

Atlantic salmon at West Greenland

Summary of the advice for 2020

ICES advises that when the Framework of Indicators (FWI) was applied in early 2020, a full reassessment was not required and the 2018 ICES advice remains valid (ICES, 2018). Consequently, in line with the management objectives agreed by the North Atlantic Salmon Conservation Organization (NASCO) and consistent with the MSY approach, there are no mixed-stock fishery options at West Greenland for the fishing year 2020. 2020 marks the final year of NASCO's three-year multi-annual regulatory measure for fishing Atlantic salmon at West Greenland (NASCO, 2018).

NASCO 4.1 Describe the key events of the 2019 fishery, including details of catch, gear, effort, composition and origin of the catch, rates of exploitation, and location of the catch as in-river, estuarine, and coastal

Fishing for salmon at Greenland is currently allowed, using hook, fixed gillnets, and driftnets along the entire coast (Figure 1). The commercial fishery for export closed in 1998; the fishery for internal use, however, continues to date. Since 2002, licensed commercial fishers have only been allowed to sell salmon to hotels, institutions, local markets, and factories when factory landings were allowed. People fishing for private consumption only were not required to have a licence until 2018, and are prohibited from selling salmon. The Government of Greenland unilaterally set the quotas for the fisheries from 2012 to 2017 (Table 1). Specific annual factory quotas were set at 35 tonnes (t) for 2012 and 2013, and 30 t in 2014. Licensed fishers were permitted to sell to factories during these years, although the export ban persisted. The Government of Greenland set annual quotas for the 2015–2017 fisheries for all components of the fishery (private, commercial, and factory landings) at 45 t, but stated that any overharvest in a particular year would result in an equal reduction in the quota the following year. As a result of an overharvest in 2015, the 2016 quota was set at 32 t by Greenland. The quota for 2017 remained at 45 t. Factory landings were not permitted in 2016 and 2017.

In 2018, the Government of Greenland set an annual quota for the 2018–2020 fisheries to 30 t, as agreed by all parties of the West Greenland Commission of NASCO. A 10 t quota was allocated for the private fishery, with the balance (20 t) for the commercial fishery. Within the regulatory measure, the Government of Greenland agreed to continue its ban on the export of both wild Atlantic salmon and its products from Greenland, and to prohibit landings and sales to fish-processing factories. As in the previous agreement, they also agreed the fishery should be restricted to run from 15 August to no later than 31 October each year, and that any overharvest in a particular year would result in an equal reduction in the total allowable catch in the following year. The regulatory measure also set out a number of provisions aimed at improving the monitoring, management control, and surveillance of the fishery. These include a new requirement for all fishers (private and commercial) to obtain a licence to fish for Atlantic salmon, an agreement to collect catch and fishing activity data from all fishers, and mandatory reporting requirements. The measure also stated that as a condition of the licence, all fishers would be required to allow samplers from the NASCO sampling programme to take samples of their catches upon request.

Catches of Atlantic salmon at West Greenland (Figure 2 and Table 1) increased through the 1960s, reached a peak in reported harvest of approximately 2700 t in 1971, and then decreased until the closure of the commercial fishery for export in 1998. Catches are reported from all six NAFO divisions, and proportions vary annually (Table 2). A total salmon catch of 29.8 t was reported for the 2019 fishery, a decrease from the 2018 catch (39.9 t), but an overharvest of 10.3 t over the 19.5 t quota (Table 2). The 2019 quota was reduced from 30 t to 19.5 t due to overharvest in 2018. In 2019, commercial landings represented the majority of the harvest at 22.0 t (74.0%) and the remaining 7.7 t was for private use, compared to 32.5 t and 7.4 t, respectively in 2018 (Table 3). In 2018 and 2019, the percentage of commercial landings reported for private use dropped to 0.4% and 0.3%, respectively, compared to an average of 44% from 1997 to 2017. Reported commercial and private landings by NAFO/ICES areas in 2019 are presented in Table 4. The number of licences issued, the number of fishers who reported, and the number of reports received have increased greatly since 2017, a result of both the new regulations requiring all fishers to obtain a licence and the mandatory reporting requirements.

The fishery was closed on 25 September 2019 as 19.5 t of landings had been registered; this number was later revised to 29.8 t, resulting in an overharvest of 10.3 t for the 2019 fishery. The Greenlandic authorities indicated a further 10 t of unreported harvest.

An adjustment for some of the unreported catch has been carried out since 2002 by two approaches: comparisons of the sampling programme statistics and reported landings (adjusted landings [survey]), and utilizing results from the previously implemented phone surveys (adjusted landings [sampling]). Adjusted landings (sampling) are estimated by comparing the weight of salmon observed by the sampling teams and the corresponding community-specific reported landings for the entire fishing season. Sampling is not random and only occurs during part of the fishing season; it is therefore not representative of the total unreported catch. Adjusted landings (survey) are estimated from results of phone surveys, conducted after the fishing seasons 2014 to 2016, to gain further information on inconsistencies in the reported catch data. Adjusted landings (survey) are added to the adjusted landings (sampling) and reported landings to estimate the landings for assessment. Landings for assessment do not replace the official reported statistics (Table 5).

The international sampling programme continued in 2019 (Figure 1). A summary of the biological characteristics of the 2019 catch is presented in Table 6. In 2019, 71.5% of the salmon sampled were determined to be of North American origin and 28.5% of European origin (Figure 3); approximately 6800 (20.3 t) North American and 2600 (8.1 t) fish of European origin were harvested in 2019 (Figure 4). The total number of fish harvested in 2019 (9400) is a decrease from the estimated number harvested in 2018 (13 200). The origin of salmon harvested at West Greenland in 2019 has been estimated based on an updated genetic range-wide baseline (using Single Nucleotide Polymorphisms [SNPs]). This baseline, based on samples from 189 rivers (Jeffery *et al.*, 2018), was updated in 2018 (ICES, 2018) and can discriminate salmon from 21 North American and 10 European genetic reporting groups (Figure 5). The North American contributions to the West Greenland fishery are dominated by the Gaspé Peninsula, Gulf of St Lawrence, and Labrador South genetic reporting groups (65%; Table 7). The Northeast Atlantic contributions were dominated by the United Kingdom/Ireland genetic reporting group (99%). There are smaller, but consistent contributions to the harvest for a number of other genetic reporting groups. Results are similar to those reported for the 2017 and 2018 fisheries (ICES, 2019a, 2019b). A single sample, based on the individual assignment method, was identified as having originated from the Greenland genetic reporting group (Kapisillit River) in 2018, but no samples were identified in 2019.

Table 1 Nominal catches of salmon at West Greenland since 1960 (tonnes, round fresh weight) by participating nations. For Greenlandic vessels specifically, all catches up to 1968 were taken with set gillnets only, and catches after 1968 were taken with set gillnets and driftnets. All non-Greenlandic vessel catches from 1969 to 1975 were harvested with driftnets. The quota figures applied to Greenlandic vessels only, and parenthetical entries identify when quotas did not apply to all sectors of the fishery.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1960	-	-	-	-	60	60		
1961	-	-	-	-	127	127		
1962	-	-	-	-	244	244		
1963	-	-	-	-	466	466		
1964	-	-	-	-	1539	1539		
1965	-	36	-	-	825	858		Norwegian harvest figures not available, but known to be less than Faroese catch.
1966	32	87	-	-	1251	1370		
1967	78	155	-	85	1283	1601		
1968	138	134	4	272	579	1127		
1969	250	215	30	355	1360	2210		
1970	270	259	8	358	1244	2139		Greenlandic total includes 7 t caught by longlines in the Labrador Sea.
1971	340	255	-	645	1449	2689	-	
1972	158	144	-	401	1410	2113	1100	
1973	200	171	-	385	1585	2341	1100	
1974	140	110	-	505	1162	1917	1191	
1975	217	260	-	382	1171	2030	1191	
1976	-	-	-	-	1175	1175	1191	
1977	-	-	-	-	1420	1420	1191	
1978	-	-	-	-	984	984	1191	
1979	-	-	-	-	1395	1395	1191	
1980	-	-	-	-	1194	1194	1191	
1981	-	-	-	-	1264	1264	1265	Quota set to a specific opening date for the fishery.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1982	-	-	-	-	1077	1077	1253	Quota set to a specific opening date for the fishery.
1983	-	-	-	-	310	310	1191	
1984	-	-	-	-	297	297	870	
1985	-	-	-	-	864	864	852	
1986	-	-	-	-	960	960	909	
1987	-	-	-	-	966	966	935	
1988	-	-	-	-	893	893	840	1988–1990 quota was 2520 t, with a 1 August opening date. Annual catches were not to exceed an annual average (840 t) by more than 10%. Quota adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates.
1989	-	-	-	-	337	337	900	
1990	-	-	-	-	274	274	924	
1991	-	-	-	-	472	472	840	
1992	-	-	-	-	237	237	258	Quota set by Greenlandic authorities.
1993	-	-	-	-			89	The fishery was suspended. NASCO adopted a new quota allocation model.
1994	-	-	-	-			137	Fishery suspended and quotas were bought out.
1995	-	-	-	-	83	83	77	Quota advised by NASCO.
1996	-	-	-	-	92	92	174	Quota set by Greenlandic authorities.
1997	-	-	-	-	58	58	57	Private (non-commercial) catches to be reported after 1997.
1998	-	-	-	-	11	11	20	Fishery restricted to catches used for internal consumption in Greenland.
1999	-	-	-	-	19	19	20	
2000	-	-	-	-	21	21	20	
2001	-	-	-	-	43	43	114	Final quota calculated according to the <i>ad hoc</i> management system.
2002	-	-	-	-	9	9	55	Quota bought out; quota represented the maximum allowable catch (no factory landings allowed), and higher catch figures based on sampling programme information are used for the assessments.
2003	-	-	-	-	9	9		Quota set to nil (no factory landings allowed); fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2004	-	-	-	-	15	15		Same as previous year.
2005	-	-	-	-	15	15		Same as previous year.
2006	-	-	-	-	22	22		Quota set to nil (no factory landings allowed) and fishery restricted to catches used for internal consumption in Greenland.
2007	-	-	-	-	25	25		Quota set to nil (no factory landings allowed); fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2008	-	-	-	-	26	26		Same as previous year.
2009	-	-	-	-	26	26		Same as previous year.
2010	-	-	-	-	40	40		No factory landings allowed and fishery restricted to catches used for internal consumption in Greenland.
2011	-	-	-	-	28	28		Same as previous year.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
2012	-	-	-	-	33	33	(35)	Unilateral decision made by Greenland for a 35 t quota for factory landings only; fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2013	-	-	-	-	47	47	(35)	Same as previous year.
2014	-	-	-	-	58	58	(30)	Unilateral decision made by Greenland to allow factory landings with a 30 t quota for factory landings only; fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2015	-	-	-	-	57	57	45	Unilateral decision made by Greenland to set a 45 t quota for all sectors of the fishery; fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2016	-	-	-	-	27	27	32	Unilateral decision made by Greenland to reduce the previously set 45 t quota for all sectors of the fishery to 32 t based on the average of the 2015 fishery; fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2017	-	-	-	-	28	28	45	Unilateral decision made by Greenland to set a 45 t quota for all sectors of the fishery; fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2018	-	-	-	-	40	40	30	No factory landings allowed and fishery restricted to catches used for internal consumption in Greenland.
2019	-	-	-	-	30	30	19.5	No change from previous year.

Table 2 Annual distribution of nominal catches (t) at Greenland by NAFO division (when known). NAFO divisions are shown in Figure 2. Since 2005, gutted weights have been reported and converted to total weight by a factor of 1.11. Rounding issues are evident for some totals.

Year	NAFO Division						Unknown	West Greenland	East Greenland	Total
	1A	1B	1C	1D	1E	1F				
1960							60	60		60
1961							127	127		127
1962							244	244		244
1963	1	172	180	68	45			466		466
1964	21	326	564	182	339	107		1539		1539
1965	19	234	274	86	202	10	36	861		861
1966	17	223	321	207	353	130	87	1338		1338
1967	2	205	382	228	336	125	236	1514		1514
1968	1	90	241	125	70	34	272	833		833
1969	41	396	245	234	370		867	2153		2153
1970	58	239	122	123	496	207	862	2107		2107
1971	144	355	724	302	410	159	560	2654		2654
1972	117	136	190	374	385	118	703	2023		2023
1973	220	271	262	440	619	329	200	2341		2341
1974	44	175	272	298	395	88	645	1917		1917
1975	147	468	212	224	352	185	442	2030		2030
1976	166	302	262	225	182	38		1175		1175
1977	201	393	336	207	237	46	-	1420	6	1426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1395	+	1395
1980	52	275	404	231	158	74	-	1194	+	1194
1981	105	403	348	203	153	32	20	1264	+	1264
1982	111	330	239	136	167	76	18	1077	+	1077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993*	-	-	-	-	-	-	-	-	-	-
1994*	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19
2000	+	+	1	7	+	13	-	21	-	21
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9
2004	3	1	4	2	3	2	-	15	-	15
2005	1	3	2	1	3	5	-	15	-	15
2006	6	2	3	4	2	4	-	22	-	22
2007	2	5	6	4	5	2	-	25	-	25
2008	4.9	2.2	10.0	1.6	2.5	5.0	0	26.2	0	26.2
2009	0.2	6.2	7.1	3.0	4.3	4.8	0	25.6	0.8	26.3
2010	17.3	4.6	2.4	2.7	6.8	4.3	0	38.1	1.7	39.6
2011	1.8	3.7	5.3	8.0	4.0	4.6	0	27.4	0.1	27.5
2012	5.4	0.8	15.0	4.6	4.0	3.0	0	32.6	0.5	33.1
2013	3.1	2.4	17.9	13.4	6.4	3.8	0	47.0	0.0	47.0

Year	NAFO Division						Unknown	West Greenland	East Greenland	Total
	1A	1B	1C	1D	1E	1F				
2014	3.6	2.8	13.8	19.1	15.0	3.4	0	57.8	0.1	57.9
2015	0.8	8.8	10.0	18.0	4.2	14.1	0	55.9	1.0	56.8
2016	0.8	1.2	7.3	4.6	4.5	7.3	0	25.7	1.5	27.1
2017	1.1	1.7	9.3	6.9	3.2	5.6	0	27.8	0.3	28.0
2018	2.4	5.7	13.7	8.2	4.2	4.8	0	39.0	0.8	39.9
2019	0.8	3.0	4.4	8.0	4.8	7.3	0	28.3	1.4	29.8

* The fishery was suspended.

+ Small catches, < 5 t.

- No catch.

Table 3 Reported 2018 and 2019 catches by fisher. Licences for private fishers were introduced in 2018. Entries of 0.0 represent reported values of < 0.1. Note: Due to rounding, numbers presented may not add up precisely to the totals indicated.

Licence status	Landings type	Reported 2018 catch (t)	Reported 2019 catch (t)
Licensed	Commercial (from commercial fishers)	32.5	21.8
	Private use (from commercial fishers)	0.1	0.1
	Commercial use (from private fishers)	0.0	0.2
	Private use (from private fishers)	7.2	7.6
Total commercial catch		32.5	22.0
Total private use catch		7.4	7.7
Total catch		39.9	29.8

Table 4 Reported landings (t) by licence type, landing category, the number of fishers reporting, and the total number of landing reports received in 2019. Empty cells identify categories with no reported landings and 0.0 entries represent reported values of < 0.1. Note: Due to rounding, numbers presented may not add up precisely to the totals indicated.

NAFO/ICES	Licence type	No. of fishers	No. of reports	Commercial	Private	Total
NAFO 1A	Private	42	60		0.1	0.1
	Commercial	54	105	0.7		0.7
	TOTAL	96	165	0.7	0.1	0.8
NAFO 1B	Private	35	62	0.1	0.4	0.5
	Commercial	34	126	2.5	0.0	2.6
	TOTAL	70	191	2.6	0.4	3.0
NAFO 1C	Private	29	40	0.1	0.2	0.3
	Commercial	88	176	4.0	0.0	4.0
	TOTAL	117	216	4.1	0.3	4.4
NAFO 1D	Private	136	176	0.0	1.2	1.3
	Commercial	33	98	6.7	0.0	6.8
	TOTAL	169	274	6.8	1.2	8.0
NAFO 1E	Private	31	106		2.0	2.0
	Commercial	23	110	2.8	0.0	2.9
	TOTAL	54	216	2.8	2.0	4.8
NAFO 1F	Private	70	228	0.0	2.8	2.9
	Commercial	38	145	4.5		4.5
	TOTAL	108	373	4.5	2.8	7.3
ICES Subarea 14	Private	18	65		1.0	1.0
	Commercial	6	31	0.5		0.5
	TOTAL	24	96	0.5	1.0	1.4
ALL	Private	361	737	0.2	7.6	7.9
	Commercial	276	791	21.8	0.1	21.9
	TOTAL	638	1531	22.0	7.7	29.8

Table 5 Reported landings and adjusted landings (t) for the assessment of Atlantic salmon at West Greenland, 2002–2019. The total adjusted landings do not include the unreported catch (10 t per year since 2000).

Year	Reported landings (West Greenland)	Adjustment to landings (Sampling)	Adjustment to landings (Survey)	Total adjusted landings
2002	9.0	0.7	-	9.8
2003	8.7	3.6	-	12.3
2004	14.7	2.5	-	17.2
2005	15.3	2.0	-	17.3
2006	23.0	0.0	-	23.0
2007	24.6	0.2	-	24.8
2008	26.1	2.5	-	28.6
2009	25.5	2.5	-	28.0
2010	37.9	5.1	-	43.1
2011	27.4	0.0	-	27.4
2012	32.6	2.0	-	34.6
2013	46.9	0.7	-	47.7
2014	57.7	0.6	12.2	70.5
2015	55.9	0.0	5.0	60.9
2016	25.7	0.3	4.2	30.2
2017	27.8	0.3	-	28.0
2018	39.0	0.0	-	39.0
2019	28.3	0.0	-	28.3

Table 6 Summary of biological characteristics of catches of Atlantic salmon at West Greenland in 2019 (NA = North America, E = Europe).

River-age distribution (%) by origin								
Continent of origin	1	2	3	4	5	6	7	8
NA	0.6	26.9	32.5	25.4	13.7	0.8	0	0
E	7.5	60.5	24.2	7.5	0.4	0	0	0
Length and weight by origin and sea age								
Continent of origin	1 SW		2 SW		Previous spawners		All sea ages	
	Fork length	Whole	Fork length	Whole	Fork length	Whole	Fork	Whole
NA	63.9	2.93	78.4	6.62	72.1	4.01	64.4	3.01
E	63.4	2.89	76.8	6.27	62.1	2.76	62.3	2.83
Continent of origin (%)								
North America				Europe				
71.5				28.5				
Sea-age composition (%) by continent of origin								
Continent of origin	1SW		2SW		Previous spawners			
NA	95.9		1.4		2.7			
E	97.9		1.7		0.3			

Table 7 Bayesian estimates of mixture composition for the West Greenland Atlantic salmon fishery, by region and overall for 2019. Baseline locations refer to regional reporting groups identified in Figure 5. Sample locations are identified by NAFO divisions. Mean estimates are provided with 95% credible interval in parentheses. Estimates of mixture contributions not supported by significant individual assignments ($P > 0.8$) are represented as zero.

Regional group	COO	NAFO 1B	NAFO 1C	NAFO 1E	NAFO 1F	Overall
Baltic Sea	EUR	0	0	0	0	0
Barents/White seas	EUR	0	0	0	0	0
European broodstock	EUR	0	0	0	0	0
France	EUR	0	0.2 (0.0, 0.9)	0	0	0.1 (0.0, 0.3)
Greenland	EUR	0	0	0	0	0
Iceland	EUR	0	0	0	0	0
Northern Norway	EUR	0	0	0	0	0
Southern Norway	EUR	0	0	0	0	0
Spain	EUR	0.5 (0.0, 1.6)	0	0	0.4 (0.0, 1.5)	0.2 (0.0, 0.6)
United Kingdom/Ireland	EUR	13.5 (10.2, 17.2)	40.7 (36.1, 45.4)	51.7 (35.8, 67.3)	24.0 (18.9, 29.5)	28.2 (25.6, 31.0)
Anticosti	NA	0	1.5 (0.5, 2.9)	0.0 (0.0, 0.0)	1.6 (0.4, 3.7)	0.9 (0.4, 1.7)
Avalon Peninsula	NA	0	0	0	0	0
Burin Peninsula	NA	0	0	0	0	0
Eastern Nova Scotia	NA	0	0	0	0.9 (0.1, 2.5)	0.4 (0.1, 0.9)
Fortune Bay	NA	0	0	0	0	0
Gaspé Peninsula	NA	20.1 (15.7, 24.7)	15.3 (11.8, 19.2)	24.8 (12.2, 40.1)	20.8 (15.4, 26.7)	18.6 (16.1, 21.2)
Gulf of St Lawrence	NA	19.2 (14.9, 23.8)	12.1 (8.9, 15.6)	2.8 (0.0, 10.8)	14.3 (9.8, 19.3)	14.2 (12.0, 16.6)
Inner Bay of Fundy	NA	0	0	0	0	0
Labrador central	NA	7.0 (3.8, 10.9)	5.0 (2.8, 7.6)	7.3 (0.3, 18.1)	3.3 (1.3, 6.2)	5.4 (3.9, 7.2)
Labrador south	NA	19.1 (14.6, 23.9)	11.8 (8.6, 15.3)	0	12.6 (8.7, 17.2)	13.5 (11.4, 15.8)
Lake Melville	NA	1.6 (0.3, 3.7)	1.5 (0.5, 3.1)	0	0	1.5 (0.8, 2.6)
Maine, United States	NA	1.7 (0.6, 3.4)	1.4 (0.5, 2.8)	0	3.2 (1.4, 5.8)	1.9 (1.2, 2.9)
Newfoundland 1	NA	0.6 (0.1, 1.6)	0	0	2.1 (0.5, 4.3)	0.7 (0.2, 1.4)
Newfoundland 2	NA	0.8 (0.1, 2.1)	0	0	0.9 (0.1, 2.5)	0.9 (0.4, 1.6)
Northern Newfoundland	NA	0	0	0	0.4 (0.0, 1.5)	0.1 (0.0, 0.4)
Quebec City Region	NA	2.6 (0.7, 5.0)	1.9 (0.7, 3.7)	0	3.5 (1.1, 6.8)	2.3 (1.3, 3.7)
St John River & aquaculture	NA	0	0	0	0	0
St Lawrence N. Shore Lower	NA	4.4 (2.4, 7.0)	2.3 (1.0, 4.1)	7.8 (1.2, 18.8)	2.9 (1.1, 5.5)	3.7 (2.6, 5.0)
Ungava	NA	6.6 (4.3, 9.4)	2.1 (1.0, 3.7)	0	6.1 (3.4, 9.4)	4.6 (3.4, 5.9)
Western Newfoundland	NA	2.2 (0.9, 4.1)	3.0 (1.5, 5.1)	0	2.3 (0.7, 4.6)	2.3 (1.4, 3.4)
Western Nova Scotia	NA	0	0	0	0	0

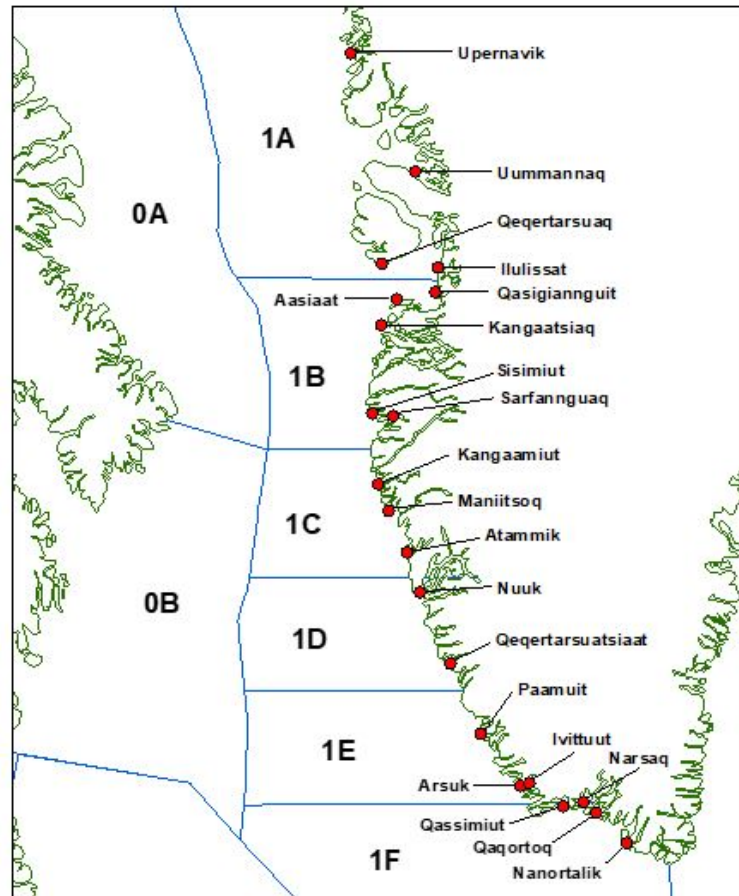


Figure 1* Map of communities in West Greenland, where Atlantic salmon have historically been landed and the corresponding NAFO divisions (1A–1F). In 2019, samples were obtained from Sisimiut (1B), Maniitsoq (1C), Nuuk (1D), and Qaqortoq (1F).

* Version 2: Figure updated.

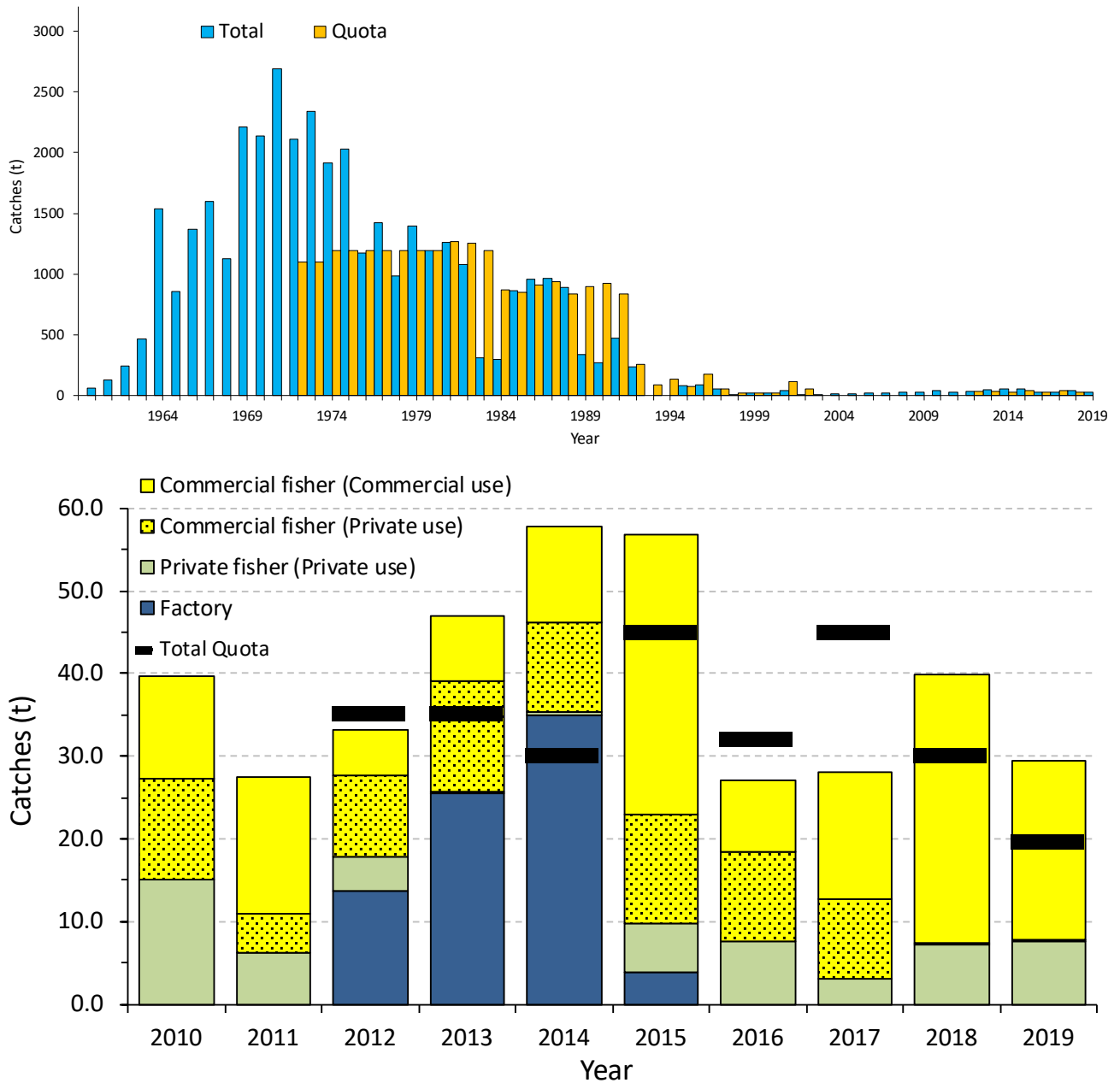


Figure 2 Nominal landings and commercial quotas (tonnes, round fresh weight) of salmon at West Greenland from 1960 to 2019 (upper panel). Landings from 2010 to 2019 are also displayed by landing type (lower panel). No quotas were set for 2002–2011 and the quotas for 2012–2014 were for factory landings only.

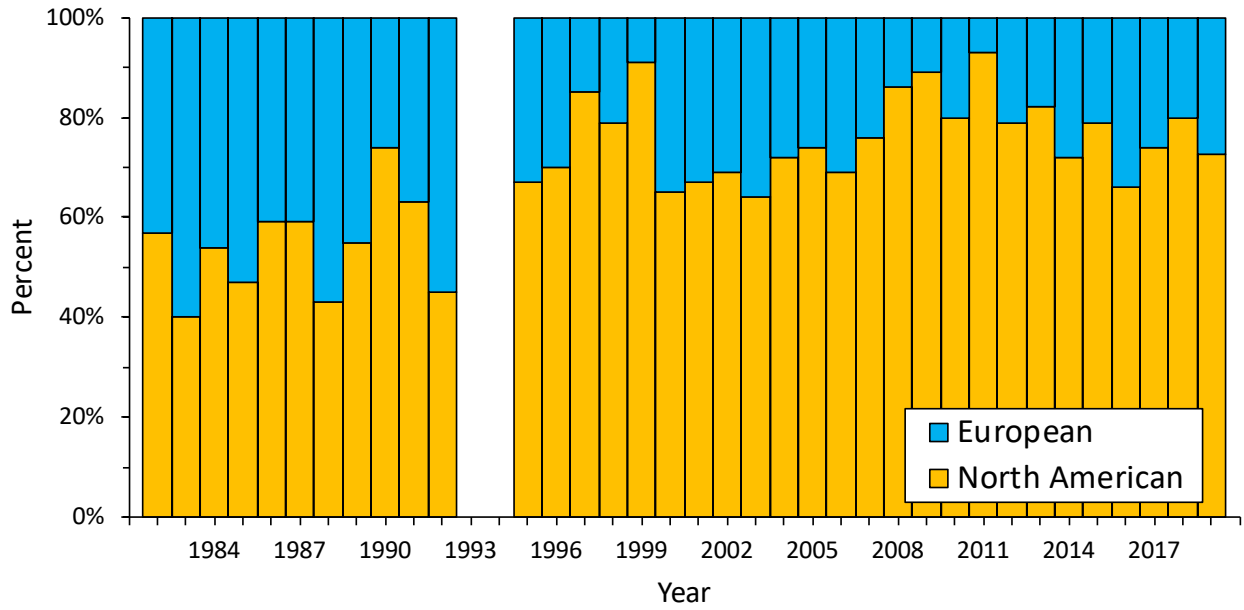


Figure 3 Estimated percent of continental origin of Atlantic salmon, harvested at West Greenland from 1982 to 2019.

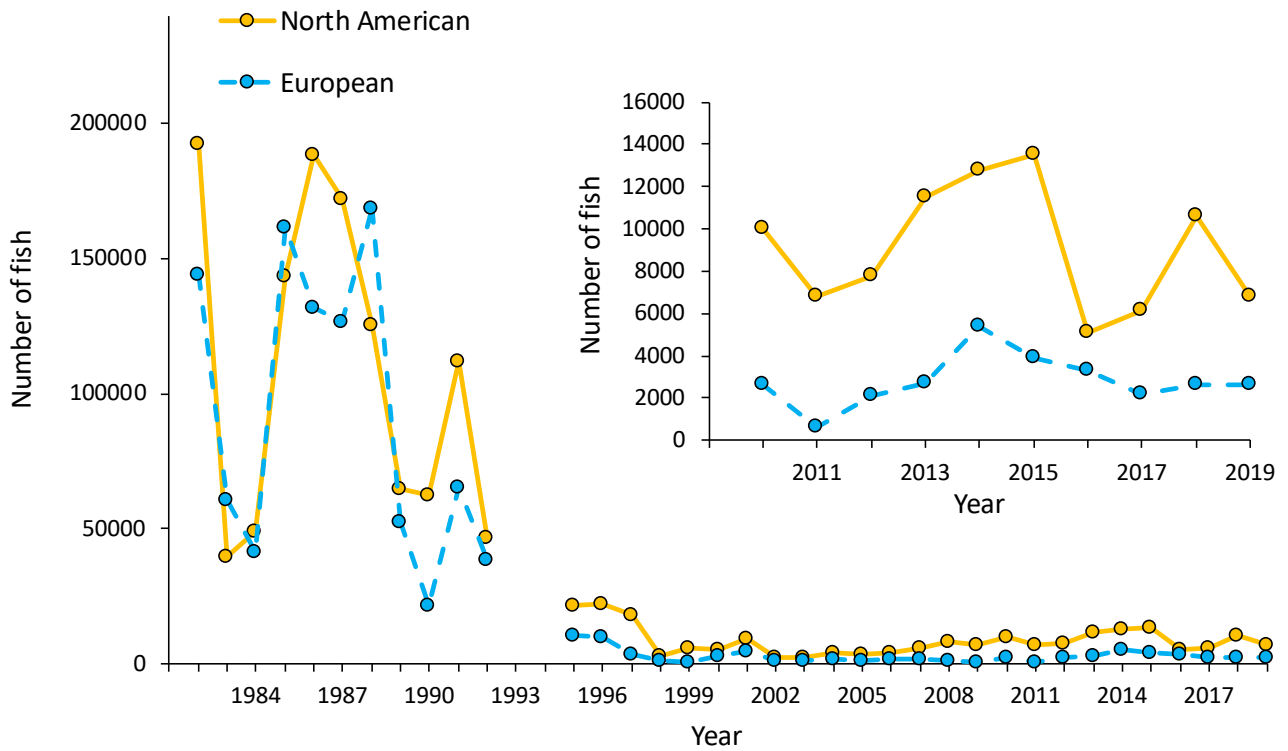


Figure 4 Number of North American and European Atlantic salmon, caught at West Greenland in 1982–2019 and 2010–2019 (inset). Estimates are based on continent of origin by NAFO division, weighted by catch (weight) in each division. Unreported catch is not included.

ICES REGION	REGIONAL GROUP	GROUP ACRONYM
Quebec (North)	Ungava	UNG
Labrador	Labrador central	LAC
	Lake Melville	MEL
	Labrador South	LAS
Quebec	St Lawrence North Shore Lower	QLS
	Anticosti	ANT
	Gaspé Peninsula	GAS
	Quebec City Region	QUE
Gulf	Gulf of St Lawrence	GUL
Scotia–Fundy	Inner Bay of Fundy	IBF
	Eastern Nova Scotia	ENS
	Western Nova Scotia	WNS
	Saint John River & aquaculture	SJR
Newfoundland	Northern Newfoundland	NNF
	Western Newfoundland	WNF
	Newfoundland 1	NF1
	Newfoundland 2	NF2
	Fortune Bay	FTB
	Burin Peninsula	BPN
	Avalon Peninsula	AVA
	USA	Maine, United States

ICES REGION	REGIONAL GROUP	GROUP ACRONYM
Europe	Spain	SPN
	France	FRN
	European broodstock	EUB
	United Kingdom/Ireland	BRI
	Barents/White seas	BAR
	Baltic Sea	BAL
	Southern Norway	SNO
	Northern Norway	NNO
	Iceland	ICE
	Greenland	GL

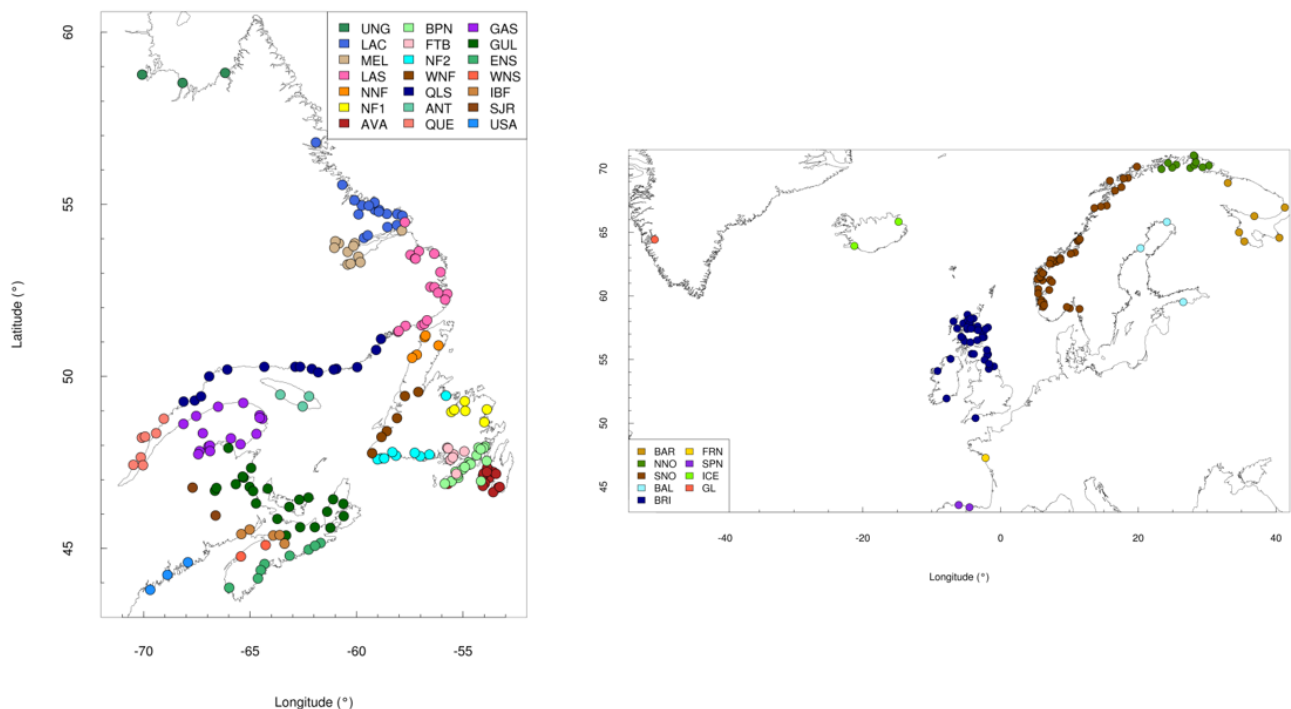


Figure 5* Regional group and codes from the SNP-based genetic baseline (upper table) and location maps for North America (left) and Europe (right). The EUB (European broodstock) regional group does not have a geographic location and therefore is not represented on the map.

* Version 2: Figure updated.

NASCO 4.2 Describe the status of the stocks

Recruitment (pre-fishery abundance) estimates of non-maturing 1SW salmon at Greenland show continued low abundance compared to historical levels and are currently below the spawner escapement reserves (SER) for the North American Commission (NAC; Figure 6) and Southern NEAC (Figure 7) stock complexes.

In 2019, the median estimates of spawners were below the conservation limits (CLs; suffering reduced reproductive capacity) for 2SW salmon in all six regions of NAC, and for MSW salmon in Southern NEAC (Figure 8). Particularly large deficits relative to CLs and rebuilding management objectives are noted in the NAC Scotia–Fundy and USA regions.

The exploitation rate (catch in Greenland divided by pre-fishery abundance [PFA]) in 2018 was 12.9% for NAC fish and 0.7% for Southern NEAC fish (Figure 9). Despite major changes in fisheries management in the past few decades and increasingly more restrictive fisheries measures, returns have remained near historical lows. It is likely, therefore, that other factors besides fisheries are constraining production.

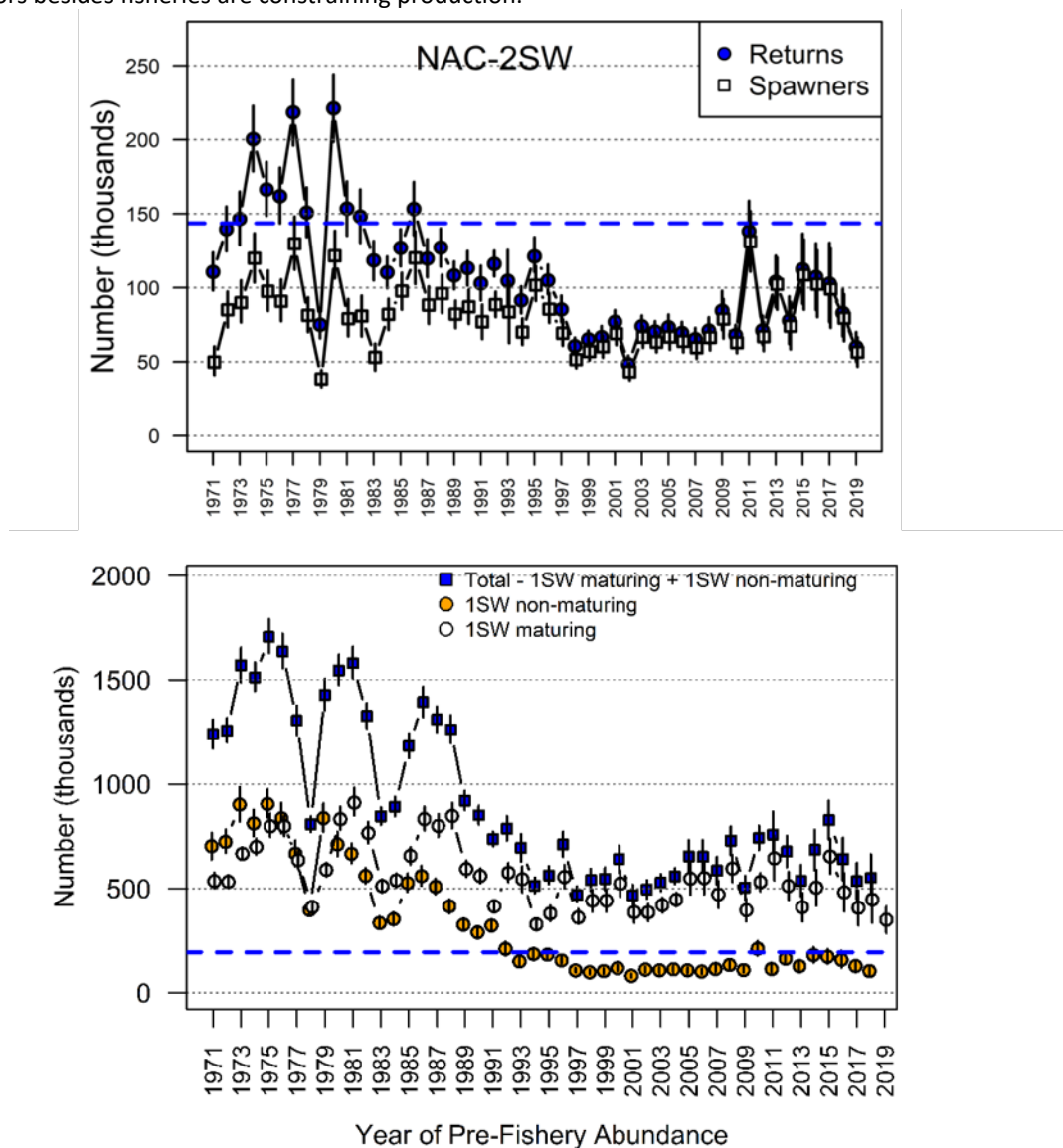


Figure 6 Top panel: Estimated (median, 5th to 95th percentile range, in thousands) returns (blue circles) and spawners (white squares) of 2SW salmon for NAC, 1971–2019. The dashed line is the corresponding 2SW conservation limit for NAC. Bottom panel: Estimated (median, 5th to 95th percentile range, in thousands) pre-fishery abundance (PFA) for 1SW maturing, 1SW non-maturing, and the total cohort of 1SW salmon for NAC, PFA years 1971–2018. The dashed blue horizontal line is the corresponding sum of the 2SW conservation limits for NAC (143 494), corrected for 11 months of natural mortality (193 697) against which 1SW non-maturing salmon are assessed.

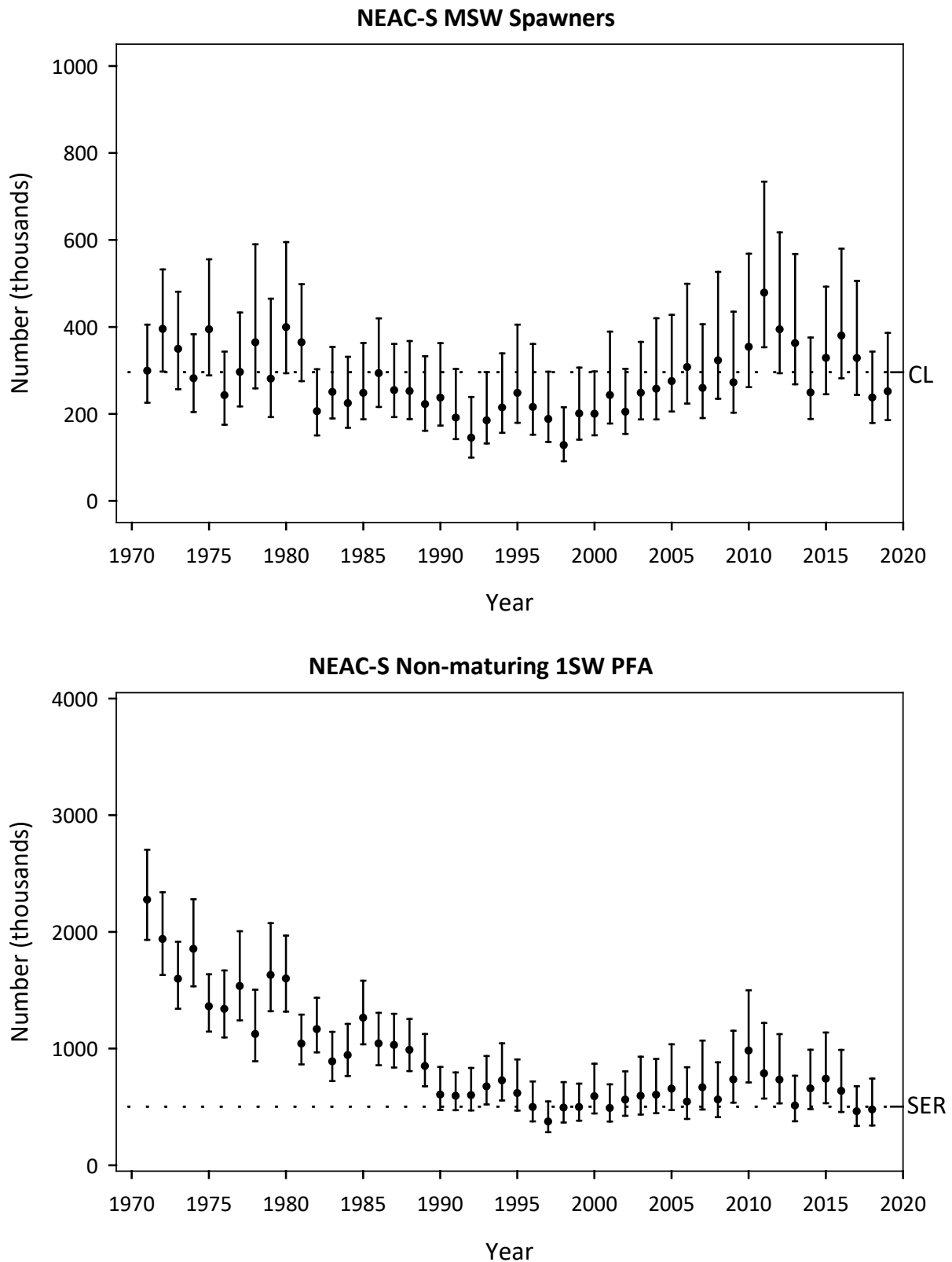


Figure 7 Estimated spawning escapement (upper panel) and PFA (lower panel), and spawning escapement with 90% confidence limits for non-maturing 1SW salmon (MSW spawners) in the Southern NEAC (NEAC-S) stock complex.

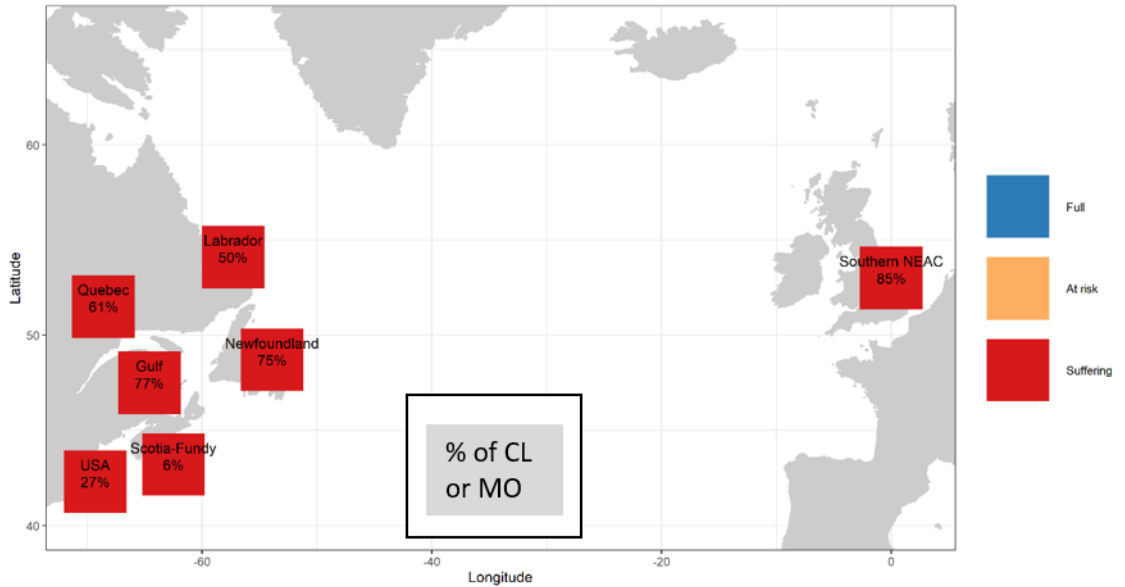


Figure 8 Summary of 2SW (NAC regions) and MSW (Southern NEAC) 2019 median (from the Monte Carlo posterior distributions) spawner estimates in relation to conservation limits (CLs) or management objectives (MO – only for USA and Scotia–Fundy). The colour shading, which in this case is relevant for red only as all stocks in these regions are categorized as suffering reduced reproductive capacity, represents the three ICES stock status designations: full (blue – at full reproductive capacity: the 5th percentile of the spawner estimate is above the CL); at risk (orange – at risk of suffering reduced reproductive capacity: the median spawner estimate is above the CL, but the 5th percentile is below); and suffering (red – suffering reduced reproductive capacity: the median spawner estimate is below the CL).

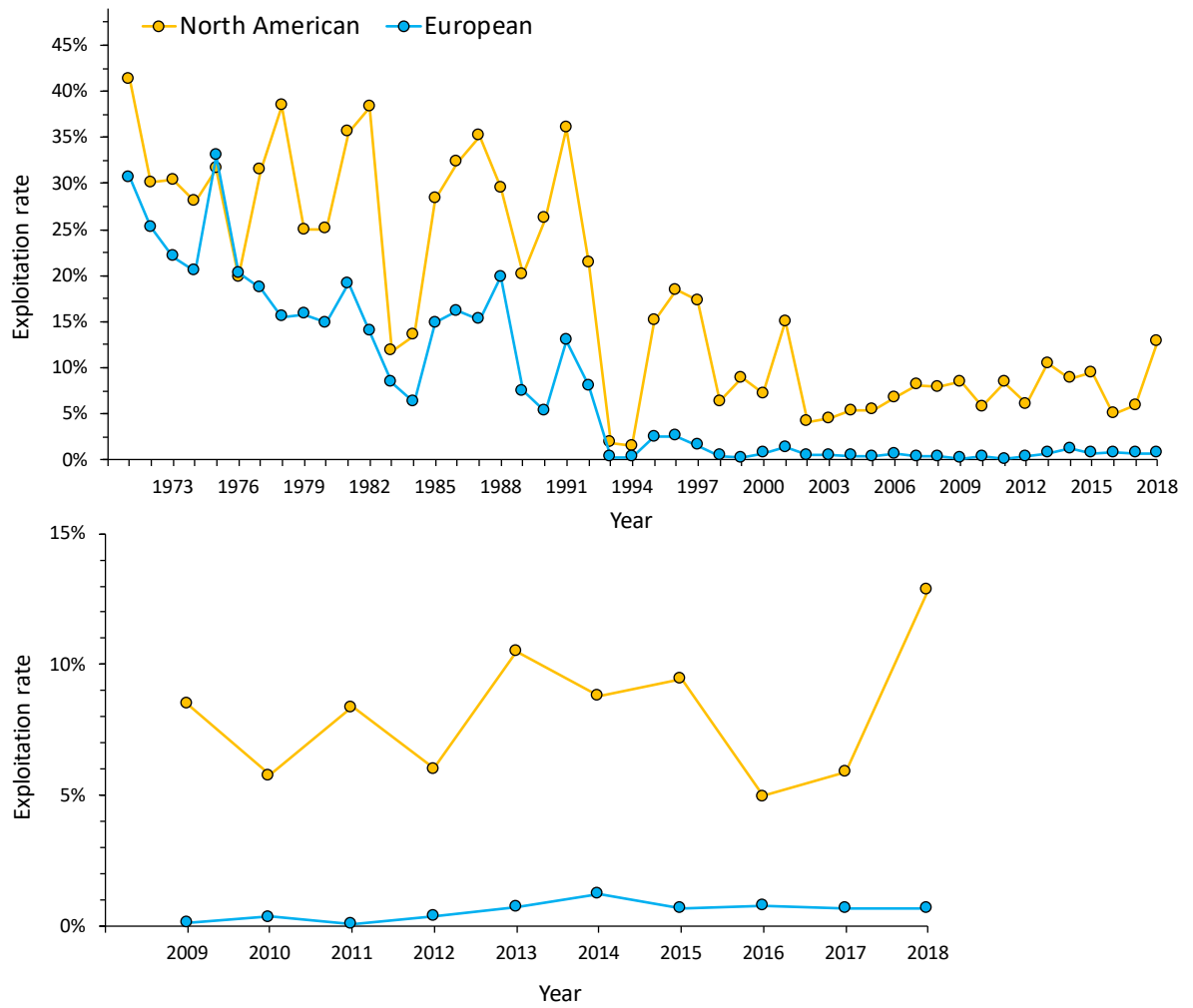


Figure 9 Exploitation rate (%) for NAC 1SW non-maturing and southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2018 (top) and 2009–2018 (bottom). Exploitation rate estimates are only available to 2018, as 2019 exploitation rates are dependent on 2020 returns.

References

- ICES. 2018. North Atlantic Salmon Stocks. *In* Report of the ICES Advisory Committee, 2018. ICES Advice 2018, Book 14, sal.oth.nasco. 33 pp. <https://doi.org/10.17895/ices.pub.4335>.
- ICES. 2019a. North Atlantic Salmon Stocks. *In* Report of the ICES Advisory Committee, 2019. ICES Advice 2019, sal.oth.nasco. 35 pp. <https://doi.org/10.17895/ices.advice.5230>.
- ICES. 2019b. Report of the Working Group on North Atlantic Salmon (WGNAS), 25 March–4 April 2019, Bergen, Norway. ICES Scientific Reports, 1:16. 368 pp. <http://doi.org/10.17895/ices.pub.4978>.
- ICES. 2019c. Advice basis. *In* Report of the ICES Advisory Committee, 2019. ICES Advice 2019, section 1.2. 17 pp. <https://doi.org/10.17895/ices.advice.5757>.
- ICES. 2019d. Stock Annex: Atlantic salmon (*Salmo salar*). Created 28 March 2014 by the Working Group on North Atlantic Salmon (WGNAS). Updated: April 2019. 140 pp.
- ICES. 2020. Working Group on North Atlantic Salmon (WGNAS). ICES Scientific Reports. 2:21. 357 pp. <http://doi.org/10.17895/ices.pub.5973>.
- Jeffery, N. W., Wringe, B. F., McBride, M., Hamilton, L. C., Stanley, R. R. E., Bernatchez, L., Kent, M., Clément, M., Gilbey, J., Sheehan, T. F., Bentzen, P., and Bradbury, I. R. 2018. Range-wide regional assignment of Atlantic salmon (*Salmo salar*) using genome wide single-nucleotide polymorphisms. *Fisheries Research*, 206: 163–175. <https://doi.org/10.1016/j.fishres.2018.05.017>.
- NASCO. 2018. Multi-Annual Regulatory Measure for Fishing for Atlantic Salmon at West Greenland. NASCO WGC (18)11. 2 pp. <http://www.nasco.int/2018commissiondocs.html>.

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Annex 1 Glossary of acronyms and abbreviations

1SW (*one-sea-winter*). Maiden adult salmon that has spent one winter at sea.

2SW (*two-sea-winter*). Maiden adult salmon that has spent two winters at sea.

CL, i.e. S_{lim} (*conservation limit*). Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries is to ensure that there is a high probability that undesirable levels are avoided.

ICES (*International Council for the Exploration of the Sea*).

NAC (*North American Commission*). A commission under NASCO.

NAFO (*Northwest Atlantic Fisheries Organization*). NAFO is an intergovernmental fisheries science and management organization that ensures the long-term conservation and sustainable use of fishery resources in the Northwest Atlantic.

NASCO (*North Atlantic Salmon Conservation Organization*).

NEAC (*North-East Atlantic Commission*). A commission under NASCO.

PFA (*pre-fishery abundance*). The numbers of salmon estimated to be alive in the ocean from a particular stock at a specific time.

Annex 2† General considerations

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach, which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits (CLs) by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a simultaneous risk level (probability) of 75% has been agreed for the provision of catch advice on the stock complexes exploited at West Greenland (non-maturing 1SW fish from North America and Southern NEAC). The management objectives are to meet (a) the Southern NEAC MSW CL, (b) the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, and Gulf) to achieve a 25% increase in returns of 2SW salmon from the average returns in the period 1992–1996 for the Scotia–Fundy region of NAC, and (c) to achieve 2SW adult returns of 4549 fish or greater for the USA region of NAC. A framework of indicators has been developed in support of the multi-annual catch options.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northeast Atlantic area their current distribution extends from northern Portugal to the Pechora River in northwestern Russia and Iceland. In the Northwest Atlantic distribution ranges from the Connecticut River in USA (41.6°N) to the Leaf River in Ungava Bay (Quebec, Canada; 58.8°N). Juveniles migrate to the ocean at ages one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds are known to take place, with adult salmon from both the North American and Northeast Atlantic stocks migrating to West Greenland to feed during their second summer and autumn at sea.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions, and the impact of predators of salmon at sea, are considered to be the main factors contributing to lower productivity, which is expressed almost entirely in terms of lower marine survival.

Effects of the fisheries on the ecosystem

The current salmon fishery uses nearshore surface gillnets. There is no information on bycatch of other species with this gear. The fisheries probably have no influence, or only a minor influence, on the marine ecosystem.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Catch reporting at Greenland is considered to be incomplete.

† Version 2: All text prior to Scientific basis table inserted

Scientific basis

ICES stock data category	1 (ICES, 2019c).
Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in the data.
Input data	Nominal catches (by sea-age class and continent of origin) for internal use fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	No salmon discards in the directed salmon fishery.
Indicators	A framework of indicators (FWI) is used to indicate whether a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies.
Other information	Advice subject to annual review. Stock annex completed in 2014 and updated in 2019 (ICES, 2019d).
Working group	Working Group on North Atlantic Salmon (WGNAS) (ICES, 2020).