15 Cod (*Gadus morhua*) in NAFO Subarea 1, inshore (West Greenland cod)

15.1 Stock description and management units

Cod in Greenland originate from four distinct stocks that are labelled by their spawning areas: I) offshore West Greenland; II) West Greenland fjords (inshore); III) East Greenland and offshore Icelandic and IV) inshore Icelandic waters (Therkildsen *et al*., 2013).

The inshore component (West Greenland, NAFO Subarea 1) has since 2012 been assessed separately from the offshore stocks. The Stock Annex provides more details on the stock identities including the references to the primary literature.

15.2 Scientific data

Historical trends in landings and fisheries

Details on the historical development of the fishery is described in the stock annex. The fishery developed in the yearly part of the 20th century, and by 1960 it peaked at 35 000 t (Figure 15.2.1). The fishery then declined but additional peaks in landings resulted from single large year classes during the 1970s and 1980s. Between 1990 and 2000, landings were below 5000 t, but has since increased gradually to a historic high of 35.000 tons in 2016. Catches have since then declined.

The present fishery

The TAC in 2020 was originally 30 000 tons. The 2020 catches were 17 926 t, which is a decrease of 9% compared to 2019 (Table 15.2.1). Pound net remains the dominant gear, accounting for 69% of the catches followed by the longlines (17%), hooks (8%) and gill nets (6%) (Table 15.2.2, Figure 15.2.1,). Approximately 72% of the total catch is fished from May-August with a peak (25%) in June (Table 15.2.3). More details on the inshore fishery are given in Retzel 2021a.

North Greenland (NAFO division 1A, subarea 1AX (Disco Bay))

Catches in North Greenland have gradually increased from 500 t in 2012 to an historic high of nearly 6000 t comprising close to 20% of the catches in 2017 (Table 15.2.1, Figure 15.2.2). Since 2017 catches decreased with app. 75% in 2020 to 931 t. and they accounted for 5% of the total catch in 2020 (Table 15.2.3). Cod are caught as a combination of bycatch in the gillnet and longline fishery for Greenland Halibut and a pound net directed fishery (Table 15.2.2).

Midgreenland (NAFO divisions 1B and 1C)

6806 tons were fished in Midgreenland in 2020 which is a decrease of 70% from the historic high of 22 000 t in 2016 and 2017 (Table 15.2.1, Figure 15.2.2). In both areas the dominating gear are pound nets which caught 30% of the total catch in 2020 (Table 15.2.2). The fishery is concentrated around the towns of Kangatsiaq, Sisimiut and Maniitsoq (figure 15.2.3 and 15.2.4).

Midgreenland (NAFO divisions 1D)

The fishery in NAFO division 1D south of 1C has in contrast with the northern areas increased to historic height in 2019 with 8700 tons. This is the highest caught since 1990. In 2020 catches decreased by 15 % to 7412 t (Table 15.2.3). The catches in NAFO 1D comprised 41% of the total catch in 2020.

South Greenland (NAFO divisions 1E and 1F)

The catches in South Greenland have over the last decade gradually declined to 421 tons in 2018 corresponding to 2 % of the total inshore catch (Table 15.2.1, Figure 15.2.2). In 2019 and 2020 however a drastic increase from 390 t in 2018 to 1823 t in 2019 and 2104 t in 2020 occurred in NAFO 1F resulting in 12% of the total inshore catch was caught in this region (table 15.2.3). The inshore cod stock is believed to be distributed from Midgreenland and northwards as there are no significant spawning taking place in South Greenland (Retzel and Hedeholm, 2012). Hence, the fishery in this area depends on offshore fish migrating inshore. Survey results from the offshore area found increasing numbers of cod in South Greenland especially of the 2015-Yearclass which is the main YearClass in the inshore fishery in this area (Retzel 2021b, Werner & Fock 2021).

East Greenland (ICES Subdivision 14.b)

Over the past five years, a small inshore fishery using hooks has developed in East Greenland, but less than 250 t are caught annually (Table 15.2.1, Figure 15.2.3). No length measurements are available from this fishery but individuals in this area do not belong to the West Greenland inshore cod stock. These fish are therefore not included in the overall calculations of catch and weight at age, but since the area is by definition part of the inshore area the catches are compiled here.

Catch-at-age

Several YC (YC 2013-2016) were caught in the inshore fishery in 2020, with the 2014 and 2015 YC (age 5-6) dominating the catches (Table 15.2.4, Figure 15.2.5, Figure 15.2.6).

Weight-at-age

Geographical conditions, i.e., the existence of many small landing sites separated along more than 1000 km of coastline prevents a well-balanced sampling of the Greenland coastal fleets catches. Cod are also landed without head, which hinder otolith sampling. This means that age information from the commercial fishery is limited. The mean weight-at-age in the landings are therefore primarily based on survey sampling and set equal to stock mean weight-at-age in the assessment. A more comprehensive description of the fishery and sampling procedures are provided in the stock annex.

Maturity-at-age

Maturity information from the early period of the assessment is only available for November 1987 (n = 484 cod). Although of limited size, the sample is from the bottom of the fjord where there is minimal mixing with the offshore stock (Storr-Poulsen *et al.*, 2004) and represents the best estimate of maturity during this period. Recent maturity (2007–2015) information is available from the spawning season (n = 3326 cod). The maturity ogive for the two periods was estimated by a general linear model (GLM) with binomial errors. The ogives for the two periods are different: L50 was 5.07 years in 1987 (SE = 0.18), and 4.32 years (SE = 0.04) from 2007 to 2015. It was decided to use the years with very low catches (600–800 t) as transition years between the two maturity ogives. The maturity ogive for the period 1976–2006 was set to that of the 1987 ogive. For the remaining period (2007–present) the maturity ogive was set constant based on maturity information from 2007–2015. The reason for not applying different maturity ogives for each year is due to high variation in number of samples between years that results in noisy data. Even though the maturity ogive for the period 1976–2006 is based on relatively few fish caught outside spawning season it was decided to use it as this maturity ogive is supported by earlier maturity ogives from the 1930s with a similar L50 (Hansen, 1949).

Results of the West Greenland gillnet survey

The numbers of valid net settings in 2020 was 53 in NAFO 1B and 50 in NAFO 1D (Table 15.2.5). Area and site specific catch rates can be seen in Figure 15.2.7.

In Sisimiut (NAFO 1B) the index of age 2 (45 cod/100hr) and 3 (99 cod/100 hr) abundance have decreased compared to 2019 (Table 15.2.6) and are below the time series mean (figure 15.2.8). The overall abundance index including all ages have also decreased (233 cod/100 hr) and is at the time series mean (230 cod/100hr).

In NAFO 1D the abundance index of age 2 (7 cod/100hr) decreased whereas the index of age 3 (60 cod/100 hr) increased compared to 2019 (Table 15.2.6). The combined index for age 2 and 3 is around the time series mean (figure 15.2.8). The overall abundance index including all ages have decreased (165 cod/100 hr) but is above the time series mean (113 cod/100 hr).

Combining 1B and 1D in a joint index across all ages results in a decrease compared to 2019, but is around the time series mean (Figure 15.2.8). The index remains intermediate compared to 2010–2013 and is similar to the values in 2014 and 2018, but 2010–2013 was a period of historic high recruitment. Normally, catch rates are highest in 1B, but in the period 2014-2018, the two areas have had similar recruitment (Table 15.2.6, Figure 15.2.8). In 2020 recruitment was higher in 1B.

In 2017 and 2019 the survey was extended to include Kangaatsiaq (NAFO 1B) and since 2017 to include Maniitsoq (NAFO 1C). A similar number of stations as in the traditional areas were successfully fished (Table 15.2.5). In Maniitsoq, the index combining all ages was similar to 1B and 1D in 2017. The index decreased in 2018 and further in 2019 and increased slightly in 2020 (Table 15.2.6). Similar to 1D, the number of 2 year olds decreased, whereas number of 3 year olds increased. In Kangatsiaq, the index combining all ages was much lower than in Sisimiut, Maniitsoq and Nuuk in both 2017 and 2019.

Disko Bay survey

For 2020 40 gillnets where set targeting Greenland Halibut at fixed stations corresponding to previous years in the Disko Bay. Catches in the Disko Bay gill net survey were low from 2005–2012 (Table 15.2.7). From 2013–2016, catches of cod increased substantially, mainly driven by the 2009 and 2010 YCs. Catches declined in 2017, 2018 and 2020 but were in 2019 slightly below the high catch rates in the period 2013-2016.

Disko Bay is also covered as part of the annual bottom trawl survey in West Greenland. The trawl survey catches smaller cod, and a similar increase as seen in the gill net survey was documented two years earlier, driven by the 2009 YC and subsequently by the relatively large 2010 and 2011 YCs (Table 15.2.8). In the period 2011-2016, catches have remained substantial in both the gill net and the trawl survey, but since 2016 numbers indicate a decline in abundance, which is consistent with smaller year classes as observed in the 1B and 1D recruitment surveys. Jointly, the inshore surveys suggests that the increase in recruitment starting with the 2009 YC resulted in not only local biomass increases, but also an expansion of the stock into the northern part of the inshore area. Recent recruitment declines can therefore also be expected to have the largest effect in the northern part of the area.

More details on inshore survey results can be found in Retzel (2021c).

Genetics

In 2019 samples for genetic analysis were taken from the inshore fishery in 5 areas from NAFO 1B (Kangaatsiaq) in the north to NAFO 1F in the South. A shift in genetic composition in the inshore fishery is seen from north to south (figure 15.2.9). In the north (Kangaatsiaq) the West-Greenland offshore stock is dominating with 40% in the catches followed by the WestGreenland

inshore stock (35%) and the EastGreenland-Iceland offshore stock (25%). In contrast the West-Greenland Inshore stock is dominating in MidGreenland, especially in Sisimiut where 70% belongs to the WestGreenland inshore stock. In Maniitsoq and Nuuk 50% belong to this stock. In SouthGreenland (NAFO 1F) the dominating stock is the EastGreenland-Iceland offshore stock with 60%, followed by the WestGreenland inshore stock with 30%. Ages were only obtained from the collections from the fishery in the Nuuk (NAFO 1D) area and South Greenland (NAFO 1F). The composition between YearClasses seems stable in the Nuuk area (figure 15.2.10), whereas the 2015 and 2014 YC in SouthGreenland predominantly belongs to the EastGreenland-Iceland offshore stock and the 2013 YC belongs to the WestGreenland inshore stock.

In 2019 genetic samples were taken from every inshore survey. The results of the genetic investigation in 2019 showed that the majority (50%) of the cod in the surveys in the northern area (Disco Bay and Kangaatsiaq, figure 15.2.11) belong to the WestGreenland offshore stock component. The WestGreenland inshore and EastGreenland-Iceland stock component constituted 25% each. In contrast further south the WestGreenland inshore stock component dominates, especially in the Sisimiut area where 70% belong to this stock. In Maniitsoq and Nuuk 55% belong to this stock. The WestGreenland offshore stock component is the second largest in the survey with 25% in Sisimiut and 30% in Maniitsoq and Nuuk. Investigations of the split in yearclasses revealed that in the Sisimiut area older yearclasses belong almost exclusively to the WestGreenland inshore stock component (figure 15.2.12). This pattern seems only to be evident in Sisimiut.

15.3 Tagging experiments

A total of 5642 cod have been tagged inshore in West Greenland from 2003–2019, primarily in NAFO 1B, 1D and 1F (table 15.3.1).

Inshore recaptures are found almost exclusively in the same fjord as tagged (Table 15.3.2). No tags from the inshore area have been recaptured offshore except three that were recaptured in Iceland. These three cod were tagged in the South Greenland (1F) inshore area. Three cod tagged offshore in NAFO 1C was recaptured inshore in NAFO 1E, 29 cod tagged offshore on Dana Bank have been recaptured in the inshore fjord system. Most of these were recaptured in the inshore area south of Dana Bank, but four were recaptured inshore north of Dana Bank. These results confirm the general perception: adult cod present deep in the fjords tends to remain in the same area and that the southern part of the inshore area is a mixing area of different stocks.

15.4 Methods

The stock was benchmarked in 2018 (ICES, 2018). It was decided to use the SAM model and perform an analytical assessment. Hence, the assessment was upgraded from a category 3 (Data Limited Stock) to a category 1 stock. This is considered a vast improvement, as all data are now utilized, and the assessment is presented with uncertainty estimates and multiple catch options.

15.5 Reference points

Reference points were defined at IBPGCod (ICES, 2018). The estimations were conducted in EQSIM according to ICES guidelines (see ICES (2018) for details). The reference points are shown in Table 15.5.1. However, F_{lim} and F_{pa} has not be defined. A benchmark for the stock is proposed to take place in 2022.

15.6 State of the stock

There have been several years of high recruitment between 2003 and 2012 and the spawning stock biomass was at a level not seen for 25 years in 2015, since then it has declined. The recruitment has been stable on a low level in the last five years. The recent decrease in stock size was expected as the failing recruitment begins to affect the number of adults. The catches have decreased since the time series highs in 2016 and 2017. Catches are comprised of ages 4–7 and low recruitment for a few consecutive years will quickly affect the fishable biomass, which is evident in the catches of 2020 that was around half compared to 2016. TACs have not been obtained the last four years and it is unlikely that the TAC of 21 000 t in 2021 will be caught.

Genetic studies have been carried out on catches from the surveys and the fishery along the coast line from Disko Bay in the north to South Greenland. Both in surveys and the fishery a gradient is evident with the West Greenland Offshore stock dominating in the north (NAFO 1A+ northern part of NAFO 1B), the Inshore stock dominating in mid (Southern part of NAFO 1B+NAFO 1C and 1D) and the East Greenland – Iceland offshore stock dominating in the South (NAFO 1F). The main part of the fishery is conducted in mid Greenland where the Inshore stock is dominating the catches, the proportion varies between 50%–70% (Christensen, 2019, Retzel, 2021a).

However, a considerable proportion (30%) of the inshore catches belongs to the West Greenland offshore stock. The stock is in a depleted condition and the current ICES advice is zero catch. A continued high fishing pressure in the inshore areas can prolong the recovery time of the offshore stock.

The remaining part (20%) of the inshore catches belongs to the East Greenland/Icelandic offshore stock. It is assumed that a large part of these cod migrates to East Greenland/Iceland to spawn. The spawning stock in East Greenland has in recent years declined. A continued high fishing pressure in the inshore areas can have a negative influence on the spawning stock in East Greenland.

15.7 Short term forecast

Input data

The SAM model provides predictions that carry the signals from the assessment into the short-term forecast. The forecast procedure starts from the last year's estimate of the state (log(N) and log(F)). One thousand replicates of the last state are simulated from the estimated joint distribution. Each of these replicates are then simulated forward according to the assumptions and parameter estimates found by the assessment model.

In the forward simulations, a 5-year average (up to the assessment year) is used for catch mean weight, stock mean weight, proportion mature, and natural mortality. Recruitment is re-sampled from the entire time series. In each forward simulation step the fishing mortality is scaled, such that the median of the distribution is matching the requirement in the scenario (e.g. hitting a specific mean F value, a specific catch or level of SSB).

Results

The results from the assessment are shown as estimated numbers-at-age and F-at-age in Tables 15.7.1 and 15.7.2. All other output can be found on stockassessment.org (run: codWestInsNWWG2021, Riget *et al*., 2021).

The forecasts from the different scenarios are presented in Table 15.7.3. Fishing at F_{MSY} in 2022 will result in catches of 4780 t and a spawning stock biomass increase with 18% in 2023. Recently

the catches have been above the ICES advice, and an F status quo will result in catches of 10 141 t, but at the same time a decrease in the spawning stock biomass of 11% in 2023.

15.8 Long term forecast

No long-term forecast was performed for this stock.

15.9 Uncertainties in assessment and forecast

The major uncertainty of the assessment is related to mixing of cod stocks (West Greenland offshore and East Greenland/Icelandic offshore).

There is no incentive to discard fish or misreport catches under the current management system and any small cod released from the pound nets survive. The surveys show relatively good internal consistency and jointly data input to the assessment is of high quality and the time series are long which should provide a good basis for a robust assessment.

The model fits the data relatively well (Figure 15.9.2) but does consistently underestimate the spawning stock biomass (Figure 15.9.3). Although this is consistently a way-residual, the Mohn's rho measure of uncertainty is -0.22, which is not considered high (Hurtado-Ferro *et al*., 2015) and the 95% confidence intervals include the most recent years retrospective runs. For the fishing mortality, there are also year-to-year changes in the perception (Figure 15.9.4). These are, however, both positive and negative, and the resulting Mohn's rho is only 0.03 with all retrospective runs being inside the model 95% confidence intervals.

The poorest model performance is in the fit between actual and estimated catches (Figure 15.9.2). Especially the poor fit to the catches in years with large catches is noteworthy, as catches are known with a high degree of certainty. The cause of this is emigration; immigration and mixing of stocks both in the survey and in the catches (see 'State of the stock'). The general picture of the stock dynamics is relatively well understood, but difficult to quantify, especially on an annual basis. It does present a challenge in the forecast. The TAC in the intermediate year is known at the time of the assessment meeting. This TAC is valid for the mixed fishery and does not reflect the expected catch of solely the inshore stock. Because of this, the TAC is not used in the forecast. Instead, we have assumed that F will be similar and applied an F-scaler of 1 in the intermediate year. This then assumes that the model output is a valid estimate of the inshore cod stock landings and not total catches. In the current period, with very high landings, the model has estimated the actual landings to be roughly double the model estimate.

Hence, the forecast should be considered as an estimate of the development of the inshore cod stock and not cod in the inshore area.

15.10 Comparison with previous assessment and forecast

The stock was benchmarked in 2018 (ICES, 2018) and the SAM model accepted. The spawning-stock biomass (SSB) of West Greenland inshore cod has decreased since 2015 after having been at a historical high level. Fishing mortality (F) has increased slightly in recent years and have been above F_{MSY} during the whole time-series. Recent recruitment has gradually decreased from a decade of high values and is currently close to historically low levels.

15.11 Management plans and evaluations

There is no management plan for this stock.

15.12 Management considerations

The TAC for this stock has consistently been set above the ICES advice. The quota is a common TAC for the entire inshore area and does not distinguish between stocks. Furthermore, it is allowed to fish offshore on the inshore quota. Historically, when the TAC was reached, the TAC was increased. Hence, the fishery in the West Greenland inshore area has always been an unlimited fishery.

Due to stock mixing, ICES is currently not able to accurately estimate the stock proportions in the catches. Therefore, the TAC can be set higher than the ICES advice, while still being in accordance with the advice. ICES cannot advice on such a TAC level.

15.13 Ecosystem considerations

The gear used for this fishery have little effect on the ecosystem, especially the main gear (pound-net).

15.14 Regulations and their effects

The fishery has never been limited by a TAC, as the TAC has always been set well above the fleet capacity or raised when reached. Therefore, it is unknown what the effect would be of limiting the fishery.

15.15 Changes in fishing technology and fishing patterns

With the northward expansion of the fishery over the past decade, there has been an increase in the importance of the gill nets, long liners and hooks. This has changed the selectivity of the fishery, as these gears have a higher selectivity for the older ages. This is also reflected in the assessment, where the F selectivity has gradually increased in recent years and the SAM model is explicitly able to handle time-varying selectively (Nielsen and Berg, 2014).

15.16 Changes in the environment

No data is collected to support any conclusions.

15.17 Benchmark 2022

Inshore catches have recently increased to historic highs. New genetic investigations of especially the inshore component reveals that the WestGreenland offshore component (cod.21.1.a-e) is mixing with the inshore component to a larger extent than previously thought (Christensen 2019, Buch et al. 2021, Retzel 2021a, Retzel 2021c).

The main aim of the benchmark is to move away from using the current simplified geographical borders to separate the three cod stocks in Greenland waters. This will be done by developing a modelling approach that can use genetic data based on samples covering the distribution of the three stocks (Buch et al. 2021). The model will utilize the spatial resolution of the genetics data to estimate the split between the stocks along a spatial gradient. The catch and survey data will then be split into separate stocks and used as input into an analytical assessment models for each stock. This would account for differences in stock dynamics between stocks and may improve the understanding of migration patterns.

15.18 References

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15.19 Tables

Table 15.2.1. Cod catches (t) divided into NAFO divisions, caught in the inshore fishery (1911–1993: Horsted 2000, 1994–2006: ICES 2007, Statistic Greenland, 2007-present: Greenland Fisheries License Control). ICES 14.b = inshore East Greenland.

	NAFO divisions								
Year	1A	1B	1C	1D	1E	1F	Unknown NAFO div.	Total West Greenland	ICES 14b
1911				19				19	
1912				5				5	
1913				66				66	
1914				60				60	
1915		47	6	45				98	
1916		66	24	103				193	
1917		67	28	59				154	
1918		106	26	140		169		441	
1919		39	37	140	148	137		501	
1920		117	32	187	23	95		454	
1921		116	92	97	7	196		508	
1922		82	178	144	40	158		602	
1923		120	116	147	0	307		690	
1924		131	223	221	1	267		843	
1925		122	371	318	45	168		1024	
1926		97	785	673	170	499		2224	
1927		282	974	982	305	1027		3570	
1928		426	888	1153	497	1199		4163	
1929		1479	1572	1335	642	2052		7080	
1930	137	2208	2326	1681	994	2312		9658	
1931	315	1905	2026	1520	835	2453		9054	
1932	358	1713	2130	1042	731	3258		9232	
1933	304	1799	1743	1148	948	2296		8238	
1934	451	2080	1473	652	921	3591		9168	

	NAFO divisions								
Year	1A	1B	1C	1D	1E	1F	Unknown NAFO div.	Total West Greenland	ICES 14b
1935	524	1870	1277	769	670	2466		7576	
1936	329	2039	1199	705	717	2185		7174	
1937	135	1982	1433	854	496	2061		6961	
1938	258	1743	1406	703	347	1035		5492	
1939	416	2256	1732	896	431	1430		7161	
1940	482	2478	1600	1061	646	1759		8026	
1941	636	3229	1473	823	593	1868		8622	
1942	879	3831	2249	1332	1003	2733		12027	
1943	1507	5056	2016	1240	1134	2073		13026	
1944	1795	4322	2355	1547	1198	2168		13385	
1945	1585	4987	2844	1207	1474	2192		14289	
1946	1889	5210	2871	1438	1139	2715		15262	
1947	1573	5261	3323	2096	1658	4118		18029	
1948	1130	5660	3756	1657	1652	4820		18675	
1949	1403	4580	3666	2110	2151	3140		17050	
1950	1657	6358	4140	2357	2278	4383		21173	
1951	1277	5322	3324	2571	2101	3605		18200	
1952	646	4443	2906	2437	2216	4078		16726	
1953	1092	5030	3662	5513	3093	4261		22651	
1954	950	6164	3118	3275	1773	3418		18698	
1955	591	5523	3225	4061	2773	3614		19787	
1956	475	5373	3175	5127	3292	3586		21028	
1957	277	6146	3282	5257	4380	5251		24593	
1958	19	6178	3724	5456	3975	6450		25802	
1959	237	6404	5590	5009	3767	6570		27577	
1960	188	6741	6230	3614	3626	6610		27009	
1961	601	6569	6726	4178	6182	9709		33965	

	NAFO divisions								
Year	1A	1B	1C	1D	1E	1F	Unknown NAFO div.	Total West Greenland	ICES 14b
1962	315	7809	6269	3824	5638	11525		35380	
1963	295	4877	3178	2804	3078	9037		23269	
1964	275	3311	2447	8766	2206	4981		21986	
1965	325	5209	4818	6046	2477	5447		24322	
1966	483	8738	5669	7022	2335	4799		29046	
1967	310	5658	6248	6747	2429	6132		27524	
1968	142	1669	2738	6123	2837	7207		20716	
1969	57	1767	4287	7540	2017	5568		21236	
1970	136	1469	2219	3661	2424	5654		15563	
1971	255	1807	2011	3802	1698	3933		13506	
1972	263	1855	3328	3973	1533	3696		14648	
1973	158	1362	1225	3682	1614	1581		9622	
1974	454	926	1449	2588	1628	1593		8638	
1975	216	1038	1930	1269	964	1140		6557	
1976	204	644	1224	904	1367	831		5174	
1977	216	580	2505	2946	3521	4231		13999	
1978	348	1587	3244	2614	4642	7244		19679	
1979	433	1768	2201	6378	9609	15201		35590	
1980	719	2303	2269	7781	10647	14852		38571	
1981	281	2810	3599	6119	7711	11505	7678	39703	
1982	206	2448	3176	7186	4536	3621	5491	26664	
1983	148	2803	3640	7430	5016	2500	7205	28742	
1984	175	3908	1889	5414	1149	1333	6090	19958	
1985	149	2936	957	1976	1178	1245		8441	
1986	76	1038	255	1209	1456	1268		5302	
1987	77	2366	423	6407	3602	1326	403	14604	
1988	333	6294	1342	2992	3346	4484		18791	

	NAFO divisions								
Year	1A	1B	1C	1D	1E	1F	Unknown NAFO div.	Total West Greenland	ICES 14b
1989	634	8491	5671	8212	10845	4676		38529	
1990	476	9857	1482	9826	1917	5241		28799	
1991	876	8641	917	2782	1089	4007		18312	
1992	695	2710	563	1070	239	450		5727	
1993	333	327	168	970	19	109		1926	
1994	209	332	589	914	11	62		2117	
1995	53	521	710	332	4	81		1701	
1996	41	211	471	164	11	46		944	
1997	18	446	198	99	13	130	282	1186	
1998	9	118	79	78	0	38		322	
1999	68	142	55	336	8	4		613	
2000	154	266	0	332	0	12		764	
2001	117	1183	245	54	0	81		1680	
2002	263	1803	505	214	24	813		3622	
2003	1109	1522	334	274	3	479	1494	5215	
2004	535	1316	242	116	47	84	2608	4948	
2005	650	2351	1137	1162	278	382	83	6043	
2006	922	1682	577	943	630	1461	1173	7388	
2007	416	2547	1195	1842	659	4391		11050	42
2008	870	3066	1539	3172	225	1133		10005	6
2009	325	1288	1189	2009	1142	1581		7534	2
2010	559	2990	1607	1795	1458	859		9268	2
2011	567	2364	2850	2905	1274	1047		11007	0
2012	546	1376	2061	4375	1989	325		10672	0.02
2013	1506	2552	2784	4711	1450	198		13202	35
2014	3084	6142	3710	4629	684	82		18331	38
2015	4088	7912	6426	6613	117	115		25272	50

	NAFO divisions								
Year	1A	1B	1C	1D	1E	1F	Unknown NAFO div.	Total West Greenland	ICES 14b
2016	5929	11466	11270	5279	87	173		34204	39
2017	5797	11110	10060	4066	56	131		31220	82
2018	2213	6422	6190	7043	31	390		22290	51
2019	1987	2925	4214	8673	131	1823		19753	143
2020	1382	2324	4482	7412	222	2104		17926	223

Table 15.2.2: Landings (%) divided into month and gear and NAFO divisions and gear.

Gear/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Poundnet	0.006%		0.1%	2%	13%	24%	19%	7%	2%	2%	1%	1%	**69%**
Gillnet	0.3%	0.4%	0.4%	0.5%	1%	0.2%	1%	0.3%	0.2%	1%	1%	1%	**6%**
Jig	0.1%	0.2%	0.2%	0.2%	0.4%	1%	2%	2%	1%	1%	0.5%	0.1%	**8%**
Longline	2%	2%	1%	2%	1%	1%	1%	1%	1%	2%	2%	2%	**17%**
Total	**2%**	**2%**	**2%**	**5%**	**15%**	**25%**	**22%**	**10%**	**4%**	**5%**	**4%**	**4%**	

Gear/NAFO	1AUM	1AUP	1AX	1B	1C	1D	1E	1F	Total	14b	
Poundnet	1%		1%	10%	20%	29%	1%	7%	**69%**		
Gillnet	0.2%		2%	2%	0.3%	0.4%	0.01%	2%	**6%**		
Jig	0.1%		1%	1%	2%	3%	0.3%	1%	**8%**	6%	
Longline	1%	0.001%	1%	0.2%	3%	10%	0.03%	2%	**17%**	94%	
Total	**3%**		**5%**	**13%**	**25%**	**41%**	**1%**	**12%**			

Table 15.2.3 Catches (t) divided into month and NAFO Divisions, caught by the coastal fisheries.

NAFO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
1AUM	8	17	18	25	23	17	14	208	85	22	7	7	451	3%
1AUP														
1AX	22	55	58	42	36	157	204	67	57	87	113	33	931	5%
1B	0.1	1	7	47	273	813	416	170	62	122	207	206	2324	13%
1C	67	33	24	76	783	1302	1152	355	94	231	202	163	4482	25%
1D	268	243	189	588	1117	1693	1372	685	333	426	245	253	7412	41%
1E	0.1	0.1	4	21	54	6	40	57	29	8	1	2	222	1%
1F	19	26	35	42	329	561	780	166	50	55	23	18	2104	12%
Total	384	375	335	841	2615	4549	3978	1708	710	951	798	682	17926	
%	2%	2%	2%	5%	15%	25%	22%	10%	4%	5%	4%	4%		
ICES 14b				1	1	1	22	37	63	79	19		223	

Table 15.2.4 Estimated commercial landings in numbers ('000) at age, and total tones by year. * no sampling.

Year	Age								Tonnes
	3	4	5	6	7	8	9	10+	Landed
1976	2508	924	556	287	38	31	11	7	5174
1977	467	5437	1100	883	179	7	142	46	13999
1978	97	1262	9904	132	68	7	3		19679
1979	323	2297	2380	8281	170	96	4	14	35590
1980	4343	4334	1646	806	6492	106	29	37	38571
1981	87	15793	5225	725	499	2906	61	17	39703
1982	3013	1587	6309	1545	798	152	610	154	26664
1983	229	16877	1381	4352	368	139	65	75	28742
1984	520	4451	9269	346	634	18	42	12	19958
1985	5	2400	1028	2229	196	363	14	78	8441
1986	286	178	896	460	721	16	102	38	5302
1987	5503	1334	228	710	340	1084	46	265	14604
1988	419	15588	150	51	39	90	161	12	18791
1989	15	5962	23956	271	46	2	93	176	38529
1990	212	2997	15403	6732	33	11	7	16	28799
1991	124	6022	4910	5695	330	0			18312
1992	8	2408	2344	452	139	46	13	5	5727
1993	28	661	575	206	34	41	10	7	1926
1994	22	1468	342	62	45	8	11	1	2117
1995	1	834	773	37	5	0	0		1701
1996	2	165	362	130	25	3	1	0	944
1997	1	397	311	179	31	0			1186
1998*									322
1999	87	465	105	1	0	0			613
2000	4	228	336	7	0	0			764
2001*									1680
2002	532	2243	657	29	9	1	0	0	3622

Year	Age								Tonnes
	3	4	5	6	7	8	9	10+	Landed
2003	152	581	1547	258	51	16	15	11	5215
2004	530	1669	1095	228	37	3			4948
2005	1392	2408	944	186	36	10	4	0	6043
2006	4256	3363	680	22	0	0	0		7388
2007	1944	7910	1010	116	38	13	8	4	11050
2008	1176	5012	2793	319	36	6	2		10005
2009	487	3540	2372	194	13	3	0	4	7534
2010	301	1091	2475	1524	141	32	21	27	9268
2011	129	2929	2567	1480	255	90	12	7	11007
2012	735	1725	2681	850	182	21	13	13	10672
2013	143	3806	2477	1083	361	115	67	9	13202
2014	40	1389	4024	2292	328	168	103	52	18331
2015	20	2006	5680	3008	1337	133	9	8	25272
2016	32	2146	9701	5732	1179	239	57	7	34203
2017	44	1384	6351	5241	3370	498	168	48	31220
2018	21	2214	4255	4180	2319	850	169	76	22290
2019	47	1941	6727	3679	1885	624	145	46	19753
2020	113	1686	4418	4437	987	534	136	63	17926

Table 15.2.5: Survey effort in the Greenland Inshore Gill-net survey (nos. of valid net settings)

Division (area)	1B (Kangtsiaq)	1B (Sisimiut)	1C	1D	1F	Total
1985		3		38	27	68
1986		26		22	23	71
1987		24		27	26	77
1988		21		24	24	69
1989		28		19	32	79
1990		18		21	18	57
1991		23		24	20	67
1992		27		29	23	79
1993		23		25	19	67
1994		20		29	17	66
1995		24		21	20	65
1996		26		25	-	51
1997		20		23	-	43
1998		24		26	22	72
1999		-		24	-	24
2000		-		27	20	47
2001		-		-	-	-
2002		21		20	-	41
2003		33		27	-	60
2004		27		31	-	58
2005		25		28	-	53
2006		45		51	-	96
2007		52		-	39	91
2008		-		58	60	118
2009		-		58	18	76
2010		66		52	-	118
2011		57		44	-	101
2012		54		52	-	106

Division (area)	1B (Kangtsiaq)	1B (Sisimiut)	1C	1D	1F	Total
2013		58		52	-	110
2014		60		41	-	101
2015		59		44	-	103
2016		58		40	-	98
2017	60	57	59	46	-	222
2018		58	61	52	-	171
2019	50	48	47	54	-	199
2020	-	53	50	50	-	153

Table 15.2.6: NAFO Div. 1B. Cod abundance indices (numbers of cod caught per 100 hours net settings) by age in the West Greenland inshore gill-net survey. Na = data not available.

Year	Age								All
	1	2	3	4	5	6	7	8+	
1985	26	23	0	6	0	0	0	0	54
1986	4	245	16	8	2	2	0	0	278
1987	0	122	233	25	1	0	0	0	381
1988	0	33	130	111	2	0	0	0	276
1989	1	110	83	57	32	1	0	0	283
1990	0	109	108	62	53	12	0	0	344
1991	0	3	131	53	11	3	0	0	202
1992	0	43	10	18	3	0	0	0	74
1993	0	22	22	2	1	0	0	0	47
1994	4	8	19	12	0	0	0	0	43
1995	2	115	19	7	1	0	0	0	143
1996	0	28	40	7	1	0	0	0	77
1997	0	14	8	3	1	0	0	0	26
1998	2	7	4	6	3	0	0	0	23
1999	na	na	na	na	na	na	na	na	na
2000	na	na	na	na	na	na	na	na	na
2001	na	na	na	na	na	na	na	na	na

Year	Age								All
	1	2	3	4	5	6	7	8+	
2002	31	207	72	21	9	1	0	0	340
2003	1	68	69	21	3	0	0	0	163
2004	32	28	29	9	5	0		0	102
2005	47	123	35	7	5	1	3	0	221
2006	32	148	60	24	1	1	0	0	170
2007	7	170	82	15	1	0	0	0	275
2008	na	na	na	na	na	na	na	na	na
2009	na	na	na	na	na	na	na	na	na
2010	138	155	120	58	12	1	0	0	484
2011	20	526	106	44	19	1	0	0	717
2012	7	184	304	30	8	3	0	0	536
2013	4	158	105	104	27	8	1	1	408
2014	7	46	45	25	19	4	0	1	146
2015	2	39	44	59	49	39	3	1	236
2016	6	31	98	42	36	23	7	2	245
2017	1	6	71	79	33	23	10	2	225
2018	1	27	25	26	15	6	2	1	103
2019	0	80	136	19	35	12	1	2	285
2020	17	45	99	51	15	5	0	1	233

Table 15.2.6, *continued* : NAFO Div. 1D. Cod abundance indices (numbers of cod caught per 100 hours net settings) by age in the West Greenland inshore gill-net survey.

Year	Age								All
	1	2	3	4	5	6	7	8+	
1985	68	77	0	3	3	3	0	1	155
1986	0	96	15	0	0	0	0	0	114
1987	1	16	68	5	0	0	0	0	90
1988	0	20	48	30	1	0	0	0	99
1989	0	78	47	13	13	0	0	0	152
1990	0	14	35	4	4	3	0	0	60
1991	124	3	17	6	2	1	0	0	154
1992	0	61	22	10	7	1	0	0	100
1993	0	4	57	20	2	0	0	0	83
1994	0	0	6	5	1	0	0	0	12
1995	0	3	2	4	4	0	0	0	12
1996	0	1	1	1	2	0	0	0	4
1997	3	3	1	0.2	0.5	0.4	0.1	0	8
1998	0	10	17	1	0	0	0	0	28
1999	0	0	1	3	0	0	0	0	5
2000	0	2	2	1	1	0	0	0	6
2001	na	na	na	na	na	na	na	na	na
2002	0	7	4	3	0	0	0	0	14
2003	0	6	4	2	1	0	0	0	13
2004	3	43	6	3	1	1	0	0	57
2005	9	27	7	2	0	0	0	0	45
2006	2	114	37	13	4	0	0	0	170
2007	na	na	na	na	na	na	na	na	na
2008	4	4	47	63	7	0	0	0	124
2009	4	52	14	72	23	1	0	0	166
2010	1	33	107	18	27	3	0	0	189
2011	10	45	3	18	6	4	1	0	88

Year	Age								All
	1	2	3	4	5	6	7	8+	
2012	2	52	46	21	28	2	0	1	151
2013	0	91	61	77	25	8	3	2	267
2014	0	41	74	46	27	6	1	0	196
2015	2	42	79	68	30	7	2	0	229
2016	1	59	92	34	47	9	1	1	243
2017	0	8	81	57	51	18	1	1	217
2018	0	14	50	59	44	31	10	2	210
2019	0	29	41	60	60	20	7	0	217
2020	1	7	60	24	31	32	5	5	165

Table 15.2.6, *continued* : NAFO division 1F, 1B (Kangatsiaq) and 1C Cod abundance indices (numbers of cod caught per 100 hours net settings) by age in the West Greenland inshore gill-net survey. Na = Data not available.

Year	Age NAFO 1F								All
	1	2	3	4	5	6	7	8+	
1985	204	8	1	1	1	1	1	0	217
1986	17	112	5	0	2	0	0	0	136
1987	0	143	147	1	0	0	0	0	291
1988	0	1	83	6	0	0	0	0	89
1989	0	5	2	19	2	0	0	0	29
1990	0	0	3	2	13	1	0	0	18
1991	2	2	0	2	0	1	0	0	7
1992	0	3	1	0	1	0	1	0	6
1993	0	5	2	1	0	0	0	0	8
1994	0	0	1	1	0	0	0	0	3
1995	0	0	0	0	0	0	0	0	0
1996	na	na	na	na	Na	na	na	na	na
1997	na	na	na	na	Na	na	na	na	na
1998	0	4	12	0	0	0	0	0	17
1999	na	na	na	na	Na	na	na	na	na
2000	0	14	8	0	2	0	1	0	24
2001	na	na	na	na	Na	na	na	na	na
2002	na	na	na	na	Na	na	na	na	na
2003	na	na	na	na	Na	na	na	na	na
2004	na	na	na	na	Na	na	na	na	na
2005	na	na	na	na	Na	na	na	na	na

Year	Age NAFO 1F								All
	1	2	3	4	5	6	7	8+	
2006	na	na	na	na	Na	na	na	na	na
2007	6	90	9	21	1	0	0	0	108
2008	8	17	30	4	2	0	0	0	62
2009	3	39	14	15	0	0	0	0	71
2010–2020	na	na	na	na	na	na	na	na	na

Year	Age NAFO 1B (Kangatsiaq)								All
	1	2	3	4	5	6	7	8+	
2017	1	2	40	8	13	6	5	1	75
2018	na	na	na	na	na	na	na	na	Na
2019	0	26	14	6	5	1	0	0	52

Year	Age NAFO 1C								All
	1	2	3	4	5	6	7	8+	
2017	1	9	94	40	35	18	12	1	210
2018	0	13	19	47	19	11	10	3	122
2019	0	20	34	14	40	4	2	2	116
2020	1	6	56	33	30	18	2	1	147

Table 15.2.7: Cod abundance indices (numbers of cod caught per 100 hours net settings) by age in the Greenland Halibut gill net survey in Disco Bay. Na = Data not available.

Year/age	1	2	3	4	5	6	7	8	9	10+	Total
2005	0	0.07	0.35	0.51	0.51	0.04	0.04	0	0	0	1.52
2006	0	0.21	0.12	0.02	0	0.07	0.04	0	0	0	0.46
2007	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2008	0	0.01	0.01	0.63	3.38	1.80	0.46	0	0	0	6.29
2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2010	0	0	0.01	0.98	2.71	1.81	0.13	0	0	0	5.64
2011	0	0.48	0.17	1.26	0.93	2.94	1.38	0.10	0	0	7.26
2012	0	0.01	2.09	2.75	1.65	1.09	0.24	0.16	0	0	7.99
2013	0	0	3.45	43.43	38.21	13.59	2.58	1.06	0.41	0	102.73
2014	0	0	0.37	23.92	46.16	20.56	0.78	0.08	0.26	0.23	92.36
2015	0	0	1.18	8.13	53.86	31.50	6.05	1.70	0	0.40	102.82
2016	0	0	0.6	11	29	59	17	1	0.4	0.1	119
2016 cod st.	0	0	0	5	9	12	4	0.1	0	0	30
2017	0	0	3	4	11	13	17	2	0	0	50
2018		0.2	1	3	3	7	6	8	1	0.3	28
2019			3	3	10	10	31	20	6	0.3	83
2020			0.5	2.6	0.5	2.5	2.1	2.7	2.6	0.7	14.2

Table 15.2.8: Cod abundance indices ('000) by age and total in Disco Bay (NAFO 1AX) in the Greenland Shrimp and Fish bottom trawl survey.

Year/age	0	1	2	3	4	5	6	7	8	9	10+	All
2005	0	52	0	0	90	0	0	0	0	0	0	142
2006	0	0	117	1	1	0	0	0	0	0	0	119
2007	0	20	142	98	0	0	0	0	0	0	0	261
2008	0	38	21	25	24	0	0	0	0	0	0	108
2009	0	0	14	1	16	11	0	0	0	0	0	41
2010	0	0	7	0	9	0	0	0	0	0	0	16
2011	0	400	2907	324	47	26	5	0	0	0	0	3710
2012	0	0	1967	661	31	0	0	0	0	0	0	2659
2013	0	137	1420	1656	479	111	14	0	0	0	0	3817
2014	0	14	159	119	79	25	8	0	13	0	10	428
2015	0	93	411	1271	502	429	197	27	4	0	0	2935
2016	0	24	177	76	38	95	56	40	0	0	0	506
2017	0	19	42	386	84	50	21	64	15	0	0	681
2018	24	29	204	99	121	26	30	44	31	0	0	607
2019	0	0	103	341	139	71	0	22	18	1	0	693
2020	0	0	20	80	110	0	16	0	0	10	0	236

Table 15.3.1. Number of tagged cod in the period of 2003 to 2019 in different regions. Bank (West) = NAFO Division 1D+1E. East Greenland = NAFO Division 1F + ICES Division 14.b.

Year	Fjord	Bank (West) NAFO 1C Tovqussaq	TAGGED Bank (West) NAFO 1D + 1E Dana	East Greenland
2003	599			
2004	658			
2005	565			
2006	41			
2007	1137		1061	1047
2008	231			1296
2009	633			526
2010	88			
2011	28			403
2012	86		1563	2359
2013	186		2321	
2014				1203
2015	57			1220
2016		299	998	1912
2017	350	1871	706	
2018		115		
2019	1040	325		
2020				458

Table 15.3.2: Number of recaptured cod in the period of 2003 to 2019 in different regions. Fjord (West) = NAFO divisions 1B–1F. Bank (West) = NAFO Division 1D+1E. East Greenland = NAFO division 1F + ICES Division 14.

	Recaptures			
	Fjord (West)	Bank (West) NAFO 1C Tovqussaq	Bank (West) NAFO 1D + 1E Dana	East Greenland
Fjord (West)	547	3	29	8
Bank (West) NAFO 1C, Tovqussaq		1		4
Bank (West) NAFO 1D+1E, Dana		2	69	
East Greenland			35	118
Iceland	3		45	192

Table 15.5.1: Reference points

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5983 t	Assumed at B_{pa}	ICES (2018a)
	F_{MSY}	0.27	Stochastic simulations with segmented regression and a Beverton–Holt stock–recruitment curve from 1973 to 2018.	ICES (2018a)
Precautionary approach	B_{lim}	4346 t	Breakpoint in segmented regression	ICES (2018a)
	B_{pa}	5983 t	$B_{lim} \times e^{1.645\sigma}$, $\sigma = 0.194$	ICES (2018a)
	F_{lim}	-	Not defined	
	F_{pa}	-	Not defined	
Management plan	SSB_{mgt}	-	-	
	F_{mgt}	-	-	

Table 15.7.1: Estimated number at age in the stock

Year / Age	1	2	3	4	5	6	7	8	9	10
1976	14624	12644	62173	3692	1944	422	65	277	63	29
1977	21448	11416	10352	47991	2256	966	149	19	179	55
1978	39060	17093	8911	7874	31382	1012	359	39	10	116
1979	17196	38166	13622	7466	4781	15660	495	143	20	63
1980	35916	11597	37291	10778	4449	2056	7172	218	68	45
1981	15819	35695	7821	30757	5578	1968	859	2421	108	50
1982	8177	12696	35476	5686	15441	1848	842	269	843	73
1983	3073	6965	10189	30739	2579	5878	511	253	106	247
1984	8103	1974	5934	8173	14908	871	1879	112	110	108
1985	34624	6247	1268	4358	3463	5719	286	619	49	97
1986	24423	35476	4816	962	1627	1350	2138	88	289	58
1987	12688	20773	36350	3308	435	496	472	873	44	130
1988	16891	9930	18940	30750	1117	158	90	171	393	43
1989	8490	15613	8065	16439	14731	398	47	22	83	134
1990	4479	7889	12934	7016	8724	4183	87	15	11	53
1991	12947	2967	6767	9823	3226	2082	436	29	7	19

Year / Age	1	2	3	4	5	6	7	8	9	10
1992	4630	9732	2410	4827	3363	515	242	85	13	8
1993	2212	3656	6704	1944	1357	323	67	68	24	7
1994	2746	1608	2995	4511	697	100	50	19	26	8
1995	1837	2212	1185	2375	1579	91	20	13	8	13
1996	2487	1288	1495	970	1044	242	30	7	5	9
1997	3273	2043	860	1108	471	240	90	11	3	7
1998	3046	2429	1678	685	480	73	112	38	6	5
1999	4438	2308	1781	1330	291	33	39	51	20	5
2000	6318	3644	1749	1248	616	38	20	18	29	12
2001	7752	5269	3308	1679	623	104	23	10	11	21
2002	9750	6327	4394	2932	996	130	55	11	6	16
2003	10049	6950	4598	3104	1380	252	60	28	8	11
2004	23537	8610	5022	3340	1369	299	98	23	17	7
2005	36788	19148	7087	3436	1273	259	107	40	13	10
2006	26635	29758	15717	5344	1149	201	89	43	23	10
2007	14870	22533	22779	10835	1696	206	82	33	25	15
2008	21829	10882	18614	16616	3907	315	73	35	16	20
2009	21261	18784	9118	14076	7043	699	97	31	21	18
2010	38708	16044	15523	7300	6852	1580	232	50	20	21
2011	34175	34528	11395	11523	4286	1824	419	101	26	17
2012	24212	27262	28954	9760	6750	1411	490	163	44	18
2013	18524	22138	21277	22102	7017	2678	427	199	84	22
2014	19049	15806	18430	16978	13339	3406	898	145	81	38
2015	14871	16639	13855	17561	13358	6401	1433	330	43	31
2016	9627	14425	15259	13393	14367	7353	2444	535	124	24
2017	9962	7670	14197	13749	11181	7742	3123	834	208	57
2018	11666	9303	7646	13575	10203	6019	3073	1008	271	92
2019	9600	11724	9359	7755	11100	5349	2379	951	288	113
2020	11829	7474	11259	8258	5933	5565	1900	748	264	129

Table 15.7.2: Estimated fishing mortality-at-age in the stock

Year Age	1	2	3	4	5	6	7	8	9	10
1976			0.037	0.280	0.529	0.813	1.030	0.324	0.417	0.417
1977			0.035	0.273	0.566	0.750	1.036	0.390	0.510	0.510
1978			0.032	0.303	0.567	0.603	0.790	0.446	0.493	0.493
1979			0.034	0.361	0.632	0.630	0.749	0.541	0.494	0.494
1980			0.039	0.435	0.681	0.676	0.880	0.608	0.618	0.618
1981			0.035	0.496	0.816	0.742	0.960	0.751	0.708	0.708
1982			0.038	0.540	0.795	0.956	1.047	0.717	0.972	0.972
1983			0.035	0.586	0.831	0.941	1.178	0.651	0.872	0.872
1984			0.034	0.649	0.798	0.895	0.967	0.587	0.692	0.692
1985			0.027	0.690	0.789	0.856	0.930	0.577	0.751	0.751
1986			0.030	0.636	0.892	0.951	0.813	0.545	0.854	0.854
1987			0.028	0.693	0.863	1.333	0.888	0.597	1.109	1.109
1988			0.019	0.629	0.898	1.141	1.048	0.558	1.024	1.024
1989			0.012	0.600	1.119	1.347	0.983	0.518	1.159	1.159
1990			0.011	0.667	1.313	1.797	0.970	0.601	1.012	1.012
1991			0.010	0.825	1.658	1.963	1.145	0.647	0.966	0.966
1992			0.007	0.906	2.095	1.813	1.086	0.760	0.953	0.953
1993			0.006	0.802	2.320	1.628	1.070	0.747	0.920	0.920
1994			0.005	0.757	1.859	1.351	1.058	0.704	0.690	0.690
1995			0.004	0.637	1.665	0.951	0.870	0.672	0.614	0.614
1996			0.004	0.554	1.408	0.763	0.796	0.586	0.548	0.548
1997			0.005	0.579	1.685	0.588	0.684	0.506	0.540	0.540
1998			0.008	0.572	2.266	0.440	0.618	0.437	0.534	0.534
1999			0.012	0.537	1.833	0.334	0.576	0.380	0.528	0.528
2000			0.014	0.499	1.572	0.365	0.548	0.337	0.529	0.529
2001			0.024	0.497	1.373	0.440	0.533	0.303	0.549	0.549
2002			0.040	0.577	1.212	0.529	0.542	0.276	0.605	0.605
2003			0.052	0.629	1.365	0.697	0.678	0.314	0.730	0.730
2004			0.072	0.765	1.469	0.778	0.686	0.312	0.662	0.662

Year Age	1	2	3	4	5	6	7	8	9	10
2005			0.088	0.881	1.568	0.791	0.691	0.335	0.597	0.597
2006			0.091	0.864	1.520	0.711	0.714	0.356	0.555	0.555
2007			0.073	0.774	1.519	0.828	0.665	0.376	0.499	0.499
2008			0.055	0.584	1.467	0.945	0.625	0.348	0.475	0.475
2009			0.040	0.440	1.242	0.958	0.560	0.360	0.527	0.527
2010			0.026	0.336	1.064	1.124	0.642	0.467	0.700	0.700
2011			0.018	0.289	0.892	1.124	0.715	0.560	0.726	0.726
2012			0.013	0.235	0.726	0.998	0.739	0.554	0.803	0.803
2013			0.009	0.201	0.593	0.866	0.829	0.703	0.883	0.883
2014			0.006	0.166	0.549	0.784	0.812	0.879	1.050	1.050
2015			0.004	0.154	0.508	0.758	0.841	0.813	0.867	0.867
2016			0.004	0.153	0.509	0.744	0.882	0.815	0.811	0.811
2017			0.004	0.153	0.504	0.755	0.949	0.923	0.896	0.896
2018			0.004	0.165	0.514	0.779	0.975	1.033	0.949	0.949
2019			0.005	0.179	0.540	0.825	0.974	1.074	0.924	0.924
2020			0.006	0.187	0.576	0.863	0.963	1.092	0.904	0.904

Table 15.7.3: Cod in NAFO Subarea 1, inshore. Catch scenarios for 2022 assuming $F_{2020} = F_{2021}$. All weights are in tonnes.

Rationale	Catch (2022)	F (2022)	SSB (2023)	% SSB change *	% advice change **	% TAC change ***
ICES advice basis						
MSY approach: F_{MSY}	4780	0.268	23880	+18%	-10%	-75%
Other scenarios						
F = 0	0	0	29570	+46%	-100%	-100%
$F = F_{2020}$ (*status quo*)	10141	0.736	17907	-11%	+92%	-52%
$SSB_{2022} = B_{lim}$	24387	11.7	4261	-79%	+410%	+16%
$SSB_{2022} = B_{pa}$= MSY $B_{trigger}$	22191	5.6	6024	-70%	+364%	+6%

*** SSB2023 relative to SSB2022.**
**** Advice value for 2022 relative to the advice value for 2021, from this updated assessment.**
***** Advice value for 2022 relative to the TAC in 2021, from this updated assessment.**

15.20 Figures

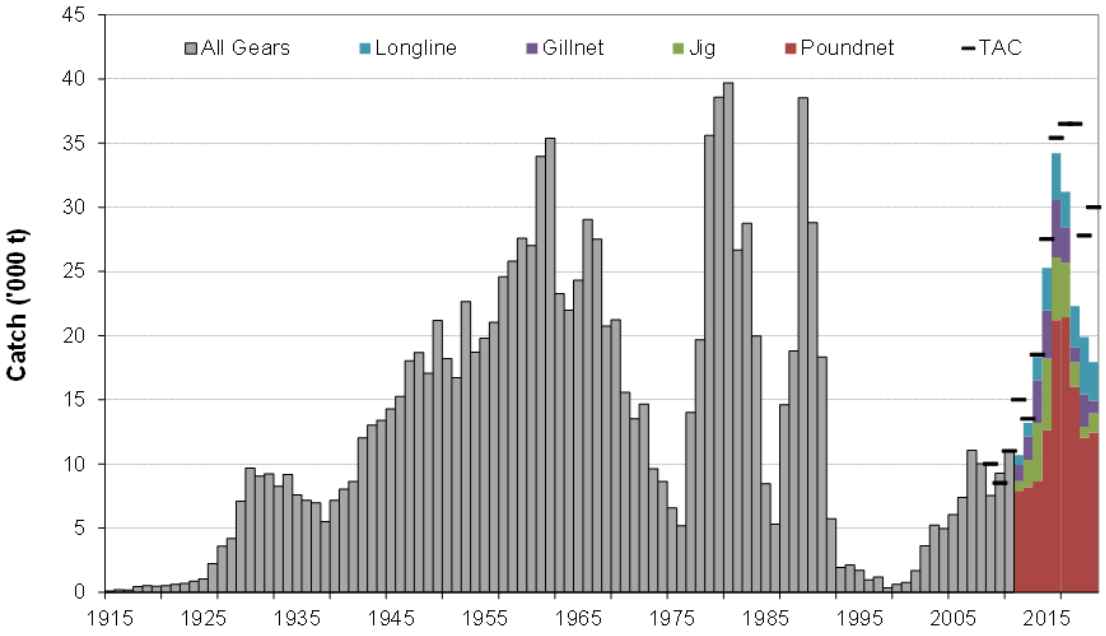

Figure 15.2.1 Inshore landings from West Greenland (Horsted, 1994; 2000). From 2012 divided into gears.

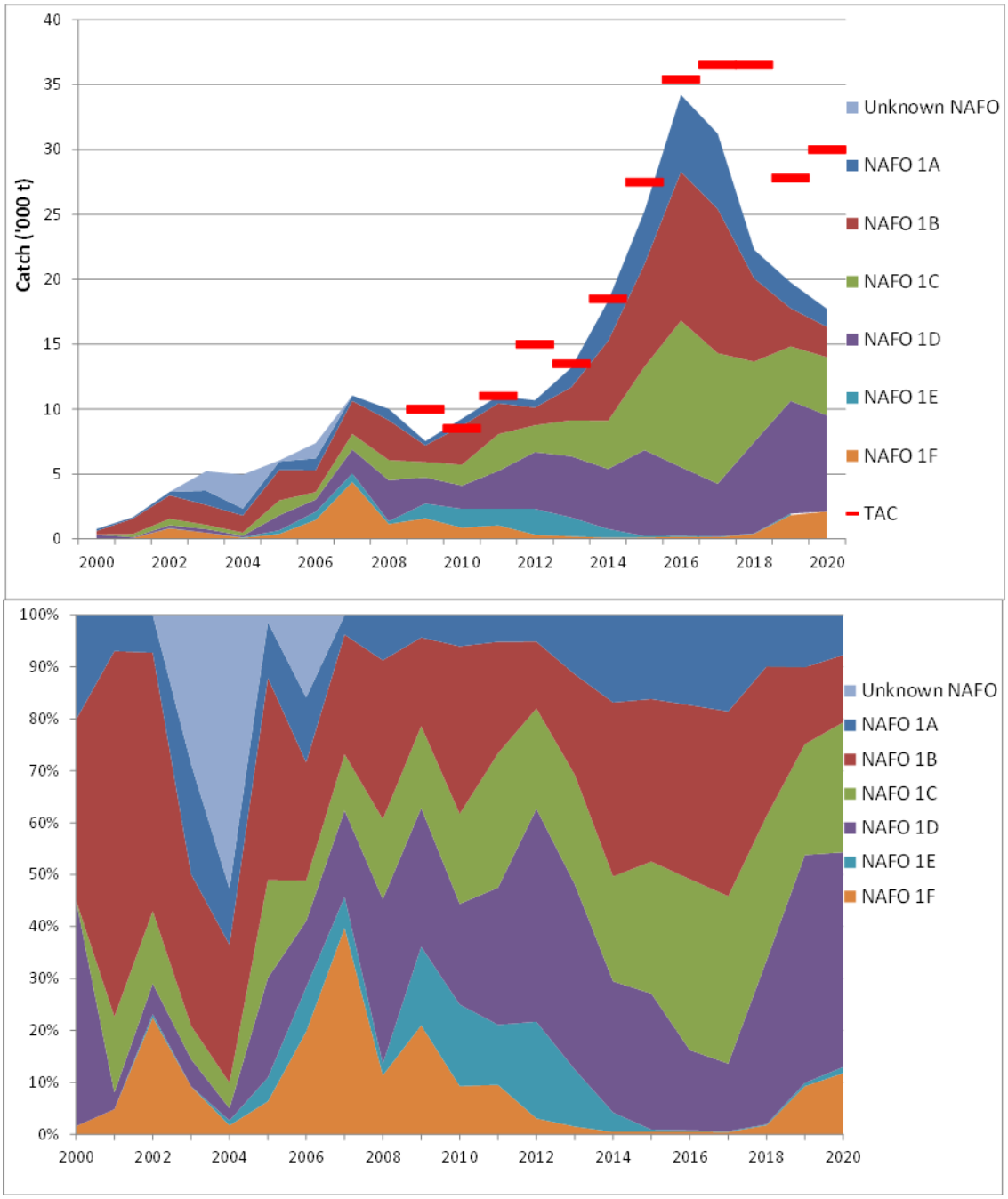

Figure 15.2.2. Total (top) and percentage (bottom) cod catches and TAC in the inshore fishery by NAFO divisions from 2000.

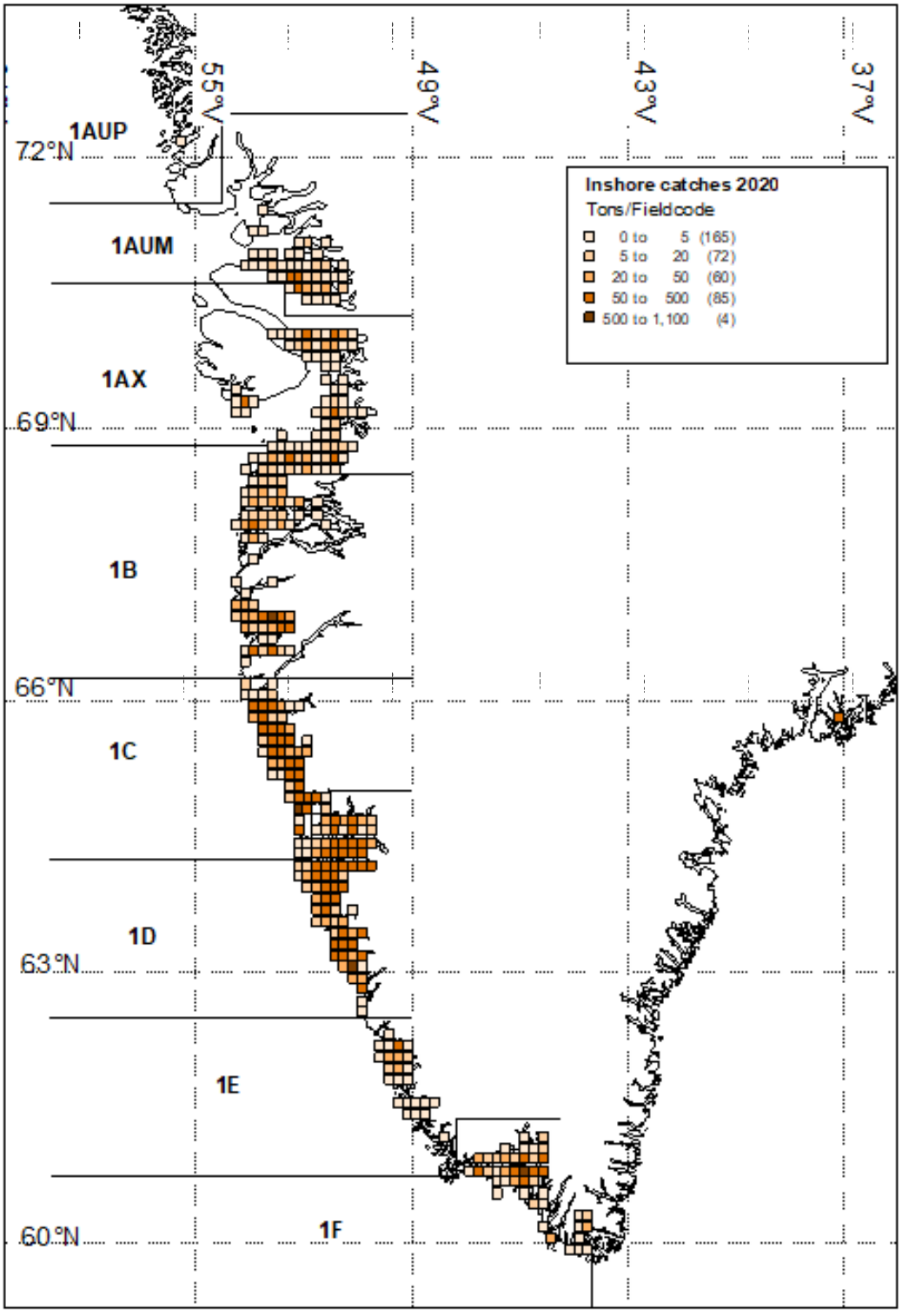

Figure 15.2.3. Distribution of commercial fishery along the coastline of West Greenland in total tonnes by field code.

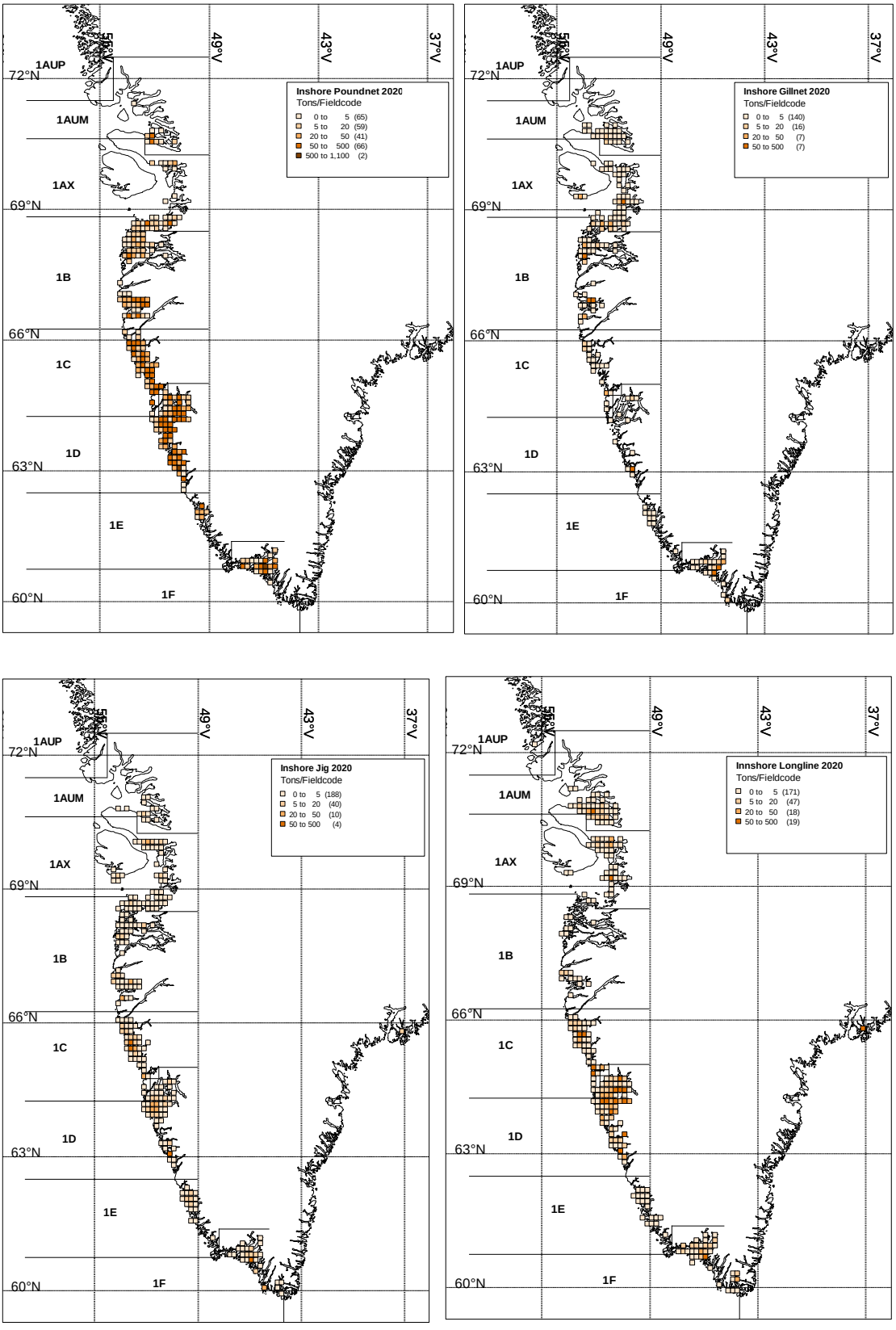

Figure 15.2.4 Distribution of the inshore commercial fishery by gear (tonnes/fieldcode).

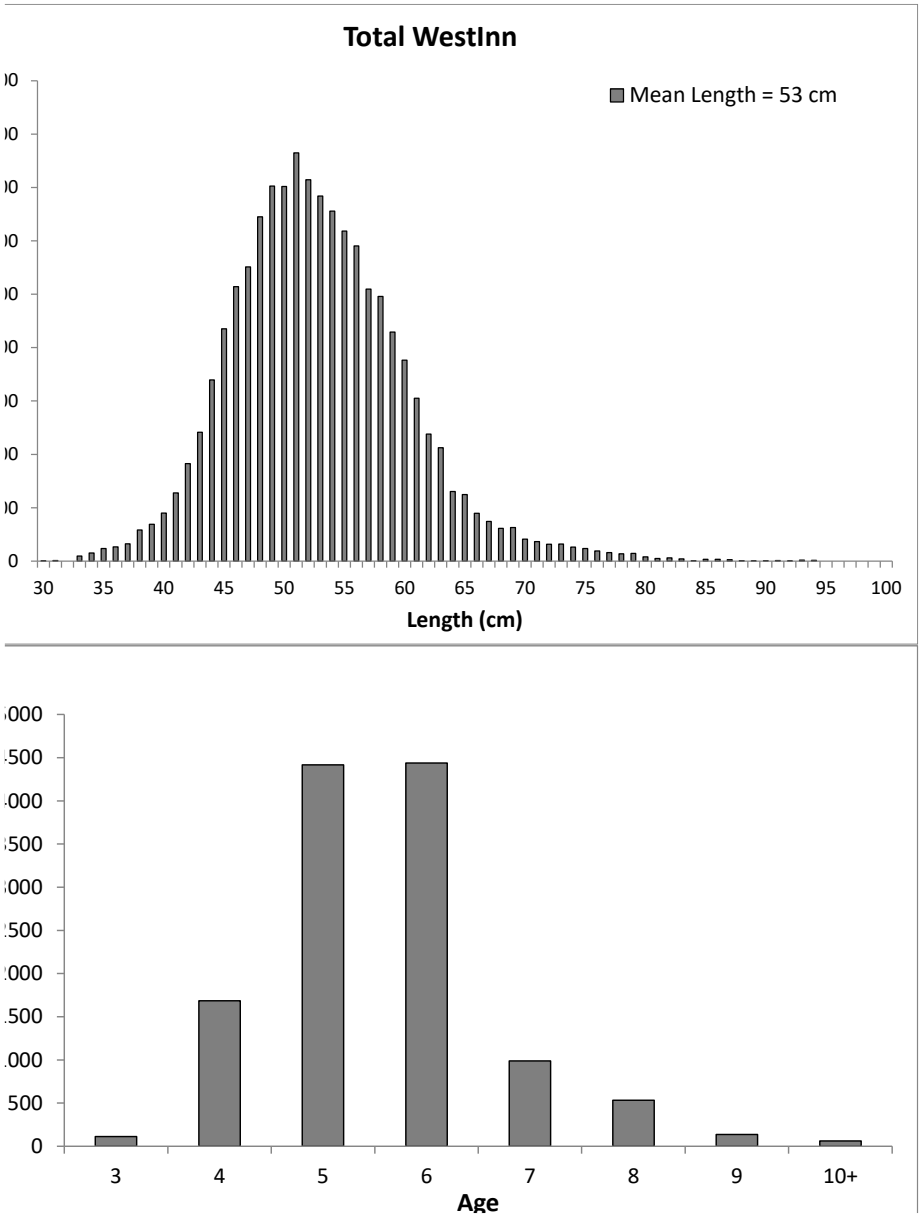

Figure 15.2.5. Total length and age distributions of inshore cod catches.

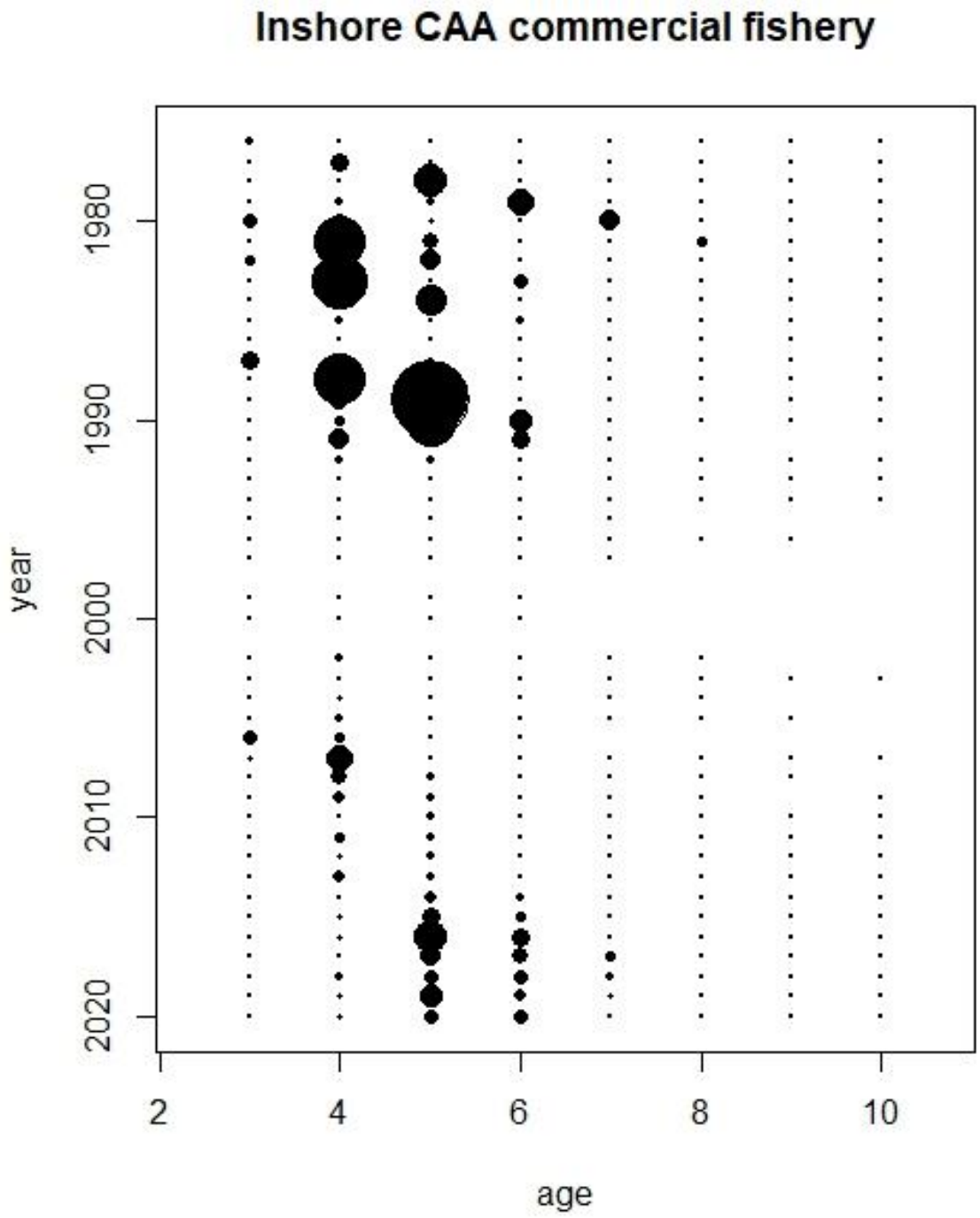

Figure 15.2.6. Catch at age in the commercial fishery in the West Greenland inshore area. Size of circles represents size of catch numbers.

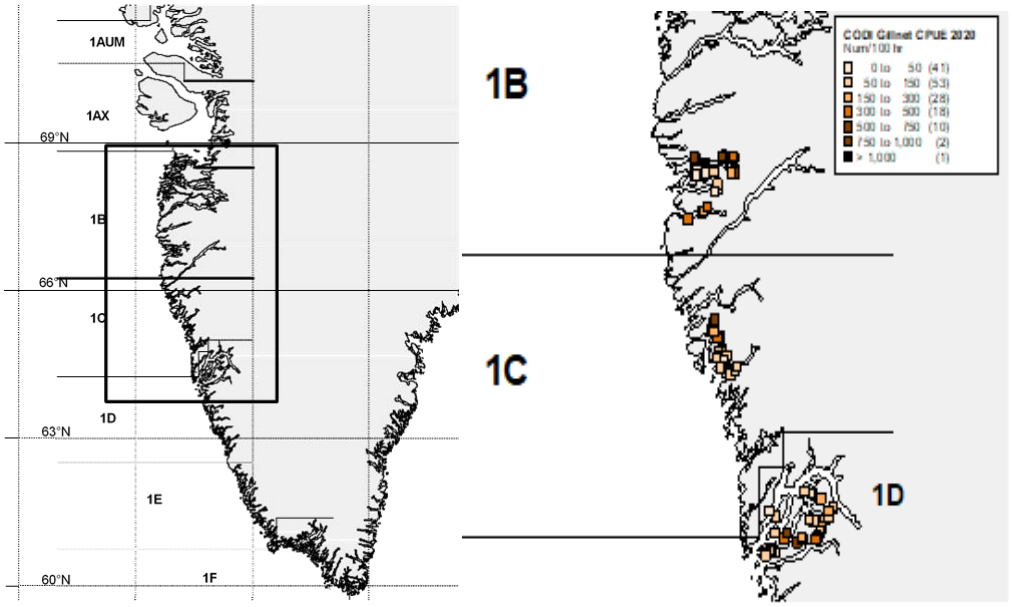

Figure 15.2.7. The inshore gill net survey area on the Greenland West coast. Survey catch rates are indicated on both as #caught/100h.

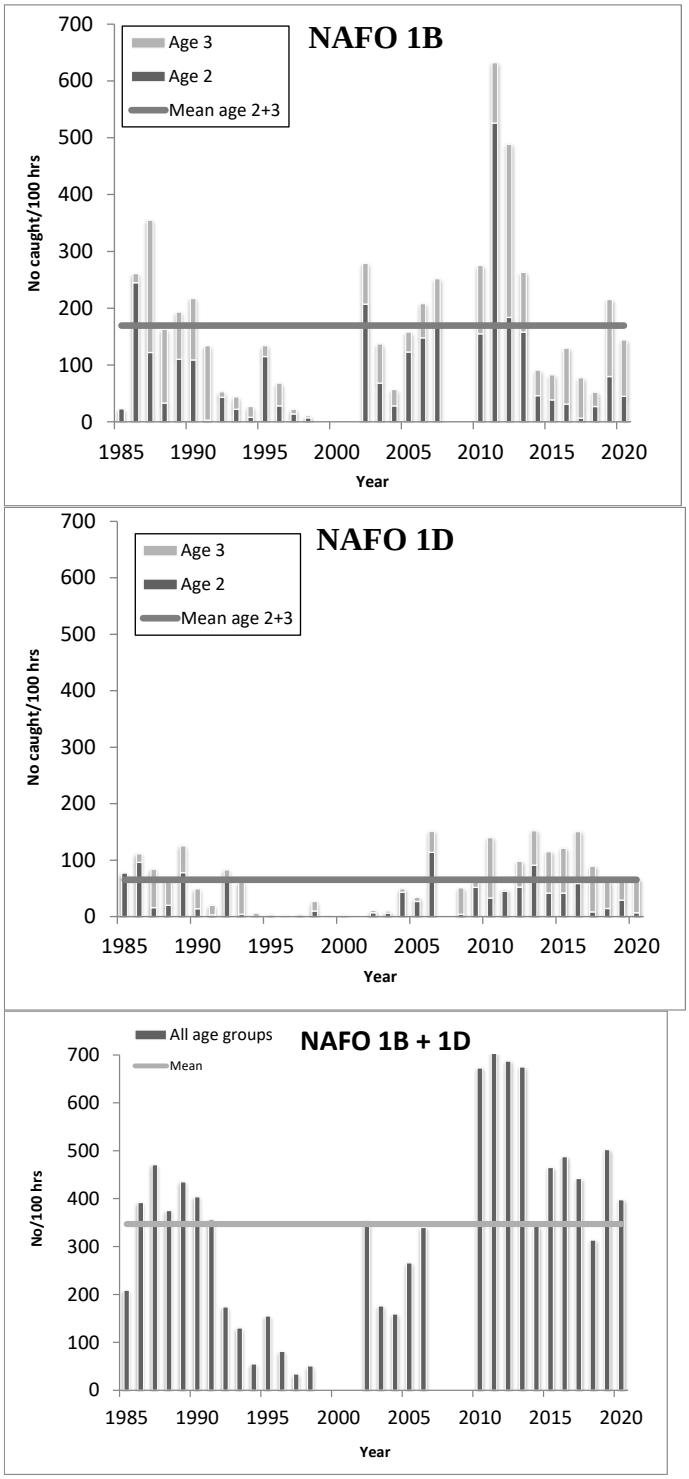

Figure 15.2.8: Recruitment indices (numbers caught/100 hr.) for ages 2 and 3 in 1B (top), 1D (middle) and all age groups (ages 1-8) 1B and 1D combined (lower) in West Greenland. Simultaneous surveys were not carried out 1999–2001 and 2007–2009.

Figure 15.2.9: Genetic composition in the inshore fishery in 2019 by NAFO divisions. Left: Samples analysed, right: In percentage.

Figure 15.2.10: Genetic composition in the inshore fishery in 2019 by Yearclasses within NAFO division 1D and 1F. Left: Samples analysed, Right: in percentage.

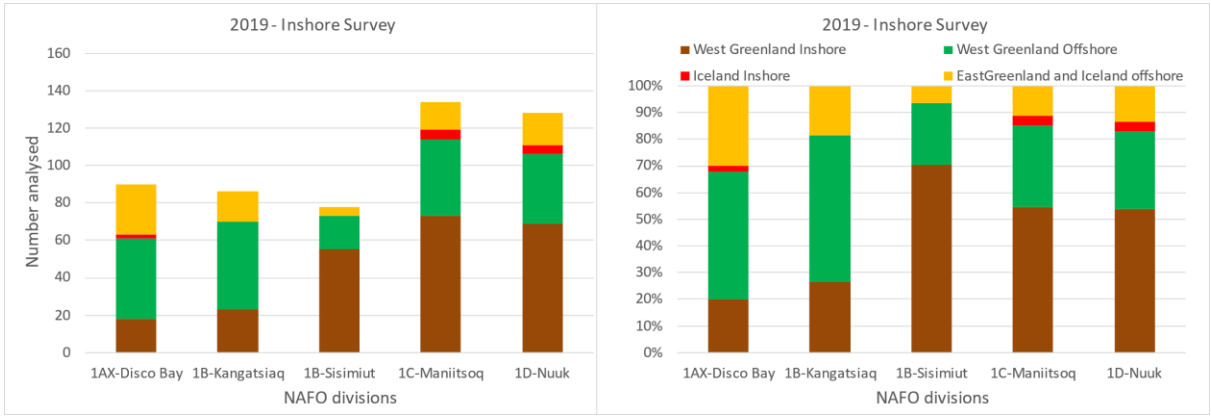

Figure 15.2.11: Genetic composition in the inshore surveys by fjord systems. Left: Samples analysed, right: In percentage.

Figure 15.2.12: Genetic composition in the inshore surveys by yearclass and fjord systems. Left: Samples analysed, right: In percentage.

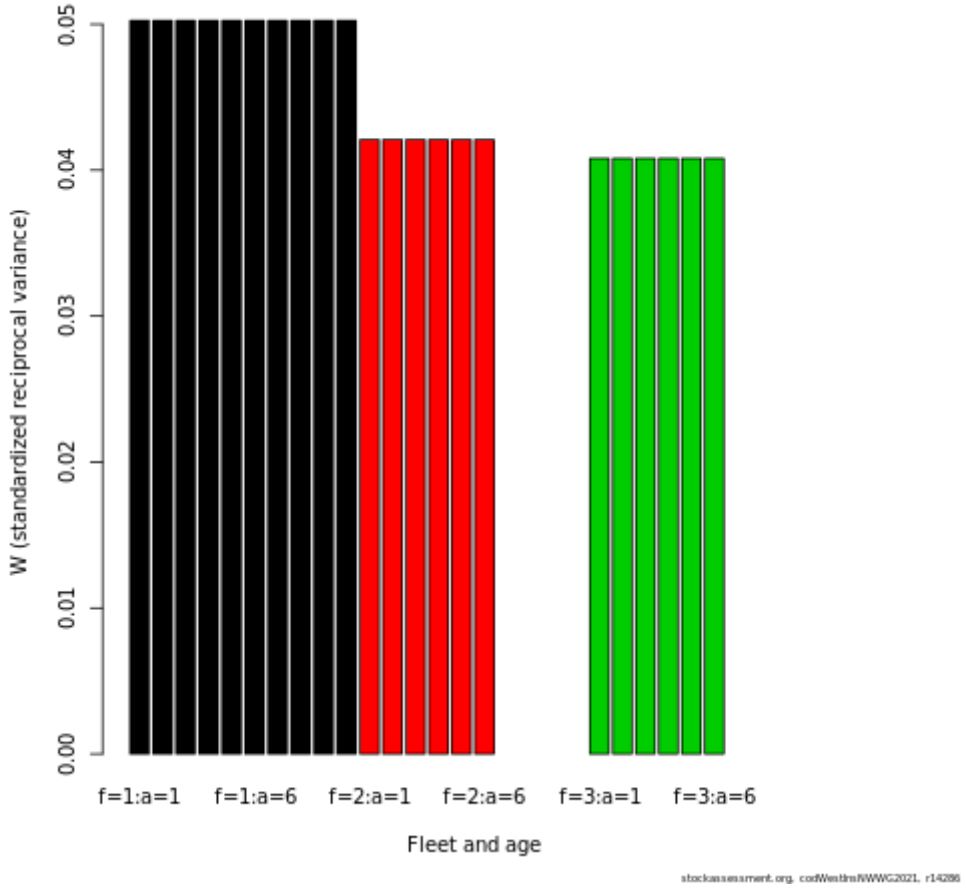

Figure 15.6.1: Standardized reciprocal variance from left to right: catches, 1B survey and 1D survey.

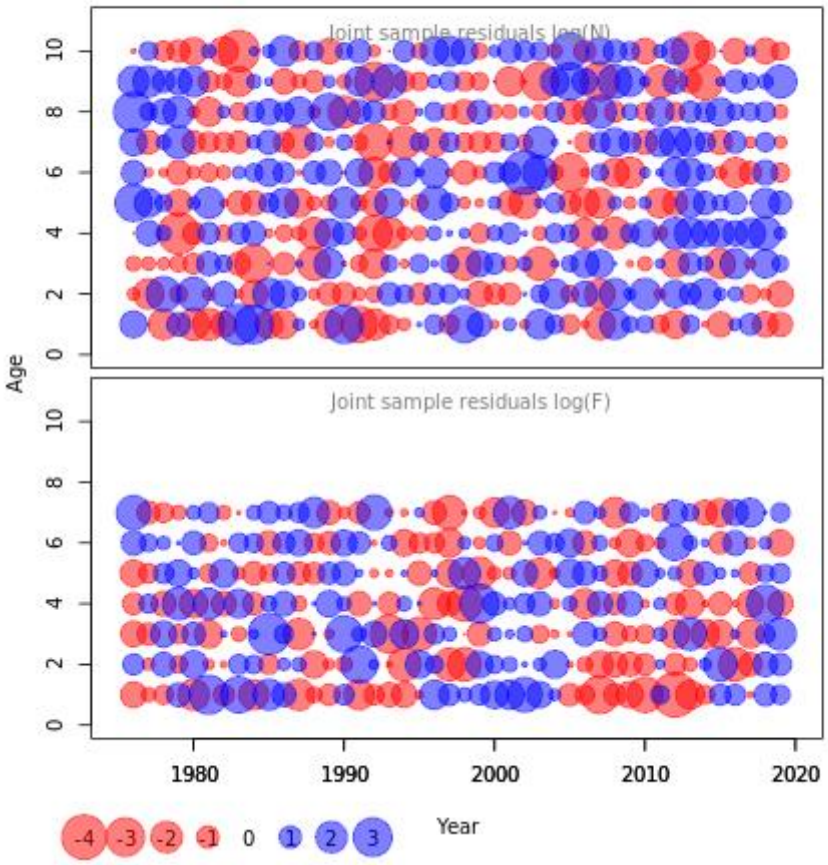

Figure 15.9.1: Normalized residuals derived from the SAM base run. Blue circles indicate positive residuals (observation larger than predicted) and filled red circles indicate negative residuals.

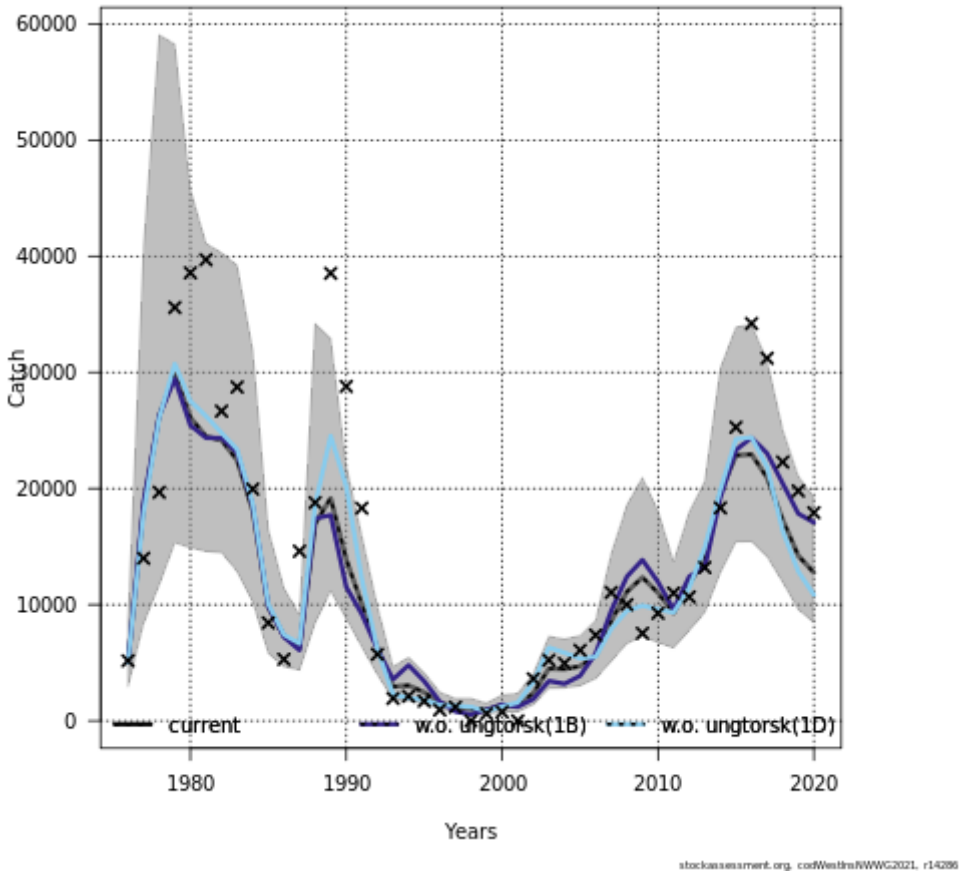

Figure 15.9.2: Estimated (line) and observed catch (x). Estimated catch is shown with 95% confidence intervals.

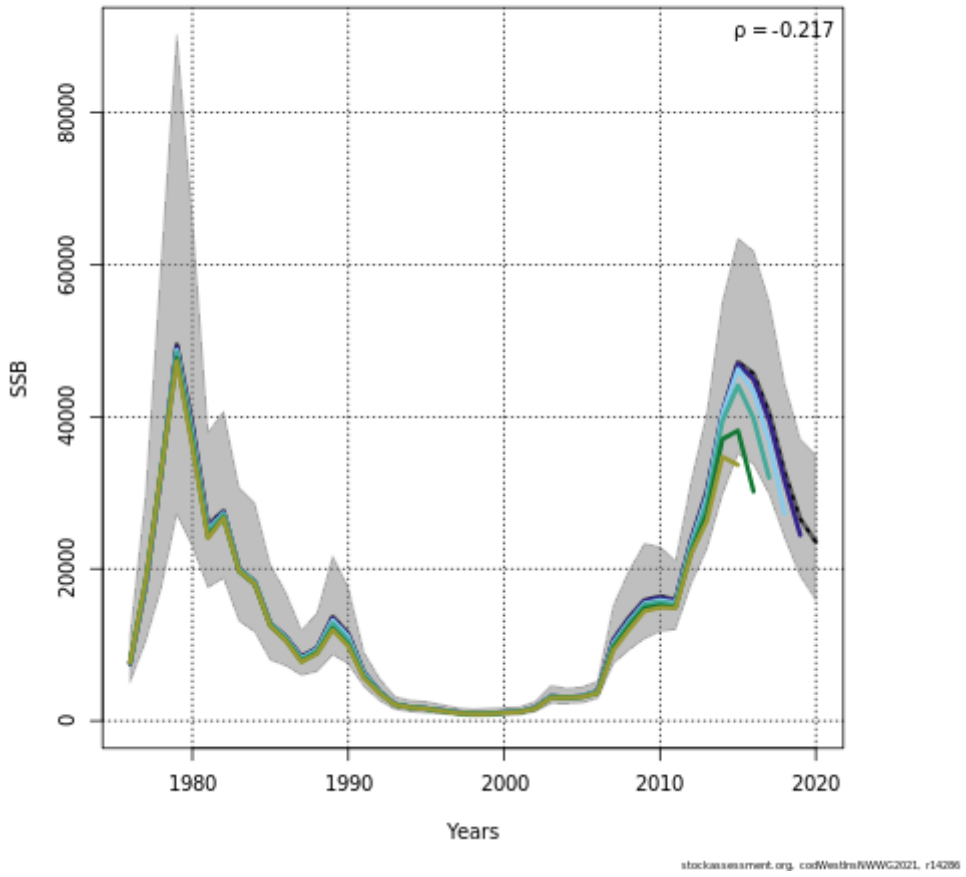

Figure 15.9.3: Analytical retrospective plots of spawning stock biomass. Mohn's rho is given in the upper right corner.

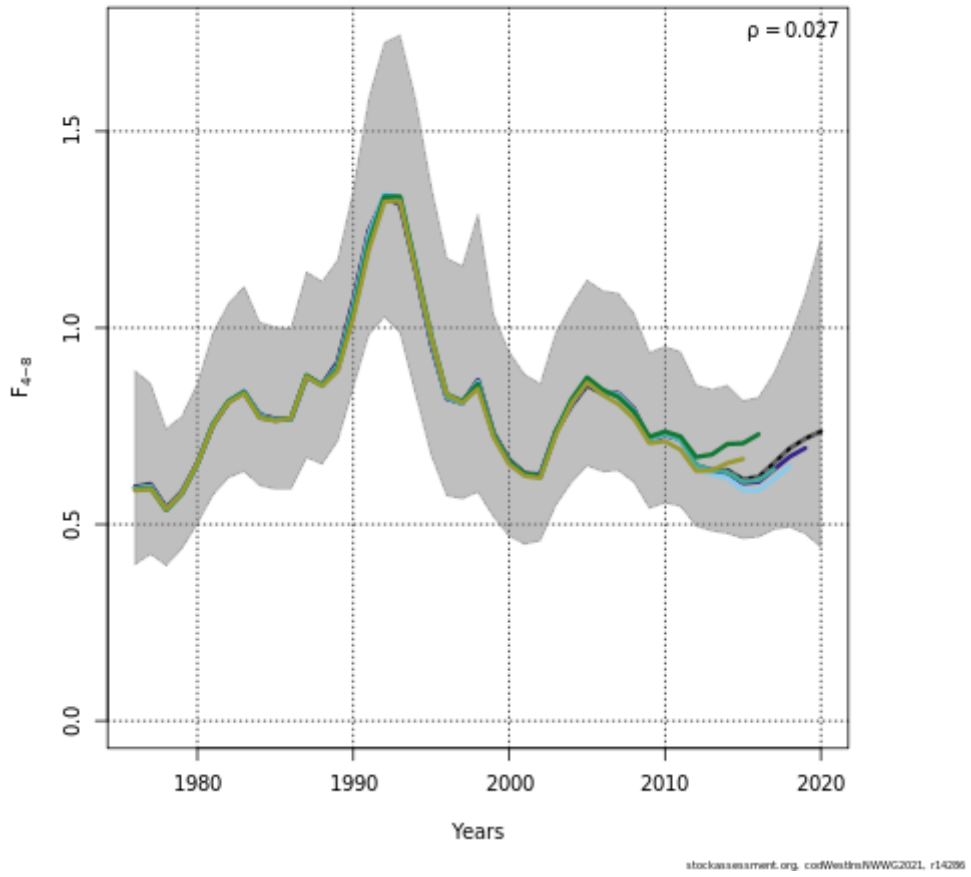

Figure 15.9.4: Analytical retrospective plots of $F_{4\text{-}8s}$. Mohn's rho is given in the upper right corner.

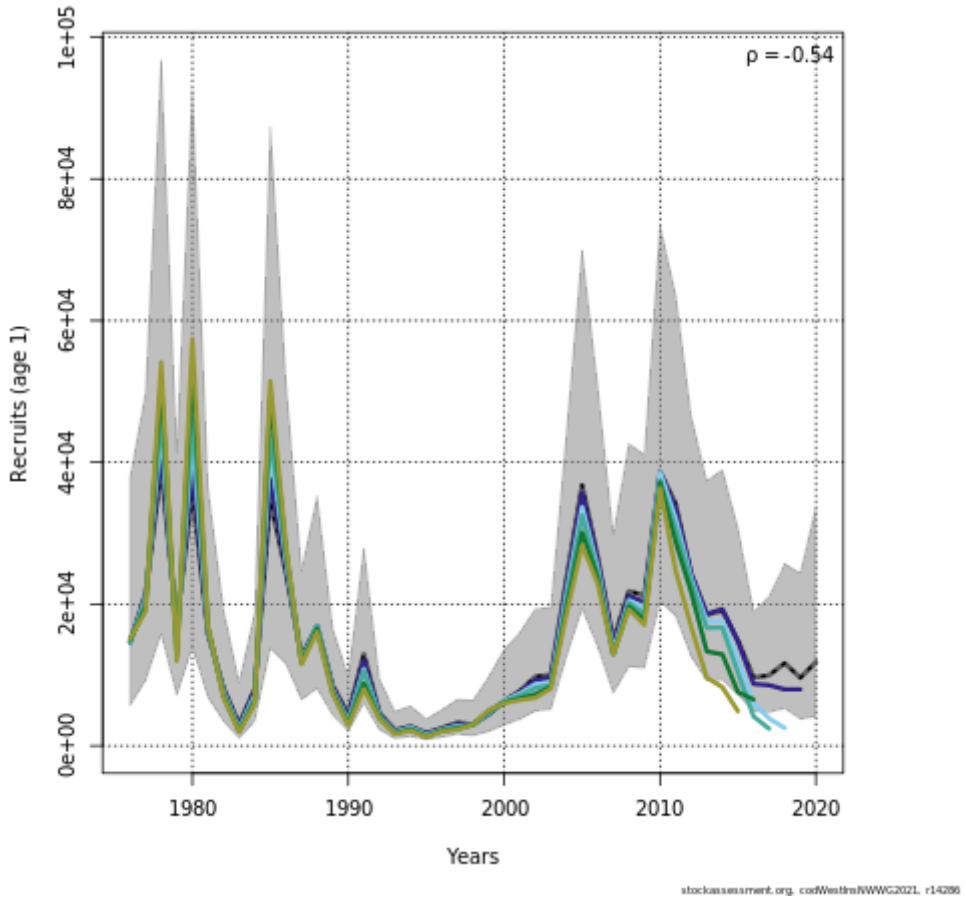

Figure 15.9.5: Analytical retrospective plots of Recruiet. Mohn's rho is given in the upper right corner.

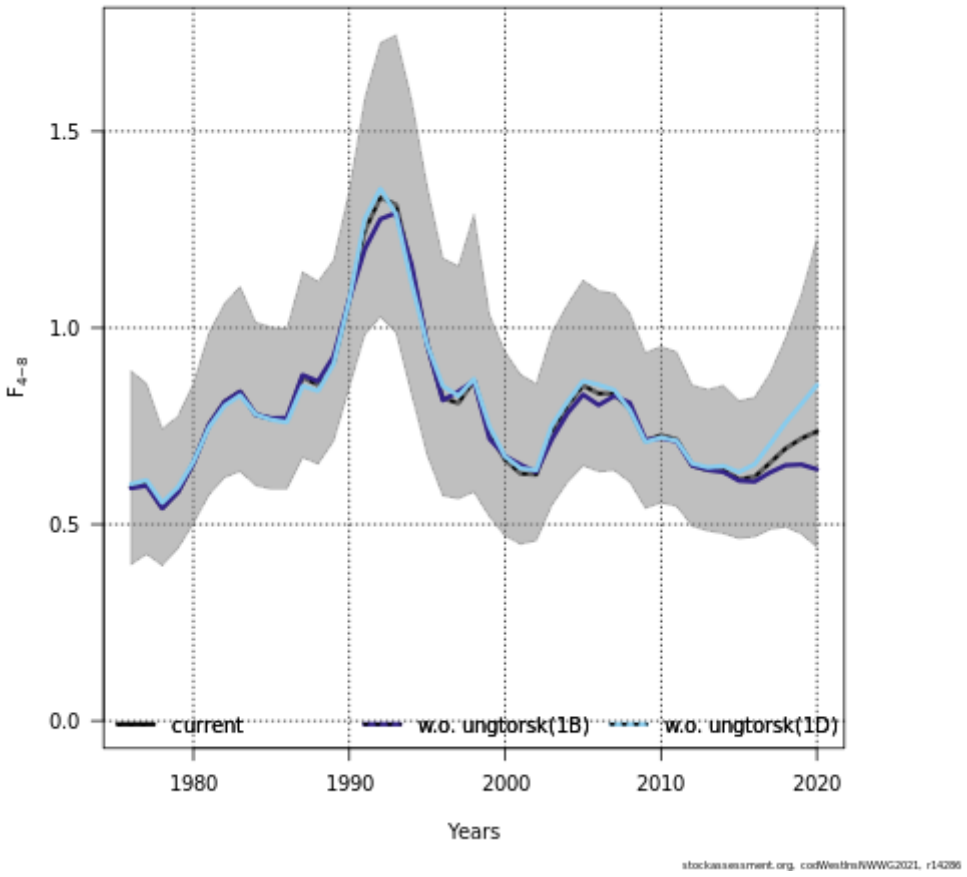

Figure 15.9.6: Leave out plot of F_{4-8}.