73	6.32	7.20	8.45	9.20	11.99	10.14	13.11
2005	3	0.57	0.77	1.13	1.66	2.33	3.36	4.38	5.92	6.65	7.26	10.01	11.14		
2006	2	0.71	0.91	1.39	1.88	2.56	3.77	5.33	6.68	9.14	10.89	11.51	16.83	18.77	
2007	3	0.59	1.35	1.79	2.51	3.53	4.00	4.95	6.55	7.54	9.71	11.40	11.57	23.34	15.61
2008	3	0.23	0.51	1.14	1.76	2.57	3.15	4.40	5.43	7.18	8.39	10.15	10.03	10.99	14.26
2009	3	0.35	0.60	1.19	1.83	2.96	4.08	5.61	6.97	8.55	9.13	10.54	13.34	10.30	17.06
2010	3	0.36	0.67	0.93	1.71	2.46	3.21	4.93	6.75	7.80	8.70	8.53	10.17	12.36	14.11
2011	1			1.75	3.09	3.30	3.28	4.13	4.99	6.61	7.91	9.38	10.79	14.67	14.91
2013	3			1.03	1.37	1.87	2.65	3.45	4.49	7.26	11.42	12.86	13.07		
2014	4		0.68	0.96	1.39	1.69	3.06	4.07	5.65	8.15	10.36	13.07	13.52		
2015	4	0.82	1.05	1.67	2.33	3.56	4.50	5.41	6.20	6.39					
2016	1		1.38	2.60	3.55	4.81	6.33	7.61	8.90	9.26	10.83	13.41	16.84	17.03	17.76
2017	1		1.58	2.79	3.93	3.93	4.77	6.35	8.16	9.09	10.39	11.24	12.48	14.39	13.04
2018	3	0.58	1.16	1.76	2.45	3.34	4.13	5.81	7.16	8.99	9.96	10.85	11.73	14.01	17.79
2019	1		0.82	1.37	1.80	2.26	3.49	4.45	5.44	7.08	9.25	9.39	13.30	12.24	15.25
2020	5			1.6	1.63	2.48	3.13	5.01	5.93	8.36	9.31	12.16	12.96	12.77	14.08
2021	2		0.68	1.3	1.52	2.25	3.22	4.58	6.49	7.43	10.37	11.73	14.64	14.34	15.74
2022	1		0.59	0.82	1.40	2.20	3.04	4.13	5.54	7.36	8.56	10.79	13.12	14.96	15.18
2023	2		0.74	0.94	1.25	1.89	2.97	4.36	5.7	5.55	8.4	10.06	9.86	22.68	
2024	1			2.05	2.43	2.46	2.66	3.24	3.89	3.87					

[1] Division IIa only

[2] IIa and IIb combined

[3] I,IIa and IIb combined

[4] Division IIb only

[5] I and IIa combined

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

Spain (Division IIb)														
Year				**Age**										
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**
1994		0.43	1.08	1.38	2.32	2.47	2.68	3.46	5.20	7.04	6.79	7.20	8.04	10.46	15.35
1995		0.42	0.51	0.98	1.99	3.41	4.95	5.52	8.62	9.21	11.42	9.78	8.08		
1996			0.66	1.12	1.57	2.43	3.17	3.59	4.44	5.48	6.79	8.10			
1997	1	0.51	0.65	1.22	1.68	2.60	3.39	4.27	6.67	7.88	11.34	13.33	10.03	8.69	
1998		0.47	0.74	1.15	1.82	2.44	3.32	3.71	5.00	7.26					
1999	1	0.21	0.69	1.06	1.69	2.50	3.32	4.72	5.76	6.77	7.24	7.63			
2000	1	0.23	0.61	1.24	1.75	2.47	3.12	4.65	6.06	7.66	10.94	11.40	7.20		
2001		0.23	0.64	1.25	1.95	2.86	3.55	4.95	6.46	8.50	11.07	13.09			
2002		0.16	0.55	1.00	1.48	2.17	3.29	4.47	5.35	8.29	12.23	9.01	12.16	15.2	
2003			0.58	1.05	1.70	2.33	3.33	4.92	6.24	9.98	13.07	14.74	14.17		
2004	1	0.31	0.56	0.80	1.28	1.96	2.59	3.72	5.36	5.28	7.41		11.43		
2005	1		0.63	1.14	1.85	2.48	3.43	4.25	5.38	8.41	11.19	15.04	16.93		
2006		0.30	0.61	0.99	1.46	2.04	2.55	3.39	3.50	4.70	6.36				
2007		0.42	0.60	1.20	1.76	2.40	3.18	3.96	5.19	6.61	9.48	7.65	12.65	15.74	19.66
2009	1	0.12	0.45	0.95	1.60	2.18	3.36	4.52	6.04	7.30	9.42	10.35	11.47	12.54	
2010	2	0.18	0.56	1.11	1.73	2.36	3.36	5.14	6.88	8.64	9.65	6.83			
2011	1		0.45	0.90	1.26	1.84	2.55	4.08	5.61	8.17	8.14	7.31	8.91		
2012	2		0.40	0.84	1.29	1.96	2.78	3.71	4.99	7.42		7.19	9.32		
2013		0.17	0.72	1.06	1.63	2.36	3.14	3.90	4.36	6.55					
2014		0.24	0.43	0.74	1.27	1.85	2.60	3.56	4.51	5.52	7.18	9.42	9.26	13.16	15.05
2015	2		0.40	0.80	1.19	1.79	2.45	3.38	4.41	5.85	6.64	7.48	6.77		
2016	3	0.11	0.38	0.76	1.20	1.72	2.50	3.39	4.96	7.11	8.56				
2017	2	0.12	0.42	0.75	1.17	1.69	2.50	3.39	4.47	5.69	5.93	6.00	10.91	13.57	10.52
2018	2	0.19	0.45	0.83	1.30	1.86	2.57	3.55	4.92	5.51	7.84	7.08	7.28		
2019	2	0.19	0.39	0.90	1.30	1.85	2.65	3.48	4.83	5.96	5.67	7.04	8.36		

2021	2		0.36	0.60	1.20	1.83	2.49	3.11	4.55	6.10	6.50	7.03		9.013	17.13
2022	2		0.49	0.80	1.25	1.83	2.77	4.06	5.52	7.71	8.87	12.18			
2023	2		0.54	1.15	1.56	2.28	3.27	4.24	5.56	6.62	8.62	7.00	12.98	16.92	
2024	2	0.15	0.44	0.71	1.41	1.98	2.69	3.74	5.24	5.93	8.41	10.28	9.99	12.26	20.16
1	IIa and IIb combined														
2	I,IIa and IIb combined														
3	I and IIb combined														
Iceland (Sub-area I)															
1994		0.42	0.85	1.44	2.77	3.54	4.08	5.84	6.37	7.02	7.48	7.37			
1995			1.17	0.91	1.60	2.28	3.61	4.73	6.27			6.26			
1996			0.36	0.99	1.55	2.83	3.79	4.81	5.34	7.25	7.68	9.08	8.98	10.52	
1997		0.42	0.43	0.76	1.60	2.40	3.45	4.40	5.74	6.15		8.28	10.52	9.89	
UK (England & Wales)															
1995	1			1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.2	10.1		
1996	2			1.55	1.81	2.42	3.61	6.3	6.47	7.83	7.91	8.93	9.38	10.9	
1997	2			1.93	2.17	3.07	4.17	4.89	6.46		12.3	8.44			
	1	Division IIa and IIb													
	2	Division IIa													
Poland (Division IIb)															
2006		0.18	0.51	0.89	1.55	2.23	3.6	5.28	6.95	8.478	11	10.8	15.6	18.9	
2008			0.49	0.90	1.45	2.24	2.79	3.82	4.68	5.015	6.45	7.02	7.22	5.99	6.91
2009				1.02	1.72	2.65	3.81	5.23	6.91	8.862	11.1	13.6	16.5		
2010				1.39	1.66	2.29	2.98	3.92	5.18	6.313	6.66	8.72	9.05		
2011				0.99	1.50	2.17	3.15	4.43	7.45	7.28					
2016	1		0.84	1.59	2.29	2.81	3.91	4.78	5.61	6.709	7.89	8.54	11.6	13.7	16.09
2017	2		0.71	1.23	1.52	2.47	3.52	4.78	6.97	9.193	9.95	10.9	14.1		
2018	3		0.74	1.15	1.66	2.45	3.55	4.48	6.06	6.31	7.59	7.91	8.28	8.52	9.40
2019	1				1.57	2.00	2.69	4.04	5.61	7.23	9.13	11.62	12.41	13.46	11.47
	1	Division IIa													
	2	Division IIa and IIb													
	3	I and IIb combined													

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Table 3. 8 . Northeast Arctic COD. Catch weights at age (kg).

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.350	0.590	1.110	1.690	2.370	3.170	3.980	5.050	5.920	7.200	8.150	8.130	9.250
1947	0.320	0.560	0.950	1.500	2.140	2.920	3.650	4.560	5.840	7.420	8.850	8.790	10.000

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1948	0.340	0.530	1.260	1.930	2.460	3.360	4.220	5.310	5.920	7.090	8.430	8.180	9.430
1949	0.370	0.670	1.110	1.660	2.500	3.230	4.070	5.270	5.990	7.080	8.220	8.260	8.700
1950	0.390	0.640	1.290	1.700	2.360	3.480	4.520	5.620	6.400	7.960	8.890	9.070	10.270
1951	0.400	0.830	1.390	1.880	2.540	3.460	4.880	5.200	7.140	8.220	9.390	9.500	9.520
1952	0.440	0.800	1.330	1.920	2.640	3.710	5.060	6.050	7.420	8.430	10.190	10.130	10.560
1953	0.400	0.760	1.280	1.930	2.810	3.720	5.060	6.340	7.400	8.670	10.240	11.410	11.930
1954	0.440	0.770	1.260	1.970	3.030	4.330	5.400	6.750	7.790	10.670	9.680	9.560	11.110
1955	0.320	0.570	1.130	1.730	2.750	3.940	4.900	7.040	7.200	8.780	10.080	11.020	12.110
1956	0.330	0.580	1.070	1.830	2.890	4.250	5.550	7.280	8.000	8.350	9.940	10.250	11.560
1957	0.330	0.590	1.020	1.820	2.890	4.280	5.490	7.510	8.240	9.250	10.610	10.820	12.070
1958	0.340	0.520	0.950	1.920	2.940	4.210	5.610	7.350	8.670	9.580	11.630	11.000	13.830
1959	0.350	0.720	1.470	2.680	3.590	4.320	5.450	6.440	7.170	8.630	11.620	11.950	13.000
1960	0.340	0.510	1.090	2.130	3.380	4.870	6.120	8.490	7.790	8.300	11.420	11.720	13.420
1961	0.310	0.550	1.050	2.200	3.230	5.110	6.150	8.150	8.680	9.600	11.950	13.180	13.420
1962	0.320	0.550	0.930	1.700	3.030	5.030	6.550	7.700	9.270	10.560	12.720	13.480	14.440
1963	0.320	0.610	0.960	1.730	3.040	4.960	6.440	7.910	9.620	11.310	12.740	13.190	14.290
1964	0.330	0.550	0.950	1.860	3.250	4.970	6.410	8.070	9.340	10.160	12.890	13.250	14.000
1965	0.380	0.680	1.030	1.490	2.410	3.520	5.730	7.540	8.470	11.170	13.720	13.460	14.120
1966	0.440	0.740	1.180	1.780	2.460	3.820	5.360	7.270	8.630	10.660	14.150	14.000	15.000
1967	0.290	0.810	1.350	2.040	2.810	3.480	4.890	7.110	9.030	10.590	13.830	14.150	16.760
1968	0.330	0.700	1.480	2.120	3.140	4.210	5.270	6.650	9.010	9.660	14.850	16.300	17.000
1969	0.440	0.790	1.230	2.030	2.900	3.810	5.020	6.430	8.330	10.710	14.210	15.000	17.000
1970	0.370	0.910	1.340	2.000	3.000	4.150	5.590	7.600	8.970	10.990	14.070	14.610	16.000
1971	0.450	0.880	1.380	2.160	3.070	4.220	5.810	7.130	8.620	10.830	12.950	14.250	15.970
1972	0.380	0.770	1.430	2.120	3.230	4.380	5.830	7.620	9.520	12.090	13.670	13.850	16.000
1973	0.380	0.910	1.540	2.260	3.290	4.610	6.570	8.370	10.540	11.620	13.900	14.000	15.840
1974	0.320	0.660	1.170	2.220	3.210	4.390	5.520	7.860	9.820	11.410	13.240	13.700	14.290
1975	0.410	0.640	1.110	1.900	2.950	4.370	5.740	8.770	9.920	11.810	13.110	14.000	14.290
1976	0.350	0.730	1.190	2.010	2.760	4.220	5.880	9.300	10.280	11.860	13.540	14.310	14.280
1977	0.490	0.900	1.430	2.050	3.300	4.560	6.460	8.630	9.930	10.900	13.670	14.260	14.910
1978	0.490	0.810	1.450	2.150	3.040	4.460	6.540	7.980	10.150	10.850	13.180	14.000	15.000
1979	0.350	0.700	1.240	2.140	3.150	4.290	6.580	8.610	9.220	10.890	14.340	14.500	15.310
1980	0.270	0.560	1.020	1.720	3.020	4.200	5.840	7.260	8.840	9.280	14.450	15.000	15.500
1981	0.490	0.980	1.440	2.090	2.980	4.850	6.570	9.160	10.820	10.770	13.930	15.000	16.000
1982	0.370	0.660	1.350	1.990	2.930	4.240	6.460	8.510	12.240	10.780	14.040	15.000	16.000
1983	0.840	1.370	2.090	2.860	3.990	5.580	7.770	9.290	11.550	11.420	12.800	14.180	15.550

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1984	1.420	1.930	2.490	3.140	3.910	4.910	6.020	7.400	8.130	11.420	12.800	14.180	15.550
1985	0.940	1.370	2.020	3.220	4.630	6.040	7.660	9.810	11.800	11.420	12.800	14.180	15.550
1986	0.640	1.270	1.880	2.790	4.490	5.840	6.830	7.690	9.810	11.420	12.800	14.180	15.550
1987	0.490	0.880	1.550	2.330	3.440	5.920	8.600	9.600	12.170	11.420	12.800	14.180	15.550
1988	0.540	0.850	1.320	2.240	3.520	5.350	8.060	9.510	11.360	11.420	12.800	14.180	15.550
1989	0.740	0.960	1.310	1.920	2.930	4.640	7.520	9.120	11.080	11.420	12.800	14.180	15.550
1990	0.810	1.220	1.640	2.220	3.240	4.680	7.300	9.840	13.250	11.420	12.800	14.180	15.550
1991	1.050	1.450	2.150	2.890	3.750	4.710	6.080	8.820	11.800	11.420	12.800	14.180	15.550
1992	1.160	1.570	2.210	3.100	4.270	5.190	6.140	7.770	10.120	11.420	12.800	14.180	15.550
1993	0.810	1.520	2.160	2.790	4.070	5.530	6.470	7.190	7.980	11.457	12.800	14.180	15.550
1994	0.820	1.300	2.060	2.890	3.210	5.200	6.800	7.570	8.010	9.955	13.012	14.180	15.550
1995	0.770	1.200	1.780	2.590	3.810	4.990	6.230	8.050	8.740	9.774	11.388	14.546	15.550
1996	0.790	1.110	1.610	2.460	3.820	5.720	6.740	8.040	9.280	10.451	11.190	12.819	16.045
1997	0.670	1.040	1.530	2.220	3.420	5.200	7.190	7.730	8.610	11.145	11.926	12.608	14.234
1998	0.680	1.050	1.620	2.300	3.300	4.860	6.870	9.300	10.300	10.754	12.676	13.394	14.011
1999	0.630	1.010	1.540	2.340	3.210	4.290	6.000	6.730	10.080	11.151	12.255	14.191	14.839
2000	0.570	1.040	1.610	2.340	3.340	4.480	5.720	7.520	8.020	11.930	12.682	13.743	15.675
2001	0.660	1.050	1.620	2.510	3.510	4.780	6.040	7.540	9.000	10.230	13.519	14.197	15.206
2002	0.720	1.130	1.560	2.310	3.520	4.780	6.200	7.660	9.140	10.379	11.687	15.081	15.681
2003	0.670	1.120	1.830	2.500	3.580	5.040	6.360	8.200	10.710	10.167	11.848	13.138	16.602
2004	0.720	1.130	1.610	2.430	3.270	4.720	6.710	7.980	9.190	10.840	11.619	13.310	14.571
2005	0.690	1.080	1.570	2.210	3.260	4.440	6.230	8.190	9.720	10.626	12.347	13.066	14.752
2006	0.720	1.160	1.600	2.390	3.320	4.540	5.470	6.780	7.700	10.800	12.116	13.842	14.494
2007	0.740	1.210	1.830	2.510	3.820	5.040	6.580	8.080	8.940	10.349	12.304	13.596	15.309
2008	0.770	1.270	1.870	2.820	3.790	5.120	6.220	7.750	8.400	10.139	11.816	13.795	15.052
2009	0.750	1.170	1.740	2.420	3.860	5.350	6.430	8.010	8.670	10.055	11.588	13.276	15.261
2010	0.780	1.200	1.740	2.440	3.400	5.040	6.250	7.320	8.530	10.378	11.496	13.033	14.715
2011	0.780	1.310	1.720	2.370	3.200	4.620	6.180	7.470	8.570	10.387	11.847	12.935	14.459
2012	0.670	1.140	1.730	2.340	3.120	4.400	6.280	8.240	10.350	10.367	11.857	13.309	14.356
2013	0.710	1.170	1.670	2.360	3.190	4.220	5.580	7.310	9.080	11.029	11.835	13.320	14.750
2014	0.790	1.200	1.730	2.340	3.280	4.210	5.490	6.980	8.670	10.823	12.551	13.297	14.761
2015	0.780	1.090	1.550	2.180	3.140	4.460	5.610	6.620	7.340	10.215	12.328	14.058	14.737
2016	0.780	1.140	1.660	2.260	3.250	4.500	5.980	7.310	8.540	9.372	11.670	13.822	15.536
2017	0.710	1.150	1.660	2.320	3.320	4.670	6.130	7.150	8.140	9.597	10.752	13.121	15.288
2018	0.860	1.170	1.710	2.500	3.310	4.610	6.030	7.320	8.060	9.707	10.998	12.137	14.552
2019	0.680	1.150	1.660	2.390	3.330	4.450	6.110	7.290	8.410	9.806	11.117	12.401	13.513

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2020	0.709	1.084	1.604	2.195	3.092	4.390	5.731	7.218	8.406	9.989	11.226	12.529	13.793
2021	0.527	0.896	1.487	2.159	2.982	4.364	6.048	7.348	8.796	9.991	11.424	12.645	13.928
2022	0.623	0.956	1.478	2.245	3.247	4.441	5.877	7.328	8.738	10.122	11.427	12.858	14.051
2023	0.638	1.056	1.617	2.346	3.310	4.470	5.794	7.141	8.777	9.988	11.519	12.792	14.184
2024	0.727	1.109	1.612	2.279	3.135	4.387	5.469	7.019	8.828	10.093	11.408	12.942	14.187

* values starting from 1993, ages 12-15, have been updated by the VB model using the most recent actual data for ages 3-11.

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Table 3. 9 . Northeast Arctic COD. Stock weights at age (kg) .

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.35	0.59	1.11	1.69	2.37	3.17	3.98	5.05	5.92	7.2	8.146	8.133	9.253
1947	0.32	0.56	0.95	1.5	2.14	2.92	3.65	4.56	5.84	7.42	8.848	8.789	9.998
1948	0.34	0.53	1.26	1.93	2.46	3.36	4.22	5.31	5.92	7.09	8.43	8.181	9.433
1949	0.37	0.67	1.11	1.66	2.5	3.23	4.07	5.27	5.99	7.08	8.218	8.259	8.701
1950	0.39	0.64	1.29	1.7	2.36	3.48	4.52	5.62	6.4	7.96	8.891	9.07	10.271
1951	0.4	0.83	1.39	1.88	2.54	3.46	4.88	5.2	7.14	8.22	9.389	9.502	9.517
1952	0.44	0.8	1.33	1.92	2.64	3.71	5.06	6.05	7.42	8.43	10.185	10.134	10.563
1953	0.4	0.76	1.28	1.93	2.81	3.72	5.06	6.34	7.4	8.67	10.238	11.409	11.926
1954	0.44	0.77	1.26	1.97	3.03	4.33	5.4	6.75	7.79	10.67	9.68	9.557	11.106
1955	0.32	0.57	1.13	1.73	2.75	3.94	4.9	7.04	7.2	8.78	10.077	11.023	12.105
1956	0.33	0.58	1.07	1.83	2.89	4.25	5.55	7.28	8	8.35	9.944	10.248	11.564
1957	0.33	0.59	1.02	1.82	2.89	4.28	5.49	7.51	8.24	9.25	10.605	10.825	12.075
1958	0.34	0.52	0.95	1.92	2.94	4.21	5.61	7.35	8.67	9.58	11.631	11	13.832
1959	0.35	0.72	1.47	2.68	3.59	4.32	5.45	6.44	7.17	8.63	11.621	11.95	13
1960	0.34	0.51	1.09	2.13	3.38	4.87	6.12	8.49	7.79	8.3	11.422	11.719	13.424
1961	0.31	0.55	1.05	2.2	3.23	5.11	6.15	8.15	8.68	9.6	11.952	13.181	13.422
1962	0.32	0.55	0.93	1.7	3.03	5.03	6.55	7.7	9.27	10.56	12.717	13.482	14.44
1963	0.32	0.61	0.96	1.73	3.04	4.96	6.44	7.91	9.62	11.31	12.737	13.193	14.287
1964	0.33	0.55	0.95	1.86	3.25	4.97	6.41	8.07	9.34	10.16	12.886	13.251	14
1965	0.38	0.68	1.03	1.49	2.41	3.52	5.73	7.54	8.47	11.17	13.722	13.465	14.118
1966	0.44	0.74	1.18	1.78	2.46	3.82	5.36	7.27	8.63	10.66	14.148	14	15
1967	0.29	0.81	1.35	2.04	2.81	3.48	4.89	7.11	9.03	10.59	13.829	14.146	16.756
1968	0.33	0.7	1.48	2.12	3.14	4.21	5.27	6.65	9.01	9.66	14.848	16.3	17
1969	0.44	0.79	1.23	2.03	2.9	3.81	5.02	6.43	8.33	10.71	14.211	15	17
1970	0.37	0.91	1.34	2	3	4.15	5.59	7.6	8.97	10.99	14.074	14.611	16

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1971	0.45	0.88	1.38	2.16	3.07	4.22	5.81	7.13	8.62	10.83	12.945	14.25	15.973
1972	0.38	0.77	1.43	2.12	3.23	4.38	5.83	7.62	9.52	12.09	13.673	13.852	16
1973	0.38	0.91	1.54	2.26	3.29	4.61	6.57	8.37	10.54	11.62	13.904	14	15.841
1974	0.32	0.66	1.17	2.22	3.21	4.39	5.52	7.86	9.82	11.41	13.242	13.704	14.291
1975	0.41	0.64	1.11	1.9	2.95	4.37	5.74	8.77	9.92	11.81	13.107	14	14.293
1976	0.35	0.73	1.19	2.01	2.76	4.22	5.88	9.3	10.28	11.86	13.544	14.311	14.284
1977	0.49	0.9	1.43	2.05	3.3	4.56	6.46	8.63	9.93	10.9	13.668	14.255	14.906
1978	0.49	0.81	1.45	2.15	3.04	4.46	6.54	7.98	10.15	10.85	13.177	14	15
1979	0.35	0.7	1.24	2.14	3.15	4.29	6.58	8.61	9.22	10.89	14.344	14.5	15.315
1980	0.27	0.56	1.02	1.72	3.02	4.2	5.84	7.26	8.84	9.28	14.448	15	15.5
1981	0.49	0.98	1.44	2.09	2.98	4.85	6.57	9.16	10.82	10.77	13.932	15	16
1982	0.37	0.66	1.35	1.99	2.93	4.24	6.46	8.51	12.24	10.78	14.041	15	16
1983	0.37	0.92	1.6	2.44	3.82	4.76	6.17	7.7	9.25	12.621	14.544	16.466	18.388
1984	0.42	1.16	1.81	2.79	3.78	4.57	6.17	7.7	9.25	12.621	14.544	16.466	18.388
1985	0.413	0.875	1.603	2.81	4.059	5.833	7.685	10.117	14.29	12.621	14.544	16.466	18.388
1986	0.311	0.88	1.47	2.467	3.915	5.81	6.58	6.833	11.004	12.621	14.544	16.466	18.388
1987	0.211	0.498	1.254	2.047	3.431	5.137	6.523	9.3	13.15	12.621	14.544	16.466	18.388
1988	0.212	0.404	0.79	1.903	2.977	4.392	7.812	12.112	13.107	12.621	14.544	16.466	18.388
1989	0.299	0.52	0.868	1.477	2.686	4.628	7.048	9.98	9.25	12.621	14.544	16.466	18.388
1990	0.398	0.705	1.182	1.719	2.458	3.565	4.71	7.801	8.956	12.621	14.544	16.466	18.388
1991	0.518	1.136	1.743	2.428	3.214	4.538	6.88	10.719	9.445	12.621	14.544	16.466	18.388
1992	0.44	0.931	1.812	2.716	3.895	5.176	6.774	9.598	12.427	12.621	14.544	16.466	18.388
1993	0.344	1.172	1.82	2.823	4.031	5.497	6.765	8.571	10.847	12.621	14.544	16.466	18.388
1994	0.237	0.757	1.419	2.458	3.845	5.374	6.648	7.653	8.136	12.916	16.114	16.466	18.388
1995	0.197	0.487	1.141	2.118	3.504	4.915	6.949	9.051	9.775	11.409	15.248	18.62	18.388
1996	0.206	0.482	0.98	2.041	3.52	5.507	7.74	9.922	10.63	12.093	13.533	17.659	21.171
1997	0.211	0.537	1.11	1.876	3.381	5.258	8.546	10.653	10.776	13.232	14.313	15.745	20.122
1998	0.242	0.561	1.179	1.936	2.944	4.583	7.092	10.7	12.042	13.771	15.607	16.617	18.021
1999	0.209	0.514	1.183	2.007	3.037	4.479	6.512	10.028	11.117	14.698	16.215	18.057	18.981
2000	0.194	0.465	1.218	1.963	3.064	4.12	5.746	7.157	9.961	14.589	17.26	18.733	20.557
2001	0.284	0.513	1.21	2.25	3.299	5.066	6.373	9.29	11.456	13.317	17.138	19.887	21.294
2002	0.23	0.603	1.184	2.138	3.336	4.81	6.912	8.809	10.475	12.534	15.703	19.752	22.549
2003	0.233	0.551	1.317	2.022	3.239	4.984	6.727	8.422	14.226	12.524	14.815	18.164	22.403
2004	0.24	0.55	1.074	2.038	2.911	4.402	6.263	8.535	10.197	12.371	14.803	17.176	20.674
2005	0.225	0.61	1.083	1.87	3.002	3.971	5.789	8.127	12.759	12.611	14.63	17.163	19.594
2006	0.252	0.591	1.219	2.014	3.028	4.434	5.999	7.774	9.954	13.679	14.902	16.971	19.58

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
2007	0.249	0.663	1.329	2.127	3.183	4.59	6.477	8.88	12.124	12.261	16.111	17.274	19.368
2008	0.286	0.726	1.418	2.41	3.331	4.914	6.747	8.851	10.393	12.776	14.504	18.617	19.701
2009	0.274	0.652	1.353	2.312	3.803	5.103	6.75	9.252	10.119	12.323	15.09	16.83	21.168
2010	0.258	0.608	1.208	2.01	3.088	4.903	6.498	7.992	9.689	12.467	14.574	17.483	19.214
2011	0.225	0.6	1.097	1.926	2.861	4.403	6.531	8.648	9.885	12.508	14.738	16.909	19.929
2012	0.227	0.555	1.182	1.834	2.831	4.124	6.056	8.584	11.498	12.249	14.785	17.092	19.3
2013	0.247	0.577	1.134	1.998	2.841	4.015	5.523	8.077	10.304	13.207	14.491	17.144	19.501
2014	0.216	0.577	1.137	1.791	2.781	3.85	5.245	6.992	9.378	12.746	15.578	16.816	19.558
2015	0.229	0.54	1.134	1.934	2.753	4.081	5.315	7.135	8.947	11.778	15.056	18.025	19.198
2016	0.21	0.536	1.001	1.812	2.72	3.958	5.64	7.064	8.569	10.885	13.954	17.445	20.522
2017	0.255	0.675	1.107	1.896	2.826	4.158	5.7	7.628	9.071	10.634	12.934	16.216	19.888
2018	0.286	0.62	1.188	1.949	2.768	4.059	5.749	7.38	9.097	10.8	12.646	15.073	18.54
2019	0.24	0.603	1.085	1.82	3.025	4.296	5.891	7.293	9.667	11.186	12.837	14.749	17.28
2020	0.148	0.503	1.055	1.692	2.59	4.064	5.617	7.673	9.313	11.306	13.278	14.964	16.922
2021	0.17	0.437	0.954	1.718	2.669	3.804	5.822	7.396	9.334	11.187	13.415	15.459	17.159
2022	0.293	0.48	0.929	1.616	2.741	3.933	5.744	8.012	9.648	11.361	13.279	15.613	17.706
2023	0.272	0.645	1.022	1.71	2.876	4.352	5.925	7.879	9.79	11.36	13.478	15.46	17.876
2024	0.246	0.706	1.075	1.803	2.667	3.995	5.95	7.011	9.436	11.714	13.477	15.683	17.707
2025	0.196	0.586	1.154	1.895	2.794	3.842	5.418	7.034	7.511	11.349	13.881	15.683	17.953

values starting from 1993, ages 12-15, have been updated by the VB model using the most recent actual data for ages 3-11

Table 3. 10 . Northeast Arctic COD. Basis for maturity ogives (percent) used in the assessment. Norwegian and Russian data.

Norway								
	Percentage mature							
	Age							
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1982	0	5	10	34	65	82	92	100
1983	5	8	10	30	73	88	97	100
Russia								
	Percentage mature							
	Age							
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

1984	0	5	18	31	56	90	99	100
1985	0	1	10	33	59	85	92	100
1986	0	2	9	19	56	76	89	100
1987	0	1	9	23	27	61	81	80
1988	0	1	3	25	53	79	100	100
1989	0	0	2	15	39	59	83	100
1990	0	2	6	20	47	62	81	95
1991	0	3	1	23	66	82	96	100
1992	0	1	8	31	73	92	95	100
1993	0	3	7	21	56	89	95	99
1994	0	1	8	30	55	84	95	98
1995	0	0	4	23	61	75	94	97
1996	0	0	1	22	56	82	95	100
1997	0	0	1	10	48	73	90	100
1998	0	0	2	15	47	87	97	96
1999	0	0.2	1.3	9.9	38.4	74.9	94	100
2000	0	0	6	19.2	51.4	84	95.5	100
2001	0.1	0.1	3.9	27.9	62.3	89.4	96.3	100
2002	0.1	1.9	10.9	34.4	68.1	82.8	97.6	100
2003	0.2	0	11	29.2	65.9	89.6	95.1	100
2004	0	0.7	8	33.8	63.3	83.4	96.4	96.4
2005	0	0.6	4.6	24.2	61.5	84.9	95.3	98.1
2006	0	0	6.1	29.6	59.6	89.5	96.4	100
2007	0	0.4	5.7	20.8	60.4	83.5	96	100
2008	0	0.5	4	24.6	48.3	84.4	94.7	98.7
2009	0	0	6	28	66	85	97	100
2010	0	0.2	1.5	22.8	47	77.4	90.2	95.5
2011	0	0	2.2	20.7	50.4	73.7	90.6	95.6
2012	0.2	0	1.5	10.8	43.9	76.1	90.8	96.4
2013	0	0	0.6	10.6	41.8	70.6	89.8	96.9
2014	0	0	1.9	14.1	45.9	76	92	97.5
2015	0	0.2	0.2	7.9	27	60.8	83.4	93.7
2016	0	0	0.2	5.2	22.4	44.1	74.8	92.5
2017*	0	0	0.8	6.3	20.8	51.6	80.4	98.6
2018	0	0.5	2.5	23.6	53.9	79.4	92.5	96.0
2019**	0	0	4.5	11.9	56.4	91.8	95.1	100

2020**	0	0.4	1.7	15.8	43.8	71.2	74.9	84.9
2021**	0	0	2.7	16.1	44.1	72.2	87.1	88.1
2022**	0	0	0.8	11.6	59.7	72.6	80.4	96.2
2023**	0	0	0.3	12.3	50.9	84.3	92.6	97.5
2024**	0	0	1.4	10.2	32.5	74.8	97.4	100
2025**	0	0	1.6	8.7	26.6	57.6	80.3	91.2
***Not used in inputs (instead ratios presented in WD 10, 2017 used for further calculations) **Not used in inputs (instead ratios presented in WD 15, 2019 used for further calculations)**								

Norway								
	Percentage mature							
	Age							
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1985	0.31	1.36	8.94	38.33	51.27	85.13	100	79.2
1986	2.92	7	7.85	18.85	49.72	66.52	35.59	80.09
1987	0	0.07	4.49	12.42	16.28	31.23	19.32	
1988	0	2.35	6.16	40.54	53.63	45.36	100	100
1989	1.52	0.67	3.88	30.65	70.36	82.02	100	100
1990	1.52	0.67	4.18	22	57.45	80.95	100	100
1991	0.1	3.4	13.93	38.03	75.52	90.12	95.39	100
1992	0.22	1.85	21.04	52.83	86.95	96.52	99.83	100
1993	0	2.6	10.37	52.6	84.8	97.25	99.3	99.73
1994	0.51	0.33	15.78	36.92	62.84	88.44	97.56	100
1995	0	0.62	8.19	51.48	63.75	81.11	98.01	99.34
1996	0.03	0	2.82	29.56	70.22	82.06	100	100
1997	0	0	1.48	17.91	73.31	93.01	99.12	100
1998	0.12	0.68	3.17	15.42	47.31	75.73	94.3	100
1999	0.42	0.16	1.6	27.46	70.48	94.57	98.99	100
2000	0	0.11	8.15	30.23	77.3	81.95	100	100
2001	0.49	0.51	9.03	43.81	62.52	74.36	94.13	100
2002	0.27	0.73	5.94	43.22	68.4	85.31	92.52	100
2003	0.02	0.18	6.5	35.97	68.56	87.97	96.3	100
2004	0.24	1.36	10.23	54.56	81.84	90.94	98.76	98.91
2005	0	0.27	9	55.16	81.77	93.51	98.03	100
2006	0	0.22	5.92	44.25	69.85	89.89	96.65	100
2007	0.12	0.33	8.7	47.88	84.29	91.68	99.11	100
2008	0	0.27	9.27	34.13	61.39	88.04	91.17	100
2009	0	0	9	46	85	86	98	99

2010	0	0.36	7.5	41.75	67.7	90.1	95.29	98.55
2011	0	0.2	5.2	48	77.7	89.7	97.3	97.2
2012	0	0	7.7	32.2	67.5	81	90.9	96.3
2013	0	0.3	1	20.2	55.3	80	91.8	99.3
2014	0	0.4	2	13.3	56.7	85	93.8	98.7
2015	0	0	1.9	10.9	29.2	79.1	93.1	99.6
2016	0.07	0.2	1.0	6.4	28.5	71.3	86.1	98.6
2017	0	0.2	0.5	18	54.8	81.4	95.9	100
2018	0	0.1	3.0	16.2	38.3	61.0	93.7	98.9
2019	0	0.4	4.0	24.0	68.6	93.2	96.7	99.8
2020	0	0.44	3.18	13.68	42.51	80.06	91.18	94.03
2021	0.28	0.25	0.79	17.11	43.21	68.80	90.75	98.63
2022	1.55	0	1.19	9.54	44.22	70.17	77.19	98.50
2023	0.80	2.10	2.29	8.89	49.84	80.60	94.93	94.05
2024	0.00	0.30	1.08	10.98	37.92	73.88	96.51	99.23
2025	0	0.55	2.10	8.73	34.70	60.27	84.23	95.63

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Table 3. 11 . Northeast Arctic cod. Proportion mature-at-age.

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0	0	0.01	0.03	0.06	0.11	0.18	0.44	0.65	0.86	0.96	0.96	1
1947	0	0	0.01	0.03	0.06	0.13	0.16	0.42	0.75	0.91	0.95	1	1
1948	0	0	0.01	0.03	0.07	0.13	0.25	0.47	0.73	0.91	0.97	1	1
1949	0	0	0.01	0.03	0.09	0.17	0.29	0.54	0.79	0.88	0.97	1	1
1950	0	0	0.01	0.03	0.09	0.23	0.35	0.52	0.79	0.95	0.97	1	1
1951	0	0	0.01	0.03	0.1	0.24	0.4	0.58	0.72	0.85	0.96	1	1
1952	0	0	0.01	0.03	0.08	0.22	0.41	0.63	0.82	0.92	0.97	1	1
1953	0	0	0.01	0.03	0.07	0.19	0.4	0.64	0.84	0.94	0.97	1	1
1954	0	0	0.01	0.03	0.08	0.16	0.37	0.68	0.87	0.93	0.96	1	1
1955	0	0	0.01	0.03	0.07	0.13	0.26	0.53	0.83	0.92	0.97	1	1
1956	0	0	0.01	0.03	0.06	0.12	0.14	0.41	0.67	0.91	0.96	1	1
1957	0	0	0.01	0.03	0.06	0.09	0.12	0.22	0.6	0.82	0.97	1	1
1958	0	0	0.01	0.03	0.06	0.1	0.1	0.3	0.5	0.82	0.97	1	1
1959	0	0	0.01	0.04	0.12	0.34	0.49	0.67	0.84	0.87	1	1	1
1960	0	0.01	0.03	0.06	0.1	0.19	0.45	0.69	0.77	0.85	0.99	1	1
1961	0	0	0.01	0.06	0.12	0.31	0.65	0.91	0.98	0.98	1	0.96	1

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1962	0	0	0.01	0.05	0.15	0.34	0.61	0.81	0.92	0.97	1	0.932	1
1963	0	0.01	0.01	0.03	0.07	0.28	0.42	0.81	0.98	0.98	1	0.966	1
1964	0	0	0	0.03	0.13	0.37	0.66	0.89	0.95	0.99	1	1	1
1965	0	0	0	0.01	0.06	0.2	0.55	0.73	0.99	0.98	1	1	1
1966	0	0	0.01	0.02	0.06	0.22	0.35	0.74	0.94	0.94	1	1	1
1967	0	0	0	0.03	0.07	0.14	0.38	0.64	0.89	0.9	1	1	1
1968	0	0	0.03	0.05	0.09	0.19	0.39	0.58	0.82	1	1	1	1
1969	0	0	0	0.02	0.04	0.12	0.34	0.55	0.74	0.95	1	1	1
1970	0	0.01	0	0.01	0.07	0.23	0.58	0.81	0.89	0.91	1	1	1
1971	0	0	0.01	0.05	0.11	0.3	0.59	0.79	0.86	0.88	1	1	1
1972	0.01	0.02	0.02	0.01	0.1	0.34	0.64	0.81	0.94	1	1	1	1
1973	0	0	0	0.02	0.16	0.53	0.81	0.92	0.95	0.98	1	1	1
1974	0	0	0	0.01	0.03	0.21	0.5	0.96	1	0.96	1	1	1
1975	0	0	0.01	0.02	0.09	0.21	0.56	0.78	0.79	0.95	1	1	1
1976	0	0	0	0.05	0.12	0.29	0.45	0.84	0.83	1	0.9	1	1
1977	0	0	0.02	0.08	0.26	0.54	0.76	0.87	0.93	0.94	0.9	1	1
1978	0	0	0	0.02	0.13	0.44	0.71	0.77	0.81	0.89	0.8	1	1
1979	0	0	0	0.03	0.13	0.39	0.77	0.89	0.83	0.78	0.9	1	1
1980	0	0	0	0.02	0.13	0.35	0.65	0.82	1	0.9	0.9	1	1
1981	0	0	0.02	0.07	0.2	0.54	0.8	0.97	1	1	1	1	1
1982	0	0.05	0.1	0.34	0.65	0.82	0.92	1	1	1	1	1	1
1983	0.01	0.08	0.1	0.3	0.73	0.88	0.97	1	1	1	1	1	1
1984	0	0.05	0.18	0.31	0.56	0.9	0.99	1	1	1	1	1	1
1985	0	0.01	0.09	0.36	0.55	0.85	0.96	0.9	1	1	1	1	1
1986	0	0.05	0.08	0.19	0.53	0.71	0.62	0.9	1	1	1	1	1
1987	0	0.01	0.07	0.18	0.22	0.46	0.5	0.75	1	1	1	1	1
1988	0	0.02	0.05	0.33	0.53	0.62	1	1	1	1	1	1	1
1989	0.008	0.003	0.029	0.228	0.547	0.705	0.915	1	1	1	1	1	1
1990	0.008	0.013	0.051	0.21	0.522	0.715	0.905	0.975	1	1	1	1	1
1991	0.001	0.032	0.075	0.305	0.708	0.861	0.957	1	1	1	1	1	1
1992	0.001	0.014	0.145	0.419	0.8	0.943	0.974	1	1	1	1	1	1
1993	0	0.028	0.087	0.368	0.704	0.931	0.972	0.994	1	1	1	1	1
1994	0	0.005	0.119	0.336	0.583	0.876	0.965	0.99	1	1	1	1	1
1995	0	0.005	0.06	0.373	0.614	0.748	0.955	0.98	1	1	1	1	1
1996	0	0	0.016	0.252	0.619	0.817	0.975	1	1	1	1	1	1
1997	0	0	0.014	0.14	0.597	0.842	0.95	0.967	1	1	1	1	1

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1998	0	0.005	0.031	0.168	0.468	0.828	0.956	0.98	1	1	1	1	1
1999	0	0.001	0.014	0.17	0.506	0.841	0.961	1	1	1	1	1	1
2000	0	0	0.066	0.261	0.699	0.872	0.978	1	1	1	1	1	1
2001	0.001	0.006	0.069	0.378	0.646	0.851	0.955	1	1	1	1	1	1
2002	0.001	0.015	0.085	0.412	0.695	0.846	0.97	1	1	1	1	1	1
2003	0.001	0	0.089	0.331	0.662	0.882	0.96	1	1	1	1	1	1
2004	0	0.009	0.092	0.438	0.728	0.883	0.973	0.974	1	1	1	1	1
2005	0	0.003	0.066	0.366	0.72	0.897	0.971	0.991	1	1	1	1	1
2006	0	0.015	0.061	0.367	0.633	0.907	0.961	1	1	1	1	1	1
2007	0	0.007	0.076	0.37	0.719	0.884	0.977	1	1	1	1	1	1
2008	0.005	0.008	0.082	0.309	0.539	0.869	0.928	0.994	1	1	1	1	1
2009	0	0	0.081	0.362	0.745	0.859	0.978	0.997	0.994	1	1	1	1
2010	0.005	0.006	0.06	0.335	0.552	0.838	0.931	0.971	0.983	1	1	1	1
2011	0	0	0.04	0.339	0.644	0.798	0.932	0.963	0.991	1	1	1	1
2012	0.001	0	0.058	0.209	0.544	0.799	0.93	0.967	0.99	1	1	1	1
2013	0	0	0.01	0.156	0.482	0.763	0.913	0.982	0.985	1	1	1	1
2014	0	0	0.025	0.137	0.516	0.806	0.935	0.984	0.996	1	1	1	1
2015	0	0.001	0.004	0.074	0.282	0.681	0.891	0.963	0.984	1	1	1	1
2016	0	0	0.002	0.057	0.256	0.569	0.832	0.955	0.984	1	1	1	1
2017	0	0.018	0.003	0.148	0.463	0.749	0.931	0.99	1	1	1	1	1
2018	0	0.003	0.028	0.207	0.478	0.731	0.916	0.971	1	1	1	1	1
2019	0	0	0.01	0.126	0.466	0.842	0.942	0.968	0.996	1	1	1	1
2020	0	0	0.014	0.112	0.356	0.775	0.904	0.955	1	1	1	1	1
2021	0.002	0.002	0.006	0.14	0.386	0.657	0.893	0.974	0.959	1	1	1	1
2022	0.014	0	0.01	0.079	0.402	0.674	0.756	0.975	1	1	1	1	1
2023	0.007	0.02	0.019	0.074	0.454	0.774	0.93	0.931	1	1	1	1	1
2024	0	0.003	0.009	0.091	0.345	0.709	0.946	0.982	1	1	1	1	1
2025	0	0.005	0.017	0.072	0.316	0.579	0.825	0.947	1	1	1	1	1

Table 3. 12 . The Northeast Arctic cod stock's consumption of cod in million individuals.

Year/Age	0	1	2	3	4	5	6
1984	0.000	444.645	22.443	0.216	0.000	0.000	0.000
1985	1629.210	353.507	71.713	0.198	0.000	0.000	0.000
1986	69.414	1116.753	342.936	87.470	0.000	0.000	0.000
1987	648.257	194.043	325.367	14.368	0.000	0.000	0.000
1988	32.159	484.833	26.462	1.790	0.000	0.000	0.000

1989	953.775	142.792	0.000	0.000	0.000	0.000	0.000
1990	0.000	110.335	23.571	0.000	0.000	0.000	0.000
1991	118.114	138.946	182.634	1.622	0.000	0.000	0.000
1992	3146.950	894.563	143.691	4.186	0.000	0.000	0.000
1993	3864.986	18259.227	479.691	46.381	1.304	0.419	0.000
1994	7960.935	7018.114	648.243	129.483	49.524	7.849	0.408
1995	8168.720	14857.403	758.574	210.988	66.925	3.723	0.222
1996	10172.142	21684.662	1472.711	136.498	52.787	18.482	1.068
1997	3066.930	17597.352	1897.168	165.956	15.751	1.216	0.219
1998	92.085	5687.772	577.123	204.440	23.490	1.457	0.465
1999	633.747	2101.439	303.073	50.786	4.184	0.004	0.000
2000	1911.839	2546.412	187.545	38.214	13.930	3.827	0.042
2001	94.329	2392.570	114.362	23.729	11.540	1.778	0.904
2002	7554.084	455.682	403.547	41.159	5.269	0.796	0.017
2003	5388.152	4094.448	107.320	24.014	0.000	0.000	0.000
2004	6467.802	2398.286	565.143	20.275	10.294	1.281	0.218
2005	2469.290	3029.168	132.574	79.144	4.455	5.433	0.507
2006	3305.898	2112.928	149.520	6.199	2.001	0.074	0.000
2007	2297.064	1145.805	186.937	72.874	3.311	0.121	0.000
2008	14395.315	703.213	84.239	95.204	31.285	4.114	0.000
2009	9611.083	7297.934	142.432	64.990	20.077	4.983	0.211
2010	4155.801	7124.027	299.027	52.911	27.069	15.944	2.112
2011	12478.492	4387.126	447.353	170.626	39.282	10.182	4.895
2012	20993.689	11862.632	1008.419	99.934	29.813	4.207	0.000
2013	26032.737	4728.075	1525.644	168.519	16.077	7.080	1.066
2014	35702.765	6013.764	712.499	187.060	50.726	4.909	0.060
2015	1512.075	10411.771	299.834	65.468	36.839	15.515	1.528
2016	11771.420	2492.324	494.026	11.310	17.189	25.033	5.908
2017	20934.993	1538.748	376.044	112.676	7.678	4.040	2.765
2018	7129.053	13213.861	269.334	34.540	2.151	0.257	0.000
2019	811.081	8246.983	814.040	51.641	5.440	0.017	0.000
2020	3094.784	2471.154	329.817	143.152	41.086	10.047	0.520
2021	22914.810	1533.503	228.205	69.330	21.359	11.358	1.339
2022	9546.380	4392.396	277.132	11.931	1.191	0.055	0.000
2023	3094.475	1757.988	187.826	41.931	0.649	0.015	0.000
2024	3010.924	2755.337	277.878	120.746	19.058	0.187	0.000

Table 3. 13 . Northeast Arctic COD. Tuning data.

```
104
FLT15_I: NorBarTrSur_I
1981	2025
1	1	0.085	0.189
3	12
1	1640	2330	4000	3840	480	100	30	NA	NA	NA
1	2830	2770	2360	1550	1600	140	20	NA	NA	NA
1	2495	5234	4333	1696	582	321	97	NA	NA	NA
1	9749	2828	2144	1174	407	40	8	NA	NA	NA
1	16679	12598	1992	767	334	21	7	NA	NA	NA
1	80500	14393	6414	830	191	34	4	NA	NA	NA
1	24038	39115	5435	1570	200	45	3	NA	NA	NA
1	14803	8049	17331	2048	358	53	3	NA	NA	NA
1	4636	7586	3779	9019	982	94	10	NA	NA	NA
1	2835	3487	3459	2056	2723	161	38	NA	NA	NA
1	4585	3367	2565	2149	1215	1267	61	NA	NA	NA
1	15826	5771	1782	1283	767	429	272	NA	NA	NA
1	27389	14013	7248	1583	624	389	223	NA	NA	NA
1	29392	30704	15333	4572	795	261	148	55	55	13
1	28284	24236	25101	7642	1798	242	107	50	61	19
1	16308	11743	13859	10888	2443	264	37	17	12	16
1	31799	6844	7426	5999	2667	485	64	91	8	NA
1	35510	16694	3167	2615	1752	816	79	52	4	4
1	18848	18075	6139	1271	681	514	101	26	2	6
1	24581	13003	11173	2675	456	184	121	33	10	5
1	18279	19511	8290	3796	945	117	44	19	4	1
1	11836	13756	10895	4579	1440	220	32	18	5	2
1	37670	12631	9393	6688	1750	467	102	17	4	4
1	6388	18462	5346	4324	3059	685	165	28	7	2
1	24888	5506	10297	2238	1636	381	92	30	4	10
1	11649	11538	2832	4342	1372	524	136	24	18	18
1	36113	12773	6851	1365	2360	682	230	41	11	10
1	19437	30059	11190	4024	1734	811	179	36	3	3
1	12628	19670	22023	6069	1790	902	524	51	17	7
1	3681	11425	15480	14450	3956	1124	367	160	58	12
1	8540	5037	12970	13866	10351	1637	436	120	82	39
1	7572	6459	3371	9069	13258	4861	902	226	88	111
1	6884	11409	6318	4043	6454	7638	3352	222	287	84
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLT15_II:	NorBarTrSur_II
2014	2025
1	1	0.085	0.189
3	12
1	22685	9379	8859	5639	3274	5305	3619	981	101	120
1	14407	22825	14729	11353	7443	2922	5351	1808	338	98
1	9937	13548	18831	11347	7233	2856	1317	1606	677	180
1	17925	6215	8454	9016	3782	2633	818	326	261	451
1	13941	18478	6181	6417	7388	2588	928	587	129	419
1	28157	17915	22190	7965	3296	3831	815	262	54	70
1	23773	16024	13156	11488	4983	2426	2044	453	166	243
1	11150	11935	11231	5428	3798	1357	727	353	125	103
1	5198	8868	8660	6651	4460	3042	570	229	208	255
1	4121	3982	4652	4317	3224	1426	749	158	34	35
1	19871	6331	3621	2996	2822	1615	890	268	37	20
1	15443	16818	5763	2976	2350	1897	953	355	85	49
FLT16: NorBarLofAcSur
1985		2025
```

```
1   1   0.085   0.26
3   12
1   1530   1416   204   151   157   33   13   10   5   NA
1   4996   1343   684   116   77   31   3   NA   4   NA
1   628   2049   502   174   14   30   7   NA   NA   NA
1   504   355   578   109   40   3   0   1   NA   NA
1   170   344   214   670   166   32   5   2   NA   NA
1   148   206   262   269   668   73   6   3   NA   NA
1   502   346   293   339   367   500   37   2   2   NA
1   1765   658   215   184   284   254   824   43   17   NA
1   3572   1911   1131   354   255   252   277   442   49   NA
1   3239   3745   2293   961   234   118   103   42   187   29
1   1377   1395   2036   1016   281   47   45   29   26   81
1   994   896   1128   974   462   59   11   4   9   15
1   1586   442   503   459   510   215   23   7   1   8
1   3912   1898   449   415   349   271   51   10   2   1
1   1476   1303   523   139   118   187   99   10   2   1
1   2948   1673   1492   546   146   69   50   13   6   2
1   1774   1606   851   621   191   27   8   6   3   1
1   614   1062   1011   713   366   94   12   8   6   0
1   3067   1168   1271   1461   677   235   38   4   1   2
1   334   852   349   456   480   217   88   24   2   7
1   1250   333   693   341   438   180   75   18   1   3
1   648   538   186   420   176   159   87   23   3   10
1   585   304   308   129   466   151   80   33   9   4
1   1999   2887   1166   789   248   352   55   28   17   7
1   1078   1825   1415   560   415   128   266   36   17   4
1   228   880   1614   1750   618   314   108   125   40   29
1   404   283   674   1595   2727   645   233   68   75   9
1   828   494   344   895   2266   1335   257   104   38   28
1   606   845   724   541   1336   2338   1617   215   111   88
1   2869   1242   1115   777   553   1490   1739   980   146   105
1   1387   2356   1300   1442   964   498   969   686   325   127
1   563   769   1199   664   594   409   356   565   344   286
1   1115   424   444   742   486   484   268   167   146   230
1   1090   1499   540   584   775   456   193   141   61   137
1   2036   1254   1446   639   493   739   273   218   65   111
1   1173   1173   819   943   506   509   495   195   84   80
1   649   591   558   402   369   163   114   143   82   34
1   294   530   570   504   476   345   116   68   53   39
1   287   265   336   346   278   183   135   32   17   15
1   1507 510 299   286   304   265   185   59   11   2
1   1304 1533 549 275 241 213   109   39   15   6
FLT18: RusSweptArea
1982   2025
1   1   0.9   1
3   12
1   1413   1525   721   198   551   174   37   19   15.1   1.5
1   520   642   506   358   179   252   94   NA   NA   NA
1   1189   700   489   357   154   69   61   17   14.6   7.4
1   1188   1592   1068   365   165   37   8   16   1.5   20.9
1   1622   1532   1493   481   189   42   2   6   NA   NA
1   557   3076   900   701   184   60   25   4   0.7   3.3
1   993   938   2879   583   260   47   24   NA   NA   NA
1   490   978   1062   1454   1167   299   112   47   18.5   11.7
1   167   487   627   972   1538   673   153   49   9.1   1.7
1   1077   484   532   583   685   747   98   14   2.6   NA
1   675   308   239   273   218   175   25   25   4.0   0.1
1   1604   1135   681   416   354   87   3   7   0.6   0.7
1   1363   1309   1019   354   128   49   21   11   5.7   2.2
1   589   1065   1395   849   251   83   19   18   9.5   5.8
1   733   784   1035   773   348   132   19   5   12.0   1.6
1   1342   835   613   602   348   116   32   30   NA   NA
1   2028   1363   788   470   259   130   48   5   NA   0.9
1   1587   2072   980   301   123   94   42   4   NA   NA
1   1839   1286   1786   773   114   52   23   9   3.9   0.4
1   1224   1557   1290   1061   304   50   14   5   25.4   13.1
```

```
1   980    1473   1473   896    600    182   29    8     0.8    0.5
1   1246   1057   1166   1203   535    241   40    9     3.1    1.1
1   329    1576   880    1111   776    279   93    23    3.6    2.5
1   1408   631    1832   744    605    244   88    28    6.4    1.1
1   927    1613   777    1801   662    342   161   43    17.5   7.4
1   2579   1617   1903   846    1525   553   226   86    49.0   18.5
1   2203   3088   1635   1472   830    863   291   115   33.0   19.0
1   974    2317   3687   2016   1175   620   413   205   65.0   41.0
1   334    1070   2505   3715   1817   789   395   299   155.9  75.2
1   882    508    1432   3065   3300   917   439   176   175.5  105.4
1   815    1114   839    2122   3358   1878  432   195   45.7   76.3
1   747    1174   1177   884    2349   3132  1367  306   92.4   98.5
1   1399   1368   1725   1483   1111   1929  1297  383   93.4   55.1
1   657    1583   1742   1932   1610   925   1158  761   241.6  113.6
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   1456   884    1063   1952   1231   567   266   120   119.8  103.8
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
FLT007: Ecosystem_2018corr
2004   2024
1   1   0.65   0.75
3   12
1   1477   4215   1502   798    402    101   22    5    1.3   2
1   2166   558    1009   280    156    57    12    5    1.2   0.5
1   1861   2056   599    698    176    81    26    6    2.5   0.4
1   5862   1592   791    246    269    60    22    9    1.5   2.4
1   6526   4834   1323   511    128    175   33    9    2.3   3.9
1   2023   2806   2896   1017   319    127   73    26   8.1   5.1
1   568    1770   3972   4249   1427   385   105   68   15.9  6.2
1   1236   1015   2402   3004   1784   323   77    18   13.4  8.7
1   2291   1464   700    1508   1652   845   127   44   15.5  20.8
1   2491   1836   1257   632    1182   1302  538   91   33.2  24.6
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   1744   2252   1413   726    486    262   353   266  78.7  27
1   772    937    1216   701    444    272   138   132  54.2  30.2
1   3750   1415   1049   1209   626    280   112   64   44.5  71.7
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   4166   2323   2151   766    422    444   161   49   21.9  29.5
1   1395   1356   934    829    308    142   107   31   10.3  14.8
1   847    998    811    457    336    124   47    50   23.8  16.8
1   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
1   699    401    571    527    450    233   93    22   8.0   8.9
1   2344 682 468   410    290    145   77    25   6.3   3.5
```

Table 3. 14 . Parameters settings used in SAM run.

```
Where a matrix is specified rows corresponds to fleets and columns to ages.
# Same number indicates same parameter used
# Numbers (integers) starts from zero and must be consecutive
#
$minAge
# The minimium age class in the assessment
 3

$maxAge
# The maximum age class in the assessment
 15
```

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

$keyLogFsta
# Coupling of the fishing mortality states (nomally only first row is used).
  0  1  2  3  4  5  6  7  8  9 10 11 11
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

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

$keyLogFpar
# Coupling of the survey catchability parameters (nomally first row is not used, as that is covered by fishing mortality).
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
  0  1  2  3  4  5  6  7  8  8 -1 -1 -1
  9 10 11 12 13 14 15 16  17 17 -1 -1 -1
 18 19 20 21 22 23 24 25 26 26 -1 -1 -1
 27 28 29 30 31 32 33 34 35 35 -1 -1 -1
 36 37 38 39 40 41 42 43 44 44 -1 -1 -1
$keyQpow
# Density dependent catchability power parameters (if any).
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarF
# Coupling of process variance parameters for log(F)-process (nomally only first row is used)
  0  1  1  1  1  1  1  1  1  1  1  1  1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1

$keyVarLogN
# Coupling of process variance parameters for log(N)-process
 0 1 1 1 1 1 1 1 1 1 1 1 1
$keyVarObs
# Coupling of the variance parameters for the observations.
  0  1  2  2  2  2  2  2  3  3  4  4  4
  5  6  6  6  6  7  7  7  7  7 -1 -1 -1
  5  6  6  6  6  7  7  7  7  7 -1 -1 -1
  8  8  8  8  8  8  9  9  9  9 -1 -1 -1
 10 10 10 10 10 10 11 11 11 11 -1 -1 -1
 12 12 12 12 12 12 12 12 12 12 -1 -1 -1

$obsCorStruct
# Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for unstructured). | Possible
```

```
values are: "ID" "AR" "US"
 "ID" "AR" "AR" "AR" "AR" "AR"

$keyCorObs
# Coupling of correlation parameters can only be specified if the AR(1) structure is chosen above.
# NA's indicate where correlation parameters can be specified (-1 where they cannot).
#3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-11 11-12 12-13 13-14 14-15
NA NA NA NA NA NA NA NA NA NA NA NA
0 0 0 0 1 1 2 2 3 -1 -1 -1
0 0 0 0 1 1 2 2 3 -1 -1 -1
4 4 4 5 6 6 6 7 8 -1 -1 -1
9 9 9 9 9 10 10 10 11 -1 -1 -1
12 12 12 13 13 13 14 14 15 -1 -1 -1

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

$noScaledYears
# Number of years where catch scaling is applied.
 0

$keyScaledYears
# A vector of the years where catch scaling is applied.


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

$fbarRange
# lowest and higest age included in Fbar
 5 10

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

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

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

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Table 3. 15 . Northeast Arctic cod. Fishing mortality.

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1946	0.003	0.020	0.069	0.136	0.269	0.247	0.378	0.395	0.573	0.564	0.628	0.652	0.652	0.249
1947	0.002	0.021	0.090	0.187	0.387	0.293	0.450	0.447	0.692	0.636	0.689	0.783	0.783	0.309
1948	0.001	0.021	0.095	0.220	0.465	0.347	0.513	0.450	0.714	0.695	0.741	0.922	0.922	0.348
1949	0.002	0.029	0.138	0.302	0.473	0.367	0.459	0.476	0.771	0.753	0.788	1.027	1.027	0.369

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1950	0.002	0.043	0.163	0.314	0.436	0.363	0.480	0.538	0.838	0.855	0.816	1.146	1.146	0.382
1951	0.009	0.079	0.232	0.343	0.445	0.393	0.496	0.567	0.780	0.866	0.840	1.194	1.194	0.413
1952	0.014	0.104	0.278	0.432	0.476	0.409	0.524	0.640	0.844	0.920	0.843	1.195	1.195	0.460
1953	0.020	0.113	0.251	0.359	0.401	0.373	0.472	0.612	0.814	0.823	0.799	1.020	1.020	0.411
1954	0.017	0.116	0.268	0.383	0.423	0.355	0.488	0.707	0.832	0.823	0.791	0.929	0.929	0.437
1955	0.015	0.108	0.295	0.495	0.497	0.510	0.565	0.752	0.894	0.866	0.791	0.862	0.862	0.519
1956	0.018	0.122	0.350	0.583	0.560	0.600	0.590	0.740	0.892	0.984	0.823	0.804	0.804	0.571
1957	0.021	0.136	0.290	0.529	0.548	0.589	0.536	0.673	0.879	0.913	0.820	0.720	0.720	0.528
1958	0.035	0.182	0.359	0.543	0.540	0.510	0.507	0.692	0.829	0.879	0.721	0.633	0.633	0.525
1959	0.035	0.203	0.426	0.524	0.526	0.527	0.552	0.720	0.787	0.801	0.708	0.645	0.645	0.546
1960	0.036	0.212	0.405	0.509	0.493	0.546	0.522	0.754	0.854	0.803	0.699	0.711	0.711	0.538
1961	0.038	0.226	0.491	0.576	0.546	0.645	0.696	0.850	0.897	0.863	0.742	0.748	0.748	0.634
1962	0.036	0.225	0.585	0.752	0.633	0.684	0.796	1.010	0.935	0.845	0.775	0.738	0.738	0.743
1963	0.024	0.194	0.586	0.803	0.762	0.774	0.894	1.085	1.080	0.850	0.802	0.735	0.735	0.818
1964	0.019	0.159	0.412	0.553	0.585	0.700	0.936	0.882	0.979	0.801	0.879	0.754	0.754	0.678
1965	0.023	0.143	0.364	0.459	0.471	0.588	0.784	0.797	0.805	0.670	0.889	0.757	0.757	0.577
1966	0.030	0.140	0.285	0.387	0.468	0.599	0.751	0.790	0.713	0.655	0.799	0.674	0.674	0.547
1967	0.029	0.155	0.263	0.327	0.463	0.639	0.829	0.811	0.771	0.666	0.792	0.611	0.611	0.555
1968	0.025	0.176	0.356	0.433	0.494	0.631	0.846	0.832	0.747	0.600	0.798	0.631	0.631	0.599
1969	0.026	0.183	0.406	0.483	0.631	0.813	1.007	0.923	0.835	0.631	0.757	0.621	0.621	0.711
1970	0.034	0.164	0.377	0.469	0.590	0.824	0.997	0.933	0.796	0.577	0.714	0.631	0.631	0.698
1971	0.030	0.155	0.305	0.353	0.505	0.810	0.980	0.920	0.801	0.605	0.693	0.618	0.618	0.645
1972	0.051	0.183	0.332	0.402	0.426	0.718	1.060	1.014	0.895	0.652	0.746	0.637	0.637	0.659
1973	0.132	0.226	0.385	0.438	0.459	0.699	0.921	0.860	0.846	0.673	0.758	0.622	0.622	0.627
1974	0.159	0.298	0.482	0.520	0.508	0.621	0.665	0.870	0.910	0.715	0.891	0.630	0.630	0.611
1975	0.115	0.277	0.507	0.623	0.641	0.729	0.721	0.729	0.938	0.778	0.951	0.601	0.601	0.658
1976	0.143	0.308	0.530	0.615	0.687	0.853	0.873	0.672	0.797	0.821	0.942	0.678	0.678	0.705
1977	0.129	0.337	0.636	0.678	0.707	0.902	1.129	0.858	0.894	0.813	1.050	0.810	0.810	0.818
1978	0.110	0.253	0.573	0.739	0.768	0.894	1.221	0.946	1.302	1.009	1.193	0.915	0.915	0.857
1979	0.056	0.201	0.410	0.621	0.710	0.803	1.093	0.992	1.295	1.094	1.122	1.006	1.006	0.771
1980	0.038	0.157	0.345	0.628	0.722	0.808	0.996	1.058	1.230	0.996	1.157	0.907	0.907	0.760
1981	0.032	0.140	0.281	0.580	0.785	0.974	1.162	0.977	1.071	0.937	1.042	0.837	0.837	0.793
1982	0.040	0.158	0.286	0.640	0.841	0.919	1.133	0.826	0.823	0.925	0.867	0.824	0.824	0.774
1983	0.028	0.165	0.300	0.547	0.902	1.081	1.067	0.848	0.714	0.727	0.802	0.867	0.867	0.791
1984	0.024	0.157	0.331	0.581	1.064	1.168	1.171	0.900	0.748	0.703	0.672	0.893	0.893	0.869
1985	0.038	0.162	0.391	0.667	0.944	1.148	0.929	0.779	0.758	0.656	0.596	0.949	0.949	0.810

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
1986	0.031	0.172	0.458	0.768	0.907	1.143	0.925	1.045	0.886	0.851	0.589	1.071	1.071	0.874
1987	0.039	0.155	0.472	0.831	1.017	1.116	0.892	1.253	0.977	1.000	0.637	1.251	1.251	0.930
1988	0.034	0.128	0.335	0.637	0.941	1.020	1.031	1.360	0.961	0.915	0.729	1.214	1.214	0.887
1989	0.030	0.107	0.252	0.455	0.646	0.838	0.821	1.004	0.757	0.710	0.697	1.426	1.426	0.669
1990	0.020	0.092	0.177	0.306	0.413	0.499	0.549	0.590	0.655	0.613	0.627	1.311	1.311	0.422
1991	0.020	0.101	0.212	0.342	0.433	0.469	0.504	0.483	0.497	0.595	0.574	1.265	1.265	0.407
1992	0.024	0.114	0.280	0.429	0.528	0.555	0.564	0.563	0.518	0.705	0.544	1.255	1.255	0.487
1993	0.014	0.110	0.316	0.523	0.618	0.657	0.694	0.718	0.691	0.831	0.678	1.228	1.228	0.588
1994	0.012	0.109	0.323	0.597	0.929	0.919	0.879	0.858	0.917	0.938	0.777	1.217	1.217	0.751
1995	0.014	0.117	0.323	0.605	0.933	0.896	0.954	0.928	1.012	0.967	0.855	1.130	1.130	0.773
1996	0.021	0.134	0.353	0.616	0.882	0.940	0.852	1.112	0.961	0.965	0.922	1.037	1.037	0.792
1997	0.022	0.170	0.448	0.684	0.894	1.205	1.130	1.280	1.031	1.022	0.921	0.941	0.941	0.940
1998	0.026	0.183	0.477	0.713	0.851	1.161	1.138	1.323	1.054	0.903	0.832	0.793	0.793	0.944
1999	0.015	0.150	0.466	0.684	0.868	1.102	1.230	1.306	0.957	0.888	0.698	0.704	0.704	0.943
2000	0.009	0.114	0.365	0.588	0.831	1.021	1.113	1.192	0.850	0.907	0.561	0.688	0.688	0.852
2001	0.009	0.096	0.294	0.533	0.755	0.928	0.894	1.060	0.739	0.775	0.451	0.725	0.725	0.744
2002	0.008	0.091	0.277	0.521	0.777	0.889	0.845	0.801	0.632	0.738	0.398	0.690	0.690	0.685
2003	0.010	0.089	0.285	0.474	0.729	0.812	0.779	0.755	0.577	0.641	0.371	0.659	0.659	0.639
2004	0.010	0.090	0.294	0.501	0.772	0.858	0.905	0.968	0.649	0.685	0.353	0.558	0.558	0.716
2005	0.011	0.102	0.321	0.519	0.744	0.870	0.971	0.912	0.686	0.758	0.358	0.506	0.506	0.723
2006	0.016	0.102	0.283	0.444	0.623	0.744	0.826	0.812	0.692	0.787	0.389	0.599	0.599	0.622
2007	0.017	0.091	0.243	0.350	0.451	0.545	0.575	0.551	0.664	0.768	0.404	0.532	0.532	0.453
2008	0.011	0.069	0.163	0.277	0.371	0.452	0.499	0.456	0.610	0.722	0.425	0.451	0.451	0.370
2009	0.010	0.058	0.132	0.222	0.320	0.358	0.472	0.384	0.557	0.779	0.472	0.396	0.396	0.315
2010	0.009	0.049	0.107	0.178	0.285	0.382	0.404	0.438	0.630	0.642	0.545	0.373	0.373	0.299
2011	0.006	0.048	0.105	0.161	0.258	0.357	0.462	0.559	0.593	0.545	0.533	0.314	0.314	0.317
2012	0.007	0.047	0.119	0.161	0.243	0.330	0.434	0.505	0.578	0.507	0.512	0.309	0.309	0.299
2013	0.007	0.048	0.122	0.190	0.272	0.368	0.464	0.543	0.592	0.518	0.500	0.346	0.346	0.327
2014	0.008	0.054	0.143	0.230	0.318	0.401	0.437	0.542	0.626	0.567	0.526	0.383	0.383	0.345
2015	0.010	0.056	0.151	0.272	0.330	0.401	0.378	0.529	0.775	0.642	0.570	0.430	0.430	0.343
2016	0.009	0.053	0.150	0.260	0.347	0.425	0.422	0.580	0.857	0.707	0.642	0.505	0.505	0.364
2017	0.011	0.059	0.155	0.276	0.365	0.487	0.491	0.618	0.931	0.792	0.727	0.581	0.581	0.399
2018	0.012	0.063	0.163	0.274	0.377	0.474	0.540	0.680	0.904	0.888	0.826	0.645	0.645	0.418
2019	0.010	0.067	0.164	0.265	0.389	0.518	0.550	0.741	0.877	0.918	0.880	0.681	0.681	0.438
2020	0.010	0.069	0.178	0.296	0.429	0.552	0.651	0.843	0.952	0.971	0.979	0.729	0.729	0.491
2021	0.013	0.077	0.218	0.367	0.508	0.606	0.795	1.005	0.982	1.135	1.112	0.812	0.812	0.583

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	FBAR5-10
2022	0.028	0.100	0.257	0.413	0.515	0.632	0.807	1.079	1.143	1.308	1.260	0.790	0.790	0.617
2023	0.037	0.116	0.249	0.387	0.510	0.667	0.838	1.136	1.153	1.297	1.186	0.703	0.703	0.631
2024	0.025	0.123	0.249	0.377	0.516	0.773	0.783	1.066	0.986	1.149	1.093	0.542	0.542	0.627

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Table 3. 16 . Northeast Arctic COD Stock number-at-age (Thous) .

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1946	1132096	676614	372493	172094	78325	84512	227436	80676	36043	30432	18917	8126	1988	291975
1947	589871	678524	498704	298694	133722	53620	56383	132850	45752	17332	14548	8430	4482	253291
1948	453140	338426	463367	346726	207023	75405	34972	29935	69608	18410	7623	6036	4941	205561
1949	625645	293248	264498	354528	229334	103972	42981	16909	15967	28191	7441	2989	3585	198928
1950	1027105	395632	231397	187600	208586	114845	57041	22827	8655	6119	11030	2744	1933	227551
1951	2401535	778450	310611	178117	114884	111006	66001	28209	10921	2985	2095	4016	1200	401002
1952	2324908	1127676	461480	189739	116014	61798	61011	33246	13114	4219	1025	731	1282	439624
1953	2401079	1114374	637540	245326	90917	60064	33176	28489	13952	4522	1351	357	483	463163
1954	832048	1381918	709021	387423	137944	48991	34651	17321	12896	5055	1644	497	247	356965
1955	384763	551134	921171	434561	223736	75044	30596	18113	6949	4681	1834	615	241	265343
1956	750267	246958	395305	550615	211845	112701	35631	14605	7020	2288	1648	689	297	232987
1957	1437103	407106	151593	208919	238058	94823	49048	15389	5685	2355	671	593	361	261170
1958	926298	717693	249950	95977	100371	109259	40944	23259	6425	1914	779	232	379	227348
1959	1312899	485837	429014	141321	47171	47642	54769	20187	9511	2298	642	318	268	255187
1960	1476668	625889	253248	208017	69488	23075	22980	25326	8052	3635	860	257	260	271775
1961	1544416	706275	347928	134352	102684	36341	11339	12027	9807	2792	1367	359	209	290989
1962	1246539	810200	391099	168643	64385	49274	15643	4565	4392	3277	946	538	220	275972
1963	909759	701952	455542	165607	62670	28830	20762	5763	1331	1463	1159	353	299	235549
1964	474078	412501	369741	179049	54680	21545	10557	6916	1519	352	513	432	257	153214
1965	879969	251321	259545	200214	83063	23750	8185	3216	2384	451	124	172	266	171266
1966	1841575	567564	167228	145000	106347	44094	10954	3043	1180	892	192	40	164	288827
1967	1312548	1270602	397250	106498	80647	55359	20431	4381	1135	491	387	72	82	324988
1968	182591	1014379	889836	280094	72502	42319	23749	7292	1619	422	206	145	70	251522
1969	110956	137717	703331	495057	154642	41124	19660	8561	2636	651	193	75	95	167469
1970	206571	86217	88097	368851	238029	64428	15103	5829	2766	914	281	75	75	107723
1971	407906	145948	58066	45468	174297	103216	22553	4578	1863	1029	427	113	65	965527
1972	1055799	314338	105334	37381	27301	81783	36109	6978	1527	696	465	180	79	166797
1973	1700630	753828	212871	63955	21257	15875	32410	9724	1984	500	297	179	114	281362

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
1974	563413	1199683	516400	123229	35431	11339	6618	10183	3408	701	207	117	130	247086
1975	611367	365886	668805	258327	61609	18483	5370	3066	3320	1119	283	68	109	199781
1976	599717	445857	226973	311574	108415	26036	7508	2266	1292	1008	418	89	82	173123
1977	371308	413737	273329	112774	137070	43294	8837	2630	1044	518	350	136	72	136509
1978	622541	247481	218005	112277	47528	55772	14034	2248	898	382	204	99	76	132154
1979	204644	448075	155306	90652	40755	17622	18407	3264	697	187	115	50	57	97983
1980	131376	156660	302080	87122	39225	16102	6535	5044	981	154	49	31	31	74539
1981	144660	103263	113458	174763	37977	15672	6035	2072	1397	231	47	12	20	59960
1982	181444	125599	83717	64136	81931	15197	4643	1517	640	380	74	13	11	55930
1983	140148	136361	92240	51934	28934	28281	4891	1235	567	229	119	26	9	48497
1984	442650	114519	83478	54193	24685	10669	7713	1352	437	241	94	42	12	74008
1985	528064	385014	81788	44961	24338	6374	2802	1907	437	165	100	41	18	107601
1986	1368715	402337	243127	46326	19125	7444	1604	1008	749	175	73	46	19	209074
1987	355710	999739	254839	109372	16400	6841	1792	574	287	255	61	34	19	174592
1988	332586	237973	591618	118772	32894	4992	1737	627	134	90	73	27	12	132153
1989	158314	228237	147633	305426	54830	9836	1474	485	125	40	29	27	10	90646
1990	132921	129067	129914	95622	142232	22737	2892	531	137	47	16	11	7	65613
1991	299535	127081	97980	86406	61770	82147	11392	1368	247	55	21	7	4	76801
1992	714326	272194	101077	69261	48844	33876	46406	6013	794	131	25	10	3	129295
1993	989320	503298	240765	72801	36734	23575	15470	23823	2986	426	56	13	3	190927
1994	748873	733142	398449	147000	39032	15927	10626	6348	9657	1295	156	24	4	211053
1995	536652	491361	523169	231795	63180	12418	5292	3409	2187	3158	413	59	7	187310
1996	400009	302266	335214	283599	104293	19784	4275	1571	1104	613	991	143	17	145387
1997	774447	207114	203611	182861	120351	37587	6281	1644	427	335	191	325	47	153522
1998	1042448	471770	125723	97521	71058	41782	9474	1620	352	127	94	61	117	186214
1999	623066	597465	262180	62109	32893	26125	11609	2510	341	97	44	33	66	161853
2000	745655	408259	373946	121876	24398	11224	7404	2628	573	107	32	18	40	169616
2001	589453	532799	290325	184465	51876	8964	3388	1922	655	196	34	15	25	166411
2002	374279	429272	367497	186089	82067	20277	3073	1166	553	246	76	18	16	146462
2003	758269	287413	287200	235285	84395	30176	6698	1112	431	255	94	43	14	169138
2004	242549	577021	214249	182353	115994	33877	10871	2595	458	215	120	53	24	138037
2005	693644	186027	405938	136050	94004	39089	11144	3876	793	197	92	73	36	157096
2006	538707	468518	140827	231646	68446	33820	13421	3289	1265	345	75	55	60	150047
2007	1254408	438991	303622	88686	119494	30205	12405	4379	1131	525	132	41	53	225407
2008	1015559	975223	335505	167516	52948	62369	15242	5537	1866	501	196	73	46	263258
2009	590917	795147	741822	248460	89180	33359	28574	7630	2925	879	205	104	62	253926

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp	TOTAL
2010	205971	460685	651227	550536	166523	54166	18704	14353	4427	1505	319	107	93	212861
2011	364181	183437	380687	534063	386511	85734	31005	10428	7797	1899	681	143	112	198667
2012	508680	278113	147374	315868	404250	219254	44345	15693	5043	3604	908	335	152	194361
2013	467710	372141	226757	129241	240629	263242	133707	22692	8148	2307	1796	447	304	186912
2014	850150	355642	298296	182598	101544	168145	144595	63866	10776	3619	1110	894	442	218167
2015	448454	568416	299427	214729	131647	67681	95467	73020	29151	4896	1653	534	754	193582
2016	282842	312464	416279	215874	135733	76195	43216	52321	33467	10975	2105	760	692	158292
2017	756942	235722	226381	286617	145081	78727	40745	23804	22351	12124	4448	907	714	183456
2018	482707	525504	185637	158877	184911	85029	39665	21315	10540	7109	4444	1745	732	170821
2019	616881	358318	380589	147601	90704	106517	45131	19112	8787	3577	2323	1556	1036	178213
2020	526121	416245	272516	246475	99388	53219	53538	21703	7795	3084	1174	780	1041	170307
2021	366624	334619	307222	190663	144187	52393	26017	22717	8220	2524	968	360	702	145721
2022	185968	243287	238409	192617	118782	71999	22981	9782	6540	2479	656	260	368	109412
2023	240885	142700	161744	137774	105797	60258	31263	8530	2712	1639	525	147	223	89419
2024	632470	183306	105577	94751	77407	48025	27701	10425	2285	654	351	128	139	118321
2025		425383	132325	65384	52041	37843	18747	10144	2931	709	170	96	128	120163

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Table 3. 17 . Northeast Arctic COD. Natural mortality used in final run.

Year_age	3	4	5	6	7	8	9	10	11	12	13	14	+gp
1946	0.490	0.304	0.226	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1947	0.544	0.325	0.231	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1948	0.493	0.305	0.226	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1949	0.434	0.282	0.221	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1950	0.316	0.236	0.210	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1951	0.724	0.394	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1952	0.715	0.391	0.246	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1953	0.537	0.322	0.230	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1954	0.388	0.264	0.217	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1955	0.406	0.271	0.218	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1956	0.590	0.343	0.235	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1957	0.725	0.395	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1958	0.562	0.332	0.233	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1959	0.713	0.390	0.246	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1960	0.704	0.387	0.245	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1961	0.609	0.350	0.237	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

1962	0.520	0.315	0.229	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1963	0.788	0.419	0.253	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1964	0.603	0.348	0.236	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1965	0.416	0.275	0.219	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1966	0.353	0.251	0.214	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1967	0.271	0.219	0.206	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1968	0.224	0.201	0.202	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1969	0.206	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1970	0.293	0.227	0.208	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1971	0.256	0.213	0.205	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1972	0.323	0.239	0.211	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1973	0.217	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1974	0.217	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1975	0.232	0.204	0.203	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1976	0.224	0.200	0.202	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1977	0.249	0.210	0.204	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978	0.234	0.205	0.203	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1979	0.208	0.200	0.201	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1980	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	0.200	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1983	0.203	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1984	0.201	0.200	0.219	0.210	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1985	0.204	0.224	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1986	0.270	0.215	0.250	0.231	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1987	0.255	0.236	0.217	0.270	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1988	0.222	0.211	0.241	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1989	0.200	0.230	0.200	0.233	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1990	0.200	0.200	0.207	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1991	0.200	0.200	0.200	0.208	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1992	0.207	0.200	0.200	0.204	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1993	0.240	0.200	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1994	0.347	0.260	0.214	0.220	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1995	0.531	0.314	0.226	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1996	0.525	0.327	0.242	0.218	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1997	0.422	0.268	0.239	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1998	0.428	0.273	0.216	0.267	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

1999	0.264	0.233	0.236	0.222	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2000	0.248	0.212	0.242	0.225	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2001	0.236	0.220	0.200	0.231	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2002	0.278	0.212	0.200	0.224	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2003	0.239	0.200	0.200	0.212	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2004	0.250	0.215	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2005	0.297	0.212	0.215	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2006	0.203	0.229	0.200	0.207	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2007	0.246	0.200	0.247	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2008	0.258	0.214	0.200	0.233	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.273	0.209	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2010	0.297	0.234	0.207	0.201	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2011	0.423	0.309	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2012	0.377	0.297	0.200	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.391	0.233	0.204	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2014	0.368	0.292	0.212	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.354	0.259	0.233	0.205	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2016	0.216	0.252	0.260	0.216	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2017	0.388	0.217	0.214	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2018	0.268	0.212	0.200	0.218	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2019	0.291	0.210	0.213	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2020	0.441	0.230	0.200	0.210	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2021	0.421	0.265	0.232	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2022	0.261	0.221	0.217	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2023	0.301	0.202	0.219	0.200	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2024	0.386	0.281	0.208	0.207	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

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Table 3. 18 . Northeast Arctic COD. Summary table.

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1946	1132096	3936948	952566	706000	0.741	0.249
1947	589871	3388287	901673	882017	0.978	0.309
1948	453140	3358491	784027	774295	0.988	0.348
1949	625645	2895545	594525	800122	1.346	0.369
1950	1027105	2796138	535621	731982	1.367	0.382
1951	2401535	3689758	495101	827180	1.671	0.413
1952	2324908	4112827	488885	876795	1.794	0.460

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1953	2401079	4090414	412279	695546	1.687	0.411
1954	832048	4198700	408274	826021	2.023	0.437
1955	384763	3537671	327990	1147841	3.500	0.519
1956	750267	3318877	281202	1343068	4.776	0.571
1957	1437103	2814508	212161	792557	3.736	0.528
1958	926298	2356486	205333	769313	3.747	0.525
1959	1312899	2725120	434387	744607	1.714	0.546
1960	1476668	2352506	384713	622042	1.617	0.538
1961	1544416	2349043	386652	783221	2.026	0.634
1962	1246539	2173243	315466	909266	2.882	0.743
1963	909759	2008977	215997	776337	3.594	0.818
1964	474078	1509582	200005	437695	2.188	0.678
1965	879969	1458870	107910	444930	4.123	0.577
1966	1841575	2222024	121043	483711	3.996	0.547
1967	1312548	2736891	128802	572605	4.446	0.555
1968	182591	3285822	223126	1074084	4.814	0.599
1969	110956	2820971	149020	1197226	8.034	0.711
1970	206571	2161933	241962	933246	3.857	0.698
1971	407906	1660046	330131	689048	2.087	0.645
1972	1055799	1616269	353264	565254	1.600	0.659
1973	1700630	2277172	334209	792685	2.372	0.627
1974	563413	2177597	159059	1102433	6.931	0.611
1975	611367	2090625	133590	829377	6.208	0.658
1976	599717	1939387	167156	867463	5.190	0.705
1977	371308	1929680	335912	905301	2.695	0.818
1978	622541	1584427	227783	698715	3.068	0.857
1979	204644	1136772	180283	440538	2.444	0.771
1980	131376	853805	108445	380434	3.508	0.760
1981	144660	967282	161401	399038	2.472	0.793
1982	181444	751434	321579	363730	1.131	0.774
1983	140148	746890	311707	289992	0.930	0.791
1984	442650	830492	243746	277651	1.139	0.869
1985	528064	1000004	195409	307920	1.576	0.810
1986	1368715	1399590	163758	430113	2.627	0.874
1987	355710	1233607	114830	523071	4.555	0.930
1988	332586	1005681	191155	434939	2.275	0.887

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
1989	158314	956019	237018	332481	1.403	0.669
1990	132921	912628	303147	212000	0.699	0.422
1991	299535	1347968	636285	319158	0.502	0.407
1992	714326	1688732	802773	513234	0.639	0.487
1993	989320	2199248	698689	581611	0.832	0.588
1994	748873	2112371	568482	771086	1.356	0.751
1995	536652	1847875	532011	739999	1.391	0.773
1996	400009	1695624	550682	732228	1.330	0.792
1997	774447	1537235	546271	762403	1.396	0.940
1998	1042448	1349759	385902	592624	1.536	0.944
1999	623066	1197590	280398	484910	1.729	0.943
2000	745655	1220552	254492	414868	1.630	0.852
2001	589453	1474589	382131	426471	1.116	0.744
2002	374279	1591497	519299	535045	1.030	0.685
2003	758269	1678998	569338	551990	0.970	0.639
2004	242549	1564826	662610	606445	0.915	0.716
2005	693644	1512941	574664	641276	1.116	0.723
2006	538707	1534688	576532	537642	0.933	0.622
2007	1254408	1857781	639925	486883	0.761	0.453
2008	1015559	2543523	707321	464171	0.656	0.370
2009	590917	3077905	993561	523430	0.527	0.315
2010	205971	3312511	1220028	609983	0.500	0.299
2011	364181	3529710	1769171	719830	0.407	0.317
2012	508680	3599416	1979958	727663	0.368	0.299
2013	467710	3661930	2185755	966209	0.442	0.327
2014	850150	3377876	2057014	986449	0.480	0.345
2015	448454	3198970	1639801	864384	0.527	0.343
2016	282842	2781907	1303470	849422	0.652	0.364
2017	756942	2715451	1333156	868276	0.651	0.399
2018	482707	2505096	1198557	778627	0.650	0.418
2019	616881	2378542	1131791	692609	0.612	0.438
2020	526121	2085058	893213	692903	0.776	0.491
2021	366624	1868398	758857	767284	1.011	0.583
2022	185968	1633687	636057	719211	1.131	0.617
2023	240885	1435914	657327	582552	0.886	0.631
2024	632470	1243966	490319	453040	0.924	0.627

Year	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 5-10
Arith. Mean	717811	2173812	559723	670352	1.987	0.599

Table 3. 19 .a. Northeast Arctic COD. Input for the short term prediction.

2025								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	537000	0.316	0	0	0	0.1961	0.048	0.625
4	425383	0.235	0.005	0	0	0.58636	0.181	1.112
5	132325	0.215	0.017	0	0	1.154409	0.403	1.640
6	65384	0.202	0.072	0	0	1.895186	0.628	2.288
7	52041	0.2	0.316	0	0	2.794182	0.822	3.166
8	37843	0.2	0.579	0	0	3.842038	1.104	4.353
9	18747	0.2	0.825	0	0	5.418	1.294	5.748
10	10144	0.2	0.947	0	0	7.511	1.749	6.768
11	2931	0.2	1	0	0	8.230782	1.75	8.463
12	709	0.2	1	0	0	11.349	2.002	10.220
13	170	0.2	1	0	0	13.882	1.888	11.511
14	96	0.2	1	0	0	15.682	1.086	12.817
15	128	0.2	1	0	0	17.954	1.086	14.326
2026								
Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWT**	**Sel**	**CWT**
3	378000	0.316	0.002	0	0	0.225	0.048	0.538
4		0.235	0.009	0	0	0.571	0.181	1.010
5		0.215	0.015	0	0	1.06	0.403	1.643
6		0.202	0.079	0	0	1.948	0.628	2.316
7		0.2	0.372	0	0	2.964	0.822	3.174
8		0.2	0.687	0	0	4.096	1.104	4.384
9		0.2	0.900	0	0	5.513	1.294	5.714
10		0.2	0.953	0	0	6.853	1.749	7.047
11		0.2	1	0	0	8.552	1.75	8.212
12		0.2	1	0	0	10.081	2.002	9.855
13		0.2	1	0	0	13.483	1.888	11.638
14		0.2	1	0	0	16.079	1.086	12.920
15		0.2	1	0	0	17.943	1.086	14.201
2027								

Age	N	M	Mat	PF	PM	SWT	Sel	CWT
3	322000	0.316	0.002	0	0	0.232	0.048	0.538
4		0.235	0.009	0	0	0.6	0.181	1.010
5		0.215	0.015	0	0	1.045	0.403	1.643
6		0.202	0.079	0	0	1.854	0.628	2.316
7		0.2	0.372	0	0	3.017	0.822	3.174
8		0.2	0.687	0	0	4.266	1.104	4.384
9		0.2	0.900	0	0	5.767	1.294	5.714
10		0.2	0.953	0	0	6.948	1.749	7.047
11		0.2	1	0	0	8.371	1.75	8.212
12		0.2	1	0	0	10.402	2.002	9.855
13		0.2	1	0	0	12.215	1.888	11.638
14		0.2	1	0	0	15.68	1.086	12.920
15		0.2	1	0	0	18.339	1.086	14.201

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

Yearclass	recruitment	BST1	BST2	BST3	BSA1	BSA2	BSA3
1982	528	NA	NA	NA	NA	NA	NA
1983	1369	NA	NA	NA	NA	NA	NA
1984	356	NA	NA	NA	NA	NA	NA
1985	333	NA	NA	NA	NA	NA	NA
1986	158	NA	NA	NA	NA	NA	NA
1987	133	NA	NA	NA	NA	NA	NA
1988	300	NA	NA	NA	NA	NA	NA
1989	714	NA	NA	NA	NA	NA	NA
1990	989	NA	NA	NA	NA	NA	NA
1991	749	NA	NA	294	NA	NA	324
1992	537	NA	557	283	NA	624	138
1993	400	1044	541	163	903	212	99
1994	774	5356	792	318	2175	272	159
1995	1042	5899	1423	355	1826	565	391
1996	623	5044	496	188	1698	475	148
1997	746	2491	350	246	2524	232	295
1998	589	473	242	183	365	263	177
1999	374	129	78	118	153	51	61
2000	758	713	419	377	364	209	307
2001	243	34	66	64	19	53	33
2002	694	3022	243	249	1505	117	125

2003	539	323	217	116	161	139	65
2004	1254	853	289	361	500	158	58
2005	1016	674	370	194	411	47	200
2006	591	595	102	126	85	94	108
2007	206	69	36	37	51	25	23
2008	364	389	95	85	205	44	40
2009	509	1028	226	76	620	91	83
2010	468	617	100	69	266	40	61
2011	850	703	143	227	496	89	287
2012	448	436	191	144	313	211	139
2013	283	1246	343	99	1759	211	56
2014	757	1642	306	179	1904	202	112
2015	483	312	129	139	241	73	109
2016	617	645	501	282	439	280	204
2017	526	2714	559	238	2058	362	117
2018	367	1791	274	112	1437	158	65
2019	186	165	35	52	93	29	29
2020	241	81	66	41	46	43	29
2021	632	668	163	199	525	103	151
2022	NA	305	307	154	244	201	130
2023	NA	378	119	NA	328	106	NA
2024	NA	165	NA	NA	199	NA	NA

Table 3.19.c. Results of RCT3 prediction of NEA cod recruitment (in million individuals of age 3).

prediction							
	WAP	**logWAP**	**int.se**				
yearclass:2017	873.1	6.77	0.24				
yearclass:2018	505.8	6.23	0.24				
yearclass:2019	242	5.49	0.25				
yearclass:2020	197.6	5.29	0.24				
yearclass:2021	585.4	6.37	0.20				
yearclass:2022	536.6	6.29	0.18				
yearclass:2023	377.6	5.93	0.31				
yearclass:2024	321.8	5.77	0.39				

Table 3.19.d. Results of various recruitment models (million individuals age 3). Values used in the predictions are shown in green.

Iner: averages over 4 years or all years. M2: A model based on Water temperature at stations 3-7 of the Kola section (0-200 m layer), length of thermal front zones and storm activity in the year the year class was spawned M4, M5, M6: models based on water temperature at stations 3-7 of the Kola section (0-200 m layer), length of thermal front zones and spawning stock biomass in the year the year class was spawned

NEA cod recruitment at age 3				
Year	**2025**	**2026**	**2027 2028+**	**2027+**
Yearclass	**2022**	**2023**	**2024**	
RCT3	537	378	322	
M2	493	465	450	
M4	498			
M5	554	443		
M6	551	498	524	**340**
SAM	456			**717**
Iner4 (2021-2024)	356	356	356	

Table 3. 20 . Northeast Arctic COD. Management option table.

2025					
Biomass (t)	**SSB (t)**	**FMult**	**FBar**	**Landings (t)**	
1131360	330491	1	0.511	340000	
2026				**2027**	
Biomass	**SSB**	**FBar**	**Landings**	**Biomass**	**SSB**
1222722	325486	0.00	0	1693969	527732
		0.05	41888	1647871	500116
		0.10	81960	1603881	474161
		0.15	120319	1561875	449756
		0.20	157065	1521739	426799
		0.25	192289	1483365	405195
		0.30	226074	1446652	384855
		0.35	258502	1411505	365698
		0.40	289647	1377839	347646
		0.45	319578	1345570	330629
		0.50	348360	1314622	314581
		0.55	376054	1284923	299440
		0.60	402717	1256407	285149
		0.65	428403	1229010	271654
		0.70	453161	1202674	258906
		0.75	477039	1177343	246859
		0.80	500082	1152965	235469
		0.85	522329	1129493	224696

		0.90	543820	1106881	214503
		0.95	564593	1085085	204853
		1.00	584680	1064065	195716
Tonnes	Tonnes		Tonnes	Tonnes	Tonnes

Table 3. 21 . Northeast Arctic COD. Detailed prediction output assuming TAC constraint in 2025 and HCR in 2026.

Fbar	age						
range:	5-10						
Year:	2025						
F	multiplier:	1					
Fbar:	0.5113						
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos**	**SSB**
3	0.025	11170	6981	537000	105306	0	0
4	0.093	33570	37329	425383	249428	2127	1247
5	0.206	22253	36495	132325	152757	2250	2597
6	0.321	16348	37403	65384	123915	4708	8922
7	0.420	16298	51600	52041	145412	16445	45950
8	0.564	14933	65004	37843	145394	21911	84183
9	0.662	8314	47787	18747	101571	15466	83796
10	0.894	5515	37323	10144	71353	9606	67571
11	0.895	1594	13490	2931	22015	2931	22015
12	1.024	419	4279	709	8047	709	8047
13	0.965	97	1116	170	2360	170	2360
14	0.555	37	480	96	1506	96	1506
15+	0.555	50	715	128	2298	128	2298
Total	NA	130596	340000	1282901	1131360	76547	330491
		Thous	Tonnes	Thous	Tonnes	Thous	Tonnes
Fbar	age						
range:	5-10						
Year:	2026						
F	multiplier:	0. 72					
Fbar:	0.3673						
Age	**F**	**CatchNos**	**Yield**	**StockNos**	**Biomass**	**SSNos**	**SSB**
3	0.018	5667	3049	378000	85050	756	170
4	0.066	21928	22147	382013	218130	3438	1963
5	0.148	38058	62529	306570	324964	4599	4874

6	0.231	16264	37667	86852	169188	6861	13366
7	0.302	9200	29200	38752	114861	14416	42728
8	0.406	8514	37323	27987	114635	19227	78755
9	0.475	6089	34793	17619	97133	15857	87420
10	0.642	3439	24234	7920	54277	7548	51726
11	0.643	1475	12114	3396	29043	3396	29043
12	0.735	468	4617	981	9887	981	9887
13	0.694	96	1113	209	2812	209	2812
14	0.399	16	206	53	852	53	852
15+	0.399	32	449	105	1889	105	1889
Total	NA	111244	269440	1250458	1222722	77446	325486
		Thous	Tonnes	Thous	Tonnes	Thous	Tonnes

Table 3. 22 . Northeast Arctic COD. Assessments results by means of TISVPA.

Year	B(3+)	SSB	R(3)	F(5-10)
1984	826353	254816	418707	0.777
1985	988211	200451	555765	0.637
1986	1358622	180465	1083011	0.786
1987	1206518	131324	287539	1.029
1988	982587	216777	215207	0.978
1989	917299	241526	172574	0.467
1990	985294	331063	226737	0.311
1991	1570251	726058	403702	0.226
1992	1944359	941272	700444	0.404
1993	2397901	831095	903164	0.605
1994	2179331	644927	702509	0.803
1995	1839228	556844	478459	0.748
1996	1743552	604035	383350	0.718
1997	1626860	649830	639025	1.042
1998	1293247	425162	787373	1.063
1999	1103004	288052	480656	0.914
2000	1084482	247296	561759	0.642
2001	1332265	372688	479603	0.515
2002	1468431	503946	418301	0.506
2003	1568045	542115	665526	0.505

2004	1511119	636262	272109	0.596
2005	1475261	574806	525749	0.601
2006	1497685	592634	525403	0.625
2007	1789065	630701	1248402	0.489
2008	2508120	683440	1220468	0.349
2009	3142920	972812	820781	0.334
2010	3403632	1158779	469001	0.366
2011	3578625	1634487	581696	0.319
2012	3682936	1871336	657990	0.287
2013	3797845	2077417	778141	0.295
2014	3517977	1975393	972909	0.326
2015	3322508	1568638	483897	0.357
2016	2945685	1269581	377636	0.340
2017	2961737	1401448	765172	0.430
2018	2715617	1274968	601811	0.501
2019	2529784	1171537	600642	0.454
2020	2244846	923447	490470	0.492
2021	2047307	812085	314771	0.600
2022	1742638	687563	197392	0.741
2023	1511749	705466	371641.4	0.656
2024	1361502	523271	830947	0.572
2025	1167123	357507		

Table 3. 23 . NEA cod TISVPA estimates of abundance at age (thousands).

	3	4	5	6	7	8	9	10	11	12	13	14	15
1984	418707	134387	77053	45219	23977	12557	8996	1428	628	403	182	32	21
1985	555765	335856	96918	44998	19543	6721	3329	2363	458	326	155	98	25
1986	1083011	434236	230359	55486	20690	6820	2182	1296	1089	223	226	93	38
1987	287539	803556	290649	114032	22387	7037	2092	744	402	375	69	142	48
1988	215207	212429	522112	144660	35585	5993	2086	726	157	131	105	35	13
1989	172574	164747	150236	284912	60482	9612	1616	592	161	33	42	47	69
1990	226737	137370	116641	94864	154630	25704	3440	643	248	91	16	31	12
1991	403702	183952	105771	82557	61128	97461	14578	2022	365	150	59	8	17
1992	700444	326608	141812	73298	50760	34465	58529	8565	1264	248	108	46	5
1993	903164	553336	238791	93286	40328	25659	16361	30977	4456	740	130	81	4
1994	702509	701156	412494	142053	47782	18793	11234	6800	13140	1826	277	58	12
1995	478459	490323	487165	244107	62497	13608	5991	3338	1963	4009	542	127	3
1996	383350	277418	322001	286577	115422	22932	4688	1993	1020	540	1462	257	3

1997	639025	221218	177009	183935	139436	46554	8439	1850	672	347	197	568	2
1998	787373	408521	138898	83828	73241	46836	11992	1975	413	136	65	52	126
1999	480656	490259	241618	68244	30696	25504	11911	3332	466	120	33	21	77
2000	561759	362091	321093	113170	25767	10914	6822	2384	971	148	48	3	47
2001	479603	433252	262958	171535	49641	9663	3576	1855	639	461	57	29	90
2002	418301	374113	316679	162185	81525	20961	3473	1477	612	243	275	39	26
2003	665526	314262	276150	194584	75713	31250	7627	1318	732	300	101	194	5
2004	272109	517472	238556	172516	98240	32109	12813	3532	608	439	157	63	32
2005	525749	209781	382057	151278	84503	37910	11281	4621	1315	233	234	93	27
2006	525403	385378	152749	215877	73464	32676	13412	3957	1564	538	97	161	556
2007	1248402	421329	267732	95057	106111	32260	12688	4535	1529	534	227	56	150
2008	1220468	956011	308292	157062	54125	54035	15965	6356	2224	748	192	143	72
2009	820781	935202	724939	214712	93184	31427	26497	8330	3505	1161	404	121	115
2010	469001	620222	722695	514211	133865	55958	17896	13793	4909	2028	248	264	188
2011	581696	346655	473427	529831	341429	75662	29861	10057	7226	1741	923	70	0
2012	657990	379474	246570	353530	363360	208355	42375	14589	4273	3288	922	436	149
2013	778141	448794	272166	185386	248832	231884	124201	23593	7465	1976	1734	512	834
2014	972909	523474	341971	200061	130873	154545	126491	61930	11531	3609	1029	1052	787
2015	483897	668545	373020	240924	130582	80237	79423	63277	30296	5945	1866	588	1115
2016	377636	336085	487109	256183	149313	75959	45146	42913	30183	11611	2657	1116	1380
2017	765172	302223	249901	327671	164344	88366	41281	24260	18777	12106	5325	1465	1046
2018	601811	513687	230566	173398	202471	90059	44727	20001	11177	5965	4611	2755	889
2019	600642	455082	388820	161813	105164	109447	44821	20766	8011	3618	1925	1968	1123
2020	490470	444961	348811	268220	103418	59471	52405	20769	8988	2891	1319	977	876
2021	314771	312188	332296	247705	165516	55783	28538	21633	7181	2548	1076	598	903
2022	197392	203701	222302	213422	145951	79821	24660	10179	6097	1865	673	356	232
2023	371641	147230	142452	131050	110845	71230	32653	8917	2702	1473	335	128	215
2024	830947	266342	104089	85055	70603	52681	31107	11764	2446	593	365	115	42
2025	0	556288	182805	65483	45001	31959	21496	12501	4567	977	247	204	64

Table 3. 24 . NEA cod TISVPA estimates of fishing mortality coefficients.

	3	4	5	6	7	8	9	10	11	12	13	14	15	F(5-10)
1984	0.022	0.133	0.321	0.546	0.943	0.954	0.951	0.946	0.320	1.041	0.544	0.544	0.544	0.777
1985	0.021	0.121	0.308	0.454	0.620	0.886	0.767	0.785	0.715	0.255	0.446	0.446	0.446	0.637
1986	0.021	0.150	0.383	0.620	0.747	0.877	1.114	0.975	0.908	0.801	0.520	0.520	0.520	0.786
1987	0.026	0.150	0.496	0.816	1.107	1.104	1.112	1.539	1.160	1.040	0.614	0.614	0.614	1.029
1988	0.024	0.158	0.403	0.872	1.160	1.280	1.056	1.097	1.328	0.999	0.582	0.582	0.582	0.978
1989	0.014	0.088	0.236	0.355	0.568	0.594	0.555	0.497	0.473	0.526	0.296	0.296	0.296	0.467

1990	0.008	0.058	0.156	0.255	0.308	0.410	0.377	0.363	0.306	0.287	0.195	0.195	0.195	0.311
1991	0.007	0.038	0.110	0.183	0.242	0.251	0.294	0.278	0.250	0.209	0.142	0.142	0.142	0.226
1992	0.010	0.068	0.164	0.305	0.430	0.502	0.459	0.562	0.487	0.425	0.244	0.244	0.244	0.404
1993	0.015	0.085	0.255	0.394	0.632	0.787	0.814	0.751	0.872	0.720	0.358	0.358	0.358	0.605
1994	0.017	0.111	0.281	0.546	0.701	1.006	1.102	1.185	0.969	1.117	0.451	0.451	0.451	0.803
1995	0.016	0.105	0.297	0.469	0.758	0.815	1.007	1.139	1.098	0.882	0.443	0.443	0.443	0.748
1996	0.020	0.101	0.286	0.514	0.661	0.919	0.846	1.083	1.102	1.032	0.448	0.448	0.448	0.718
1997	0.026	0.169	0.364	0.681	1.078	1.190	1.526	1.411	1.747	1.716	0.622	0.622	0.622	1.042
1998	0.029	0.169	0.487	0.642	1.005	1.354	1.230	1.661	1.338	1.573	0.624	0.624	0.624	1.063
1999	0.023	0.175	0.443	0.807	0.827	1.077	1.197	1.132	1.314	1.064	0.563	0.563	0.563	0.914
2000	0.018	0.110	0.362	0.549	0.776	0.655	0.713	0.797	0.698	0.762	0.397	0.397	0.397	0.642
2001	0.014	0.094	0.239	0.490	0.590	0.691	0.514	0.568	0.580	0.505	0.315	0.315	0.315	0.515
2002	0.012	0.081	0.237	0.373	0.634	0.641	0.652	0.499	0.510	0.509	0.295	0.295	0.295	0.506
2003	0.013	0.074	0.206	0.376	0.482	0.704	0.617	0.644	0.457	0.457	0.281	0.281	0.281	0.505
2004	0.014	0.095	0.225	0.399	0.613	0.674	0.882	0.784	0.751	0.513	0.329	0.329	0.329	0.596
2005	0.016	0.091	0.260	0.382	0.559	0.741	0.706	0.956	0.773	0.722	0.335	0.335	0.335	0.601
2006	0.017	0.106	0.264	0.485	0.579	0.733	0.854	0.833	1.045	0.815	0.368	0.368	0.368	0.625
2007	0.014	0.086	0.235	0.359	0.533	0.535	0.585	0.689	0.620	0.736	0.299	0.299	0.299	0.489
2008	0.009	0.064	0.173	0.290	0.356	0.445	0.394	0.438	0.471	0.420	0.224	0.224	0.224	0.349
2009	0.008	0.054	0.160	0.268	0.368	0.388	0.429	0.389	0.401	0.422	0.213	0.213	0.213	0.334
2010	0.008	0.054	0.149	0.281	0.388	0.461	0.430	0.487	0.408	0.413	0.230	0.230	0.230	0.366
2011	0.008	0.044	0.128	0.219	0.339	0.402	0.422	0.402	0.422	0.349	0.209	0.209	0.000	0.319
2012	0.008	0.044	0.106	0.193	0.272	0.363	0.381	0.408	0.362	0.372	0.196	0.196	0.196	0.287
2013	0.008	0.050	0.122	0.185	0.278	0.341	0.407	0.437	0.435	0.378	0.213	0.213	0.213	0.295
2014	0.009	0.057	0.151	0.228	0.285	0.375	0.410	0.505	0.504	0.491	0.249	0.249	0.249	0.326
2015	0.010	0.065	0.169	0.285	0.354	0.382	0.450	0.505	0.581	0.567	0.290	0.290	0.290	0.357
2016	0.009	0.060	0.166	0.270	0.372	0.396	0.380	0.456	0.475	0.533	0.283	0.283	0.283	0.340
2017	0.011	0.065	0.193	0.342	0.461	0.554	0.520	0.508	0.572	0.584	0.358	0.358	0.358	0.430
2018	0.011	0.074	0.192	0.364	0.537	0.623	0.660	0.632	0.569	0.629	0.411	0.411	0.411	0.501
2019	0.011	0.062	0.182	0.293	0.457	0.577	0.584	0.633	0.560	0.495	0.381	0.381	0.381	0.454
2020	0.012	0.072	0.182	0.335	0.446	0.608	0.678	0.705	0.704	0.606	0.432	0.432	0.432	0.492
2021	0.017	0.093	0.233	0.370	0.576	0.664	0.811	0.944	0.896	0.871	0.547	0.547	0.547	0.600
2022	0.032	0.134	0.310	0.493	0.651	0.902	0.905	1.183	1.269	1.155	0.712	0.712	0.712	0.741
2023	0.023	0.198	0.349	0.499	0.642	0.714	0.852	0.879	1.027	1.063	0.662	0.662	0.662	0.656
2024	0.015	0.095	0.255	0.430	0.593	0.696	0.712	0.746	0.717	0.674	0.382	0.382	0.382	0.572

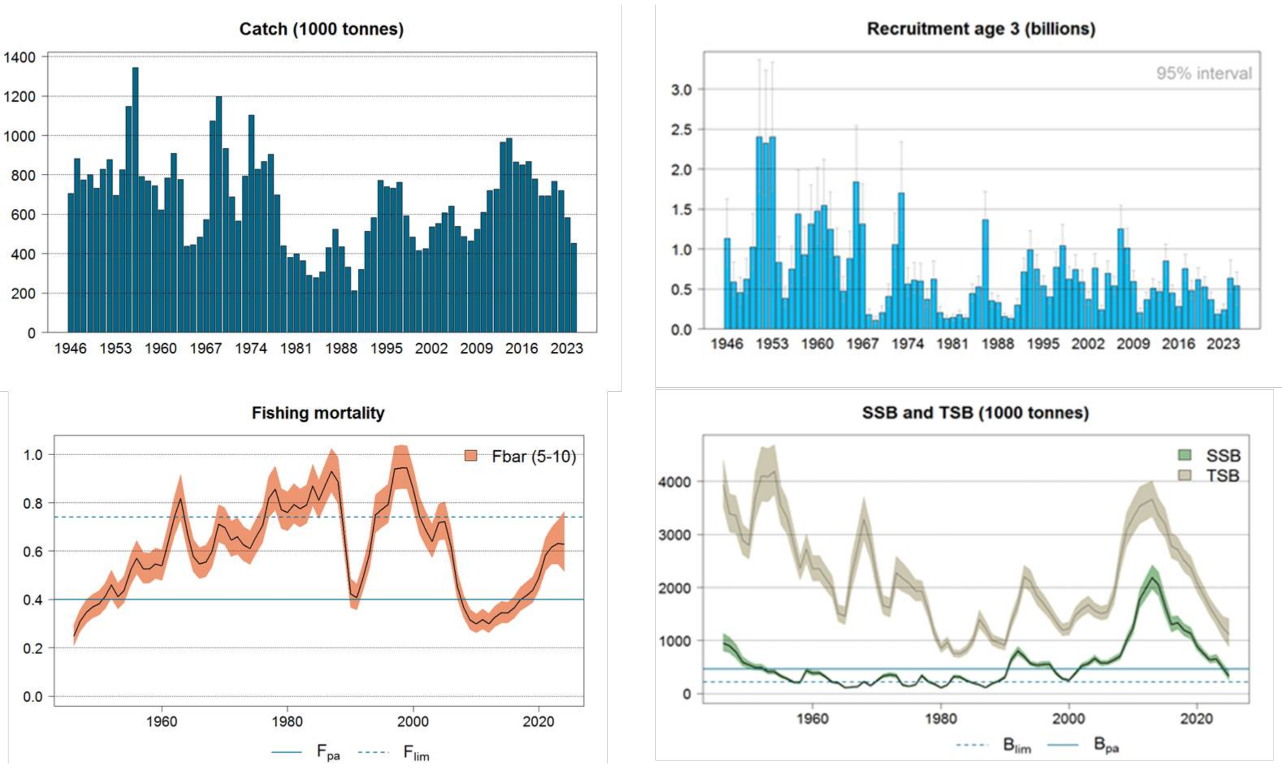


Figure 3.1. Standard plots for Northeast Arctic cod (ICES subareas 1 and 2).

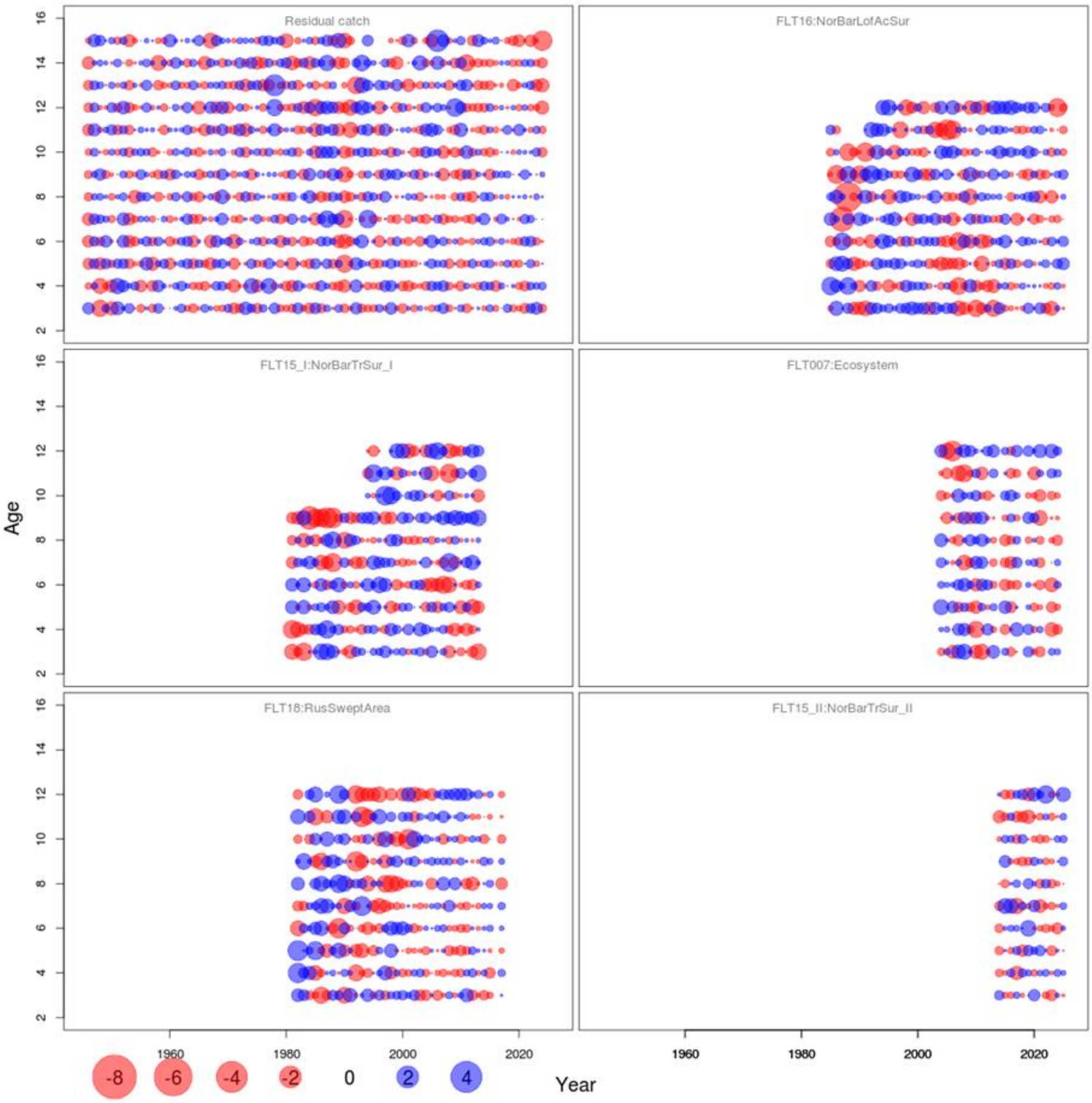


Figure 3. 2 .a. Standardized one-observation-ahead residuals for log-catches and log-indices (Thygesen et al. 2017) in the final SAM run.

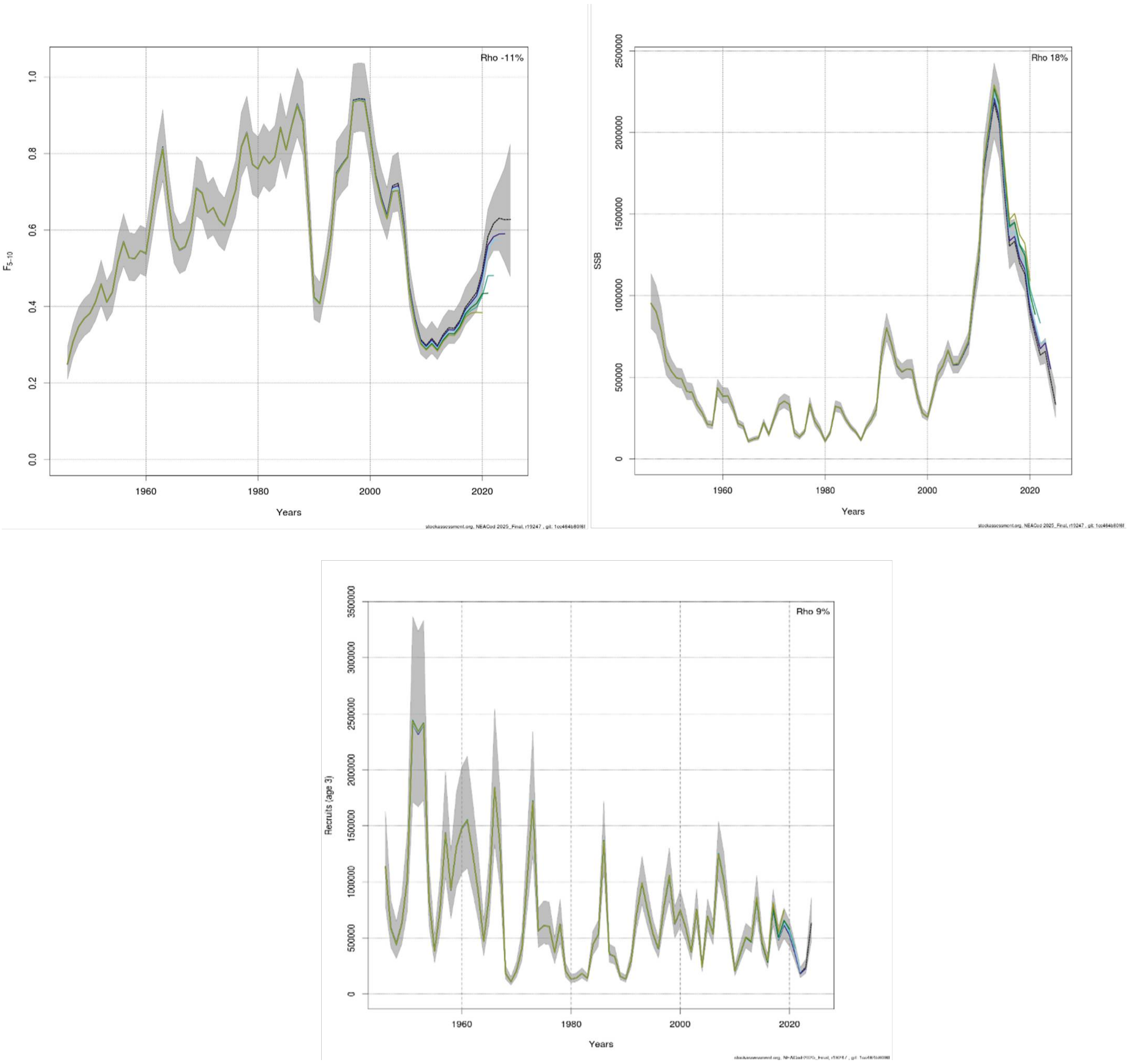


Figure 3.2.b. NEA cod SSB, R and F_{bar} model retrospective pattern for final SAM run.

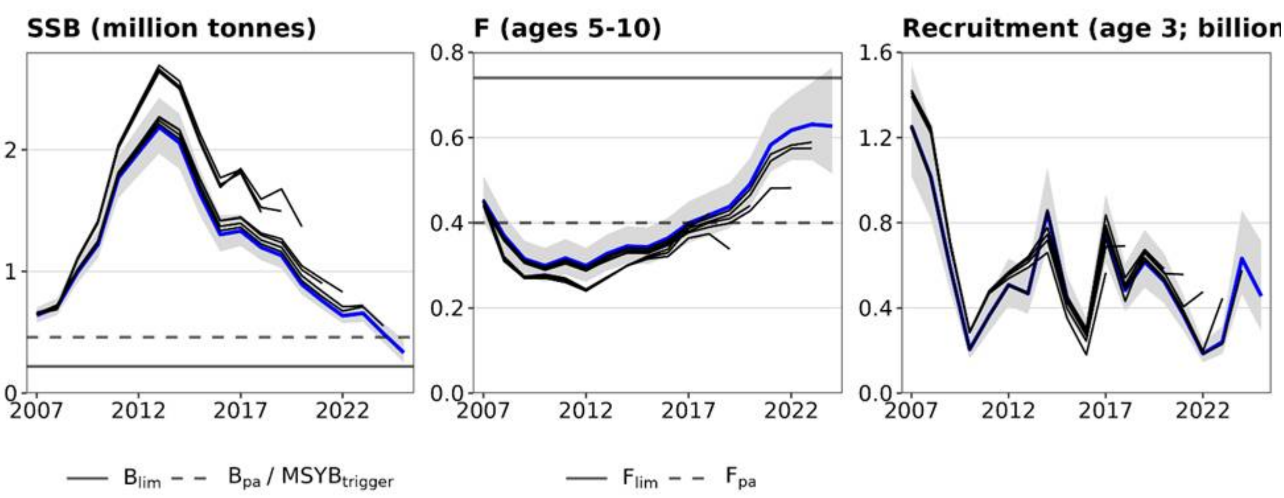


Figure 3. 2.c . NEA cod SSB, F bar and R historical retrospective pattern for final SAM run.

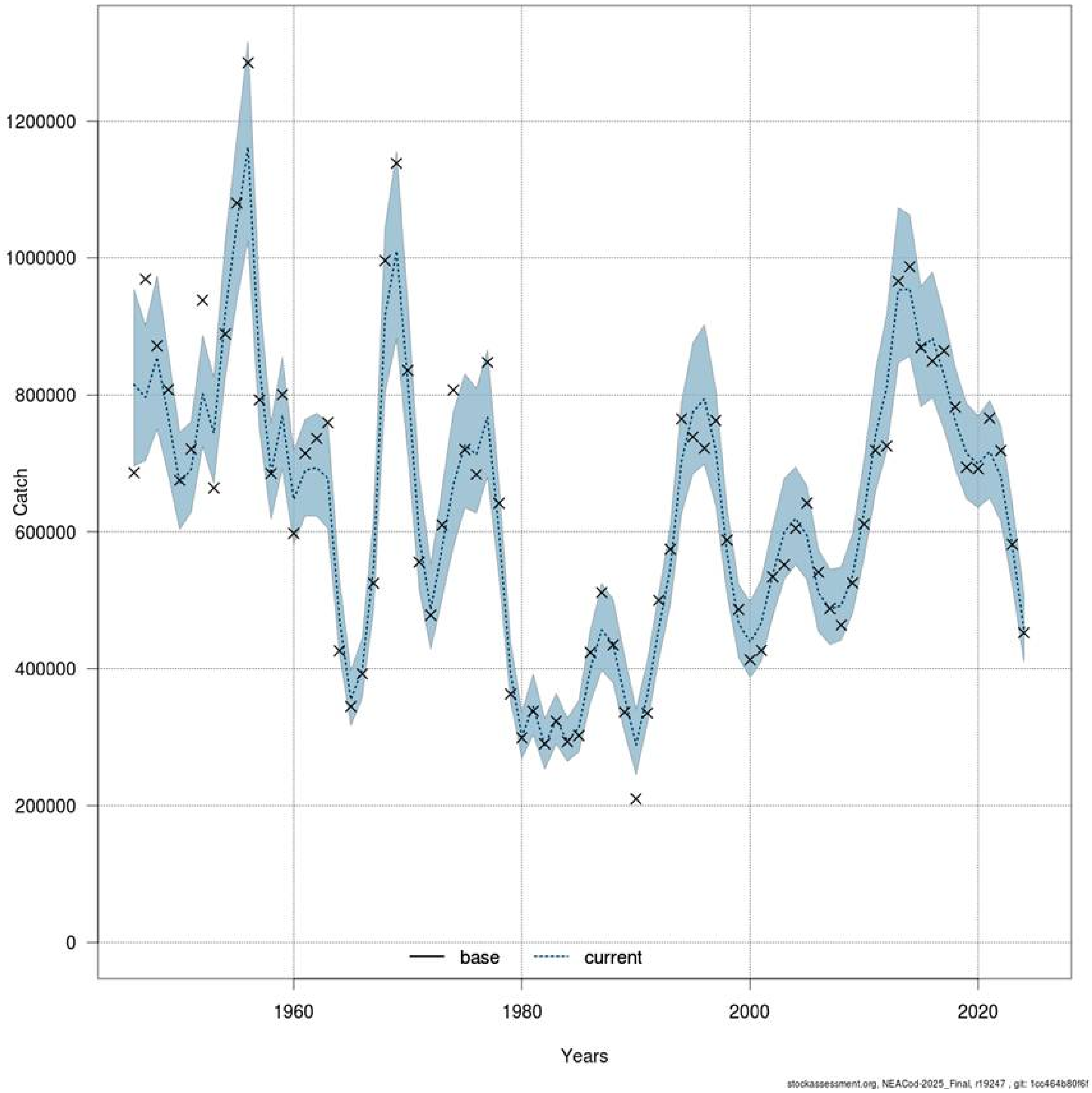


*Figure 3.2.d. NEA cod final SAM run fit. Total catch in weight. Modelled catches from the final run and point wise 95% confidence intervals are shown by line and shaded area. The yearly observed total catch weight (crosses) are calculated as Catch(y)=sum(W(a,y)*C(a,y)).*

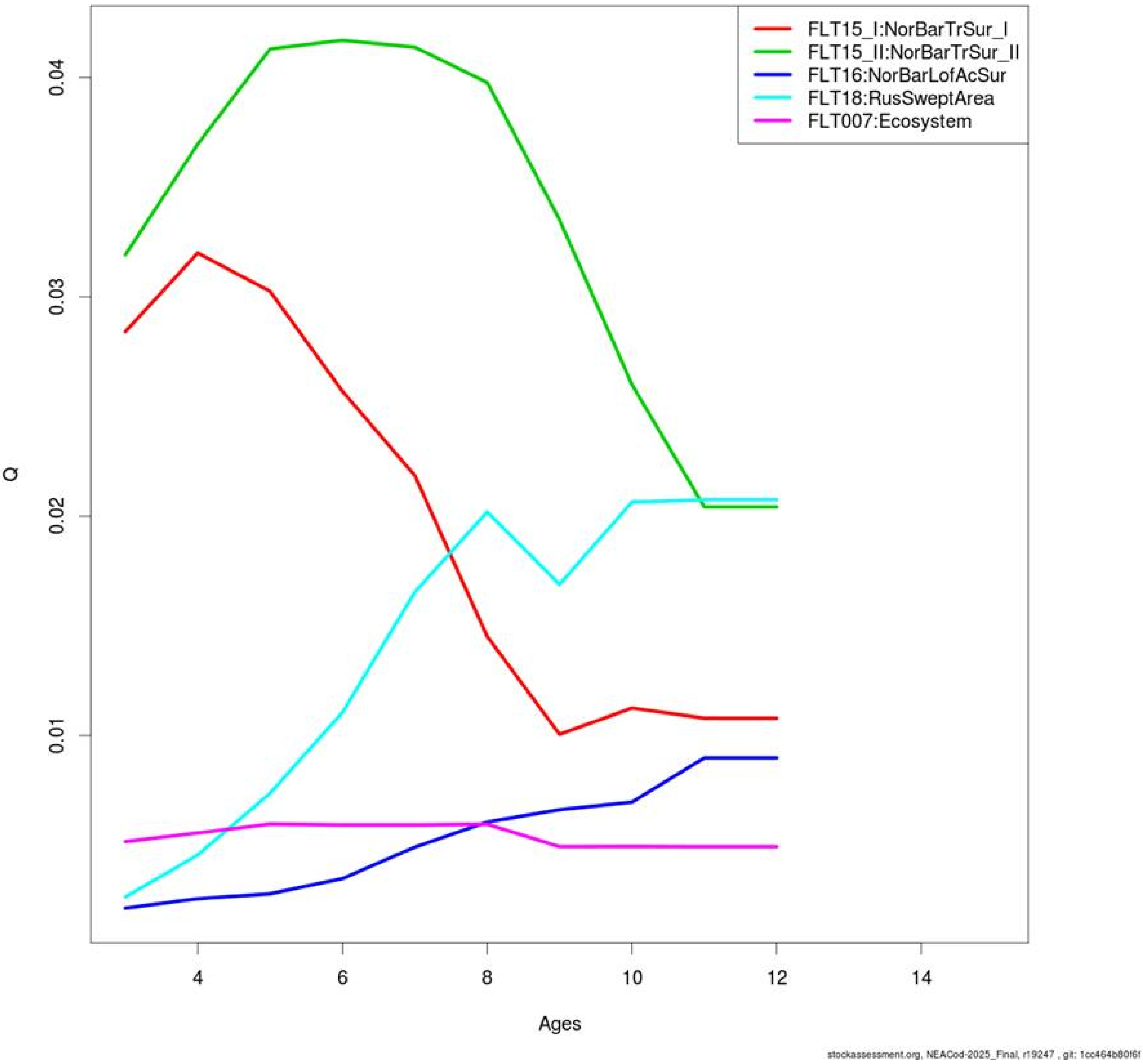


Figure 3.2.e. NEA cod. Catchability of different fleets used for final SAM run fit.

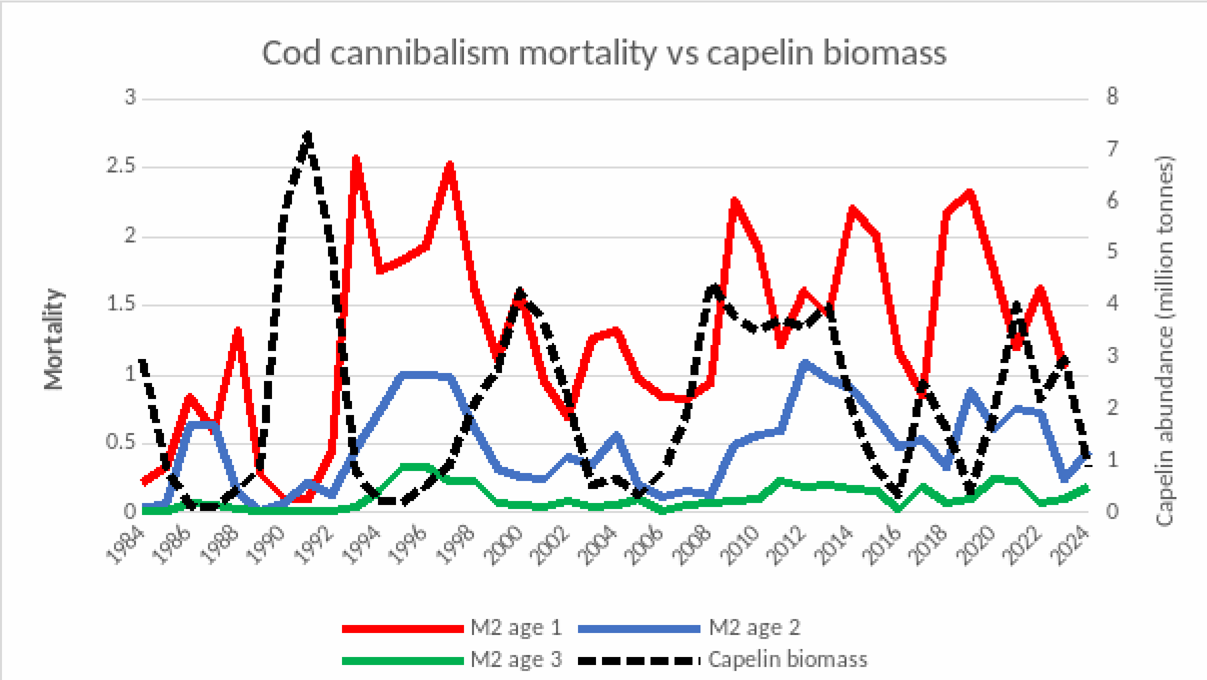


Figure 3 .3. NEA cod cannibalism mortality vs. capelin abundance.

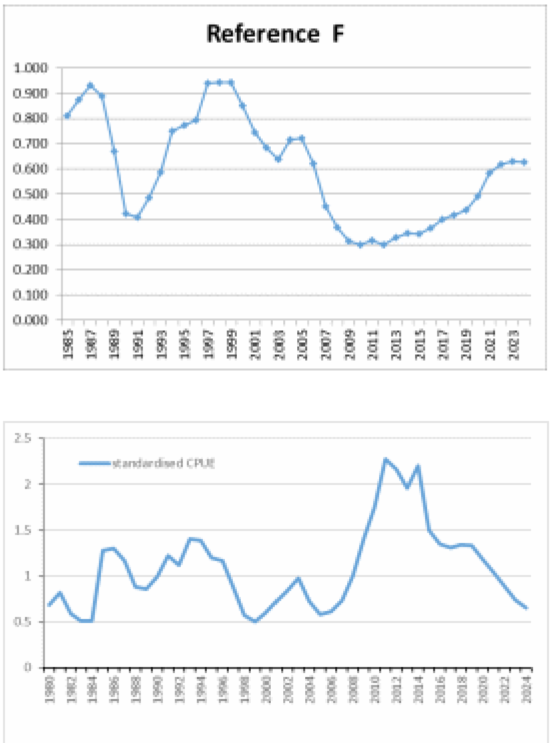


Figure 3. 4 . Northeast Arctic cod. Fishing mortality (F5-10) (top panel) and standardized CPUE on Russian trawl fishery for 9 main vessel types (bottom panel) (Kovalev, WD1).

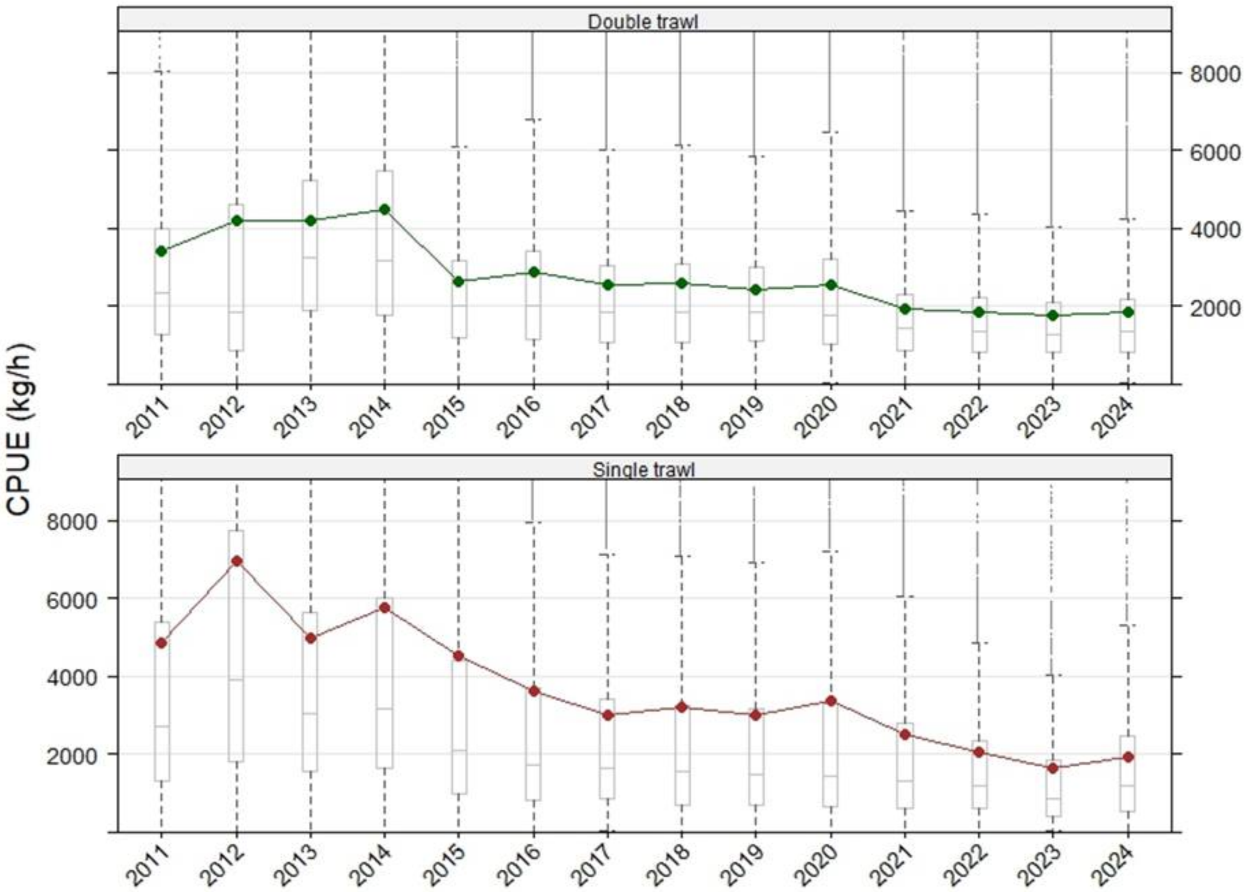


Figure 3. 5 . od CPUE in Norwegian trawl catches where cod is the main species (double and single trawl, Nedreaas WD2). Connected line shows mean, line inside the box shows the median, and the box shows 25 and 75 percentiles.

Figure 3. 6 .a. Residuals of the TISVPA data approximation (yellow circles are positive residuals, white – negative).

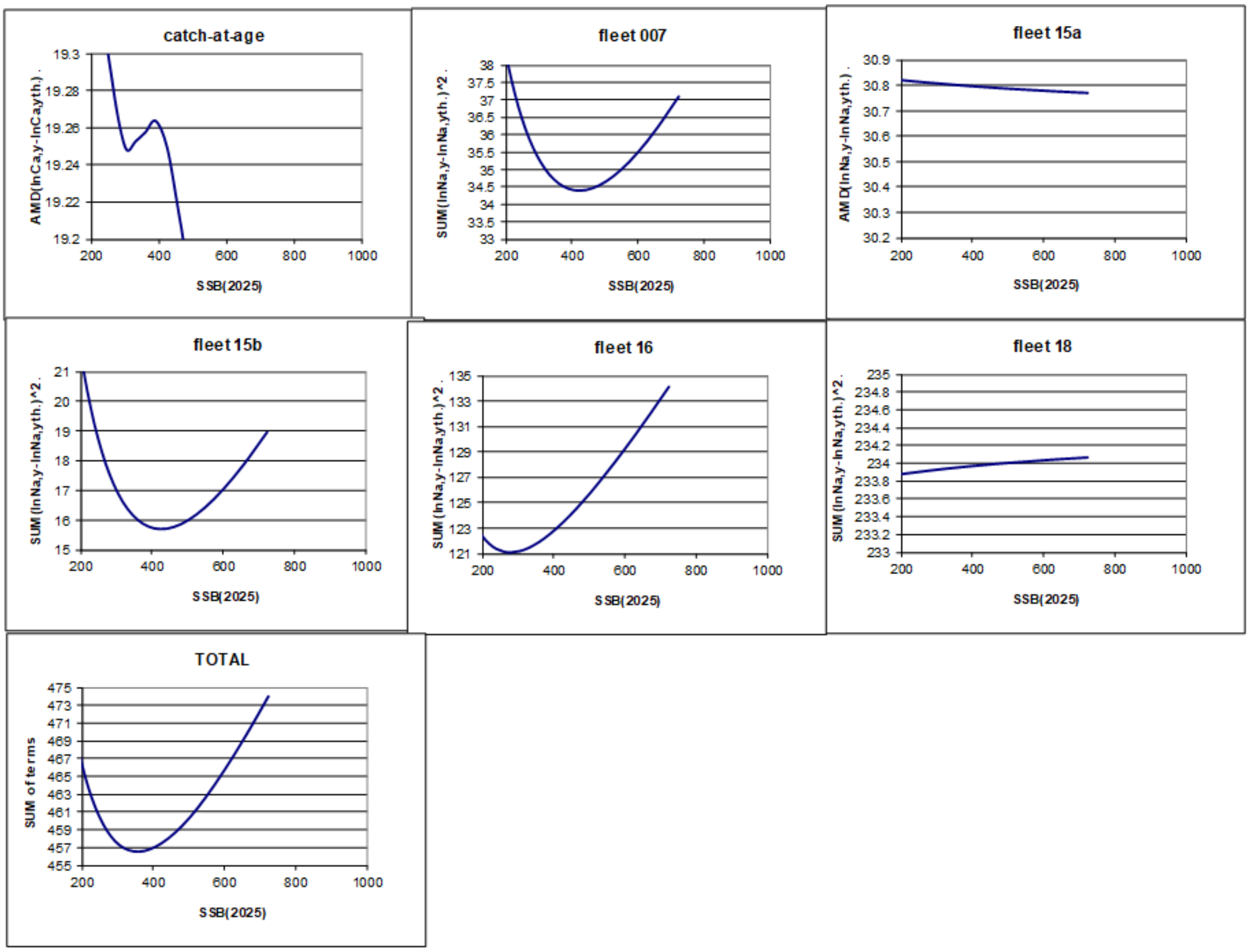
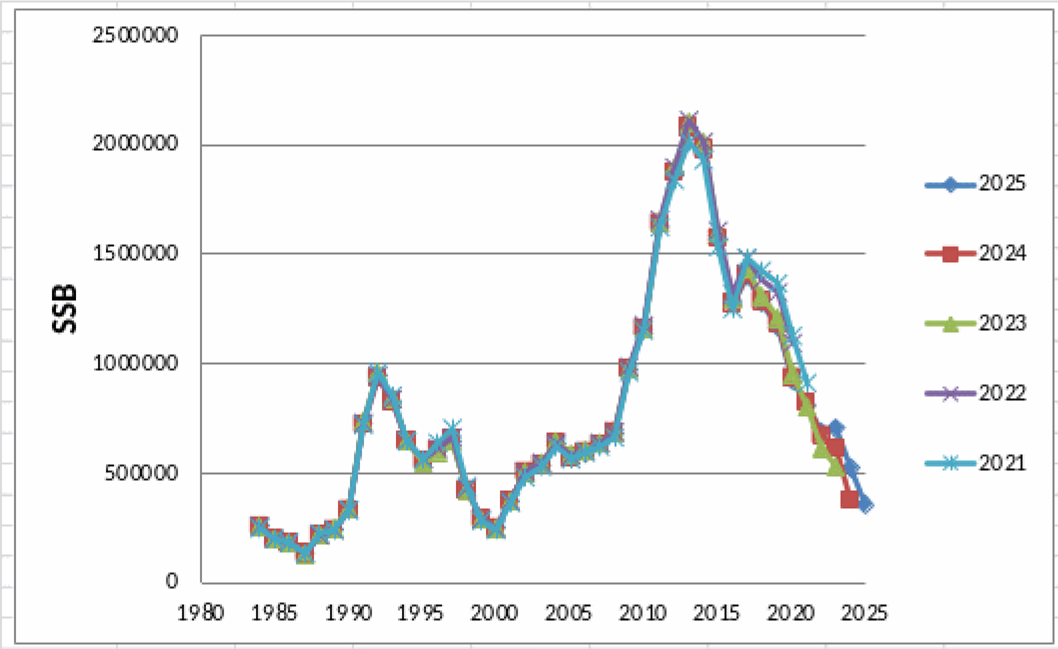
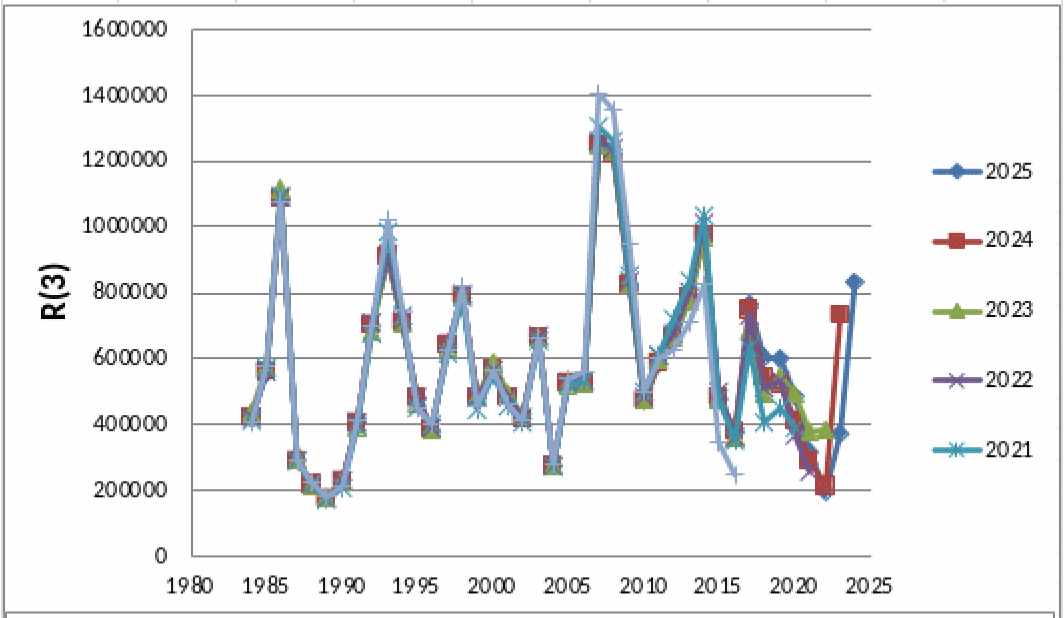


Figure 3.6.b. Profiles of the components of the TISVPA objective function.


SSB
2500000
2000000
1500000
1000000
500000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2025
2024
2023
2022
2021


R(3)
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2025
2024
2023
2022
2021

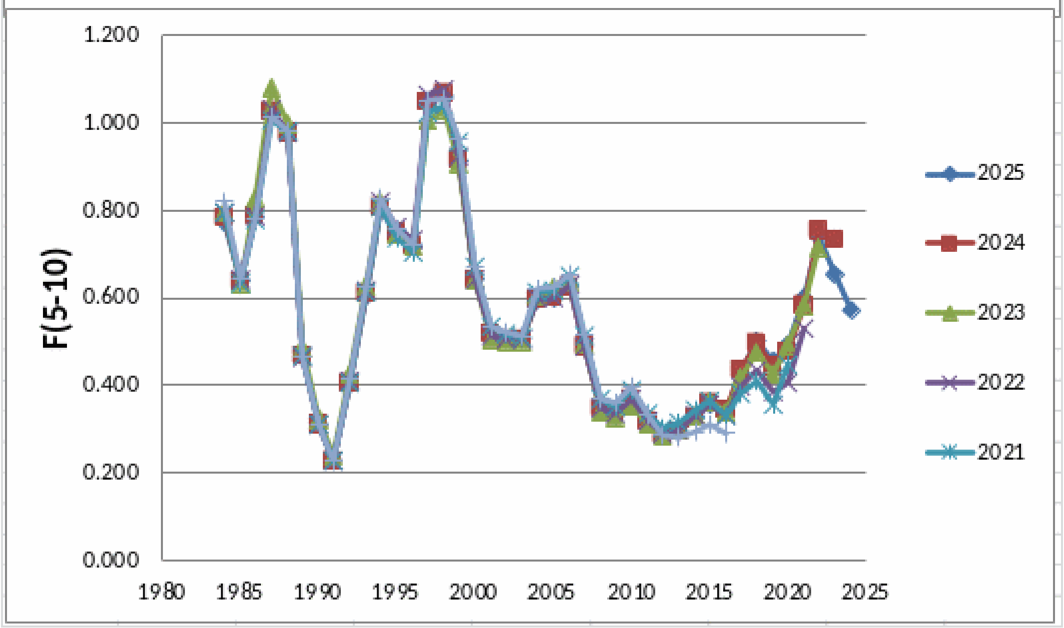

F(5-10)
1.200
1.000
0.800
0.600
0.400
0.200
0.000
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2025
2024
2023
2022
2021

Figure 3.6.c. TISVPA retrospective runs.

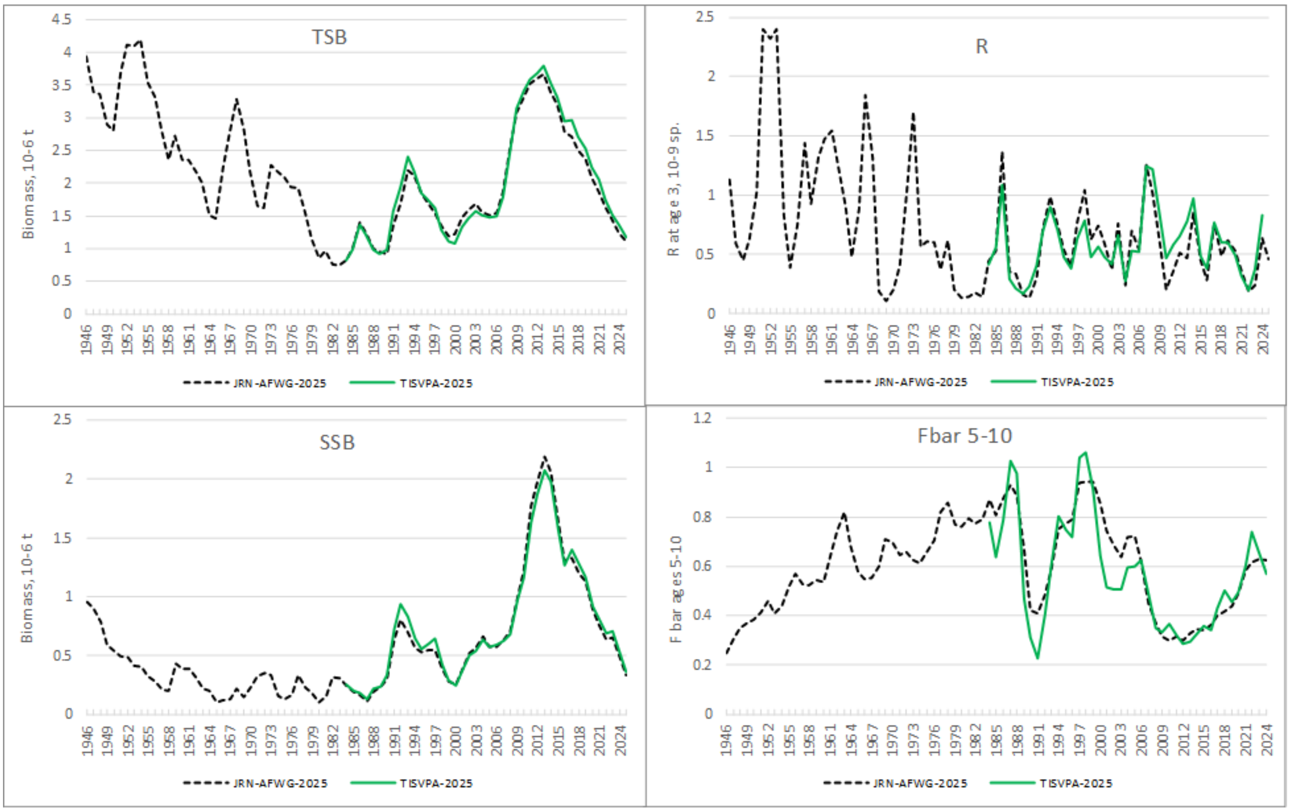
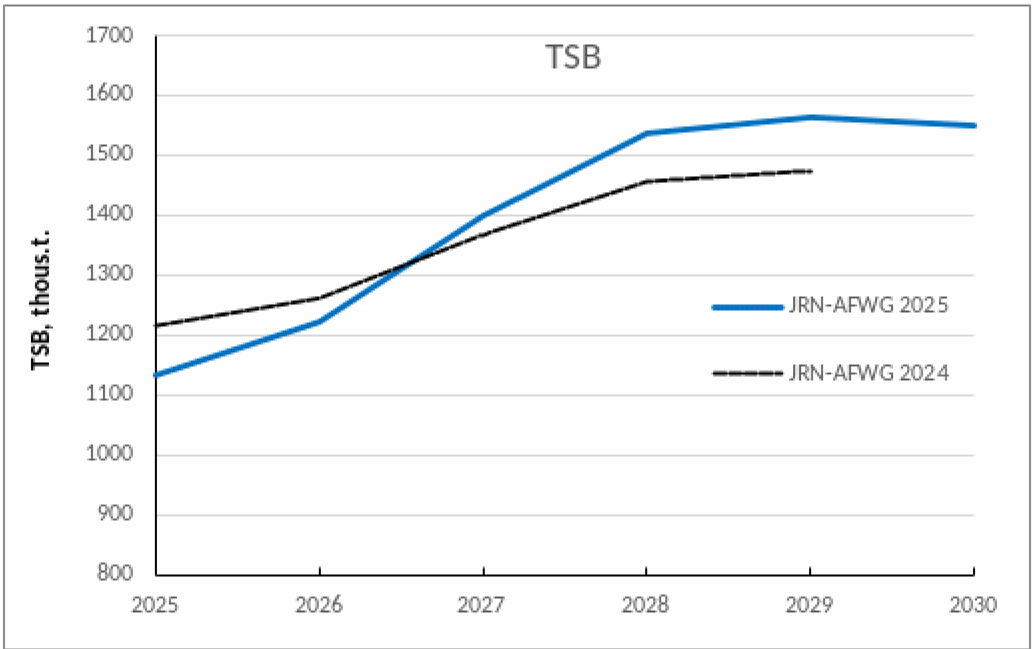
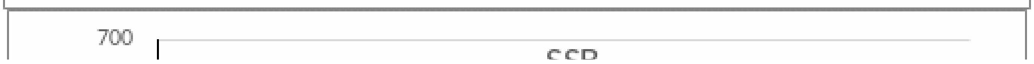


Figure 3. 7 . Model comparison. TSB (total stock biomass, age 3+), SSB recruitment and F in SAM and TISVPA.





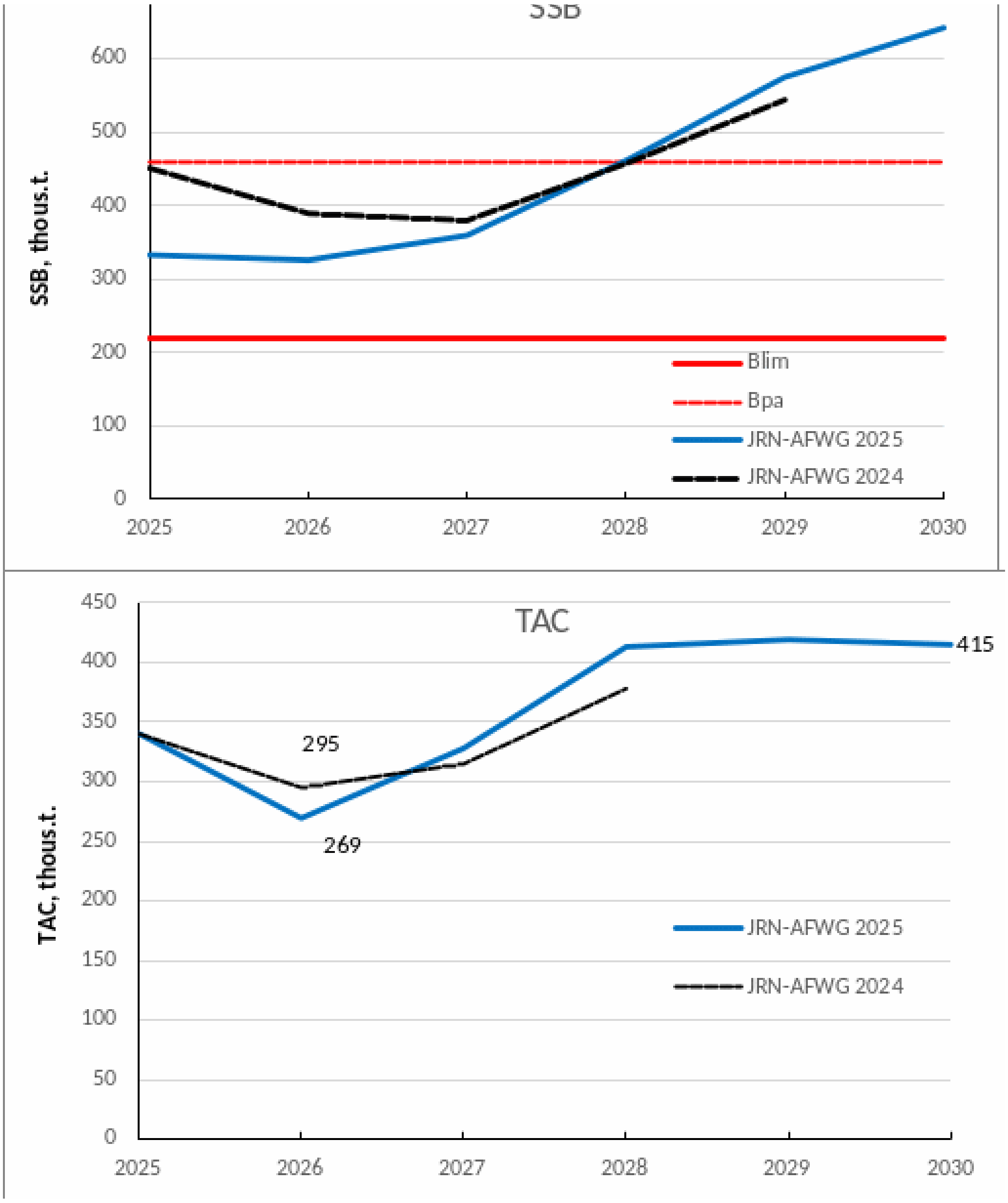


Figure 3. 8 . Medium term prediction of NEA cod stock dynamics and TAC according to HCR based on assessments of current year and previous year.

Table A1. North-East Arctic COD. Catch per unit effort.

Year	Norway Single trawl	Norway double trawl	Russian [2] trawl fishery for 9 main vessel types [4]
1980			0.68
1981	1.21		0.82
198 2	1.09		0.59
1983	1.11		0.51
1984	0.96		0.51
1985	1.29		1.28
1986	1.70		1.30
1987	1.77		1.17

1988	1.03		0.88
1989	0.76		0.86
1990	0.49		0.99
1991	0.44		1.22
1992	1.29		1.12
1993	1.87		1.40
1994	1.59		1.39
1995	1.92		1.20
1996	1.81		1.17
1997	1.36		0.87
1998	0.83		0.57
1999	0.74		0.50
2000	0.92		0.60
2001	1.21		0.72
2002	1.35		0.84
2003	1.67		0.98
2004	1.67		0.72
2005	1.23		0.58
2006	0.88		0.61
2007	1.16		0.73
200 8			1.00
2009			1.40
2010			1.75
2011	4.87 [3]	3.43	2.27
2012	6.97 [3]	4.21	2.16
201 3	4.96 [3]	4.21	1.96
201 4	5.75 [3]	4.47	2.20
2015	4.54 [3]	2.62	1.50
2016	3.64 [3]	2.90	1.35
201 7	3.01 [3]	2.53	1.31
2018	3.20 [3]	2.57	1.34
2019	3.02 [3]	2.44	1.33
2020	3.38 [3]	2.56	1.18
2021	2.51 [3]	1.93	1.04
2022	2.04 [3]	1.87	0.89
2023	1.66 [3]	1.78	0.74
2024 [1]	1.92 [3]	1.86	0.65

[1] Preliminary figures.

[2] USSR prior to 1991.

[3] 2011-2024 Norwegian data on t per hour fishing are not comparable to data from previous year

[4] standardized by GLM method (WD 1)

Table A2. Northeast Arctic COD. Abundance indices (millions) from the Norwegian acoustic survey in the Barents Sea in January-March. New TS and rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl. Data from 1994 onwards corrected for three northern areas and the method of filling in gaps (WD 1, WKBarFar 2021).

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

2009		204.9	25.46	107.83	182.54	138.08	41.48	13.87	4.69	4.32	0.5	0.14	0.02	0.01	NA	0		7
2010		620.25	43.56	22.82	87.98	160.16	154.39	44.56	14.57	3.9	2.89	0.94	0.11	0.12	0.09	0.01		11
2011		266	91	40.36	28.32	65.2	106.97	101.8	19.76	6.11	1.7	0.92	0.25	0.15	0.09	0.02		7
2012		496.49	40.23	82.79	49.38	33.77	72.53	132.31	65.59	8.37	4.39	1.21	0.66	0.47	0.04	0.1		9
2013		313.11	89.17	60.55	84.49	72.18	47.75	98.41	130.54	55.32	5.41	4.02	1.3	0.73	0.2	0.07		9
2014		1758.58	211.04	286.89	124.18	111.14	74.47	39.41	89.89	61.31	22.64	2.56	1.31	0.16	0.05	0.19		27
2015		1903.54	211.41	138.71	235.58	128.8	140.36	80.55	35.07	53.8	24.38	7.91	0.8	0.13	0.05	0.01		29
2016		240.8	201.89	56.29	76.91	119.38	64.84	50.17	25.8	13.49	17.83	7.35	2.15	0.72	0.22	0.1		8
2017		439.4	73.3	111.54	42.35	44.25	65.3	35.75	24.31	11.97	4	2.88	3.15	0.67	0.19	0.11		8
2018		2057.6	280.29	109.03	149.94	53.4	54.93	66.09	34.35	10.78	6.27	1.73	2.25	1.5	0.15	0.23		28
2019		1437.21	362.38	203.63	125.42	144.06	60.98	34.99	37.86	9.64	3.47	0.55	0.32	0.18	0.28	0.24		24
2020		92.68	157.92	117.32	117.32	81.36	90.6	42.35	26.57	21.41	6.23	1.75	0.67	0.66	0.51	0.89		7
2021		45.92	28.51	64.86	59.08	55.48	38.54	30.80	12.41	6.32	4.67	2.17	0.29	0.18	0	0.21		3
2022		524.71	43.42	29.42	52.98	56.69	47.05	42.94	27.77	7.85	2.44	1.51	0.94	0.18	0	0.28		8
2023		244.43	103.24	28.66	26.54	33.54	33.83	23.81	12.62	7.08	1.58	0.33	0.11	0.04	0.00	0.08		5
2024		328.44	200.98	150.72	50.97	29.34	27.31	28.25	18.83	11.29	3.82	0.43	0.12	0.02	0.05	0.01		8
2025		199.10	106.07	130.40	153.29	54.85	27.37	23.40	19.65	8.96	3.39	0.92	0.33	0.09	0.01	0.01		7

Table A3. North-East Arctic COD. Abundance indices (millions) from the Norwegian bottom trawl survey in the Barents Sea in January-March. Rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl. Data from 1994 and onwards corrected - WD 1, WKBarFar 2021.

				Age														
Year		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**10+**	**To**
1981		4.60	34.30	16.40	23.30	40.00	38.40	4.80	1.00	0.30							0.00	
1982		0.80	2.90	28.30	27.70	23.60	15.50	16.00	1.40	0.20							0.00	
1983		152.90	13.40	24.95	52.34	43.33	16.96	5.82	3.21	0.97							0.05	
1984		2755.04	379.11	97.49	28.28	21.44	11.74	4.07	0.40	0.08							0.08	3
1985		49.49	660.04	166.79	125.98	19.92	7.67	3.34	0.21	0.07							0.05	1
1986		665.79	399.61	805.00	143.93	64.14	8.30	1.91	0.34	0.04							0.03	2
1987		30.72	444.98	240.38	391.15	54.35	15.70	2.00	0.45	0.03							0.00	1
1988		3.21	72.83	148.03	80.49	173.31	20.48	3.58	0.53	0.03							0.00	
1989		8.24	15.62	46.36	75.86	37.79	90.19	9.82	0.94	0.10							0.07	
1990		207.17	56.72	28.35	34.87	34.59	20.56	27.23	1.61	0.38							0.03	
1991		460.45	220.14	45.85	33.67	25.65	21.49	12.15	12.67	0.61							0.02	
1992		126.56	570.92	158.26	57.71	17.82	12.83	7.67	4.29	2.72							0.22	
1993		534.48	420.40	273.89	140.13	72.48	15.83	6.24	3.89	2.23							2.36	1
1994		1043.78	556.68	293.92	307.04	153.33	45.72	7.95	2.61	1.48	0.55	0.55	0.08	0.05	NA	0		2
1995		5356.43	541.25	282.84	242.36	251.01	76.42	17.98	2.42	1.07	0.5	0.61	0.19	NA	NA	0		6

1996		5899.23	791.62	163.08	117.43	138.59	108.88	24.43	2.64	0.37	0.17	0.12	0.07	0.07	0.02	0		7
1997		5044.09	1422.92	317.99	68.44	74.26	59.99	26.67	4.85	0.64	0.91	0.08	NA	NA	NA	0		7
1998		2490.54	496.48	355.1	166.94	31.67	26.15	17.52	8.16	0.79	0.52	0.04	NA	NA	NA	0.04		3
1999		473.04	350.21	188.48	180.75	61.39	12.71	6.81	5.14	1.01	0.26	0.02	0.04	0.02	NA	0		1
2000		128.57	242.33	245.81	130.03	111.73	26.75	4.56	1.84	1.21	0.33	0.1	0.03	0.02	NA	0		
2001		712.77	78.03	182.79	195.11	82.9	37.96	9.45	1.17	0.44	0.19	0.04	NA	NA	NA	0.01		1
2002		34.11	418.73	118.36	137.56	108.95	45.79	14.4	2.2	0.32	0.18	0.05	NA	NA	NA	0.02		
2003		3022.23	65.78	376.7	126.31	93.93	66.88	17.5	4.67	1.02	0.17	0.04	NA	0.02	0.02	0		3
2004		322.87	242.94	63.88	184.62	53.46	43.24	30.59	6.85	1.65	0.28	0.07	0.01	0.01	NA	0		
2005		853.43	216.67	248.88	55.06	102.97	22.38	16.36	3.81	0.92	0.3	0.04	0.02	0.04	0.04	0		1
2006		674.21	289.39	116.49	115.38	28.32	43.42	13.72	5.24	1.36	0.24	0.18	0.18	NA	NA	0		1
2007		594.69	369.74	361.13	127.73	68.51	13.65	23.6	6.82	2.3	0.41	0.11	0.1	NA	NA	0		1
2008		68.83	101.96	194.37	300.59	111.9	40.24	17.34	8.11	1.79	0.36	0.03	0.02	0.01	NA	0		
2009		389.48	35.59	126.28	196.7	220.23	60.69	17.9	9.02	5.24	0.51	0.17	0.03	0.04	NA	0		1
2010		1027.59	95.14	36.81	114.25	154.80	144.50	39.56	11.24	3.67	1.60	0.58	0.04	0.02	0.04	0.02		1
2011		617.18	225.81	85.40	50.37	129.70	138.66	103.51	16.37	4.36	1.20	0.82	0.19	0.14	0.04	0.02		1
2012		702.97	100.30	75.72	64.59	33.71	90.69	132.58	48.61	9.02	2.26	0.88	0.55	0.44	0.07	0.05		1
2013		435.72	142.96	68.84	114.09	63.18	40.43	64.54	76.38	33.52	2.22	2.87	0.40	0.35	0.06	0.03		1
2014		1245.71	191.48	226.85	93.79	88.59	56.39	32.74	53.05	36.19	9.81	1.01	0.95	0.15	0.02	0.08		2
2015		1642.00	342.76	144.07	228.25	147.29	113.53	74.43	29.22	53.51	18.08	3.38	0.75	0.12	0.07	0.04		2
2016		312.16	305.57	99.37	135.48	188.31	113.47	72.33	28.56	13.17	16.06	6.77	0.97	0.52	0.17	0.14		1
2017		644.51	128.92	179.25	62.15	84.54	90.16	37.82	26.33	8.18	3.26	2.61	3.70	0.58	0.17	0.06		1
2018		2714.35	500.69	139.41	184.78	61.81	64.17	73.88	25.88	9.28	5.87	1.29	2.46	1.23	0.13	0.37		3
2019		1790.57	559.44	281.57	179.15	221.90	79.65	32.96	38.31	8.15	2.62	0.54	0.24	0.16	0.18	0.12		3
2020		164.75	273.82	237.73	160.24	131.56	114.88	49.83	24.26	20.44	4.53	1.66	0.93	0.51	0.26	0.73		1
2021		80.88	34.87	111.50	119.35	112.31	54.28	37.98	13.57	7.27	3.53	1.25	0.42	0.25	0.04	0.32		
2022		667.82	65.64	51.98	88.68	86.60	66.51	44.60	30.42	5.70	2.29	2.08	1.49	0.16	0.00	0.90		1
2023		305.40	163.06	41.21	39.82	46.52	43.17	32.24	14.26	7.49	1.58	0.34	0.14	0.06	0.00	0.14		
2024		377.90	307.04	198.71	63.31	36.21	29.96	28.22	16.15	8.90	2.68	0.37	0.10	0.02	0.01	0.07		10
2025		165.47	119.23	154.43	168.18	57.63	29.76	23.50	18.97	9.53	3.55	0.85	0.33	0.08	0.01	0.07		7

Table A4. North East Arctic COD. Abundance at age (millions) from the Norwegian acoustic survey on the spawning grounds off Lofoten in March-April.

Year	5	6	7	8	9	10	11	12+	Sum
1985	0.68	7.45	12.36	3.11	1.15	1.01	0.45		26.21
1986	2.49	3.30	5.54	2.71	0.16		0.40	0.08	14.68
1987	8.77	7.04	0.23	2.83	0.04		0.03	0.03	18.97
1988	1.57	4.43	2.56	0.05	0.01	0.05			8.67

1989	0.04	13.20	9.73	2.20	0.38	0.12		0.06	25.73
1990	0.13	2.60	27.02	4.85	0.49	0.32			35.41
1991	0.00	5.00	19.83	32.67	2.75	0.19	0.17		60.61
1992	2.74	5.23	20.80	20.87	79.60	4.17	1.61	0.22	135.24
1993	4.87	14.58	17.35	20.22	25.44	41.95	4.74	0.71	129.86
1994	23.78	25.85	10.36	8.21	7.68	3.49	17.53	2.61	99.51
1995	6.49	35.24	12.34	2.27	3.60	2.56	2.15	7.96	72.61
1996	1.41	14.43	24.00	3.65	0.79	0.25	0.80	1.30	46.63
1997	0.40	4.95	27.56	16.50	1.50	0.42		0.75	52.08
1998	0.05	0.30	7.06	11.05	3.24	0.51	0.18	0.02	22.41
1999	0.25	1.92	4.84	14.58	8.42	0.75	0.19	0.10	31.05
2000	3.61	3.85	3.25	2.15	2.23	0.45	0.39	0.05	15.98
2001	4.33	17.61	8.03	0.96	0.33	0.36	0.26	0.09	31.97
2002	2.30	19.11	16.50	6.49	0.83	0.31	0.47	0.01	46.02
2003	2.49	29.56	30.01	13.46	1.90	0.11	0.04	0.02	77.59
2004	1.96	17.52	29.82	16.34	7.67	2.04	0.15	0.68	76.18
2005	3.33	12.93	28.75	13.06	6.51	1.55	0.06	0.16	66.35
2006	0.20	12.50	8.11	10.98	7.42	2.12	0.16	0.66	42.14
2007	1.46	3.88	28.52	8.69	5.35	2.80	0.68	0.36	51.72
2008	0.45	5.96	2.95	20.72	2.70	2.02	1.66	0.71	37.17
2009	3.42	14.48	27.64	8.10	22.31	3.07	1.56	0.37	80.95
2010	0.96	20.06	16.98	16.84	6.89	9.61	3.05	2.60	76.96
2011	2.01	51.73	170.09	44.72	17.16	5.12	6.54	0.40	297.76
2012	0.46	12.56	91.58	67.75	17.30	5.98	2.59	1.53	199.76
2013	0.22	5.89	33.69	101.76	106.39	16.08	7.05	6.48	277.56
2014	0.25	2.82	15.49	58.75	112.10	75.33	12.07	8.82	285.62
2015	0.87	1.40	15.42	14.73	42.98	44.20	24.62	11.75	155.97
2016	0.24	1.46	9.05	14.53	22.06	38.65	27.06	25.45	138.51
2017	0.17	7.51	12.84	21.94	14.79	12.70	11.67	18.84	100.46
2018	0.61	3.28	11.11	11.21	8.44	7.82	4.42	9.60	56.50
2019	0.25	2.35	13.34	36.00	17.68	18.35	5.96	9.93	103.87
2020	0.58	3.17	7.75	24.37	28.05	13.28	6.66	5.29	89.15
2021	0.34	1.68	6.13	3.90	5.04	9.68	5.99	2.77	35.53
2022	0.31	3.34	4.58	6.70	3.77	4.39	3.75	2.53	29.37
2023	0.08	0.72	4.01	5.73	6.45	1.66	1.40	1.28	21.34
2024	0.55	1.31	2.10	7.63	7.23	2.12	0.68	0.00	21.62
2025	0.00	0.13	0.68	1.64	1.98	0.53	0.57	0.19	5.73

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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1981	17.0	26.1	35.5	44.7	52.0	61.3	69.6	77.9						
1982	14.8	25.8	37.6	46.3	54.7	63.1	70.8	82.9						
1983	12.8	27.6	34.8	45.9	54.5	62.7	73.1	78.6						
1984	14.2	28.4	35.8	48.6	56.6	66.2	74.1	79.7						
1985	16.5	23.7	40.3	48.7	61.3	71.1	81.2	85.7						
1986	11.9	21.6	34.4	49.9	59.8	69.4	80.3	93.8						
1987	13.9	21.0	31.8	41.3	56.3	66.3	77.6	87.9						
1988	15.3	23.3	29.7	38.7	47.6	56.8	71.7	79.4						
1989	12.5	25.4	34.7	39.9	46.8	56.2	67.0	83.3						
1990	14.4	27.9	39.4	47.1	53.8	60.6	68.2	79.2						
1991	13.6	27.2	41.6	51.7	59.5	67.1	72.3	77.6						
1992	13.2	23.9	41.3	49.9	60.2	68.4	76.1	82.8						
1993	11.3	20.3	35.9	50.8	59.0	68.2	76.8	85.8						
1994	11.3	17.9	30.2	44.6	55.2	65.7	73.9	78.9	87.4	97.2	97.6	104.7	122.4	
1995	12.2	18.1	29.0	42.2	53.9	63.9	75.4	80.4	85.9	99.1	90.1	109.0		
1996	12.1	18.8	28.8	40.5	49.4	60.9	71.8	85.1	92.4	94.9	96.1	104.2	103.9	121.0
1997	10.8	16.9	29.7	41.0	50.6	59.4	69.6	81.2	92.3	80.4	103.2			
1998	10.5	17.8	30.8	40.9	50.9	58.5	67.7	76.7	87.2	103.0	111.4		105.9	
1999	12.0	18.4	29.0	40.0	50.4	59.4	70.4	78.4	88.5	87.6	117.0	62.0	108.0	
2000	12.8	20.7	28.4	39.7	51.5	61.4	70.4	76.3	84.9	84.3	100.0	116.2	90.0	
2001	11.6	22.6	33.0	41.2	52.2	63.3	70.4	78.3	86.0	95.7	104.7			
2002	12.0	19.6	28.9	43.6	52.1	61.9	71.4	79.5	91.2	89.7	103.7			
2003	11.4	18.1	29.1	39.7	53.4	61.7	70.6	80.8	89.1	90.1	105.4		104.3	110.5
2004	10.6	18.4	31.7	40.6	51.7	61.6	68.6	79.7	90.9	90.4	92.2	116.0	112.0	
2005	11.2	18.3	29.5	43.4	51.1	60.4	71.0	79.6	89.0	96.4	109.3	113.7	129.6	107.0
2006	12.0	19.4	30.9	42.1	53.8	60.3	66.7	76.7	84.9	98.9	95.4	84.9		
2007	13.2	20.7	29.6	41.1	52.8	62.5	70.4	78.2	87.5	92.7	101.8	121.6	110.0	
2008	12.1	22.3	33.0	43.2	51.8	64.0	69.9	81.3	88.7	95.3	108.9	103.0	102.0	
2009	11.2	21.1	32.1	42.6	53.2	61.9	76.6	81.8	89.5	97.8	99.5	94.2	110.0	
2010	11.2	18.4	31.4	42.7	52.4	60.7	70.5	80.4	88.8	96.3	102.2	99.8	100.8	126.0
2011	11.9	19.5	29.4	41.9	51.0	60.7	68.1	78.3	86.1	95.4	102.2	110.4	114.3	116.9
2012	10.6	18.4	29.7	41.0	52.4	58.1	66.5	75.6	86.0	91.8	105.9	114.0	119.0	115.5
2013	11.2	19.3	31.1	41.1	51.7	62.0	69.7	76.5	81.2	95.3	93.7	110.7	110.8	145.0
2014	9.7	17.1	29.5	40.5	52.0	59.6	70.2	76.8	81.8	87.1	97.4	98.9	107.8	91.1
2015	10.5	15.9	30.0	40.3	51.1	60.2	68.8	77.5	81.2	88.7	94.0	101.9	127.5	121.1

2016	12.2	18.3	27.7	40.6	49.8	60.5	68.3	76.6	85.5	86.5	90.5	94.1	112.0	122.5
2017	12.3	22.2	31.2	42.5	51.2	60.5	69.6	75.5	85.2	90.9	96.0	92.6	108.6	108.7
2018	11.2	19.1	32.7	42.4	51.2	61.6	69.0	77.5	83.4	87.6	97.0	99.3	101.8	106.8
2019	11.7	17.5	31.2	42.4	51.0	59.6	69.7	77.0	84.1	87.1	99.3	103.4	104.6	109.8
2020	12.0	17.5	25.5	39.5	50.2	58.6	66.7	74.8	83.0	90.0	93.9	92.4	111.2	113.9
2021	11.6	19.9	26.5	37.4	48.0	58.5	66.7	74.9	84.0	91.7	97.7	102.1	105.8	115.0
2022	10.8	20.4	32.4	39.1	49.3	58.4	68.7	75.3	84.1	92.5	98.2	102.6	113.2	
2023	11.4	19.7	32.3	42.2	50.0	59.1	67.6	75.9	81.7	86.8	104.2	104.1	115.6	
2024	11.3	18.1	30.9	42.2	50.7	59.6	66.7	76.0	80.4	85.9	96.6	99.5	117.0	117.0
2025	11.6	17.3	27.8	41.0	50.4	58.3	67.9	73.7	81.6	86.2	91.8	101.0	108.2	119.0

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

Year \ Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1983	20	190	372	923	1597	2442	3821	4758						
1984	23	219	421	1155	1806	2793	3777	4566						
1985	20	171	576	1003	2019	3353	5015	6154						
1986	20	119	377	997	1623	2926	3838	7385						
1987	21	65	230	490	1380	2300	3970	6000						
1988	24	114	241	492	892	1635	3040	4373						
1989	16	158	374	604	947	1535	2582	4906	10943	5226				
1990	26	217	580	1009	1435	1977	2829	4435	10772	11045	9615			
1991	18	196	805	1364	2067	2806	3557	4502	7404	13447				
1992	20	136	619	1118	1912	2792	3933	5127	6420	8103	17705	22060		
1993	9	71	415	1179	1743	2742	3977	5758	7068	7515	7521	10744		
1994	13	56	262	796	1470	2386	3481	4603	6777	8195	8516	13972		
1995	15	54	240	658	1336	2207	3570	4715	5712	8816	6817	12331		
1996	15	62	232	627	1084	1980	3343	5514	7722	8873	9613	12865	12556	
1997	13	52	230	638	1175	1797	2931	4875	7529	5739	10194			
1998	11	52	280	635	1182	1728	2588	4026	6076	11257	14391			
1999	14	59	231	592	1178	1829	2991	4128	6321	7342				
2000	16	74	210	558	1210	1963	3036	3867	5401	6154	10023			
2001	14	106	336	646	1288	2233	3088	4439	5732	8442	11429			
2002	14	67	238	747	1229	2063	3199	4578	7525	6598	12292			
2003	13	61	234	597	1316	2014	2989	4715	6517	7500	12812			
2004	11	59	275	608	1143	1947	2623	4137	6673	7368	8109			
2005	13	61	246	723	1146	1866	2949	4226	6436	8646	12537		24221	11640
2006	13	69	280	669	1420	1970	2641	4260	5914	10179	9439	8328		

2007	19	73	235	639	1302	2190	3039	4411	6394	8056	10826	20104		
2008	15	90	335	798	1399	2442	3235	5210	6981	9641				
2009	13	83	294	704	1302	2065	4067	5087	6874	9460	9511			
2010	12	64	304	700	1296	2033	3162	4743	6562	8984	10315			22766
2011	15	66	246	668	1131	1940	2726	4013	5969	8275	10309	13159	14868	
2012	13	62	252	609	1276	1681	2489	3764	5920	7809	12199	15006	17582	
2013	11	65	269	602	1208	2055	2809	3843	4822	8447	9101	15108	14743	
2014	8	50	246	603	1226	1780	2866	3930	4927	6203	8570	9566	12239	
2015	10	44	242	602	1221	1929	2741	4043	4804	6817	7759	11544	21652	
2016	13	53	200	593	1049	1928	2674	3830	5540	6129	7110	8272	15256	21945
2017	15	102	292	720	1178	1972	3056	3962	5901	7429	9301	8599	12958	14894
2018	12	69	320	688	1228	2062	2803	4154	5409	6632	9156	10510	11810	12443
2019	12	48	273	685	1164	1870	2916	3974	5394	6068	9637	11507	12371	13993
2020	14	44	153	548	1077	1692	2476	3625	5074	6758	8040	8107	14892	15793
2021	14	68	164	462	910	1682	2484	3620	5379	7160	9313	10923	12410	
2022	11	77	311	535	1052	1716	2885	3855	5321	7751	9538	11432	14940	
2023	12	71	316	694	1111	1757	2802	4097	5119	6443	10937	10668	14732	
2024	12	57	289	701	1133	1855	2571	3834	4994	5931	8809	10805	17000	
2025	13	51	217	648	1176	1778	2678	3516	5033	6267	7722	10640	13730	

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

Year/age	5	6	7	8	9	10	11	12	13	14	12+
1985	59.6	71.1	79.0	88.2	97.3	105.2	114.0				
1986	62.7	70.0	80.0	89.4	86.6		105.8				115.0
1987	58.2	64.5	76.7	86.2	88.0		118.5				116.0
1988	53.1	67.1	71.6	94.0	97.0	119.6					
1989	54.0	59.0	69.8	80.8	96.6	103.0					125.0
1990	56.9	65.1	69.2	79.5	83.7	100.1					
1991	59.0	67.3	74.4	81.0	91.3	99.8	85.0				
1992	66.3	68.7	78.3	83.9	89.2	92.2	101.9				127.0
1993	58.3	66.1	72.8	83.6	87.4	92.7	95.4				111.2
1994	64.3	70.6	82.0	87.3	90.0	95.3	92.4				101.4
1995	61.5	69.7	77.8	84.4	92.6	96.7	100.3				99.5
1996	62.2	67.1	75.9	81.0	93.6	100.9	97.4				104.1
1997	63.7	68.6	74.2	83.8	99.9	108.4					109.0
1998	55.0	62.6	70.2	80.0	92.0	98.0	96.7				115.0
1999	52.7	67.0	69.4	78.6	85.8	100.3	102.0				125.0
2000	58.4	66.5	72.6	77.0	83.9	90.6	93.7				112.4

2001	59.3	66.9	73.2	87.1	88.7	102.8	98.5				128.2
2002	58.6	66.0	73.2	80.8	88.2	101.8	91.0				101.4
2003	62.3	65.0	73.2	80.9	88.9	86.4	120.0				122.0
2004	58.8	64.7	71.2	80.1	85.6	97.0	102.6				115.8
2005	56.3	65.4	72.3	76.0	85.3	95.5	110.5				117.8
2006	56.2	63.7	72.6	77.5	82.9	88.3	89.2				116.3
2007	63.0	66.4	72.4	82.5	88.2	99.8	103.7				115.0
2008	63.8	69.1	73.6	80.9	90.0	94.9	94.9				96.5
2009	60.5	69.3	76.5	82.7	88.7	98.8	92.9				111.6
2010	59.9	64.9	73.6	83.3	89.2	96.3	100.8	103.1	118.2	123.0	
2011	57.1	64.3	70.0	79.9	91.2	98.3	101.6	103.6	110.0	102.0	
2012	65.3	65.1	69.9	76.6	85.3	98.7	104.6	103.9	116.2	89.0	
2013	63.6	68.7	73.0	78.4	83.5	90.9	99.1	96.6	103.0	116.8	
2014	55.9	66.0	74.5	77.9	82.8	86.8	93.4	99.1	109.2	116.0	
2015	61.0	66.5	72.9	78.6	83.4	89.0	95.4	99.5	106.1	114.5	
2016	64.0	63.0	74.3	81.1	88.8	93.2	95.5	97.1	103.2	117.1	
2017	58.0	64.8	70.7	81.6	87.3	94.8	98.7	99.4	102.7	106.1	
2018	67.9	67.3	72.9	79.5	89.4	93.6	99.3	104.9	104.3	107.9	
2019	59.9	69.4	74.7	81.4	87.9	93.9	98.1	106.2	111.1	109.8	
2020	66.1	68.3	75.1	81.8	88.9	95.1	96.3	106.0	109.5	109.1	
2021	63.3	66.3	74.3	78.6	89.4	93.3	96.9	103.7	103.1	108.4	
2022	61.4	67.9	72.9	81.0	88.4	96.5	100.1	98.3	99.3	104.0	
2023	60.0	69.1	76.7	80.5	87.1	93.1	99.3	107.2	114.0	120.6	
2024	52.2	64.7	73.5	77.9	81.7	91.3	96.4				
2025	59.0	65.0	73.5	80.6	86.8	91.2	97.2	99.8	97.7		

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

Year	5	6	7	8	9	10	11	12	13	14+	12+
1985	2.00	3.42	4.61	6.67	8.89	10.73	14.29				
1986	2.22	3.22	4.74	6.40	5.80		10.84				13.48
1987	1.44	1.94	3.61	5.40	5.64		13.15				12.55
1988	1.46	2.82	3.39	6.63	7.27	13.64					
1989	1.30	1.77	2.89	4.74	8.28	9.98					26.00
1990	1.54	2.32	2.55	3.78	4.77	8.80					
1991	2.21	2.52	3.51	5.18	7.40	11.36	5.35				
1992	2.56	2.85	3.99	5.43	6.35	8.03	9.50				17.80
1993	1.79	2.58	3.55	5.31	6.21	7.69	9.28				14.71
1994	2.31	3.27	5.06	6.39	6.64	7.92	7.73				10.10

1995	2.20	3.24	4.83	5.98	7.80	10.03	10.39				10.68
1996	2.22	2.75	4.11	5.63	7.92	10.53	10.58				12.08
1997	2.42	2.92	3.86	5.71	9.65	13.41					12.67
1998	1.88	2.09	2.98	4.85	7.92	9.91	11.05				18.34
1999	1.51	2.80	2.96	4.22	5.92	9.33	9.17				16.00
2000	1.71	2.50	3.16	3.85	5.32	7.07	7.62				12.84
2001	1.90	2.72	3.49	6.23	6.82	10.95	10.29				28.58
2002	1.87	2.57	3.52	4.71	6.18	10.56	8.70				10.48
2003	2.30	2.34	3.48	4.59	5.89	8.07	24.50				27.70
2004	1.74	2.30	3.02	4.50	5.77	7.81	9.95				13.25
2005	1.56	2.40	3.20	3.71	5.79	8.52	16.27				18.63
2006	1.54	2.35	3.44	4.19	5.43	6.57	6.19				18.15
2007	2.34	2.67	3.53	5.30	6.70	9.95	11.24				16.62
2008	2.21	2.97	3.63	4.88	6.74	8.18	7.70				9.07
2009	2.04	2.98	4.10	5.19	6.56	9.38	8.58				15.67
2010	1.90	2.46	3.47	5.13	6.26	7.83	9.59	10.77	18.31	20.84	
2011	1.66	2.28	2.89	4.52	6.82	8.82	9.55	9.08	13.38	10.70	
2012	3.07	2.47	2.93	3.89	5.37	8.79	11.53	12.28	15.04	5.41	
2013	2.49	3.05	3.52	4.46	5.54	7.56	10.26	10.23	11.49	16.61	
2014	1.90	2.52	3.80	4.04	5.06	5.96	7.36	9.01	12.20	16.95	
2015	2.16	2.62	3.42	3.95	5.21	6.53	8.32	9.95	12.45	14.21	
2016	2.53	2.31	3.72	5.05	6.79	8.03	8.93	9.02	12.12	18.46	
2017	2.01	2.52	2.94	4.91	5.75	7.16	8.18	9.10	10.49	11.59	
2018	3.25	2.77	3.41	4.53	6.51	7.94	9.65	12.05	12.04	12.85	
2019	2.12	3.02	3.76	4.81	6.07	7.44	8.71	11.06	13.86	13.40	
2020	2.75	2.79	3.64	4.69	6.06	7.78	8.70	10.86	12.93	13.95	
2021	2.30	2.62	3.76	4.40	6.59	7.39	8.56	10.15	11.821	14.79	
2022	2.61	3.00	3.59	5.01	7.15	8.34	9.34	9.35	9.41	11.63	
2023	1.86	2.94	4.16	4.84	6.00	7.19	9.36	11.88	15.31	17.69	
2024	1.13	2.32	3.95	4.38	5.68	7.16	9.72				
2025	1.44	2.50	3.46	4.59	5.87	7.02	8.41	9.44	8.17		

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

Year					Age								
		1	2	3	4	5	6	7	8	9	10+	Total	
1985	[1]	77	569	400	568	244	51	20	8	1	3	1941	
1986	[1]	25	129	899	612	238	69	20	3	2	1	1998	

1987	2	2	58	103	855	198	82	19	4	1	1	1323	
1988	2	3	23	96	100	305	54	16	3	1	1	602	
1989	1	1	3	17	45	57	91	75	25	13	5	332	
1990	1	36	27	8	27	62	74	91	39	10	3	377	
1991	1	63	65	96	45	50	54	66	49	5	1	494	
1992	1	133	399	380	121	56	58	33	29	11	2	1222	
1993	1	20	44	220	234	164	51	19	13	8	10	783	
1994	1	105	38	147	275	303	314	100	35	10	8	1335	
1995	1	242	42	111	219	229	97	21	6	2	2	971	
1996	1,3,5	424	275	189	316	449	314	126	27	3	4	2127	
1997	4,5	72	160	263	198	112	57	27	9	1	1	900	
1998	1	26	86	279	186	57	23	10	4	1	0	672	
1999	1	19	79	166	260	98	20	8	5	2	1	658	
2000	1,rev	24	82	191	159	127	48	6	3	1	1	642	
2001	1	38	59	148	204	120	70	14	2	1		656	
2002	1,5,6	83	2	106	85	140	151	67	30	7	1	672	
2003		69	36	25	218	142	167	163	60	23	4	908	
2004		375	35	170	85	345	194	229	167	49	19	1669	
2005		112	48	65	154	70	214	68	47	17	8	803	
2006	7	12	20	39	49	78	32	64	23	13	8	341	
2007		13	35	165	372	208	189	74	113	32	20	1221	
1	October-December												
2	September-October												
3	Area IIb not covered												
4	Areas IIa, IIb covered in October-December, part of Area I covered in February-March 1998												
5	Adjusted for incomplete area coverage												
6	Area IIa not covered												
7	Area I not fully covered												

Table A10. Northeast Arctic COD. Abundance indices (millions) from the Russian bottom trawl survey in the Barents Sea. Total (Sub-area I and Division IIa and IIb).

Year			Age												
	0	1	2	3	4	5	6	7	8	9	10	11	12	13+	Sum
1982	849.3	1905.3	33.2	141.3	152.5	72.1	19.8	55.1	17.4	3.7	1.9	1.5	0.1	0.0	3253.3
1983	1872.2	2003.4	73.2	52.0	64.2	50.6	35.8	17.9	25.2	9.4	0	0	0	0	4203.9
1984	363.3	180.5	104.4	118.9	70.0	48.9	35.7	15.4	6.9	6.1	1.7	1.5	0.6	0.2	954.0
1985	284.6	15.6	129.0	118.8	159.2	106.8	36.5	16.5	3.7	0.8	1.6	0.1	2.1	0.0	875.3
1986	329.9	7.6	31.7	162.2	153.2	149.3	48.1	18.9	4.2	0.2	0.6	0.0	0.0	0.0	905.9

1987	7.7	1.3	46.9	55.7	307.6	90.0	70.1	18.4	6.0	2.5	0.4	0.1	0.3	0.0	607.0
1988	92.5	2.9	31.3	99.3	93.8	287.9	58.3	26.0	4.7	2.4	0.1	0.0	0.0	0.0	699.2
1989	355.8	3.0	14.7	49.0	97.8	106.2	145.4	116.7	29.9	11.2	4.7	1.8	0.7	0.5	937.4
1990	1248.4	31.1	51.0	16.7	48.7	62.7	97.2	153.8	67.3	15.3	4.9	0.9	0.2	0.0	1798.2
1991	974.0	64.0	91.1	107.7	48.4	53.2	58.3	68.5	74.7	9.8	1.4	0.3	0.0	0.0	1551.4
1992	1204.8	157.7	151.1	67.5	30.8	23.9	27.3	21.8	17.5	2.5	2.5	0.4	0.0	0.0	1707.8
1993	484.8	38.0	158.6	160.4	113.5	68.1	41.6	35.4	8.7	0.3	0.7	0.1	0.1	0.0	1110.3
1994	1606.6	833.2	69.9	136.3	130.9	101.9	35.4	12.8	4.9	2.1	1.1	0.6	0.2	0.0	2935.9
1995	5703.5	471.9	36.9	58.9	106.5	139.5	84.9	25.1	8.3	1.9	1.8	0.9	0.6	0.0	6640.8
1996	2660.3	396.5	128.5	73.3	78.4	103.5	77.3	34.8	13.2	1.9	0.5	1.2	0.2	0.0	3569.6
1997	1371.4	353.9	135.3	134.2	83.5	61.3	60.2	34.8	11.6	3.2	3.0	0.0	0.0	0.0	2252.4
1998	304.8	276.8	89.6	202.8	136.3	78.8	47.0	25.9	13.0	4.8	0.5	0.0	0.1	0.0	1180.4
1999	266.9	40.1	118.4	158.7	207.2	98.0	30.1	12.3	9.4	4.2	0.4	0.0	0.0	0.0	945.7
2000	1436.5	37.7	103.6	183.9	128.6	178.6	77.3	11.4	5.2	2.3	0.9	0.4	0.0	0.0	2166.4
2001	321.6	233.8	77.3	122.4	155.7	129.0	106.1	30.4	5.0	1.4	0.5	2.5	1.3	0.0	1187.1
2002	1797.9	26.7	135.6	98.0	147.3	147.3	89.6	60.0	18.2	2.9	0.8	0.1	0.1	0.0	2524.4
2003	489.5	517.5	26.8	124.6	105.7	116.6	120.3	53.5	24.1	4.0	0.9	0.3	0.0	0.1	1583.9
2004	1770.4	158.4	87.5	32.9	157.6	88.0	111.1	77.6	27.9	9.3	2.3	0.4	0.2	0.0	2523.6
2005	2298.0	323.9	61.7	140.8	63.1	183.2	74.4	60.5	24.4	8.8	2.8	0.6	0.1	0.0	3242.4
2006	427.4	52.4	63.2	92.7	161.3	77.7	180.1	66.2	34.2	16.1	4.3	1.7	0.7	0.0	1178.1
2007	177.5	37.0	148.6	257.9	161.7	190.3	84.6	152.5	55.3	22.6	8.6	4.9	1.1	0.7	1303.3
2008	1468.6	45.2	86.3	220.3	308.8	163.5	147.2	83.0	86.3	29.1	11.5	3.3	1.7	0.2	2654.9
2009	1877.7	287.8	21.9	97.4	231.7	368.7	201.6	117.5	62.0	41.3	20.5	6.5	3.2	0.9	3338.7
2010	2210.4	214.9	47.0	33.4	107.0	250.5	371.5	181.7	78.9	39.5	29.9	15.6	5.5	2.0	3587.7
2011	2296.1	125.9	80.0	88.2	50.8	143.2	306.5	330.0	91.7	43.9	17.6	17.5	7.0	3.5	3602.1
2012	1096.0	196.2	45.1	81.5	111.4	83.9	212.2	335.8	187.8	43.2	19.5	4.6	5.7	1.9	2424.8
2013	297.1	654.0	107.6	74.7	117.4	117.7	88.4	234.9	313.2	136.7	30.6	9.2	5.4	4.5	2191.5
2014	909.7	211.0	72.1	139.9	136.8	172.5	148.3	111.1	192.9	129.7	38.3	9.3	3.5	2.0	2277.1
2015	572.9	465.4	51.5	65.7	158.3	174.2	193.2	161.0	92.5	115.8	76.1	24.2	6.5	4.9	2162.0
2016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2017	4325.9	5257.4	94.5	145.6	88.4	106.3	195.2	123.1	56.7	26.6	12.0	12.0	7.5	2.8	10454.0
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

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

Year	Age												
	0	1	2	3	4	5	6	7	8	9	10	11	12
1984	15.7	22.3	30.7	44.3	51.7	63.6	73.4	82.5	88.4	97.0	-	-	-

1985	15.0	21.1	30.6	43.2	53.7	61.2	72.8	83.0	92.8	101.3	-	-	-
1986	15.2	19.7	28.3	39.0	51.8	62.2	70.9	83.0	91.3	104.0	-	-	-
1987	-	19.2	27.9	33.4	41.4	59.1	69.2	80.1	95.7	102.6	-	-	-
1988	11.3	21.3	28.7	36.2	43.9	53.3	65.3	79.5	85.0	-	-	-	-
1989	-	20.8	28.8	34.8	46.0	53.9	61.8	69.8	78.7	88.6	-	-	-
1990	16.0	24.0	30.4	46.5	54.9	62.5	69.7	77.6	87.8	102.0	-	-	-
1991	11.5	22.4	30.6	43.0	55.9	64.6	72.8	78.5	87.9	101.8	-	-	-
1992	11.3	21.3	31.9	50.1	59.8	69.1	78.6	84.0	90.8	97.5	-	-	-
1993	12.1	17.4	29.1	43.4	52.7	64.3	73.9	81.2	89.1	91.8	-	-	-
1994	12.2	20.3	26.3	33.7	47.4	58.7	70.6	80.8	90.1	96.1	-	-	-
1995	11.6	19.8	27.6	33.8	45.2	60.5	71.1	83.5	92.9	99.1	-	-	-
1996	10.2	20.0	28.1	36.7	48.7	58.9	70.5	80.0	93.6	102.7	-	-	-
1997	9.6	18.5	28.8	38.2	50.8	62.0	70.5	80.1	88.9	103.5	-	-	-
1998	11.4	19.0	28.0	36.4	50.5	61.0	70.7	80.3	91.1	102.5	-	-	-
1999	11.7	19.7	27.9	35.3	51.6	60.6	70.6	78.9	86.8	94.3	-	-	-
2000	10.7	20.8	30.1	34.7	49.8	61.1	71.6	82.0	88.3	85.7	104.2	-	-
2001	10.6	19.4	29.8	37.3	50.4	61.9	71.9	81.4	91.0	98.7	103.8	-	-
2002	10.7	19.2	29.9	38.2	52.5	60.4	70.6	82.2	91.3	97.2	104.1	-	-
2003	9.8	18.9	28.3	34.9	49.2	62.2	71.0	81.5	92.3	100.9	104.3	-	-
2004	9.8	19.6	29.3	38.4	49.1	60.0	70.5	80.0	91.0	98.0	106.0	-	-
2005	11.2	19.4	29.7	38.5	48.7	59.3	69.3	79.2	87.7	96.1	104.4	-	-
2006	13.0	21.9	31.6	42.7	53.2	60.1	70.2	79.1	88.3	95.2	107.7	-	-
2007	10.7	21.5	30.8	42.2	53.6	63.7	71.0	79.6	87.3	95.9	-	-	-
2008	10.2	20.0	30.3	40.2	53.7	64.5	74.6	82.7	89.5	98.2	102.3	110.2	111.9
2009	12.9	19.3	29.5	38.4	50.7	61.5	70.7	81.7	89.9	94.7	101.8	105.9	109.4
2010	11.1	19.3	28.7	38.5	48.9	59.1	68.0	78.4	88.2	97.3	102.5	108.4	117.7
2011	11.2	20.3	29.2	38.5	49.5	58.6	68.7	78.2	90.0	97.9	106.9	109.3	116.0
2012	11.0	20.3	31.1	40.8	50.8	60.7	68.4	77.6	87.4	97.7	105.2	111.7	116.6
2013	9.5	19.5	29.0	40.3	50.4	59.3	67.3	75.3	84.4	95.3	104.5	111.9	119.4
2014	10.1	20.1	29.8	39.2	50.7	60.9	69.4	77.9	85.1	93.6	102.7	113.3	122.8
2015	11.5	19.0	28.5	37.5	48.0	58.4	67.4	76.3	83.5	91.0	98.8	107.1	117.9
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	15	21	31	40	52	59	67	76	85	92.6	97.9	104	110.1
2018	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A12. Northeast Arctic COD. Weight (g) at age from Russian surveys in November-December.

	Age		

Year	Age											
	0	1	2	3	4	5	6	7	8	9	10	11	12
1984	26	90	250	746	1187	2234	3422	5027	6479	9503	-	-	-
1985	26	80	245	762	1296	1924	3346	5094	7360	6833	11167	-	-
1986	25	63	191	506	1117	1940	2949	4942	7406	9300	-	-	-
1987	-	54	182	316	672	1691	2688	3959	8353	10583	13107	-	-
1988	15	78	223	435	789	1373	2609	4465	5816	-	-	-	-
1989	-	73	216	401	928	1427	2200	3133	4649	6801	8956	-	-
1990	28	106	230	908	1418	2092	2897	4131	6359	10078	13540	-	-
1991	26	93	260	743	1629	2623	3816	4975	7198	11165	15353	-	-
1992	10	76	273	1165	1895	2971	4377	5596	7319	9452	12414	-	-
1993	11	46	211	717	1280	2293	3509	4902	6621	7339	8494	-	-
1994	12	69	153	316	919	1670	2884	4505	6520	8207	9812	-	-
1995	11	61	180	337	861	1987	3298	5427	7614	9787	10757	-	-
1996	7	64	191	436	1035	1834	3329	5001	8203	10898	11358	-	-
1997	6	48	203	487	1176	2142	3220	4805	6925	10823	12426	-	-
1998	11	55	187	435	1186	2050	3096	4759	7044	11207	12593	-	-
1999	10	58	177	371	1214	1925	3064	4378	6128	7843	11543	-	-
2000	8	74	232	379	1101	2128	3341	5054	6560	8497	12353	-	-
2001	9	58	221	459	1125	2078	3329	4950	7270	9541	11672	-	-
2002	8	65	232	505	1299	1964	3271	5325	7249	9195	11389	-	-
2003	6	49	205	492	972	1993	2953	4393	6638	9319	11085	-	-
2004	6	55	231	543	1079	1798	2977	4110	5822	8061	12442	-	-
2005	10	59	223	521	1034	1910	3036	4619	6580	9106	12006	-	-
2006	13	72	270	707	1332	1953	2969	4340	6410	8622	12436	-	-
2007	10	96	252	669	1344	2277	3140	4691	6178	8567	10014	-	-
2008	7	58	228	558	1332	2305	3527	5001	6519	8848	10339	13276	15196
2009	15	54	214	495	1116	2024	3090	4876	6592	8087	10262	11472	13268
2010	9	54	191	794	989	1784	2719	4246	6384	8747	10499	12117	14199
2011	10	63	206	486	1037	1691	2827	4312	6698	8979	11557	12915	15694
2012	9	62	237	561	1087	1877	2688	3974	5930	8495	11000	13377	14826
2013	5	55	202	546	1062	1718	2541	3667	5258	7821	10509	13161	16581
2014	7	64	221	508	1079	1849	2734	3994	5418	7480	10100	14163	18404
2015	11	55	198	452	947	1735	2588	3728	5081	6827	8877	11623	15626
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	22	69	248	571	1150	1771	2539	3819	5426	7554	9236	11220	13536
2018	-	-	-	-	-	-	-	-	-	-	-	-	-

2019	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A13. Northeast Arctic COD. Sum of acoustic abundance estimates (millions) in the Joint winter Barents Sea survey (Table A2) and the Norwegian Lofoten acoustic survey (Table A4).

					Age								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13+**	**12+**
1985	69.1	446.3	153.0	141.6	20.4	15.1	15.7	3.3	1.3	1.0	0.5	na	na	0.0
1986	353.6	243.9	499.6	134.3	68.4	11.6	7.7	3.1	0.3	0.0	0.4	na	na	0.1
1987	1.6	34.1	62.8	204.9	50.2	17.4	1.4	3.0	0.7	0.0	0.0	na	na	0.0
1988	2.0	26.3	50.4	35.5	57.8	10.9	4.0	0.3	0.0	0.1	0.0	na	na	0.0
1989	7.5	8.0	17.0	34.4	21.4	67.0	16.6	3.2	0.5	0.2	0.0	na	na	0.1
1990	81.1	24.9	14.8	20.6	26.2	26.9	66.8	7.3	0.6	0.3	0.0	na	na	0.0
1991	181.0	219.5	50.2	34.6	29.3	33.9	36.7	50.0	3.7	0.2	0.2	na	na	0.0
1992	241.4	562.1	176.5	65.8	21.5	18.4	28.4	25.4	82.4	4.3	1.7	na	na	0.2
1993	1074.0	494.7	357.2	191.1	113.1	35.4	25.5	25.2	27.7	44.2	4.9	na	na	0.8
1994	902.6	624.4	323.9	374.5	229.3	96.1	23.4	11.8	10.3	4.2	18.7	na	na	2.9
1995	2175.3	212.3	137.7	139.5	203.6	101.6	28.1	4.7	4.5	2.9	2.6	na	na	8.1
1996	1826.3	271.7	99.4	89.6	112.8	97.4	46.2	5.9	1.1	0.4	0.9	na	na	1.5
1997	1698.5	565.3	158.6	44.2	50.3	45.9	51.0	21.5	2.3	0.7	0.1	na	na	0.8
1998	2523.6	475.2	391.2	189.8	44.9	41.5	34.9	27.1	5.1	1.0	0.2	na	na	0.1
1999	364.8	231.5	147.6	130.3	52.3	13.9	11.8	18.7	9.9	1.0	0.2	na	na	0.1
2000	153.4	262.8	294.8	167.3	149.2	54.6	14.6	6.9	5.0	1.3	0.6	na	na	0.2
2001	363.6	51.5	177.4	160.6	85.1	62.1	19.1	2.7	0.8	0.6	0.3	na	na	0.1
2002	19.2	209.1	61.4	106.2	101.1	71.3	36.6	9.4	1.2	0.8	0.6	na	na	0.0
2003	1505.0	52.5	306.7	116.8	127.1	146.1	67.7	23.5	3.8	0.4	0.1	na	na	0.2
2004	161.2	117.2	33.4	85.2	34.9	45.6	48.0	21.7	8.8	2.4	0.2	na	na	0.7
2005	499.7	138.7	125.0	33.3	69.3	34.1	43.8	18.0	7.5	1.8	0.1	na	na	0.3
2006	411.2	158.0	64.8	53.8	18.6	42.0	17.6	15.9	8.7	2.3	0.3	na	na	1.0
2007	85.1	47.1	58.5	30.4	30.8	12.9	46.6	15.1	8.0	3.3	0.9	na	na	0.4
2008	50.9	94.2	199.9	288.7	116.6	78.9	24.8	35.2	5.5	2.8	1.7	na	na	0.7
2009	204.9	25.5	107.8	182.5	141.5	56.0	41.5	12.8	26.6	3.6	1.7	na	na	0.4
2010	620.3	43.6	22.8	88.0	161.4	175.0	61.8	31.4	10.8	12.5	4.0	2.0	0.9	2.9
2011	266.0	91.0	40.4	28.3	67.4	159.5	272.7	64.5	23.3	6.8	7.5	0.4	0.5	0.9
2012	496.5	40.2	82.8	49.4	34.4	89.5	226.6	133.5	25.7	10.4	3.8	1.8	1.0	2.8
2013	313.1	89.2	60.6	84.5	72.4	54.1	133.6	233.8	161.7	21.5	11.1	5.5	3.2	8.8
2014	1758.6	211.0	286.9	124.2	111.5	77.7	55.3	149.0	173.9	98.0	14.6	6.8	3.8	10.5
2015	1903.5	211.4	138.7	235.6	130.0	144.2	96.4	49.8	96.9	68.6	32.5	6.6	6.1	12.7
2016	240.8	201.9	56.3	76.9	119.9	66.4	59.4	40.9	35.6	56.5	34.4	17.6	11.0	28.6

2017	439.4	73.3	111.5	42.4	44.4	74.2	48.6	48.4	26.8	16.7	14.6	15.1	7.8	23.0
2018	2057.6	280.3	109.0	149.9	54.0	58.4	77.5	45.6	19.3	14.1	6.1	6.0	7.8	13.7
2019	1437.2	362.4	203.6	125.4	144.6	63.9	49.3	73.9	27.3	21.8	6.5	2.9	8.1	11.1
2020	92.7	157.9	117.3	117.3	81.9	94.3	50.6	50.9	49.5	19.5	8.4	2.6	5.4	8.0
2021	45.9	28.5	64.9	59.1	55.8	40.2	36.9	16.3	11.4	14.3	8.2	1.9	1.6	3.4
2022	524.7	43.4	29.4	53.0	57.0	50.4	47.5	34.5	11.6	6.8	5.3	2.2	1.8	3.9
2023	244.4	103.2	28.7	26.5	33.6	34.6	27.8	18.3	13.5	3.2	1.7	0.8	0.7	1.5
2024	328.4	201.0	150.7	51.0	29.9	28.6	30.4	26.5	18.5	5.9	1.1	0.1	0.1	0.2
2025	199.0	106.1	130.4	153.3	54.9	27.5	24.1	21.3	10.9	3.9	1.5	0.5	0.2	0.7

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

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13+
2004	543.0	330.6	329.7	147.7	421.5	150.2	79.8	40.2	10.1	2.2	0.5	0.1	0.1	0.1
2005	180.2	440.7	146.6	216.6	55.8	100.9	28.0	15.6	5.7	1.2	0.5	0.1	0.0	0.1
2006	276.0	479.0	509.7	186.1	205.6	59.9	69.8	17.6	8.1	2.6	0.6	0.2	0.0	0.0
2007	101.0	333.3	505.4	586.2	159.2	79.1	24.6	26.9	6.0	2.2	0.9	0.1	0.2	0.0
2008	483.4	130.9	372.6	652.6	483.4	132.3	51.1	12.8	17.5	3.3	0.9	0.2	0.2	0.2
2009	903.3	569.7	93.5	202.3	280.6	289.6	101.7	31.9	12.7	7.3	2.6	0.8	0.3	0.2
2010	652.6	310.3	84.2	56.8	177.0	397.2	424.9	142.7	38.5	10.5	6.8	1.6	0.3	0.3
2011	2083.0	509.8	160.0	123.6	101.5	240.2	300.4	178.4	32.3	7.7	1.8	1.3	0.6	0.3
2012	1412.7	1454.3	255.9	229.1	146.4	70.0	150.8	165.2	84.5	12.7	4.4	1.6	1.4	0.6
2013	2281.8	914.2	659.0	249.1	183.6	125.7	63.2	118.2	130.2	53.8	9.1	3.3	1.5	0.9
2014	2445.2	308.2	155.1	190.0	108.6	93.9	52.8	30.4	50.2	36.3	12.1	3.4	1.0	1.4
2014 *	***2445.2***	***339.0***	***184.0***	***226.3***	***122.2***	***103.4***	***67.7***	***42.1***	***81.3***	***78.9***	***28.1***	***4.7***	***1.3***	***1.5***
2015	350.9	725.3	154.0	174.4	225.2	141.3	72.6	48.6	26.2	35.3	26.6	7.9	1.7	1.0
2016	1164.8	350.8	341.3	77.2	93.7	121.6	70.1	44.4	27.2	13.8	13.2	5.4	1.7	1.4
2017	2316.3	757.5	260.6	375.0	141.5	104.9	120.9	62.6	28.0	11.2	6.4	4.4	4.5	2.7
2018*	***1841.2***	***2100.3***	***413.8***	***183.6***	***148.9***	***60.0***	***37.6***	***57.1***	***20.2***	***14.4***	***5.8***	***3.6***	***3.5***	***2.8***
2019	313.4	560.2	475.2	416.6	232.3	215.1	76.6	42.2	44.4	16.1	4.9	2.2	1.1	1.8
2020**	115.6	63.5	106.3	139.5	135.6	93.4	82.9	30.8	14.2	10.7	3.1	1.0	0.5	1.0
2021	749.1	62.1	51.2	84.7	99.8	81.1	45.7	33.6	12.4	4.7	5.0	2.4	1.0	0.7
2022***	399.2	218.2	39.6	25.6	32.8	34.4	33.8	18.6	9.8	2.5	0.8	0.5	0.1	0.2
2023	359.7	322.1	275.2	69.9	40.1	57.1	52.7	45.0	23.3	9.3	2.2	0.8	0.6	0.3
2024	300.9	226.0	237.0	234.4	68.2	46.8	41.0	29.0	14.5	7.7	2.5	0.6	0.2	0.1

*data adjusted taking into account not complete area coverage

** revised

*** incomplete and unsynoptic coverage

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

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2004		30	127	415	823	1464	2448	3266	4608	6323	9444	18331	13830	-	15924			
2005		37	162	428	985	1723	2553	3697	4808	5958	8583	7662	-	8799	-			
2006		39	155	473	1068	1759	2723	3725	5220	6798	10769	8904	9520	-	-			
2007		52	173	523	1237	2078	3004	4163	5860	7638	11251	-	12683	-	15529			
2008		39	193	511	1154	1958	3187	4262	5793	7741	9563	12039	11149	16320	-			
2009		29	164	462	989	1614	2453	4034	5313	6334	7595	8221	12001	12040	-			
2010		37	152	470	946	1634	2551	3801	5381	6921	7986	9063	8868	13406	19217			
2011		35	143	419	991	1672	2523	3500	4812	6826	9403	12623	10379	10945	-			
2012		34	149	418	904	1634	2388	3276	4344	6466	8459	9798	11181	14621	10895			
2013		28	129	429	918	1553	2249	3230	4443	5805	8454	9817	12531	14308	17723			
2014		28	148	374	897	1684	2244	3501	4511	5933	7183	7894	11979	7602	13250			
2015		28	149	414	823	1483	2297	3219	4490	5635	6962	8478	12148	10385	15370			
2016		45	162	527	914	1563	2308	3324	4492	6472	7476	8689	10939	7485	16645			
2017		37	185	441	953	1660	2414	3398	4821	5876	7173	8345	9968	12765	12445			
2018		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2019		28	103	386	899	1458	2208	3369	4508	6355	7734	9351	9147	11394	11403			
2020		38	125	343	864	1514	2311	3204	4609	6020	7589	8685	10474	12242	13537	10724	14504	19800
2021		41	200	359	714	1278	2224	3196	4482	6355	7527	9165	10910	12089		15930	17193	
2022*		33	171	499	828	1451	2415	3688	5088	7208	7524	12754	9535				17880	
2023		37	152	584	899	1533	2331	3371	5354	6170	7201	9392	9284	8430	15030			
2024		32	129	443	996	1763	2518	3436	4553	6207	6454							

*revised

** Biofox value

Table A16. Mean weight at age of cod (kg), combined data from Joint Barents Sea winter survey and Lofoten survey.

Year/age	1	2	3	4	5	6	7	8	9	10	11
1985	0.02	0.171	0.576	1.003	2.018	3.386	4.696	6.636	8.245	10.321	14.290
1986	0.02	0.119	0.377	0.997	1.645	3.010	4.488	6.518	4.218	0.000	13.480
1987	0.021	0.065	0.23	0.49	1.390	2.155	3.913	5.438	0.322		12.550
1988	0.024	0.114	0.241	0.492	0.907	2.116	3.269	4.937	3.635	13.640	
1989	0.016	0.158	0.374	0.604	0.948	1.581	2.762	4.791	8.835	8.582	
1990	0.026	0.217	0.58	1.009	1.436	2.010	2.716	3.995	5.425	8.992	
1991	0.018	0.196	0.805	1.364	2.067	2.764	3.532	4.945	7.401	11.645	5.350
1992	0.02	0.136	0.619	1.118	1.994	2.808	3.975	5.376	6.352	8.034	9.500

1993	0.009	0.071	0.415	1.179	1.745	2.675	3.686	5.399	6.280	7.680	9.280
1994	0.013	0.056	0.262	0.796	1.557	2.624	4.181	5.846	6.675	7.966	7.778
1995	0.015	0.054	0.24	0.658	1.364	2.565	4.124	5.326	7.379	9.895	9.738
1996	0.015	0.062	0.232	0.627	1.098	2.094	3.742	5.586	7.866	10.057	10.502
1997	0.013	0.052	0.23	0.638	1.185	1.918	3.433	5.515	8.889	10.408	12.405
1998	0.011	0.052	0.28	0.635	1.183	1.731	2.667	4.362	7.259	10.577	11.657
1999	0.014	0.059	0.231	0.592	1.180	1.964	2.978	4.200	5.980	8.848	9.642
2000	0.016	0.074	0.21	0.558	1.222	2.001	3.064	3.862	5.365	6.471	8.379
2001	0.014	0.106	0.336	0.646	1.319	2.371	3.257	5.078	6.186	10.084	10.558
2002	0.014	0.067	0.238	0.747	1.244	2.199	3.344	4.669	6.554	8.078	9.277
2003	0.013	0.061	0.234	0.597	1.335	2.080	3.207	4.643	6.206	7.649	17.062
2004	0.011	0.059	0.275	0.608	1.177	2.083	2.870	4.411	5.889	7.752	9.310
2005	0.013	0.061	0.246	0.723	1.166	2.068	3.114	3.852	5.877	8.538	14.573
2006	0.013	0.069	0.28	0.669	1.421	2.083	3.009	4.212	5.501	6.881	7.646
2007	0.019	0.073	0.235	0.639	1.351	2.334	3.340	4.923	6.598	9.649	11.132
2008	0.015	0.09	0.335	0.798	1.402	2.482	3.282	5.015	6.863	8.598	7.822
2009	0.013	0.083	0.294	0.704	1.320	2.302	4.089	5.152	6.611	9.391	8.657
2010	0.012	0.064	0.304	0.7	1.300	2.082	3.251	4.951	6.366	8.095	9.757
2011	0.015	0.066	0.246	0.668	1.146	2.050	2.830	4.367	6.592	8.681	9.647
2012	0.013	0.062	0.252	0.609	1.295	1.792	2.664	3.827	5.551	8.373	11.741
2013	0.011	0.065	0.269	0.602	1.212	2.163	2.988	4.103	5.292	7.782	9.842
2014	0.008	0.05	0.246	0.603	1.228	1.804	3.121	3.975	5.015	6.018	7.575
2015	0.01	0.044	0.242	0.602	1.227	1.936	2.849	4.015	4.981	6.630	8.187
2016	0.013	0.053	0.2	0.593	1.051	1.936	2.835	4.240	6.315	7.431	8.541
2017	0.015	0.102	0.292	0.72	1.181	2.024	3.026	4.363	5.817	7.223	8.405
2018	0.012	0.069	0.32	0.688	1.251	2.099	2.890	4.246	5.893	7.356	9.512
2019	0.012	0.048	0.273	0.685	1.165	1.908	3.139	4.384	5.833	7.221	8.788
2020	0.014	0.044	0.153	0.548	1.089	1.729	2.650	4.133	5.633	7.455	8.566
2021	0.014	0.068	0.164	0.462	0.918	1.721	2.696	3.807	5.916	7.314	8.762
2022	0.011	0.077	0.311	0.535	1.061	1.801	2.953	4.079	5.915	8.126	9.399
2023	0.012	0.071	0.316	0.694	1.113	1.782	2.997	4.330	5.537	6.824	9.661
2024	0.012	0.057	0.289	0.701	1.133	1.876	2.666	3.991	5.262	6.370	9.367
2025	0.013	0.051	0.217	0.648	1.176	1.781	2.700	3.598	5.184	6.370	7.983

Chapter 4. Haddock in subareas 1 and 2 (Northeast Arctic)

Introductory note

On 30th March 2022 all Russian participation in ICES was suspended. The AFWG report 2025 chapter on haddock was therefore not updated.

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

Status of the fisheries

Historical development of the fisheries

Haddock is mainly fished by trawl as bycatch in the fishery for cod. Also, a directed trawl fishery for haddock is conducted. The proportion of the total catches taken by direct fishery varies between years. On average approximately 70% of the catches are taken by trawl. Norway takes about half of the quota with other gear, in particular long line and Danish seine. Danish seine has become more important in the Norwegian fisheries the last 10 years. Some of the longline catches are from a directed fishery, which is restricted by national quotas. In the Norwegian management, the quotas are set separately for trawl and other gears. The fishery is also regulated by a minimum landing size (40 cm), a minimum mesh size in trawls and Danish seine, a maximum bycatch of undersized fish, closure of areas with high density/catches of juveniles and other seasonal and area restrictions.

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

The exceptionally strong year classes 2005–2006 contributed to the strong increase to all-time high stock levels and high catch levels in the last decade. Their importance in the catches is currently minimal. Currently, the 2017 year-class dominated the catches, with 30% of the total catch in t. The strong 2016 constituted 14% of the catches, the contribution of fish older than eight years of age was negligible.

Catches prior to 2025 (Table 4.1–Table 4.3, Figure 4.1)

The highest landings of haddock historically were 322 kt in 1973. Since 1973 the highest catches observed was 316 kt in 2012. The landings in 2018-2024 were below 200 kt (Figure 4.1).

Provisional official landings for 2024 are about 140 kt, which below the agreed TAC (141 kt) but 11 % above the advice (128 kt).

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

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

2011/ACOM:38; Table 4.1).

We continue to include the estimates of IUU catches 2002–2008. The IUU catches are assumed to be negligible for the period 2009–2024 and therefore set to zero.

Catch advice and TAC for 2025

The catch advice for 2025 was 107 k t – a 24% reduction from the year before, following the Harvest Control Rule, and a F of 0.35. The Joint Norwegian-Russian Fisheries Commission set the TAC to 130 kt, which is 22% higher than the advice and not in accordance with the HCR. Russia and Norway can transfer the unused part of their own quota, restricted to a maximum of 10% of own quotas from 2024 to 2025. The catch in 2024 was close to the agreed TAC.

Status of research

Survey results

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

The Joint Barents Sea winter survey provides two index series used for tuning and recruitment forecast (bottom trawl: FLT02, NoRu-BTr-Q1 and acoustics: FLT04, NoRu-Aco-Q1). The survey area has been extended from 2014 with additional northern areas (N) covered. The extended area is now included in total and standard survey index calculations for haddock (WKDEM 2020) and is done using the StoX software (Johnsen et al. 2019). Overall, this survey tracks both strong and poor year classes well. The indices from the Joint winter survey of cod and haddock in the Barents Sea are provided in the annual survey reports from this survey (e.g., Godiksen et al. 2025). Due to challenging weather conditions, the coverage in parts of the survey area was lacking. In 2025, the survey did parts of strata 13 and 14 which was strata with the highest densities of haddock, leading to increased unquantifiable uncertainty in the abundance estimates from this survey.

The Joint Barents Sea ecosystem survey provides indices by age from bottom trawl data (FLT007, Eco-NoRu-Q3 Btr) used for tuning and recruitment forecast. At the benchmark in 2011 it was decided to include this survey as tuning series. Tuning indices by age from the Joint ecosystem survey is calculated using the BIOFOX programme (Prozorkevich and Gjøsæter 2014). The survey covered the distribution of haddock well in 2024. The estimates for cod and haddock are provided to the group as an excel file.

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

Data used in the assessment

Catch-at-age (Table 4.4)

Relevant data of estimated catch-at-age was obtained from InterCatch for the period 2008–2020 and is presented together with historical values from 1950–2007 in Table 4.4. Catch at age from 2021 to 2024, instead of using InterCatch, the same algorithm was realized in Excel. Excel was used for comparison with InterCatch for data 2008-202 0 , and no differences between InterCatch and Excel allocations were detected.

Age and length composition of the landings in 2024 were available from Norway and Russia in Subarea 1, Division 2.a and 2b. Norwegian catch at age data was calculated using StoX-R Eca. International landings data were downloaded from https://data.ices.dk/ except for Belarus that reports directly to Russian authorities. Data was combined in excel as for 2021-2024. The biological sampling of NEA haddock catches is considered good for the most important ages in the fisheries.

Catch-weight-at-age (Table 4.5)

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

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).

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, see stock annex for details).

Natural mortality (Table 4.8)

Natural mortality used in the assessment was 0.2. For ages 3–6 mortality predation by cod is added (see stock annex). For the period from 1984 and onwards actual estimates of predation by cod was used. For the years 1950–1983 the average natural mortality for 1984–202 4 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.

Data for tuning (Table 4.9)

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

Name	Acronym	Place	Season	Age	Year	prior weight
FLT01: Russian bottom trawl	RU-BTr-Q4	Barents Sea	October–December	3–8+	1991–2017	1
FLT02: Joint Barents Sea survey–acoustic	BS-NoRU-Q1(Aco)	Barents Sea	February–March	3–9+	1993–2025	1
FLT04: Joint Barents Sea survey–bottom trawl	BS-NoRu-Q1 (BTr)	Barents Sea	February–March	3–10+	1994–2025	1
FLT007: Joint Russian-Norwegian ecosystem autumn survey in the Barents Sea–bottom trawl	Eco-NoRu-Q3 (Btr)	Barents Sea	August–September	3–9+	2004–2024	1

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

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

Natural mortality includes cod predation for the ages 3–6. The data from 1984 and onwards are updated every year after the update of the cod assessment. The averages from 1994-2024 are used for the historic period (1950–1983) and were updated and used in the assessment.

Assessment models and settings (Table 4.10)

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

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

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

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

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

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

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

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 combined with reduced fishing pressure. Since then, the stock has declined (Table 4.11; Figure 4.1).

The estimated SSB for 2025 is at the lowest levels since 2003. The estimate of SSB for 2025 is 149 kt which is above MSY $B_{trigger}$ = 80kt (Figure 4.1). The residuals and retrospective patterns are shown in Figure 4.2 and 4.3.

Fbar has increased since 2013 and has been over F_{msy} from 2017.

Comparison with last year's assessment (Figure 4.4)

The text table below compares this year's estimates with last year's estimates. Compared to last year, the current estimates of the total stock (TSB) in 2024 is 2 % higher whereas the spawning stock (SSB) estimate is 9% higher. Fbar in 2023 was the same as last year's assessment. Current estimates for 2025 for ages 3- 4 and 8-9 were lower compared to last year's assessment. The estimates of 5-7 and 10-13+ were higher or identical, contributing the higher 2024 SSB estimates compared to last year's assessment. Ratios are calculated on original numbers (not rounded as shown in table).

Assessment year, model	F (2023)	Numbers 2024 (ages)											SSB (2024)	(2
		3	4	5	6	7	8	9	10	11	12	13+		
2024 SAM	0.45	469037	105164	18270	52217	44856	34295	4681	1276	611	321	713	150433	4

2025 SAM	0.45	427761	100331	25683	57426	51877	30239	4196	1301	610	367	778	163226	42
Ratio 2025/2024	1.0	0.91	0.95	1.41	1.10	1.16	0.88	0.90	1.02	1.00	1.14	1.09	1.09	

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

XSA (Figure 4.5)

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

The estimated consumption of NEA haddock by NEA cod is incorporated into the XSA analysis by first constructing a catch number-at-age matrix, adding the numbers of haddock eaten by cod to the catches for the years where such data are available (1984–2024). The summary of XSA stock estimates with shrinkage value 0.5 are presented in Table 4.15. A retrospective estimate for XSA gave same signals as for the main model SAM (Figure 4.5).

TISVPA (Figure 4.5)

The TISVPA (Triple Instantaneous Separable VPA) model (Vasilyev 2005, 2006) represents fishing mortality coefficients (more precisely – exploitation rates) as a product of three parameters: f(year)*s(age)*g(cohort). The generation-dependent parameters, which are estimated within the model, are intended to adapt traditional separable representation of fishing mortality to situations when several year classes may have peculiarities in their interaction with fishing fleets caused by different spatial distribution, higher attractiveness of more abundant schools to fishers, or by some other reasons. The TISVPA model was presented at benchmark groups for haddock stock (WKARCT 2015, WKDEM, 2020) and it was decided to apply to NEA haddock using the same data as SAM except that natural mortality values from cannibalism were taken from the SAM runs. All the input data, including catch-at-age, weight-at-age in stock and in catches, maturity-at-age were the same as used in SAM. All results of model run presented in WD #5. Generally, the biomass estimates of this model were higher than SAM estimates, which can be explained by different assumptions about catchability of indices. The retrospective pattern for TISVPA shows the same trends as both the SAM and XSA models (Figure 4.5).

Model comparisons (Figure 4.6)

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

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

Recruitment (Table 4.16–Table 4.17)

SAM was used to estimate the recruitment at age 3 of the 2022 year-class in 2025. The RCT3 program (R version) was used to estimate the recruiting year classes 2023–2024 in 2026 and 2027 with survey data from the ecosystem survey and winter survey (acoustics and bottom trawl). Input data and results are shown in

Tables 4.16 and 4.17, respectively.

The text table below shows the recruitment estimates for the year classes 2008–2024 from assessments and RCT3 forecasts (shaded cells). In the most recent years, it is noticeable that the 2018 year-class was less than 50% of the initial RCT3 estimate: The SAM estimates for the following year classes were higher than the RCT3 estimates, the 2020 year class were estimated by SAM to be 75% than the initial RCT3 estimate, respectively.

Year Class	Year of assessment, base model															
	2011 XSA	2012 XSA	2013 XSA	2014 XSA	2015 XSA	2015 SAM	2016 SAM	2017 SAM	2018 SAM	2019 SAM	2020 SAM	2021 SAM	2022 SAM	202 3 SAM	202 4 SAM	2025 SAM
2008	120	151	155	169	178	89	157	107	109	110	122	117	119	118	117	117
2009	315	320	345	357	363	230	351	294	291	293	356	340	344	335	331	333
2010	188	146	137	146	150	100	133	105	105	106	124	119	120	118	117	117
2011		483	513	482	398	298	397	340	329	332	425	411	415	407	400	402
2012			124	145	104	78	73	79	70	68	75	72	73	73	72	72
2013				394	290	197	235	184	174	177	219	213	215	212	206	207
2014					279	198	247	189	146	148	202	194	198	195	191	193
2015							422	398	333	336	384	368	370	363	353	354
2016								1067	933	930	875	822	831	808	775	776
2017									577	629	497	442	449	432	414	415
2018										344	294	154	164	161	154	156
2019											39	31	38	47	45	45
2020												95	89	158	164	166
2021													303	372	514	428
2022														231	360	532
2023															387	433
2024																649

Prediction data (Table 4.18, Figure 4.7)

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

Stock numbers for 2026–2027 at age 3 are taken from RCT3, and abundance-at-ages 3–13+ in 2025 from the SAM assessment.

The average fishing pattern observed in 2022–2024 scaled to F in 2024 was used for distribution of fishing mortality-at-age for 2025–2027 (Figure 4.7). The proportion of M and F before spawning was set to 0.

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

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.

Fishing mortality reference points (Figure 4.1)

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

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

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

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

Harvest control rule

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

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

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

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

Prediction results and catch options for 2026 (Table 4.19–Table 4.20)

The projection shows an increase in SSB from 128 kt in 2025 to 158 kt in 2026 (Table 4.19). TAC constraint F is used for 2025. The TAC set by the Joint Norwegian-Russian Fisheries Commission was 130 kt, which is 22% higher than the advice and not in accordance with the HCR.

Catch options for 2026 are shown in the text table below (weights in tonnes).

Basis	**Total catch (2026)**	**F ages 4−7 (2026)**	**SSB (2027)**	**% SSB change ***	**% TAC change ****	**% Advice change *****
Advice basis						
Management plan	153 293	0.35	195 888	24	18	43
Other scenarios						
MSY approach: F_{MSY}	153 293	0.35	195 888	24	18	43
F = 0	0	0.00	265 334	6 8	-100	-100
F = F2025	172 237	0.4 0	1 87 7 14	19	32	61
F_{pa}	197 014	0.47	177178	12	52	8 4
F_{lim}	290 750	0.77	139 065	-1 2	124	172

* SSB 2027 relative to SSB 2026.

** Catch in 2026 relative to TAC in 2025 (130000 t)

*** Catch value for 2026 relative to advice value for 2025 (106912 t))

Detailed information about expected catches by following the HCR in 2026 and 2027 is given in Table 4.20. The forecast covers all catches. It is then implied that all types of catches are to be counted against this TAC.

Comments to the assessment and predictions (Figure 4.2-4.4 and Figure 4.7- 4.8)

The one step ahead residuals did not show strong patterns (Figure 4.2). The leave one out analysis did not result in any large changes to the results (maximum change: 11% larger R3 2025 leave out BS-NoRu-Q1 (Btr)).

The retrospective bias was reduced after the revision at the 2020 benchmark (WKDEM 2020). Mohn's Rho has increased compared to the years following the benchmark, especially for SSB, but was slightly lower from the assessment of this year, compared to that of last year (Figure 4.3). This year's assessment, like the assessment of last year, showed a downwards revision for the SSB and TSB and an upwards revision for F_{bar4-7} with changes most apparent for the estimates back to 2018/2019 (Figure 4.4).

Retrospective bias (Mohn's Rho), 5-year peel	**R**	**SSB**	**F**	**TSB**

AFWG 2018	−3%	24%	−7%	14%
AFWG 2019	−5%	18%	−7%	7%
WKDEM 2020 (Benchmark)	−2%	3%	−3%	1%
AFWG 2020	−4%	−3%	0%	−5%
AFWG 2021	1%	6%	−7%	3%
JRN_AFWG 2022	-2%	5%	-6%	1%
JRN_AFWG 2023	0%	7%	-6%	3%
JRN_AFWG 2024	4%	17%	-13%	12%
JRN_AFWG 2025	2%	16%	-12%	11%

The 2015-2017 year-classes that have dominated the catches are now being fished out and the following 2018-2020 year-classes are weak, so there are few older fish in the stock (Figure 4.8). The 2021 - 2023 year-classes are estimated to be above average, although the precise level of these estimates for the youngest fish are uncertain.

In the forecast, 31% and 37% of the catches in 2025 and 2026 respectively are expected to come from the 2021 year-class. The 2022 year-class is expected to contribute 11% of the catches as 3-year-olds 2025, but a large proportion 3-year-olds are expected to be below minimum catching size. The population average of the 2022 year-class is expected to become larger than 40 cm (minimum catching size) during 2026 and is forecasted to contribute 29% of the catches in that year. However, the prediction is highly dependent on the selectivity (when and where the fishing takes place) and growth of the year-class. In the recent years, the Russian fishery has moved further east, where the growth of the haddock tends to be slower.

A high proportion of the catches in 2025 and 2026 is predicted to be made up by immature fish, implying growth overfishing, this implies that a large proportion of the fish are caught before they reach the optimum catching size. This will result in a significant loss in overall yield.

Also, typically, haddock grows above the minimum catching size during the year they are 4 years old. The selectivity pattern used in the forecast does not currently depend on the expected growth of a cohort and the proportion of fish by age above minimum catching size. The effect on the selectivity pattern of large incoming year-classes should be further explored in future method revision, like what has been implemented for Icelandic haddock (ICES 2025).

References

Berg CW and Nielsen A. 2016. Accounting for correlated observations in an age-based state-space stock assessment model. ICES Journal of Marine Science, 73: 1788–1797.

Breivik ON, Nielsen A and Berg CW 2021. Prediction–variance relation in a state-space fish stock assessment model. ICES Journal of Marine Science, 78, 3650–3657

Fall, J., Wenneck, T. de Lange, Bogstad, B., Fuglebakk, E., Godiksen, J., Høines, E. Johannesen, Å., Korsbrekke, K., Skage, M. L., Staby, A., Tranang, C. Aa., Windsland, K., Russkikh, A. A., and Kharlin, S. 2023. Fish investigations in the Barents Sea winter 2023. IMR-PINRO Joint Report Series 1-2023, 100 pp.

ICES 2006a. ICES Workshop on Biological Reference Points for North East Arctic Haddock (WKHAD). Svanhovd, Norway, 6-10 March 2006. ICES C.M. 2006/ACFM:19, 102 pp.

ICES 2006b. Report of the Arctic Fisheries Working Group, 19-28 April. 2006. ICES C.M. 2006/ACFM:25, 594 pp.

ICES 2011. Report of the Benchmark Workshop on Roundfish and Pelagic Stocks, Lisbon 24-31 January 2011. ICES C.M. 2011/ACOM:38, 418 pp.

ICES 2015. Report of the first Workshop on Management Plan Evaluation on Northeast Arctic cod and haddock and Barents Sea capelin (WKNEAMP-1) , , . ICES CM 2015/ACOM:60, 27 pp.

ICES 2016. Report of the second Workshop on Management Plan Evaluation on Northeast Arctic cod and haddock and Barents Sea capelin (WKNEAMP-2) , 25-28 January 2016, Kirkenes, Norway. ICES CM 2016/ACOM:47, 76 pp.

ICES. 2015. Report of the Benchmark Workshop on Arctic Stocks (WKARCT), 26-30 January 2015, ICES Headquarters, Denmark. ICES CM 2015\ACOM:31. 126 pp.

ICES 2020. Report of the Arctic Fisheries Working Group (AFWG). ICES Scientific Reports. 2:52. 577 pp.

ICES 2025. Workshop on the assessment and Management Plan Evaluation for Icelandic haddock and saithe (WKICEGAD). ICES Scientific Reports. 7:26. 161 pp. https://doi.org/10.17895/ices.pub.28444499

Johnsen E, Totland A , Skålevik Å , et al. 2019. StoX: An open source software for marine survey analyses. Methods in Ecology and Evolution 2019; 10: 1523 – 1528.https://doi.org/10.1111/2041-210X.13250

Prozorkevich D and Gjøsæter H 2014. WD_02 cod BESS_assessment. AFWG 2014.

Vasilyev D. 2005 Key aspects of robust fish stock assessment. M: VNIRO Publishing, 2005. 105 p.

Vasilyev D. 2006. Change in catchability caused by year class peculiarities: how stock assessment based on separable cohort models is able to take it into account? (Some illustrations for triple-separable case of the ISVPA model - TISVPA). ICES CM 2006/O:18. 35 pp

WKDEM 2020. Benchmark Workshop for Demersal Species (WKDEM). ICES Scientific Reports. 2:31. 136 pp. http://doi.org/10.17895/ices.pub.5548

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	-

Year	Subarea 1	Division 2.a	Division 2.b	un-reported	Total	Norw. stat.areas 06 and 07
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
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

Year	Subarea 1	Division 2.a	Division 2.b	un-reported	Total	Norw. stat.areas 06 and 07
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
2018	80902	58522	51853	0	191276	4437
2019	87446	50967	36989	0	175402	2812
2020	98341	57397	26730	0	182468	3196
2021	109914	58006	36823	0	204743	2363
2022	85887	63415	27604	0	176906	-
2023(1	92760	70916	15223	0	178899	-
2024(1	70393	59778	9821	0	139992	-

1) Provisional figures, preliminary catches estimated by JRN AFWG in May 2025

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	-	-

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

	Subarea 1		Division 2.a		Division 2.b		Unreported
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
2015	49.1	26.1	34.6	27	48.5	9.4	0
2016	56.4	22.3	62.5	32.5	45.4	14.1	0
2017	65	29.8	50.7	24.7	47.1	10.3	0
2018	51.7	29.2	36.9	21.6	43.2	8.6	0
2019	53.9	33.5	30.4	20.4	31.0	5.9	0
2020	66.7	31.6	35.1	22.3	23.2	3.5	0
2021	81.4	28.5	41.0	17.0	31.0	5.8	0
2022	63.4	22.5	44.7	18.7	22.1	5.5	0
2023 (1	69.6	23.2	51.7	19.2	11.1	4.1	0
2024(1	52.7	17.7	35.9	23.8	4.9	5.0	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) & Greenland (1992–)	Germany	Norway	Poland	UK	Russia	Others	Total
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	-	**Greenland**	213	22178	-	514	12177	17	36216
1992	1093	151	1719	387	36238	38	596	19699	1	59922
1993	546	1215	880	1165	40978	76	1802	35071	646	82379
1994	2761	678	770	2412	71171	22	4673	51822	877	135186
1995	2833	598	1097	2675	76886	14	3111	54516	718	142448
1996	3743	6	1510	942	94527	669	2275	74239	217	178128
1997	3327	540	1877	972	103407	364	2340	41228	304	154359
1998	1903	241	854	385	75108	257	1229	20559	94	100630
1999	1913	64	437	641	48182	652	694	30520	92	83195
2000	631	178	432	880	42009	502	747	22738	827	68944
2001	1210	324	553	554	49067	1497	1068	34307	1060	89640
2002	1564	297	858	627	52247	1505	1125	37157	682	114798
2003	1959	382	1363	918	56485	1330	1018	41142	1103	138926
2004	2484	103	1680	823	62192	54	1250	54347	1569	158279
2005	2138	333	15	996	60850	963	1899	50012	1262	158751
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	249200
2011	1759	268	2110	1724	158202	502	1379	139912	4763	309785

Year	Faroe Islands	France	GDR (–1990) & Greenland (1992–)	Germany	Norway	Poland	UK	Russia	Others	T ot al
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	233416
2017	2776	108	1810	170	113132	228	372	106714	2279	227588
2018	2333	183	1317	385	93839	169	453	90486	2173	191276
2019	1515	143	1208	204	93860	280	456	76125	1611	175402
2020	1392	96	910	282	88108	45	320	89030	2286	182468
2021	1722	105	1101	365	100673	131	78	98296	2390	204743
2022	1831	164	1101	268	89044	99	138	82364	1897	176906
2023 (1	1993	235	672	296	91325	139	112	81751	2376	178899
2024 (1	1637	188	645	180	71226	0	152	64423	1541	139992

1) Provisional figures, preliminary catches estimated by JRN AFWG in May 2024., 2) USSR prior to 1991, 3) Figures based on Norwegian IUU estimates in 2002–2008 (see table 4.1), 4) Included landings in Norwegian statistical areas 06 and 07 (from 1983)

Table 4. 4 . Northeast Arctic haddock. Catch numbers-at-age (numbers, ´000).

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950	0	4446	3189	37949	35344	18849	28868	9199	1979	1093	853	867	1257
1951	4069	222	65643	9178	18014	13551	6808	6850	3322	1182	734	178	436
1952	0	13674	6012	151996	13634	9850	4693	3237	2434	606	534	185	161
1953	392	8031	64528	13013	70781	5431	2867	1080	424	315	393	202	410
1954	1726	493	6563	154696	5885	27590	3233	1302	712	319	126	68	349
1955	0	989	1154	10689	176678	4993	28273	1445	271	100	50	30	20
1956	97	3012	16437	5922	14713	127879	3182	8003	450	200	80	60	45
1957	828	243	2074	24704	7942	12535	46619	1087	1971	356	17	40	119
1958	153	2312	1727	5914	31438	5820	12748	17565	822	1072	226	79	296
1959	169	2425	20318	7826	7243	14040	3154	2237	5918	285	316	71	113
1960	2319	3613	39910	70912	13647	7101	6236	1579	2340	2005	497	70	42
1961	362	5531	15429	56855	63351	8706	3578	4407	788	527	1287	67	80
1962	0	4524	39503	30868	48903	33836	3201	1341	1773	242	247	483	28
1963	3	2143	28466	72736	18969	13579	9257	1239	559	409	80	84	212
1964	149	834	22363	49290	30672	5815	3527	2716	833	104	206	235	190
1965	0	3498	5936	46356	40201	12631	1679	974	897	123	204	123	471

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
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
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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
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
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	6 640	1872	317
2018	679	1438	9424	16291	34060	8466	18882	5123	8902	4125	3564	4504	1040
2019	797	968	13908	28572	24171	32555	6278	6803	2601	3618	1225	1715	1400
2020	122	1298	10797	62206	46715	18137	10773	3051	2839	1445	996	915	1092
2021	263	641	2882	31573	99086	31202	7412	3595	1985	1161	814	802	966
2022	49	752	2836	18050	50522	55469	11172	2368	1016	544	285	335	479
2023	60	6615	10603	8935	29024	46726	27135	3052	888	337	175	222	313
2024	42	1420	18364	18151	11128	22770	23900	9319	953	388	152	158	262

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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
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
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

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1996	0.287	0.427	0.683	0.868	1.045	1.363	1.71	1.886	2.214	2.37	2.438	2.707	2.896
1997	0.408	0.575	0.682	1.028	1.151	1.369	1.637	1.856	2.073	2.5	2.279	2.532	2.609
1998	0.409	0.593	0.748	0.974	1.262	1.433	1.641	1.863	2.069	2.335	2.511	2.8	2.849
1999	0.435	0.695	0.826	1.079	1.261	1.485	1.634	1.798	2.032	2.237	2.339	2.611	2.865
2000	0.378	0.577	0.853	1.186	1.395	1.588	1.808	1.989	2.264	2.415	2.587	2.647	3.098
2001	0.391	0.647	0.751	1.104	1.459	1.709	1.921	2.182	2.331	2.609	2.757	3.376	3.338
2002	0.159	0.407	0.687	1.001	1.363	1.643	1.975	2.086	2.294	2.487	2.612	2.847	3.501
2003	0.198	0.384	0.594	0.875	1.113	1.364	1.361	1.972	1.636	1.877	2.088	2.351	2.842
2004	0.328	0.429	0.636	0.886	1.183	1.508	1.821	2.075	2.339	2.58	2.527	3.153	3.197
2005	0.285	0.492	0.722	0.906	1.121	1.343	1.619	2.036	2.177	2.382	2.527	2.496	2.81
2006	0.311	0.567	0.745	1.041	1.287	1.504	1.72	2.082	2.377	2.738	3.082	3.02	3.43
2007	0.329	0.431	0.652	0.899	1.197	1.435	1.722	1.99	2.309	2.715	2.987	2.947	3.591
2008	0.383	0.484	0.658	0.901	1.242	1.515	1.781	2.18	2.33	2.664	3.019	3.326	3.829
2009	0.378	0.508	0.707	1.024	1.28	1.538	1.806	2.107	2.398	2.531	2.606	3.089	3.541
2010	0.317	0.499	0.642	0.887	1.137	1.396	1.702	1.907	2.095	2.404	2.534	3.064	3.249
2011	0.423	0.513	0.811	0.953	1.093	1.254	1.462	1.715	1.978	2.328	2.305	2.55	2.76
2012	0.271	0.506	0.756	1.004	1.174	1.371	1.514	1.715	2.051	2.444	2.414	2.615	2.932
2013	0.469	0.542	0.821	1.014	1.217	1.401	1.571	1.714	1.914	2.168	2.24	2.516	2.807
2014	0.469	0.645	0.792	1.033	1.253	1.417	1.625	1.793	1.941	2.081	2.479	2.703	3.011
2015	0.473	0.647	0.876	1.054	1.327	1.571	1.777	1.934	2.025	2.216	2.481	2.99	3.455
2016	0.497	0.743	0.882	1.115	1.369	1.662	1.917	2.089	2.301	2.567	3.076	3.286	3.331
2017	0.449	0.608	0.874	1.088	1.378	1.666	1.879	2.146	2.258	2.476	2.72	2.98	3.713
2018	0.443	0.663	0.820	1.051	1.339	1.629	1.927	2.156	2.372	2.588	2.728	2.773	3.175
2019	0.341	0.508	0.729	0.955	1.275	1.581	1.834	2.151	2.378	2.607	2.868	2.934	3.382
2020	0.364	0.523	0.629	0.788	1.131	1.489	1.821	2.126	2.426	2.651	2.771	3.147	3.359
2021	0.257	0.445	0.57	0.773	0.997	1.351	1.716	2.15	2.388	2.682	3.073	3.201	4.139
2022	0.175	0.436	0.642	0.808	1.093	1.329	1.651	2.031	2.473	2.727	3.000	3.278	4.297
2023	0.248	0.394	0.684	1.02	1.203	1.458	1.673	1.98	2.334	2.676	3.122	3.223	3.849
2024	0.21	0.418	0.627	0.896	1.233	1.463	1.719	1.957	2.263	2.695	2.946	3.529	3.964

Table 4. 6 a. Northeast Arctic haddock. Smoothed stock weights-at-age (kg). The data from 1950–1993 is unchanged since AFWG 2019, the data from 1994 and onward have been updated this year.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1950-1979	0.031	0.145	0.354	0.653	1.016	1.427	1.867	2.327	2.771	3.195	3.597	3.597	3.597
1980	0.063	0.262	0.454	0.878	1.159	1.675	2.292	3.134	3.31	3.553	3.792	3.792	3.792
1981	0.051	0.274	0.603	0.805	1.315	1.582	2.118	2.728	3.51	3.679	3.904	3.904	3.904
1982	0.036	0.224	0.631	1.049	1.217	1.782	2.017	2.553	3.14	3.853	4.016	4.016	4.016

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
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

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

Year	3	4	5	6	7	8	9	10	11	12	13
1994	0.252	0.505	0.94	1.652	2.166	2.708	2.86	2.826	2.973	3.618	4.157
1995	0.263	0.472	0.798	1.316	2.121	2.643	3.161	3.29	3.222	3.173	3.932
1996	0.28	0.488	0.747	1.137	1.721	2.577	3.088	3.604	3.697	3.398	3.476
1997	0.345	0.518	0.77	1.072	1.496	2.13	3.03	3.524	4.02	3.864	3.715
1998	0.345	0.625	0.816	1.101	1.418	1.88	2.541	3.46	3.951	4.157	4.175
1999	0.365	0.63	0.974	1.159	1.452	1.778	2.271	2.966	3.881	4.087	4.464
2000	0.294	0.665	0.98	1.366	1.523	1.829	2.155	2.665	3.36	4.035	4.391
2001	0.307	0.54	1.028	1.374	1.77	1.911	2.212	2.547	3.045	3.538	4.336
2002	0.274	0.563	0.853	1.433	1.78	2.198	2.295	2.599	2.916	3.247	3.848
2003	0.249	0.505	0.883	1.205	1.851	2.198	2.606	2.691	2.987	3.114	3.554
2004	0.289	0.463	0.805	1.243	1.578	2.28	2.618	3.038	3.089	3.173	3.429
2005	0.285	0.532	0.742	1.137	1.625	1.975	2.71	3.038	3.438	3.276	3.491
2006	0.294	0.532	0.834	1.057	1.506	2.03	2.367	3.14	3.438	3.618	3.586
2007	0.224	0.545	0.834	1.182	1.4	1.88	2.428	2.771	3.55	3.618	3.932
2008	0.222	0.417	0.859	1.182	1.559	1.769	2.271	2.84	3.163	3.715	3.932
2009	0.249	0.417	0.672	1.212	1.55	1.943	2.144	2.665	3.237	3.352	4.017
2010	0.292	0.467	0.667	0.962	1.587	1.943	2.342	2.522	3.06	3.413	3.666
2011	0.297	0.536	0.742	0.962	1.284	1.987	2.331	2.744	2.902	3.247	3.732
2012	0.372	0.549	0.846	1.057	1.284	1.632	2.38	2.73	3.133	3.1	3.554
2013	0.341	0.67	0.865	1.198	1.4	1.623	1.989	2.784	3.133	3.322	3.398
2014	0.393	0.625	1.042	1.22	1.569	1.769	1.977	2.359	3.177	3.322	3.634
2015	0.355	0.708	0.974	1.451	1.597	1.965	2.144	2.348	2.724	3.367	3.634

2016	0.361	0.645	1.092	1.358	1.872	1.997	2.355	2.522	2.71	2.916	3.683
2017	0.351	0.655	1.001	1.514	1.77	2.304	2.391	2.757	2.902	2.916	3.232
2018	0.277	0.64	1.015	1.399	1.945	2.187	2.737	2.798	3.148	3.1	3.217
2019	0.258	0.514	0.994	1.417	1.811	2.388	2.606	3.154	3.192	3.337	3.413
2020	0.272	0.48	0.811	1.391	1.83	2.233	2.819	3.023	3.566	3.383	3.65
2021	0.297	0.505	0.759	1.152	1.8	2.257	2.658	3.259	3.422	3.732	3.699
2022	0.334	0.549	0.798	1.086	1.514	2.233	2.685	3.08	3.663	3.602	4.052
2023	0.272	0.616	0.865	1.137	1.435	1.89	2.645	3.11	3.486	3.831	3.915
2024	0.297	0.501	0.96	1.22	1.496	1.799	2.282	3.067	3.517	3.666	4.139
2025	0.258	0.549	0.798	1.341	1.597	1.87	2.178	2.677	3.486	3.699	3.966

Table 4. 7 a. Northeast Arctic haddock. Proportion mature at age. The data from 1950-1993 is unchanged since AFWG 2019. Age 1-2 are 0, and ages 11-13+ set to 1 (not shown).

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

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

Year	3	4	5	6	7	8	9	10
1994	0.027	0.087	0.281	0.665	0.864	0.956	0.968	0.964
1995	0.029	0.078	0.215	0.52	0.854	0.95	0.985	0.985
1996	0.031	0.082	0.193	0.431	0.745	0.943	0.98	0.994
1997	0.043	0.09	0.203	0.397	0.66	0.878	0.977	0.992
1998	0.043	0.124	0.223	0.411	0.627	0.824	0.942	0.991
1999	0.047	0.126	0.297	0.442	0.642	0.795	0.91	0.971

2000	0.035	0.138	0.3	0.544	0.672	0.81	0.894	0.953
2001	0.036	0.097	0.323	0.548	0.761	0.831	0.902	0.944
2002	0.031	0.104	0.239	0.575	0.764	0.89	0.913	0.949
2003	0.027	0.087	0.254	0.466	0.786	0.89	0.948	0.955
2004	0.033	0.075	0.218	0.485	0.694	0.904	0.949	0.976
2005	0.032	0.094	0.19	0.431	0.711	0.847	0.957	0.976
2006	0.035	0.094	0.231	0.39	0.665	0.858	0.923	0.98
2007	0.023	0.098	0.231	0.453	0.618	0.824	0.93	0.96
2008	0.022	0.064	0.242	0.453	0.687	0.792	0.91	0.965
2009	0.027	0.064	0.162	0.469	0.682	0.839	0.892	0.953
2010	0.033	0.076	0.16	0.339	0.697	0.839	0.92	0.942
2011	0.035	0.095	0.19	0.339	0.564	0.849	0.919	0.959
2012	0.048	0.099	0.236	0.39	0.564	0.749	0.925	0.958
2013	0.042	0.14	0.245	0.461	0.618	0.746	0.864	0.961
2014	0.052	0.124	0.33	0.473	0.69	0.792	0.862	0.927
2015	0.045	0.153	0.297	0.583	0.7	0.843	0.892	0.926
2016	0.047	0.131	0.354	0.54	0.792	0.851	0.922	0.942
2017	0.045	0.134	0.31	0.609	0.761	0.908	0.926	0.96
2018	0.031	0.129	0.316	0.559	0.812	0.888	0.959	0.962
2019	0.028	0.089	0.307	0.567	0.774	0.92	0.948	0.98
2020	0.03	0.08	0.22	0.555	0.78	0.897	0.965	0.974
2021	0.035	0.087	0.198	0.438	0.77	0.9	0.953	0.984
2022	0.041	0.099	0.215	0.404	0.668	0.897	0.955	0.977
2023	0.03	0.121	0.245	0.431	0.634	0.826	0.952	0.979
2024	0.035	0.085	0.291	0.473	0.66	0.802	0.912	0.977
2025	0.028	0.099	0.215	0.531	0.7	0.82	0.897	0.954

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	2209.91	1018.37	15.31	0.09	0	0	0	55.39
1985	2007.23	1364.84	5.06	0	0	0	0	53.02
1986	91.71	594.67	222.71	166.58	0	0	0	108.23
1987	0	1052.64	0.00	0.00	0	0	0	5.79
1988	0.00	16.60	0.48	8.67	0	0	0	2.49
1989	21.07	219.58	0.00	0.00	0	0	0	9.81
1990	48.42	137.38	34.32	3.33	0	0	0	14.10
1991	0.00	355.86	12.99	0.00	0	0	0	15.69

Age	0	1	2	3	4	5	6	Biomass
1992	132.15	1743.81	123.41	0.93	0	0	0	88.06
1993	825.96	1442.40	143.43	32.05	3.09	2.62	0	69.30
1994	1347.11	1483.12	73.19	23.83	6.89	0.81	0.01	48.23
1995	181.37	2863.85	166.95	12.36	28.08	27.70	0.32	113.33
1996	356.94	1529.51	154.53	38.21	5.18	2.45	3.18	66.25
1997	0	936.80	38.58	26.31	1.69	0.75	0.51	43.55
1998	0	1715.38	27.40	1.74	2.56	0.45	0	35.57
1999	0	1030.05	25.06	0.35	0	0	0	29.27
2000	808.29	1403.05	71.16	2.20	1.14	0.19	0.08	57.96
2001	1046.54	592.43	53.15	4.67	0.07	0.00	0.00	51.15
2002	455.05	2432.46	240.07	39.36	2.25	0.36	0.16	126.72
2003	1139.62	3565.66	213.45	39.16	12.66	1.21	0	165.56
2004	5381.41	2858.09	302.58	39.46	9.81	2.44	0	197.42
2005	7696.27	6668.01	274.88	54.59	9.19	2.22	0.85	323.67
2006	12781.51	8398.02	372.83	5.45	4.36	1.16	0.47	359.95
2007	1211.32	10160.34	653.43	70.82	3.78	2.16	0.21	376.02
2008	1364.86	964.09	889.66	226.11	42.80	5.50	3.11	289.78
2009	5620.83	1860.99	273.70	258.79	67.47	21.78	1.50	250.41
2010	1978.44	5695.49	177.95	65.33	66.34	59.99	11.17	262.95
2011	2314.10	2618.13	446.20	55.32	73.44	84.01	18.21	273.62
2012	233.89	7052.98	132.78	105.81	14.81	6.58	4.16	216.64
2013	2139.05	1572.97	370.12	30.62	21.42	5.32	3.99	195.20
2014	1140.59	1960.11	136.38	26.41	1.76	0.61	0	85.26
2015	4850.73	2512.52	125.49	12.82	41.47	1.37	0.21	172.22
2016	7979.06	2610.73	273.93	21.17	2.29	7.14	1.64	217.57
2017	4463.68	7552.61	224.84	22.11	12.13	6.03	12.93	266.57
2018	2252.55	6785.00	565.68	62.25	6.50	0.56	0.01	266.54
2019	517.10	4340.79	390.88	111.82	7.55	0.28	0.00	200.86
2020	1823.24	482.57	73.95	52.20	66.28	3.43	0.12	81.08
2021	987.59	293.16	78.88	5.14	4.08	0.73	0.09	24.65
2022	4118.28	2086.61	210.69	7.91	1.16	0.05	0	75.55
2023	1608.84	816.64	184.66	7.82	1.79	0.07	0	67.16
2024	11028.33	3966.76	350.40	16.92	3.13	0.91	0.38	293.05
Average 1984-2024	2247.88	2603.78	198.32	40.46	12.81	6.08	1.54	137.94

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

Survey	Year\Age	3	4	5	6	7	8	9	10
RU-BTr-Q4	1991	62	9	3	6	18	17		
RU-BTr-Q4	1992	346	50	4	6	9	9		
RU-BTr-Q4	1993	1985	356	48	8	4	4		
RU-BTr-Q4	1994	442	1014	116	15	1	6		
RU-BTr-Q4	1995	31	123	370	40	5	4		
RU-BTr-Q4	1996	28	49	362	334	29	6		
RU-BTr-Q4	1997	32	32	10	27	10	8		
RU-BTr-Q4	1998	38	46	8	5	15	5		
RU-BTr-Q4	1999	196	39	37	8	3	14		
RU-BTr-Q4	2000	60	109	26	11	2	5		
RU-BTr-Q4	2001	334	40	65	11	4	4		
RU-BTr-Q4	2002	399	450	47	24	4	3		
RU-BTr-Q4	2003	221	299	231	34	16	3		
RU-BTr-Q4	2004	113	94	107	87	5	6		
RU-BTr-Q4	2005	240	86	48	57	24	3		
RU-BTr-Q4	2006	113	119	57	26	24	13		
RU-BTr-Q4	2007	838	73	137	38	14	15		
RU-BTr-Q4	2008	2557	1051	124	111	17	11		
RU-BTr-Q4	2009	1647	1704	631	57	32	9		
RU-BTr-Q4	2010	299	1697	1589	466	34	17		
RU-BTr-Q4	2011	47	268	1087	783	165	13		
RU-BTr-Q4	2012	209	49	160	720	480	70		
RU-BTr-Q4	2013	61	175	50	104	374	272		
RU-BTr-Q4	2014	250	46	175	56	142	416		
RU-BTr-Q4	2015	22	199	40	74	28	171		
RU-BTr-Q4	2016	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2017	71	99	9	38	6	27		
RU-BTr-Q4	2018	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2019	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2020	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2021	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2022	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2023	-1	-1	-1	-1	-1	-1		
RU-BTr-Q4	2024	-1	-1	-1	-1	-1	-1		
BS-NoRU-Q1(Aco)	1994	348.73	626.65	121.38	8.55	0.7	0.33	2.71	
BS-NoRU-Q1(Aco)	1995	41.47	121.49	395.37	47.61	2.8	0.05	0.83	

BS-NoRU-Q1(Aco)	1996	29.97	22.09	68.65	143.69	5.67	0.93	0.07	
BS-NoRU-Q1(Aco)	1997	57.27	22.22	15.47	56.13	62.77	4.68	0.19	
BS-NoRU-Q1(Aco)	1998	33.78	58.79	24.2	7.7	14.06	20.69	1.62	
BS-NoRU-Q1(Aco)	1999	83.67	21.64	22.1	6.17	1.55	3.88	2.77	
BS-NoRU-Q1(Aco)	2000	36.39	75.53	14.01	12.61	1.57	0.53	3.02	
BS-NoRU-Q1(Aco)	2001	233.45	40.2	41.38	2.2	1.61	0.15	0.71	
BS-NoRU-Q1(Aco)	2002	255.2	201.84	18.47	11.7	1.59	0.29	0.56	
BS-NoRU-Q1(Aco)	2003	203.68	184.57	136.04	12.26	6.01	0.26	0.9	
BS-NoRU-Q1(Aco)	2004	151.01	101.85	107.82	57.68	7.61	1.15	0.55	
BS-NoRU-Q1(Aco)	2005	221.33	115.67	57.43	56.71	12.69	0.38	0.33	
BS-NoRU-Q1(Aco)	2006	56.32	123.84	47.37	19.26	13.64	3.23	0.35	
BS-NoRU-Q1(Aco)	2007	209.28	46.14	80.57	28.92	10	5.05	2.79	
BS-NoRU-Q1(Aco)	2008	812.41	303.04	90.02	74.12	7.41	12.77	2.11	
BS-NoRU-Q1(Aco)	2009	883.68	629.98	266.65	38.87	14.57	1.26	1.05	
BS-NoRU-Q1(Aco)	2010	128.07	631.03	603.99	166.96	12.07	2.94	2.11	
BS-NoRU-Q1(Aco)	2011	54.16	84.23	313.02	292.21	54.91	1.71	1.46	
BS-NoRU-Q1(Aco)	2012	191.63	48.84	88.12	310.6	172.52	30.09	1.01	
BS-NoRU-Q1(Aco)	2013	67.29	146.77	35.41	53.03	223.77	102.68	14.37	
BS-NoRU-Q1(Aco)	2014	334.82	39.12	108.72	23.18	34.77	86.36	38.82	
BS-NoRU-Q1(Aco)	2015	24.35	189.4	26.63	46.13	9.22	22.45	31.99	
BS-NoRU-Q1(Aco)	2016	71.81	12.08	59.62	12.52	17.28	7.48	33.24	
BS-NoRU-Q1(Aco)	2017	81.15	65.05	4.81	34.81	6.24	7.93	17.72	
BS-NoRU-Q1(Aco)	2018	171.03	62.74	64.4	6.77	15.57	2.75	14.69	
BS-NoRU-Q1(Aco)	2019	507.61	146.22	31.73	21.88	4.72	3.46	4.19	
BS-NoRU-Q1(Aco)	2020	286.32	306.38	79.18	22.38	11.59	1.84	6.33	
BS-NoRU-Q1(Aco)	2021	50.76	130.37	181.8	19.35	5.44	0.94	1.77	
BS-NoRU-Q1(Aco)	2022	11.35	63.4	95.3	101.24	11.79	0.82	1.08	
BS-NoRU-Q1(Aco)	2023	76.99	9.02	51.28	53.25	38.07	2.69	0.49	
BS-NoRU-Q1(Aco)	2024	337.4	44	3.7	14.9	12.5	7.8	0.33	
BS-NoRU-Q1(Aco)	2025	369.4	173.1	22.8	3.7	10.1	7.51	3.65	
BS-NoRu-Q1 (BTr)	1994	314.533	436.251	46.176	3.54	0.163	0.13	0.2	0.651
BS-NoRu-Q1 (BTr)	1995	54.857	167.104	343.38	29.623	1.441	0.025	0.043	0.404
BS-NoRu-Q1 (BTr)	1996	55.843	31.334	150.768	238.108	16.131	1.15	0	0.069
BS-NoRu-Q1 (BTr)	1997	79.632	39.855	18.255	61.566	88.411	3.277	0.082	0.043
BS-NoRu-Q1 (BTr)	1998	21.681	36.749	11.844	1.294	9.203	7.212	0.648	0.092
BS-NoRu-Q1 (BTr)	1999	56.92	15.874	9.418	2.831	0.807	1.282	0.771	0.034
BS-NoRu-Q1 (BTr)	2000	24.08	35.241	6.789	4.134	0.684	0.083	0.802	0.288

BS-NoRu-Q1 (BTr)	2001	293.996	26.252	22.997	1.634	0.752	0.058	0.06	0.329
BS-NoRu-Q1 (BTr)	2002	312.87	185.453	12.417	8.04	0.846	0.218	0.009	0.325
BS-NoRu-Q1 (BTr)	2003	352.236	174.452	72.708	5.104	1.682	0.119	0.104	0.217
BS-NoRu-Q1 (BTr)	2004	173.132	100.516	77.021	51.281	7.409	0.912	0.133	0.228
BS-NoRu-Q1 (BTr)	2005	317.889	141.058	50.664	61.191	10.082	0.249	0.08	0.009
BS-NoRu-Q1 (BTr)	2006	78.798	130.76	46.048	20.874	16.208	3.184	0.094	0.265
BS-NoRu-Q1 (BTr)	2007	443.266	81.784	84.667	26.279	5.411	2.197	1.376	0.896
BS-NoRu-Q1 (BTr)	2008	1591.031	583.606	53.079	54.732	6.794	10.248	0.23	0.167
BS-NoRu-Q1 (BTr)	2009	1230.426	751.012	368.33	25.414	12.437	0.851	0.09	0.363
BS-NoRu-Q1 (BTr)	2010	102.451	510.449	443.759	139.316	7.988	1.016	0.386	0.574
BS-NoRu-Q1 (BTr)	2011	52.883	123.634	469.482	290.036	65.236	1.416	1.121	0.184
BS-NoRu-Q1 (BTr)	2012	316.077	28.785	74.714	267.945	154.601	24.766	3.115	0.391
BS-NoRu-Q1 (BTr)	2013	57.444	143.984	22.019	33.624	191.145	69.385	6.114	0.076
BS-NoRu-Q1 (BTr)	2014	381.173	32.729	104.397	23.257	50.035	97.536	38.692	2.425
BS-NoRu-Q1 (BTr)	2015	30.615	187.035	43.601	39.44	14.668	18.735	30.744	10.2
BS-NoRu-Q1 (BTr)	2016	163.385	34.342	115.597	22.406	41.948	12.437	32.396	33.161
BS-NoRu-Q1 (BTr)	2017	134.9	105.5	7.553	55.338	9.692	15.6	2.527	23.861
BS-NoRu-Q1 (BTr)	2018	336.307	86.656	65.764	7.771	15.59	3.621	2.564	11.931
BS-NoRu-Q1 (BTr)	2019	1075.552	187.224	49.399	16.996	4.038	2.948	0.736	1.91
BS-NoRu-Q1 (BTr)	2020	424.225	586.985	99.123	22.08	6.057	2.605	1.042	2.827
BS-NoRu-Q1 (BTr)	2021	111.35	176.57	265.49	19.32	3.57	0.68	0.19	0.72
BS-NoRu-Q1 (BTr)	2022	12.226	86.54	121.699	113.566	9.099	0.617	0.113	0.44
BS-NoRu-Q1 (BTr)	2023	82.055	8.058	50.201	49.022	33.313	2.168	0.096	0.318
BS-NoRu-Q1 (BTr)	2024	346.712	40.855	3.345	15.762	12.595	7.724	0.355	0.119
BS-NoRu-Q1 (BTr)	2025	477.027	186.551	17.784	2.422	7.565	5.048	2.564	0.146
FLT007: Eco-NoRu-Q3 (Btr)	2004	123.368	70.303	69.118	31.482	2.989	1.721	0.22	
FLT007: Eco-NoRu-Q3 (Btr)	2005	324.56	89.531	30.44	32.246	15.035	0.472	1.116	
FLT007: Eco-NoRu-Q3 (Btr)	2006	107.467	124.64	41.597	18.98	17.482	7.289	1.384	
FLT007: Eco-NoRu-Q3 (Btr)	2007	1282.94	88.498	90.369	19.227	5.881	7.102	3.209	
FLT007: Eco-NoRu-Q3 (Btr)	2008	1154.869	405.999	43.133	35.517	4.94	2.514	2.539	
FLT007: Eco-NoRu-Q3 (Btr)	2009	650.742	619.088	305.883	21.045	6.549	0.87	0.576	
FLT007: Eco-NoRu-Q3 (Btr)	2010	184.001	865.318	666.439	147.72	15.84	2.73	0.589	
FLT007: Eco-NoRu-Q3 (Btr)	2011	40.446	73.802	392.93	301.368	37.357	2.972	0.514	
FLT007: Eco-NoRu-Q3 (Btr)	2012	92.468	20.348	67.607	214.052	152.03	12.739	2.003	
FLT007: Eco-NoRu-Q3 (Btr)	2013	25.779	65.228	19.575	50.846	150.131	76.427	7.561	
FLT007: Eco-NoRu-Q3 (Btr)	2014	261.631	40.768	70.161	25.781	60.452	85.771	19.646	
FLT007: Eco-NoRu-Q3 (Btr)	2015	42.148	213.636	25.132	37.111	20.577	47.868	42.903	

FLT007: Eco-NoRu-Q3 (Btr)	2016	209.303	34.43	184.09	47.965	56.787	40.367	125.907	
FLT007: Eco-NoRu-Q3 (Btr)	2017	70.313	70.306	11.47	20.537	3.963	4.025	15.265	
FLT007: Eco-NoRu-Q3 (Btr)	2018	-1	-1	-1	-1	-1	-1	-1	
FLT007: Eco-NoRu-Q3 (Btr)	2019	896.982	160.736	38.067	15.133	5.303	5.037	11.56	
FLT007: Eco-NoRu-Q3 (Btr)	2020	204.059	341.372	58.813	4.918	1.959	0.802	1.483	
FLT007: Eco-NoRu-Q3 (Btr)	2021	129.533	345.768	330.627	32.25	5.446	0.885	1.41	
FLT007: Eco-NoRu-Q3 (Btr)	2022	-1	-1	-1	-1	-1	-1	-1	
FLT007: Eco-NoRu-Q3 (Btr)	2023	182.62	13.345	37.289	36.344	12.06	0.456	0.341	
FLT007: Eco-NoRu-Q3 (Btr)	2024	213.83	26.90	19.47	17.33	13.40	3.17	0.97	

Table 4.10 SAM model configuration used. Updated at WKDEM 2020.

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

2 3 3 3 3 4 4 -1 -1 -1 -1
5 6 6 6 6 7 7 7 -1 -1 -1
8 9 9 9 9 9 9 -1 -1 -1 -1
$keyQpow
Density dependent catchability power parameters (if any).
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
0 0 0 0 0 0 -1 -1 -1 -1 -1
1 1 1 1 1 2 2 -1 -1 -1 -1
3 3 3 3 3 4 4 4 -1 -1 -1
5 5 5 5 5 5 5 -1 -1 -1 -1
$keyVarF
Coupling of process variance parameters for log(F)-process (nomally only first row is used)
0 1 1 1 1 1 1 1 1 1 1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
$keyVarLogN
Coupling of process variance parameters for log(N)-process
0 1 1 1 1 1 1 1 1 1 1
$keyVarObs
Coupling of the variance parameters for the observations.
0 1 2 2 2 2 2 2 2 2 2
3 3 3 3 3 3 -1 -1 -1 -1 -1
4 4 4 4 4 4 4 -1 -1 -1 -1
5 5 5 5 5 5 5 5 -1 -1 -1
6 6 6 6 6 6 6 -1 -1 -1 -1
$obsCorStruct
Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for unstructured). | Possible values are: "ID" "AR" "US"
"ID" "AR" "AR" "AR" "AR"
$keyCorObs
Coupling of correlation parameters can only be specified if the AR(1) structure is chosen above.
NA's indicate where correlation parameters can be specified (-1 where they cannot).
#V1 V2 V3 V4 V5 V6 V7 V8 V9 V10
NA NA NA NA NA NA NA NA NA NA
0 1 1 1 2 -1 -1 -1 -1 -1
3 3 3 3 3 4 -1 -1 -1 -1

5 5 5 5 5 6 6 -1 -1 -1
7 7 7 7 7 7 -1 -1 -1 -1
$stockRecruitmentModelCode
Stock recruitment code (0 for plain random walk, 1 for Ricker, 2 for Beverton–Holt, and 3 piece-wise constant).
0
$noScaledYears
Number of years where catch scaling is applied.
0
$keyScaledYears
A vector of the years where catch scaling is applied.
$keyParScaledYA
A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).
$fbarRange
lowest and higest age included in Fbar
4 7
$keyBiomassTreat
To be defined only if a biomass survey is used (0 SSB index, 1 catch index, 2 FSB index, 3 total catch, 4 total landings and 5 TSB index).
-1 -1 -1 -1 -1
$obsLikelihoodFlag
Option for observational likelihood | Possible values are: "LN" "ALN"
"LN" "LN" "LN" "LN" "LN"
$fixVarToWeight
If weight attribute is supplied for observations this option sets the treatment (0 relative weight, 1 fix variance to weight).
0
$fracMixF
The fraction of t(3) distribution used in logF increment distribution
0
$fracMixN
The fraction of t(3) distribution used in logN increment distribution
0
$fracMixObs
A vector with same length as number of fleets, where each element is the fraction of t(3) distribution used in the distribution of that fleet
0 0 0 0 0
$constRecBreaks
This option is only used in combination with stock-recruitment code 3)
$predVarObsLink

Coupling of parameters used in a mean-variance link for observations.
0 1 2 2 2 2 2 2 2 2 2 2
3 3 3 3 3 3 -1 -1 -1 -1 -1
4 4 4 4 4 4 4 -1 -1 -1 -1
5 5 5 5 5 5 5 5 -1 -1 -1
6 6 6 6 6 6 6 -1 -1 -1 -1

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

Year	R(age 3)	Low	High	SSB	Low	High	Fbar(4-7)	Low	High	TSB	Low	High
1950	109205	69850	170733	213037	190711	237977	0.794	0.673	0.936	396433	355768	441746
1951	627326	417573	942440	124773	110703	140633	0.683	0.576	0.810	425468	340792	531184
1952	83903	54178	129937	100853	88165	115368	0.702	0.588	0.839	414379	331979	517232
1953	1175428	784414	1761354	120273	104016	139071	0.533	0.441	0.643	710782	550758	917301
1954	130455	84294	201893	173161	147274	203599	0.432	0.357	0.524	808235	643274	1015497
1955	58576	37390	91767	309089	264221	361577	0.448	0.373	0.539	836155	706490	989619
1956	221231	142492	343478	363732	310115	426617	0.474	0.395	0.569	680251	585441	790414
1957	60392	38608	94466	253141	217080	295193	0.428	0.357	0.513	432450	376133	497200
1958	73501	47508	113717	181369	157528	208818	0.517	0.430	0.622	314304	276817	356867
1959	382306	253852	575758	125449	109005	144374	0.446	0.369	0.540	331320	274259	400252
1960	312759	206179	474435	112805	99525	127858	0.541	0.452	0.647	414469	346875	495234
1961	141716	93577	214619	124378	110802	139617	0.664	0.562	0.784	398840	347573	457669
1962	288516	191930	433707	124539	110587	140251	0.793	0.674	0.932	372594	321945	431212
1963	310273	208224	462335	93925	82650	106737	0.760	0.638	0.905	349414	293699	415698
1964	349427	233167	523656	84228	74078	95769	0.634	0.528	0.762	383262	318904	460607
1965	125264	81812	191793	102863	89899	117696	0.527	0.437	0.636	384555	326205	453343
1966	308278	203489	467027	144655	126065	165986	0.559	0.466	0.670	446661	382712	521294
1967	336411	221609	510684	150640	130041	174503	0.444	0.368	0.536	460702	388958	545679
1968	18630	11587	29955	166970	144796	192540	0.485	0.401	0.586	423233	360117	497411
1969	20294	12601	32685	166741	143546	193685	0.416	0.340	0.508	314376	269840	366261
1970	204608	132949	314890	154465	131254	181780	0.386	0.313	0.477	283804	240016	335581
1971	110060	71679	168993	127035	107265	150449	0.329	0.264	0.410	261919	223270	307258
1972	1063159	699647	1615540	127920	111215	147135	0.654	0.537	0.797	603949	463099	787637
1973	309302	205800	464858	125158	107948	145113	0.539	0.442	0.657	637434	514771	789325
1974	64978	42349	99699	154044	134410	176547	0.503	0.416	0.608	464133	401371	536709
1975	58765	38294	90180	194620	166846	227016	0.497	0.415	0.594	378081	328453	435208
1976	59524	38039	93144	195464	167823	227657	0.718	0.606	0.851	294497	257819	336393

1977	120299	76136	190079	118892	100276	140964	0.734	0.607	0.889	200380	171891	233591
1978	211943	140914	318773	80839	67032	97489	0.628	0.511	0.770	197661	163877	238411
1979	159503	105599	240923	62230	52414	73885	0.584	0.472	0.722	204520	170694	245050
1980	23166	14478	37069	62493	53169	73453	0.476	0.383	0.591	211914	177477	253032
1981	10834	6488	18090	72359	61298	85417	0.437	0.351	0.543	167595	141696	198227
1982	16365	10014	26744	68355	56657	82469	0.383	0.305	0.481	122361	102660	145843
1983	8087	4722	13852	58470	48118	71048	0.350	0.274	0.446	87673	73543	104519
1984	13091	8028	21348	53097	43383	64986	0.315	0.245	0.406	71456	59753	85452
1985	357274	235746	541451	48966	40785	58788	0.399	0.314	0.507	190737	141173	257704
1986	476016	315391	718444	54557	46327	64250	0.536	0.428	0.672	372321	294507	470695
1987	91595	59489	141030	77165	66019	90192	0.630	0.508	0.782	354129	296609	422804
1988	39726	25023	63068	79572	67080	94390	0.512	0.411	0.637	253762	215637	298627
1989	27985	17392	45031	84270	69583	102057	0.371	0.295	0.467	192286	161430	229040
1990	36259	23363	56275	86046	70288	105337	0.212	0.167	0.270	153395	128592	182983
1991	108038	76133	153312	100226	84341	119104	0.240	0.191	0.300	184623	157973	215768
1992	317123	226311	444375	110154	95331	127283	0.296	0.239	0.366	285180	240189	338599
1993	807521	590108	1105035	123904	109396	140336	0.320	0.262	0.393	509250	423978	611671
1994	388099	316581	475773	156808	140427	175100	0.375	0.310	0.454	633752	557316	720671
1995	99893	78807	126622	191602	171330	214274	0.305	0.256	0.362	632711	561965	712364
1996	99365	78795	125305	222898	199541	248989	0.372	0.317	0.436	550974	493390	615279
1997	119217	94787	149943	194388	173628	217630	0.450	0.382	0.531	400918	361105	445121
1998	63007	49253	80602	134234	119187	151181	0.455	0.382	0.542	265960	239054	295894
1999	146615	118401	181552	96981	86161	109160	0.464	0.386	0.559	231721	207490	258782
2000	82744	65532	104476	80889	71779	91156	0.343	0.282	0.418	213204	189217	240233
2001	357393	295558	432164	94278	84250	105501	0.370	0.308	0.445	314791	279627	354376
2002	385143	317862	466665	111802	99993	125005	0.355	0.296	0.426	428762	380794	482773
2003	333954	271890	410184	141057	126864	156837	0.429	0.363	0.507	499309	446943	557810
2004	256154	211388	310400	160281	144197	178159	0.395	0.336	0.464	488503	440125	542199
2005	354219	294011	426756	171410	154221	190516	0.409	0.349	0.480	505054	455849	559569
2006	153964	125825	188397	156157	140474	173591	0.373	0.317	0.440	436241	393895	483140
2007	510371	422347	616740	157546	142097	174675	0.389	0.330	0.460	495715	446511	550342
2008	1048496	877115	1253363	165470	148295	184636	0.322	0.270	0.385	712535	632849	802255
2009	979985	821372	1169226	185526	166520	206700	0.269	0.226	0.321	961376	852223	1084510
2010	234126	192163	285253	249278	223638	277859	0.254	0.216	0.300	1091839	968367	1231055
2011	116753	93342	146037	361199	323994	402677	0.266	0.228	0.311	1143359	1021054	1280315
2012	332647	274160	403611	480135	427624	539095	0.229	0.195	0.268	1139697	1019203	1274436
2013	117381	94167	146318	526559	467084	593606	0.153	0.129	0.182	978860	874858	1095226

2014	402425	333405	485733	526163	469932	589124	0.158	0.132	0.189	962829	869017	1066767
2015	72042	56928	91169	503022	453702	557703	0.192	0.161	0.229	857782	778635	944974
2016	207043	168898	253803	494946	447283	547689	0.264	0.223	0.312	788822	716895	867966
2017	192788	157574	235870	415349	377738	456703	0.355	0.301	0.417	691950	631707	757938
2018	354062	290241	431917	305316	276968	336566	0.412	0.351	0.484	598656	544238	658516
2019	776087	645770	932701	232647	210882	256659	0.450	0.380	0.531	646597	582425	717839
2020	414649	342860	501469	191172	172921	211349	0.479	0.406	0.566	655246	587684	730576
2021	155855	125600	193399	174736	157928	193333	0.496	0.422	0.584	591402	531488	658071
2022	45328	34673	59258	172599	153861	193620	0.427	0.361	0.507	485024	433243	542994
2023	166467	134426	206146	177438	156774	200825	0.448	0.376	0.534	417283	372157	467882
2024	427761	351365	520767	163226	140567	189539	0.470	0.378	0.586	424313	372971	482722
2025	532133	426734	663565	149209	120565	184657	0.467	0.289	0.756	493213	418756	580910

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

Year Age	3	4	5	6	7	8	9	10	11	12	13
1950	0.196	0.481	0.750	0.873	1.071	0.894	0.894	0.894	0.894	0.894	0.894
1951	0.132	0.373	0.615	0.767	0.977	0.881	0.881	0.881	0.881	0.881	0.881
1952	0.125	0.379	0.627	0.783	1.020	0.927	0.927	0.927	0.927	0.927	0.927
1953	0.081	0.280	0.468	0.583	0.800	0.738	0.738	0.738	0.738	0.738	0.738
1954	0.055	0.209	0.359	0.470	0.692	0.651	0.651	0.651	0.651	0.651	0.651
1955	0.051	0.202	0.372	0.506	0.714	0.603	0.603	0.603	0.603	0.603	0.603
1956	0.055	0.212	0.393	0.554	0.737	0.624	0.624	0.624	0.624	0.624	0.624
1957	0.050	0.200	0.370	0.495	0.647	0.551	0.551	0.551	0.551	0.551	0.551
1958	0.061	0.237	0.451	0.601	0.780	0.691	0.691	0.691	0.691	0.691	0.691
1959	0.062	0.231	0.411	0.522	0.621	0.569	0.569	0.569	0.569	0.569	0.569
1960	0.096	0.320	0.538	0.633	0.672	0.616	0.616	0.616	0.616	0.616	0.616
1961	0.127	0.408	0.684	0.782	0.782	0.692	0.692	0.692	0.692	0.692	0.692
1962	0.160	0.504	0.857	0.943	0.867	0.720	0.720	0.720	0.720	0.720	0.720
1963	0.140	0.471	0.809	0.913	0.847	0.681	0.681	0.681	0.681	0.681	0.681
1964	0.098	0.360	0.637	0.772	0.767	0.647	0.647	0.647	0.647	0.647	0.647
1965	0.077	0.294	0.516	0.639	0.659	0.568	0.568	0.568	0.568	0.568	0.568
1966	0.091	0.331	0.565	0.668	0.671	0.555	0.555	0.555	0.555	0.555	0.555
1967	0.072	0.271	0.449	0.518	0.538	0.466	0.466	0.466	0.466	0.466	0.466
1968	0.085	0.302	0.494	0.556	0.589	0.514	0.514	0.514	0.514	0.514	0.514
1969	0.081	0.273	0.433	0.472	0.484	0.418	0.418	0.418	0.418	0.418	0.418
1970	0.083	0.268	0.406	0.431	0.442	0.382	0.382	0.382	0.382	0.382	0.382

1971	0.072	0.238	0.354	0.357	0.368	0.326	0.326	0.326	0.326	0.326	0.326
1972	0.211	0.509	0.761	0.694	0.653	0.544	0.544	0.544	0.544	0.544	0.544
1973	0.218	0.494	0.647	0.534	0.480	0.384	0.384	0.384	0.384	0.384	0.384
1974	0.189	0.432	0.546	0.513	0.521	0.460	0.460	0.460	0.460	0.460	0.460
1975	0.208	0.459	0.547	0.494	0.487	0.419	0.419	0.419	0.419	0.419	0.419
1976	0.319	0.645	0.782	0.720	0.725	0.640	0.640	0.640	0.640	0.640	0.640
1977	0.361	0.712	0.852	0.717	0.657	0.559	0.559	0.559	0.559	0.559	0.559
1978	0.243	0.552	0.733	0.647	0.578	0.506	0.506	0.506	0.506	0.506	0.506
1979	0.167	0.447	0.675	0.654	0.558	0.503	0.503	0.503	0.503	0.503	0.503
1980	0.102	0.320	0.531	0.567	0.484	0.461	0.461	0.461	0.461	0.461	0.461
1981	0.085	0.279	0.477	0.542	0.448	0.430	0.430	0.430	0.430	0.430	0.430
1982	0.075	0.249	0.415	0.479	0.389	0.382	0.382	0.382	0.382	0.382	0.382
1983	0.076	0.247	0.386	0.425	0.341	0.340	0.340	0.340	0.340	0.340	0.340
1984	0.067	0.228	0.348	0.376	0.309	0.293	0.293	0.293	0.293	0.293	0.293
1985	0.075	0.261	0.417	0.485	0.433	0.414	0.414	0.414	0.414	0.414	0.414
1986	0.089	0.316	0.543	0.667	0.620	0.587	0.587	0.587	0.587	0.587	0.587
1987	0.100	0.360	0.647	0.789	0.726	0.659	0.659	0.659	0.659	0.659	0.659
1988	0.072	0.279	0.514	0.659	0.595	0.540	0.540	0.540	0.540	0.540	0.540
1989	0.055	0.218	0.386	0.466	0.414	0.363	0.363	0.363	0.363	0.363	0.363
1990	0.028	0.127	0.215	0.257	0.249	0.234	0.234	0.234	0.234	0.234	0.234
1991	0.030	0.137	0.244	0.292	0.286	0.263	0.263	0.263	0.263	0.263	0.263
1992	0.032	0.148	0.295	0.368	0.373	0.342	0.342	0.342	0.342	0.342	0.342
1993	0.025	0.132	0.297	0.412	0.441	0.402	0.402	0.402	0.402	0.402	0.402
1994	0.023	0.128	0.311	0.481	0.581	0.548	0.548	0.548	0.548	0.548	0.548
1995	0.018	0.103	0.238	0.375	0.503	0.496	0.496	0.496	0.496	0.496	0.496
1996	0.024	0.127	0.293	0.447	0.620	0.627	0.627	0.627	0.627	0.627	0.627
1997	0.033	0.161	0.379	0.540	0.721	0.689	0.689	0.689	0.689	0.689	0.689
1998	0.039	0.180	0.404	0.555	0.682	0.684	0.684	0.684	0.684	0.684	0.684
1999	0.047	0.205	0.434	0.562	0.656	0.630	0.630	0.630	0.630	0.630	0.630
2000	0.034	0.161	0.327	0.414	0.472	0.443	0.443	0.443	0.443	0.443	0.443
2001	0.035	0.166	0.359	0.458	0.496	0.453	0.453	0.453	0.453	0.453	0.453
2002	0.032	0.154	0.325	0.455	0.485	0.425	0.425	0.425	0.425	0.425	0.425
2003	0.037	0.173	0.372	0.536	0.635	0.571	0.571	0.571	0.571	0.571	0.571
2004	0.036	0.163	0.336	0.491	0.589	0.553	0.553	0.553	0.553	0.553	0.553
2005	0.038	0.167	0.339	0.500	0.631	0.605	0.605	0.605	0.605	0.605	0.605
2006	0.038	0.161	0.319	0.448	0.565	0.553	0.553	0.553	0.553	0.553	0.553
2007	0.039	0.162	0.324	0.472	0.600	0.581	0.581	0.581	0.581	0.581	0.581

2008	0.026	0.117	0.237	0.393	0.544	0.536	0.536	0.536	0.536	0.536	0.536
2009	0.021	0.094	0.187	0.319	0.478	0.491	0.491	0.491	0.491	0.491	0.491
2010	0.021	0.089	0.177	0.299	0.453	0.501	0.501	0.501	0.501	0.501	0.501
2011	0.022	0.093	0.192	0.317	0.463	0.506	0.506	0.506	0.506	0.506	0.506
2012	0.021	0.086	0.165	0.275	0.389	0.417	0.417	0.417	0.417	0.417	0.417
2013	0.015	0.064	0.111	0.176	0.262	0.326	0.326	0.326	0.326	0.326	0.326
2014	0.017	0.071	0.123	0.182	0.257	0.360	0.360	0.360	0.360	0.360	0.360
2015	0.022	0.091	0.161	0.224	0.293	0.409	0.409	0.409	0.409	0.409	0.409
2016	0.029	0.118	0.226	0.314	0.397	0.521	0.521	0.521	0.521	0.521	0.521
2017	0.039	0.153	0.307	0.441	0.518	0.598	0.598	0.598	0.598	0.598	0.598
2018	0.038	0.161	0.354	0.530	0.605	0.648	0.648	0.648	0.648	0.648	0.648
2019	0.036	0.163	0.385	0.616	0.634	0.613	0.613	0.613	0.613	0.613	0.613
2020	0.038	0.170	0.409	0.650	0.688	0.622	0.622	0.622	0.622	0.622	0.622
2021	0.039	0.174	0.413	0.665	0.732	0.676	0.676	0.676	0.676	0.676	0.676
2022	0.041	0.172	0.371	0.553	0.613	0.544	0.544	0.544	0.544	0.544	0.544
2023	0.052	0.203	0.411	0.579	0.601	0.498	0.498	0.498	0.498	0.498	0.498
2024	0.059	0.225	0.452	0.601	0.604	0.469	0.469	0.469	0.469	0.469	0.469
2025	0.058	0.224	0.450	0.596	0.598	0.464	0.464	0.464	0.464	0.464	0.464

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	109205	99279	73820	36899	46521	16578	4932	2705	1377	1453	2049
1951	627326	56171	45134	26820	12672	12341	5388	1926	1004	444	1089
1952	83903	422960	32370	19056	9013	4292	3826	1645	730	355	509
1953	1175428	49840	209003	14438	6407	2662	1334	1062	537	251	308
1954	130455	885992	25851	91828	6986	2339	1092	548	391	200	226
1955	58576	84299	620245	14554	51512	3103	923	454	236	161	168
1956	221231	40861	55900	320224	7235	17614	1441	403	213	112	153
1957	60392	148229	27646	35753	111024	3088	6156	696	168	98	128
1958	73501	40295	91829	15503	20530	40272	1621	2518	347	84	117
1959	382306	51838	26170	40063	7328	7272	14936	717	907	145	86
1960	312759	263706	35713	15594	17157	3465	3632	6212	355	374	107
1961	141716	190100	144793	17668	6951	8007	1590	1505	2808	154	205
1962	288516	85170	91652	59390	6769	2697	3273	658	610	1166	139
1963	310273	174590	37685	26427	17517	2637	1085	1230	273	244	538

1964	349427	198074	75335	12243	7708	5819	1213	440	509	122	346
1965	125264	239043	114569	30255	4176	2799	2268	531	198	218	210
1966	308278	82034	157882	61677	12336	1706	1279	949	268	91	187
1967	336411	199088	43520	72304	24748	4866	791	602	452	130	132
1968	18630	244826	117376	21901	35935	12409	2357	409	313	233	136
1969	20294	12119	140694	54866	10670	15727	5738	1166	197	156	175
1970	204608	12577	7579	69889	25063	5867	8055	3006	643	106	185
1971	110060	132966	7129	4520	33307	12256	3334	4541	1689	370	162
1972	1063159	80128	81165	4488	3089	17547	6729	1999	2769	1022	314
1973	309302	613376	45603	23373	1692	1533	7663	2914	921	1373	610
1974	64978	168222	252478	16442	10694	878	995	4442	1679	542	1211
1975	58765	37015	90272	140233	6825	4973	445	551	2143	816	924
1976	59524	33587	16601	44241	78693	3171	2769	244	325	1145	961
1977	120299	30288	13748	6470	17671	30362	1295	1183	102	145	810
1978	211943	54625	9624	4462	2893	7755	15022	631	562	44	430
1979	159503	116393	23102	3225	2035	1398	4090	7070	337	272	226
1980	23166	101991	58069	8297	1152	1040	712	2151	3476	174	240
1981	10834	16190	62866	26080	3458	550	553	377	1132	1715	213
1982	16365	7133	11192	31460	10527	1724	277	304	215	618	959
1983	8087	11159	4767	6820	13608	5594	982	146	175	125	805
1984	13091	4944	6647	2795	3887	8775	2898	576	80	103	520
1985	357274	8968	2849	3596	1796	2555	5336	1843	367	51	397
1986	476016	275369	5239	1567	1837	992	1461	2782	1024	204	260
1987	91595	250107	154890	2556	642	787	468	674	1205	469	207
1988	39726	70401	135599	46132	1068	230	318	203	298	506	279
1989	27985	26102	49084	70494	12249	546	95	151	98	143	363
1990	36259	20597	17341	26283	32727	5522	351	58	87	56	275
1991	108038	24515	13589	14116	20140	20216	3159	246	39	57	204
1992	317123	82171	15797	10061	10364	12560	12587	1895	162	25	157
1993	807521	218975	56427	10503	5909	6207	7598	7239	1053	99	106
1994	388099	563086	151472	31131	4652	3142	3715	4689	4272	593	114
1995	99893	222155	422904	77675	14540	2077	1428	1842	2163	2108	337
1996	99365	61536	166063	244574	32069	7203	1073	706	920	1081	1240
1997	119217	55574	37872	95308	102850	13927	2518	486	310	407	1071
1998	63007	79976	35390	17934	36956	38440	5228	991	206	130	688
1999	146615	48525	47265	17553	8858	15746	13696	1911	409	91	374
2000	82744	116962	30976	21563	6924	4249	6576	5387	809	186	222

2001	357393	69177	92018	16824	10264	3495	2544	3500	2656	435	229
2002	385143	290591	51908	47075	9190	5484	1875	1426	1920	1397	349
2003	333954	255179	191564	34423	24302	4598	3448	1205	817	1086	991
2004	256154	169937	162939	110293	16475	10591	2158	1646	606	388	1061
2005	354219	170232	94610	109331	50127	6687	5427	1137	730	303	774
2006	153964	215189	108565	52291	44926	20509	3226	2779	553	344	525
2007	510371	120816	163638	61527	27035	19068	8193	1752	1456	282	436
2008	1048496	443192	96502	102061	21706	14226	7133	3315	887	706	351
2009	979985	688572	364960	61588	39909	10217	5372	3154	1467	485	577
2010	234126	654904	582499	229779	31969	15032	4823	2751	1612	782	622
2011	116753	189388	532448	413472	121997	13937	6246	2135	1348	826	800
2012	332647	72969	134925	386010	260450	54631	6090	2578	1032	693	912
2013	117381	197582	57715	93465	269090	124646	23777	3123	1398	582	951
2014	402425	73108	145650	49704	86625	142262	61280	10866	1835	869	963
2015	72042	278986	66129	92741	40543	67844	72638	25704	5344	997	1002
2016	207043	49951	166172	46355	62202	33028	48476	37708	12801	2565	983
2017	192788	173668	33632	109626	28253	36537	18427	21644	17865	5607	1477
2018	354062	134181	123682	24687	43504	14635	17673	8777	9200	8414	3120
2019	776087	234755	87101	61980	16278	17293	6891	7511	3638	3837	4236
2020	414649	495082	152514	44895	22074	8369	7086	3393	3194	1720	3332
2021	155855	256157	331207	65513	18003	7903	3830	2891	1604	1460	2194
2022	45328	138208	178235	158707	26355	6318	2937	1561	1149	693	1484
2023	166467	33367	102157	109411	69824	9908	2707	1277	723	556	1016
2024	427761	100331	25683	57426	51877	30239	4196	1301	610	367	778
2025	532133	282978	58948	13390	27447	24704	15639	2125	664	312	585

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

Year	3	4	5	6	7	8	9	10	11	12	13
1950	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1951	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1952	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1953	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1954	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1955	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1956	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2

1957	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1958	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1959	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1960	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1961	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1962	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1963	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1964	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1965	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1966	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1967	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1968	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1969	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1970	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1971	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1972	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1973	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1974	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1975	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1976	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1977	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1979	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1980	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1983	0.338	0.253	0.24	0.238	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1984	0.215	0.22	0.213	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1985	0.209	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1986	0.636	0.262	0.2	0.21	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1987	0.2	0.207	0.415	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1988	0.38	0.2	0.2	0.385	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1989	0.2	0.2	0.2	0.231	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1990	0.33	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1991	0.202	0.214	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1992	0.215	0.204	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1993	0.252	0.246	0.273	0.257	0.2	0.2	0.2	0.2	0.2	0.2	0.2

1994	0.288	0.211	0.289	0.223	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1995	0.379	0.339	0.313	0.29	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1996	0.72	0.32	0.247	0.278	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1997	0.501	0.265	0.256	0.277	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1998	0.231	0.29	0.268	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1999	0.2	0.208	0.272	0.263	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2000	0.213	0.2	0.215	0.244	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2001	0.21	0.2	0.225	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2002	0.322	0.211	0.2	0.203	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2003	0.415	0.247	0.206	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2004	0.413	0.298	0.2	0.228	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2005	0.395	0.302	0.229	0.268	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2006	0.222	0.214	0.275	0.209	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2007	0.295	0.2	0.235	0.326	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2008	0.374	0.272	0.263	0.333	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.404	0.246	0.277	0.255	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2010	0.357	0.246	0.27	0.279	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2011	0.526	0.465	0.303	0.224	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2012	0.589	0.31	0.202	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.453	0.333	0.244	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2014	0.282	0.205	0.218	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.338	0.392	0.209	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2016	0.301	0.2	0.243	0.226	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2017	0.339	0.294	0.231	0.407	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2018	0.435	0.266	0.268	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2019	0.372	0.263	0.223	0.282	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2020	0.348	0.357	0.293	0.224	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2021	0.215	0.2	0.243	0.218	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2022	0.345	0.2	0.2	0.221	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2023	0.279	0.214	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2024	0.257	0.255	0.23	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2025	0.257	0.255	0.23	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4.15. Northeast Arctic haddock. Summary XSA (p-shrinkage not applied, F shrinkage= 0.5). FLR Tue Jun 03 19:01:02 2025.

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1950	81677	242242	134529	132125	0.9821	1.5897	0.8315
1951	663622	354239	101024	120077	1.1886	1.2272	0.6242

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1952	76240	234936	57440	127660	2.2225	1.7404	0.7248
1953	1264003	508893	82405	123920	1.5038	1.4279	0.5162
1954	151250	536523	117188	156788	1.3379	1.474	0.3805
1955	68041	484886	178637	202286	1.1324	1.536	0.512
1956	206957	474081	243486	213924	0.8786	1.2623	0.4335
1957	65596	325912	186222	123583	0.6636	1.2455	0.4328
1958	86292	276560	156921	112672	0.718	1.1252	0.519
1959	395168	363527	133216	88211	0.6622	0.9405	0.3672
1960	287477	399949	114568	154651	1.3499	1.0411	0.4845
1961	129789	390654	129899	193224	1.4875	0.9942	0.637
1962	288717	345543	118812	187408	1.5773	1.0518	0.801
1963	338192	309650	82597	146224	1.7703	1.1458	0.8655
1964	394864	300687	63783	99158	1.5546	1.3572	0.6528
1965	123280	357098	95353	118578	1.2436	1.1507	0.4938
1966	291448	386593	127441	161778	1.2694	1.1621	0.5838
1967	359235	466398	154432	136397	0.8832	0.9984	0.4152
1968	23722	420706	169413	181726	1.0727	0.9976	0.5035
1969	21252	342151	184036	130820	0.7108	0.882	0.3975
1970	200821	285972	156039	88257	0.5656	0.9762	0.358
1971	121458	344845	168534	78905	0.4682	0.7638	0.2468
1972	1242369	616109	122911	266153	2.1654	1.0883	0.6925
1973	339326	601872	114569	322226	2.8125	1.1656	0.537
1974	68685	602582	200548	221157	1.1028	0.8946	0.4322
1975	59735	492450	256090	175758	0.6863	0.8957	0.4275
1976	66435	307132	206675	137264	0.6642	1.12	0.5712
1977	133592	228676	141794	110158	0.7769	1.09	0.6845
1978	211904	255336	130559	95422	0.7309	0.9219	0.512
1979	174603	317372	129485	103623	0.8003	0.7684	0.552
1980	34438	342532	133155	87889	0.6601	0.7568	0.3982
1981	13306	292519	148158	77153	0.5207	0.7174	0.4018
1982	17254	211659	127181	46955	0.3692	0.7224	0.3093
1983	9509	104296	71460	24600	0.3442	1.0373	0.2715
1984	13434	83502	64118	20945	0.3267	1.0547	0.2498
1985	288301	182801	62013	45052	0.7265	0.9761	0.32
1986	527812	343187	62296	100563	1.6143	1.0484	0.4388
1987	109761	333920	75055	154916	2.064	0.992	0.5958

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
1988	54817	260031	78423	95255	1.2146	0.9955	0.499
1989	26591	212726	91989	58518	0.6361	0.9774	0.3892
1990	36934	170801	95308	27182	0.2852	1.0159	0.1562
1991	104276	195370	110525	36216	0.3277	1.0374	0.2082
1992	207548	269163	125748	59922	0.4765	0.9797	0.2838
1993	661420	442058	130406	82379	0.6317	1.0031	0.359
1994	292013	545112	150591	135186	0.8977	1.0056	0.425
1995	97769	541424	166124	142448	0.8575	1.0247	0.3828
1996	102109	474111	193160	178128	0.9222	1.0175	0.4235
1997	115462	351358	170081	154359	0.9076	1.0519	0.4862
1998	58315	250670	128542	100630	0.7829	1.0113	0.4235
1999	230844	253844	96266	83195	0.8642	1.021	0.4212
2000	89291	252459	89291	68944	0.7721	1.026	0.2802
2001	365849	359747	115898	89640	0.7734	0.9903	0.2792
2002	341859	445830	135007	114798	0.8503	1.011	0.317
2003	222966	476398	158105	138926	0.8787	1.019	0.4298
2004	223988	457207	164946	158279	0.9596	1.0192	0.3812
2005	345084	471750	174290	158298	0.9082	1.0029	0.493
2006	155170	415444	147917	153157	1.0354	0.9938	0.4088
2007	662178	496229	144142	161525	1.1206	0.9916	0.4288
2008	1330118	736982	149335	155604	1.042	0.9928	0.3955
2009	1447015	1075967	172388	200061	1.1605	1.0019	0.3585
2010	523446	1255703	238160	249200	1.0464	0.9994	0.2985
2011	243968	1282531	350009	309785	0.8851	0.9978	0.32
2012	382118	1164362	437237	315627	0.7219	0.9994	0.2652
2013	150303	991705	485092	193744	0.3994	0.9967	0.133
2014	374732	993346	532091	177522	0.3336	0.9968	0.1108
2015	100817	932603	546389	194756	0.3564	0.9953	0.158
2016	252599	839082	513257	233183	0.4543	1.0006	0.2248
2017	172395	710594	426046	227588	0.5342	0.994	0.3512
2018	315402	574608	308100	191276	0.6208	0.9943	0.426
2019	712887	593297	224182	175402	0.7824	0.9963	0.5128
2020	397126	605020	176880	182468	1.0316	0.9962	0.5825
2021	181783	545520	158732	204743	1.2899	0.9981	0.585
2022	65914	460587	154516	176906	1.1449	0.998	0.5145
2023	157194	397908	161601	178898	1.107	0.9854	0.4992

YEAR	RECR_a3	TOTBIO	TOTSPB	LANDINGS	YIELDSSB	SOPCOFAC	FBAR 4–7
2024	413932	400606	143462	139992	0.9758	0.9956	0.562

Table 4.16. Northeast Arctic haddock. Input data for recruitment prediction (RCT3)- recruits as 3 year-olds. R3: recruitment estimate from SAM 2024. NT1: Norwegian Russian winter bottom trawl survey age 1 NT2: Norwegian Russian winter bottom trawl survey age. NAK1: Norwegian Russian winter acoustic survey age 1 NAK2: Norwegian Russian winter acoustic survey age 2. ECO1: Ecosystem survey age 1. ECO2: Ecosystem survey age 2. The Russian survey (RT) was discontinued in 2017 and has not been used for recruitment forecast since.

YC	recruitment	NT1	NT2	NT3	NAK1	NAK2	NAK3	EC01	ECO2
1990	807521	NA	NA	NA	NA	NA	NA	NA	NA
1991	388099	NA	NA	314.50	NA	NA	348.73	NA	NA
1992	99893	NA	224.79	54.90	NA	187.96	41.47	NA	NA
1993	99365	604.2	199.52	55.80	887.82	88.59	29.97	NA	NA
1994	119217	1429.0	265.08	79.60	1198.18	94.52	57.27	NA	NA
1995	63007	300.8	90.81	21.70	132.6	26.51	33.78	NA	NA
1996	146615	1117.8	196.70	56.90	508.87	150.99	83.67	NA	NA
1997	82744	248.3	83.20	24.10	210.96	30.11	36.39	NA	NA
1998	357393	1208.0	437.22	294.00	653.4	404.77	233.45	NA	NA
1999	385143	832.3	446.84	312.90	1063.01	266.12	255.2	NA	NA
2000	333954	1231.0	475.31	352.20	753.01	267.9	203.68	NA	NA
2001	256154	1700.2	471.68	173.10	1315.15	362.35	151.01	NA	NA
2002	354219	3327.3	706.61	317.90	2743.74	466.54	221.33	NA	268.46
2003	153964	700.9	386.39	78.80	528.97	143.98	56.32	188.99	114.24
2004	510371	4473.2	1310.22	443.30	2276.46	624.78	209.28	603.79	929.12
2005	1048496	4944.6	1684.83	1591.00	2091.11	953.5	812.41	2270.19	1818.93
2006	979985	3731.2	2042.01	1230.40	2015.71	1753.54	883.68	988.39	1291.86
2007	234126	853.1	317.05	102.50	778.39	209.05	128.07	322.02	143.82
2008	116753	562.6	79.90	52.90	443.93	86.03	54.16	134.83	65.09
2009	332647	1634.8	353.87	316.10	1559.42	288.27	191.63	274.35	113.56
2010	117381	676.3	137.38	57.40	428.46	94.54	67.29	105.26	41.53
2011	402425	1867.0	490.28	381.20	1583.44	407.16	334.82	591.10	222.99
2012	72042	344.6	123.95	30.60	292.71	109.92	24.35	155.94	75.05
2013	207043	1281.4	342.02	163.40	1838.71	246.59	71.81	264.81	145.25
2014	192788	1134.0	561.96	134.94	1593.12	107.18	81.15	319.96	144.86
2015	354062	2299.4	770.00	336.31	1276	331.42	171.03	793.77	189.25
2016	776087	5065.4	1675.64	1075.55	3343.93	810.16	507.61	935.79	NA
2017	414649	3823.3	1125.27	424.22	2925.9	687.8	286.32	NA	585.30
2018	155855	1898.2	267.79	109.80	1544.96	260.72	50.76	379.39	57.78
2019	45328	110.6	25.12	12.20	272.94	15.69	11.4	26.82	35.88

YC	recruitment	NT1	NT2	NT3	NAK1	NAK2	NAK3	EC01	ECO2
2020	166467	406.3	110.30	82.50	431.68	70.15	77	107.62	106.65
2021	427761	1662.1	583.90	346.71	1797.1	511.1	337.4	691.82	964.83
2022	532133	1343.8	650.98	477.03	1032.7	634	369.4	648.48	174.85
2023	NA	2179.5	843.01	NA	1690.2	529.2	NA	322.44	NA
2024	NA	4369.7	NA	NA	4070.5	NA	NA	NA	NA

Table 4.17. Northeast Arctic haddock Analysis by RCT3 ver3.1 - R translation. Data for 6 surveys over 32 year classes : 1990 – 2024 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: 2022									
index	**slope**	**intercept**	**se**	**rsquare**	**n**	**indices**	**prediction**	**se.pred**	**WAP.weights**
NT1	0.8353	6.421	0.3887	0.8343	20	7.204	12.44	0.4431	0.06452
NT2	0.7431	8.017	0.3372	0.8700	20	6.480	12.83	0.3894	0.08354
NT3	0.6644	8.956	0.1028	0.9863	20	6.170	13.06	0.1207	0.31667
NAK1	1.1245	4.441	0.5070	0.7474	20	6.941	12.25	0.5778	0.03795
NAK2	0.7854	8.129	0.3696	0.8478	20	6.454	13.20	0.4373	0.06625
NAK3	0.7393	8.838	0.1612	0.9669	20	5.915	13.21	0.1919	0.31667
ECO1	0.8651	7.399	0.4125	0.8296	18	6.476	13.00	0.4889	0.05300
ECO2	0.8289	8.056	0.4695	0.7636	19	5.170	12.34	0.5418	0.04315
yearclass: 2023									
index	**slope**	**intercept**	**se**	**rsquare**	**n**	**indices**	**prediction**	**se.pred**	**WAP.weights**
NT1	0.8917	6.082	0.4685	0.7771	20	7.687	12.94	0.5414	0.14719
NT2	0.7636	7.925	0.3503	0.8621	20	6.738	13.07	0.4087	0.25824
NT3	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAK1	1.2305	3.761	0.6117	0.6716	20	7.433	12.9	0.7045	0.08690
NAK2	0.7766	8.178	0.3564	0.8580	20	6.273	13.05	0.4152	0.25019
NAK3	NA	NA	NA	NA	NA	NA	NA	NA	NA
ECO1	0.8728	7.369	0.4074	0.8336	19	5.779	12.41	0.4698	0.19547
ECO2	NA	NA	NA	NA	NA	NA	NA	NA	NA
yearclass: 2024									
index	**slope**	**intercept**	**se**	**rsquare**	**n**	**indices**	**prediction**	**se.pred**	**WAP.weights**
NT1	0.8847	6.137	0.4824	0.7709	19	8.383	13.55	0.5933	0.4869
NT2	NA	NA	NA	NA	NA	NA	NA	NA	NA
NT3	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAK1	1.2314	3.747	0.6250	0.6671	19	8.312	13.98	0.7968	0.2700
NAK2	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAK3	NA	NA	NA	NA	NA	NA	NA	NA	NA

ECO1	NA	NA	NA	NA	NA	NA	NA	NA	NA
ECO2	NA	NA	NA	NA	NA	NA	NA	NA	NA
	WAP	**logWAP**	**int.se**						
yearclass: 2022	432712	12.98	0.08956						
yearclass: 2023	384665	12.86	0.20770						
yearclass: 2024	649065	13.38	0.41401						

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

2025									
	Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWt**	**Sel**	**CWt**
	3	532133	0.294	0.028	0	0	0.258	0.0530	0.680
	4	282978	0.223	0.099	0	0	0.549	0.2100	0.963
	5	58948	0.21	0.215	0	0	0.798	0.4310	1.153
	6	13390	0.207	0.531	0	0	1.341	0.6060	1.578
	7	27447	0.2	0.7	0	0	1.597	0.6350	1.734
	8	24704	0.2	0.82	0	0	1.87	0.5280	1.986
	9	15639	0.2	0.897	0	0	2.178	0.5280	2.207
	10	2125	0.2	0.954	0	0	2.677	0.5280	2.540
	11	664	0.2	1.000	0	0	3.486	0.5280	2.882
	12	312	0.2	1.000	0	0	3.699	0.5280	3.118
	13	585	0.2	1.000	0	0	3.966	0.5280	3.861
2026									
	Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWt**	**Sel**	**CWt**
	3	384665	0.294	0.031	0	0	0.276	0.053	0.699
	4	-	0.223	0.08	0	0	0.48	0.210	0.889
	5	-	0.21	0.245	0	0	0.865	0.431	1.214
	6	-	0.207	0.427	0	0	1.13	0.606	1.386
	7	-	0.2	0.755	0	0	1.75	0.635	1.825
	8	-	0.2	0.851	0	0	1.997	0.528	1.999
	9	-	0.2	0.909	0	0	2.26	0.528	2.234
	10	-	0.2	0.947	0	0	2.573	0.528	2.496
	11	-	0.2	1.000	0	0	3.075	0.528	2.75
	12	-	0.2	1.000	0	0	3.65	0.528	3.074
	13	-	0.2	1.000	0	0	4	0.528	3.527
2027									
	Age	**N**	**M**	**Mat**	**PF**	**PM**	**SWt**	**Sel**	**CWt**
	3	649065	0.294	0.031	0	0	0.269	0.053	0.692

	4	-	0.223	0.088	0	0	0.51	0.21	0.921
	5	-	0.21	0.2	0	0	0.764	0.431	1.122
	6	-	0.207	0.473	0	0	1.22	0.606	1.468
	7	-	0.2	0.657	0	0	1.487	0.635	1.669
	8	-	0.2	0.884	0	0	2.164	0.528	2.075
	9	-	0.2	0.926	0	0	2.391	0.528	2.245
	10	-	0.2	0.952	0	0	2.651	0.528	2.517
	11	-	0.2	1.000	0	0	2.944	0.528	2.712
	12	-	0.2	1.000	0	0	3.261	0.528	2.986
	13	-	0.2	1.000	0	0	3.966	0.528	3.491

Table 4.19. Northeast Arctic haddock. Prediction with management option table for 2025-2027

2025						
Biomass	**SSB**	**FMult**	**FBar**	**Landings**		
493210	149206	0.8516	0.4007	130000		
2026					**2027**	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
583540	157726	0	0	0	870223	265334
.	.	0.1	0.047	23151	849616	254503
.	.	0.2	0.0941	45447	829837	244179
.	.	0.3	0.1412	66927	810848	234338
.	.	0.4	0.1882	87625	792613	224955
.	.	0.5	0.2352	107575	775099	216009
.	.	0.6	0.2823	126810	758273	207477
.	.	0.7	0.3294	145360	742104	199339
.	.	0.8	0.3764	163255	726562	191577
.	.	0.9	0.4234	180522	711620	184171
.	.	1	0.4705	197189	697250	177105
.	.	1.1	0.5176	213279	683428	170361
.	.	1.2	0.5646	228818	670129	163924
.	.	1.3	0.6116	243829	657330	157780
.	.	1.4	0.6587	258333	645010	151913
.	.	1.5	0.7058	272353	633147	146311
.	.	1.6	0.7528	285906	621721	140961
.	.	1.7	0.7999	299014	610714	135850
.	.	1.8	0.8469	311693	600107	130968
.	.	1.9	0.894	323962	589883	126303

.	.	2	0.941	335837	580026	121844

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

Year:	2025	**F multiplier:**	1.0962	**Fbar:**	0.4007	
age	**CatchN**	**CatchYield**	**F**	**SSB (Jan)**	**StockBiomass (Jan)**	**StockN (Jan)**
3	20368	13850	0.0451	3844	137290	532133
4	41673	40131	0.1788	15380	155355	282978
5	16439	18954	0.367	10114	47040.5	58948
6	4919	7762	0.5161	9535	17956	13390
7	10484	18179	0.5407	30683	43832.9	27447
8	8169	16224	0.4496	37881	46196.5	24704
9	5171	11413	0.4496	30553	34061.7	15639
10	703	1785	0.4496	5427	5688.63	2125
11	220	633	0.4496	2315	2314.7	664
12	103	322	0.4496	1154	1154.09	312
13	193	747	0.4496	2320	2320.11	585
TOTAL	108442	130000		149206	493210	958925
Year:	2026	**F multiplier:**	0.7439	**Fbar:**	0.35	
age	**CatchN**	**CatchYield**	**F**	**SSB (Jan)**	**StockBiomass (Jan)**	**StockN (Jan)**
3	12897	9015	0.0394	3291	106168	384665
4	49285	43815	0.1562	14557	181961	379085
5	47107	57188	0.3206	40126	163778	189339
6	10935	15156	0.4508	15973	37406.6	33103.2
7	2235	4078	0.4724	8585	11371.1	6497.76
8	3878	7751	0.3928	22238	26131.9	13085.6
9	3823	8540	0.3928	26504	29157.2	12901.4
10	2420	6041	0.3928	19901	21014.5	8167.3
11	329	904	0.3928	3413	3412.51	1109.76
12	103	316	0.3928	1266	1265.7	346.767
13	139	490	0.3928	1874	1873.8	468.449
TOTAL	133149	153293		157726	583540	1028769
Year:	2027	**F multiplier**:	0.82551	**Fbar**:	0.33	
age	**CatchN**	**CatchYield**	**F**	**SSB (Jan)**	**StockBiomass (Jan)**	**StockN (Jan)**
3	20587	14246	0.0373	5413	174598	649065
4	34000	31314	0.1476	12369	140555	275599
5	61497	69000	0.3030	39643	198216	259445
6	35157	51610	0.4260	64271	135880	111377

7	5638	9409	0.4464	16752	25498	17147
8	938	1946	0.3712	6346	7178	3317
9	2046	4592	0.3712	16016	17296	7234
10	2017	5076	0.3712	17999	18906	7132
11	1277	3463	0.3712	13292	13292	4515
12	173	518	0.3712	2001	2001	613
13	127	445	0.3712	1787	1787	451
TOTAL	163457	191620		195888	735208	1335895

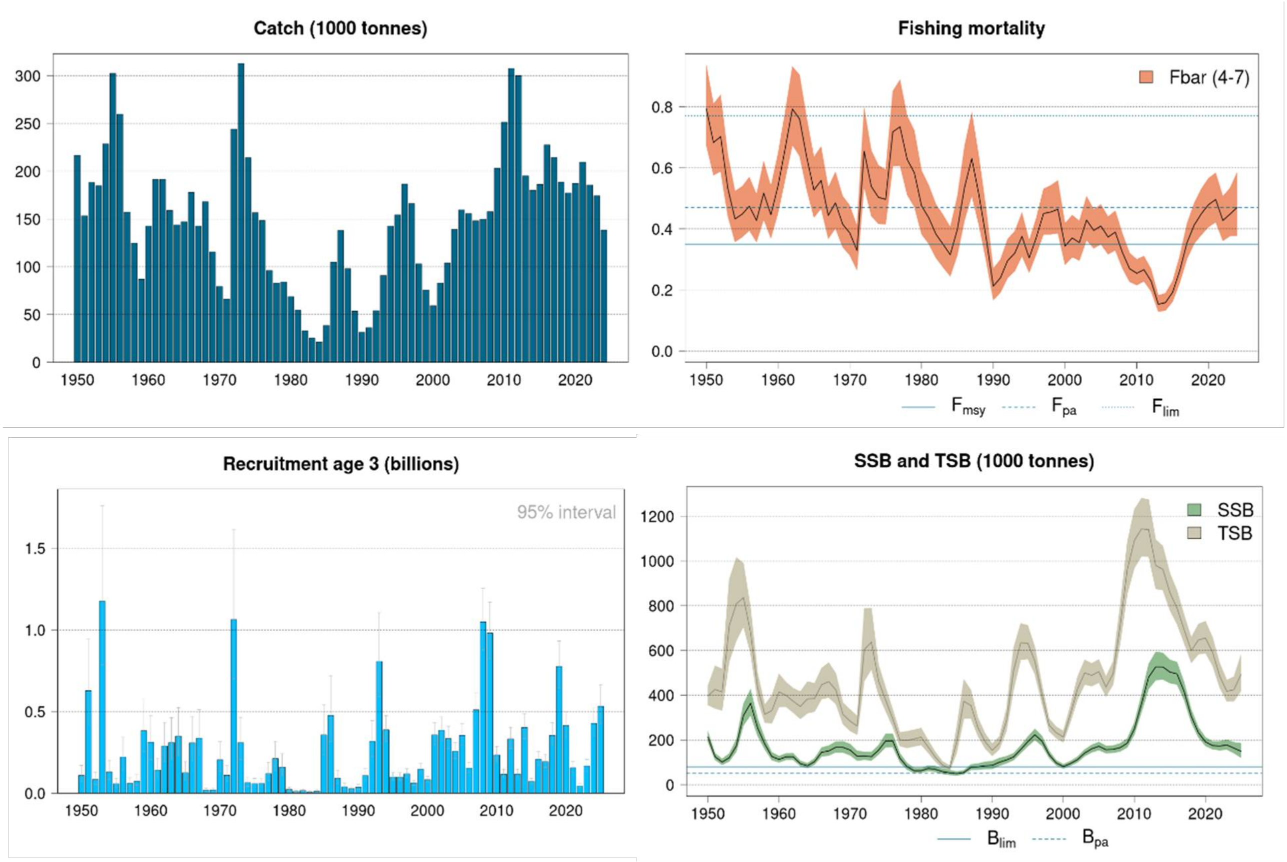


Figure 4.1. Northeast Arctic haddock landings (top left 1950-2024), fishing mortality (top right 1950-2024), recruitment (bottom left 1950-2024), and total stock biomass for ages 3+ (TSB) and spawning-stock biomass (SSB) (bottom right 1950–2024). The reference points in the SSB and TSB plot refers to the spawning stock biomass. Fishing mortality and total and spawning stock biomass are given with point wise 95% confidence intervals (shaded areas), recruitment is given with upper 95% confidence interval (bar).

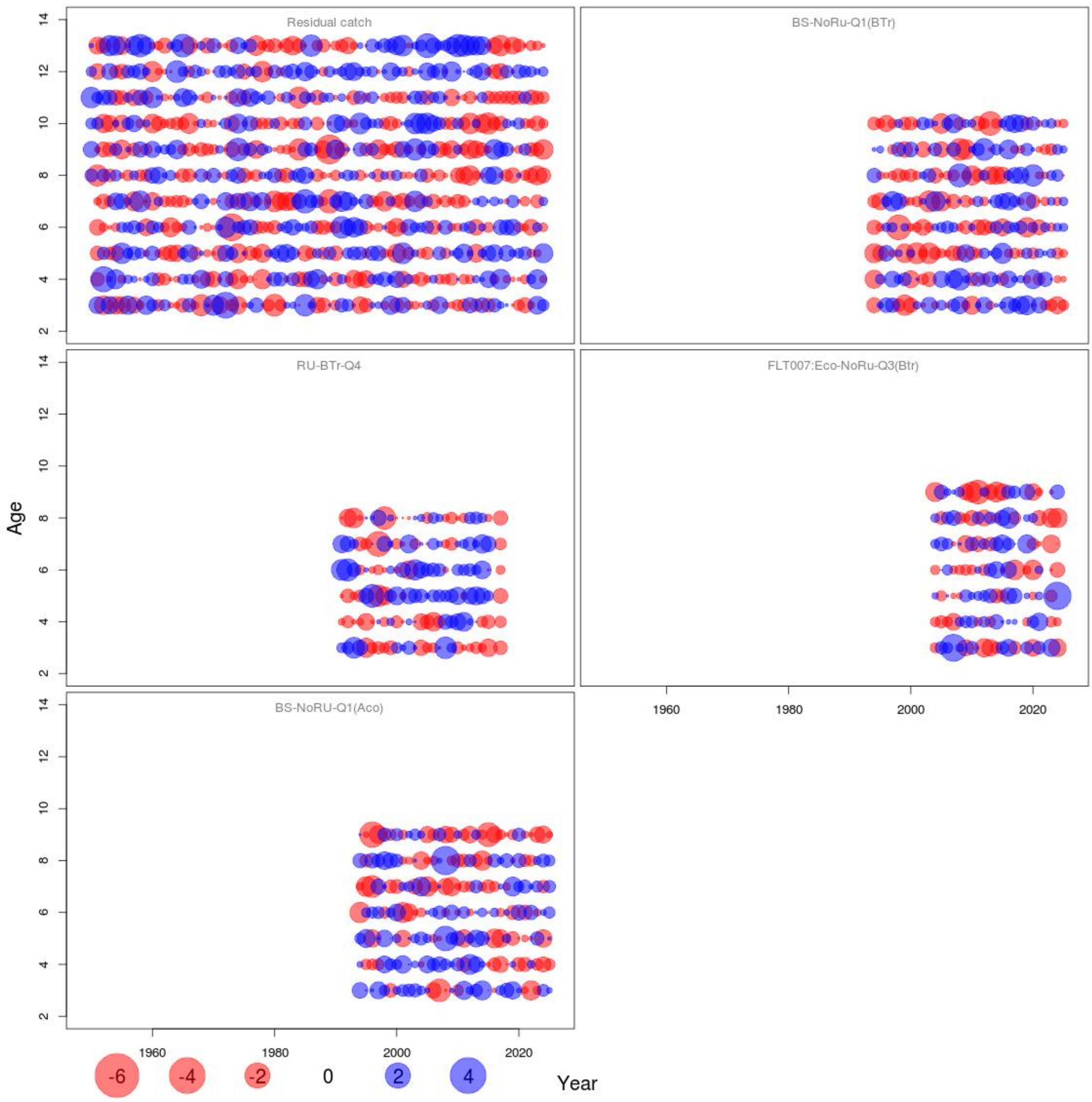


Figure 4.2. Northeast Arctic haddock; one step ahead residuals for the final SAM run 2025. Blue circles indicate positive residuals (observations larger than predicted) and red circles indicate negative residuals.

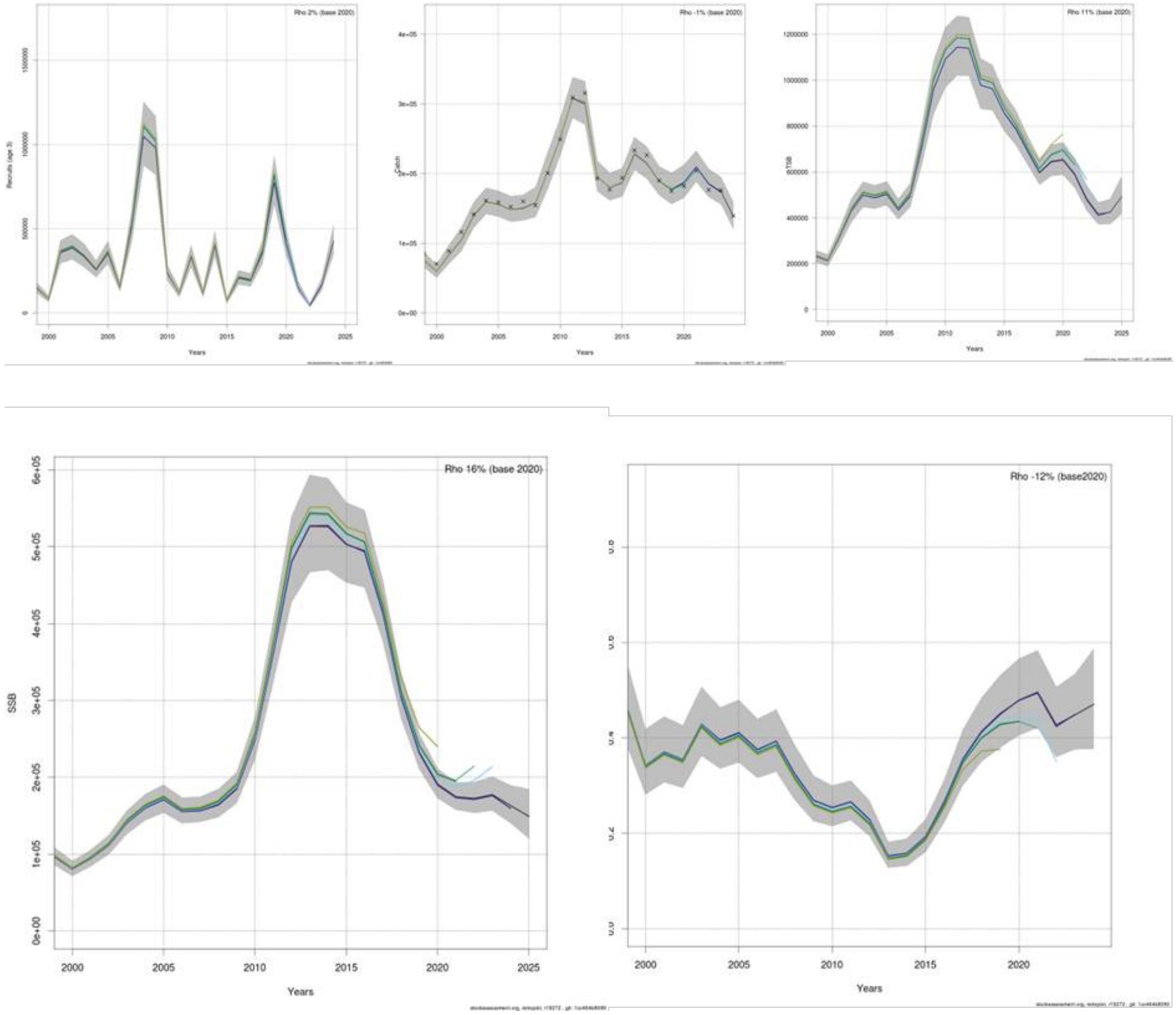


Figure 4.3 Northeast Arctic haddock. 5 year retrospective plots of Recruitment (top left), catch (top middle) and TSB (top right), SSB (bottom left), and fishing mortality TSB (bottom right) for years 1950–2024 (2023 catches and F) (SAM with 95% confidence interval.

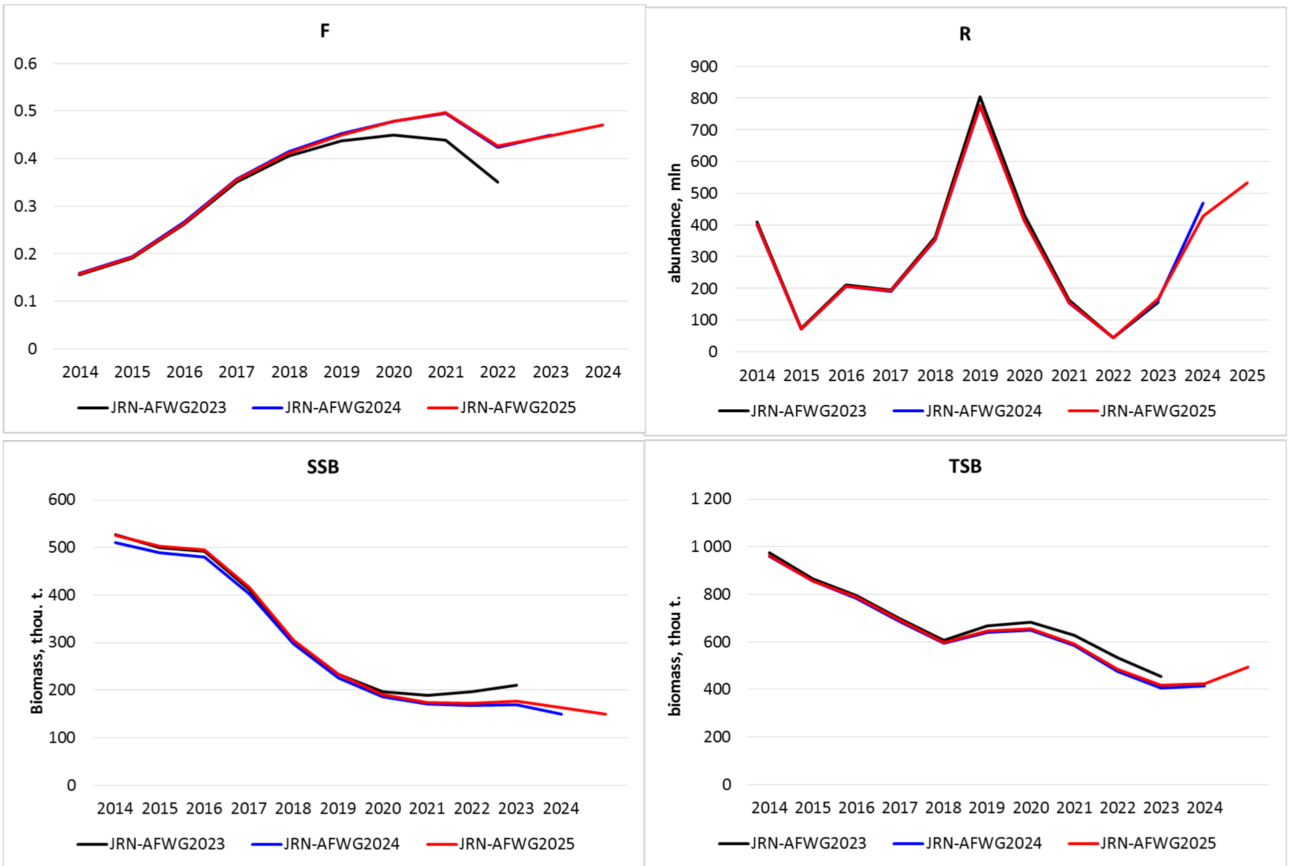


Figure 4.4. Results of assessment of NEA haddock. Fbar(4-7), TSB, recruits and SSB from AFWG 2023 (black), JRN-AFWG 2024 (blue) and this year's (2025) assessment (red) from 2014 and onwards.

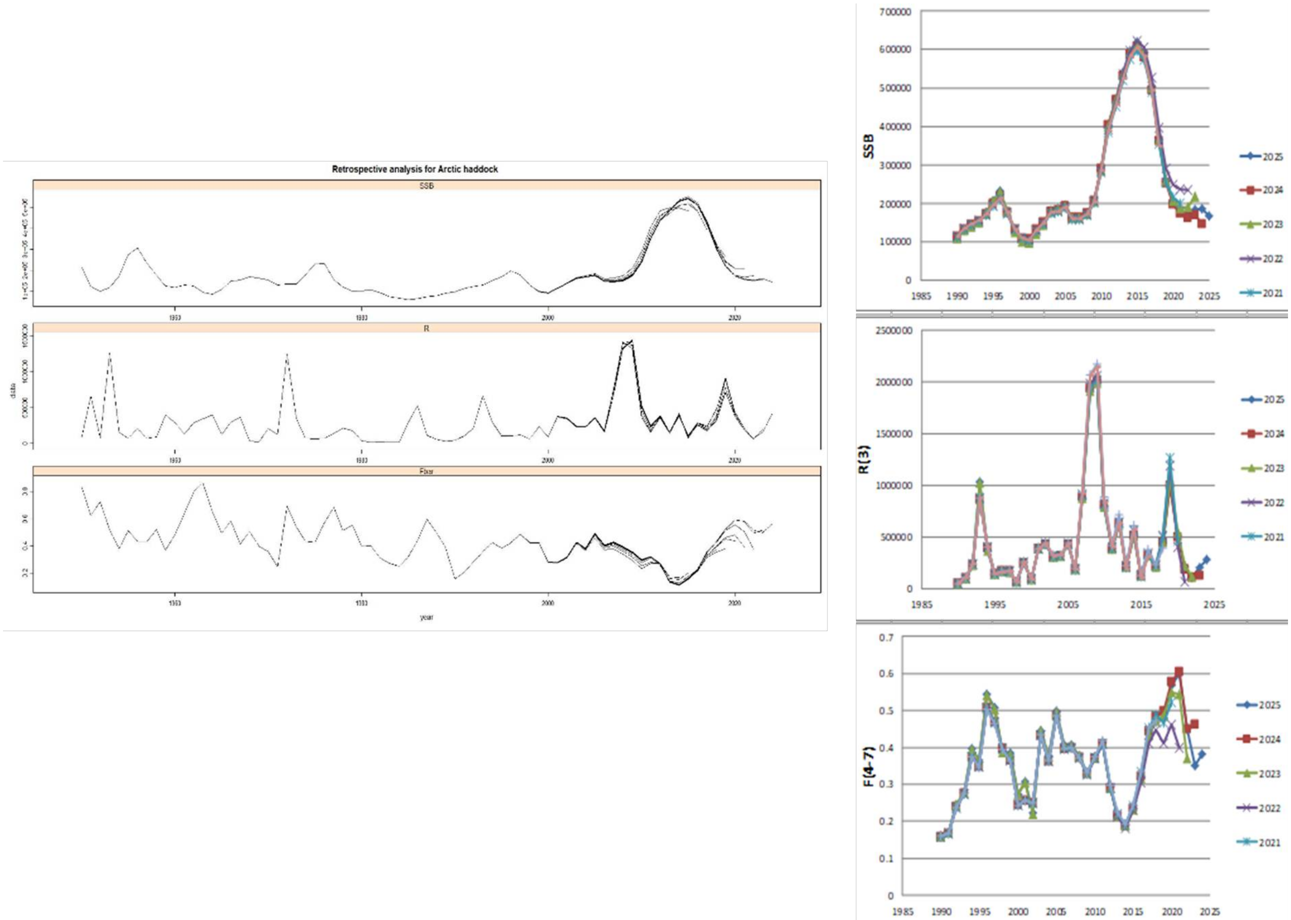


Figure 4.5. Northeast Arctic haddock. Retrospective plots of SSB, fishing mortality and recruitment for assessment years 1950–2024 (left - XSA without P shrinkage, F shrinkage= 0.5) and right - for assessment years 1990–2025 from the TSVPA model.

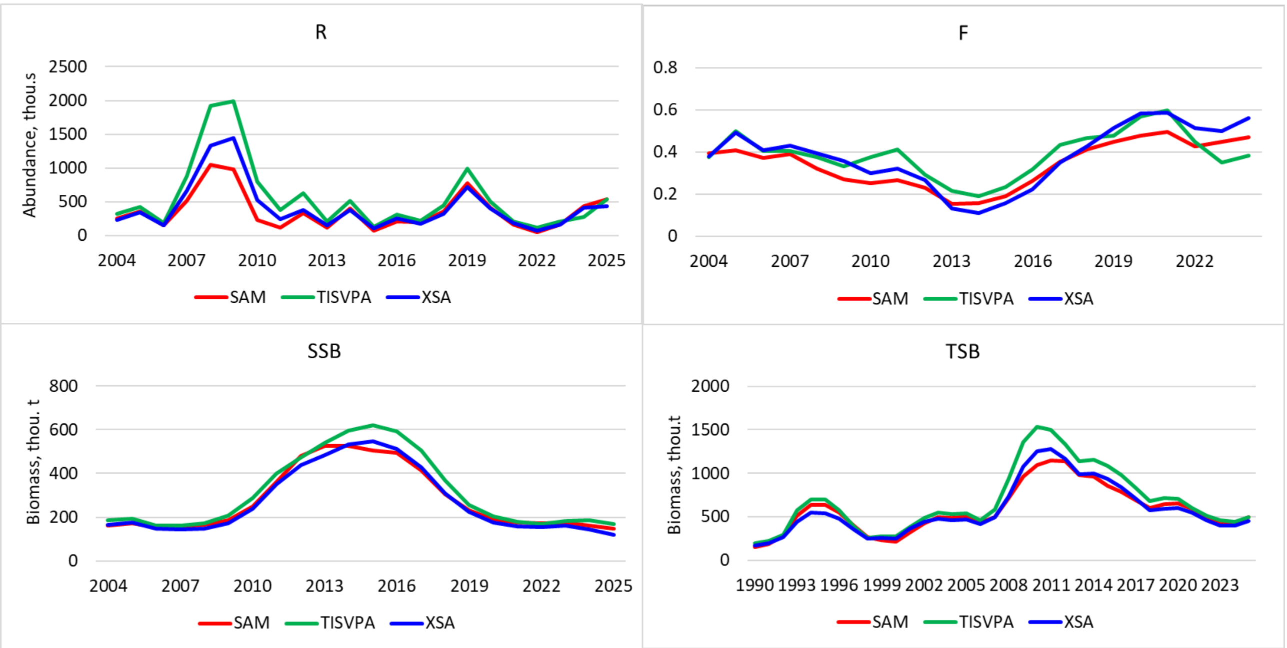


Figure 4.6. Comparison of results of assessment of NEA haddock. Recruits, biomass, spawning biomass and F in 1990–2025 by different models: median SAM estimates, XSA with setting mentioned at section 4.9 and TISVPA with settings established in WKDEM 2020.

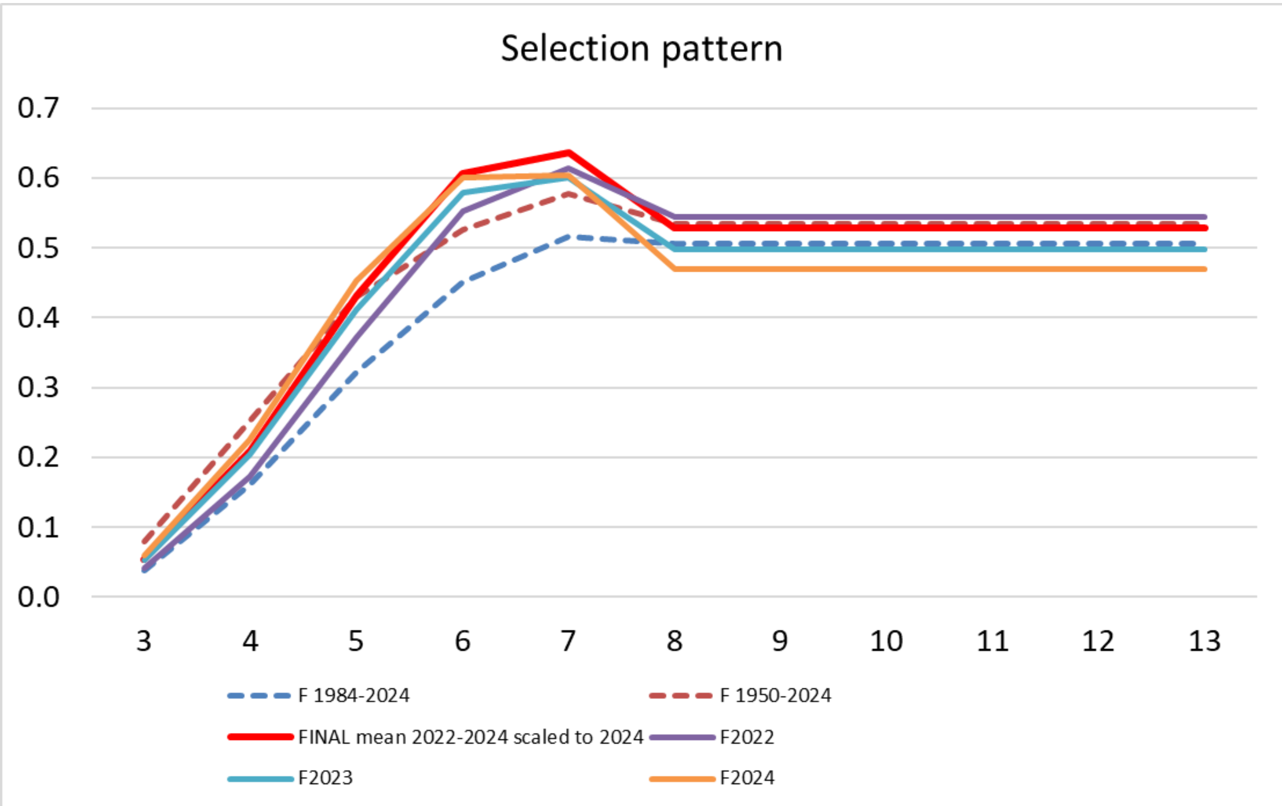


Figure 4.7 Standard selection pattern model (red) used for short-term forecasts at the current meeting.

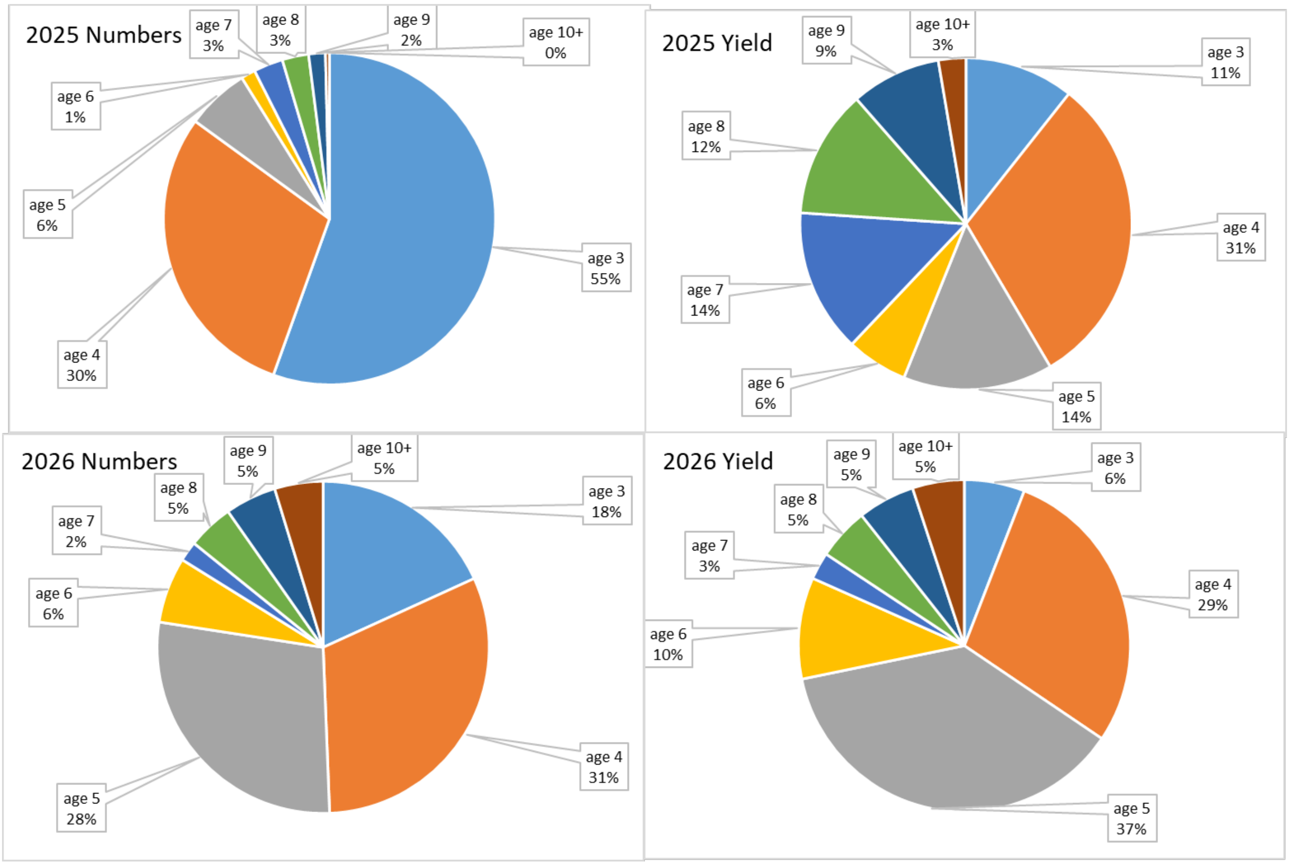


Figure 4.8 Top left: proportion of the stock (number of individuals) by age in 2025, output from SAM (Table 4.13). Top right: proportion of yield in biomass by age forecasted for 2025, using TAC constraint for 2025, taken from Table 4.20. Bottom left: proportion of the stock (number of individuals) by age in 2026, taken from Table 4.20. Bottom right: proportion of yield in biomass by age forecasted for 2026 applying Fbar=0.35, taken from Table 4.20.

Chapter 6. Beaked redfish in subareas 1 and 2 (Northeast Arctic)

Status of the fisheries

Development of the fishery

A description of the historical development of the fishery in subareas 1 and 2 is found in the ICES stock annex (ICES 2018c) for this stock (Figure 6.1). An international pelagic fishery for *S. mentella* in the Norwegian Sea outside EEZs has developed since 2004 (Figure 6.2, left panel). This pelagic fishery, which is further described in the stock annex, is managed by the Northeast Atlantic Fisheries Commission (NEAFC). Since 2014 the directed demersal and pelagic fisheries are reopened in the Norwegian Economic Zone, the Fisheries Protection Zone around Svalbard and, for pelagic fisheries only, in the Fishing Zone around Jan Mayen. The spatial regulation for this fishery is illustrated in Figures 6.2 and 6.3. In 2024, most of the catches of *S. mentella* from the Norwegian fisheries were taken in the Norwegian Exclusive Economic Zone and from the Russian fisheries in the Fisheries Protection Zone around Svalbard.

Figure 6.2 (right panel) shows the location of Norwegian *S. mentella* catches in the Norwegian EEZ in 2024 as well as bycatch in other areas. The 44th Session of the Joint Norwegian-Russian Fisheries Commission decided to split the total TAC among countries as follows: Norway: 72%, Russia: 18%, Third countries: 10% (as bycatch in the fishery protection zone at Svalbard (Spitsbergen): 4.1%, and international waters of the Norwegian Sea (NEAFC-area): 5.9%). This split was confirmed at the 51 st session of the commission in 2021.

Bycatch in other fisheries

During 2003–2013, all catches of *S. mentella*, except the pelagic fishery in the Norwegian Sea outside EEZ, were taken as bycatches in other fisheries. Some of the pelagic catches are taken as bycatches in the blue whiting and herring fisheries. From 2014 onwards most of the catch is taken as targeted catch and no longer as bycatch, following the opening of a targeted fishery in the Norwegian EEZ, Svalbard Fisheries Protection Zone and around Jan Mayen. When fishing for other species it has since 2013 been allowed to have up to 20% redfish (both species together) in round weight as bycatch outside 12 nautical miles and only 10% bycatch inside 12 nautical miles to better protect *S. norvegicus*.

Landings prior to 2025 (Tables 6.1–6.7, Figure 6.1)

Nominal catches of *S. mentella* by country for subareas 1 and 2 combined are presented in Table 6.1, while they are presented separately for Subarea 1 and divisions 2.a and 2.b in Tables 6.2–6.4. The pelagic catch of *S. mentella* in the Norwegian Sea outside EEZs reported to NEAFC and/or ICES amounted to 7 739 t in 2018, 6060 t in 2019, 5469 t in 2020, 2 872 t in 2021, 2 680t in 2022, 5t in 2023 and 1693t in 2024, as shown by country in Table 6.5. Nominal catches for both redfish species combined (i.e. *S. mentella* and *S. norvegicus*) by country are presented in Table 6.6. The sources of information used are catches reported to ICES, NEAFC, Norwegian and Russian authorities (foreign vessels fishing in the Norwegian and Russian economic zones) or direct reporting to the AFWG. Where catches are reported as Sebastes sp., they are split into *S. norvegicus* and *S. mentella* by AFWG experts based on available correlation between official catches of these two species in the considered areas. All tables have been updated with 2024 data. Total international landings in 1952–2024 are also shown in Figure 6.1.

JRN-AFWG advised an annual catch of no more than 66 779 t in 2023 and 70 164 t in 2024, corresponding to F = 0.097. In 2023, the catch was 60 466 t, of which only 5 t were reported from the pelagic fishery in international waters of the Norwegian Sea. As such, the catch was 6 313 t below the TAC advised by the JRN-AFWG in

2023, whereas in 2024, the total landings were 3 399 t below the advised TAC. Finally, JRN-AFWG 2024 advised an annual catch of no more than 67 191 t in 2025 and 69 177 t in 2026, corresponding to F = 0.077.

The redfish population in Subarea 4 (North Sea) is believed to belong to the Northeast Arctic stock. Since this area is outside the traditional areas handled by this Working Group, the catches are not included in the assessment. The total redfish landings (golden and beaked redfish combined) from Subarea 4 were up to 2003 between 1000–3000 t per year. Since 2005 the annual landings from this area have varied between 77 t (2024) and 341 t (2006) (Table 6.7).

Expected landings in 2025

JRN-AFWG has advised on the basis of precautionary considerations that the annual catch should be set at no more than 67 191 t in 2025. The 534st sessions of the Joint Norwegian-Russian Fisheries Commission decided to follow this advice.

In 2025, Norwegian fishing vessels can catch and land up to 486 3778 t of redfish in the Norwegian economic zone (NEZ) in a limited area north of 65°20'N (see map in Figure 6.3), in international waters and the fisheries zone around Jan Mayen. Only vessels with cod and saithe trawl permits can participate in the directed fishery for redfish. Each vessel which has the right to participate is assigned a maximum quota, which can be adjusted during the year, per how much of the national quota is exploited. The fishery may be stopped if the total quota is reached. This quota must also cover catches of redfish (both species) in other fisheries. It is prohibited to fish for redfish with bottom trawls in the period from 1 March until 10 May. Investigations were conducted in 2015–2016 to see if the protection of females during the main time of larvae release should be improved by extending the period of prohibited fishing until later in May, and to see if the area south of Bear Island (Area 20 in Figure 6.3) can be opened for directed fishing, either with or without sorting grid, and permissions were granted to a small number of vessels of the Norwegian reference fleet for an earlier onset of fishing to gain further data. The hitherto conclusion is that males dominated the catches (more than 70%) in the main fishing areas south and southwest of Bear Island during the investigations from late April until the directed fishery started on 10 May, and that the area south of Bear Island should stay closed during January-February due to smaller *S. mentella* inhabiting this area at the beginning of the year.

Since 2015, Russia has had access to the NEZ when fishing their quota share. In 2025 Russia may fish 12 094 t (18%) plus 2000 t transferred from Norway to Russia. Apart from this an additional 2200 t were transferred from Norway to Russia to cover bycatch of redfish (both species) in Russian fisheries targeting other species. The remaining 6 719 t are divided between third countries in the NEZ and Svalbard Zone and the NEAFC areas.

The Joint Russian-Norwegian Fisheries Commission agreed the possibility of transferring uo 10 % of national quotas for redfish (S. Mentella) from 2024 to 2025 (paragraph 8 of the Prptocol of the 54-st session).

Catch in the NEAFC areas in 2024 amounted to 1 693 t. In 2024, the total landings were 3 399 t below the advised TAC.

Data used in the assessment

Analytical assessment was conducted for this stock following recommendation from the benchmark assessment working group (WKREDFISH, ICES 2018a). Input datasets were updated with the most recently available data. The analytical assessment, based on a statistical catch-at-age model (SCAA), covers the period 1992–2023. The input data consists of the following tables:

- Total catch in tonnes (Table 6.1)
- Catch in tonnes in the pelagic fishery Norwegian Sea outside EEZs (Table 6.5)
- Total catch numbers-at-age 6–19+ (Table 6.8)
- Catch numbers-at-age 7–19+ in the pelagic fishery (Table 6.9)
- Weight-at-age 2–19+ in the population (Table 6.12)
- Maturity-at-age 2–19+ in the population (Table 6.14)
- Russian autumn survey numbers-at-age 0–11 (Table 6.15)
- Ecosystem survey numbers-at-age 2–15 (Table 6.17)
- Winter survey numbers-at-age 2–15 (Table 6.18b)
- Deep pelagic ecosystem survey proportions-at-age (Table 6.19)

There was no direct observation of catch numbers-at-age for the pelagic fishery in the Norwegian Sea outside EEZs in 2012–2023. Instead, numbers-at-age were estimated based on catch-at-age from previous or following year, and weight-at-age and fleet selectivities (section 6.2.2 in AFWG report 2013). In 2013, 2016, 2019 and 2022, observations from the scientific survey in the Norwegian Sea were used to derive numbers-at-age in the pelagic fishery. This was considered appropriate given that the survey operates in the area of the fishery, with a commercial pelagic trawl and at the time of the start of the fishery.

Length- composition from the fishery (Figure 6.4)

Comparison of length distributions of the Norwegian and Russian catches of *S. mentella* in 2022–2023 are shown in Figure 6.4. In 2022, the length distributions from Russian and Norwegian fleets were almost identical, with maximum catches around 38 cm length. In 2023, length of beaked redfish in Norwegian catches was slightly larger than in Russian catches. This may be due to differences in the fishing areas. The Russian fleet largely operated in area 2b, and the Norwegian fleet in area 2a. No Norwegian data were available for such comparison 2024.

Catch-at-age (Tables 6.8–6.11, Figure 6.5)

For JRN-AFWG 2022, catch-at-age in the Norwegian fishery was estimated using StoX-Reca for 2014 and 2020. For 2015, 2016 and 2018, running StoX-Reca failed and catch-at-age for the Norwegian Fishery was estimated using the older Biomass program in SAS (Table 6.8).

Not enough age readings were available to estimate catch-at-age in 2017, 2019 and 2021. For the pelagic fisheries 2017, 2018, 2020 and 2021 (Table 6.9) proportions-at-age in the catch were derived from proportions at-age in earlier years, weight-at-age and fleet selectivity (section 6.2.2 in AFWG report 2013). This procedure for estimating catch-at-age for recent years in which age data are not available is somewhat problematic. This is because the last year of observation has a large effect on the estimated catch-at-age for several years. At the assessment working group in 2017 and at the benchmark assessment in January 2018, the last year of observations for the catch-at-age was 2014 and the values for the years 2015 and 2016 were extrapolated. Once available, the data for 2015 (demersal) and 2016 (pelagic) were substantially different from these earlier extrapolations. In the 2022 assessment the catch-at-age observations in 2018, had a large effect on the years around it, producing a very large proportion of the 19+ class in the catch and a correspondingly high F. As the age structure in 2018 was based on less than 1000 aged fish it was decided to use a time-averaged age-length-key (ALK) to convert the length distribution in 2017-2019 and in 2021 to an age distribution. The time averaged ALK is based on the Norwegian age-length data back to 2009, excluding the years 2017, 2019 and 2021 and on commercial catches with demersal gears. The conversion still produced a fraction of the 19+-group of >60% but F was lower than in the standard method.

Several other options were considered. Firstly, extrapolation as in the standard method but extrapolating also the 19+-group and then rescaling to sum up to 100%, rather than calculating the 19+ as the difference between other ages and 100%. Secondly, calculating the fraction of each age-class as an average of the same cohort's fraction in the year before and after. Thirdly, as an average of the fraction of the same age-class in the last 3 years with data or last 3 calendar years. Finally, using a combined Russian-Norwegian ALK for individual years. Whilst some of these options produced lower fishing mortalities for the 19+-group, the change in observed selectivity for the demersal catches since 2017 remained largely the same. Therefore, the option of a common ALK across years was chosen because a as the option with the most sensible underlying reasoning.

Age composition of the Russian and Norwegian catches in 2021 was calculated using the age–length key, based on Russian age readings. The joint age–length key for the last three years (2019–2021) was applied. In general, the age distribution in the Norwegian fishery was shifted towards older fish compared to the Russian fishery. In the Russian catches fish at age 15–16 dominated, while in the Norwegian catches 16–17 years old made up the majority of the catches (Figure 6.5). The proportion (by numbers) of individuals at age 18 and older in the Norwegian catches was almost twice as large as in the Russian ones.

For JRN-AFWG 2024, StoX-Reca again failed in producing catch-at-age data for Norwegian catch in 2022. In addition, the older Biomass program could not be run. A simplified method was therefore used. Catch-at-length was calculated (by gear “bottom trawl” and “pelagic trawl”, and by stratum “Norwegian statistical area 12/20” and “other areas”) through a length-weight relationship and length distributions from the Norwegian reference fleet. An age-length-key was used to convert catch-at-length to catch-at-age. Ages were not available for 2023, and proportions-at-age in the catch were derived from proportions at-age in earlier years, similar to earlier years.

Catch-at-age for the pelagic fleet in 2022 was derived from proportion-at-age in the scientific survey in the Norwegian Sea. Catch-at-age for the 2023 pelagic catches (only 5 tonnes) were extrapolated for 2023 like earlier years.

Age–length-keys for *S. mentella* are uncertain because of the slow growth rate of individuals and therefore these data should be used with caution. Given that age is difficult to derive from length it is important that age readings are available for the most recent years, at the time of the working group.

Weight-at-age (Tables 6.12, 6.13, Figures 6.6, 6.7)

In earlier assessment, weight-at-age in the stock was set equal to the weight-at-age in the catch. This turned out to be problematic because of important fluctuations in reported weight-at-age in the catch that cannot be xplained biologically (i.e. these are noisy data). In 2015, it was advised to either use a fixed weight-at-age for the 19+ group, or use a modelled weight-at-age based on catch and survey records (Planque, 2015). The second option was chosen. Weight-at-age in the population was modelled for each year using mixed-effect models of a von Bertalanffy growth function (in weight). In 2018 an attempt was made to model weight-at-age for each cohort (rather than each year of observation). This showed that the growth function is nearly invariant between cohorts. Therefore, it was decided to use a fixed (i.e. common to all years) weight-at-age as input to the Statistical Catch-at-age model. The observed and modelled weight-at-age are presented in Table 6.12 as well as Figures 6.6 and 6.7 (not updated after 2019).

Maturity-at-age (Table 6.14, Figure 6.8)

The proportion maturity-at-age was estimated for individual years using a mixed-effect statistical model (Table 6.14, Figure 6.8). Since JRN-AFWG 2024 maturity-at-age used in the statistical catch-at-age model are identical for every year, based on average values from the previous years.

Natural mortality

In previous years, natural mortality for *S. mentella* was set to 0.05 for all ages and all years. This was based on life-history correlates presented in Hoenig (1983). Thirty-nine alternative mortality estimates were explored during the 2018 benchmark workshop, based on the review work by Kenchington (2014) and several additional recent papers (Then et al., 2014; Hamel, 2014; Charnov et al., 2013). Overall, the mode of these natural mortality estimates is 0.058 which departs only slightly from the original estimate of 0.050 (Figure 6.9). WKREDFISH (ICES, 2018a) decided to continue using 0.050 as the value of M in the assessment model. These estimates were updated for a peer-reviewed paper submitted in 2022 (Höffle and Planque, 2023) with 44 estimators resulting in a mode of the distribution of 0.07.

Figure 6.10 shows cod's predation on juvenile (5–14 cm) redfish during 1984–2020. This time-series confirms the presence of redfish juveniles and may be used as an indicator of redfish abundance. A clear difference is seen between the abundance/consumption ratio in the 1980s and at present. A change in survey trawl catchability (smaller meshes) from 1993 onwards (Jakobsen et al., 1997) and/or a change in the cod's prey preference may cause this difference. As long as the trawl survey time-series has not been corrected for the change in catchability, the abundance index of juvenile redfish less than 15 cm during the 1980s might have been considerably higher, if this change in catchability had been corrected for. The decrease in the abundance of young redfish in the surveys during the 1990s is consistent with the decline in the consumption of redfish by cod. It is important that the estimation of the consumption of redfish by cod is being continued.

Scientific surveys

Following a dedicated review, ICES AFWG approved the use of the new SToX versions of winter and ecosystem surveys for use in the *S. mentella* assessment (WD 17 and WD 18 in ICES AFWG 2020). The group recommended that the data be monitored annually to identify if a significant portion of the mentella stock moves east of the strata system. The group further recommended that work continues to investigate redfish-specific strata systems for the winter survey.

The results from the following research vessel survey series were evaluated by the Working Group:

Surveys in the Barents Sea and Svalbard area (Tables 6.15–6.18, Figures 6.11, 6.12)

Russian bottom-trawl survey in the Svalbard and Barents Sea areas in October-December for 1978–2015 in fishing depths of 100–900 m (Table 6.15, Figure 6.11). ICES acronym: RU-BTr-Q4.

Russian-Norwegian Barents Sea 'Ecosystem survey' (bottom-trawl survey, August-September) from 1996–2024 in fishing depths of 100–500 m (Figures 6.11–6.12). Data disaggregated by age for the entire period 1996–2024 apart from 2010 (Tables 6.16b-6.17). ICES acronym: Since 2003 part of Eco-NoRu-Q3 (BTr), survey code: A5216.

Winter Barents Sea seabed-trawl survey (February) from 1986–2025 (jointly with Russia since 2000, except 2006 and 2007) in fishing depths of 100–500 m (Figures 6.11–6.12). Data disaggregated by age for the period 1992–2011, 2013, 2018 and 2020 (Table 6.18b). ICES acronym: BS-NoRu-Q1 (BTr), survey code: A6996.

The Norwegian survey initially designed for redfish and Greenland halibut is now part of the ecosystem survey and covers the Norwegian Economic Zone (NEZ) and Svalbard Fisheries Protection Zone incl. north and east of

Spitsbergen during August 1996–2012 from less than 100 m to 800 m depth. This survey includes survey no. 2 above, and has been a joint survey with Russia since 2003, and since then called the Ecosystem survey. ICES acronym: Eco-NoRu-Q3 (Btr), survey code: A5216.

Pelagic survey in the Norwegian Sea (Table 6.19, Figures 6.13, 6.14)

The international deep pelagic ecosystem survey in the Norwegian Sea (WGIDEEPS, ICES 2016, survey code: A3357) monitors deep pelagic ecosystems, focusing on beaked redfish (*S. mentella*). The latest survey was conducted in the open Norwegian Sea from 22 July until 12 August 2022, following similar surveys in 2008, 2009, 2013, 2016 and 2019. The spatial coverage of the 2022 survey and the catch rates of beaked redfish in the 2019 survey are presented in Figure 6.13. The survey is scheduled every third year, but the 2025 survey has been postponed until 2026 Estimated numbers-at-age from this survey were presented at the benchmark assessment in 2018 and used in the SCAA model. Data for 2016 was updated in 2019, using additional age readings and numbers-at-age for the 2019 survey were presented during AFWG 2020, used in the assessment and updated for AFWG 2021. The details of the data preparation, using StoX, are available from WD7 of AFWG 2018 (Planque et al., 2018). The data used as input to the analytical assessment consists of proportions-at-age from age 2 to 75 years (Figure 6.14).

Additional surveys (Figures 6.15–6.17)

The international 0-group survey in the Svalbard and Barents Sea areas in August-September 1980–2024, is now part of the Ecosystem survey (Figures 6.15 and 6.16). ICES acronym: Eco-NoRu-Q3 (Btr), survey code: A5216.

A slope survey, “Egga-sør survey” was carried out by IMR from 29 February to 23 March 2024, following similar surveys in 2009, 2012, 2014, 2016, 2018, 2020 and 2022. The spatial coverage of the 2022 survey and the distribution of beaked redfish registered by acoustic is presented in Figure 6.17. Egga-Sør and Egga-Nord surveys operate on a biennial basis. The length and age distributions of beaked redfish from these surveys show consistent ageing in the population and gradual incoming of new cohorts after the recruitment failure period. These surveys are considered as candidates for data input to the analytical assessment of *S. mentella* (see also Planque, 2016).

Assessment

The group performed the analytical assessment using the statistical catch-at-age (SCAA) model reviewed at the benchmark in January 2018 (WKREDFISH, ICES 2018a). The model was configured as the benchmark baseline model which includes 53 parameters to be estimated and the model converged correctly.

Results of the assessment (Tables 6.20, 6.21, Figures 6.18–6.24)

Stock trends

The temporal patterns in recruitment-at-age 2 (Figures 6.18, 6.21) imply recruitment failure for the year classes 1996 to 2003 and indicate a return to high levels of recruitment. The estimates of year-class strength for recent years are uncertain due to limited age data from the winter and ecosystem surveys. Modelled spawning-stock biomass (SSB) increased from 1992 to 2007 (Table 6.21). In the late 2000s the total-stock biomass (TSB) consisted of a larger proportion of mature fish than in the 1990s. This is reversing as individuals from new successful year classes, but still immature, are growing. TSB has increased from about 1.0 to slightly below 1.5 million tonnes in the last 10 years (Table 6.21 and Figures 6.21–6.22). The concurrent decline in SSB from 2007 to 2014 can be attributed to the weak year classes (1996–2003) entering the mature stock. This trend has levelled off, and SSB has increased every year after 2017. SSB at the start of 2022 is estimated at 1 074 827 t.

Fishing mortality (Tables 6.20a,b–6.21, Figure 6.19)

The patterns of fleet selectivity-at-age indicate that most of the fish captured by the demersal fleet as well as the pelagic fleet in 2023 are of age 15 and older (Tables 6.20a,b and Figure 6.19). Model results at the benchmark workshop did show a gradual shift in the demersal selectivity towards older ages, a shift that was not observed after the 2015 catch-at-age data were incorporated in the model. This shift towards older ages is now again visible in the data from 2017 onwards, similar to what was observed in 2014. In 2023 F_{19+} is estimated at 0.08 (Table 6.21), with 0.077 for the demersal and 0.0002 for the pelagic fleets (Table 6.20a), respectively.

Survey selectivity patterns (Figure 6.20)

Winter and ecosystem surveys selectivity at age are very similar and show reduced selectivity for age 8 years and older, which is consistent with the known geographical distribution of different life stages of *S. mentella* (Figure 6.20). Conversely, the Russian survey shows a reduced selectivity for age 7 years and younger. This is believed to result from gear selectivity.

Residual patterns (Figure 6.23)

Residual patterns in catch and survey indices are presented in Figure 6.23a-e. There is generally no visible trend in the residuals for the Russian groundfish survey neither by age nor by year. Trends in residuals are visible in recent years for winter and ecosystem surveys and will need to be investigated further. Alternative methods for the estimation of the survey selectivity patterns will be investigated in the benchmark assessment planned for 2026 and could resolve the issue. Residual patterns for the demersal fleet indicate a similar fit of the model compared to AFWG 2018, when a time varying selectivity-at-age for this fleet was introduced.

Retrospective patterns (Figure 6.24)

The historical and analytical retrospective patterns for the years 2007 to 2016 are presented in Figures 6.24 and 6.25. All model parameters were estimated in each individual run. The most recent model run (last year of data 2023) is consistent with previous runs. As observed in previous assessments, the SSB time-series is smoother than before, due to fixed weight-at-age for every year. New data led to an increase in estimated SSB, up to >26% in the early years and around 2% to 4% in later years. The benchmark run stands out and this is due to the unavailability of recent catch-at-age data during the benchmark assessment (see section 6.2.2). The analytical retrospectives back to 2022 showed similar or up to ca. 7% upwards revision in SSB. The analytical retrospectives showed a consistent pattern for $F_{12\text{-}18}$ until 2018 after which it started to deviate. Likewise, the pattern for F_{19+} was very similar in the analytical retrospectives, with small deviations from 2018 onwards.

Projections

F_{MSY} at age 19+ is approximated using $F_{0.1}$ and estimated at 0.084 (section 1.4 of the WKREBMSE report, ICES 2018b).

The estimated fishing mortality in 2023 is: $F_{19+} = 0.077$.

If the fishing mortality is maintained, this is expected to lead to a catch of 64 029 t in 2024, more than 6 000 t less than the advised TAC for 2024. This would lead to a SSB of 1 094 860 t in early 2025, catches of 67 191 t in 2025 and a SSB of 1 105 628 t in 2026. Zero catch in 2025 and 2026 would lead to SSB values of 1 168 451 t in 2026 and 1 246 963 t in 2027.

These projections assume that the selectivity patterns of the demersal and pelagic fleets are identical with those estimated for 2023. It is also assumed that the ratio of fishing mortality between these two fleets remains unchanged.

Additional considerations

Historical fluctuations in the recruitment-at-age 2 (Figures 6.18 and 6.21) are consistent with the 0-group survey index (Figure 6.16), although the 0-group survey index is not used as an input to the SCAA.

The population age structure derived from the model outputs for the old individuals (beyond 19+, Figure 6.22) is consistent with the age structure reported from the slope surveys although these are not yet used as input to the model.

Recent recruitment levels estimated with SCAA are highly uncertain since they rely on only a few years of observations and since the age readings from winter survey were not available for most of the recent years (i.e., not available in 2012, 2014-2017, 2019 or 2021-2023). The use of the autoregressive model for recruitment (random effects in the SCAA) which was introduced in 2018 allows for a projection of the recruitment in recent years, despite the current lack of age data.

Assessment summary (Table 6.21, Figure 6.21)

The history of the stock as described by the SCAA model for the period 1992–2023 is summarized in Table 6.21 and Figure 6.21. The key elements are as follows:

- upward trend in Total-stock biomass from 1992 to 2006 followed by stabilization until 2011 and a new upward trend until the present,
- upward trend in spawning-stock biomass from 1992 to 2007 followed by stabilization (or slight decline) until 2014 and subsequent increase,
- recruitment failure for year classes 1996–2003 (2y old fish in 1998–2005),
- good (although uncertain) recruitment for year classes born after 2005. Age data for recruits (at age 2y) after 2014 is limited.
- Annual fishing mortality for the 19+ group throughout the assessment period varied between 0.002 and 0.085.

Comments to the assessment

Currently, the survey series used in the SCAA do not appropriately cover the geographical distribution of the adult population. Data from the pelagic survey in the Norwegian Sea has been reviewed in the last benchmark and is now included in the assessment model. Priority should be given to including additional data from the slope surveys that include older age groups, in analytical assessments in future (WD 5 in 2016).

The SCAA model relies on the availability of reliable age data in surveys and in the catch, and it requires a continuous effort to keep these data at an appropriate level.

Biological reference points

The proposed reference points estimated during the workshop on the management plan for *S. mentella* in (ICES 2018b) were:

Reference point	Value
B_{lim}	227 000 t
B_{pa}	315 000 t
$F_{MSY19+} = F_{0.1}$	0.084

Which are revised from those set during the benchmark in the same year (ICES 2018a) which were B_{pa} = 450 kt, B_{lim} = 324 kt and $F_{MSY19+} = F_{0.1}$ = 0.08.

Management advice

The present report updates the assessment and advises that when the status quo approach is applied, catches in 2025 should be no more than 67 191 tonnes, and catches in 2026 should be no more than 69 177 tonnes. This would correspond to a fishing mortality of F_{19+} = 0.077, whilst fishing pressure across the fishable age-classes would remain nearly constant.

Possible future development of the assessment

Many developments suggested in earlier years were presented and evaluated at the benchmark in January 2018. These include integrating a stochastic process model i) for recruitment-at-age 2, ii) for the annual component of fishing mortalities, and iii) to account for annual changes in fleet selectivities-at-age. In addition, iv) a right trapezoid population matrix, v) coding of older ages into flexible predefined age-blocks, and vi) integrating of data from pelagic surveys in the Norwegian Sea were implemented. The purpose of these new features was to reduce the number of parameters to estimate (i, ii), include new data on the older age fraction of the population (iv, v, vi) and account for possible temporal changes in selectivity linked to changes in the national and international fisheries and their regulations (iii).

A new benchmark on *S. mentella* will be conducted early 2026, where a new assessment model will be implemented. In preparation of this benchmark, age reading of *S. mentella* has been prioritized. A key feature of the new model should be a flexible index combining the partial coverage of the surveyed during current bottom trawl survey programs (Vihtakari et al., in prep). Also, the model should support the possibility to combine age and length data in catches, to mitigate the challenge of reading a sufficiently high number of otoliths. A pre-screening suggests that the new version of GADGET (GADGET 3) would constitute an appropriate choice of model system.

References

Charnov, E.L., Gislason, H., and Pope, J.G. 2013. Evolutionary assembly rules for fish life histories. Fish Fish. 14(2): 213-224.

Hamel, O.S. 2014. A method for calculating a meta-analytical prior for the natural mortality rate using multiple life history correlates. ICES J. Mar. Sci. 72(1): 62-69.

Höffle H. and Tranang C. A. 2020. Use of RstoX for recalculating numbers at age of *Sebastes mentella* from the joint NOR-RUS Barents Sea Ecosystem Survey in summer and autumn. WD18 - ICES AFWG2020.

Höffle H. and Planque B. (2023). Natural mortality estimations for beaked redfish (*Sebastes mentella*) - a long-lived ovoviviparous species of the Northeast Arctic. Fisheries Research 260: 106581.

Hoenig, J. M. 1983. Empirical use of longevity data to estimate mortality rates. Fisheries Bulletin U.S. 81:898-903.

ICES 2013. Report of the Arctic Fisheries Working Group, Copenhagen, 18-24 April 2013. ICES C.M. 2013/ACOM:05, 726 pp.

ICES 2016. Final Report of the Working Group on International Deep Pelagic Ecosystem Surveys

(WGIDEEPS). ICES CM, ICES CM 2016/SSGIEOM:02: 21pp.

ICES. 2018a. Report of the Benchmark Workshop on Redfish Stocks (WKREDFISH), 29 January-2 February 2018, Copenhagen, Denmark. ICES CM 2018/ACOM:34. 174 pp.

ICES. 2018b. Report of the Workshop on the evaluation of harvest control rules for *Sebastes mentella* in ICES areas 1 and 2 (WKREBMSE), June–August 2018, by correspondence. ICES CM 2018/ACOM:52. 32 pp.

ICES. 2018c. Stock Annex: Beaked redfish (*Sebastes mentella*) in subareas 1 and 2 (Northeast Arctic). Stock Annex: Beaked redfish (*Sebastes mentella*) in subareas 1 and 2 (Northeast Arctic) (figshare.com)

Jakobsen, T., Korsbrekke, K., Mehl, S., and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES CM 1997/Y:17.

Kenchington, T.J. Natural mortality estimators for information-limited fisheries. Fish and Fisheries, 2014, 15.4: 533-562.

Planque, B. 2015. *S. mentella* assessment - handling the +group.: WD03 - ICES AFWG2015. 8 pp.

Planque, B. 2016. Possible use of the Pelagic and slope surveys in the analytical assessment of *Sebastes mentella* in ICES areas 1 and 2.: WD05 - ICES AFWG2016. 6 pp.

Planque, B., Vollen, T., Höffle, H., Harbitz A., 2018. Use of StoX for estimating numbers@age of *Sebastes mentella* from the international deep pelagic ecosystem survey in the Norwegian Sea.: WD07 - ICES AFWG2018. 38 pp.

Then, A. Y., Hoenig, J. M., Hall, N. G., and Hewitt, D. A. 2018. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES Journal of Marine Science, 75: 1509–1509. https://doi.org/10.1093/icesjms/fsx199 (Accessed 18 January 2021).

Tranang C. A., Vollen T. and Höffle H. 2020. Use of StoX for recalculating numbers at age and numbers at length of *Sebastes norvegicus* from the Barents Sea NOR-RUS demersal fish cruise in winter.: WD17 - ICES AFWG2020. 60 pp.

Tables and figures

Table 6.1. S. mentella in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1, divisions 2.a and 2.b combined.

Year	Faroe Islands	France	Germany[2]	Greenland	Latvia	Lithuania	Norway	Portugal	Russia[3]	Spain	UK[4]	Others	Total
1993	13	50	35	1	-	-	5182	963	6260	5	293	12	**12 814**
1994	4	74	18	1	-	-	6511	895	5021	30	136	31	**12 721**
1995	3	16	176	2	-	-	2646	927	6346	67	97	4	**10 284**
1996	4	75	119	3	-	-	6053	467	925	328	99	2	**8 075**
1997	4	37	81	16	-	-	4657	474	2972	272	78	7	**8 598**
1998	20	73	100	14	-	-	9733	125	3646	177	134	**22**	**14 044**
1999	73	26	202	50	-	-	7884	65	2731	29	140	9	**11 209**
2000	50	12	62	29	-	-	6020	115	3519	87	130	51	**10 075**
2001	74	16	198	17	-	-	13 937	179	3775	90	120	12	**18 418**

Year	Faroe Islands	France	Germany	Greenland	Latvia	Lithuania	Norway	Portugal	Russia	Spain	UK	Others	Total
2002	75	58	99	18	-	-	2152	242	3904	190	188	68	**6 994**
2003	64	22	32	8	-	-	1210	44	952	47	124	17	**2 520**
2004	588	13	10	4	-	-	1375	235	2879	257	76	56	**5 493**
2005	1147	46	33	39	-	-	1760	140	5023	163	95	20	**8 466**
2006	3808	215	2483	63	341	845	4710	1804	11 413	710	1027	5842	**33 261**
2007	2197	234	520	29	349	785	3209	1483	5660	2181	202	3369	**20 218**
2008	1849	187	16	25	267	117	2220	713	7117	463	83	39	**13 096**
2009	1343	15	42	-	-	-	2677	806	3843	177	80	1263	**10 246**
2010	979	175	21	12	243	457	2065	293	6414	1184	79	2	**11 924**
2011	984	175	835	-	536	565	2471	613	5037	1678	55	13	**12 962**
2012	259	-	517	-	447	449	2114	1038	4101	1780	-	354	**11 059**
2013	697	-	80	21	280	262	1750	1078	3677	1459	-	85	**9389**
2014	743	215	446	15	215	167	13 149	505	1704	1162	-	106	**18 427**
2015	657	49	242	48	537	192	19 433	678	1142	2529	52	11	**25 570**
2016	502	134	493	74	1243	1065	18 191	1066	8419	3213	122	232	**34 754**
2017	443	45	763	66	562	790	17 077	1060	6593	2838	436	109	**30 782**
2018	425	67	2473	82	1020	1010	18 594	699	10 497	2457	63	659	**38 046**
2019	156	370	1599	615	-	653	23 844	1422	13 444	2222	590	725	**45 640**
2020	149	163	1807	67	-	1081	32 950	889	13 874	744	437	1496	**53 657**
2021	290	218	1166	85	-	1379	43 794	381	14 887	615	655	9	**63 479**
2022	235	221	1758	39	-	990	40 715	464	16717	278	114	663	**62 194**
2023[1]	154	128	626	109	-	-	44 544	358	13976	295	152	45	**60 387**
2024[1]	2038	4	458	149	1	-	47 224	467	16235	105	-	84	**66 765**

1 - Provisional figures.

2 - Includes former GDR prior to 1991.

3 - USSR prior to 1991.

4 - UK(E&W) + UK(Scot.)

Table 6. 2 . S. mentella in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1.

Year	Faroe Islands	France	Germany	Greenland	Norway	Russia	Spain	Others	Total
1993	2	-	-	-	16	588	-	-	**606**
1994	2	-	2	-	36	308	-	-	**348**
1995	2	-	-	-	20	203	-	-	**225**
1996	-	-	-	-	5	101	-	-	**106**
1997	-	-	-	3	12	174	-	1	**190**

Year	**Faroe Islands**	**France**	**Germany**	**Greenland**	**Norway**	**Russia**	**Spain**	**Others**	**Total**
1998	20	-	-	-	26	378	-	-	**424**
1999	69	-	-	-	69	489	-	-	**627**
2000	-	-	-	-	47	406	-	48	**501**
2001	-	-	-	-	8	296	-	3	**307**
2002	-	-	-	-	4	587	-	-	**591**
2003	-	-	-	-	6	292	-	-	**298**
2004	-	-	-	-	2	355	-	-	**357**
2005	-	-	-	-	3	327	-	-	**330**
2006	2	-	-	-	12	460	-	2	**476**
2007	-	-	-	-	11	210	-	28	**249**
2008	-	-	-	-	5	155	-	2	**162**
2009	-	-	-	-	3	80	-	8	**91**
2010	-	-	-	-	20	10	-	-	**30**
2011	-	-	-	-	48	13	-	-	**61**
2012	-	-	-	-	34	17	-	-	**51**
2013	-	-	-	-	64	27	-	-	**91**
2014	-	-	-	-	159	63	**-**	-	**222**
2015	-	-	-	18	138	125	-	1	**282**
2016	-	-	-	-	225	229	342	1	**797**
2017	-	-	-	12	207	196	-	3	**418**
2018	-	-	19	26	255	376	-	3	**679**
2019	83	4	-	13	369	206	19	22	**716**
2020	35	12	6	21	335	118	1	12	**540**
2021	87	31	-	14	195	367	1	4	**699**
2022	91	2	3	20	508	88	1	-	**713**
2023[1]	56	8	31	17	1 333	145	69	5	**1 664**
2024[1]	125	4	33	4	1023	327	6	11	1 533

1 - Provisional figures.

Table 6. 3 . S. mentella in subareas 1 and 2. Nominal catch (t) by countries in Division 2.a (including landings from the pelagic trawl fishery in the international waters).

Year	Faroe Islands	France	Germany	Greenland	Latvia	Lithuania	Norway	Portugal	Russia	Spain	UK	Others	Total
1993	11	15	35	1	-	-	5029	648	5328	-	2	-	11 069
1994	2	33	16	1	-	-	6119	687	4692	8	4	2	11 564
1995	1	16	176	2	-	-	2251	715	5916	65	43	2	9 187

1996	-	75	119	3	-	-	5895	429	677	5	61	-	7 264
1997	-	37	77	12	-	-	4422	410	2341	9	55	2	7 365
1998	-	73	58	14	-	-	9186	118	2626	55	106	6	12 242
1999	-	16	160	50	-	-	7358	56	1340	14	120	3	9 117
2000	50	11	35	29	-	-	5892	98	2167	18	103	-	8 403
2001	63	12	161	17	-	-	13 636	105	2716	18	95	4	16 827
2002	37	54	59	18	-	-	1937	124	2615	8	157	45	5 054
2003	58	18	17	8	-	-	1014	17	448	8	102	10	1 700
2004	555	8	4	4	-	-	987	86	2081	7	18	14	3 764
2005	1101	36	17	38	-	-	1083	71	3307	20	15	6	5 694
2006	3793	199	2475	52	-	845	4010	1731	10 110	589	958	5 812	30 574
2007	2157	226	519	29	349	785	3043	1395	5061	2159	120	3 358	19 201
2008	1821	179	9	24	267	117	1952	666	6442	430	62	32	12 001
2009	1316	7	23	-	-	-	2208	764	3305	137	62	1 252	9 074
2010	961	175	13	12	243	457	1705	246	5903	1183	55	2	10 955
2011	932	175	697	-	536	561	1682	599	4326	1656	19	2	11 185
2012	259	-	469	-	447	449	1500	1038	3478	1770	-	343	9 753
2013	675	-	24	21	280	262	871	1055	3293	1435	-	69	7 985
2014	728	209	411	15	215	167	4089	505	1334	1159	-	102	8 934
2015	657	49	236	25	537	192	11 410	678	480	2508	47	9	16 828
2016	495	107	493	61	1243	1065	8887	1052	3949	2862	71	207	20 492
2017	425	38	763	44	562	790	7348	1059	3922	2813	429	97	18 290
2018	400	47	2440	51	876	1010	14 057	699	4721	2435	62	653	27 451
2019	73	363	1599	59	-	652	17 741	1421	7366	2184	569	709	32 736
2020	112	146	1797	42	-	1081	22 854	880	6085	737	403	1490	35 627
2021	151	182	1128	70	-	1379	35 798	377	6008	535	552	6	46 186
2022	112	187	1693	16	-	990	28 666	441	7793	92	11	663	40 664
2023[1]	73	37	518	92	-	-	37 437	329	2089	213	62	11	40 861

2024[1]	1906	-	382	8	-	-	38635	461	4357	50		76	45 875

1 - Provisional figures.

Table 6. 4 . S. mentella in subareas 1 and 2. Nominal catch (t) by countries in Division 2.b.

Year	Faroe Islands	France	Germany	Greenland	Norway	Poland	Portugal	Russia	Spain	UK	Others	Total
1993	-	35	-	-	137	-	315	344	57	291	12	**1 191**
1994	-	41	-	-	356	-	208	21	22	132	29	**809**
1995	-	-	-	-	375	-	212	227	2	54	2	**872**
1996	4	-	-	-	153	-	38	147	323	38	2	**705**
1997	4	-	3	1	223	1	64	457	263	22	4	**1 042**
1998	-	-	42	-	521	13	7	642	122	29	3	**1 379**
1999	4	10	42	-	457	6	9	902	15	20	-	**1 465**
2000	-	1	27	-	82	2	17	946	69	27	1	**1 172**
2001	11	4	37	-	293	5	74	763	72	25	-	**1 284**
2002	38	4	40	-	210	8	118	702	182	31	15	**1 348**
2003	6	4	15	-	190	7	27	212	39	22	-	**522**
2004	33	5	6	-	386	42	149	443	250	58	-	**1 372**
2005	46	10	17	1	673	-	69	1389	143	80	14	**2 442**
2006	13	16	8	11	688	29	73	843	121	67	1	**1 870**
2007	40	8	1	-	155	2	88	389	22	62	1	**768**
2008	28	8	7	1	263	6	47	520	33	19	-	**932**
2009	27	8	19	-	466	1	42	458	41	17	6	**1 085**
2010	18	0	8	-	339	-	47	501	1	24	-	**938**
2011	52	0	139	-	741	11	14	698	23	36	4	**1 718**
2012	0	0	48	-	581	7	-	606	10	-	4	**1 256**
2013	22	0	56	-	815	16	23	357	23	-	-	**1 312**
2014	15	6	34	-	8901	3	-	307	3	-	1	**9 270**
2015	-	-	6	5	7885	1	-	536	21	5	-	**8 459**
2016	7	27	0	14	9078	24	14	4241	9	50	-	**13 464**
2017	18	7	1	10	9522	5	1	2476	25	7	4	**12 076**
2018	25	20	14	6	4281	3	-	5400	22	1	144	**9 916**
2019	-	4	-	543	5734	-	-	5873	19	17	-	**12 190**
2020	2	5	4	4	9760	-	-	7671	6	34	-	**17 486**
2021	52	6	38	1	7801	2	-	8512	79	103	1	**16 595**
2022	32	32	62	3	11 541	-	23	8836	185	104	-	**20 818**
2023[1]	25	83	78	-	5774	-	24	11 742	12	89	33	**17 860**
2024[1]	7	-	43	137	7566	-	3	11 551	48	-	**1**	**19 356**

1 - Provisional figures.

Table 6. 5 . S. mentella in subareas 1 and 2. Nominal catch (t) by countries of the pelagic fishery in international waters of the Norwegian Sea (see text for further details).

Year	Faroe Islands	Germany	Iceland	Latvia	Lithuania	Netherland	Norway	Poland	Portugal	Russia	Spain	Other	Total
2002	-	9	-	-	-	-	-	-	-	-	-	-	**9**
2003	-	40	-	-	-	-	-	-	-	-	-	-	**40**
2004	500	2	-	-	-	-	-	-	-	1510	-	-	**2 012**
2005	1083	20	-	-	-	-	-	-	-	3299	-	-	**4 402**
2006	3766	2475	2510	341	845	-	2862	2447	1697	9390	575	1862	**28 770**
2007	1968	497	1579	349	785	-	1813	1079	1377	3645	2155	910	**16 157**
2008	1797	-	-	267	117	-	330	-	641	4901	390	-	**8 443**
2009	1253	-	-	-		-	-	337	701	1975	135	889	**5 290**
2010	912	-	-	243	457	-	450	-	244	5103	820	-	**8 229**
2011	740	693	-	536	561	-	342	-	595	3621	1648	175	**8 911**
2012	259	469	31	447	449	-	-	311	1038	2714	1768	-	**7 486**
2013	675	-	-	280	262	-	1	68	1078	2720	1435	8	**6 527**
2014	697	409	-	215	167	-	-	100	505	795	1146	-	**4 034**
2015	606	231	-	537	192	-	-	-	678	0	2508	-	**4 752**
2016	393	493	-	1243	1065	-	9	-	821	512	2862	-	**7 398**
2017	296	761	-	562	790	-	-	14	791	1014	2624	-	**6 852**
2018	400	2192	-	876	1010	374	-	116	372	-	2399	-	**7 739**
2019	-	1157	-	-	652	244	1	364	1096	117	1908	521	**6 060**
2020	-	1380	-	-	1081	1366	-	-	480	25	737	400	**5 469**
2021	-	514	-	-	1379	-	-	-	84	498	280	117	**2 872**
2022	-	938	-	-	990	586	-	-	88	-	-	78	**2 680**
2023[1]	-	-	-	-	-	-	-	-	-	-	-	5	**5**

Year	Faroe Islands	Germany	Iceland	Latvia	Lithuania	Netherland	Norway	Poland	Portugal	Russia	Spain	Other	Total
20241	1682	-	-	-	-	-	-	-	-	-	-	**11**	**1 693**

1 - Provisional figures.

Table 6. 6 . REDFISH in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1, divisions 2.a and 2.b combined for both S. mentella and S. norvegicus.

Year	Faroe Islands	France	Germany2	Greenland	Latvia	Lithuania	Norway	Portugal	Russia[3]	Spain	UK	Others	Total
1984	-	2 970	7 457	-	-	-	18 650	1806	69 689	25	716	-	**101 313**
1985	-	3 326	6 566	-	-	-	20 456	2056	59 943	38	167	-	**92 552**
1986	29	2 719	4 884	-	-	-	23 255	1591	20 694	-	143	-	**53 315**
1987	450	1 611	5 829	-	-	-	18 051	1175	7 215	25	239	-	**34 595**
1988	973	3 349	2 355	-	-	-	24 662	500	9 139	26	470	-	**41 474**
1989	338	1 849	4 245	-	-	-	25 295	340	14 344	5	272	-	**46 688**
1990	386	1 821	6 741	-	-	-	34 090	830	18 918	-	333	37	**63 156**
1991	639	791	981	-	-	-	49 463	166	15 354	1	349	23	**67 767**
1992	58	1 301	530	614	-	-	23 451	977	4 335	16	482	9	**31 773**
1993	152	921	685	15	-	-	18 319	1 040	7 573	13	735	12	**29 465**
1994	26	771	1 026	6	-	-	21 466	985	6 220	34	272	35	**30 841**
1995	30	748	693	7	-	-	16 162	936	6 985	67	265	7	**25 900**
1996	42	746	618	37	-	-	21 675	522	1 641	409	426	2	**26 118**
1997	7	1 011	538	39	-	-	18 839	535	4 556	308	264	12	**26 109**
1998	98	567	231	47	-	-	26 273	131	5 278	228	305	41	**33 199**
1999	108	61	430	97	-	-	24 634	68	4 422	36	309	30	**30 195**
2000	67	25	222	51	-	-	19 052	131	4 631	87	203	67	**24 536**
2001	111	46	436	34	-	-	23 071	186	4 738	91	239	13	**28 965**

Year	Faroe Islands	France	Germany2	Greenland	Latvia	Lithuania	Norway	Portugal	Russia	Spain	UK	Others	Total
2002	135	89	141	49	-	-	10 713	276	4 736	193	234	71	**16 637**
2003	173	30	154	44	-	-	8 063	50	1 431	47	258	110	**10 360**
2004	607	17	78	24	-	-	7 608	240	3 601	260	145	119	**12 699**
2005	1 194	56	105	75	-	-	7 845	196	5 637	171	147	76	**15 502**
2006	3 919	223	2 518	107	341	845	11 015	1 873	12 126	719	1 066	5 897	**40 649**
2007	2 343	249	587	113	349	785	8 993	1 708	6 550	2 186	257	3 470	**27 590**
2008	2 123	250	46	96	267	117	7 436	785	7 866	467	168	74	**19 695**
2009	1 413	16	100	81	-	-	8 128	836	4 541	177	111	1 330	**16 733**
2010	1 150	226	52	84	243	457	8 059	321	6 979	1 187	123	25	**18 906**
2011	1 008	228	844	51	536	565	7 152	638	5 956	1 684	68	84	**18 814**
2012	346	182	588	58	447	449	6 361	1 055	4 782	1 780	100	428	**16 576**
2013	780	353	81	66	280	262	5 586	1 114	4 474	1 459	493	114	**15 062**
2014	810	434	452	35	215	167	16 589	510	2 510	1 162	211	157	**23 252**
2015	733	102	266	259	537	192	22 166	678	1 806	2 531	109	64	**29 443**
2016	685	164	497	161	1243	1065	22 322	1 066	9 283	3 213	198	320	**40 217**
2017	566	62	782	127	562	790	20 644	1 150	7 890	2 882	596	203	**36 254**
2018	571	104	2 539	159	1 020	1 010	23 555	766	12 331	2 469	100	763	**45 387**
2019	392	395	1 692	671	-	656	29 795	1 495	15 373	2 287	615	828	**54 199**
2020	315	164	1 895	166	-	1 081	39 453	969	16 489	750	456	1 558	**63 296**
2021	613	224	1 242	177	-	1 379	51 497	441	16 624	623	751	103	**73 674**
2022	546	241	1 818	200	-	990	48 268	537	19 257	282	122	883	**73 144**
2023[1]	345	164	744	255	-	-	52 226	459	16 248	325	168	233	**71 167**
2024[1]	2 228	8	532	320	1	-	54 859	496	18 304	117	-	271	**77 136**

1 - Provisional figures.

2 - Includes former GDR prior to 1991.

3 - USSR prior to 1991.

Table 6. 7 . REDFISH in Subarea 4 (North Sea). Nominal catch (t) by countries as officially reported to ICES.

Year	Belgium	Denmark	Faroe Islands	France	Germany	Ireland	Netherlands	Norway	Portugal	UK	Others	Total
1998	2	27	12	570	370	4	21	1 113		749	0	**2 868**
1999	3	52	1	0	58	39	16	862		532	0	**1 563**
2000	5	41	0	224	19	28	19	443		618	0	**1 397**
2001	4	96	-	272	13	19	-	421	-	538	-	**1 363**
2002	2	40	2	98	11	7	-	241	-	524	-	**925**
2003	1	71	2	26	2	-	-	474	-	463	-	**1 039**
2004	-	42	3	26	1	-	-	287	-	214	-	**573**
2005	2	34	-	10	1	-	-	84	-	28	-	**159**
2006	1	49	1	12	3	-	-	163	33	79	-	**341**
2007	-	27	-	8	1	-	-	116	-	77	1	**230**
2008	-	3	-	8	1	-	-	77	-	54	1	**144**
2009	-	4	1	38	-	-	-	119	-	86	-	**248**
2010	-	5	-	3	-	-	-	62	-	150	-	**220**
2011	-	9	-	90	1	-	-	66	-	71	-	**237**
2012	-	10	-	19	-	-	-	71	-	87	-	**187**
2013	-	7	-	40	-	-	-	54	-	176	-	**277**
2014	-	-	-	32	1	-	-	146	-	93	-	**272**
2015	-	1	-	14	1	-	-	157	-	61	-	**234**
2016	-	3	-	11	-	-	-	180	-	22	-	**216**
2017	-	3	-	10	-	-	-	168	-	38	-	**219**
2018	-	10	-	4	-	-	-	71	-	29	-	**114**
2019	-	7	-	10	-	-	-	62	-	10	-	**89**
2020	-	9	-	4	-	-	-	54	-	28	-	**95**
2020	-	9	-	4	-	-	-	54	-	28	-	**95**
2021	-	4	-	11	-	-	-	30	-	123	-	**168**
2022	-	3	3	11	-	-	-	40	-	24	-	**85**
2023[1]	0	1	0	5	0	0	0	57	0	51	**0**	**114**
2024[1]	0	6	1	4	0	0	0	44	0	22	**0**	**77**

1 - Provisional figures.

Table 6. 8 . S. mentella in subareas 1 and 2. Catch numbers-at-age 6 to 18 and 19+ (in thousands) and total landings (in tonnes). For the periods 2014–2015, 2017-2018, 2020-2021 and 2023, age data are missing from the pelagic fishery. For the years 2017, 2019 and 2021, age data are missing from the demersal fishery fisheries. The numbers-at-age have been estimated following the method

outlined in section 6.2.2.

Year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	+gp	Total No.	Tonnes Land.
1992	1 873	2 498	1 898	1 622	1 780	1 531	2 108	2 288	2 258	2 506	2 137	1 512	677	9 258	33 946	15 590
1993	159	159	174	512	2 094	3 139	2 631	2 308	2 987	1 875	1 514	1 053	527	6 022	25 154	12 814
1994	738	730	722	992	2 561	2 734	3 060	1 535	2 253	2 182	3 336	1 284	734	3 257	26 118	12 721
1995	662	941	1 279	719	740	1 230	2 013	4 297	3 300	2 162	1 454	757	794	2 404	22 752	10 284
1996	223	634	1 699	1 554	1 236	1 078	1 146	1 413	1 865	880	621	498	700	2 247	15 794	8 075
1997	125	533	1 287	1 247	1 297	1 244	876	1 416	1 784	1 217	537	1 177	342	3 568	16 650	8 598
1998	37	882	2 904	4 236	3 995	2 741	1 877	1 373	1 277	1 595	1 117	784	786	6 241	29 845	14 044
1999	9	83	441	1 511	2 250	3 262	1 867	1 454	1 447	1 557	1 418	1 317	658	3 919	21 193	11 209
2000	1	24	390	1 235	2 460	2 149	1 816	1 205	1 001	993	932	505	596	5 705	19 012	10 075
2001	117	372	542	976	925	1 712	2 651	2 660	1 911	1 773	1 220	714	814	16 234	32 621	18 418
2002	2	40	252	572	709	532	1 382	1 893	1 617	855	629	163	237	4 082	12 965	6 994
2003	6	37	103	93	132	220	384	391	434	466	513	199	231	1 193	4 402	2 520
2004	7	16	70	96	278	429	611	433	1 063	813	830	841	607	3 076	9 170	5 493
2005	2	20	57	155	244	262	295	754	783	1 896	817	1 087	1 023	6 065	13 460	8 466
2006	0	4	3	38	64	121	423	1 461	1 356	2 835	4 271	3 487	3 969	32 084	50 116	33 261
2007	0	1	3	22	33	86	235	631	2 194	2 825	3 657	4 359	3 540	15 824	33 410	20 218
2008	0	0	1	10	46	100	197	469	612	1 502	1 384	894	1 886	11 906	19 007	13 096
2009	0	1	16	22	42	39	254	258	577	364	823	692	1 856	11 706	16 650	10 246
2010	10	4	6	19	34	55	61	241	267	390	566	655	667	13 879	16 854	11 924
2011	4	4	4	25	55	114	11	103	286	394	408	479	567	15 223	17 677	12 962
2012	4	24	29	24	26	66	69	78	80	279	387	365	409	13 332	15 172	11 059
2013	0	3	19	101	90	44	41	42	9	177	146	185	317	12 826	14 000	9 389

Year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	+gp	Total No.	Tonnes Land.
2014	14	27	338	95	114	92	147	54	108	68	248	287	193	23 101	24 886	18 427
2015	43	41	134	565	843	1 355	1 245	717	385	945	289	595	871	29 441	37 469	25 570
2016	40	0	977	667	3 350	2 579	2 983	1 995	1 964	1 269	1 342	1 256	1 108	36 719	56 249	34 754
2017	36	187	403	461	1 042	1 431	1 226	1 370	1 222	1 648	1 462	1 272	1 786	32 989	46 535	30 782
2018	50	319	611	822	1 363	2 481	2 663	2 825	2 816	2 872	2 623	1 804	2 353	41 030	64 632	38 046
2019	129	447	809	1 257	2 122	2 225	2 024	2 238	2 394	3 141	2 814	1 982	2 511	45 497	69 590	45 640
2020	5	14	616	239	2 368	1 948	2 085	3 541	2 861	2 882	3 974	3 454	3 136	53 208	80 331	53 657
2021	79	470	1 007	1 325	2 294	3 165	2 878	3 137	3 417	4 492	4 266	3 007	3 752	62 816	96 105	63 479
2022	0	0	0	263	667	1 600	4 071	6 377	7 329	7 367	8 715	4 173	4 529	51 317	96 408	62 194
2023	0	0	0	0	270	656	1 573	3 967	6 119	7 083	7 140	8 388	3 955	51 956	91 107	60 466
2024	Not available															

Table 6.9. Pelagic S. mentella in the Norwegian Sea (outside the EEZ). Catch numbers-at-age in thousands.

	Age											
YEAR	7	8	9	10	11	12	13	14	15	16	17	18	19+
2006	0	0	0	0	23	93	1 083	323	1 563	3 628	2 514	3 756	29 704
2007	0	0	9	18	25	154	444	1 642	2 302	3 021	3 394	3 156	12 684
2008	0	0	0	0	28	146	115	143	214	594	752	753	13 258
2009	0	0	0	0	9	1 314	294	471	889	999	869	1 150	2 981
2010	0	0	0	0	0	0	155	74	135	224	356	458	12 497
2011	0	0	0	0	0	223	83	83	168	136	166	136	13 182
2012[1]	0	0	0	0	0	0	0	0	227	90	139	206	10 087
2013[2]	0	0	78	27	28	0	0	0	94	28	104	168	9 473
2014[3]	0	0	0	74	24	25	0	0	0	58	16	57	4 920
2015[3]	0	0	0	0	170	54	51	0	0	0	84	22	6 343
2016[3]	0	0	154	307	271	276	134	90	107	239	445	229	10 499
2017[3]	0	0	0	238	462	390	370	165	100	109	226	402	8 349
2018[3]	0	0	0	0	691	1 281	1 008	874	352	195	198	393	12 659
2019	25	5	200	400	220	242	197	279	183	155	135	161	6 696
2020[3]	0	44	8	345	672	353	362	270	345	206	163	136	5 496

	Age											
YEAR	7	8	9	10	11	12	13	14	15	16	17	18	19+
2021[3]	0	0	45	8	339	631	309	290	195	228	127	96	2 380
2022	0	0	7	14	12	48	165	135	114	194	155	84	2 931
2023[3]	0	0	0	0	0	0	0	0	0	0	0	0	5
2024	Not available												

1 - No age data in 2012, catch numbers-at-age are estimated from proportions at age in 2011 and in 2013.

2 - No age data from the catches in 2013. Age readings from the research survey conducted in September 2013 are used to derive catch numbers-at-age.

3 - No age data in 2014 – 2018, 2020-2021 and 2023, catch numbers-at-age are estimated from previous year according to protocol described in section 6.2.2.

Table 6. 10 . S. mentella in subareas 1 and 2. Total catch numbers-at-length, in thousands, for 2011–2014.

Year	Length group																
	18–20	20–22	22–24	24–26	26–28	28–30	30–32	32–34	34–36	36–38	38–40	40–42	42–44	44–46	46–48	48–50	50–52
2011	0	12	0	0	1	8	249	2544	6481	6528	3620	829	95	18	1	0	0
2012	0	0	23	19	26	28	41	287	1898	5030	5385	1911	451	197	43	23	0
2013	0	0	4	32	154	137	90	69	1382	4214	4480	1633	497	197	0	0	0
2014	0	5	0	25	29	235	660	697	3358	7667	8544	3808	787	34	0	0	0
2015-2024	*Data not available at the time of the working group*																

Table 6.11. S. mentella in subareas 1 and 2. Catch numbers-at-length, in thousands, in the pelagic fishery for 2011–2021.

Length group																	
Year	18–20	20–22	22–24	24–26	26–28	28–30	30–32	32–34	34–36	36–38	38–40	40–42	42–44	44–46	46–48	48–50	50–52
2011	0	0	0	0	1	8	244	2562	5887	4425	1537	287	13	0	1	0	0
2012	0	0	0	0	0	0	106	2014	5092	3681	952	48	0	0	0	0	0
2013	0	0	0	0	0	0	75	1352	4791	2967	730	87	6	0	0	0	0
2014	0	0	0	0	0	3	14	349	2408	2454	827	80	6	1	0	0	0
2015-2024	*Data not available at the time of the working group*																

Table 6. 12 . S. mentella in subareas 1 and 2. Observed mean weights-at-age (kg) from the Norwegian data (Catches and surveys combined). Weights-at-age used in the statistical catch-at-age model are identical for every year and given at the bottom line of the table.

Year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1992	0.167	0.164	0.211	0.241	0.309	0.324	0.378	0.366	0.428	0.454	0.487	0.529	0.571	0.805
1993	0.141	0.181	0.217	0.254	0.306	0.357	0.349	0.4	0.45	0.436	0.46	0.499	0.462	0.846

Year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1994	0.174	0.188	0.235	0.298	0.361	0.396	0.415	0.48	0.492	0.562	0.642	0.636	0.72	0.846
1995	0.158	0.185	0.226	0.261	0.324	0.36	0.432	0.468	0.496	0.519	0.566	0.573	0.621	0.758
1996	0.175	0.189	0.224	0.272	0.323	0.337	0.377	0.518	0.536	0.603	0.69	0.8	0.683	0.958
1997	0.152	0.191	0.228	0.28	0.324	0.367	0.435	0.492	0.521	0.615	0.601	0.611	0.671	0.911
1998	0.12	0.148	0.192	0.261	0.326	0.373	0.427	0.496	0.537	0.566	0.587	0.625	0.658	0.809
1999	0.133	0.17	0.226	0.286	0.343	0.382	0.441	0.483	0.537	0.565	0.62	0.644	0.672	0.757
2000	0.109	0.144	0.199	0.276	0.332	0.392	0.437	0.49	0.54	0.585	0.631	0.65	0.671	0.872
2001	0.115	0.137	0.183	0.262	0.31	0.356	0.4	0.434	0.484	0.534	0.581	0.615	0.624	0.819
2002	0.114	0.139	0.182	0.253	0.329	0.372	0.392	0.434	0.476	0.52	0.545	0.587	0.601	0.833
2003	0.109	0.124	0.196	0.245	0.312	0.371	0.422	0.434	0.477	0.516	0.551	0.591	0.623	0.817
2004	0.104	0.129	0.18	0.264	0.308	0.376	0.413	0.444	0.478	0.521	0.579	0.614	0.688	0.835
2005	0.104	0.136	0.196	0.263	0.322	0.37	0.408	0.451	0.478	0.523	0.55	0.551	0.64	0.797
2006	0.107	0.143	0.2	0.266	0.314	0.374	0.419	0.462	0.489	0.527	0.57	0.602	0.59	0.796
2007	0.115	0.131	0.18	0.252	0.305	0.364	0.409	0.449	0.485	0.513	0.523	0.554	0.569	0.737
2008	0	0.158	0.177	0.242	0.304	0.402	0.465	0.486	0.511	0.546	0.6	0.596	0.635	0.803
2009	0.129	0.179	0.206	0.249	0.326	0.394	0.51	0.55	0.542	0.583	0.609	0.594	0.595	0.809
2010	0.129	0.128	0.175	0.263	0.375	0.447	0.501	0.541	0.582	0.602	0.593	0.608	0.592	0.706
2011	0.136	0.156	0.183	0.261	0.316	0.435	0.512	0.604	0.655	0.609	0.671	0.647	0.677	0.795
2012	0.135	0.178	0.225	0.246	0.249	0.356	0.474	0.582	0.53	0.626	0.654	0.73	0.699	0.833
2013	0.129	0.145	0.189	0.23	0.27	0.282	0.345	0.384	0.534	0.559	0.634	0.627	0.661	0.72
2014	0.193	0.172	0.221	0.167	0.192	0.239	0.333	0.277	0.364	0.516	0.713	0.78	0.797	0.882
2015	0.167	0.168	0.232	0.294	0.346	0.383	0.457	0.436	0.474	0.538	0.665	0.69	0.724	0.824
2016	0.11	0	0.331	0.356	0.401	0.392	0.434	0.486	0.543	0.579	0.74	0.591	0.598	0.776
2017	0.154	0.196	0.254	0.27	0.306	0.413	0.425	0.458	0.533	0.472	0.562	0.65	0.692	0.796
2018	0	0.233	0.135	0.371	0.323	0.28	0.379	0.452	0.524	0.633	0.483	0.589	0.457	0.821
2019	0.118	0.38	0.341	0.47	0.538	0.523	0.539	0.565	0.572	0.62	0.656	0.601	0.633	0.744
Modelled	0.141	0.188	0.237	0.286	0.334	0.381	0.424	0.465	0.503	0.537	0.569	0.597	0.623	0.755

Table 6. 13 . Pelagic S. mentella in the Norwegian Sea (outside the EEZ). Catch weights-at-age (kg).

Year/ Age	11	12	13	14	15	16	17	18	19+
2006	0.44	0.44	0.52	0.44	0.49	0.55	0.53	0.56	0.61
2007	0.39	0.43	0.41	0.48	0.50	0.52	0.55	0.57	0.64
2008	0.36	0.47	0.56	0.50	0.56	0.54	0.56	0.55	0.64
2009	0.38	0.44	0.45	0.48	0.54	0.59	0.64	0.58	0.69
2010	-	-	0.62	0.56	0.54	0.59	0.59	0.56	0.61
2011	-	0.48	0.54	0.54	0.64	0.59	0.54	0.59	0.59

2012	*No data*	-	-	-	-	-	-	-	-
2013[1]	0.31	-	-	-	0.56	0.62	0.60	0.62	0.68
2014-2024	*No data*	-	-	-	-	-	-	-	-

1 - As observed in the research survey in the Norwegian Sea in September 2013.

Table 6. 14 . Proportion of maturity-at-age 6–19+ in S. mentella in subareas 1 and 2 derived from Norwegian commercial and survey data. The proportions were derived from samples with at least 5 individuals. a50 w1 and w2 are the annual coefficients for modelled maturity ogives using a double half sigmoid of the form 0.5 ((1+tanh(age- a50)/w1)) for age < a50 and 0.5 (1+tanh((age- a50)/w2) for age > a50. a50 equals the age at 50% maturity. Since JRN-AFWG 2024 maturity-at-age used in the statistical catch-at-age model are identical for every year and given at the bottom line of the table.

year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1992	0.00	0.01	0.02	0.04	0.07	0.14	0.26	0.42	0.53	0.59	0.65	0.70	0.75	1.00
1993	0.01	0.02	0.04	0.08	0.15	0.28	0.44	0.55	0.61	0.67	0.72	0.77	0.82	1.00
1994	0.02	0.04	0.08	0.15	0.28	0.44	0.59	0.72	0.81	0.88	0.93	0.96	0.98	1.00
1995	0.03	0.07	0.13	0.24	0.39	0.57	0.71	0.83	0.90	0.95	0.97	0.98	0.99	1.00
1996	0.01	0.01	0.02	0.05	0.10	0.19	0.33	0.50	0.59	0.66	0.73	0.79	0.84	1.00
1997	0.02	0.04	0.08	0.16	0.29	0.46	0.55	0.61	0.66	0.71	0.76	0.80	0.84	1.00
1998	0.02	0.04	0.08	0.15	0.26	0.43	0.56	0.65	0.73	0.80	0.85	0.90	0.93	1.00
1999	0.03	0.05	0.10	0.20	0.34	0.51	0.57	0.64	0.70	0.75	0.80	0.84	0.87	1.00
2000	0.03	0.06	0.11	0.21	0.36	0.52	0.63	0.73	0.81	0.87	0.91	0.94	0.96	1.00
2001	0.01	0.02	0.04	0.09	0.17	0.30	0.47	0.56	0.62	0.68	0.74	0.79	0.83	1.00
2002	0.02	0.05	0.10	0.19	0.33	0.50	0.54	0.59	0.63	0.67	0.70	0.74	0.77	1.00
2003	0.03	0.06	0.12	0.21	0.36	0.51	0.57	0.63	0.69	0.73	0.78	0.82	0.85	1.00
2004	0.03	0.06	0.12	0.22	0.37	0.51	0.55	0.59	0.63	0.67	0.70	0.73	0.76	1.00
2005	0.02	0.05	0.09	0.18	0.31	0.49	0.55	0.61	0.66	0.71	0.75	0.79	0.83	1.00
2006	0.01	0.02	0.03	0.07	0.13	0.24	0.39	0.53	0.59	0.64	0.70	0.75	0.79	1.00
2007	0.02	0.04	0.09	0.17	0.30	0.47	0.64	0.77	0.87	0.93	0.96	0.98	0.99	1.00
2008[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2009	0.02	0.04	0.09	0.17	0.30	0.47	0.60	0.71	0.80	0.87	0.92	0.95	0.97	1.00
2010	0.02	0.04	0.08	0.16	0.28	0.45	0.54	0.60	0.66	0.71	0.76	0.80	0.83	1.00
2011[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2012	0.02	0.05	0.10	0.19	0.32	0.50	0.59	0.68	0.75	0.81	0.86	0.90	0.93	1.00
2013	0.00	0.01	0.02	0.04	0.08	0.15	0.28	0.45	0.62	0.77	0.87	0.93	0.97	1.00
2014	0.00	0.00	0.01	0.02	0.03	0.06	0.12	0.23	0.38	0.53	0.61	0.68	0.74	1.00
2015	0.01	0.02	0.05	0.09	0.17	0.31	0.48	0.54	0.58	0.63	0.67	0.71	0.74	1.00
2016	0.03	0.06	0.12	0.22	0.38	0.52	0.56	0.61	0.66	0.70	0.74	0.77	0.81	1.00
2017[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2018[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2019[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00

year/Age	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
2020[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2021[1]	0.02	0.04	0.08	0.15	0.27	0.43	0.55	0.62	0.68	0.74	0.79	0.83	0.87	1.00
2022[1]	0.02	0.05	0.09	0.17	0.30	0.46	0.80	0.96	0.99	1.00	1.00	1.00	1.00	1.00
2023[1]	0.02	0.04	0.08	0.14	0.22	0.30	0.45	0.56	0.63	0.69	0.73	0.76	0.79	1.00
Model input	0.02	0.04	0.08	0.14	0.24	0.37	0.49	0.58	0.66	0.73	0.77	0.81	0.85	1.00

1 - Model parameter estimates were unrealistic and replaced by average parameter values.

Table 6. 15 . S. mentella. Average catch (numbers of specimens) per hour trawling of different ages of S. mentella in the Russian groundfish survey in the Barents Sea and Svalbard areas (1976–1983 published in Annales Biologiques). The survey was not conducted in 2016 took place in 2017 with insufficient coverage and was terminated after that year.

Year class	0	1	2	3	4	5	6	7	8	9	10	11
1974	-	-	4.8	-	4.9	22.8	4.8	4.8	-	-	-	3
1975	-	7.4	-	1.7	6.4	2.4	3.5	5	-	-	4	-
1976	7	-	8.1	1.2	2.5	6.8	4.9	5	1	13	-	-
1977	-	0.2	0.2	0.2	0.9	5.1	3.7	1	19	2	-	-
1978	0.8	0.02	0.9	1	5	3.8	2	20	6	-	-	-
1979	-	1.9	1.4	3.6	2.3	9	11	16	1	-	-	0.1
1980	0.3	0.4	2	2.5	16	6	11	25	2	-	1.5	2
1981	-	2.2	3.9	20	6	12	47	18	6.3	1.6	0.5	1
1982	19.8	13.2	13	15	34	44	39	32.6	4.3	3.1	4.9	+
1983	12.5	3	5	6	31	34	32.3	13.3	4	4.2	0.6	1.1
1984	-	10	2	-	5	18.3	19	2.2	2.4	0.2	1.7	2.4
1985	107	7	-	1	5.2	16.2	1.7	1.7	0.6	2.8	3.8	0.3
1986	2	-	1	1.8	8.4	3.6	2.1	1.2	5.6	8.2	0.9	0.7
1987	-	3	37.9	1.3	8	4.1	2	10.6	9.6	1.4	2	1.3
1988	4	58.1	4.3	13.3	25.8	3.9	8.6	11.2	2.8	4.2	3	4.7
1989	8.7	9	17	23.4	4.6	5.4	4	6.6	6.6	4.1	7.7	5.3
1990	2.5	6.3	6.1	1	4.3	1.7	11.5	6.5	5.5	6.7	7.4	3.6
1991	0.3	1	0.5	1.5	1.2	11.3	3.9	3.3	4.6	5.8	2.7	1.9
1992	0.6	+	0.2	0.1	4.3	1.3	2	2.3	4.9	2.3	1	4.1
1993[1]	-	+	1.5	1.8	1	1.2	3	4.2	2.6	2	3.2	2.1
1994	0.3	3.5	1.7	1.7	0.9	3.6	5.2	4.3	3.1	3.3	1.8	1.2
1995	2.8	1	1.1	0.4	2.2	2.6	3.5	3.4	2.9	1.2	1	8.5
1996[2]	+	0.1	0.1	0.4	0.7	1.1	1	1.4	1	0.8	3.7	0.6
1997	-	-	+	0.4	0.5	0.3	0.9	0.6	1	1.1	0.5	0.4
1998	-	0.1	0.2	0.3	0.2	1.1	0.5	0.7	1	0.4	0.4	0.7
1999	0.1	-	0.1	+	0.1	0.3	0.5	0.8	0.5	0.2	0.4	0.6

Year class	0	1	2	3	4	5	6	7	8	9	10	11
2000	-	0.6	0.1	0.5	0.3	0.3	0.6	0.4	0.1	0.1	0.7	0.3
2001	-	0.1	0.4	-	0.1	0.2	0.2	0.3	0.2	0.8	0.1	1
2002[3]	0.1	0.5	0.1	-	-	0.1	0.5	0.4	1.5	0.5	1	1.1
2003	-	-	0.1	-	0.3	1.0	0.5	4.8	2.1	3.7	1.3	1.9
2004	-	0.2	0.3	0.5	1.5	0.9	4.4	3.7	7.5	4.1	3.1	3.3
2005	-	-	1.4	1.9	1.4	2.3	3.9	7.2	6.1	6.8	3.1	
2006[4]	0.1	1.8	1.2	1.1	0.8	2.1	4.1	3.0	6.1	5.9		
2007	2.5	0.4	0.1	1.2	1.7	2.4	3.6	4.3	7.4			
2008	0.1	0.1	1.6	1.8	4.1	2.9	5.8	5.5				
2009	1.6	1.9	1.1	4.4	4.8	2.9	4.8					
2010	7.5	0.7	1.2	1.5	1.9	1.6						
2011	0.1	0.3	0.6	1.6	1.6							
2012	0.2	0.7	0.5	0.3								
2013	0.1	0.1	0.4									
2014	3.6	1.0										
2015	6.6											

1 - Not complete area coverage of Division 2.b.

2 - Area surveyed restricted to Subarea 1 and Division 2.a only.

3 - Area surveyed restricted to Subarea 1 and Division 2.b only.

4 - Area surveyed restricted to divisions 2.a and 2.b onl

Table 6.16a. S. mentella1 in Division 2.b. Abundance indices (on length) from the bottom-trawl survey in the Svalbard area (Division 2.b) in summer/fall 1986–2024 (numbers in millions).

Year	Length group (cm)									
	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	35.0-39.9	40.0-44.5	>45	Tot
1986[2]	6	101	192	17	10	5	2	4	0	337
1987[2]	20	14	140	19	6	2	1	2	0	204
1988[2]	33	23	82	77	7	3	2	2	0	229
1989	556	225	24	72	17	2	2	8	4	910
1990	184	820	59	65	111	23	15	7	3	1287
1991	1 533	1 426	563	55	138	38	30	7	1	3791
1992	149	446	268	43	22	15	4	7	4	958
1993	9	320	272	89	16	13	3	1	0	723
1994	4	284	613	242	10	9	2	2	1	1167
1995	33	33	417	349	77	18	5	1	0	933
1996	56	69	139	310	97	8	4	1	1	685

1997	3	44	13	65	57	9	5	0	0	195
1998	0	37	35	28	132	73	45	2	0	352
1999	3	3	124	62	260	169	42	1	0	664
2000	0	10	30	59	126	143	21	1	0	391
2001	1	5	3	32	57	227	50	3	0	378
2002	1	4	6	21	62	266	47	4	0	410
2003	1	5	7	10	49	243	45	1		361
2004	0	2	8	7	14	81	52	2	0	166
2005	22	1	4	4	10	68	46	1	0	156
2006	84	6	5	7	43	198	107	3	0	453
2007	73	39	1	4	9	91	102	3	0	322
2008	125	46	22	3	8	24	78	3	-	309
2009	9	122	88	14	3	27	219	5	-	487
2010	96	18	44	37	2	20	91	7	-	315
2011	126	91	81	48	10	7	67	5	1	436
2012	28	74	68	81	47	8	94	10	-	410
2013	33	43	127	106	67	19	85	13	-	493
2014[3]	3	10	59	49	38	24	66	20	0	269
2015	89	8	29	159	116	66	69	25	-	561
2016	244	33	44	205	138	139	142	48	0	993
2017	41	38	8	20	59	76	57	17	0	316
2018	66	62	55	35	100	65	80	26	-	489
2019	3	27	89	32	59	83	74	26	1	394
2020	107	8	58	40	40	115	98	17	-	483
2021	498	136	15	39	16	58	88	18	-	868
2022	15	102	6	23	27	51	109	24	0	357
2023	5	65	90	20	68	42	87	23	0	400
2024	5	79	642	102	76	52	83	16	0	1055

[1] Includes some unidentified *Sebastes* specimens mostly less than 15 cm.

[2] Old trawl equipment (bobbins gear and 80 m sweep length).

[3] Poor survey coverage in 2014.

Table 6.16b. S. mentella1 in Division 2.b. Norwegian bottom-trawl survey indices (on age) in the Svalbard area (Division 2.b) in summer/fall 1992–2024 (numbers in millions).

	Age														
Year	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
1992	283	419	484	131	58	45	14	8	5	2	7	2	1	3	1 462

1993	2	527	117	202	142	8	23	6	13	1	7	1	1	0	1 050
1994	7	280	290	202	235	42	94	1	1	3	4	1	1	0	1 161
1995	4	50	365	237	132	61	19	17	11	0	1	3	0	0	900
1996	13	32	10	36	103	135	78	16	50	28	32	8	21	2	565
1997	8	43	6	7	38	18	29	19	6	2	0	2	1	1	181
1998	0	25	27	13	10	12	61	52	41	15	0	5	13	0	276
1999	3	16	108	25	28	39	106	59	54	26	35	14	18	12	543
2000	4	6	5	13	30	21	28	44	66	48	21	19	9	6	321
2001	1	4	2	0	12	15	18	36	28	46	45	80	53	14	354
2002	3	2	4	1	5	22	34	23	90	35	54	65	17	22	377
2003	0	3	4	3	5	4	27	26	26	28	13	132	50	21	342
2004	1	1	4	4	2	4	2	10	4	15	18	18	19	15	117
2005	18	1	1	3	1	3	3	8	5	5	14	8	29	21	120
2006	35	1	3	3	2	6	5	36	3	19	46	68	8	19	254
2007	23	24	1	0	2	1	4	4	5	3	3	8	28	17	123
2008	8	25	19	11	2	2	2	4	3	3	3	3	7	8	100
2009	11	74	54	30	25	30	8	1	1	1	4	19	10	8	276
2010	No age reading														
2011	119	43	58	42	12	47	35	4	1	0	2	0	0	1	364
2012	27	52	31	23	32	50	27	33	17	9	0	1	0	-	302
2013	30	4	30	37	7	102	75	44	41	8	8	3	3	3	395
2014[2]	0	3	2	6	23	41	12	23	5	30	13	11	3	1	173
2015	72	5	11	58	34	60	35	102	34	23	13	3	6	3	459
2016	102	13	11	88	34	102	66	31	13	80	37	2	12	30	621
2017	38	28	10	15	15	20	39	16	28	8	6	19	1	23	266
2018	44	52	14	23	88	14	4	20	27	18	16	9	14	1	344
2019	25	50	56	4	17	44	13	17	13	1	3	16	23	0	282
2020	43	9	23	27	30	13	17	20	39	7	13	17	11	8	277
2021	393	68	24	29	7	26	12	22	5	9	8	16	15	5	639
2022	12	55	35	5	6	10	7	19	12	6	5	16	5	16	209
2023	24	88	33	20	29	13	21	18	4	5	4	6	22	25	312
2024	64	15	324	263	143	2	24	54	25	10	3	31	16	3	977

[1] Includes some unidentified *Sebastes* specimens mostly less than 15 cm.

[2] Poor survey coverage in 2014.

Table 6.17. S. mentella1 in subareas 1 and 2. Abundance indices (on age) from the Ecosystem survey in August-September 1996–2024 covering the Norwegian Economic Zone (NEZ) and Svalbard incl. the area north and east of Spitsbergen (numbers in millions and total biomass in thousand tonnes) and the continental slope down to 1000 m.

Age																
year	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16+**	**Tot N**	**Tot B[3]**
1996	146	113	22	54	166	182	109	43	65	41	38	20	29	11	17	1056	171
1997	63	131	12	23	74	56	77	83	18	14	1	2	2	1	9	565	73
1998	0	79	86	40	26	23	85	100	54	24	11	7	15	1	25	577	105
1999	5	23	117	48	42	77	129	73	58	65	50	14	18	12	25	756	155
2000	6	23	14	20	53	68	84	78	100	72	71	37	17	21	27	690	178
2001	5	7	11	1	20	26	37	52	44	62	50	86	54	16	32	501	162
2002	9	7	7	4	9	28	47	64	103	50	76	72	25	37	35	574	181
2003	3	7	8	3	8	8	42	62	55	38	61	137	98	37	28	595	257
2004	8	16	11	8	4	8	7	16	11	54	27	23	27	28	65	312	91
2005	32	5	5	5	4	6	7	13	6	6	17	29	34	31	49	250	101
2006	125	5	7	7	4	8	7	38	4	23	50	69	15	37	160	560	199
2007	264	147	13	4	10	3	7	9	12	5	4	9	56	19	221	783	199
2008	56	209	137	31	7	3	3	6	6	3	3	6	8	10	108	598	84
2009	116	186	237	82	105	48	17	3	6	3	5	22	11	9	324	1173	260
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	387	320	206	61	57	75	51	13	3	2	3	1	0	3	100	1282	120
2012	335	239	365	169	127	78	60	41	20	12	4	1	2	3	145	1599	184
2013	286	173	174	181	149	178	115	95	88	15	12	9	3	3	137	1618	271
2014[2]	2	21	35	81	55	96	99	62	36	55	42	18	19	3	166	790	239
2015	414	81	55	99	54	115	49	135	77	27	20	6	6	3	121	1262	207
2016	715	136	56	133	93	129	88	61	19	92	39	13	28	31	235	1866	not updated
2017	540	251	211	210	36	46	61	63	35	34	40	38	11	34	77	1687	213
2018	162	234	153	64	124	34	29	25	86	64	31	35	24	1	129	1197	not updated
2019	85	109	114	89	38	69	28	24	22	129	33	20	40	3	189	993	211
2020	157	42	46	70	51	33	49	44	62	15	30	37	29	22	231	920	not updated
2021	957	209	108	64	25	42	28	35	21	22	10	23	23	14	154	1734	not updated
2022	55	187	220	64	16	17	35	55	16	13	24	26	10	20	237	994	not updated
2023	197	333	152	44	44	39	37	23	11	20	10	22	42	35	161	1170	not updated
2024	132	88	492	347	162	27	55	79	36	47	11	57	21	22	84	1659	not updated

[1] Includes some unidentified *Sebastes* specimens mostly less than 15 cm.

[2] Poor survey coverage in 2014.

[3] Calculated using modelled weight-at-age.

Table 6.18a. S. mentella1. Abundance indices (on length) from the bottom-trawl survey in the Barents Sea in winter 1986–2025 (numbers in millions). The area coverage was extended from 1993 onwards and from 2014 and onwards. Numbers from 1994 onwards were recalculated while numbers for 1986–1993 are as in previous reports.

Year	Length group (cm)									
	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9	35.0–39.9	40.0–44.9	>45	Total
1986	81	152	205	88	169	130	88	24	14	950
1987	72	25	227	56	35	11	5	1	0	433
1988	587	25	133	182	40	50	48	4	0	1068
1989	623	55	28	177	58	9	8	2	0	961
1990	324	305	36	56	80	13	13	2	0	828
1991	395	449	86	39	96	35	24	3	0	1127
1992	139	367	227	35	55	34	8	2	1	867
1993	31	593	320	116	24	25	6	1	0	1117
1994	5	191	345	366	55	69	23	3	0	1057
1995	301	83	516	345	75	50	22	2	0	1394
1996	211	103	197	342	136	42	18	0	0	1049
1997[2]	59	130	27	273	254	63	37	4	0	847
1998[2]	0	85	62	101	200	40	12	1	0	501
1999	0	6	68	36	172	73	21	3	0	379
2000	7	12	39	77	143	96	27	6	1	408
2001	9	21	7	55	79	75	9	0	0	255
2002	15	6	17	36	95	116	24	1	0	310
2003	4	4	10	12	76	221	51	6	0	384
2004	0	1	8	17	32	85	31	1	0	175
2005	0	5	8	10	27	153	86	2	0	291
2006[3]	98	1	8	13	23	103	81	1	1	329
2007[2]	372	121	1	5	12	132	139	6	0	788
2008	857	359	26	3	10	105	166	5	0	1531
2009	95	323	135	5	9	67	163	5	0	802
2010	652	276	217	64	7	72	190	6	0	1484
2011	501	237	219	152	13	44	156	6	0	1328
2012[2]	127	279	86	124	47	13	154	17	0	847
2013	249	225	243	157	142	35	194	26	0	1271
2014	109	182	261	119	127	53	117	14	0	982
2015	185	114	222	312	303	220	172	19	0	1547
2016	670	108	150	336	215	167	125	13	0	1784
2017[2]	646	197	70	212	294	319	236	11	0	1985
2018	239	328	85	110	195	277	223	23	1	1481
2019	52	304	276	92	157	256	213	18	0	1368
2020[2]	206	122	207	93	120	236	213	24	0	1221

2021[2]	995	129	143	130	84	201	182	22	0	1886
2022	637	1035	53	112	76	92	163	20	0	2188
2023	51	1104	369	105	152	132	196	31	1	2141
2024	34	199	689	69	205	134	156	27	0	1513
2025	47	76	554	331	122	139	198	27	0	1494

[1] Includes some unidentified *Sebastes* specimens mostly less than 15 cm.

[2] Indices not raised to represent uncovered parts of the Russian EEZ

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

Table 6.18b. S. mentella 1 in subareas 1 and 2. Norwegian bottom-trawl indices (on age) from the annual Barents Sea survey in February 1992–2024 (numbers in millions). The area coverage was extended from 1993 onwards and from 2014 and onwards. Numbers recalculated.

Year	**Age**														
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
1992	351	252	132	56	14	11	3	9	18	16	12	11	2	5	892
1993	38	473	192	242	62	45	19	22	13	11	10	4	2	3	1 136
1994	5	96	315	160	342	269	97	55	4	28	13	14	26	5	1 430
1995	312	66	178	255	329	223	73	21	7	13	20	9	10	9	1 525
1996	205	124	136	236	199	189	144	71	24	27	13	6	10	4	1 388
1997[2]	66	158	33	58	112	95	125	103	38	46	26	24	7	7	898
1998[2]	0	74	48	26	10	53	109	110	37	18	6	6	3	3	503
1999	0	0	35	41	29	28	52	62	53	32	14	5	6	1	358
2000	19	0	5	31	36	22	29	72	77	50	24	14	10	3	392
2001	0	19	9	2	6	26	37	31	42	18	21	29	5	2	247
2002	18	4	11	6	1	10	45	60	28	17	37	20	40	14	311
2003	0	3	2	3	5	5	15	39	27	23	58	39	68	36	323
2004	0	0	5	2	5	11	11	13	15	13	14	23	24	14	150
2005	0	3	3	2	6	5	6	15	21	9	18	30	41	60	219
2006	77	25	5	3	6	6	11	12	6	15	15	10	43	29	263
2007	285	73	3	0	2	1	3	7	9	5	7	21	43	71	530
2008	746	190	103	13	0	1	4	7	2	5	3	24	23	33	1 154
2009	109	112	96	89	66	32	20	13	4	5	21	0	24	7	598
2010	162	265	179	172	92	71	26	21	2	9	4	7	11	17	1 038
2011	377	233	135	130	107	70	40	22	2	5	1	1	1	23	1 147
2012[2]	No age reading														
2013	0	178	252	144	143	122	117	13	31	12	4	24	38	12	1 090
2014-2017	No age reading														

2018	195	270	126	39	25	38	44	53	48	56	61	62	87	50	1 154
2019	No age reading														
2020[2]	17	123	108	111	22	44	92	129	64	80	64	7	0	5	866
2021-2025	No age reading														

[1] Includes some unidentified *Sebastes* specimens mostly less than 15 cm.

[2] Indices not raised to represent uncovered parts of the Russian EEZ

Table 6.19. Comparison of results on S. mentella from the Norwegian Sea pelagic surveys in 2008, 2009, 2013, 2016, and 2019. Acoustic results for the 2019 and 2022 survey were not available at the time of JRN-AFWG 2025.

	2008	2009	2013	2016	2019	2022
mean length (cm) All/M/F[1]	37.0/36.4/37.5	36.6/36.0/37.1	37.5/37.0/38.1	37.7/37.0/38.3	37.6/37.2/38.0	37.4/37.2/38.5
mean length (cm) S/DSL/D[2]	37.2/36.8/39.1	37.2/36.5/38.3	37.1/37.4/38.9	38.1/37.6/38.4	37.4/37.6/37.7	-
mean weight (g) All/M/F	619/585/648	625/609/666	659/625/706	656/619/694	683/644/724	687/673/743
Mean age (y) All/M/F	25 / 25 / 25	25 / 25 / 24	28 / 29 / 28	27 / 27 / 26	- / - / -	30/31/31
Sex ratio (M/F)	45% / 55%	45% / 55%	59% / 41%	50% / 50%	51% / 49%	53%/47%
Occurrence	96%	100%	95%	80%	99%	89%
Catch rates	3.80 t/NM^2	3.94 t/NM^2	3.47 t/NM^2	1.01 t/NM^2	3.40 t/NM^2	-
mean s_A	33 m^2/NM^2	34 m^2/NM^2	19 m^2/NM^2	5.2 m^2/NM^2	-	-
Total Area	53 720 NM^2	69 520 NM^2	69 520 NM^2	67 150 NM^2	73 364 NM^2	-
Abundance (Acoustics)[3]	395 000 t	532 000 t	297 000 t	136 000 t	-	-
Abundance (Trawl)[4]	406 000 t	548 000 t	482 000 t	116 000 t	499 000 t	-

1 - M = males only, F = females only.

2 - S = shallower than DSL, DSL = deep scattering layer, D = deeper than DSL.

3 - The abundance derived from hydroacoustics is calculated assuming a Length-dependent target strength equation of TS=20log(L)-68.0. In 2016 the TS equation used was TS=20log(L)-69.6 following recommendation from ICES-WKTAR (2010).

4 - Trawls: Gloria 2048 in 2008 and 2009 Gloria 2560 HO helix in 2013 and Gloria 1024 in 2016. Trawl catchability for redfish set to 0.5 for all trawls based on results from Bethke *et al.* (2010).

Table 6.20a. S. mentella in subareas 1 and 2. Population matrix with numbers-at-age (in thousands) for each year and separable fishing mortality coefficients for the demersal and pelagic fleet by year (Fy) and selectivity at age for the pelagic fleet (Sa). Numbers are estimated from the statistical catch-at-age model.

sa (demersal)	Varies over time																
sa (pelagic)	0.000	0.000	0.000	0.000	0.000	0.014	0.024	0.039	0.063	0.100	0.155	0.234	0.337	0.458	0.584	0.699	0.

Fy (deereral)	Fy (pelagic)	Year/ Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
0.042	0	1992	429 977	415 175	375 788	242 932	149 082	102 443	97 930	107 160	130 282	91 119	102 382	75 533	77 953	65 441	46 307	30 041	19 657	207 239

Fy (deereral)	Fy (pelagic)	Year/ Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
0.031	0	1993	289 490	409 094	395 010	357 537	229 100	140 310	96 194	91 724	100 097	121 356	84 641	94 849	69 802	71 879	60 224	42 545	27 562	207 147
0.027	0	1994	209 655	275 430	389 225	375 825	340 094	217 847	133 302	91 205	86 611	93 909	113 067	78 467	87 700	64 464	66 350	55 581	39 262	216 588
0.020	0	1995	200 014	199 472	262 053	370 321	357 293	323 028	206 534	125 963	85 766	81 007	87 447	104 994	72 756	81 258	59 709	61 447	51 470	236 914
0.014	0	1996	159 840	190 300	189 784	249 325	352 084	339 424	306 393	195 374	118 715	80 518	75 820	81 695	97 990	67 870	75 784	55 681	57 298	268 907
0.013	0	1997	111 468	152 077	181 057	180 567	237 151	334 736	322 328	290 270	184 453	111 726	75 637	71 165	76 655	91 934	63 673	71 096	52 236	306 023
0.019	0	1998	57 486	106 055	144 691	172 264	171 764	225 507	317 976	305 482	274 120	173 637	104 993	71 029	66 814	71 962	86 303	59 772	66 741	336 313
0.014	0	1999	46 459	54 694	100 904	137 664	163 884	163 356	214 155	300 527	286 693	256 314	162 197	98 055	66 333	62 395	67 203	80 596	55 820	376 399
0.011	0	2000	36 893	44 203	52 037	96 003	130 976	155 913	155 358	203 324	283 878	269 463	240 519	152 154	91 978	62 221	58 528	63 037	75 600	405 428
0.020	0	2001	35 692	35 101	42 056	49 510	91 340	124 613	148 320	147 606	192 108	267 188	253 477	226 238	143 119	86 516	58 527	55 052	59 294	452 464
0.007	0	2002	42 423	33 958	33 397	40 014	47 087	86 817	118 273	140 366	139 075	180 187	249 838	236 648	211 076	133 491	80 688	54 582	51 341	477 252
0.003	0	2003	45 546	40 363	32 309	31 775	38 069	44 796	82 571	112 379	133 073	131 549	170 266	236 016	223 541	199 383	126 095	76 217	51 558	499 306
0.006	0	2004	61 313	43 334	38 402	30 740	30 228	36 213	42 602	78 502	106 794	126 400	124 904	161 623	224 002	212 145	189 211	119 660	72 327	522 741
0.008	0	2005	117 600	58 335	41 229	36 537	29 244	28 753	34 436	40 491	74 546	101 302	119 777	118 275	152 984	211 986	200 748	179 037	113 224	563 055
0.005	0.037	2006	228 265	111 888	55 502	39 227	34 760	27 819	27 345	32 730	38 440	70 642	95 818	113 149	111 658	144 385	200 048	189 434	168 944	638 148
0.004	0.020	2007	341 155	217 179	106 454	52 806	37 321	33 071	26 451	25 987	31 075	36 434	66 788	90 308	106 262	104 428	134 410	185 341	174 743	737 346
0.005	0.013	2008	379 932	324 586	206 631	101 284	50 241	35 508	31 454	25 151	24 698	29 505	34 537	63 174	85 222	100 031	98 049	125 870	173 152	847 570
0.003	0.009	2009	381 522	361 480	308 821	196 595	96 365	47 801	33 776	29 915	23 910	23 452	27 954	32 655	59 643	80 340	94 145	92 123	118 077	954 101
0.004	0.010	2010	484 675	362 993	343 923	293 822	187 046	91 683	45 471	32 123	28 436	22 703	22 238	26 479	30 904	56 389	75 871	88 806	86 806	1 007 725
0.005	0.010	2011	585 041	461 135	345 363	327 220	279 549	177 957	87 211	43 244	30 535	27 005	21 532	21 063	25 050	29 202	53 217	71 514	83 612	1 027 695
0.005	0.008	2012	514 156	556 626	438 739	328 589	311 326	265 970	169 284	82 947	41 112	29 000	25 602	20 376	19 904	23 642	27 526	50 100	67 248	1 042 065
0.004	0.007	2013	277 390	489 184	529 592	417 430	312 628	296 200	253 008	161 008	78 865	39 063	27 523	24 261	19 278	18 805	22 309	25 944	47 172	1 041 939

Fy (deereral)	Fy (pelagic)	Year/ Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
0.015	0.008	2014	301 447	263 918	465 425	503 871	397 155	297 441	281 777	240 664	153 125	74 979	37 115	26 125	22 997	18 245	17 771	21 056	24 461	1 024 513
0.025	0.008	2015	287 730	286 806	251 100	442 821	479 386	377 845	282 934	267 988	228 814	145 502	71 175	35 174	24 697	21 669	17 132	16 636	19 665	975 718
0.035	0.009	2016	261 768	273 756	272 876	238 905	421 301	456 067	359 382	269 005	254 567	216 926	137 410	66 825	32 823	22 941	20 072	15 841	15 363	916 904
0.033	0.010	2017	267 611	249 055	260 460	259 623	227 286	400 768	433 666	341 476	255 168	240 609	203 731	127 978	61 766	30 181	21 027	18 359	14 468	848 894
0.044	0.010	2018	273 985	254 614	236 958	247 810	246 992	216 208	381 114	412 212	324 304	241 952	227 513	191 794	119 756	57 411	27 883	19 337	16 829	787 387
0.058	0.008	2019	277 225	260 678	242 247	225 450	235 726	234 909	205 540	362 080	391 193	307 191	228 487	213 861	179 152	111 032	52 830	25 493	17 593	725 368
0.078	0.007	2020	271 416	263 761	248 017	230 482	214 406	224 115	223 212	195 148	343 330	370 190	289 814	214 617	199 691	166 063	102 091	48 193	23 095	662 166
0.091	0.006	2021	265 735	258 234	250 951	235 971	219 279	203 975	213 173	212 261	185 485	326 027	350 907	273 802	201 556	185 740	152 417	92 321	43 018	599 005

Table 6.20b. S. mentella in subareas 1 and 2. Fisheries selectivity at age for the demersal fleet by age (Sa). Numbers are estimated from the statistical catch-at-age model.

Year/ Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1992	0.000	0.000	0.000	0.212	0.261	0.316	0.377	0.442	0.509	0.576	0.640	0.699	0.753	0.799	0.839	0.872	0.899
1993	0.000	0.000	0.000	0.007	0.019	0.047	0.114	0.248	0.459	0.686	0.849	0.935	0.974	0.990	0.996	0.998	0.999
1994	0.000	0.000	0.000	0.029	0.063	0.131	0.252	0.432	0.631	0.793	0.896	0.951	0.978	0.990	0.995	0.998	0.999
1995	0.000	0.000	0.000	0.035	0.075	0.153	0.286	0.470	0.663	0.814	0.906	0.955	0.979	0.991	0.996	0.998	0.999
1996	0.000	0.000	0.000	0.019	0.053	0.135	0.303	0.549	0.773	0.905	0.964	0.987	0.995	0.998	0.999	1.000	1.000
1997	0.000	0.000	0.000	0.014	0.042	0.118	0.290	0.555	0.793	0.921	0.973	0.991	0.997	0.999	1.000	1.000	1.000
1998	0.000	0.000	0.000	0.004	0.022	0.100	0.357	0.735	0.933	0.986	0.997	0.999	1.000	1.000	1.000	1.000	1.000
1999	0.000	0.000	0.000	0.001	0.005	0.029	0.149	0.507	0.859	0.973	0.995	0.999	1.000	1.000	1.000	1.000	1.000
2000	0.000	0.000	0.000	0.000	0.001	0.012	0.123	0.609	0.945	0.995	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001	0.000	0.000	0.000	0.020	0.050	0.122	0.266	0.487	0.713	0.867	0.945	0.978	0.992	0.997	0.999	1.000	1.000
2002	0.000	0.000	0.000	0.003	0.012	0.049	0.184	0.495	0.810	0.949	0.988	0.997	0.999	1.000	1.000	1.000	1.000
2003	0.000	0.000	0.000	0.042	0.084	0.161	0.286	0.455	0.635	0.784	0.883	0.940	0.970	0.986	0.993	0.997	0.998
2004	0.000	0.000	0.000	0.020	0.044	0.094	0.190	0.348	0.547	0.732	0.861	0.934	0.970	0.986	0.994	0.997	0.999
2005	0.000	0.000	0.000	0.008	0.020	0.051	0.123	0.267	0.486	0.711	0.865	0.943	0.977	0.991	0.997	0.999	0.999
2006	0.000	0.000	0.000	0.003	0.008	0.022	0.057	0.140	0.306	0.543	0.763	0.897	0.959	0.985	0.994	0.998	0.999
2007	0.000	0.000	0.000	0.001	0.003	0.010	0.027	0.076	0.194	0.414	0.674	0.858	0.946	0.981	0.993	0.998	0.999
2008	0.000	0.000	0.000	0.000	0.001	0.003	0.013	0.060	0.241	0.613	0.887	0.975	0.995	0.999	1.000	1.000	1.000
2009	0.000	0.000	0.000	0.001	0.004	0.015	0.055	0.180	0.452	0.756	0.921	0.978	0.994	0.998	1.000	1.000	1.000
2010	0.000	0.000	0.000	0.003	0.007	0.020	0.056	0.146	0.328	0.582	0.800	0.919	0.970	0.989	0.996	0.999	1.000

Year/ Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2011	0.000	0.000	0.000	0.001	0.002	0.007	0.024	0.082	0.242	0.535	0.805	0.937	0.982	0.995	0.999	1.000	1.000
2012	0.000	0.000	0.000	0.002	0.005	0.012	0.031	0.076	0.178	0.363	0.599	0.797	0.911	0.964	0.986	0.995	0.998
2013	0.000	0.000	0.000	0.001	0.003	0.006	0.014	0.032	0.071	0.151	0.294	0.493	0.694	0.841	0.925	0.967	0.985
2014	0.000	0.000	0.000	0.002	0.004	0.007	0.014	0.027	0.053	0.101	0.183	0.308	0.471	0.639	0.780	0.876	0.934
2015	0.000	0.000	0.000	0.001	0.003	0.008	0.021	0.052	0.125	0.270	0.489	0.712	0.865	0.943	0.977	0.991	0.997
2016	0.000	0.000	0.000	0.002	0.005	0.013	0.032	0.077	0.174	0.348	0.575	0.774	0.897	0.956	0.982	0.993	0.997
2017	0.000	0.000	0.000	0.003	0.005	0.011	0.022	0.044	0.085	0.159	0.278	0.439	0.614	0.764	0.868	0.930	0.964
2018	0.000	0.000	0.000	0.005	0.008	0.015	0.028	0.050	0.087	0.149	0.242	0.368	0.516	0.661	0.781	0.867	0.922
2019	0.000	0.000	0.000	0.008	0.012	0.020	0.033	0.053	0.085	0.132	0.201	0.293	0.405	0.529	0.649	0.753	0.834
2020	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.009	0.019	0.039	0.077	0.146	0.260	0.419	0.598	0.754	0.863
2021	0.000	0.000	0.000	0.007	0.010	0.016	0.025	0.040	0.062	0.094	0.141	0.207	0.293	0.396	0.509	0.622	0.723

Table 6.21. Stock summary for S. mentella in subareas 1 and 2 as estimated by the statistical catch-at-age model. Stock biomass is for age 2 y+.

Year	Rec (age 2) in millions	Rec (age 6) in millions	Stock Biomass (tonnes)	SSB (tonnes)	F (12–18)	F(19+)
1992	430	149	578 519	272 832	0.033	0.042
1993	289	229	625 410	323 633	0.029	0.031
1994	210	340	683 984	408 052	0.026	0.027
1995	200	357	749 346	469 927	0.020	0.020
1996	160	352	815 427	388 973	0.014	0.014
1997	111	237	879 903	478 373	0.013	0.013
1998	57	172	939 166	540 768	0.019	0.019
1999	46	164	987 329	608 797	0.014	0.014
2000	37	131	1 028 157	705 479	0.011	0.011
2001	36	91	1 061 896	655 042	0.020	0.020
2002	42	47	1 076 158	738 944	0.007	0.007
2003	46	38	1 092 380	815 196	0.003	0.003
2004	61	30	1 105 589	821 177	0.005	0.006
2005	118	29	1 111 783	876 777	0.008	0.008
2006	228	35	1 114 129	863 053	0.022	0.042
2007	341	37	1 093 928	1 006 505	0.013	0.024
2008	380	50	1 087 883	943 961	0.011	0.018
2009	382	96	1 091 599	981 572	0.007	0.012
2010	485	187	1 104 151	934 873	0.008	0.013
2011	585	280	1 123 427	924 087	0.009	0.015
2012	514	311	1 151 950	918 287	0.008	0.013

Year	Rec (age 2) in millions	Rec (age 6) in millions	Stock Biomass (tonnes)	SSB (tonnes)	F (12–18)	F(19+)
2013	277	313	1 194 986	870 554	0.006	0.011
2014	301	397	1 253 060	818 776	0.013	0.023
2015	288	479	1 307 703	839 740	0.025	0.032
2016	262	421	1 350 509	896 320	0.035	0.044
2017	268	227	1 386 933	872 141	0.027	0.042
2018	274	247	1 427 869	892 107	0.032	0.054
2019	277	236	1 459 921	919 610	0.034	0.066
2020	271	214	1 483 445	950 770	0.038	0.085
2021	266	219	1 498 423	976 956	0.041	0.097

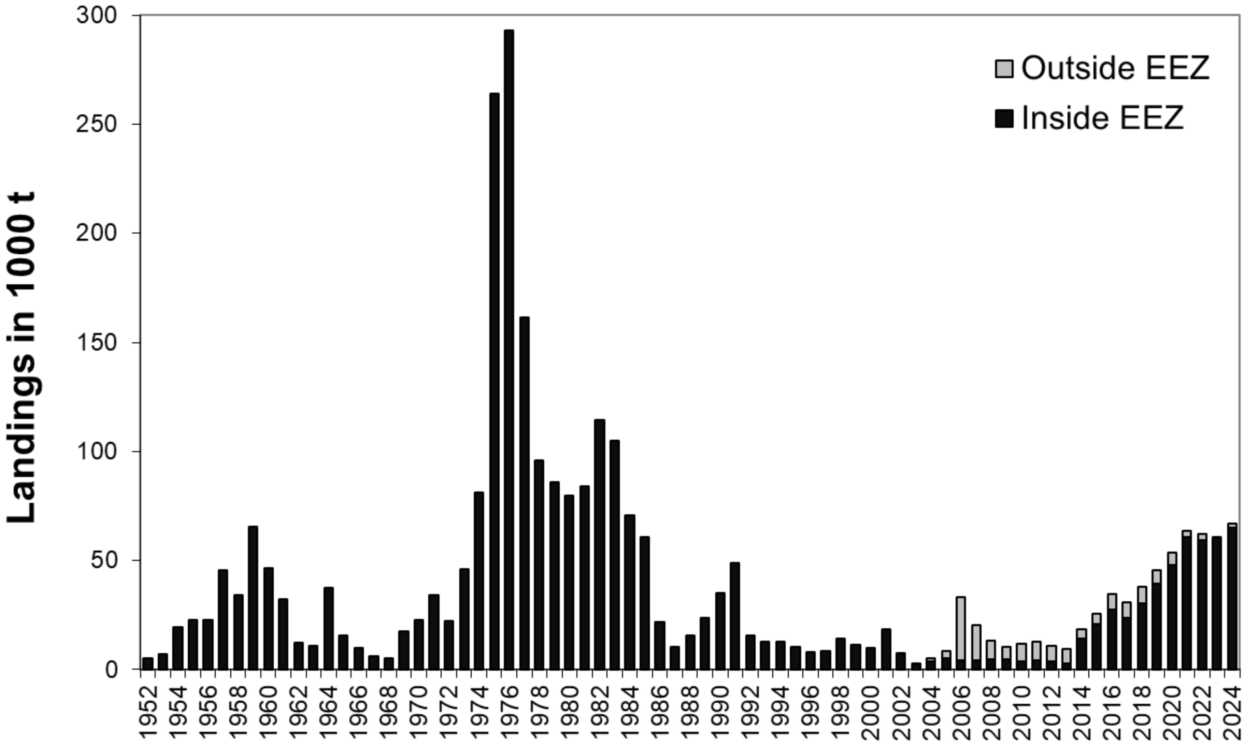


Figure 6. 1. S. mentella in subareas 1 and 2. Total international landings 1952–2024 (thousand tonnes).

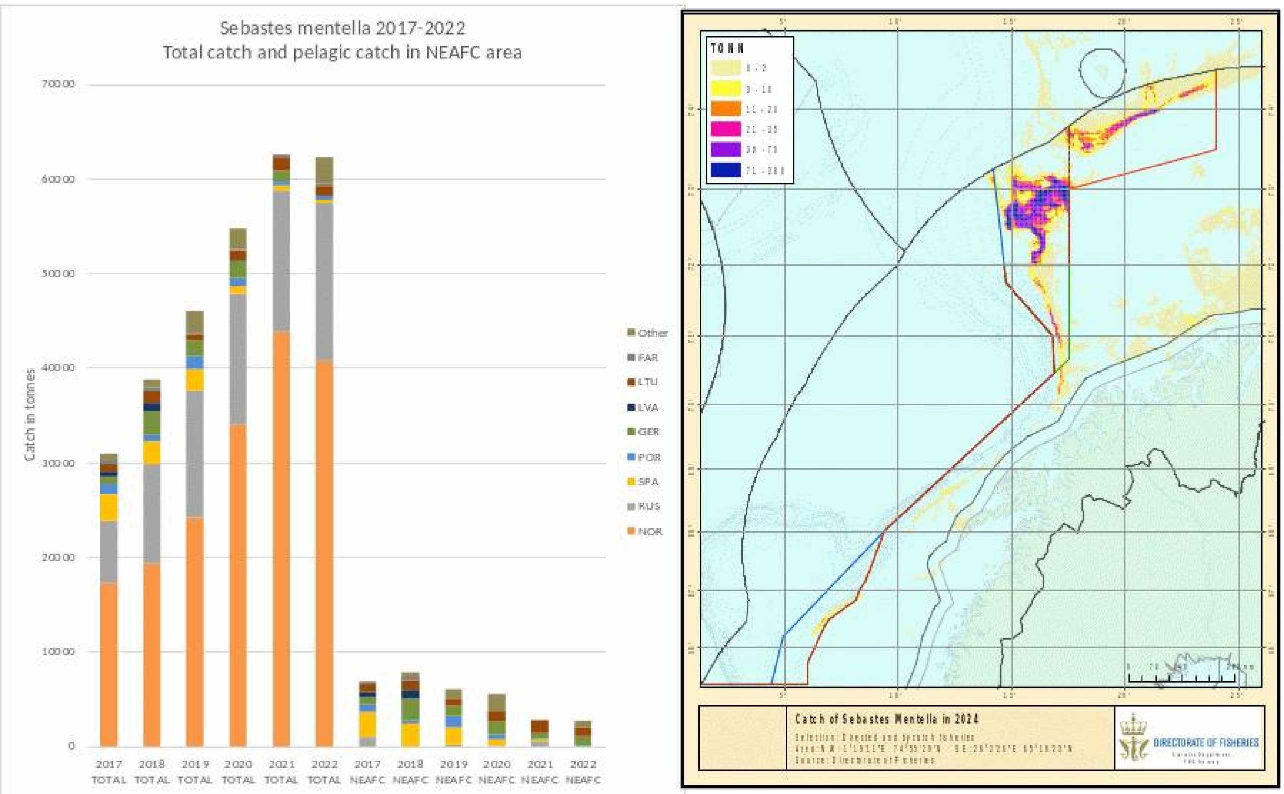


Figure 6.2. S. mentella in subareas 1 and 2. Left panel: Catch in tonnes reported by national fleets for the subareas 27.1 and 27.2 and in the NEAFC regulatory area. Right panel: Geographical location of the directed Norwegian fishery in 2021 within Norwegian Exclusive Economic Zone and bycatches by Norwegian vessels in all areas. Directed fishing with bottom trawl is not permitted to the east of the red line. Directed fishing with pelagic trawl is not permitted to the east of the blue line. Directed fishing is not permitted in the Fishery Protection Zone around Svalbard.

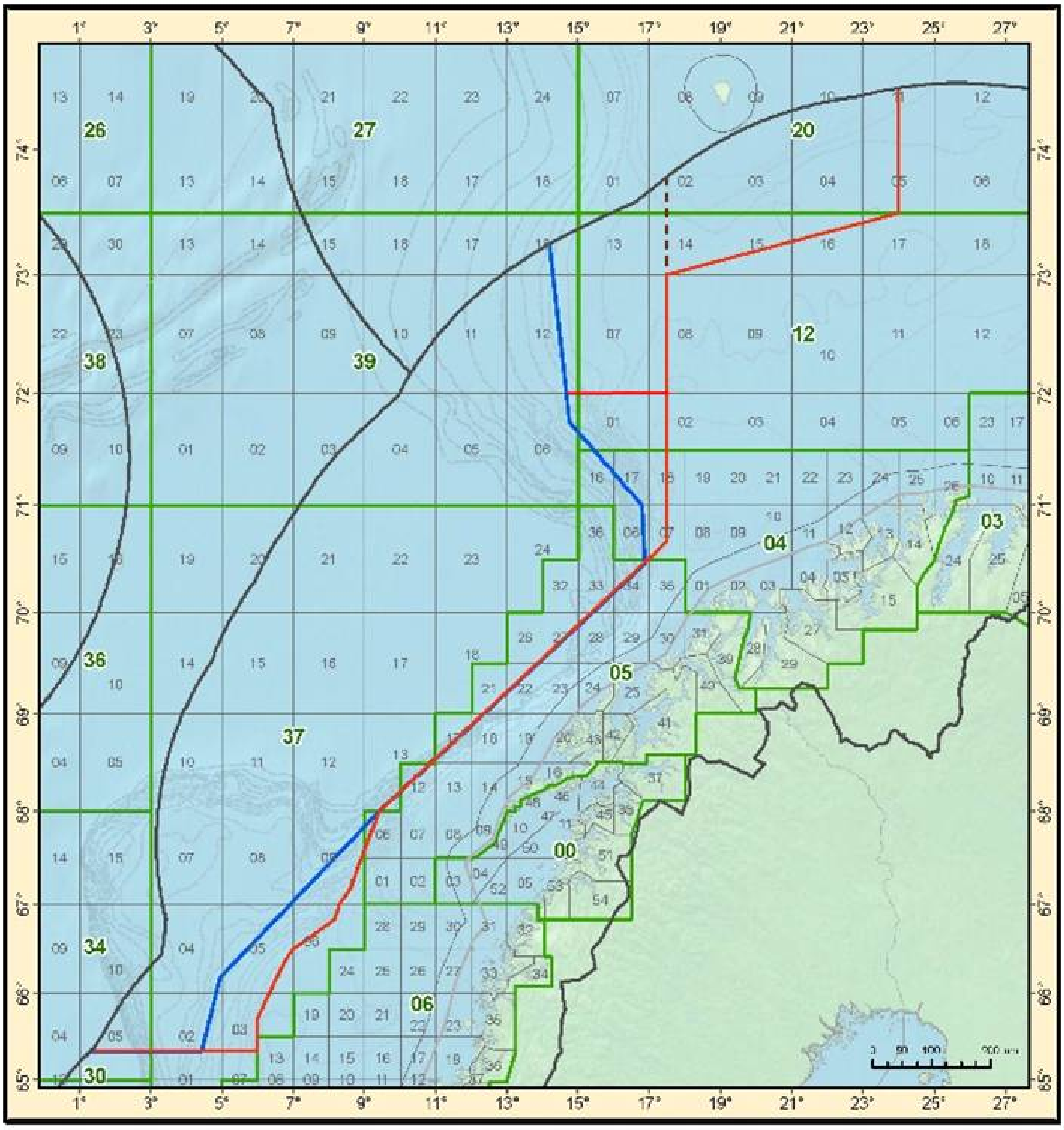


Figure 6.3. Delineation of the geographical limits for directed fishing in the Norwegian Economic Zone in 2014–2024. Directed pelagic trawling is only allowed west of the blue line. Directed demersal trawling is only allowed between the blue and the red line. The area east of the stippled line inside NEZ south of Bear Island is only open for directed demersal trawling after 10 May. The other areas for directed fishing are also open during 1 January to last February. Due to high bycatch ratios of golden redfish 72°N was suggested as southern limit for directed demersal fishing marked by the red line along that latitude to the Norwegian directorate of fisheries in November 2018.

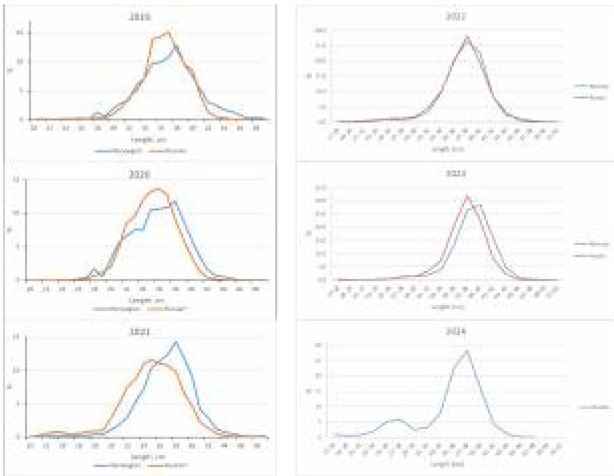


Figure 6.4. S. mentella in subareas 1 and 2. Length-distributions of the commercial demersal catches by Norway and Russia in 2019–2024. Norwegian data not available for 2024.

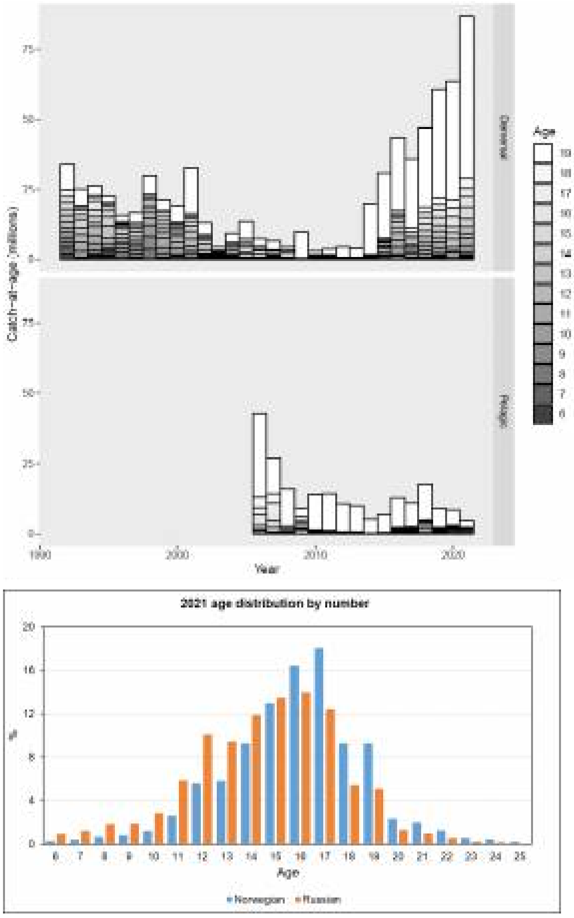


Figure 6.5. S. mentella in subareas 1 and 2. Upper panels: Catch numbers-at-age for the demersal and pelagic fleets 1992–2021. Lower panel: Age composition of the commercial demersal catches by Norway and Russia in 2021 (calculated using ALK).

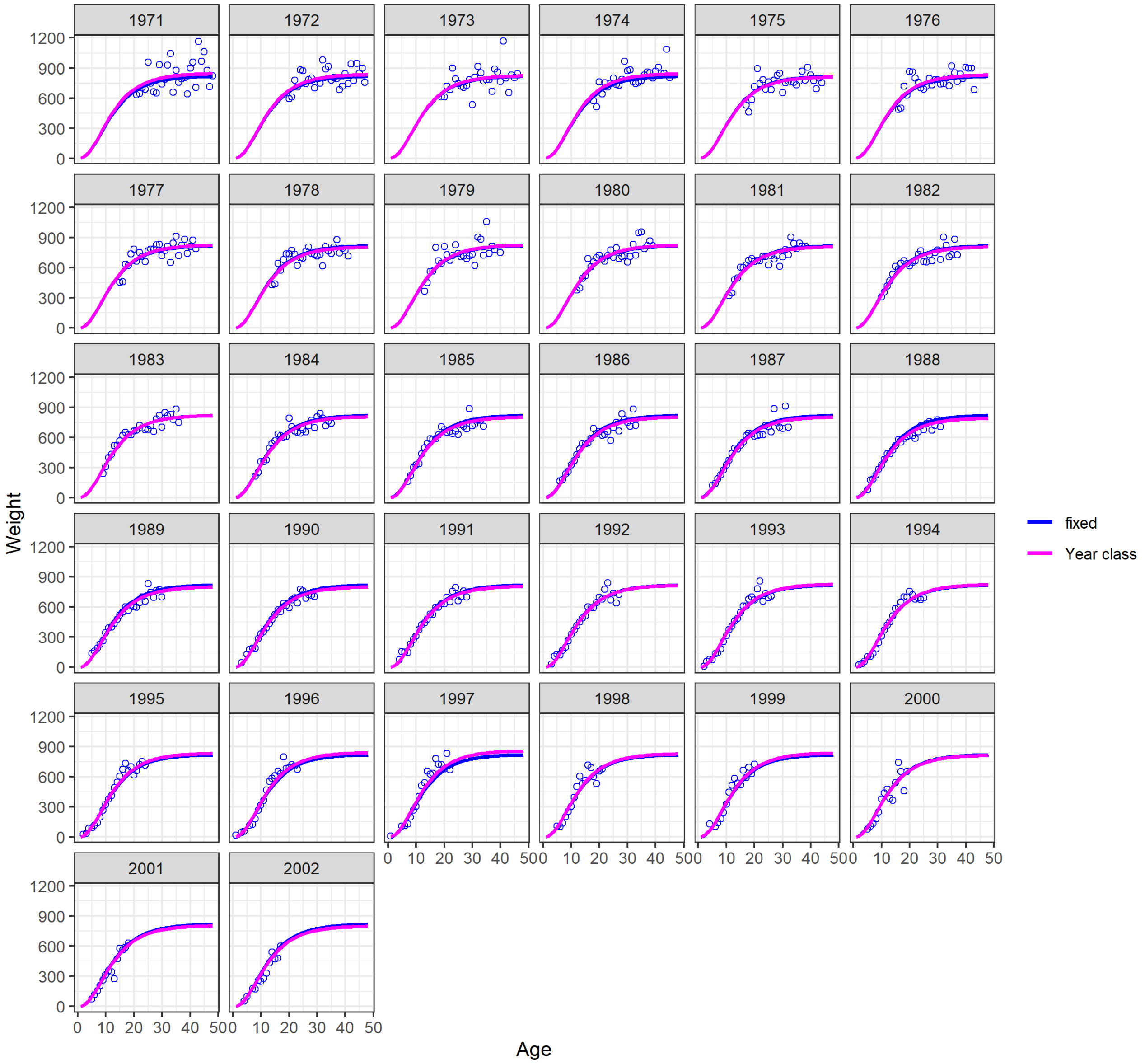


Figure 6.6. Weight-at-age of S. mentella per year class in subareas 1 and 2 derived from Norwegian commercial and survey data (Table 6.7). The weights were derived from samples with at least five individuals and are expressed in grammes. The blue and purple lines show the fitted mixed-effect models.

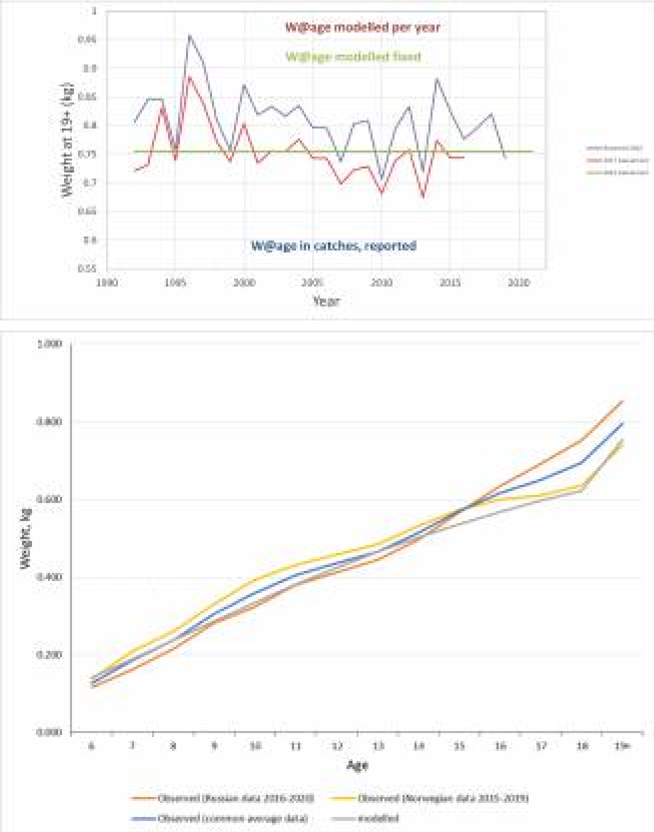


Figure 6.7. S. mentella in subareas 1 and 2. The upper panel shows weight-at-age 19+ as reported from catches (blue) or modelled from catches and survey observations (red) using a mixed effect model (Figure 6.5). AFWG 2017 was the last working group using the annual mixed effect model. The weights-at-age used in the assessment were based on the fixed effects model and are therefore the same for every year. These weights were updated in 2022 and differ only slightly from those estimated in the assessments since 2018. The bottom panel shows comparison of the observed Norwegian and Russian weight by age with the modelled one up to 2020.

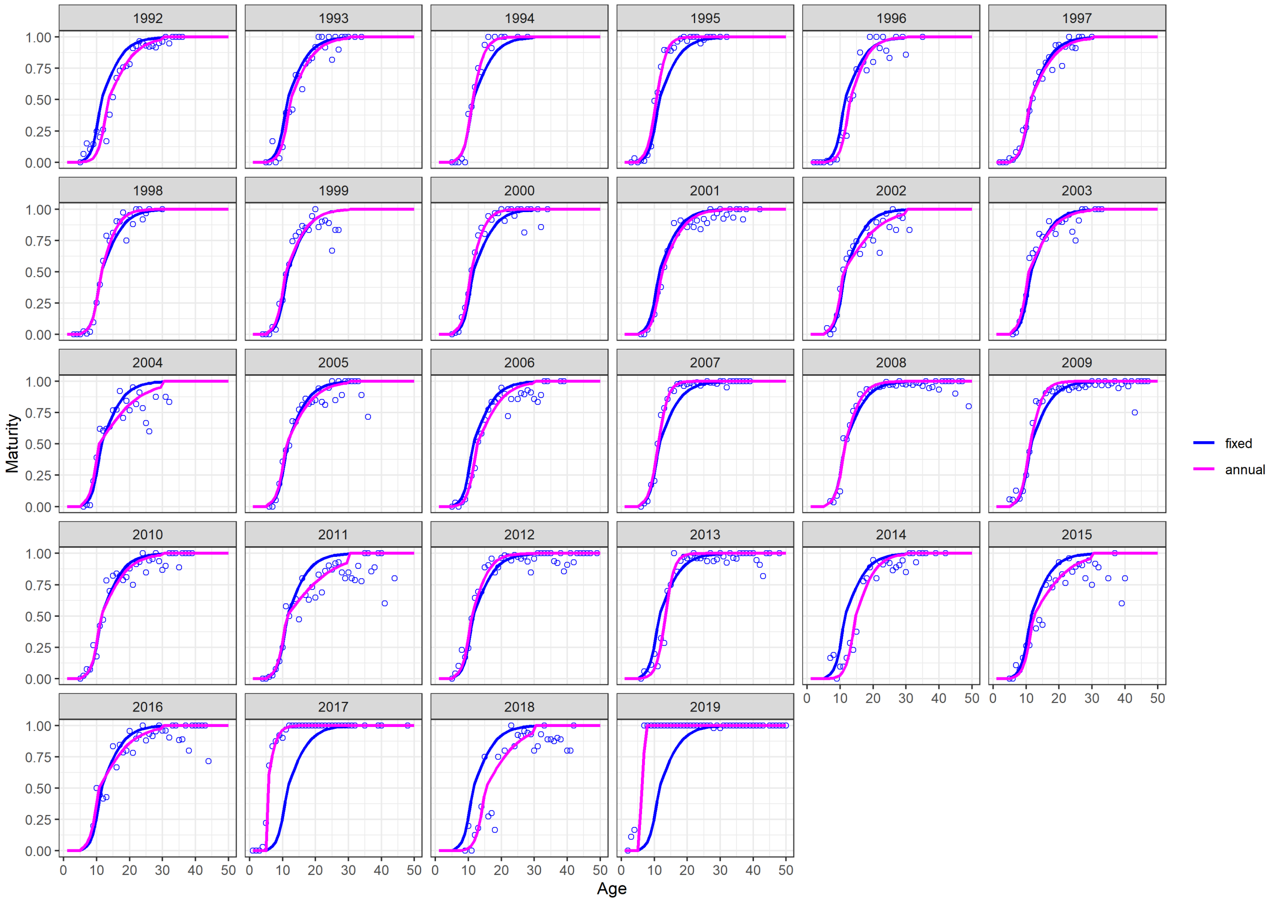


Figure 6.8. Proportion maturity-at-age of S. mentella in subareas 1 and 2 derived from Norwegian commercial and survey data (Table D7). The proportions were derived from samples with at least five individuals. The blue and purple lines show the fitted mixed-effect models. For 2008, 2011 and 2016–2019 the common model (fixed effects blue) was used for other years the annual models (random effects purple) were used. Available data for 2019 was insufficient at the time of the meeting and the fixed effect model was used and there was no age data available for 2020 or 2021.

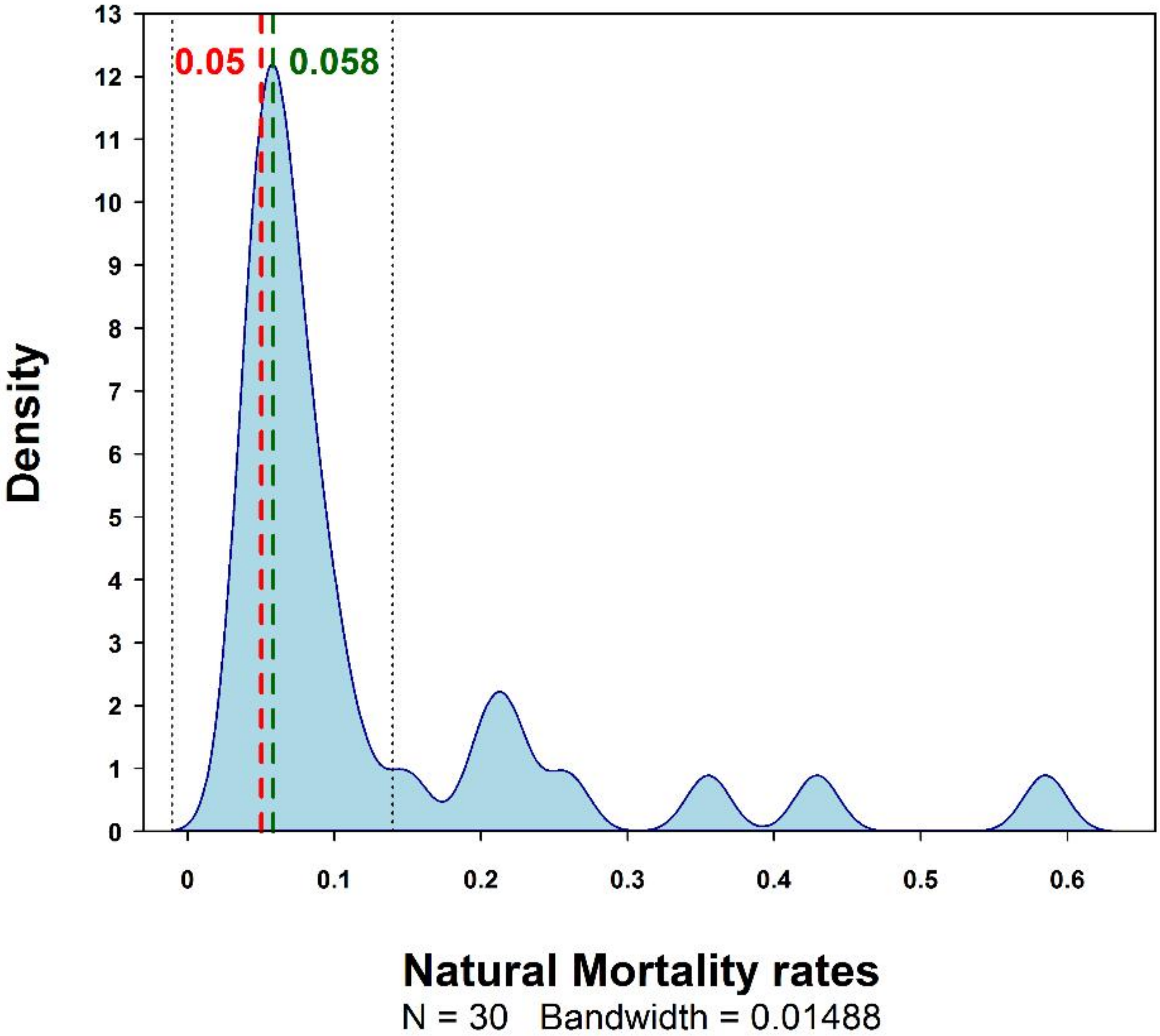


Figure 6.10. Abundance of S. mentella (5–14 cm) during the winter survey (February) in the Barents Sea compared with the consumption of redfish (mainly S. mentella) by cod (See Section 1 Table 1.1).

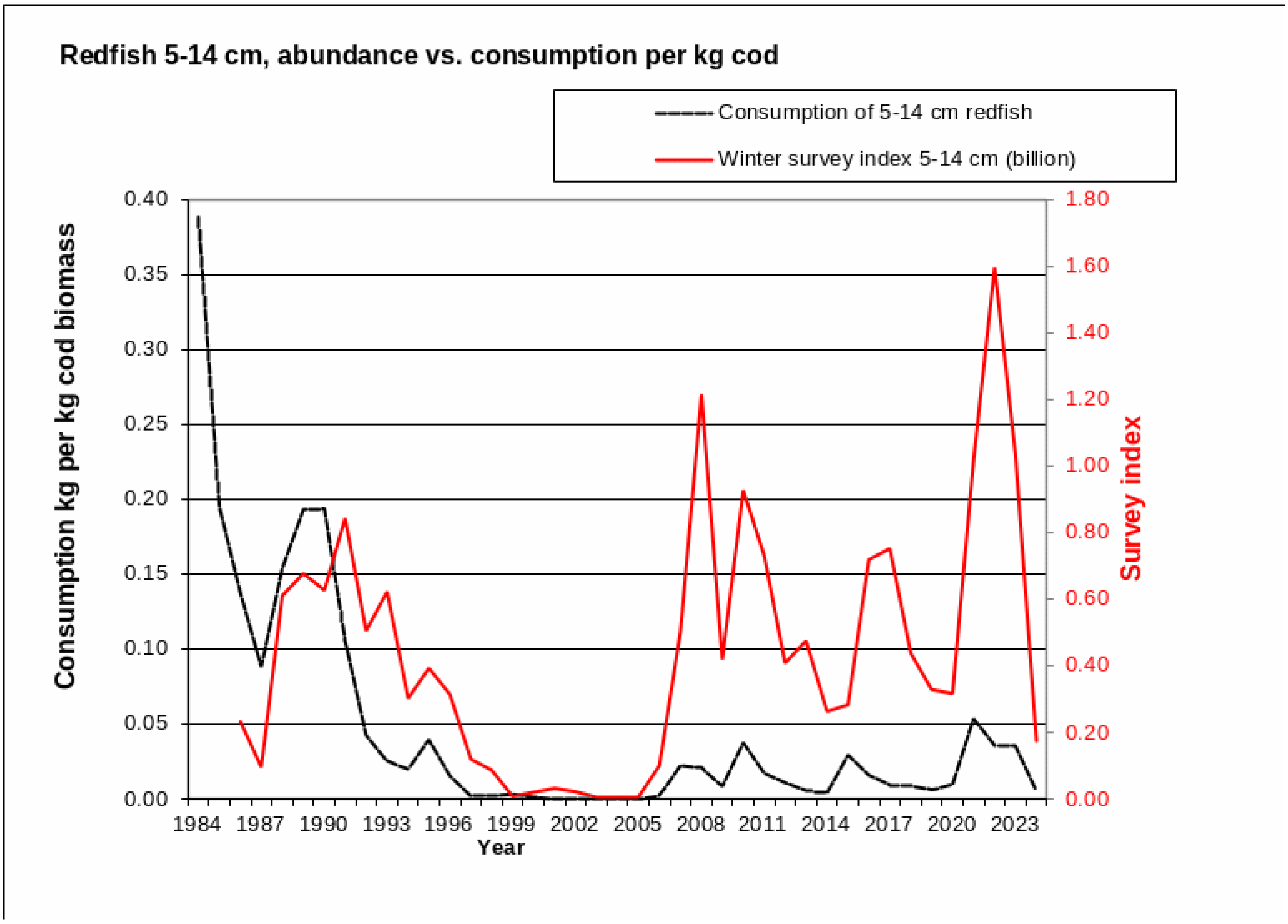
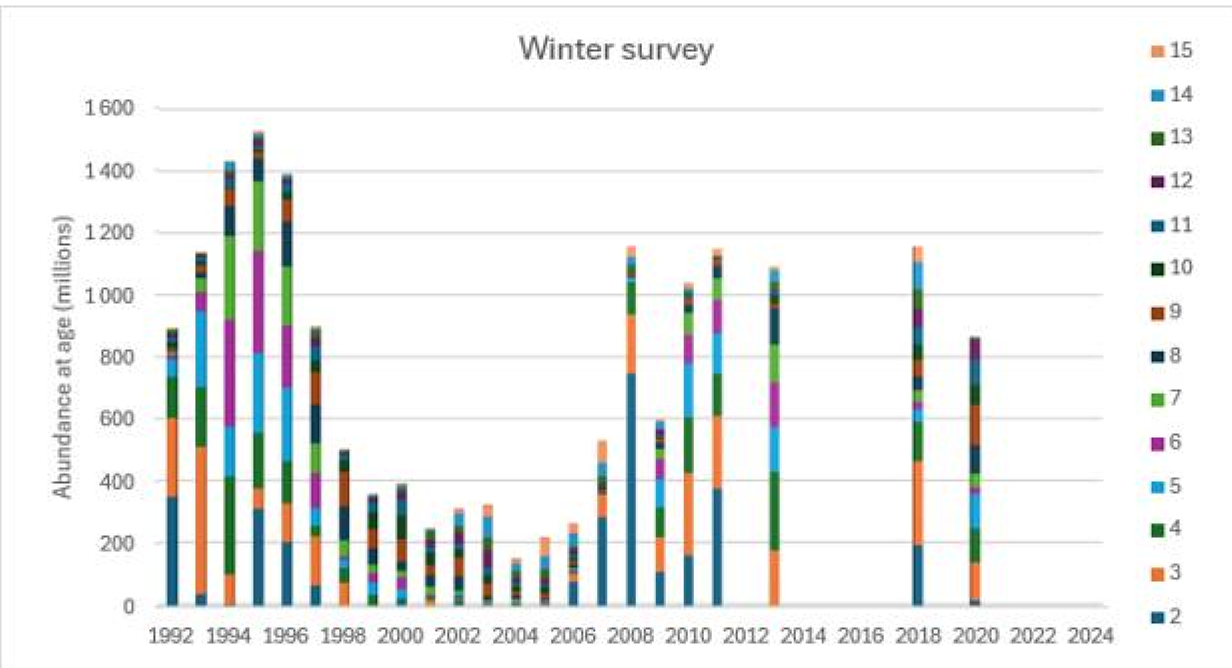
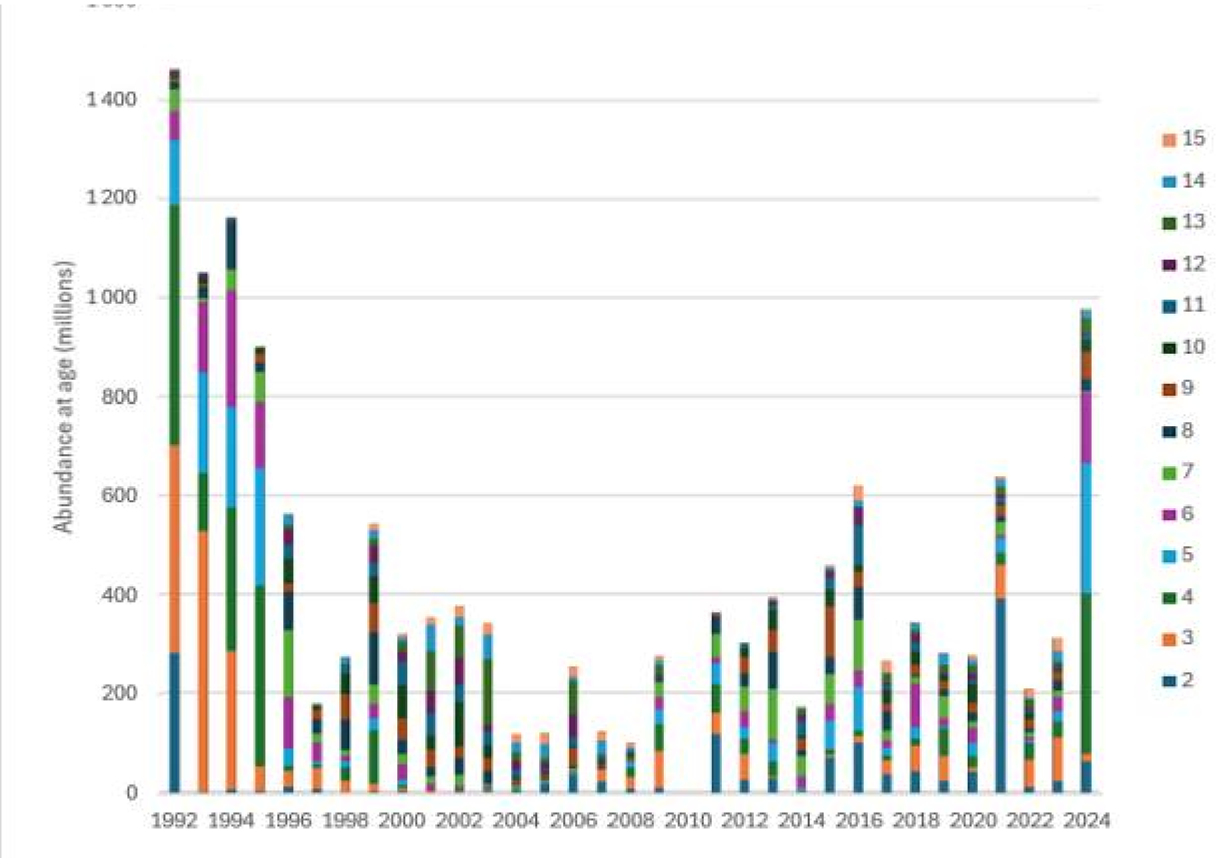


Figure 6.9. Density distribution of natural mortality rates calculated with 30 of the 39 compared methods at the 2018 benchmark. The excluded methods are those based on certain taxa or areas. The broken red line indicates the currently used value; the broken red line indicates the currently used value; the broken green line the most frequent one and the black dotted lines indicate the beginning and end of the distribution's peak.





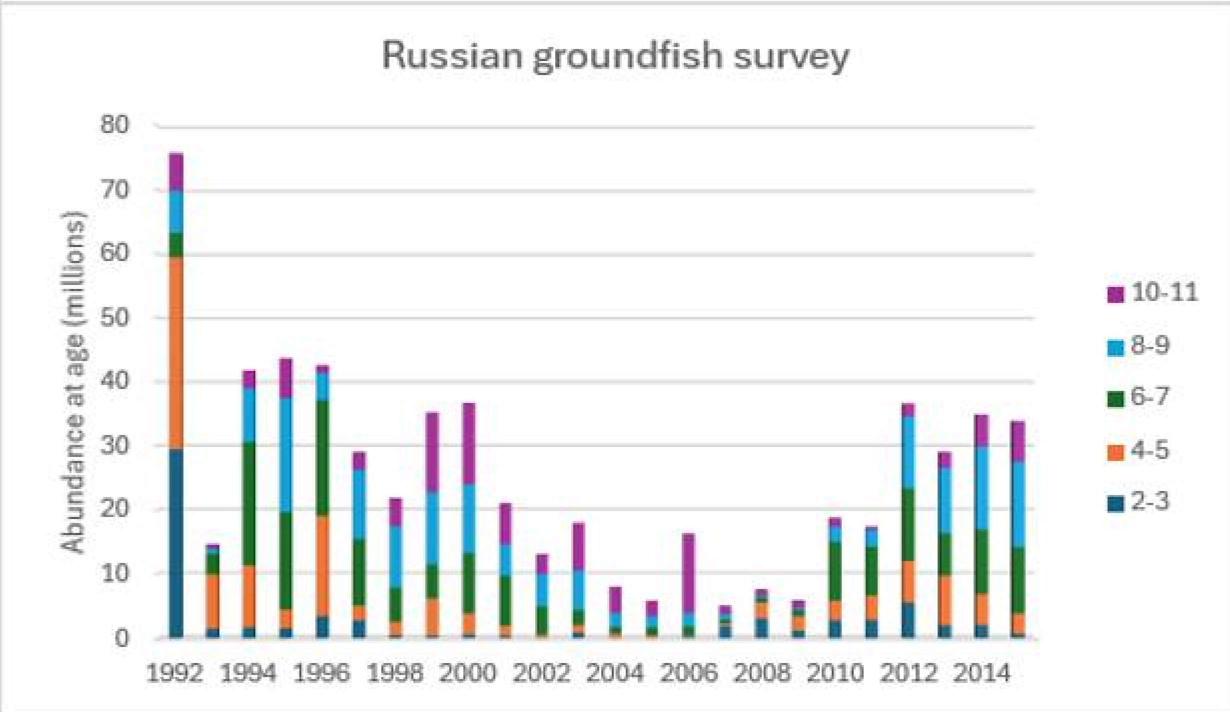


Figure 6.11. S. mentella in subareas 1 and 2. Age disaggregated abundance indices for bottom-trawl surveys 1992–2024 in the Barents Sea in winter (winter survey top) in summer (Ecosystem survey middle) and in autumn (Russian groundfish survey bottom).

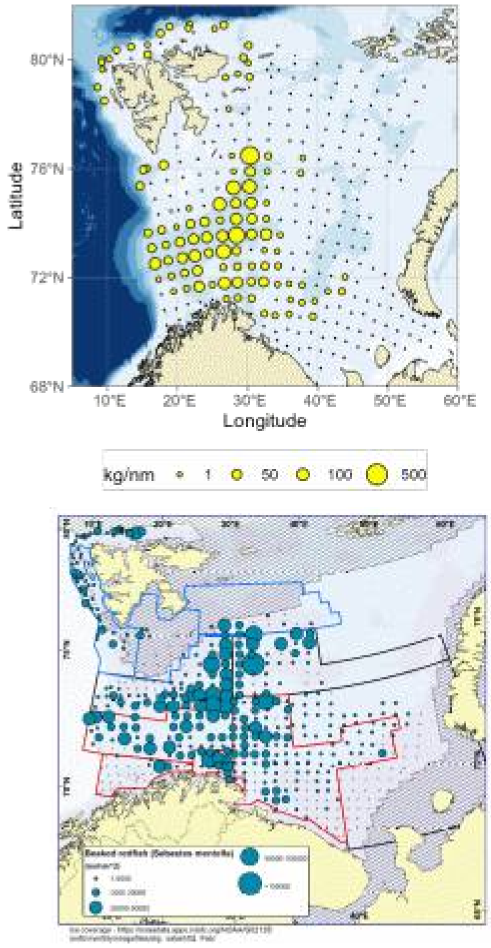


Figure 6.12. S. mentella in subareas 1 and 2. Abundance indices for individual trawl stations during the ecosystem survey in autumn 2024 (top) and winter survey 2024 bottom).

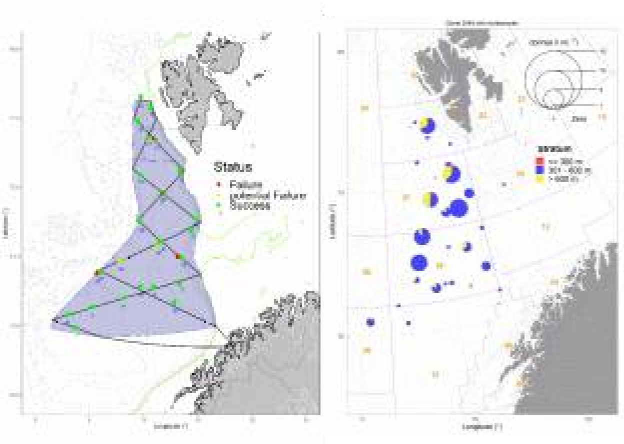


Figure 6.13. S. mentella in subareas 1 and 2. Left panel: Survey track of the Deep Pelagic Ecosystem Survey in 2022 and categorized trawls. Potential failures need further examination to determine their usability, whilst successful trawls can be used for the survey index without further consideration. Right panel: Catch rates in tonnes per square nautical mile for the surveyed depth layers (< = 300 m, 301–600 m and > 600 m) from the 2019 survey. The corresponding results for the 2022 survey are not available.

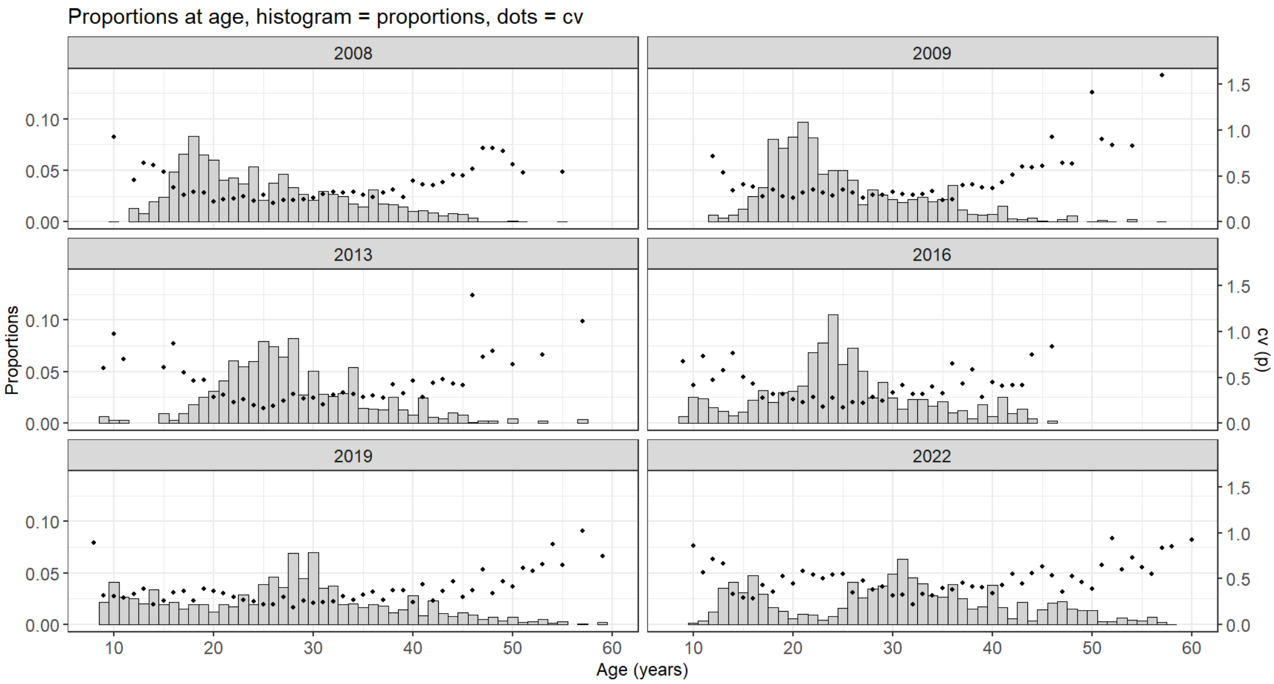


Figure 6.14. S. mentella in subareas 1 and 2. Proportions at age during the International Deep Pelagic Ecosystem Survey (WGIDEEPS) in the Norwegian Sea. Bars show proportions at age and dots shows the coefficient of variation for each age. Estimated with StoX

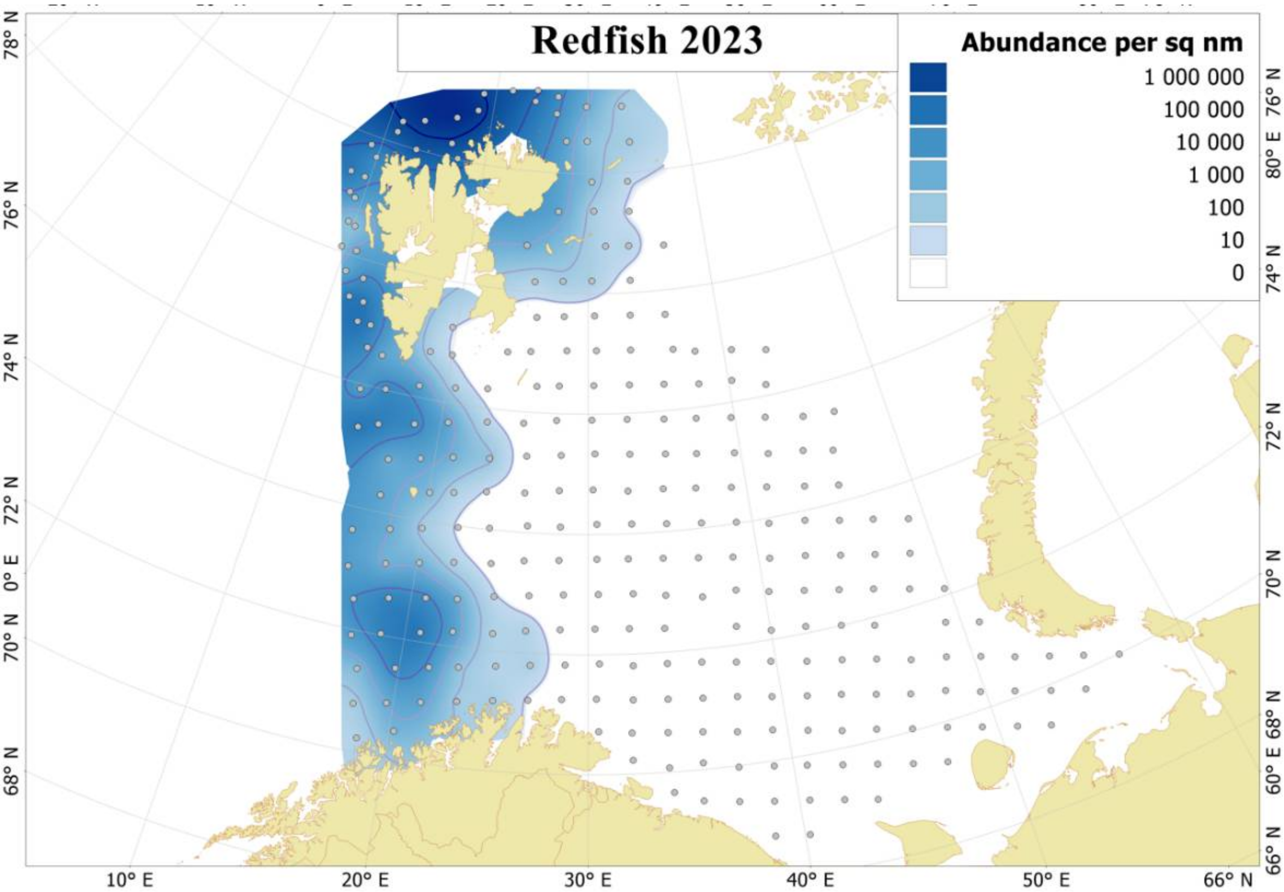


Figure 6.16. S. mentella in subareas 1 and 2. Abundance indices (in billions) of 0-group redfish (believed to be mostly S. mentella) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980–2023. Data not available from 2024-survey.

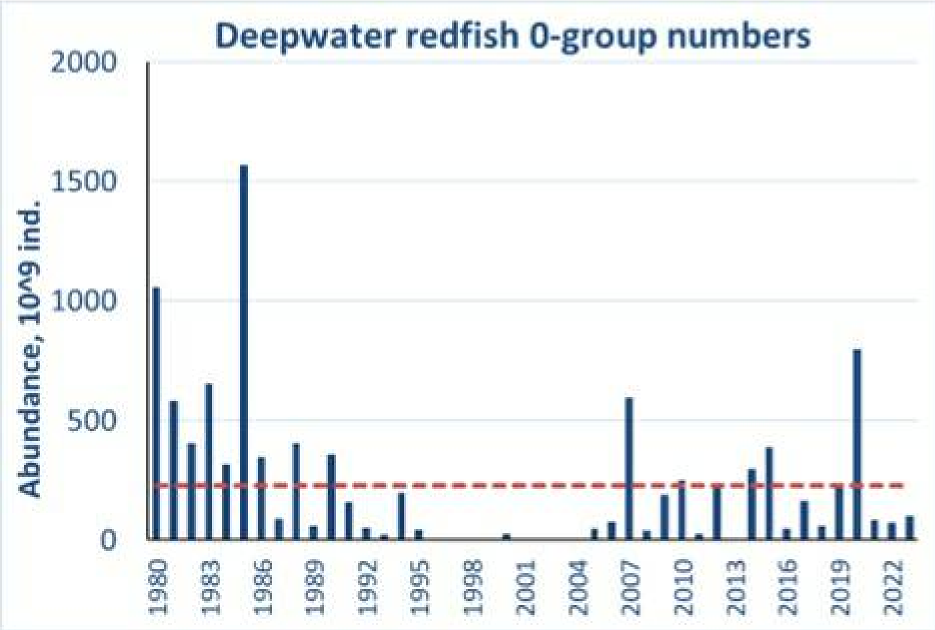


Figure 6.15. Map showing the specific pelagic 0-group trawl stations and the abundance of 0-group S. mentella during the joint Norwegian- Russian Ecosystem survey in the Barents Sea and Svalbard in 2023. Not updated in 2024.

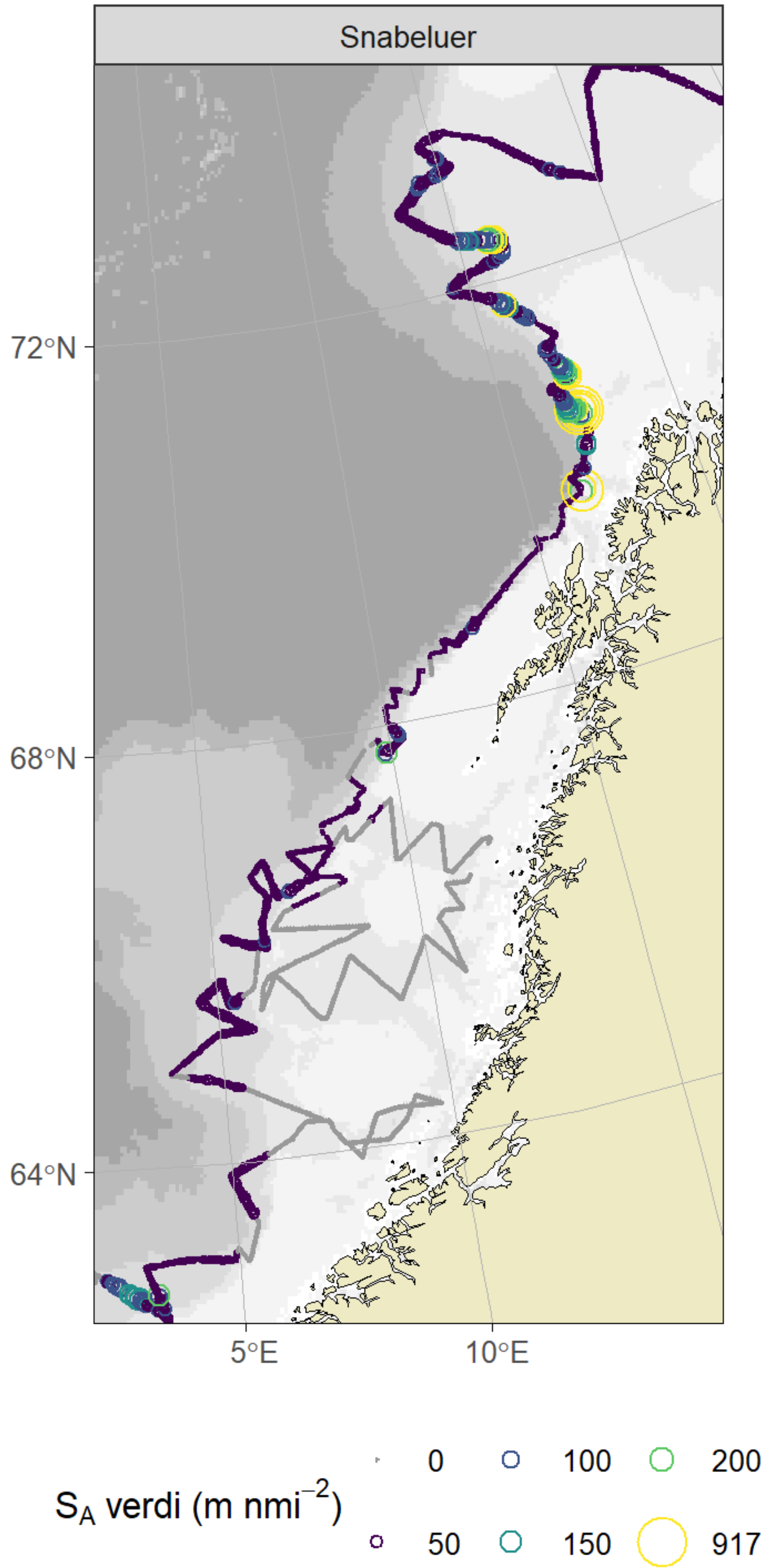


Figure 6.17. S. mentella in subareas 1 and 2. Horizontal distribution of S. mentella hydroacoustic backscattering (sA) during the Norwegian slope survey in spring 2024. The circles are proportional to the sA assigned to redfish along the vessel track.

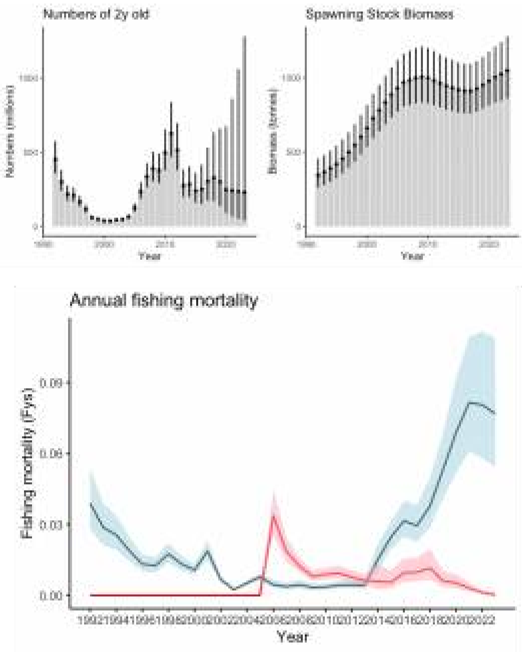


Figure 6.18. S. mentella in subareas 1 and 2. Results from the statistical catch-at-age assessment run showing the estimated recruitment-at-age 2 spawning-stock biomass from 1992 to 2023 and annual fishing mortality coefficients by year (Fy) from the demersal (blue) and pelagic (red) fleets. Error bars (top) and the coloured envelope (bottom) indicate 95% confidence limits.

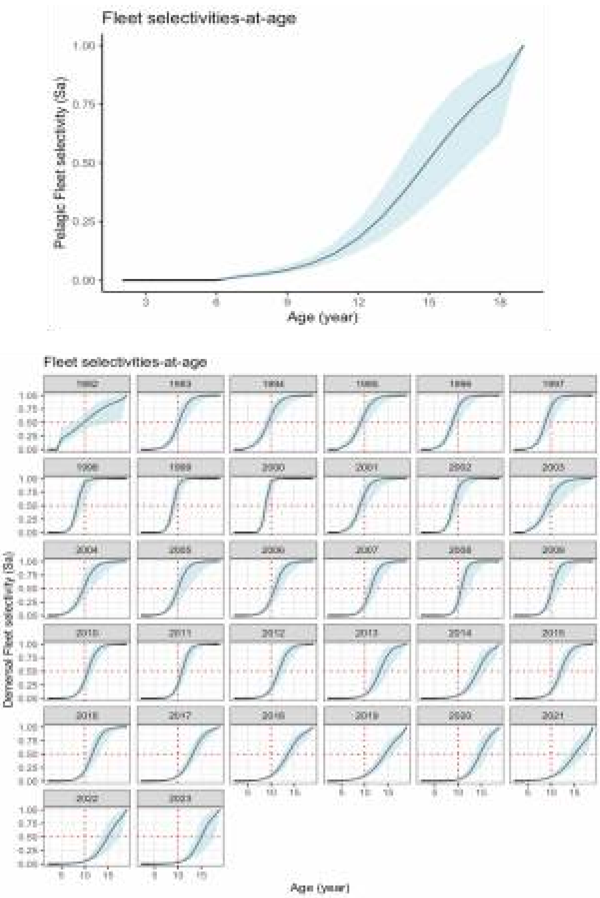


Figure 6.19. S. mentella in subareas 1 and 2. Results from the statistical catch-at-age assessment run showing the estimated annual fleet selectivity by age (Fa) from the pelagic (top panel) and demersal (lower panels) fleets. Colored envelopes indicate 95% confidence limits.

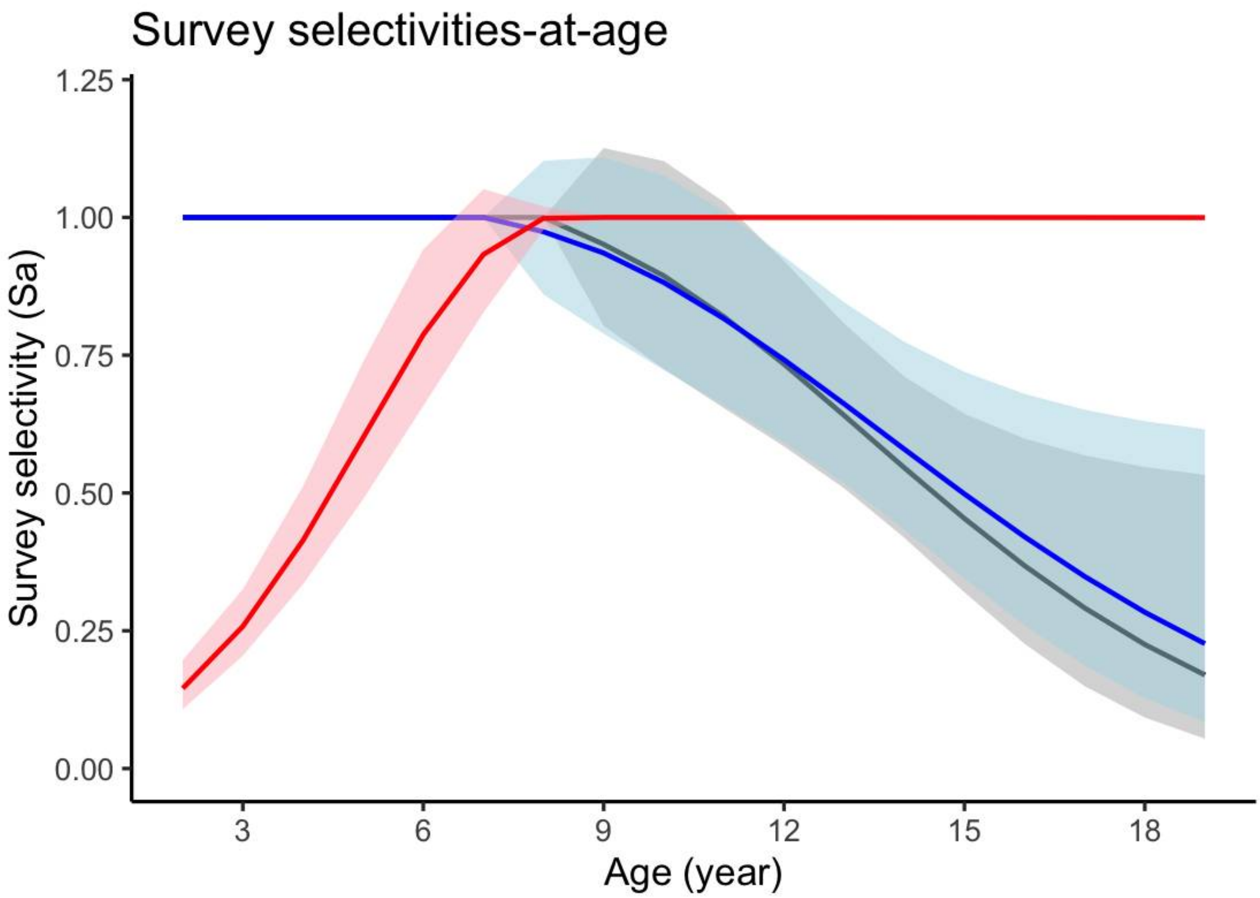


Figure 6.20. S. mentella in subareas 1 and 2. Results from the statistical catch-at-age assessment run showing the selectivity-at-age for winter (blue) ecosystem (grey) and Russian groundfish (red) surveys.

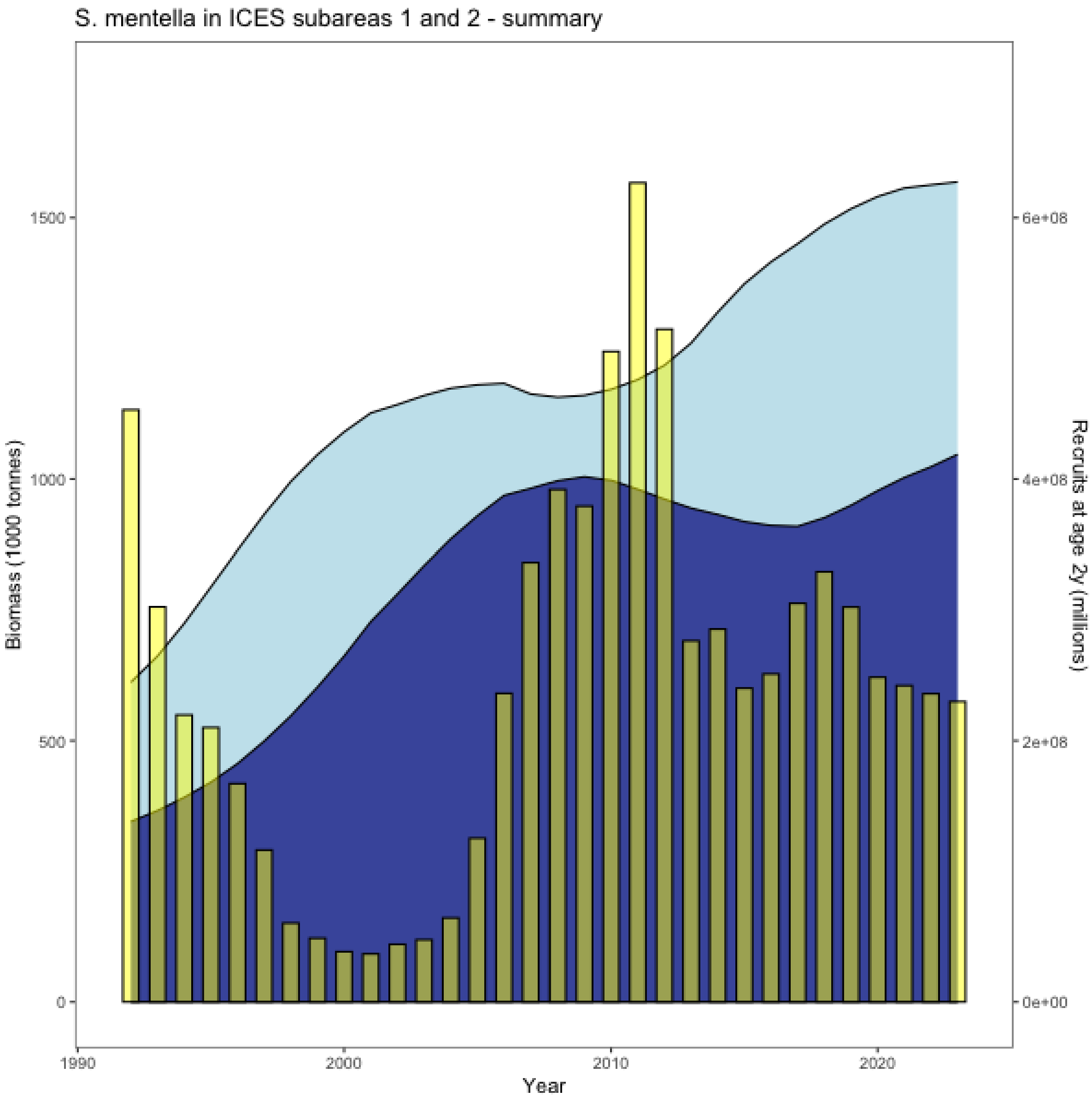


Figure 6.21. S. mentella in subareas 1 and 2. Results from the statistical catch-at-age model showing the evolution of total biomass (in tonnes light blue left axis) spawning-stock-biomass (in tonnes dark blue, left axis) and recruitment-at-age 2 (in numbers yellow, right axis) for the period 1992–2023 for S. mentella in subareas 1 and 2.

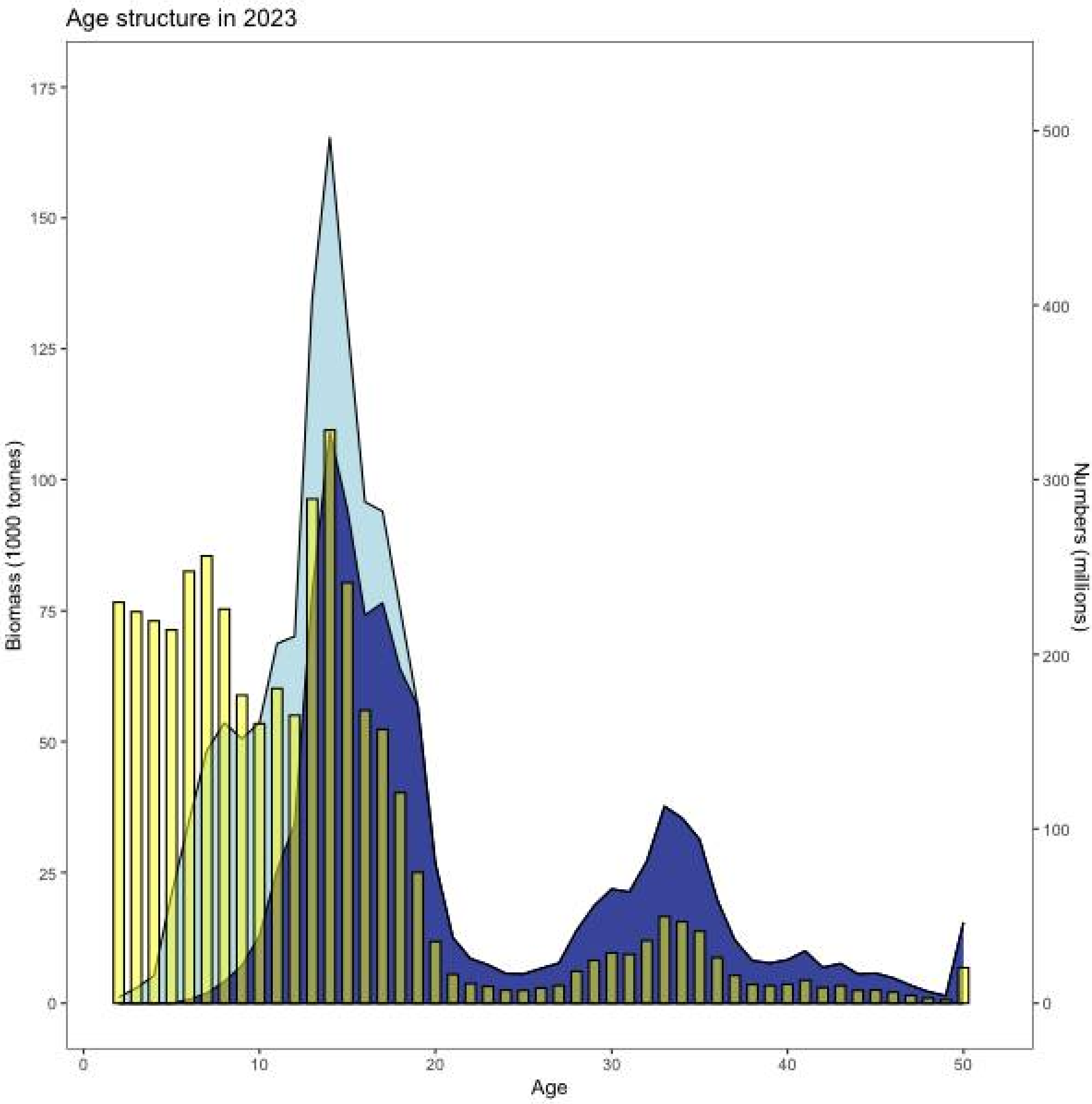


Figure 6.22. S. mentella in subareas 1 and 2. Modelled distribution of numbers (yellow bars right y-axis) biomass (light blue left y-axis) and spawning-stock-biomass (dark blue left y-axis) at age 2–45+ in 2023.

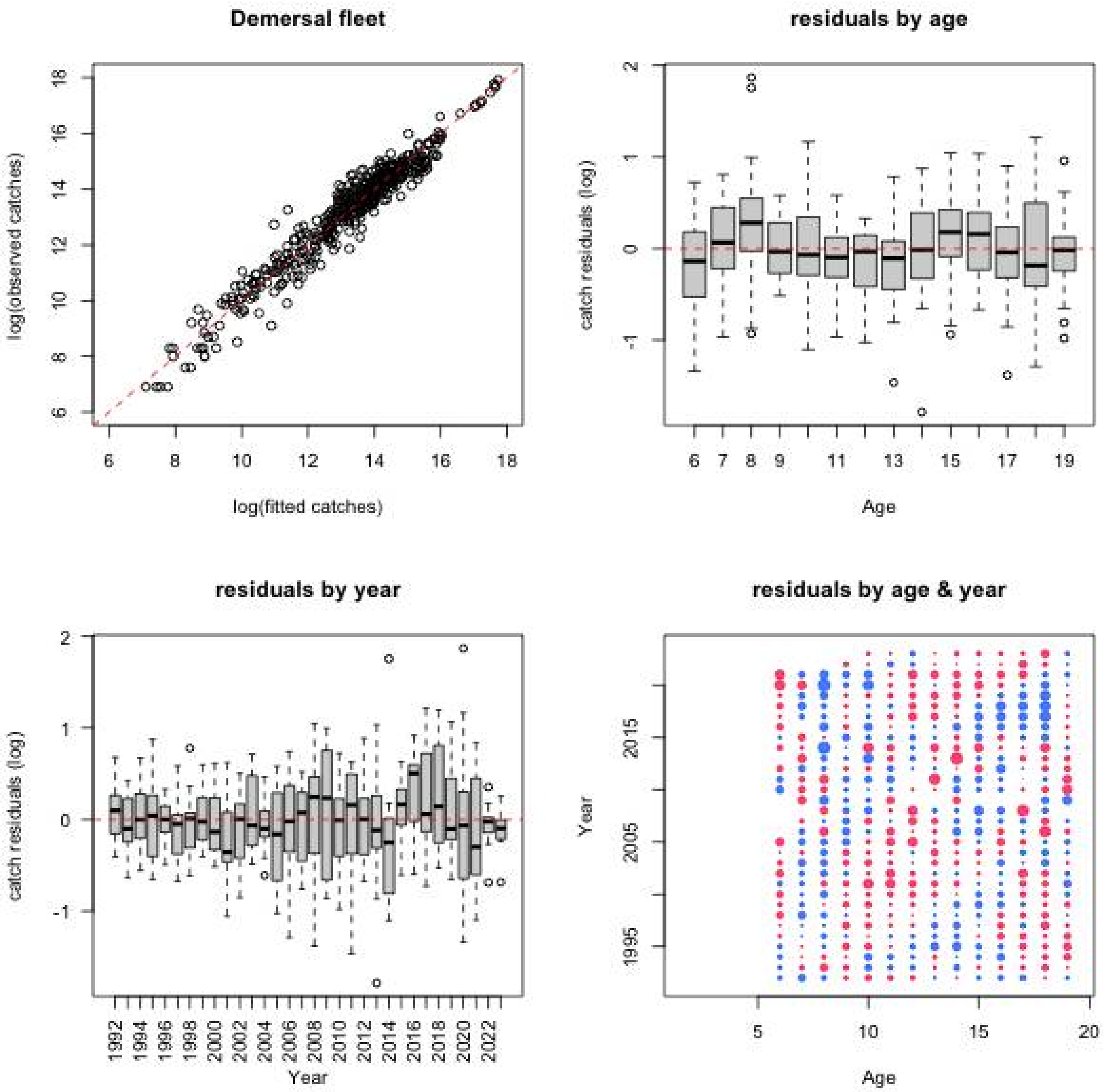


Figure 6.23a. Diagnostic plots for the demersal fleet catch-at-age data. Top-left: scatterplot of observed vs. fitted indices the dotted red line indicates 1:1 relationship. Top right: boxplot of residuals (observed-fitted) for each age. Bottom left: boxplot of residuals for each year. Bottom right: bubble plot of residuals for each age/year combination bubble size is proportional to mean residuals blue are positive and red are negative residuals.

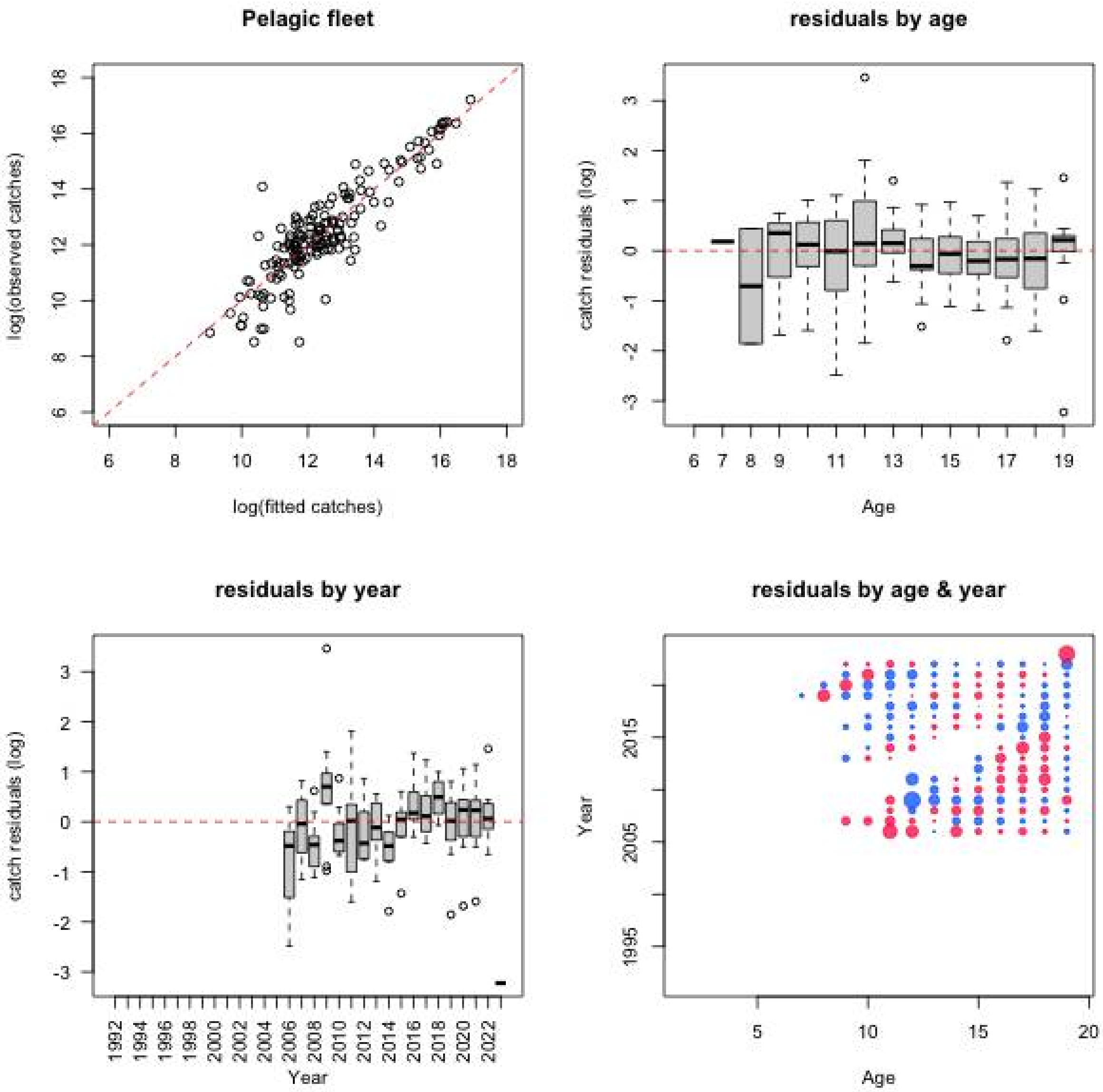


Figure 6.23b. Diagnostic plots for the pelagic fleet catch-at-age data. See legend from Figure 6.23a.

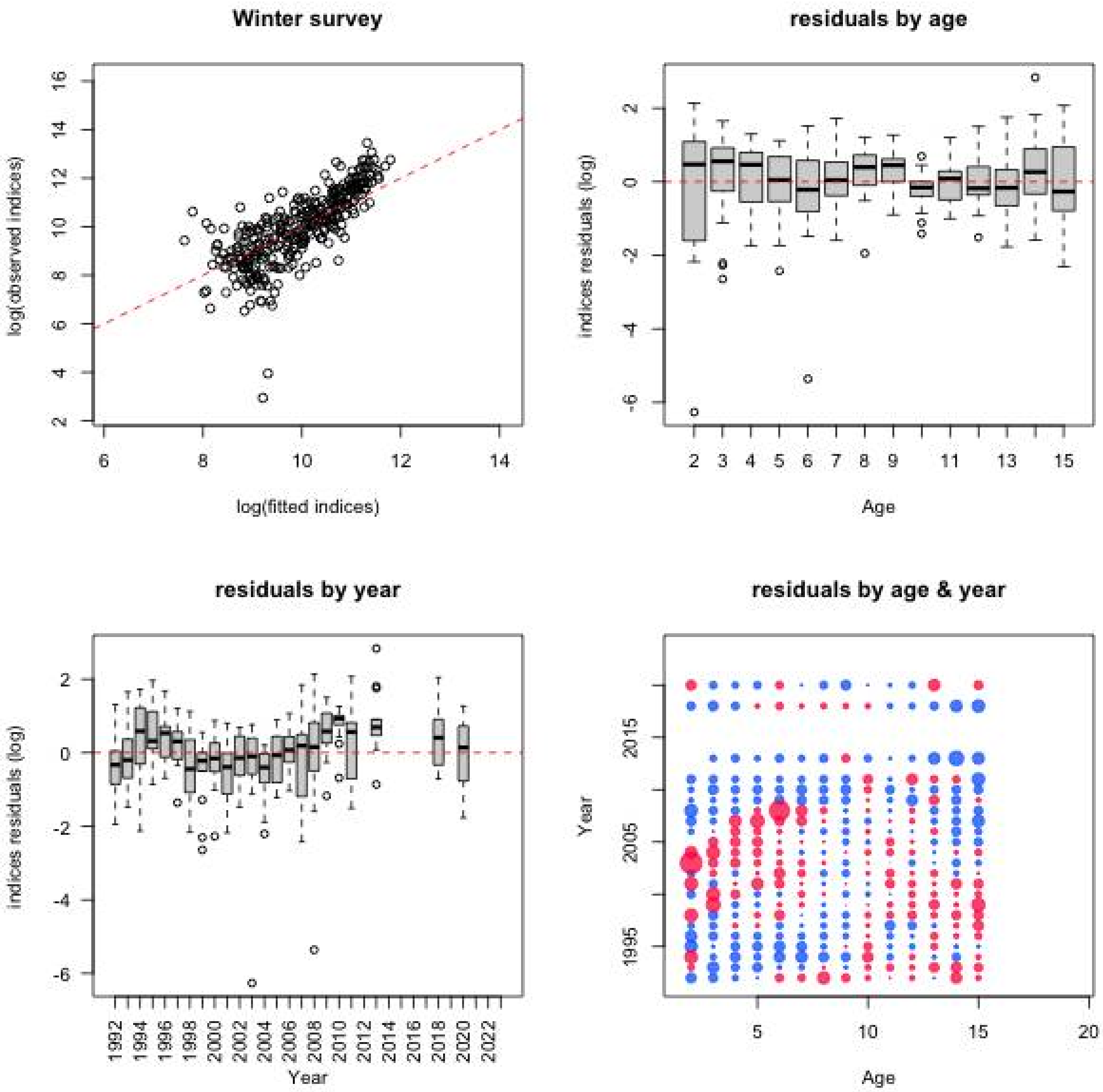


Figure 6.23c. Diagnostic plots for winter survey data. See legend from Figure 6.23a.

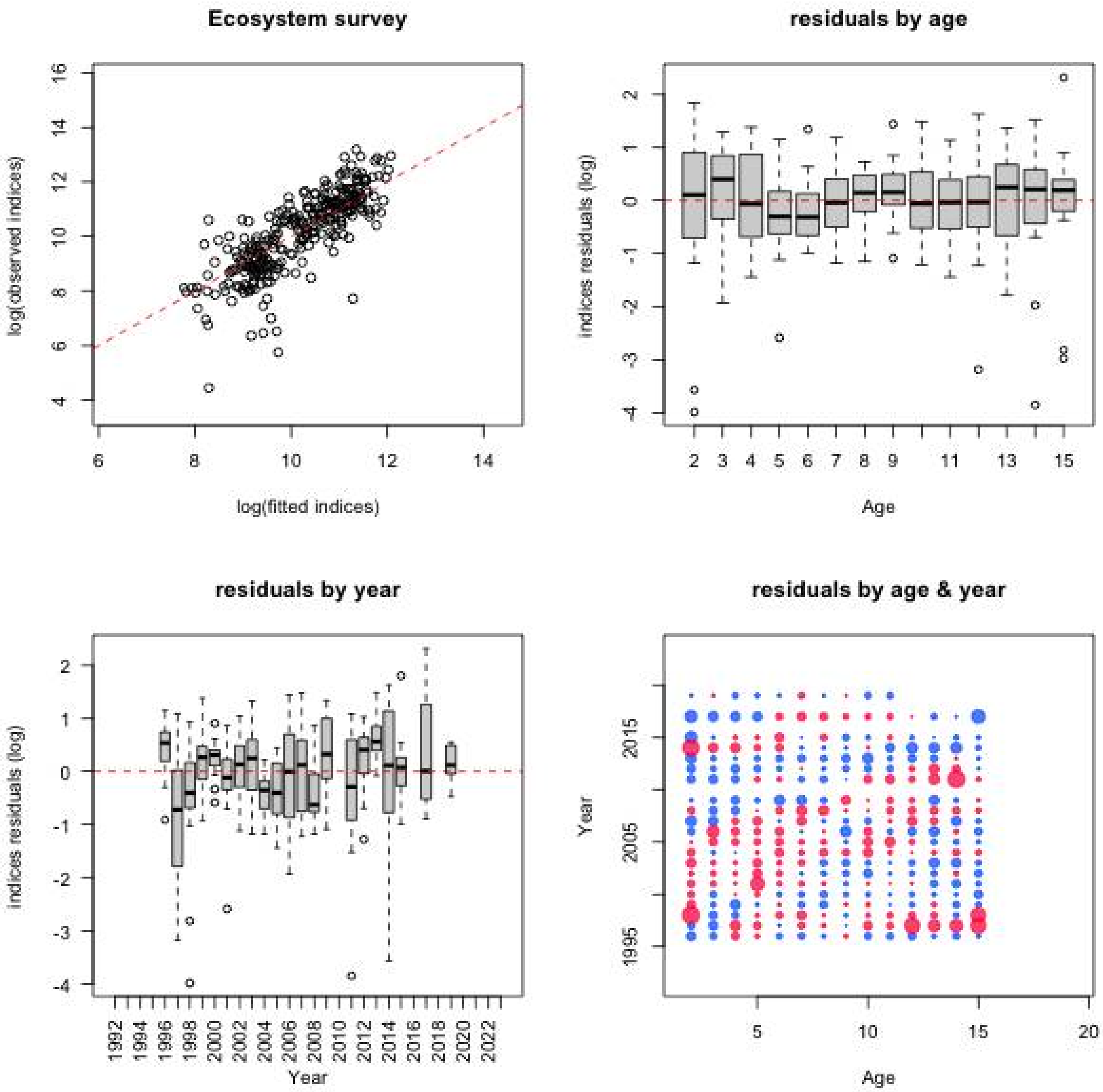


Figure 6.23d. Diagnostic plots for Ecosystem survey data. See legend from Figure 6.23a.

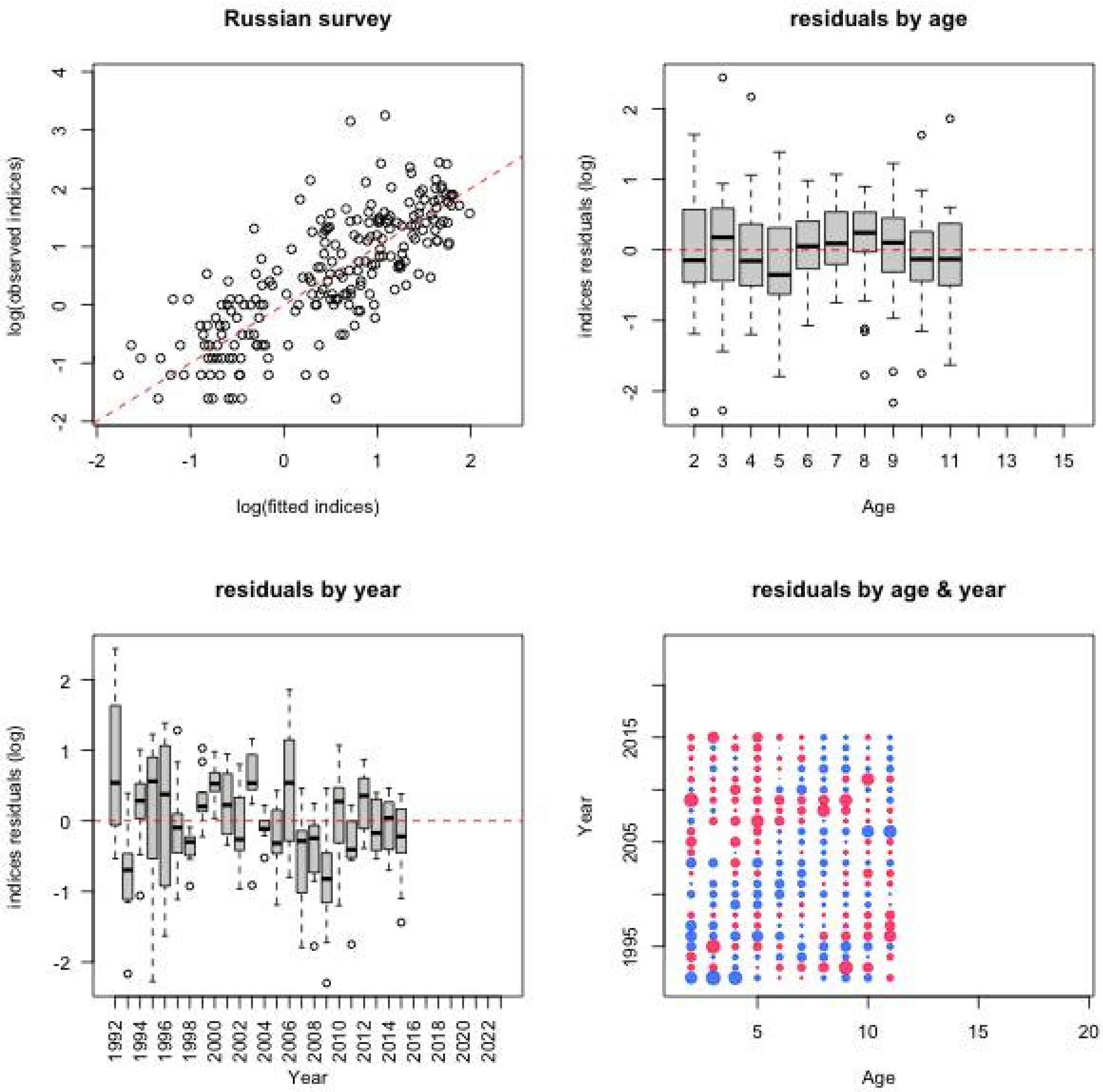
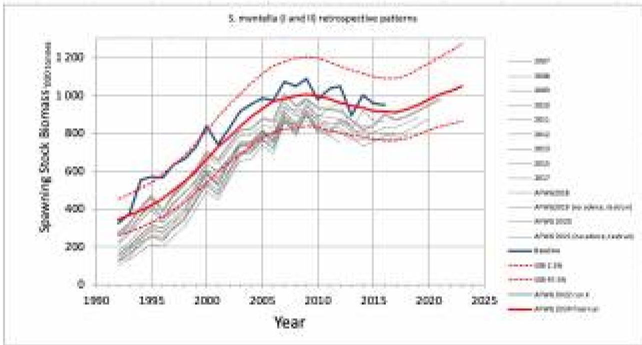


Figure 6.23e. Diagnostic plots for the Russian groundfish survey data. See legend from Figure 6.23a.



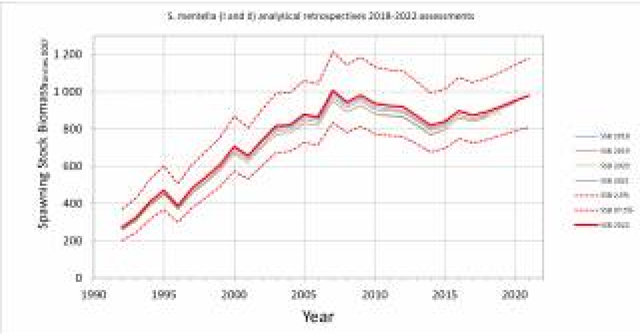


Figure 6.24. The upper panel shows the retrospective patterns of the spawning-stock biomass of S. mentella estimated by the SCAA model for runs up to years 2007–2017 and the baseline model of the 2018 benchmark. The lower panel presents the analytical retrospectives for the current assessment and back to 2018. Confidence Intervals are shown for the latest assessment.

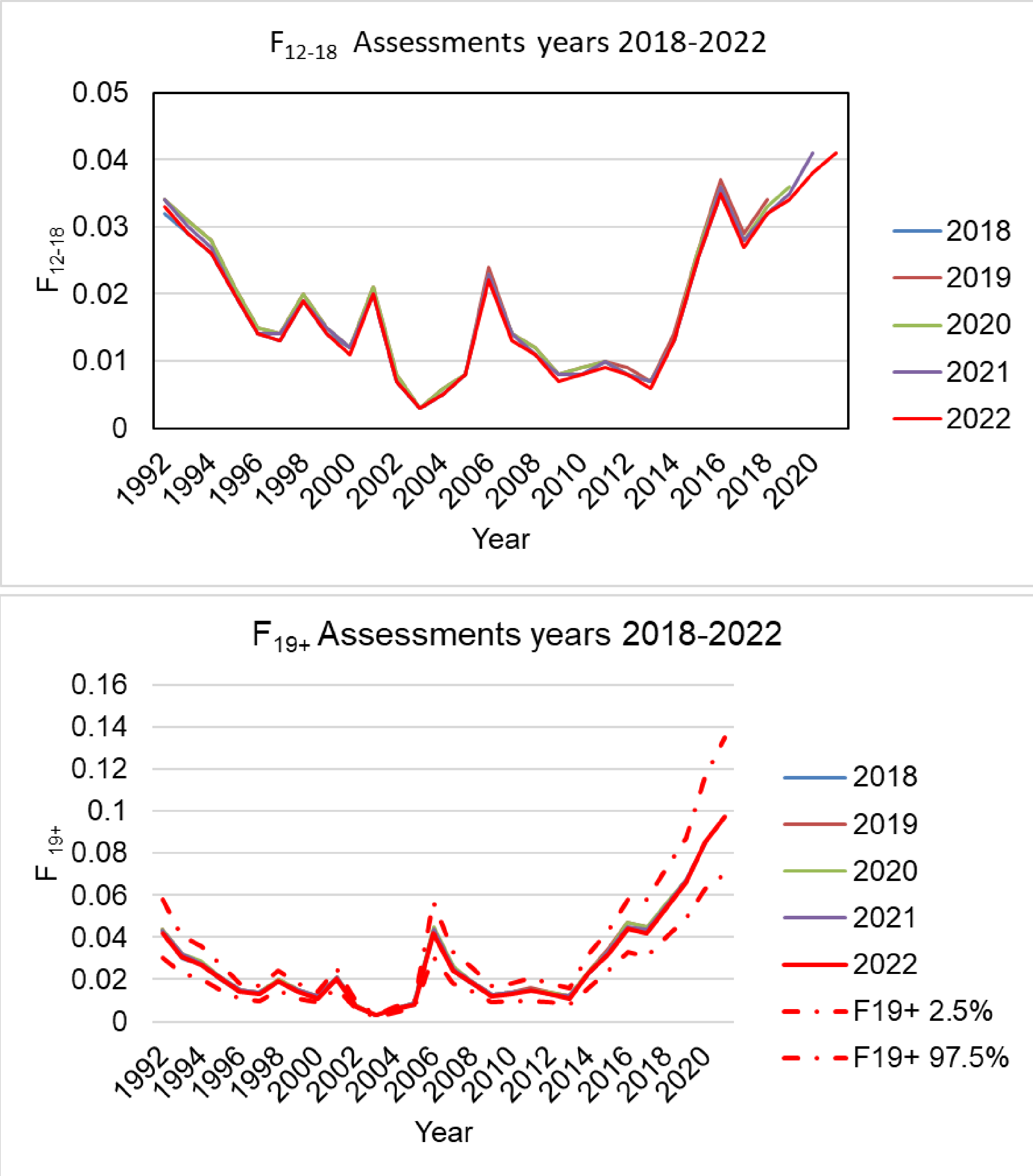


Figure 6.25. The upper panel shows the retrospective patterns of the fishing mortality for the age classes 12-18, estimated by the SCAA model for runs up to years 2018-2022. The lower panel presents fishing mortality for the age-19+ group for the same time period. Broken lines indicate the confidence intervals for the 2022 assessments.

Chapter 8. Greenland halibut in subareas 1 and 2 (Northeast Arctic)

Status of the fisheries

Landings prior to 2025 (Tables 8.1–8.8, Figures 8.1–8.3)

Nominal landings by country for subareas 1 and 2 combined are presented in Table 8.1. Tables 8.2 to 8.4 give the landings for subarea 1 and divisions 2.a and 2.b separately. Landings by gear type are presented in Table 8.5. Catch per unit effort is presented in Table 8.6 and total catch from 1935 to 2024 is presented in Table 8.7 and Figure 8.1.

The preliminary estimate of the total landings for 2024 is 22422 tonnes. This is 4814 tonnes less than the landings in 2023 and 6862 tonnes more than the JRN-AFWG advised maximum catch for 2024 (15560 tonnes). Compared to 2023, the catches from 3rd part countries remained stable, while catches from Norway and Russia were lower due to reduced quota. Commercial landings exceeded the quotas set by the Joint Norwegian-Russian Fisheries Commission for 2024 by 1172 tonnes (total TAC 21250 tonnes). Catches in the report include all landings in ICES 1 and 2 and thus include catches in UK waters in the southern part of ICES area 2.

Some fishing for Greenland halibut has taken place in the northern part of Division 4.a during the past 20–30 years, varying between a few tonnes and up to 2577 in 1999. Since 2000, total catch has ranged from 64 to 1330 tonnes, primarily taken by Norway, France, and the UK. Preliminary numbers show 966 tonnes in 2024 (Table 8.8, Figures 8.2 and 8.3). Although there is a continuous distribution of this species from the southern part of Division 2a along the continental slope towards the Shetland area, the stock structure is unclear in this area and these landings have therefore not been added to the total from subareas 1 and 2. Recent mark-recapture and genetic investigations indicate that the stock might have a more south and westward distribution than the current ICES definition of the stock boundaries (Albert and Vollen, 2015; Vihtakari et al. 2022; Lindegren et al. 2025; Westgaard et al., 2016).

JRN-AFWG advice applicable to 2025-2026

JRN-AFWG advised that when the precautionary approach is applied, catches in 2025 should be no more than 12431 tonnes. Catches in 2026 should be no more than 14891 tonnes. This corresponds to a harvest rate of 0.117 and 0.123, respectively. All catches are assumed to be landed.

Additional considerations

An ICES benchmark and data workshop process led to an agreed analytic assessment in 2023. The JRN-AFWG approved the use of this assessment method to generate advice in June the same year. The Greenland halibut is a long-lived species, and it is sufficient to give advice every other year. The next advice will be given in 2026, for catches in 2027 and 2028. The assessment is described in the benchmark report (ICES 2023).

Management

During the 38th session of the Joint Norwegian-Russian Fisheries Commission (JNRFC) in 2009, the ban on targeted Greenland halibut fishery was lifted, and a Total Allowable Catch (TAC) of 15,000 tonnes was established for the years 2010 and 2011. From then on, the TAC gradually increased, reaching 27,000 tonnes in 2021. After that, there has been a slight reduction in the TAC, driven by a reduction in the advice given.

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

In 2024, 90 tonnes were reported in the Jan Mayen area (within ICES Subarea 2), where Greenland halibut fisheries are not regulated by TAC.

Previously, Norway had a quota for Greenland halibut in the EU EEZ, which could be fished in ICES areas 2a and 6. This TAC was partially within and partially outside the stock boundary. This area is now within the UK EEZ, and there was no agreement for a quota to Norway in this area for 2021. However, Norway and the UK agreed on a 600-tonne quota for Norway in areas 2a, 4, 5b, and 6 in 2022, with only longline fisheries permitted in area 6. The TAC allocated to Norway in the UK part of area 2a was 700 tonnes in 2023 and 600 tonnes in 2024. There is no separate ICES advice for the fishery in this area.

EU has sat a TAC of 2571 t for 2024 in area 6; United Kingdom and Union waters of 4; United Kingdom waters of 2a and United Kingdom and international waters of 5b.

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

Expected landings in 2025

Catches in 2024 were 22422 tonnes, which exceeded the TAC set by JRNFC and the official advice. The total Greenland halibut landings in the Barents Sea and adjacent waters (ICES Subarea 1 and divisions 2a and 2b) in 2025 may thus be higher than the JRNFC TAC of 19000 tonnes. Discards are not regarded as a problem.

Status of research

Survey results (Tables 8.9–8.11, Figures 8.4–8.10)

The assessment uses data from the following surveys:

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

The Norwegian autumn slope survey (G1165) covers the northern part of the continental slope off Norway and thereby the main spawning area. Biomass and abundance indices show a downward trend since 2010 and are now at their lowest in the time-series (Figures 8.4–8.6). The length distributions from this survey (Figure 8.7, and Tables 8.10 and 8.11) show modes that can be followed through the years and indicate new recruitment to the adult stock in 2007. Since then, no such large recruit events are apparent in the length distributions, and since 2009 abundance of fish in adult lengths has been declining as well. This survey was conducted every year during 1994–2009 and biennially since then.

The Joint Ecosystem Survey in autumn (A5216) covers a large part of the Barents Sea down to 500 m and covers areas with mainly juvenile and immature fish. Three indices for Greenland halibut are based on the Joint Ecosystem Survey in the Barents Sea, one for fish between 10-17 cm, denoted Eco_SI_1, (Figure 8.8), one for fish between 17-27 cm, denoted Eco_SI_2 (Figure 8.8) and on for fish between 28 and 65 cm, denoted EcoS (Figure 8.9). The juvenile indices (Eco_SI_1 and Eco_Si_2), indicate a highly variable recruitment success, with good year classes occurring sporadically. The EcoS index for both females and males shows large fluctuations, with a slightly positive trend the last four years.

The joint winter survey in the Barents Sea (A6996) has been run from 1986 to the present (jointly with Russia since 2000, except 2006 and 2007). The survey mainly covers depths of 100–500 m and does not cover the deeper slope areas. Spatially, the survey focuses on the central Barents Sea, and west of Svalbard for some years. The northward coverage is limited by sea ice in some years. It is conducted in February and can thus give information on the stock at a different time of the year, as the other surveys are run in autumn. The biomass index has shown an increasing trend since 2004 with large variations in recent years. From the winter survey, only catch distributions are used in the assessment model (Figure 8.10).

Norwegian Southern Deepwater slope survey (G6149) is a trawl acoustic survey conducted in 2009, 2012 and biennially since then, along the continental slope in Norwegian EEZ from 62–74°N (subareas 1 and 2). Only catch distributions are used in the assessment (Figure 8.10).

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

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

Age readings

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

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

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

A second workshop on age reading of Greenland halibut (WKARGH2) was conducted in August 2016 and worked on further validation on new age reading methods. The workshop recommended that two of the new methods can be used to provide age estimations for stock assessments. Further, recognizing some bias and low precision in methods, the WKARGH2 suggested that an aging error matrix or growth curve with error be provided for use in future stock assessments (WKARGH2 report, ICES 2017).

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

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

Data used in the assessment

At the 2023 benchmark, all Norwegian input data were scrutinized and revised (Windsland et al. 2023, WD 2 ICES WKBNORTH). The Russian slope survey was revised by Russkikh et al. (WD 12 AFWG 2021), and implemented for the 2023 JRN-AFWG.

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

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

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

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

In addition, catch length distributions from the Norwegian Southern Deepwater slope survey and the Joint Winter Survey are used in the assessment.

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

No CPUE indices are used in the tuning.

Methods used in the assessment (Table 8.13)

A new assessment method with a revised length and age-based GADGET model was benchmarked in 2023 (ICES 2023).

At the JRN_AFWG meeting in 2023, the revision of the Russian Slope Survey was implemented in the assessment. This required recalculation of reference points that are given in table 8.13.

Advice for the stock is given biennially. Next advice will be given in 2026.

Model settings

Model used: Gadget3 (Lentin et al. 2022)

- Start year 1980.
- One year time-step.
- Single area model, with variable distributions handled through fleet selectivity (“fleets as areas” approach)
- Two sexes, split into mature and immature stock components
- Logistic maturity estimated for each sex
- 1 cm length classes and 1-year age classes
  - Lengths: females; immature 1-100 cm, mature 1-120 cm - males; immature 1-65 cm, mature 1-90 cm
  - Age: immature 1-25+, mature 3-25+
- Von Bertanlanffy growth estimated separately for males and females, with Linf for males fixed to 68 cm. Length at age one fixed.
- Natural mortality set to 0.12 for females and 0.16 for males
- Initial size of recruits fixed at 14 cm (model has proved unable to estimate this)
- Recruitment modeled as annual numbers, no relationship with SSB (estimated directly), assumed equal recruitment of male and female
- Initial population follows a simplifying assumption of constant recruitment, M and F, giving an exponential decay by age. A fixed maturity ogive is used to split immature and mature proportions. Standard deviations of lengths at age is externally fixed.
- Fisheries and surveys are modeled with fixed catch in tonnes per fleet, and sex-specific selectivity estimated using length distribution data and sex-at-length data.
- Five aggregated commercial fleets (as described above), each with sex-specific logistic selectivity
- Three surveys used for indices (EcoS, EggaN and RussianS), with logistic selectivity (but with a min:max length range to avoid bias in indices on fish suspected to be poorly selected)
- Only length distributions used from Winter and EggaS surveys

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

Results of the last assessment (Figure 8.11-8.14)

As this is not an advice year, the following results are from last year’s assessment. Model results, retrospective pattern, jitter, and short-term projections from the 2024 assessment are shown in Figures 8.11-8.15. Reference points and catch scenarios are shown in Table 8.12-8.14. The stock biomass is presented for the total 45+ cm (minimum legal landing size) population and the female spawning stock (Figure 8.11).

The biomass peaked around 2013–2014 and shows a clear downward trend since then. This trend is broadly in line with all three tuning series (Figures 8.4, 8.7 and 8.9). SSB went below B_{PA} in 2024. The harvest rate has been steadily increasing since 2009 and is now above HR_{PA} and HR_{MSY}. The retrospective analysis for model biomass has negative Mohn’s rho values (Figure 8.12).

The retrospective patterns by year show a clear structure with pairs of lines being similar and then a jump to the next pair. This is caused by the availability of survey data, with the Norwegian autumn slope survey run every other year and missing years in the Russian autumn survey. As a result of this pattern, it is recommended that the assessment be run every other year rather than annually. There is a retrospective trend to increase the stock estimate over time. Peaks in recruitment were most likely exaggerated in the assessment model used before the benchmark, while in the present model they are probably underestimated. Large uncertainties in the age reading probably smooth out the peaks, distributing the recruitment over multiple years. Even though the assessment most likely smooths out the recruitment, the modelled peaks show reasonably good agreement to the data from the juvenile survey indices. This stock is dominated by sporadic recruitment events, and the model does a reasonable job of capturing this.

Biological reference points

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

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

Exploratory assessments; surplus production models and TSVPA.

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

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

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

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

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

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

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

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

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

Comments to the last assessment

An overview of model exploration before, and at, the benchmark is given in the benchmark report (Vihtakari et al. WD 17, ICES 2023). At the JRN-AFWG in 2023 the assessment was updated by adding the revised Russian survey index. Between the end of the physical benchmark meeting and completion of the final model the following adjustments were made: Recalculation of data weighting, and flat top selectivity applied to all fleets. In addition, the Russian survey was revised as noted previously.

Within the fisheries in the Barents Sea and the associated continental slope, fish tend to move to the slope as they mature. This means that fisheries on the shelf tend to catch fewer of the large mature fish. The Barents Sea Greenland halibut Gadget model was designed to be a “fleets as areas model”, where fleet selectivity would take care of the issue of the larger fish moving out of the areas covered by some fleets and surveys. However, the dome shaped selectivity required for this was problematic. Dome-shaped selectivity increased the estimated biomass for mature females early on during the time-series but did not influence female SSB estimates toward the end of the time-series. This led to unrealistically pessimistic ratio between current stock status and recalculated Blim reducing the TAC estimate for 2025 to 7200 tonnes, which was deemed too low in the current situation by the experience and other model exploration using compiled survey indices. The model was therefore again run with logistic (flat-topped) selectivities, as in the 2023 assessment.

Prior to the 2024 assessment meeting it was experimented with changing the likelihood components weights as suggested in last year’s report. This did, however, not improve model stability any further.

The Greenland halibut population extends past the Joint Norwegian Russian Fisheries Commission (JNRFC) domain and surveys considered in the assessment do not cover the entire distribution (Albert & Vollen 2015, Westgaard et al. 2017, Vihtakari et al. 2022, Ubeda et al. 2023).

After the 2023 Benchmark, the procedures for data handling and calculations were improved, which led to minor changes in the length distributions compared to previous reports.

According to the jitter analysis, the model trends can be considered stable (Figure 8.13).

Future work

Efforts to improve stock assessment in the future should include:

- Gather age data over more years.
- Examine further Norwegian and joint Norwegian/Russian survey indices using VAST (mixed models) or similar statistical analysis.

- Develop a harvest control rule.
- Examine how to implement new evidence for south and westward extension of stock structure. Extensive work studying this extension as presented at the meeting.

Tables and figures

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

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Po
1984	0	0	0	2165	138	0	0	0	0	0	3540	0	
1985	0	0	0	4000	239	0	0	0	0	0	5287	0	
1986	0	0	42	2718	13	0	0	0	0	0	7783	0	
1987	0	0	0	2024	13	0	0	0	0	0	6893	0	
1988	0	0	186	744	67	0	0	0	0	0	8811	0	
1989	0	0	67	600	31	0	0	0	0	0	8837	0	
1990	0	0	163	954	49	0	0	0	0	0	16615	0	
1991	11	2564	314	101	119	0	0	0	0	0	27585	0	
1992	0	0	16	13	111	13	0	0	0	0	7668	0	
1993	2	0	61	22	80	8	56	0	0	30	10379	0	
1994	4	0	18	296	55	3	15	5	0	4	8428	0	
1995	0	0	12	35	174	12	25	2	0	0	9368	0	
1996	0	0	2	81	219	123	70	0	0	0	11623	0	
1997	0	0	27	56	253	0	62	2	0	0	7661	12	
1998	0	0	57	34	67	0	23	2	0	0	8435	31	
1999	0	0	94	34	0	38	7	2	0	0	15004	8	
2000	0	0	0	15	45	0	16	1	0	0	9083	3	
2001	0	0	0	58	122	0	18	1	0	0	10896	2	
2002	0	219	0	42	7	22	4	6	0	0	7143	5	
2003	0	0	459	18	2	14	0	1	0	0	8215	5	
2004	0	0	0	9	0	0	10	0	0	0	13939	1	
2005	0	170	0	8	32	0	0	0	0	0	13011	0	
2006	0	0	204	8	46	0	8	0	0	196	11118	201	
2007	0	0	203	8	40	198	15	0	0	0	8230	200	
2008	0	0	663	5	41	0	28	0	0	0	7393	201	
2009	0	0	422	19	16	16	15	2	0	0	8446	204	2
2010	0	0	272	14	102	15	16	0	0	0	7700	3	
2011	0	0	538	80	46	4	7	0	0	234	8348	169	
2012	0	0	563	40	40	12	13	0	0	0	9331	22	

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Por
2013	0	0	783	49	168	22	106	1	0	0	10404	30	
2014	0	0	887	33	269	24	86	0	0	0	10997	19	
2015	0	0	724	33	230	16	98	0	0	0	10874	13	
2016	2	353	1078	9	229	18	75	0	0	0	12932	26	
2017	0	523	993	21	177	26	10	0	3	72	13741	26	
2018	2	574	401	50	150	20	24	0	0	206	14875	27	
2019	0	588	350	44	105	23	10	0	0	348	14867	122	
2020	1	579	514	73	39	48	19	0	0	261	14526	97	
2021	1	382	749	88	137	14	0	0	0	125	14008	14	
2022	0	253	1052	94	86	50	0	0	0	136	13800	0	
2023*	2	99	1020	85	63	17	33	0	85	77	14198	0	1
2024*	0	172	1062	0	83	16	13	0	69	0	11292	0	

*** Preliminary figures.**

Table 8. 2 . Greenland halibut in subareas 1 and 2. Nominal catch (t) by countries in Subarea 1 as officially reported to ICES.

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Por
1984	0	0	0	0	0	0	0	0	0	0	398	0	
1985	0	0	0	0	0	0	0	0	0	0	524	0	
1986	0	0	0	1	0	0	0	0	0	0	538	0	
1987	0	0	0	2	0	0	0	0	0	0	771	0	
1988	0	0	9	4	0	0	0	0	0	0	901	0	
1989	0	0	0	0	0	0	0	0	0	0	2038	0	
1990	0	0	7	0	0	0	0	0	0	0	1304	0	
1991	0	164	0	0	0	0	0	0	0	0	2027	0	
1992	0	0	0	0	0	0	0	0	0	0	2349	0	
1993	0	0	32	0	0	0	56	0	0	0	1754	0	
1994	0	0	17	217	0	0	15	0	0	0	1165	0	
1995	0	0	12	0	0	0	25	0	0	0	1352	0	
1996	0	0	2	0	0	0	70	0	0	0	911	0	
1997	0	0	15	0	0	0	62	0	0	0	610	0	
1998	0	0	47	0	0	0	23	0	0	0	859	0	
1999	0	0	91	0	0	13	7	0	0	0	1101	0	
2000	0	0	0	0	0	0	16	0	0	0	1021	0	
2001	0	0	0	0	0	0	9	0	0	0	858	0	
2002	0	0	0	3	0	0	0	0	0	0	834	0	

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Po
2003	0	0	48	0	0	2	0	1	0	0	962	1	
2004	0	0	0	0	0	0	1	0	0	0	866	0	
2005	0	0	0	0	1	0	0	0	0	0	572	0	
2006	0	0	17	1	0	0	1	0	0	0	575	0	
2007	0	0	18	0	1	198	3	0	0	0	514	0	
2008	0	0	13	0	1	0	5	0	0	0	599	0	
2009	0	0	33	0	0	16	5	0	0	0	734	0	
2010	0	0	15	0	0	0	16	0	0	0	659	0	
2011	0	0	63	0	0	0	6	0	0	0	862	0	
2012	0	0	8	5	0	0	7	0	0	0	921	0	
2013	0	0	39	1	8	0	100	0	0	0	1055	4	
2014	0	0	143	8	11	19	38	0	0	0	1036	7	
2015	0	0	108	14	5	14	47	0	0	0	1091	5	
2016	0	353	88	2	3	3	38	0	0	0	1265	12	
2017	0	519	133	4	4	2	8	0	3	72	1389	9	
2018	0	574	104	9	16	2	20	0	0	199	1008	4	
2019	0	588	116	27	9	6	6	0	0	348	939	119	
2020	0	579	123	37	3	15	18	0	0	258	1389	96	
2021	0	382	200	17	1	10	0	0	0	125	1617	9	
2022	0	253	117	21	24	6	0	0	0	136	1151	0	
2023*	0	99	178	7	12	6	0	0	85	75	978	0	
2024*	0	172	73	0	7	13	0	0	63	0	632	0	

*** Preliminary figures.**

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

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Po
1984	0	0	0	265	138	0	0	0	0	0	3062	0	
1985	0	0	0	254	239	0	0	0	0	0	4691	0	
1986	0	0	6	97	13	0	0	0	0	0	6302	0	
1987	0	0	0	75	13	0	0	0	0	0	5550	0	
1988	0	0	177	150	67	0	0	0	0	0	7671	0	
1989	0	0	67	104	31	0	0	0	0	0	6265	0	
1990	0	0	133	12	49	0	0	0	0	0	7605	0	
1991	0	1400	314	21	119	0	0	0	0	0	11189	0	
1992	0	0	16	1	108	13	0	0	0	0	3586	0	

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Po
1993	0	0	29	14	78	8	0	0	0	0	7977	0	
1994	0	0	0	33	47	3	0	4	0	0	6382	0	
1995	0	0	0	30	174	12	0	2	0	0	6354	0	
1996	0	0	0	34	219	123	0	0	0	0	9508	0	
1997	0	0	0	23	253	0	0	0	0	0	5702	0	
1998	0	0	0	16	67	0	0	1	0	0	6661	0	
1999	0	0	0	20	0	25	0	2	0	0	13064	0	
2000	0	0	0	10	43	0	0	0	0	0	7536	0	
2001	0	0	0	49	122	0	9	1	0	0	8935	0	
2002	0	0	0	9	7	22	4	0	0	0	5877	0	
2003	0	0	390	5	2	12	0	0	0	0	6713	0	
2004	0	0	0	4	0	0	9	0	0	0	11704	0	
2005	0	0	0	3	31	0	0	0	0	0	11216	0	
2006	0	0	175	0	38	0	7	0	0	0	8897	0	
2007	0	0	162	2	37	0	12	0	0	0	6761	0	
2008	0	0	646	4	38	0	23	0	0	0	5566	1	
2009	0	0	379	0	13	0	10	0	0	0	6456	0	
2010	0	0	255	0	102	15	0	0	0	0	6426	0	
2011	0	0	467	0	45	4	1	0	0	0	7080	0	
2012	0	0	553	0	37	12	6	0	0	0	7934	0	
2013	0	0	739	0	150	22	6	0	0	0	8213	0	
2014	0	0	741	0	255	1	48	0	0	0	8640	0	
2015	0	0	614	2	221	2	51	0	0	0	8742	0	
2016	0	0	986	6	216	14	37	0	0	0	10073	6	
2017	0	0	841	0	161	21	2	0	0	0	10126	0	
2018	0	0	296	1	104	9	4	0	0	1	11255	2	
2019	0	0	232	15	95	16	4	0	0	0	12143	3	
2020	0	0	385	21	34	28	1	0	0	0	11430	0	
2021	0	0	530	20	123	4	0	0	0	0	9647	0	
2022	0	0	888	10	27	4	0	0	0	0	9814	0	
2023*	0	0	771	21	14	6	33	0	0	0	11421	0	
2024*	0	0	969	0	35	2	13	0	0	0	8886	0	

*** Preliminary figures.**

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

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Por
1984	0	0	0	1900	0	0	0	0	0	0	80	0	
1985	0	0	0	3746	0	0	0	0	0	0	71	0	
1986	0	0	36	2620	0	0	0	0	0	0	944	0	
1987	0	0	0	1947	0	0	0	0	0	0	572	0	
1988	0	0	0	590	0	0	0	0	0	0	239	0	
1989	0	0	0	496	0	0	0	0	0	0	533	0	
1990	0	0	23	942	0	0	0	0	0	0	7706	0	
1991	11	1000	0	80	0	0	0	0	0	0	14369	0	
1992	0	0	0	12	3	0	0	0	0	0	1732	0	
1993	2	0	0	8	2	0	0	0	0	30	649	0	
1994	4	0	1	46	8	0	0	1	0	4	881	0	
1995	0	0	0	5	0	0	0	0	0	0	1662	0	
1996	0	0	0	47	0	0	0	0	0	0	1204	0	
1997	0	0	12	33	0	0	0	2	0	0	1349	12	
1998	0	0	10	18	0	0	0	1	0	0	915	31	
1999	0	0	3	14	0	0	0	0	0	0	839	8	
2000	0	0	0	5	2	0	0	1	0	0	526	3	
2001	0	0	0	9	0	0	0	0	0	0	1103	2	
2002	0	219	0	30	0	0	0	6	0	0	432	5	
2003	0	0	21	13	0	0	0	0	0	0	541	4	
2004	0	0	0	5	0	0	0	0	0	0	1369	1	
2005	0	170	0	5	0	0	0	0	0	0	1223	0	
2006	0	0	12	7	8	0	0	0	0	196	1647	201	
2007	0	0	23	6	2	0	0	0	0	0	955	200	
2008	0	0	4	1	2	0	0	0	0	0	1229	200	
2009	0	0	10	19	3	0	0	2	0	0	1256	204	[illegible]
2010	0	0	2	14	0	0	0	0	0	0	615	3	
2011	0	0	8	80	1	0	0	0	0	234	406	169	
2012	0	0	2	35	3	0	0	0	0	0	476	22	
2013	0	0	5	48	10	0	0	1	0	0	1136	26	
2014	0	0	3	25	3	4	0	0	0	0	1321	12	
2015	0	0	2	17	4	0	0	0	0	0	1042	8	
2016	2	0	4	1	10	1	0	0	0	0	1594	8	
2017	0	4	19	17	12	3	0	0	0	0	2226	17	
2018	2	0	1	40	30	9	0	0	0	6	2611	21	

Year	Denmark	Estonia	Faroe Islands	Germany	France	Greenland	Iceland	Ireland	Latvia	Lithuania	Norway	Poland	Po
2019	0	0	2	2	1	1	0	0	0	0	1784	0	
2020	1	0	6	15	2	5	0	0	0	3	1707	1	
2021	1	0	19	51	13	0	0	0	0	0	2744	5	
2022	0	0	47	63	35	40	0	0	0	0	2835	0	
2023*	2	0	71	57	37	5	0	0	0	2	1800	0	
2024*	0	0	20	0	41	1	0	0	6	0	1774	0	

*** Preliminary figures.**

Table 8.5 . Greenland halibut in subareas 1 and 2. Landings by gear (t).

Year	Gillnet	Longline	Trawl	Danish seine	Other
1984	1198	3760	16072	9	7
1985	1668	2484	15532	2	83
1986	1637	2626	18501	4	0
1987	2021	2198	14456	7	61
1988	2691	2381	14226	21	3
1989	1282	1738	15304	NA	29
1990	1264	2322	18539	0	430
1991	1904	4652	26698	53	10
1992	1598	1913	5030	33	28
1993	1497	3047	7359	29	NA
1994	1548	2319	5330	29	0
1995	1588	4167	5902	68	8
1996	1495	4582	8123	87	60
1997	998	3388	4984	15	25
1998	1327	3834	6660	25	46
1999	2570	6842	9970	75	61
2000	1765	4972	7431	62	67
2001	2111	6239	7832	124	67
2002	1737	5273	6120	117	46
2003	2049	5330	5791	242	34
2004	2384	7126	8766	614	9
2005	1842	7512	9014	441	24
2006	1503	6137	10023	205	10
2007	998	4500	9836	120	4
2008	901	3574	9318	9	8
2009	1409	4954	6567	34	17

Year	Gillnet	Longline	Trawl	Danish seine	Other
2010	1449	5440	8166	170	10
2011	1583	5040	9807	239	15
2012	1929	5601	12337	413	5
2013	2397	5808	13600	176	0
2014	2647	6146	13628	183	8
2015	2508	6287	15778	489	18
2016	2646	7288	14771	650	30
2017	2677	7223	15832	681	27
2018	3021	7302	17423	842	11
2019	3343	7029	17335	1118	0
2020	2976	6984	17542	1055	17
2021	2930	7382	16985	884	33
2022	2996	6426	17067	990	16
2023*	3397	6244	16288	1293	15
2024*	2750	4754	13748	1154	16

*** Preliminary figures.**

Table 8. 6 . Greenland halibut in subareas 1 and 2. Catch per unit effort and total effort.

Year	USSR catch/hour trawling (t)		Norway[10] catch/hour trawling (t)		Average CPUE		Total effort (in 1000 hrs trawling)[5]	CPUE 7+[6]	GDR[7] (catch/day tonnage (kg))
	RT[1]	PST[2]	A[8]	B[9]	A[3]	B[4]			
1965	0.80	-	-	-	0.80	-	-	-	-
1966	0.77	-	-	-	0.77	-	-	-	-
1967	0.70	-	-	-	0.70	-	-	-	-
1968	0.65	-	-	-	0.65	-	-	-	-
1969	0.53	-	-	-	0.53	-	-	-	-
1970	0.53	-	-	-	0.53	-	169	0.50	-
1971	0.46	-	-	-	0.46	-	172	0.43	-
1972	0.37	-	-	-	0.37	-	116	0.33	-
1973	0.37	-	0.34	-	0.36	-	83	0.36	-
1974	0.40	-	0.36	-	0.38	-	100	0.36	-
1975	0.39	0.51	0.38	-	0.39	0.45	99	0.37	-
1976	0.40	0.56	0.33	-	0.37	0.45	100	0.34	-
1977	0.27	0.41	0.33	-	0.30	0.37	96	0.26	-
1978	0.21	0.32	0.21	-	0.21	0.27	123	0.17	-
1979	0.23	0.35	0.28	-	0.26	0.32	67	0.19	-
1980	0.24	0.33	0.32	-	0.28	0.33	47	0.25	-

Year	USSR catch/hour trawling (t)				Norway catch/hour trawling (t)		Average CPUE		Total effort (in 1000 hrs trawling)	CPUE 7+	GDR (catch/day tonnage (kg))
	RT		PST		A	B	A	B			
1981	0.30		0.36		0.36	-	0.33	0.36	42	0.28	-
1982	0.26		0.45		0.41	-	0.34	0.43	39	0.37	-
1983	0.26		0.40		0.35	-	0.31	0.38	58	0.32	-
1984	0.27		0.41		0.32	-	0.30	0.37	59	0.30	-
1985	0.28		0.52		0.37	-	0.33	0.45	44	0.37	-
1986	0.23		0.42		0.37	-	0.30	0.40	57	0.32	-
1987	0.25		0.50		0.35	-	0.30	0.43	44	0.35	-
1988	0.20		0.30		0.31	-	0.26	0.31	63	0.26	4.26
1989	0.20		0.30		0.26	-	0.23	0.28	73	0.19	2.95
1990	-		0.20		0.27	-	-	0.24	95	0.16	1.66
1991	-		-		0.24	-	-	-	134	0.18	-
1992	-		-		0.46	0.72	-	-	20	0.29	-
1993	-		-		0.79	1.22	-	-	15	0.65	-
1994	-		-		0.77	1.27	-	-	11	0.70	-
1995	-		-		1.03	1.48	-	-	-	-	-
1996	-		-		1.45	1.82	-	-	-	-	-
1997	0.71		-		1.23	1.60	-	-	-	-	-
1998	0.71		-		0.98	1.35	-	-	-	-	-
1999	0.84		-		0.82	1.77	-	-	-	-	-
2000	0.94		-		1.38	1.92	-	-	-	-	-
2001	0.82	[11]	-		1.18	1.57	-	-	-	-	-
2002	0.85		-		1.07	1.82	-	-	-	-	-
2003	0.97	[12]	-		0.86	2.45	-	-	-	-	-
2004	0.63	[13]	-		1.16	1.79	-	-	-	-	-
2005	0.61	[12]	-		1.30	2.29	-	-	-	-	-
2006	0.57	[12]	-		0.96	2.09	-	-	-	-	-
2007	0.64	[12]	-		-	-	-	-	-	-	-
2008	0.48	[12]	-		-	-	-	-	-	-	-
2009	0.77	[13]	-		-	-	-	-	-	-	-
2010			1.57	[12]	-	-	-	-	-	-	-
2011			2.32	[12]							
2012			2.06	[12]							
2013			2.25	[12]							
2014			2.52	[12]							

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

[2] Stern trawlers, up to 2000 HP.

[3] Arithmetic average of CPUE from USSR RT (or SRTM trawlers) and Norwegian trawlers.

[4] Arithmetic average of CPUE from USSR PST and Norwegian trawlers.

[5] For the years 1981–1990, based on average CPUE type B. For 1991–1993, based on the Norwegian CPUE, type A.

[6] Total catch (t) of seven years and older fish divided by total effort.

[7] For the years 1988–1989, frost-trawlers 995 BRT (FAO Code 095). For 1990, factory trawlers S IV, 1943 BRT (FAO Code 090).

[8] Norwegian trawlers, ISSC-code 07, 250–499.9 GRT.

[9] Norwegian factory trawlers, ISSCFV-code 09, 1000-1999.9 GRT

[10] From 1992 based on research fishing. 1992–1993: two weeks in May/June and October; 1994–1995: 10 days in May/June

[11] Based on fishery from April-October only, a period with relatively low CPUE. In previous years fishery was carried out throughout the whole year.

[12] Based on fishery from October-December only, a period with relatively high CPUE.

[13] Based on fishery from October-November only.

Table 8.7 . Greenland halibut in subareas 1 and 2. Catch history back to 1935.

Year	Norway	Russia	Other	Total	Year	Norway	Russia	Other	Total
1935	1534			1534	1980	2528	7670	2457	12655
1936	830			830	1981	3648	9276	1541	14465
1937	616			616	1982	2997	12394	1189	16580
1938	329			329	1983	4509	15152	2112	21773
1939	459			459	1984	3540	15181	2326	21047
1940	846			846	1985	5287	10237	4244	19768
1941	1663			1663	1986	7783	12200	2785	22768
1942	955			955	1987	6893	9733	2118	18744
1943	824			824	1988	8811	9430	1081	19322
1944	678			678	1989	8837	8812	704	18353
1945	1148			1148	1990	16615	4764	1176	22555
1946	1337	25		1362	1991	27585	2490	3243	33318
1947	1409	28		1437	1992	7668	718	217	8603
1948	1877	110		1987	1993	10379	1235	318	11932

Year	Norway	Russia	Other	Total	Year	Norway	Russia	Other	Total
1949	198	177		375	1994	8428	283	515	9226
1950	1853	221		2074	1995	9368	794	1572	11734
1951	2438	423		2861	1996	11623	1576	1148	14347
1952	2576	377		2953	1997	7661	1038	711	9410
1953	2208	393		2601	1998	8435	2659	799	11893
1954	3674	416		4090	1999	15004	3823	690	19517
1955	3010	290		3300	2000	9083	4568	646	14297
1956	3493	446		3939	2001	10896	4694	784	16374
1957	4130	505		4635	2002	7143	5584	566	13293
1958	2931	1261		4192	2003	8215	4384	847	13446
1959	4307	3632		7939	2004	13939	4662	299	18900
1960	6662	4299		10961	2005	13011	4883	940	18834
1961	7977	3836		11813	2006	11118	6055	703	17876
1962	11600	1760		13360	2007	8230	6484	744	15458
1963	11300	3240		14540	2008	7393	5294	1122	13809
1964	14200	26191		40391	2009	8446	3335	1201	12982
1965	18000	16682		34682	2010	7700	6888	647	15235
1966	16434	9768	119	26321	2011	8348	7053	1283	16684
1967	17528	5737	1002	24267	2012	9331	10041	912	20284
1968	22514	3397	257	26168	2013	10404	10306	1270	21980
1969	14856	19760	9173	43789	2014	10997	10061	1553	22611
1970	15871	35578	38035	89484	2015	10874	12953	1254	25081
1971	9466	54339	15229	79034	2016	12932	10561	1892	25385
1972	15983	16193	10872	43048	2017	13741	10713	1983	26437
1973	13989	8561	7349	29899	2018	14875	12071	1654	28600
1974	8791	16958	11972	37721	2019	14867	12196	1760	28823
1975	4858	20372	12914	38144	2020	14526	12265	1781	28572
1976	6005	16580	13469	36054	2021	14008	12396	1812	28216
1977	3017	15045	9613	27675	2022	13800	11746	1948	27494
1978	2980	14651	5884	23515	2023*	14198	11317	1721	27236
1979	2314	10311	4088	16713	2024*	11292	9581	1549	22422

*** Provisional figures.**

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

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	United Kingdom	Netherlands	Belgium	Icelan
1973	0	0	0	4	0	0	9	8	28	0	0	0
1974	0	0	0	2	0	0	2	0	30	0	0	0
1975	0	0	0	1	0	0	4	0	12	0	0	0
1976	0	0	0	1	0	0	2	0	18	0	0	0
1977	0	0	0	2	0	0	2	0	8	0	0	0
1978	0	0	2	30	0	0	0	0	1	0	0	0
1979	0	0	2	16	0	0	2	0	1	0	0	0
1980	0	177	0	34	0	0	5	0	0	0	0	0
1981	0	0	0	0	0	0	7	0	0	0	0	0
1982	0	0	2	26	0	0	17	0	0	0	0	0
1983	0	0	1	64	0	0	89	0	0	0	0	0
1984	0	0	3	50	0	0	32	0	0	0	0	0
1985	0	1	2	49	0	0	12	0	0	0	0	0
1986	0	0	30	2	0	0	34	0	0	0	0	0
1987	0	28	16	1	0	0	35	0	0	0	0	0
1988	0	71	62	3	0	0	19	0	1	0	0	0
1989	0	21	14	1	0	0	197	0	5	0	0	0
1990	0	10	30	3	0	0	29	0	4	0	0	0
1991	0	48	291	1	0	0	216	0	2	0	0	0
1992	1	15	416	3	0	0	626	0	1	0	0	0
1993	1	0	78	1	0	0	858	0	10	0	0	0
1994	0	103	84	4	0	0	724	0	6	0	0	0
1995	0	706	165	2	0	0	460	0	335	0	0	0
1996	0	0	249	1	0	0	1496	0	264	0	0	0
1997	0	0	316	3	0	0	873	0	163	0	0	0
1998	0	0	71	10	0	10	804	0	470	0	0	0
1999	0	0	0	1	0	18	2157	0	401	0	0	0
2000	0	0	41	10	0	19	498	0	259	0	0	0
2001	0	0	43	0	0	10	470	0	324	0	0	0
2002	0	0	8	0	0	2	200	0	256	0	0	0
2003	0	0	1	0	0	0	453	0	122	0	0	0
2004	0	0	0	0	0	0	413	0	90	0	0	0
2005	0	0	2	0	0	0	58	0	4	0	0	0
2006	0	0	3	0	0	0	90	0	7	0	0	0
2007	0	1	0	0	0	0	133	0	7	0	0	0

Year	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Norway	Russia	United Kingdom	Netherlands	Belgium	Iceland
2008	0	0	0	0	0	0	15	0	22	0	0	0
2009	0	9	23	0	0	0	5	0	129	0	0	0
2010	0	1	38	0	0	0	10	0	49	0	0	1
2011	0	1	39	0	0	0	95	0	44	0	0	0
2012	0	0	14	0	0	0	788	0	43	0	0	0
2013	0	0	25	0	0	0	377	0	174	0	0	0
2014	0	2	27	0	0	0	723	0	104	0	0	0
2015	0	0	34	1	0	0	1151	0	127	0	0	0
2016	0	0	31	0	0	0	983	0	120	0	0	0
2017	0	0	20	0	0	0	753	0	73	0	0	0
2018	0	1	15	0	0	0	472	0	42	2	0	0
2019	0	0	21	0	0	0	241	0	14	4	0	0
2020	0	0	10	0	0	0	663	0	45	4	0	0
2021	0	4	19	0	0	0	0	0	121	0	0	0
2022	0	207	9	0	0	0	522	0	150	0	0	0
2023	0	58	7	0	0	0	473	0	168	0	0	0
2024	0	44	6	0	125	0	739	0	52	0	0	0

*** Preliminary figures.**

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

Year	(0,30]	(30,35]	(35,40]	(40,45]	(45,50]	(50,55]	(55,60]	(60,65]	(65,70]	(70,75]	(75,80]	80+	Total
1984	1138	2975	5319	9159	7185	5597	2256	1731	1539	1033	536	246	38713
1985	5606	2581	5506	7348	6676	3978	2038	1279	1154	834	414	173	37587
1986	2273	3488	6409	8074	7712	6427	2596	1263	1335	918	398	142	41034
1987	1666	2857	4025	4357	3065	1670	696	505	357	162	105	31	19496
1988	1194	1975	2647	2007	1599	1179	270	282	181	69	118	77	11599
1989	419	2180	5852	6088	3742	1990	804	490	448	233	43	30	22318
1990	254	1601	4303	3911	3608	2729	915	309	204	191	41	40	18106
1991	306	1026	3632	5059	3590	2257	639	544	153	128	56	27	17417
1992	36	879	9184	16058	12586	10043	4542	2209	1322	380	173	53	57464
1993	0	72	1456	6016	9200	5377	1954	1324	991	574	145	122	27231
1994	107	87	725	5931	6872	5827	2262	927	602	314	40	41	23736
1995	0	14	1024	10123	12263	5162	1722	1063	640	371	101	32	32516
1996	0	21	1451	17480	30966	17523	5763	1852	1029	576	151	32	76844
1997	70	121	1056	7606	16561	10309	3292	1116	943	436	107	36	41653
1998	26	166	1559	7456	19972	15019	5668	1851	869	285	105	43	53018

Year	(0,30]	(30,35]	(35,40]	(40,45]	(45,50]	(50,55]	(55,60]	(60,65]	(65,70]	(70,75]	(75,80]	80+	Total
1999	236	131	766	5583	16452	15352	6263	2966	1435	446	194	78	49902
2000	755	708	2266	8003	17910	17443	8610	3513	2125	791	221	101	62448
2001	427	1335	4399	11113	23242	20938	9356	4117	2607	1201	518	299	79553
2002	310	1407	3845	7322	9536	5214	2657	1262	678	174	64	25	32494
2003	122	1162	3339	6484	9135	5230	3218	2948	2557	722	301	187	35403
2004	266	1529	6759	9240	13358	11174	7596	5329	3867	1819	674	506	62117
2005	136	1680	4136	8258	8866	8399	4791	3777	2361	852	293	464	44013
2006	73	1565	14827	25958	25724	18234	9501	4934	3461	1506	565	504	106850
2007	678	2394	12640	14752	15438	12187	7122	3749	2186	799	273	152	72369
2008	338	2444	10242	17093	21842	24209	18308	8870	7414	3776	1657	850	117044
2009	80	3270	22312	31713	28283	24096	16933	5995	3994	2158	706	590	140130
2010	144	3998	30662	51444	39762	32576	16815	7180	6761	3539	1334	1259	195474
2011	200	1001	18079	42924	55212	46426	38215	15612	8480	6278	3031	864	236322
2012	10	524	8728	39585	41830	33768	23212	9040	5025	3093	1598	835	167248
2013	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	16	1319	8446	30085	37787	26980	16527	5917	3299	1657	571	360	132964
2015	39	1119	9310	29876	34420	24963	12575	6904	2702	820	506	183	123416
2016	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	7	1270	5064	14951	24982	29977	17329	7054	3473	1502	343	387	106339
2018	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	144	2186	13500	27130	28572	22536	13943	5825	3080	1654	707	466	119742

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

Year	(0,30]	(30,35]	(35,40]	(40,45]	(45,50]	(50,55]	(55,60]	(60,65]	(65,70]	(70,75]	(75,80]	(80,200]	Sum
1996	2	29	1009	10692	20030	11244	3760	1536	1014	411	133	58	49918
1997	1	80	1421	10690	19311	10802	3807	1837	1052	484	184	95	49764
1998	3	74	957	5763	14474	12658	5265	2243	1309	523	192	115	43577
1999	3	57	550	4629	13893	15236	6684	3356	2305	922	393	176	48203
2000	8	169	1121	4495	9538	11646	5816	2590	1347	590	220	111	37650
2001	22	355	1955	5980	11835	12829	6680	3084	1863	694	317	131	45746
2002	43	449	1897	5234	9620	11161	6319	2987	1571	636	239	126	40281
2003	23	748	3515	6958	10931	13029	8279	4769	2547	928	469	222	52419
2004	22	1014	3674	5504	8941	11044	6255	4019	2176	968	402	232	44251
2005	110	2128	5859	8307	8145	6792	4108	2866	1724	670	294	199	41202
2006	35	1214	5140	7416	8448	8047	5092	3315	2022	809	370	253	42162
2007	144	4034	18450	16416	10410	6954	4086	2026	1125	414	163	110	64331

2008	458	6041	12820	11714	7884	5978	3023	1743	1110	440	149	176	51538
2009	54	2645	13536	16751	11332	8344	4747	2413	1823	711	284	211	62851
2011	0	377	5536	14368	13765	10668	5352	1793	1612	881	440	330	55123
2013	4	134	2420	11053	12859	7408	3880	1389	688	357	213	115	40520
2015	9	774	3982	13688	15619	9195	4165	1859	867	440	194	151	50943
2017	18	342	2259	6006	9796	8924	5035	1841	832	259	132	125	35570
2019	0	677	4192	8117	9053	5738	3064	1215	570	222	73	84	33005
2021	86	1644	4635	10264	12302	9064	4643	2445	917	275	112	32	46418
2023	362	2698	3624	5179	6120	5472	2881	1388	557	183	44	63	28571

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

Year	(0,30]	(30,35]	(35,40]	(40,45]	(45,50]	(50,55]	(55,60]	(60,65]	(65,70]	(70,75]	(75,80]	(80,200]	Sum
1996	0	11	334	2127	4277	2893	1893	1347	942	404	133	58	14420
1997	0	42	657	2052	3711	2902	1897	1643	1008	484	182	95	14671
1998	2	26	353	1037	2785	3986	2864	2050	1281	521	192	115	15210
1999	1	11	207	880	2367	4214	3510	2996	2235	906	385	176	17889
2000	5	64	435	1083	1377	2012	2428	2109	1292	589	220	111	11725
2001	11	159	758	1407	1648	1905	2556	2595	1838	694	317	131	14020
2002	29	207	733	1243	1297	1749	2297	2352	1528	632	239	126	12434
2003	18	345	1649	2009	1670	2340	3434	4121	2493	925	469	222	19695
2004	9	445	1534	1550	1436	2113	3029	3675	2145	950	401	232	17517
2005	35	737	1910	1925	1254	1341	2093	2576	1703	668	294	199	14735
2006	19	542	2096	2163	1789	1587	2158	2890	1971	801	369	249	16634
2007	85	2111	8639	6230	2667	1620	1897	1735	1106	405	163	107	26766
2008	249	3159	5536	3703	2137	1456	1463	1577	1095	440	149	175	21137
2009	28	1052	5223	5459	3072	2176	2155	2038	1736	700	268	200	24107
2011	0	149	1623	2757	2367	1578	1063	1354	1553	875	440	330	14088
2013	0	35	492	1632	2023	1421	1004	1035	679	354	213	115	9003
2015	5	308	1385	1954	2623	2502	1694	1374	854	440	194	151	13484
2017	15	169	864	1435	1863	1725	1908	1270	820	259	132	125	10587
2019	0	321	1714	2004	1867	1530	1379	952	531	222	73	84	10678
2021	40	851	1775	1793	2203	1798	2152	2066	880	275	112	32	13976
2023	164	1284	1578	1298	1390	1338	1318	1187	546	183	44	63	10392

Table 8. 12 . Reference points, values, and their technical basis for NEA G. halibut.

Framework	Reference point	Value	Technical basis
MSY approach	MSY	19142 t	Maximum sustainable yield
	HR_{MSY}	0.139	HR (>=45cm) leading to MSY

Precautionary approach	B_{lim}	33391 t	Lowest modelled mature female substock biomass
	B_{pa}	46747 t	B_{lim} x 1.4
	$B_{trigger}$	46747 t	B_{pa}
	HR_{lim}	0.165	HR (>=45cm) leading to P(SSB<B_{lim})=0.5
	HR_{pa}	0.145	HR(>=45cm), when ICES AR is applied, leading to P(SSB > Blim) = 0.05

Table 8.13 . Greenland halibut in ICES subareas 1 and 2 (Northeast Arctic). Annual catch scenarios for 2025. All weights are in tonnes. The advice basis using HRMSY and three other scenarios are listed in the first column. Columns thereafter: total allowable catch

Basis	Total catch (2025)	HR (2025)	SSB (2026)	% Biomass change *	% TAC change **	% Advice change ***
ICES advice basis						
MSY approach: HR_{MSY} x SSB_{2025}/B_{pa}	12 431	0.117	41 231	4.5	-42	-20
Other scenarios						
HR_{MSY}	14 726	0.139	40 214	1.9	-31	-5.4
HR=0	0	0	46 739	18	-100	-100
Assumed catch in 2024	23 050	0.217	35 756	-9.4	8.5	48

* SSB start of 2026 relative to end of 2024.

** Advice value for 2025 relative to the TAC value in 2024 (21 250 tonnes).

*** Advice value for 202 5 relative to the advice value for 202 4 (15560 tonnes) .

Table 8.14 . Greenland halibut in ICES subareas 1 and 2 (Northeast Arctic). Annual catch scenarios for 2026. All weights are in tonnes. The advice basis using HRMSY and three other scenarios are listed in the first column. Columns thereafter: total allowable catch

Basis	Total catch (2026)	HR (2026)	SSB (2027)	% Biomass change *	% TAC change **	% Advice change ***
ICES advice basis						
MSY approach: HR_{MSY} x SSB_{2026}/B_{pa}	14 891	0.123	43 042	9.1	-30	-4.3
Other scenarios						
HR_{MSY}	16 538	0.139	41 278	4.6	-22	6.3
HR=0	0	0	55 330	40	-100	-100
Assumed catch in 2024	23 050	0.209	33 330	-16	8.5	48

* SSB start of 2027 relative to end of 2024, i.e the cumulative change over the 2-year advice period.

** Advice value for 2026 relative to the TAC value in 2024 (21 250 tonnes).

*** Advice value for 202 6 relative to the advice value for 202 4 (15 560 tonnes) .

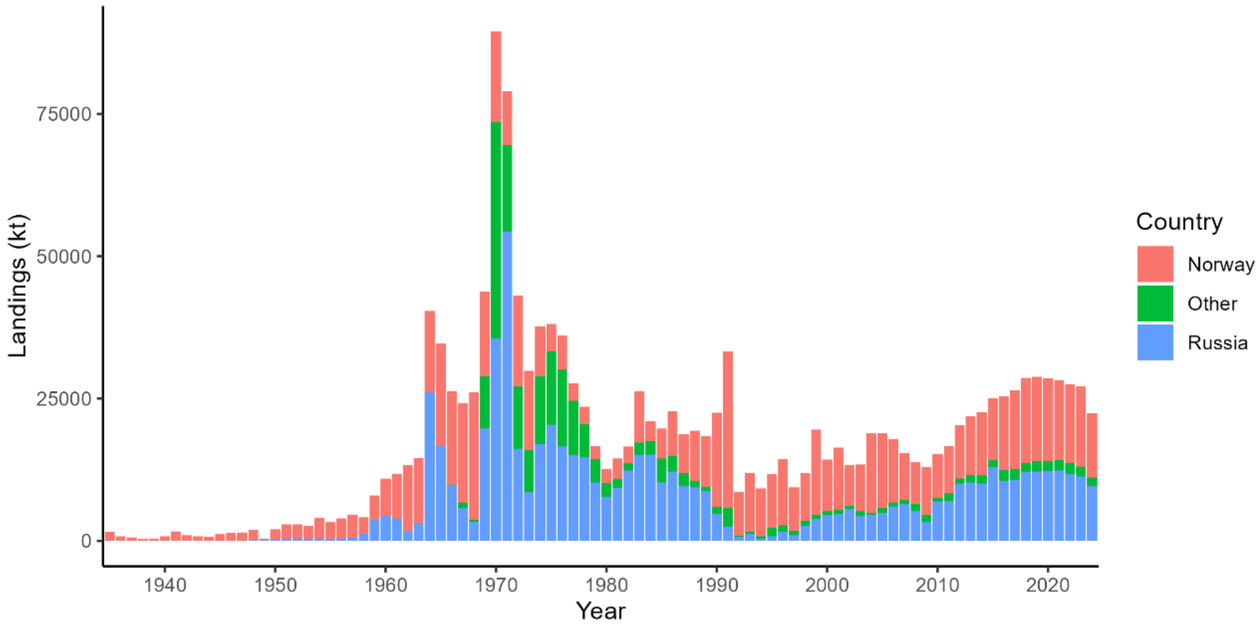


Figure 8.1. NEA Greenland halibut landings. Historical landings (Nedreaas and Smirnov 2003 and AFWG).

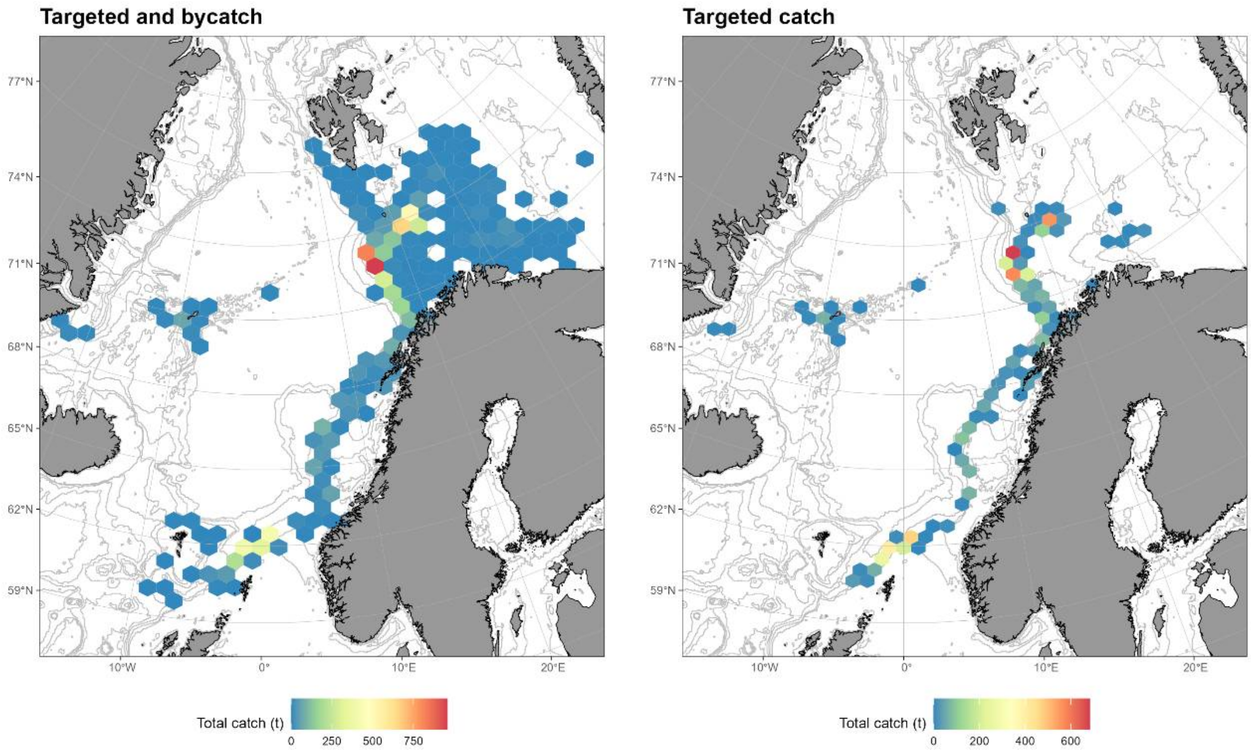


Figure 8.2. Spatial distribution of Greenland halibut catches in 2024 according to Norwegian electronic logbooks, in all registered fisheries including bycatch (A), and catches where Greenland halibut make more than 50% of the total catches (B).

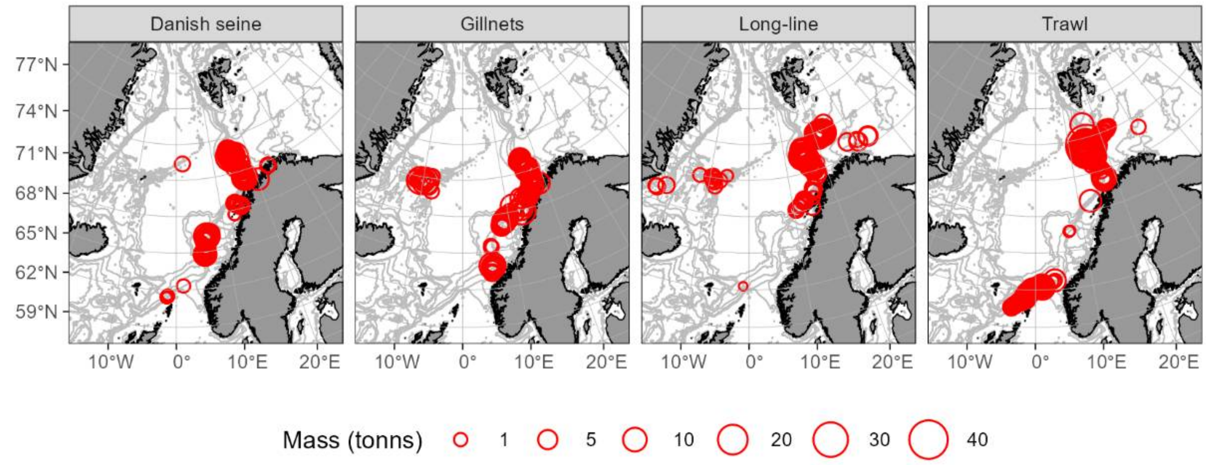


Figure 8.3. Spatial distribution of catches where Greenland halibut make more than 50% of the total catches, according to Norwegian electronic logbooks from 2024. Bubble area is proportional to the size of single catches expressed in metric tonnes.

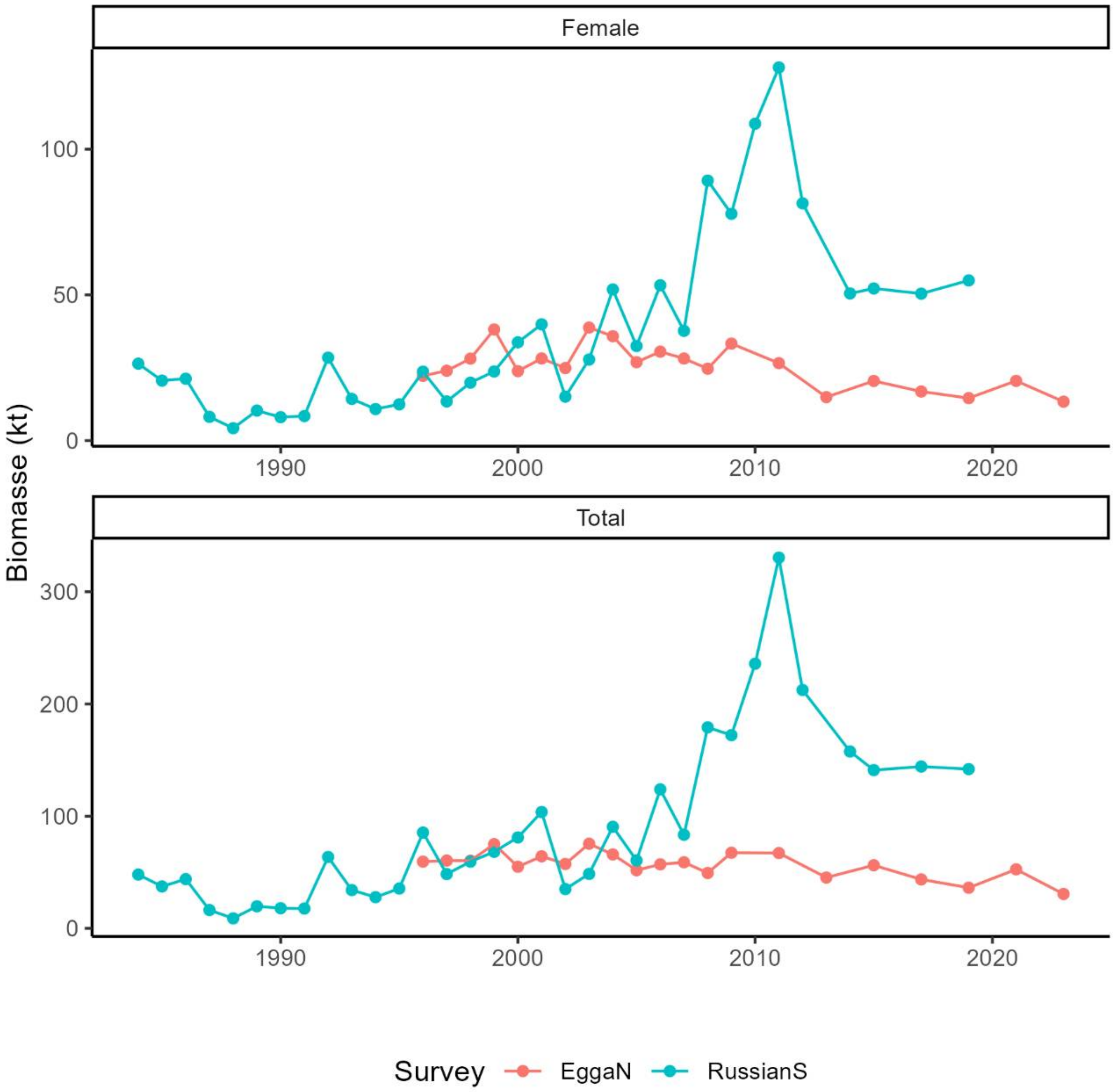


Figure 8.4 . NEA Greenland halibut. Biomass estimates from Russian autumn survey and the Norwegian slope survey (for females (top panel) and sexes combined (bottom panel)). Note that the Norwegian survey is run every other year since 2009.

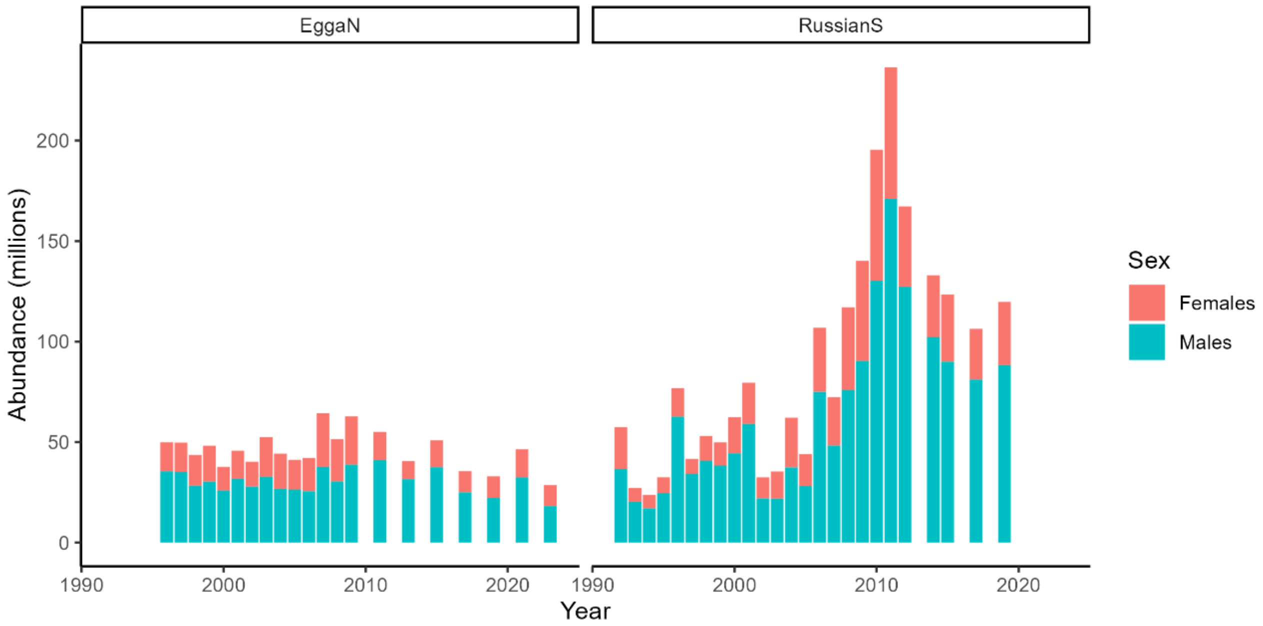


Figure 8.5 . Greenland halibut abundance by sex for Russian autumn survey (Russkikh and Smirnov, WD16 AFWG 2016) and Norwegian slope survey. Russian data from 1992 and onwards are revised in 2021 (Russkikh WD12).

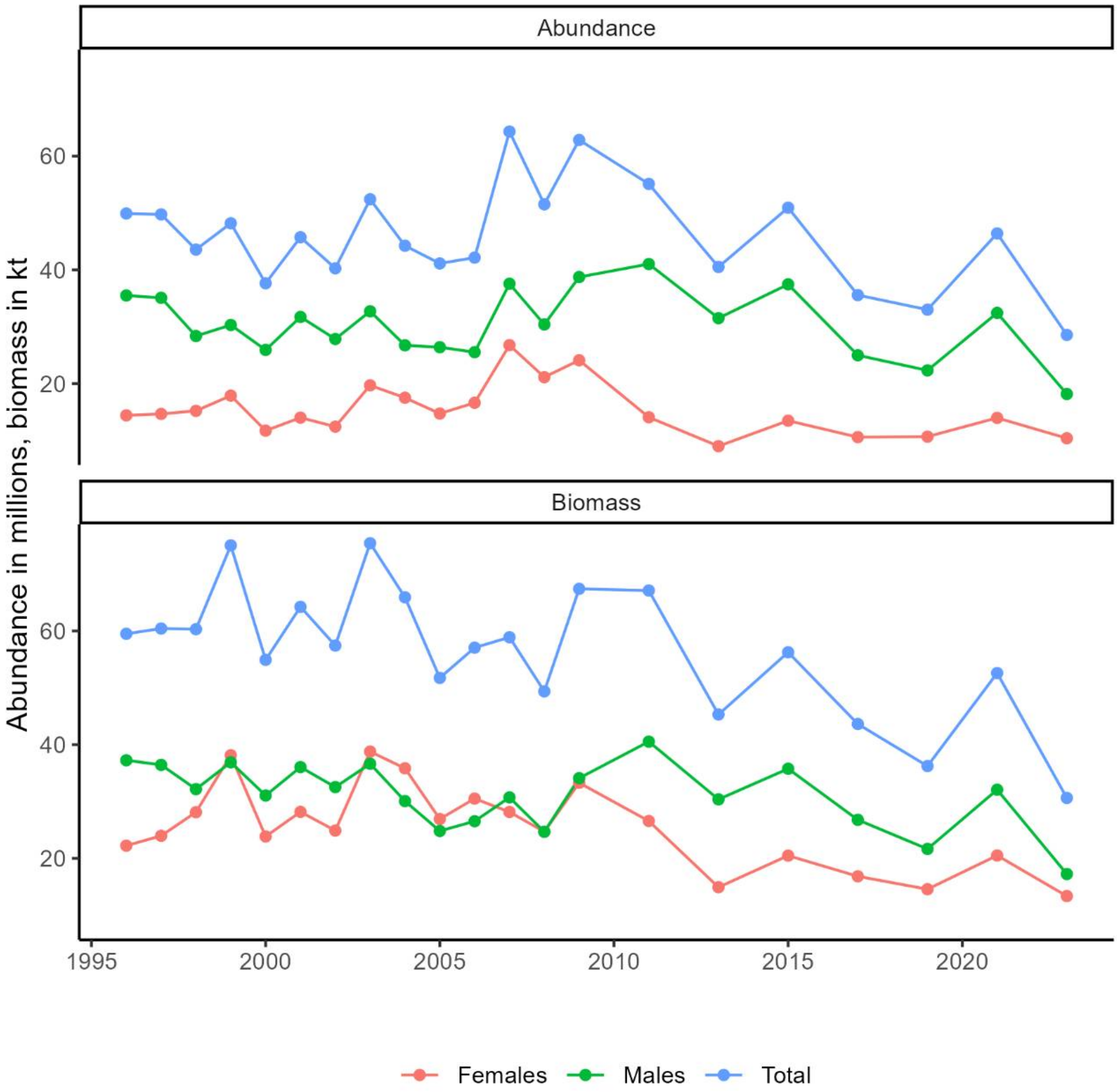


Figure 8. 6 . Estimated Greenland halibut abundance (upper panel) and biomass (lower panel), by sex, from the Norwegian autumn slope survey.

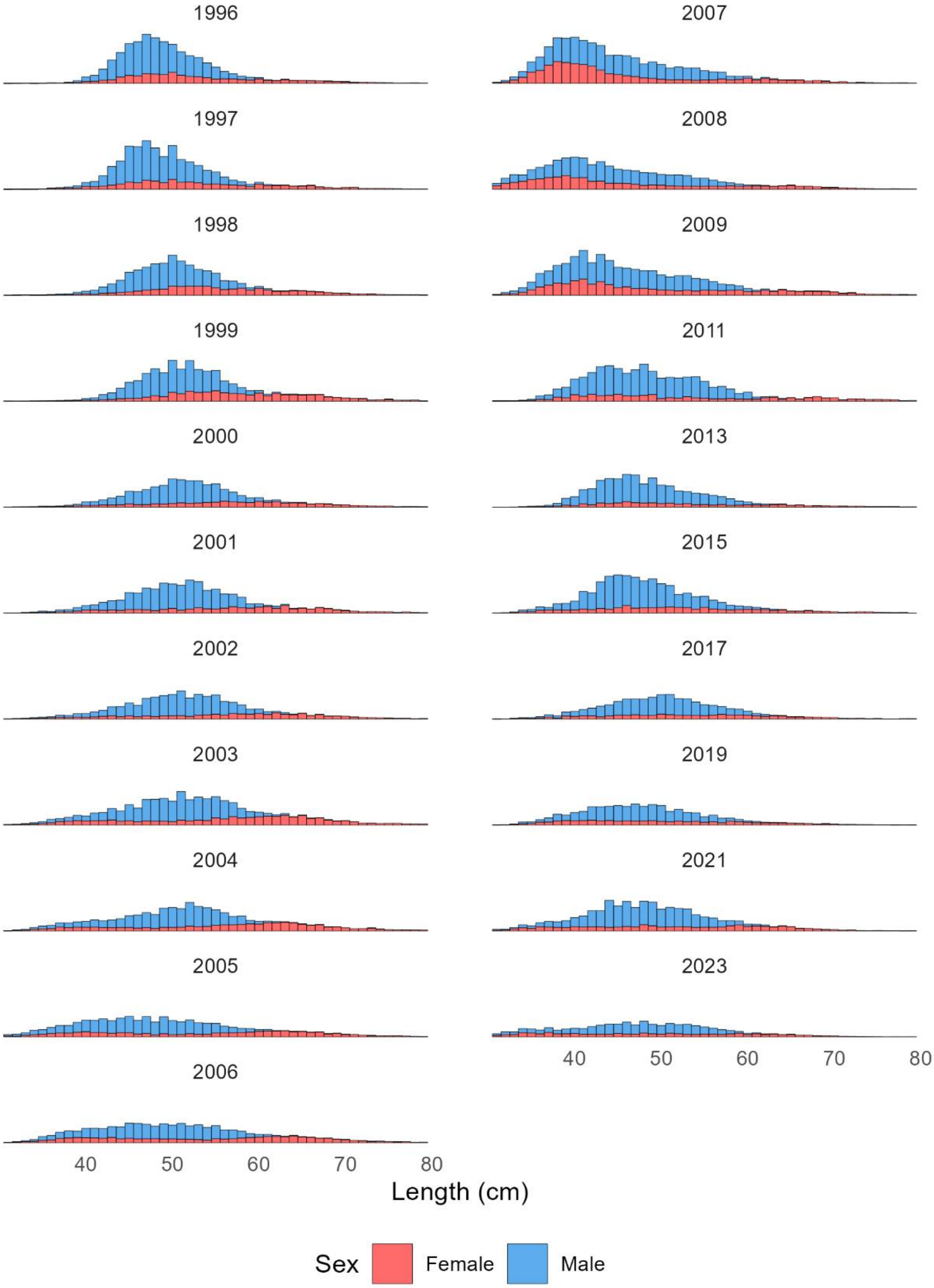


Figure 8.7 . Length frequency distribution in the EggaN abundance index. Note biennial surveys after 2009.

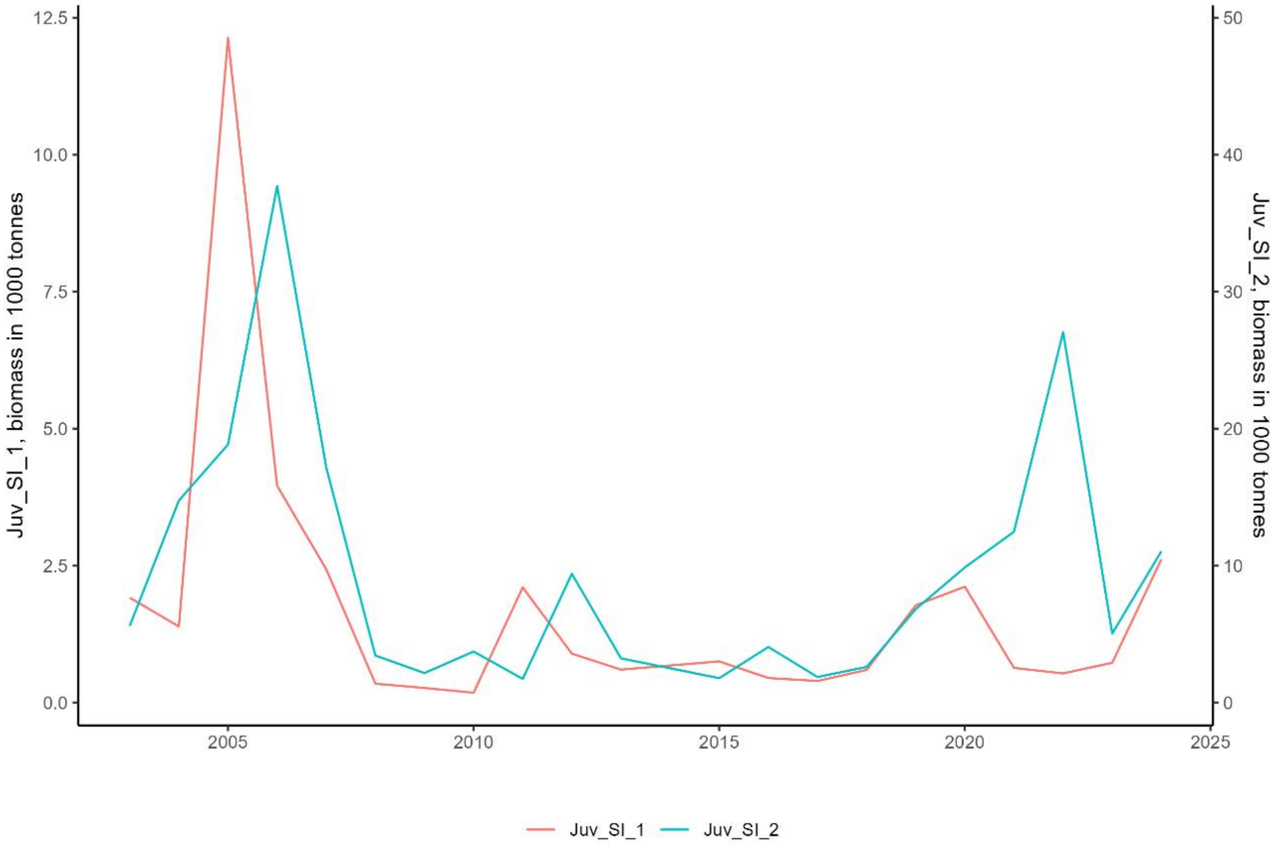


Figure 8.8 . Total juvenile biomass indices Eco_SI_1 (10-17cm) and Eco_SI_2(18-27cm) (sex distribution is assumed 50/50 in the juvenile area) for Greenland halibut based on the Barents Sea Ecosystem Survey (A5216).

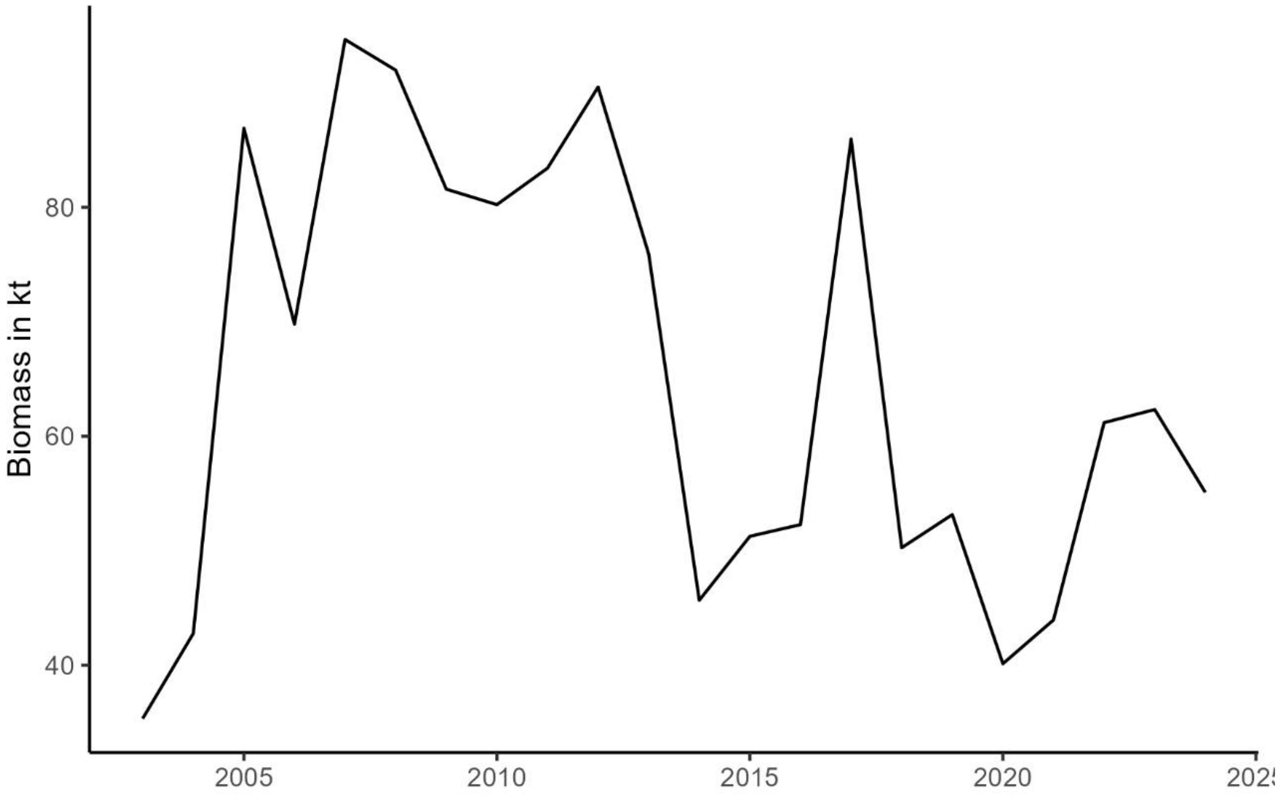


Figure 8.9 . EcoS biomass index for Greenland halibut in the Barents Sea Ecosystem Survey (A5216).

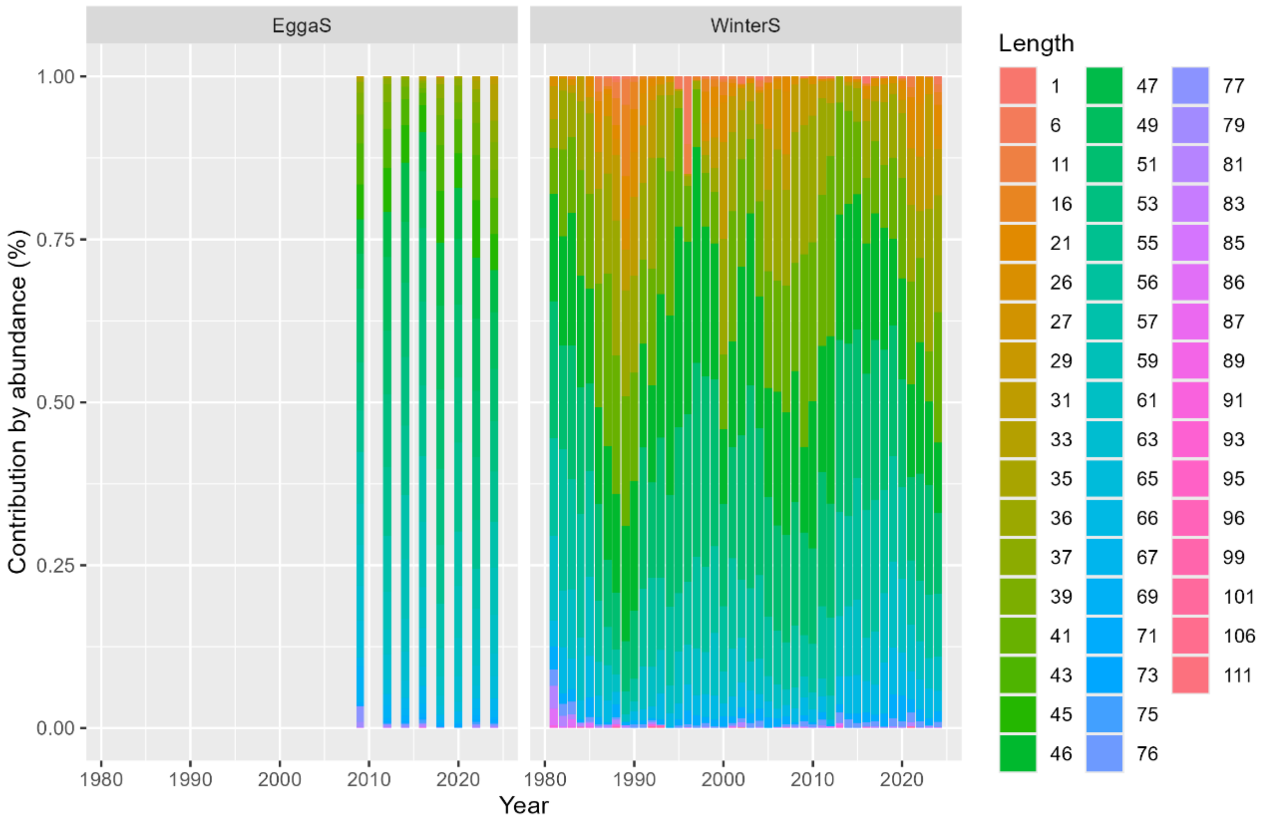


Figure 8.10 . Length distributions (in cm) from survey data: EggaS (left) and WinterS (right).

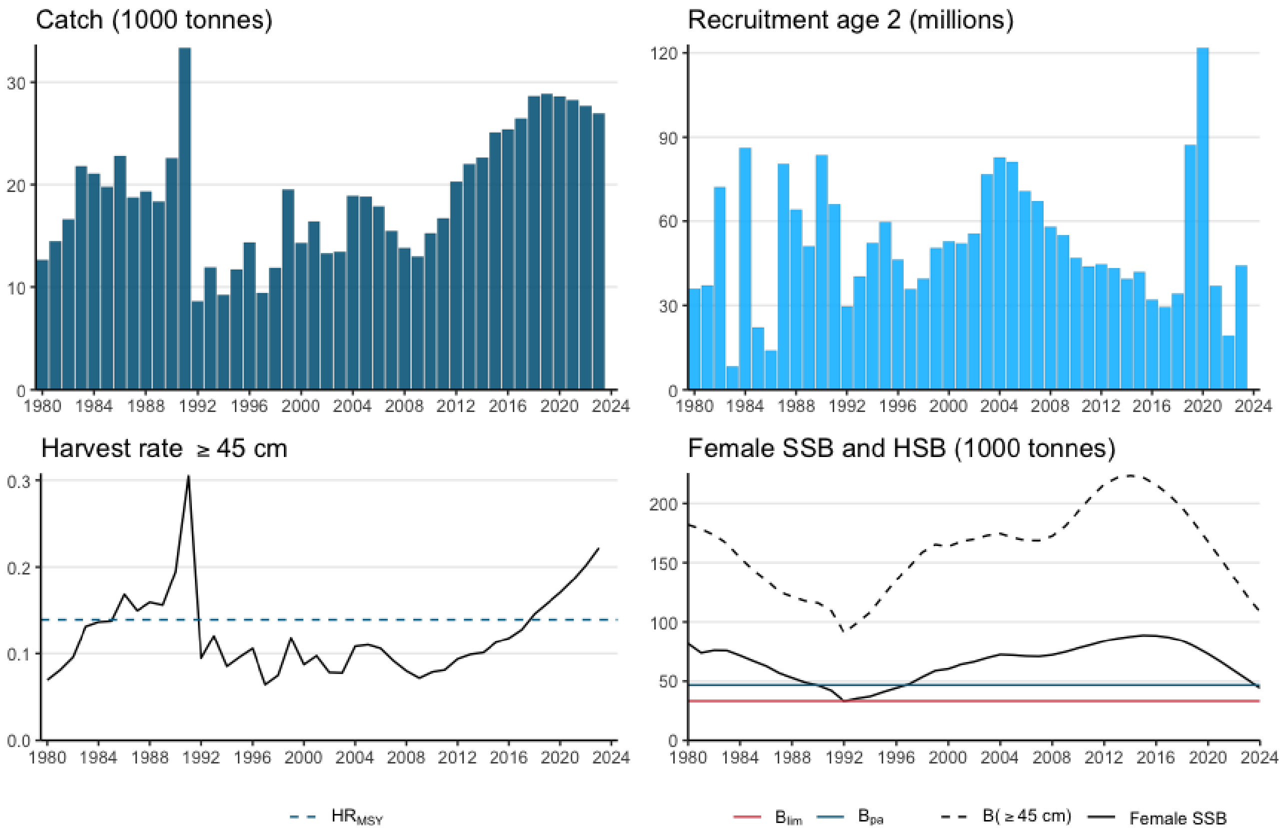


Figure 8.11 . From top left to bottom right: Catch (1000 tonnes), recruitment estimate (in millions) for 2-year-olds, harvest rate and Spawning stock biomass (SSB) and total stock biomass (TSB) for Greenland halibut as estimated by the GADGET model.

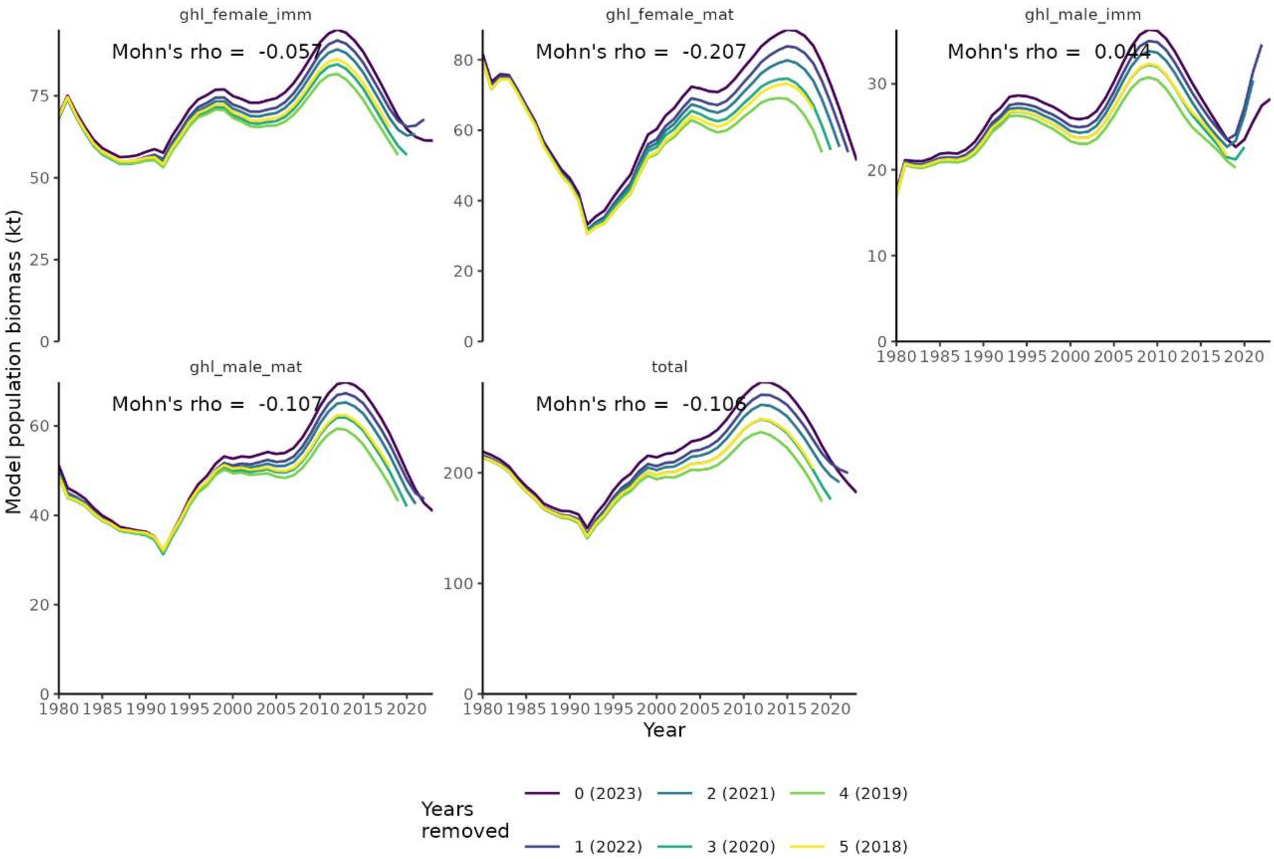


Figure 8.12 . Retrospective analysis using model biomass for each modelled stock component and total biomass. Colors are scaled to the number of years removed.

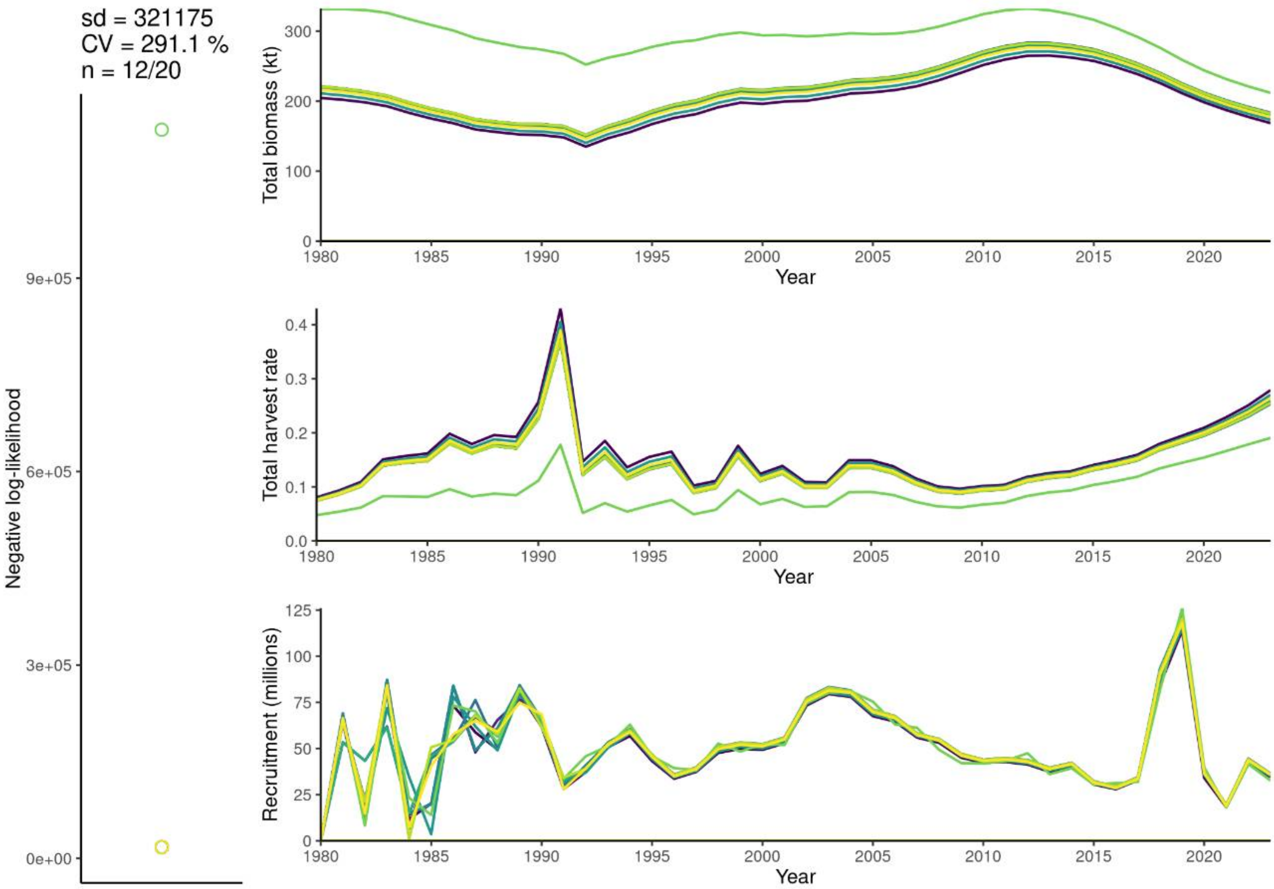


Figure 8.13 . Jitter results for the model. Negative log-likelihood scores of jitter runs are shown on the left together with standard deviation and CV (in percentage). Total biomass, harvest rate and recruitment are on top of each other on the right. Colour indicates the run number and is standardized across all panels.

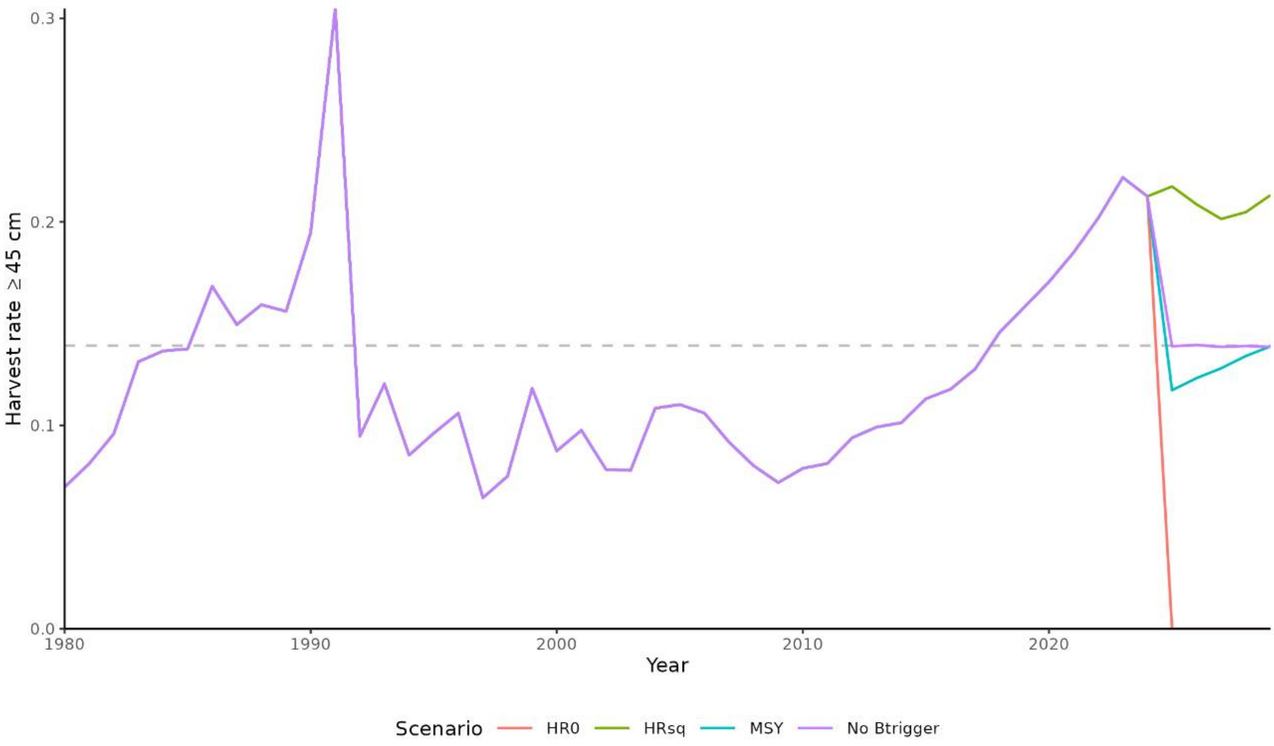


Figure 8.14. Harvest rates of short-term projection scenarios. Harvest rates are influenced by Bpa.

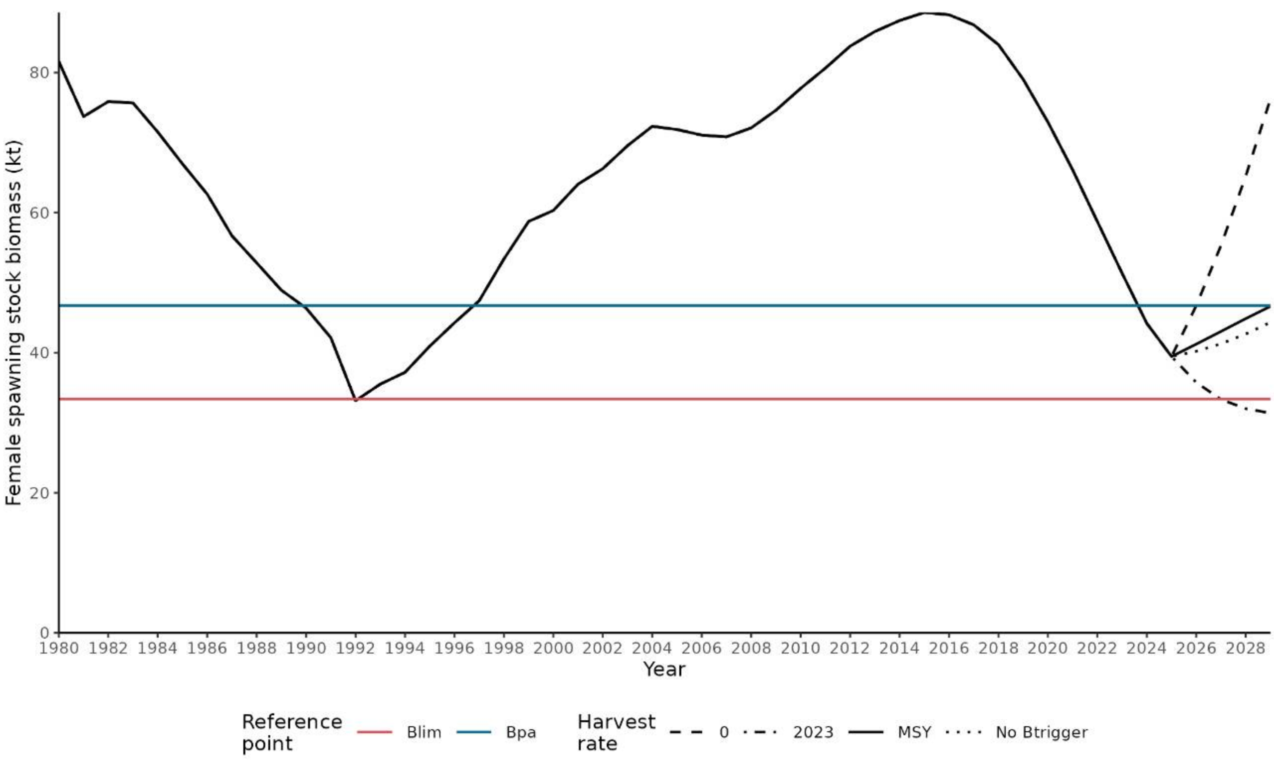


Figure 8.15 . Female spawning stock biomass (SSB) of short-term projection scenarios.

References

Albert, O.T. and Vollen, T., 2015. A major nursery area around the Svalbard archipelago provides recruits for the stocks in both Greenland halibut management areas in the Northeast Atlantic. ICES Journal of Marine Science: Journal du Conseil, 72(3): 872-879.

Bakanev, S 2013. Assessment of the Barents Sea Greenland halibut stock using the stochastic version of the production model. WD14, Report of the Benchmark Workshop on Greenland Halibut Stocks (WKBUT), 26–29 November 2013, Copenhagen, Denmark. ICES CM 2013/ ACOM:44 367 pp.

Bulatov, O.A., Russkikh, A. A., Mikhaylov, A.I., Vasilyev, D. A, 2023. The estimation of reference points of Greenland halibut stock in the Barents Sea based on production and cohort models. WD, JNR-AFWG 2023

ICES 1997. Report of the ICES/NAFO workshop on Greenland halibut age determination. ICES CM 1997/G:1, 53 p.

ICES. 2011. Report of the Workshop on Age Reading of Greenland Halibut (WKARGH), 14-17 February 2011, Vigo, Spain. ICES CM 2011/ACOM:41. 39 pp.

ICES 2017. Report of the Workshop on age reading of Greenland halibut 2 (WKARGH2), 22-26 August, Reykjavik, Iceland. ICES CM 2016/SSGIEOM:16. 36 pp.

ICES. 2018. Report of the Arctic Fisheries Working Group (AFWG), 18–24 April 2018, Ispra, Italy. ICES CM 2018/ACOM:06. 859 pp. https://doi.org/10.17895/ices.pub.5608

ICES. 2023. Benchmark workshop on Greenland halibut and redfish stocks (WKBNORTH). ICES Scientific Reports. 5:33. 408 pp. https://doi.org/10.17895/ices.pub.22304638

M. Lindegren, M. Thorlacius, J. T. Thorson, B. Þ. Elvarsson, D. Gonzalez-Troncoso, H. P. Benoît, et al. ICES Journal of Marine Science 2025 Vol. 82 Issue 5. DOI: 10.1093/icesjms/fsaf068

Lentin J., Elvarsson B.Þ., and Butler W. 2022. gadget3: Globally-Applicable Area Disaggregated General Ecosystem Toolbox V3. https://gadget-framework.github.io/gadget3/, https://github.com/gadget-framework/gadget3/.

Mikhaylov, A. 2016. Long-term HCR-parameters estimation for Greenland halibut based on production model. Working paper, no 14. in: Report of the Arctic Fisheries Working Group (AFWG), Dates 19-25 April 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:06. 621 pp.

Mikhaylov, A. 2019. Update referent point estimation for Greenland halibut based on production model. Working paper, no. 21 in: Report of the Arctic fisheries Working Group (AFWG), April 2019.

Nedreaas, K. 2014. Review of historic commercial catch-per-unit-of-effort (cpue) series previously used in stock evaluation of Greenland halibut (*Reinhardtius hippoglossoides*) in ICES Subareas I and II. Are such cpue series appropriate to use in future Greenland halibut stock assessments? Working document, no 2. in: Report of the Data Compilation Workshop on Northeast Arctic Greenland Halibut and Assessment Methods (DCWKNGHD), 10–12 November 2014, Murmansk, Russia. ICES CM 2014/ACOM:65. 56 pp.

Russkikh A.A., Kovalev Yu A., Tchetyrkin A.A. Revision of Russian survey indices used for Greenland halibut stock assessment. WD12, AFWG 2021

Úbeda, J., Nogueira, A., Tolimieri, N., Vihtakari, M., Elvarsson, B., Treble, M., and Boje, J. 2023. Using multivariate autoregressive state-space models to examine stock structure of Greenland halibut in the North Atlantic. Fisheries Management and Ecology: doi/10.1111/fme.12639.

Vihtakari, M., Elvarsson, B. Þ., Treble, M., Nogueira, A., Hedges, K., Hussey, N. E., Wheeland, L., *et al.* 2022. Migration patterns of Greenland halibut in the North Atlantic revealed by a compiled mark–recapture dataset. ICES Journal of Marine Science, 79: 1902–1917.

Vihtakari, M., Butler, W., Howell, D., Hallfredsson, E.H., Windsland, K.,Elvarsson, B., 2023. Assessment model for the Northeast Atlantic Greenland halibut stock (ghl.27.1-2). WD 17, ICES WKBNORTH.

Westgaard, J.-I., Saha, A., Kent, M.P., Hansen, H.H., Knutsen, H., Hauser, L., Cadrin, S.X., Albert, O.T. and Johansen, T., 2016. Genetic population structure in Greenland halibut (*Reinhardtius hippoglossoides*) and its relevance to fishery management. Canadian Journal of Fisheries and Aquatic Sciences, 74:475-485.

Windsland, K., Vihtakari, M., Hallfredsson, E. H., Howell, D. 2023. Data revision for the Northeast Atlantic Greenland halibut stock (ghl.27.1-2). WD2, ICES WKBNORTH 2023

Chapter 9. Evaluation of risk thresholds in escapement rule for capelin in the Barents Sea (subareas 1 and 2, excluding division 2.a west of 5°W)

Background

An evaluation of harvest control rules (HCRs) for Barents Sea capelin was conducted in 2024 (Trochta et al. 2024). The results of this analysis were presented during the meeting of the Joint Norwegian-Russian Fisheries Commission in autumn 2024 where it was requested (main protocol section 16.3) that lower values of the risk threshold in the capelin escapement rule be evaluated. The existing escapement rule states that the capelin TAC shall not be set higher that that with 95% probability of allowing 200,000 tonnes (now called $B_{escapement}$) to spawn, with 95% being the risk threshold currently used in practice. The 2024 HCR evaluation simulation tested the performance of alternative values for $B_{escapement}$ and fixed minimum quotas with the existing 95% risk threshold. A follow-up HCR evaluation was conducted for a set of combinations of alternative risk threshold values (90%, 85%, 80%, and 75%) and $B_{escapement}$ values (100,000, 150,000, and 200,000 tonnes) for JRN-AFWG 2025. The results of this analysis are presented below.

Results

The same simulation modelling framework and assumptions used in the 2024 analysis were used to obtain the results shown here (methods described in Trochta et al. 2024). For each HCR in this analysis, 1000 simulations of 36 year projections were conducted and evaluated. The following performance metrics were calculated:

- Maximum risk that April 1 SSB is below B_{lim} (from 18 years with open fishery)
- Median number of years that April 1 SSB is below B_{lim} (from 18 years with open fishery)
- Median number of years that the fishery closed (from the total 36 years)
- Median catch (from 18 years with open fishery)
- Median SSB (from 18 years with open fishery)

Most of these performance metrics were computed from a subset of years where the fishery opened in at least 5% of iterations under any HCR, and thus disregard when naturally lower recruitment caused SSB to fall below B_{lim}. This ensures the same subset of years is represented in the performance metrics as done in the 2024 analysis (Trochta et al. 2024).

Performance metrics were calculated from simulations for a total of 13 alternative HCRs based on five potential risk threshold values and three potential $B_{escapement}$ values (Figure #.1). Simulations of HCRs with $B_{escapement}$ =100,000 tonnes and risk thresholds of 75% and 80% were not conducted because these would not have been precautionary (>5% maximum risk) based on results for HCRs with the same $B_{escapement}$ and higher risk threshold values (85% and greater).

Using lower risk thresholds in the escapement rules gradually increased the maximum risk of falling below Blim, where risk threshold values less than 90% were generally not precautionary across the alternative $B_{escapement}$ considered. Importantly, the number of years where SSB fell below B_{lim} drastically increased with lower risk threshold values, going from 3 years with an 80% threshold to 12 years with a 75% threshold combined with $B_{escapement}$ =200,000 tonnes (and from 1 year with an 85% threshold to 11 years with an 80% threshold combined with $B_{escapement}$ =150,000 tonnes).

Amongst the other performance metrics, non-substantial differences were seen in the number of years with a closed fishery as well as an expected trade-off in increasing yield and decreasing SSB (and higher maximum risk) with lower HCR risk threshold values (Figure #.1). More generally, similar performance differences result from either changing only $B_{escapement}$ or the risk thresholds. In other words, one could attain similar if not identical HCR performance by changing only $B_{escapement}$ and keeping the same risk threshold (95%), compared to also changing the risk threshold.

This set of HCRs was also tested against a scenario where the absolute biomass survey that takes place in the autumn prior to the advice year (and is a crucial input for the calculation of the capelin TAC) is biased upward by 10% on average. This scenario was also simulated in the 2024 analysis for testing the robustness of HCR against a set of potentially critical yet plausible realities (Trochta et al. 2024). The performance of HCRs under this scenario clearly shows that risk thresholds less than the current value of 95% are not precautionary (Figure #.2). Additionally, most maximum risk values for thresholds less than 95% are substantially higher than 5% (the precautionary criterion). No substantial differences were seen in the trends of the other performance metrics across scenarios compared to Figure #.1. Overall, using a risk threshold lower than 95% not only increases the risk of SSB falling below Blim, but potentially by a substantial amount and especially against plausible uncertainties in the existing capelin advice process.

References

Trochta, John T, Bjarte Bogstad, Yury Kovalev, Dmitry Prozorkevich, Georg Skaret, Sindre Vatnehol, and Daniel Howell. 2024. “Report on evaluation of harvest rules for Barents Sea capelin in subareas 1 and 2 (Northeast Arctic), excluding division 2.a west of 5°W – full report“. IMR-PINRO report 2024-17. https://www.hi.no/templates/reporteditor/report-pdf?id=100338&51853545.

Tables and figures

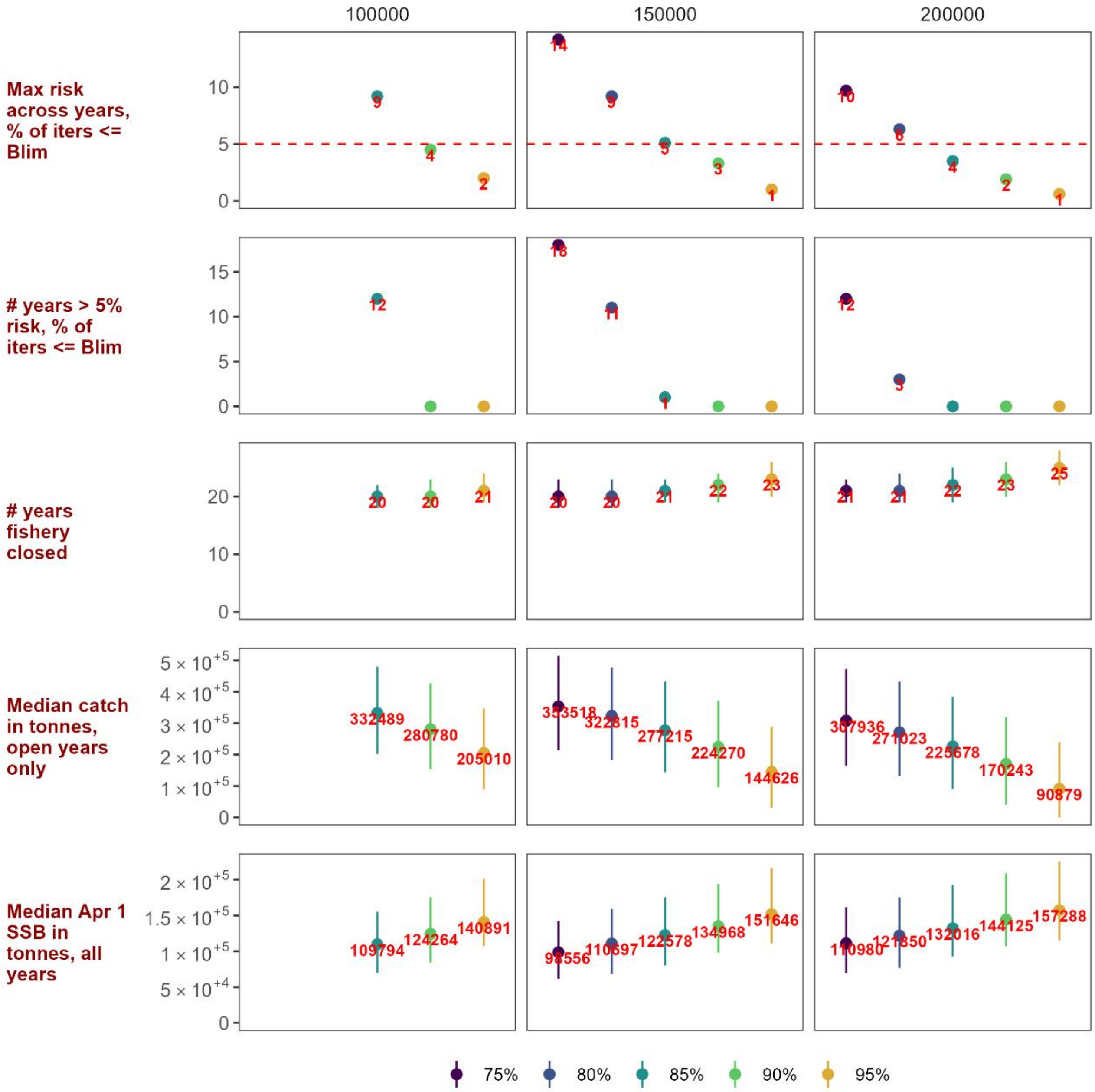


Figure 9.1. Consequences of alternative configurations of the capelin escapement rule. Rows denote the specific consequence calculated (performance statistics), columns separate the Bescapement values, and colors denote alternative risk threshold values used in the HCR. Points represent either a percentage, number of years or a median where indicated. Lines represent the inner 90th quantile of the distributions if the statistic is not a percentage. Statistics are computed from 1,000 iterations.

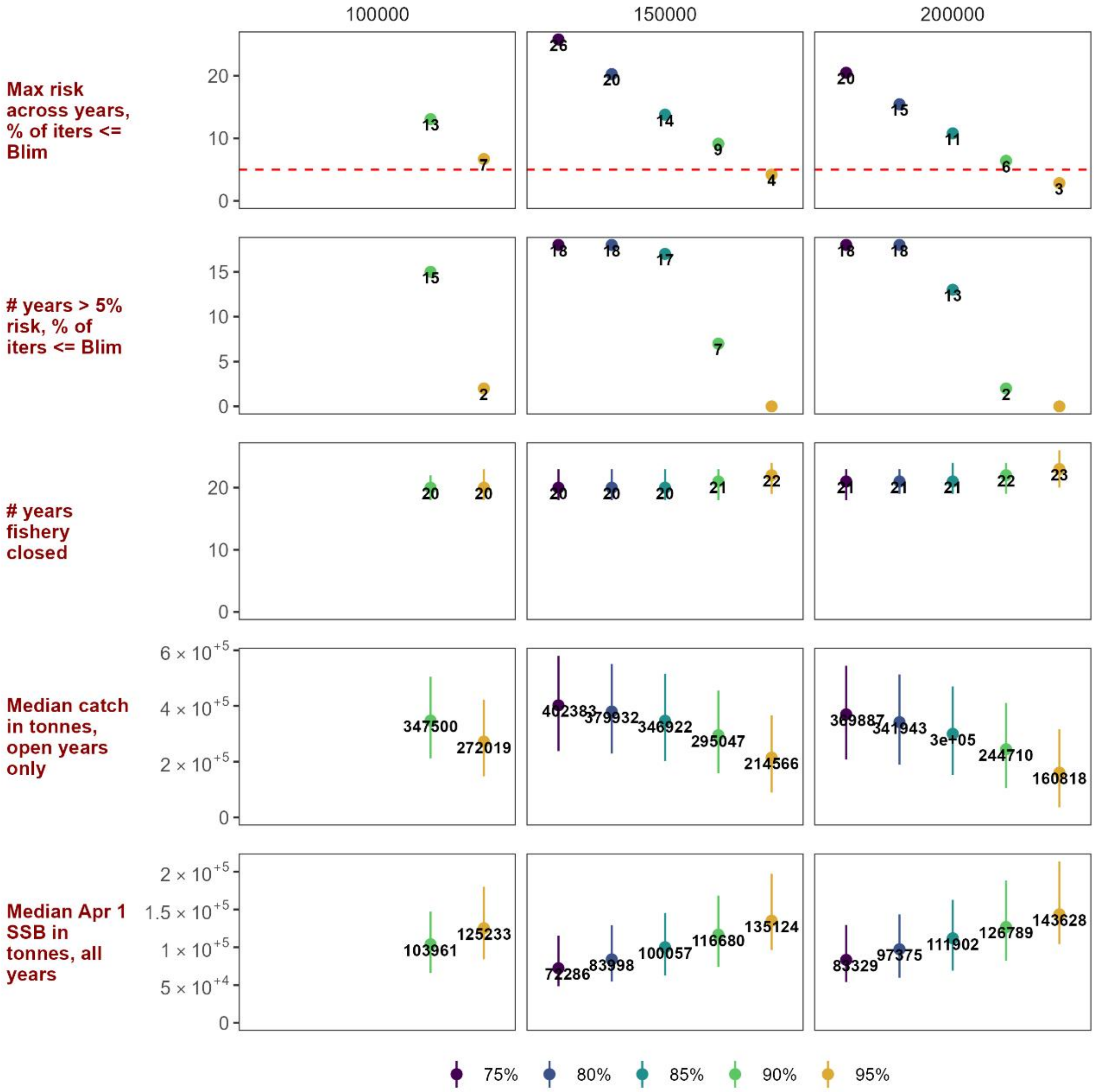


Figure 9.2. Consequences of different capelin escapement rules against a scenario where the autumn survey has a 10% upward bias on average. Rows denote the specific consequence calculated (performance statistics), columns separate the Bescapement values, and colors denote alternative risk threshold values used in the HCR. Points represent either a percentage, number of years or a median where indicated. Lines represent the inner 90th quantile of the distributions if the statistic is not a percentage. Statistics are computed from 1,000 iterations. Risk threshold values lower than 90% were not simulated with Bescapement=100,000 tonnes as these rules would not be precautionary.

1 The onshore and the at-sea sampling programs coordinated by the IEO were suspended in most of 2020, due notably to administrative problems and to a lesser extend to COVID-19. This affected all stocks. Both sampling programmes are hired by IEO through call for tenders addressed to specialized companies. The public tender launched in 2019 (to start in 2020) was declared void, having to be re-launched again. This second launch was delayed as a result of the paralysis of public activity during the state of alarm due to the COVID-19 pandemic and could only be reopened in June-July. Given that the process of awarding the contract by public tender takes three-four months under normal conditions, it was finally resolved in December 2020 and signed in January 2021. Since then, all activities have been resumed. The sampling to obtain the biological variables of the

population (mainly reproduction and growth) is normally carried out in the IEO laboratories. This activity has also faced problems in 2020. On the one hand the administrative and financial difficulties of the IEO prevented the purchasing of samples in the market and on the other hand the three months closure of the labs (15 March to 21 June) due to COVID-19 did not allow for a normal activity.

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

Institute of Marine Research – IMR

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