Northeast Fisheries Science Center Reference Document 13-20

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Contents

Introduction

An important Atlantic salmon (*Salmo salar*) mixed-stock fishery exists off the western coast of Greenland. This fishery takes primarily one-sea-winter (1SW) North American and European origin salmon that would potentially return to natal waters as mature two-sea-winter (2SW) spawning adults or older. Effective management of the resource on both continents requires annual collection of accurate landings data, continent of origin assignments, and biological characteristics data to assess the impact of the fishery on the contributing stock complexes. Data collected during the fishery are also required for use in assessment models to predict pre-fishery abundance of North American and European stocks and to provide fishery managers with catch options required for setting harvest regulations for this mixed stock fishery.

Atlantic salmon were first documented off the coast of Greenland in 1780 and were targeted by a small local inshore gillnet fishery (Jensen 1990). During the early 1960s, the fishery developed an international presence; in 1965, vessels from Norway, Denmark, Sweden, and the Faroe Islands arrived and introduced an offshore drift-gillnet fishery (Jensen 1990). Reported catches increased to a high of 2,689 metric tons (t) in 1971 (Figure 1). Tag studies conducted during this period indicated that the Atlantic salmon caught in this fishery did not originate from Greenland, but were of North American and European origin. Due to the concerns that this fishery would have deleterious impacts on the contributing stock complexes, a quota system was agreed upon and implemented in 1976 (Colligan et al. 2008), and since 1984 catch regulations have been established by the North Atlantic Salmon Conservation Organization (NASCO).

Since 1969, a coordinated international sampling program has been conducted to obtain biological samples from the Greenland salmon fishery. From 1969-1981, research vessels were used to obtain samples. Since 1982, international teams of samplers have been deployed throughout Greenland to obtain samples from fish processing plants (when a commercial fishery was allowed), local markets, and other vendors from individual communities where Atlantic salmon were being landed. The focus of this sampling program was to collect biological samples and associated data on the catch. Originally length, weight, and scale samples were collected, and individual salmon were scanned for fin clips or external/internal tags. The sampling program has continually evolved and tissue samples are now also being taken for genetic analysis.

The purpose of this paper is to:

- describe the international sampling program;
- present the results from the continent of origin analysis;
- summarize the biological characteristics of the catch from West Greenland during the internal use only fishery of 2012; and
- provide an update on the SALSEA Greenland Program.

International Sampling Program

The West Greenland Commission (WGC) of the NASCO has agreed regulatory measures for the West Greenland fishery for all years from 1984 onward (with the exception of 1985, 1991, 1992, and 1996). Since 2006, these have been applied as multi-year regulatory measures. The latest measure was established for the period 2012 to 2014 (WGC(12)12) and restricted landings in 2012 to the amount used for internal consumption in Greenland only, which in the past has been estimated to be 20 t. In addition, no commercial export of salmon is allowed. These regulatory measures will also apply in 2013 and 2014 if the Framework of Indicators (FWI) developed and updated by the International Council for the Exploration of the Sea (ICES 2007, 2012) indicate no significant change, implying that a reassessment of the catch advice is not required (WGC(12)12). The FWI will be applied in 2013 (and again in 2014, if appropriate), to determine if the 2012 regulatory measures will be applied to the 2013 and 2014 fisheries.

In 2002, the Organization of Fishermen and Hunters in Greenland (KNAPK) agreed with the North Atlantic Salmon Fund (NASF) to be compensated for not prosecuting a commercial fishery. As part of this agreement, an annual opt-out date was established whereby either party could notify the other that the agreement would not be implemented for the upcoming fishing season. In 2007, a new agreement between KNAPK, NASF, and the Atlantic Salmon Federation (ASF) was signed that effectively extended and revised the 2002 agreement through 2013, retaining the same opt-out option and date as the 2002 agreement.

Although the 2012 commercial fishery remained closed and the quota set to nil by the Home Rule Government of Greenland, the internal-use-only fishery for personal and local consumption was unaffected. As in the past, the internal-use-only fishery was without a quota limit, but was expected to be approximately 20 t. The fishery opened on 1 August 2011 and closed on 31 October 2011. The fishery is regulated according to The Government of Greenland Executive Order no. 21 of 10 August 2002.

Under NASCO's West Greenland Sampling Agreement (WGC(12)13), parties to NASCO's WGC agreed to provide staff to sample Atlantic salmon catches from the West Greenland internal-use-only fishery during the 2012 season.

The objectives of the sampling program were to:

- Continue the time series of data (1969-2011) on continent of origin and biological characteristics of the Atlantic salmon in the West Greenland fishery
- Provide data on mean weight, length, age and continent of origin for use in the North American and European Atlantic salmon run-reconstruction models
- Collect information on the recovery of internal and external tags.

The European Union agreed to provide staff to sample the fishery for a minimum of six person-weeks; the United States agreed for a minimum of two person-weeks; and Canada for a minimum of two person-weeks. Samplers from various countries involved in the program were as follows:

Country	Sampler(s)	Institute	Period	Community (NAFO Division)
USA	Timothy Sheehan	NOAA Fisheries Service	27 Aug – 06 Sept	Qaqortoq (1F)
Ireland	Macdara Ó Cuaig	Marine Institute	03 Sept – 16 Sept	Sisimiut (1B)
UK (Scotland)	Bob Laughton	Findhorn, Nairn and Lossie Fisheries Trust	06 Sep – 20 Sep	Qaqortoq (1F)
UK (England & Wales)	Marta Assunção	Cefas Laboratory	18 Sep – 01 Oct	Sisimiut (1B)
Canada	Denise Deschamps	Ministère des Ressources Naturelles et de la Faune	21 Sept – 07 Oct	Maniitsoq (1C)

Individual samplers were deployed during the course of the 2012 fishing season to provide the best possible spatial and temporal coverage of the fishery. The coordination of this effort was handled by the USA (NOAA Fisheries Service), with assistance from the Greenland Institute of Natural Resources. Samplers were stationed in three communities representing three Northwest Atlantic Fisheries Organization (NAFO) Divisions (Figure 2): Sisimiut (1B), Maniitsoq (1C) and Qaqortoq (1F). Samplers were not deployed to Nuuk (1D) due to the uncertainty of access to landed Atlantic salmon in this community (ICES 2012)

Reported landings in 2012 were 33.0 t (32.5 t for West Greenland and 0.5 t for East Greenland ICES statistical area XIV). In the past, non-reporting of harvest was identified by comparing the reported landings to the sample data. From 2002-2011 (with the exception of 2006 and 2011), the sampling team documented more fish than reported in at least one division (ICES 2012). A documented salmon could be one that was either sampled, checked for an adipose clip only, or not sampled but seen. When this type of discrepancy occurs, the reported landings are adjusted to include the total weight of the fish documented as being landed during the sampling period, and the adjusted landings are included in all subsequent assessments. In 2012, discrepancies occurred in two of the three sampled communities (Table 1). Reported landings for Sisimiut were 575 kg and the adjusted landings were determined to be 1795 kg (difference of 1220 kg, 212% of reported landings); in Qaqortoq the reported landings were 551 kg and were adjusted to be 1294 kg (difference of 743 kg, 135% of reported landings). The reported landings and adjusted landings for 2002-2012 are presented in Table 2. To provide the most reliable estimate of catch (and therefore the potential fishery impacts on contributing stocks), it is important to continue to improve the catch landings procedure and the quality of the catch statistics.

For the Baseline Sampling Program, landed fish were sampled at random and, when possible, the total catch was examined. Individual fish were measured (fork length, mm) and weighed (gutted weight or whole weight, kg). Scales were taken for age determination, and adipose fins taken for DNA analysis. Fish were also examined for fin clips, external marks, external tags, and internal tags. Adipose-clipped fish were sampled for microtags (coded wire tags).

A total of 2,047 salmon were observed by the sampling teams. Of these, 1,378 were sampled for biological characteristics (representing ~14% by weight of the reported landings), 527 fish were only checked for an adipose clip, and 142 were documented as being landed but were not sampled or examined further. Biological characteristics data were collected as follows:

- 1,377 fork lengths;
- 1,261 gutted weights;
- 142 whole weights;
- 1,376 scale samples;
- 1,373 genetic samples;
- 16 sex identifications from gonadal examination.

A total of 17 adipose-clipped fish were documented. Of all the fish examined by the samplers, none had an external or an internal tag. Six tags were submitted to the Nature Institute by local fisherman from un-sampled fish (all from fish reported harvested in 2012). The tag breakdown was as follows (Table 3):

- 6 Carlin/streamer/spaghetti tags

Sampling for the Baseline Program often takes place at a local market, as this a centralized location where harvested salmon are present and available. Prior to any sampling, the sampler always obtained permission from the market manager. This arrangement has generally been successful for all samplers, although there have been issues in some years in Nuuk (Sheehan et al. 2012). Because of concerns that proper arrangements had not been made to allow sampling of fish in Nuuk in 2012, no samples were collected from Nuuk.

The limitation of the fishery to internal-use-only caused some practical problems for the sampling teams; however, the sampling program was successful in adequately sampling the Greenland catch, both temporally and spatially. The need to obtain samples from fish landed in Nuuk and the potential bias on describing the biological characteristics of the harvest, stock assessment results, and catch advice should be considered further.

Continent of Origin

Fin tissue samples were collected and preserved in RNAlater™, an aqueous, non-toxic tissue and cell storage reagent that stabilizes and protects cellular RNA. A total of 1,373 samples were collected from three communities in three NAFO divisions: Sisimiut in 1B (n=464), Maniitsoq in 1C (n=585), and Qaqortoq in 1F (n=324).

DNA isolation and the subsequent microsatellite analyses were performed according to standardized protocols (King et al. 2001; Sheehan et al. 2010). A database of approximately 5,000 Atlantic salmon genotypes of known origin was used as a baseline to assign the samples to continent of origin. In total, 81.6% of the salmon sampled were of North American origin and 18.4% were of European origin. The NAFO Division-specific continent of origin assignments are presented in Table 4.

These findings show that high proportions of fish from the North American stock complex continue to contribute to the fishery (Figure 3). The variability in the recent stock complex contributions between Divisions and the deviation from past trends (Figure 4) underscore the need to annually sample multiple NAFO Divisions to achieve accurate estimates of continental contributions to the harvest.

Variations in the estimated weighted proportions of North American and European salmon in the fishery during 1987-2012 are shown in Table 5 and Figure 4. The 2012 North American weighted contribution (78.8%) to the fishery was above the long-term mean (68%), but equal to the recent 10-year mean (2003-2012, 78%). The European weighted contribution (21.2%) to the 2012 fishery was below the long-term mean (32%), but equal to the 2003-2012 mean. In terms of numbers of fish, the 2012 fishery caught approximately 7,800 North American salmon (27.7 t) and 2,100 European fish (7.3 t; Table 5 and Figure 5). The 2012 total is higher than in 2011 and above the 10-year mean (2003-2012; 7,490 fish), but is still among the lowest in the time series.

Biological Characteristics of the Catches

Biological characteristics (length, weight, and age) were recorded for all sampled fish. Overall across all sea ages, the mean sampled fork length was 65.8 cm and the mean gutted weight was 3.06 kg.

An overall decrease in mean whole weight of both European and North American 1SW salmon occurred between 1969 and 1995 (Table 6 and Figure 6). This trend was reversed in 1996 when mean weights began to increase. In 2012, the mean length of North American 1SW salmon was 65.5 cm and the mean whole weight was 3.34 kg; the mean length of European 1SW salmon was 64.9 cm and the mean whole weight was 3.38 kg. Although both the North American and European 1SW whole weights decreased slightly from those in 2011 (North American 3.56 kg and European 3.24 kg), the 2012 weights are higher than the recent 10-year averages (3.19 kg for North American 1SW fish and 3.18 kg for European 1SW fish). The North American 1SW fork length estimate decreased slightly from 2011 (66.2 cm), but was slightly above the 10-year mean (65.0 cm). The European 1SW mean fork length remained the same as in 2011 (65.0 cm) and was virtually identical to the 10-year mean (64.9 cm). A summary of the mean fork lengths and whole weights in the 2012 fishery by sea age, continent of origin, and NAFO Division is presented in Table 7. Note that the weight data have not been adjusted for date of capture, and hence may not represent an actual change in mean weight over the time series as fish sampled later in the fishing season have had additional time to grow compared to fish sampled early in the season (ICES 2011).

The smolt age distribution of the total catch by continent of origin is presented in Table 8. The smolt age distributions by origin for all North American and European origin salmon caught (1968-2012) are provided in Table 9.

In 2012, the percentages of fish by smolt age within continent of origin were:

Continent of origin	Percent of continent of origin by smolt age (years)					
	1	2	3	4	5	6
North American	0.3%	29.8%	39.4%	23.3%	6.5%	0.7%
European	9.3%	63.0%	24.0%	3.7%	0%	0%

The mean smolt age of the 2012 North American origin samples was 3.1 years. Age 1 smolts continue to represent a small portion of the catch (0.3%, 10-year mean of 1.6%), indicative of the

relatively minor contribution of the more southerly North American populations to the fishery. The percentage of smolt age 2 salmon of North American origin (29.8%) in the 2012 fishery is lower than in 2011 (36.1%), but higher than the 10-year mean (25.4%). Age 3 and older smolts accounted for 70.0% of the 2012 harvest of North American fish.

The mean smolt age of the European salmon in 2012 was 2.2 years. The percentage of smolt age 1 (9.3%) is lower than in 2011 (18.3%) and also below the 10-year mean of 13.9%. The percentage of smolt age 2 (63.0%) in the 2012 fishery is higher than in 2011 (54.9%) and also above the 10-year mean (58.6%). The contribution of age 3 and older European origin smolts (27.6%) is equal to the 10-year mean (27.6%).

As expected, the 1SW age group were dominant (94.1%) in the 2012 fishery (Table 10). This value is slightly above the 2011 value (92.9%). Concerns have been raised over recent difficulty with discerning winter annuli from apparent 'checks' in the marine zone of Atlantic salmon multi-sea winter scales. Care should be taken to properly discern true marine annuli from growth checks, and further study of this phenomenon is warranted.

In 2012, the proportions by sea age by continent of origin were:

Continent of origin	**Percent of continent of origin by sea age (years)**			
	1SW	**2SW**	**3SW**	**Repeat Spawners**
North American	93.2%	0.7%	0%	6.0%
European	98.0%	1.6%	0%	0.4%

As part of the sampling, sex was determined by examination of the gonads of 16 fish. Of these, 4 were male and 16 were female.

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Table 1. Evaluation of under reporting in sampled communities during the 2012 Greenland Atlantic salmon (*Salmo salar*) fishery by community/Northwest Atlantic Fisheries Organization (NAFO) Division. The total number of salmon documented by the sampling teams (salmon that have been sampled, seen but not sampled and seen and checked for an adipose fin clip only) is converted to a total whole weight and compared to the reported landings for each community.

Community (NAFO Division)	Number sampled	Number seen	Average sampled gutted wt (kg)	Average converted whole wt (kg)
Sisimiut (1B)	466	73	3.00	3.33
Maniitsoq (1C)	586	510	3.25	3.61
Qaqortoq (1F)	326	86	2.83	3.14
Total	**1378**	**669**	**3.06**	**3.40**

Community	Estimated whole wt sampled/seen (kg)	Reported landings (kg)	Adjusted Landings (kg)	Difference (kg)	% of Reported landings
Sisimiut (1B)	1795	575	**1794.9**	1219.9	212%
Maniitsoq (1C)	3954	8756	**8756.0**	0.0	0%
Qaqortoq (1F)	1294	551	**1294.2**	743.2	135%
Total	**7043**	**9882**	**11845.1**	**1963.1**	**20%**

Table 2. Reported landings (kg) for the Greenland Atlantic salmon (*Salmo salar*) fishery (2002–2012) by Northwest Atlantic Fisheries Organization (NAFO) Division as reported by the Home Rule Government and the division-specific adjusted landings where the sampling teams observed more fish landed than were reported. Landings from International Council for the Exploration of the Seas Statistical Area XIV (East Greenland) are not included in the assessment, but amounted to 0.5 t in 2012.

		NAFO Division						
Year		**1A**	**1B**	**1C**	**1D**	**1E**	**1F**	**Total**
2002	Reported	14	78	2100	3752	1417	1661	9022
	Adjusted						2408	9769
2003	Reported	619	17	1621	648	1274	4516	8694
	Adjusted			1782	2709		5912	12312
2004	Reported	3476	611	3516	2433	2609	2068	14712
	Adjusted				4929			17209
2005	Reported	1294	3120	2240	756	2937	4956	15303
	Adjusted				2730			17276
2006	Reported	5427	2611	3424	4731	2636	4192	23021
	Adjusted							
2007	Reported	2019	5089	6148	4470	4828	2093	24647
	Adjusted						2252	24806
2008	Reported	4882	2210	10024	1595	2457	4979	26147
	Adjusted				3577		5478	28627
2009	Reported	195	6151	7090	2988	4296	4777	25496
	Adjusted				5466			27975
2010	Reported	17263	4558	2363	2747	6766	4252	37949
	Adjusted		4824		6566		5274	43056
2011	Reported	1858	3662	5274	7977	4021	4613	27407
	Adjusted							
2012	Reported	5296	781	14963	4564	3993	2951	32548
	Adjusted		2001				3694	34511

Table 3. Reported tag recaptures (n=6) from the 2012 Greenland Atlantic salmon (*Salmo salar*) fishery.

tag information		**Release information**				**Recapture information**			
Tag type	**Tag code (Seq. code)**	**Country**	**River released**	**Release Date**	**Life stage**	**Community**	**Recapture year**	**Recapture Date**	**Recapture length (cm)**
carlin	YY34,105 (light blue)	Canada	NW Miramichi	9-Oct-11	adult	Nanortalik (1F)	2012		87
spaghetti	A-01698 (red)	Canada	Campbellton	11-May-12	adult	(1D)	2012	11-Aug-12	57
carlin	YY 32,569 (light blue)	Canada	SW Miramichi	26-Aug-11	adult	Nuuk (1D)	2012	8-Oct-12	94
carlin	YY35,191 (light blue)	Canada	SW Miramichi	8-Oct-11	adult	Nuuk (1D)	2012	24-Oct-12	85
carlin	R 695532 S (light green)	Sweden	Lagan	24-Apr-11	smolt	Qaqortoq (1F)	2012	27-Oct-12	75
carlin	YY35,639 (light blue)	Canada	SW Miramichi	24-Sep-11	adult	Aasiaat (1B)	2012	12-Oct-12	75

Table 4. The continental proportions of North American (NA) and European (E) Atlantic salmon (*Salmo salar*) caught in West Greenland 2012 by Northwest Atlantic Fisheries Organization (NAFO) Division. The origin of five fish could not be determined due to poor sample quality and are omitted here.

NAFO	Fishing	Number			Percentages	
Div.	dates	NA	E	Totals	NA	E
1B	Sep 03 - Oct 01	442	22	464	95.3	4.7
1C	Sep 21 - Oct 07	431	154	585	73.7	26.3
1F	Aug 28 - Sep 19	248	76	324	76.5	23.5
TOTAL		1121	252	1373	81.6	18.4

Table 5. The catch weighted numbers of North American (NA) and European (E) Atlantic salmon (*Salmo salar*) caught at West Greenland 1971-2012 and the proportion of the catch by weight. Numbers are rounded to the nearest hundred fish. Continent of origin assignments were based on scale characteristics until 1995, scale characteristics and DNA based assignments until 2001 and DNA based assignments only from 2001 onwards.

	Proportion weighted by catch		Numbers of Salmon caught	
	NA	E	NA	E
1982	57	43	192,200	143,800
1983	40	60	39,500	60,500
1984	54	46	48,800	41,200
1985	47	53	143,500	161,500
1986	59	41	188,300	131,900
1987	59	41	171,900	126,400
1988	43	57	125,500	168,800
1989	55	45	65,000	52,700
1990	74	26	62,400	21,700
1991	63	37	111,700	65,400
1992	45	55	46,900	38,500
1993	-	-	-	-
1994	-	-	-	-
1995	67	33	21,400	10,700
1996	70	30	22,400	9,700
1997	85	15	18,000	3,300
1998	79	21	3,100	900
1999	91	9	5,700	600
2000	65	35	5,100	2,700
2001	67	33	9,400	4,700

Table 5 continued

2002	69	31	2,300	1,000
2003	64	36	2,600	1,400
2004	72	28	3,900	1,500
2005	74	26	3,500	1,200
2006	69	31	4,000	1,800
2007	76	24	6,100	1,900
2008	86	14	8,000	1,300
2009	90	10	7,000	800
2010	81	19	10,000	2,600
2011	92	8	7500	600
2012	79	21	7800	2100

Table 6. Annual mean fork lengths and whole weights by continent of origin (NA - North American and E – European) and sea age (1SW – one sea-winter, 2SW – two sea-winter and PS – previous spawner) of Atlantic salmon (*Salmo salar*) caught at West Greenland, 1969-2012.

	Whole weight (kg) Sea age & origin									Fork length (cm) Sea age & origin					
	1SW		2SW		PS		All sea ages		TOTAL	1SW		2SW		PS	
	NA	E	NA	E	NA	E	NA	E		NA	E	NA	E	NA	E
1969	3.12	3.76	5.48	5.80	-	5.13	3.25	3.86	3.58	65.0	68.7	77.0	80.3	-	75.3
1970	2.85	3.46	5.65	5.50	4.85	3.80	3.06	3.53	3.28	64.7	68.6	81.5	82.0	78.0	75.0
1971	2.65	3.38	4.30	-	-	-	2.68	3.38	3.14	62.8	67.7	72.0	-	-	-
1972	2.96	3.46	5.85	6.13	2.65	4.00	3.25	3.55	3.44	64.2	67.9	80.7	82.4	61.5	69.0
1973	3.28	4.54	9.47	10.00	-	-	3.83	4.66	4.18	64.5	70.4	88.0	96.0	61.5	-
1974	3.12	3.81	7.06	8.06	3.42	-	3.22	3.86	3.58	64.1	68.1	82.8	87.4	66.0	-
1975	2.58	3.42	6.12	6.23	2.60	4.80	2.65	3.48	3.12	61.7	67.5	80.6	82.2	66.0	75.0
1976	2.55	3.21	6.16	7.20	3.55	3.57	2.75	3.24	3.04	61.3	65.9	80.7	87.5	72.0	70.7
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	2.96	3.50	7.00	7.90	2.45	6.60	3.04	3.53	3.35	63.7	67.3	83.6	-	60.8	85.0
1979	2.98	3.50	7.06	7.60	3.92	6.33	3.12	3.56	3.34	63.4	66.7	81.6	85.3	61.9	82.0
1980	2.98	3.33	6.82	6.73	3.55	3.90	3.07	3.38	3.22	64.0	66.3	82.9	83.0	67.0	70.9
1981	2.77	3.48	6.93	7.42	4.12	3.65	2.89	3.58	3.17	62.3	66.7	82.8	84.5	72.5	-
1982	2.79	3.21	5.59	5.59	3.96	5.66	2.92	3.43	3.11	62.7	66.2	78.4	77.8	71.4	80.9
1983	2.54	3.01	5.79	5.86	3.37	3.55	3.02	3.14	3.10	61.5	65.4	81.1	81.5	68.2	70.5
1984	2.64	2.84	5.84	5.77	3.62	5.78	3.20	3.03	3.11	62.3	63.9	80.7	80.0	69.8	79.5
1985	2.50	2.89	5.42	5.45	5.20	4.97	2.72	3.01	2.87	61.2	64.3	78.9	78.6	79.1	77.0
1986	2.75	3.13	6.44	6.08	3.32	4.37	2.89	3.19	3.03	62.8	65.1	80.7	79.8	66.5	73.4
1987	3.00	3.20	6.36	5.96	4.69	4.70	3.10	3.26	3.16	64.2	65.6	81.2	79.6	74.8	74.8
1988	2.83	3.36	6.77	6.78	4.75	4.64	2.93	3.41	3.18	63.0	66.6	82.1	82.4	74.7	73.8
1989	2.56	2.86	5.87	5.77	4.23	5.83	2.77	2.99	2.87	62.3	64.5	80.8	81.0	73.8	82.2
1990	2.53	2.61	6.47	5.78	3.90	5.09	2.67	2.72	2.69	62.3	62.7	83.4	81.1	72.6	78.6
1991	2.42	2.54	5.82	6.23	5.15	5.09	2.57	2.79	2.65	61.6	62.7	80.6	82.2	81.7	80.0
1992	2.54	2.66	6.49	6.01	4.09	5.28	2.86	2.74	2.81	62.3	63.2	83.4	81.1	77.4	82.7
1995	2.37	2.67	6.09	5.88	3.71	4.98	2.45	2.75	2.56	61.0	63.2	81.3	81.0	70.9	81.3
1996	2.63	2.86	6.50	6.30	4.98	5.44	2.83	2.90	2.88	62.8	64.0	81.4	81.1	77.1	79.4
1997	2.57	2.82	7.95	6.11	4.82	6.9	2.63	2.84	2.71	62.3	63.6	85.7	84.0	79.4	87.0
1998	2.72	2.83	6.44	-	3.28	4.77	2.76	2.84	2.78	62.0	62.7	84.0	-	66.3	76.0
1999	3.02	3.03	7.59	-	4.20	-	3.09	3.03	3.08	63.8	63.5	86.6	-	70.9	-
2000	2.47	2.81	-	-	2.58	-	2.47	2.81	2.57	60.7	63.2	-	-	64.7	-
2001	2.89	3.03	6.76	5.96	4.41	4.06	2.95	3.09	3.00	63.1	63.7	81.7	79.1	75.3	72.1
2002	2.84	2.92	7.12	-	5.00	-	2.89	2.92	2.90	62.6	62.1	83.0	-	75.8	-
2003	2.94	3.08	8.82	5.58	4.04	-	3.02	3.10	3.04	63	64.4	86.1	78.3	71.4	-
2004	3.11	2.95	7.33	5.22	4.71	6.48	3.17	3.22	3.18	64.7	65.0	86.2	76.4	77.6	88.0
2005	3.19	3.33	7.05	4.19	4.31	2.89	3.31	3.33	3.31	65.9	66.4	83.3	75.5	73.7	62.3
2006	3.10	3.25	9.72		5.05	3.67	3.25	3.26	3.24	65.3	65.3	90.0		76.8	69.5
2007	2.89	2.87	6.19	6.47	4.94	3.57	2.98	2.99	2.98	63.5	63.3	80.9	80.6	76.7	71.3
2008	3.04	3.03	6.35	7.47	3.82	3.39	3.08	3.07	3.08	64.6	63.9	80.1	85.5	71.1	73.0
2009	3.28	3.40	7.59	6.54	5.25	4.28	3.48	3.67	3.50	64.9	65.5	84.6	81.7	75.9	73.5
2010	3.44	3.24	6.40	5.45	4.17	3.92	3.47	3.28	3.42	66.7	65.2	80.0	75.0	72.4	70.0
2011	3.30	3.18	5.69	4.94	4.46	5.11	3.39	3.49	3.40	65.8	64.7	78.6	75.0	73.7	76.3
2012	3.34	3.38	6.00	4.51	4.65	3.65	3.44	3.40	3.44	65.5	64.9	75.9	70.4	72.8	68.9

Table 7. Mean fork lengths (cm) and whole weight (kg) by sea age (1SW – one sea-winter and 2SW – two sea-winter), continent of origin and Northwest Atlantic Fisheries Organization (NAFO) Division for Atlantic salmon (*Salmo salar*) caught at West Greenland in 2012 with corresponding standard deviation (S.D.). Table does not include salmon of unknown age (n=29) or origin (n=5).

	1 SW		2 SW		Previous spawners		All sea ages			
NAFO Div.	Fork length (cm) (S.D.)	Whole weight (kg) (S.D.)	Fork length (cm) (S.D.)	Whole weight (kg) (S.D.)	Fork length (cm) (S.D.)	Whole weight (kg) (S.D.)	Fork length (cm) (S.D.)	No.	Whole weight (kg) (S.D.)	No.
	North American and European									
1B	65.1 (2.9)	3.24 (0.51)	71.0 (10.0)	4.42 (1.86)	70.9 (6.7)	4.16 (1.25)	65.7 (3.8)	453	3.34 (0.68)	452
1C	66.1 (3.1)	3.55 (0.62)	81.4 (12.2)	7.93 (3.62)	75.6 (9.1)	5.52 (1.93)	66.6 (4.3)	580	3.66 (0.93)	580
1F	64.4 (3.4)	3.12 (0.56)	68.5 (7.8)	3.88 (1.51)	73.0 (8.3)	4.08 (1.14)	64.6 (3.8)	311	3.16 (0.61)	310
All Areas	65.4 (3.2)	3.35 (0.60)	74.1 (11.0)	5.5 (2.93)	72.8 (8.0)	4.64 (1.64)	65.8 (4.1)	1344	3.44 (0.81)	1342
	North American									
1B	65.2 (2.8)	3.25 (0.50)	72.8 (10.0)	4.76 (1.87)	70.8 (6.7)	4.16 (1.25)	65.7 (3.9)	431	3.34 (0.68)	430
1C	66.3 (3.0)	3.54 (0.62)	90.0 (0.28)	10.70 (0.40)	75.7 (9.1)	5.53 (1.93)	66.9 (4.5)	428	3.69 (1.0)	428
1F	64.6 (3.1)	3.16 (0.52)	63.0 -	2.82 -	73.6 (8.8)	4.14 (1.21)	64.9 (3.69)	235	3.19 (0.57)	235
All Areas	65.5 (3.1)	3.34 (0.58)	75.9 (12.0)	6.00 (3.30)	72.8 (8.1)	4.65 (1.65)	66.0 (4.2)	1094	3.44 (0.83)	1093
	European									
1B	64.9 (3.3)	3.29 (0.64)	62.1 -	2.77 -	- -	- -	64.8 (3.3)	22	3.26 (0.63)	22
1C	65.6 (3.2)	3.57 (0.62)	72.8 (12.3)	5.16 (2.94)	- -	- -	65.7 (3.4)	152	3.59 (0.68)	152
1F	63.6 (4.0)	3.02 (0.67)	74.0 -	4.95 -	68.9 -	3.65 -	63.8 (4.2)	75	3.06 (0.70)	75
All Areas	64.9 (3.6)	3.38 (0.68)	70.4 (9.0)	4.51 (2.06)	68.9 -	3.65 -	65.0 (3.7)	249	3.40 (0.72)	249

Table 8. The smolt-age (river age) composition (%) of Atlantic salmon (*Salmo salar*) by continent of origin (NA - North American and E – European) and Northwest Atlantic Fisheries Organization (NAFO) Division caught in 2012 at West Greenland. Table does not include salmon of unknown age (n=4) or origin (n=5).

		River age (%)						
NAFO Division	Origin	1	2	3	4	5	6	Total No.
1A	NA	0.2	29.4	36.0	25.0	8.6	0.7	428
	E	9.1	54.5	31.8	4.5	0.0	0.0	22
		0.7	30.7	35.8	24.0	8.2	0.7	450
1D	NA	0.2	30.8	40.2	22.4	5.2	1.2	425
	E	10.5	60.5	23.7	5.3	0.0	0.0	152
		2.9	38.6	35.9	17.9	3.8	0.9	577
1F	NA	0.4	28.4	44.4	22.0	4.7	0.0	232
	E	6.9	70.8	22.2	0.0	0.0	0.0	72
		2.0	38.5	39.1	16.8	3.6	0.0	304
All Areas	NA	0.3	29.8	39.4	23.3	6.5	0.7	1085
	E	9.3	63.0	24.0	3.7	0.0	0.0	246
		2.0	35.9	36.6	19.7	5.3	0.6	1331

Table 9. River age distribution (%) for North American and European origin Atlantic salmon (*Salmo salar*) caught at West Greenland, 1968-2012.

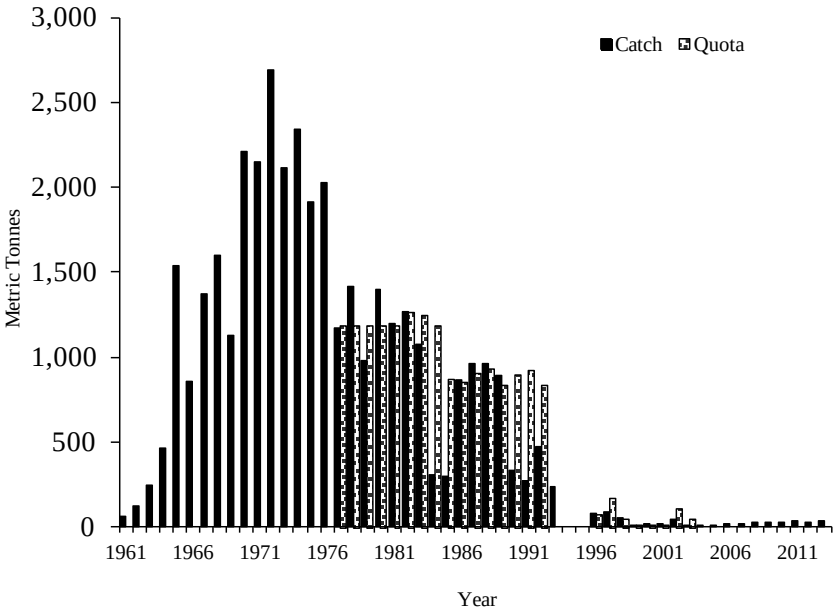
YEAR	1	2	3	4	5	6	7	8
					North American			
1968	0.3	19.6	40.4	21.3	16.2	2.2	0	0
1969	0	27.1	45.8	19.6	6.5	0.9	0	0
1970	0	58.1	25.6	11.6	2.3	2.3	0	0
1971	1.2	32.9	36.5	16.5	9.4	3.5	0	0
1972	0.8	31.9	51.4	10.6	3.9	1.2	0.4	0
1973	2	40.8	34.7	18.4	2	2	0	0
1974	0.9	36	36.6	12	11.7	2.6	0.3	0
1975	0.4	17.3	47.6	24.4	6.2	4	0	0
1976	0.7	42.6	30.6	14.6	10.9	0.4	0.4	0
1978	2.7	31.9	43	13.6	6	2	0.9	0
1979	4.2	39.9	40.6	11.3	2.8	1.1	0.1	0
1980	5.9	36.3	32.9	16.3	7.9	0.7	0.1	0
1981	3.5	31.6	37.5	19	6.6	1.6	0.2	0
1982	1.4	37.7	38.3	15.9	5.8	0.7	0	0.2
1983	3.1	47	32.6	12.7	3.7	0.8	0.1	0
1984	4.8	51.7	28.9	9	4.6	0.9	0.2	0
1985	5.1	41	35.7	12.1	4.9	1.1	0.1	0
1986	2	39.9	33.4	20	4	0.7	0	0
1987	3.9	41.4	31.8	16.7	5.8	0.4	0	0
1988	5.2	31.3	30.8	20.9	10.7	1	0.1	0
1989	7.9	39	30.1	15.9	5.9	1.3	0	0
1990	8.8	45.3	30.7	12.1	2.4	0.5	0.1	0
1991	5.2	33.6	43.5	12.8	3.9	0.8	0.3	0
1992	6.7	36.7	34.1	19.1	3.2	0.3	0	0
1995	2.4	19	45.4	22.6	8.8	1.8	0.1	0
1996	1.7	18.7	46	23.8	8.8	0.8	0.1	0
1997	1.3	16.4	48.4	17.6	15.1	1.3	0	0
1998	4	35.1	37	16.5	6.1	1.1	0.1	0
1999	2.7	23.5	50.6	20.3	2.9	0.0	0.0	0
2000	3.2	26.6	38.6	23.4	7.6	0.6	0	0
2001	1.9	15.2	39.4	32	10.8	0.7	0	0
2002	1.5	27.4	46.5	14.2	9.5	0.9	0	0
2003	2.6	28.8	38.9	21	7.6	1.1	0	0
2004	1.9	19.1	51.9	22.9	3.7	0.5	0	0
2005	2.7	21.4	36.3	30.5	8.5	0.5	0	0
2006	0.6	13.9	44.6	27.6	12.3	1	0	0
2007	1.6	27.7	34.5	26.2	9.2	0.9	0	0
2008	0.9	25.1	51.9	16.8	4.7	0.6	0	0
2009	2.6	30.7	47.3	15.4	3.7	0.4	0	0
2010	1.6	21.7	47.9	21.7	6.3	0.8	0	0
2011	1.0	35.9	45.9	14.4	2.8	0.0	0	0
2012	0.3	29.8	39.4	23.3	6.5	0.7	0	0
10 yr mean (2003-2012)	1.6	25.4	43.9	22.0	6.5	0.7	0.0	0.0
Overall Mean	2.6	31.6	39.6	18.3	6.7	1.1	0.1	0.0

Table 9. continued

YEAR	1	2	3	4	5	6	7	8
					European			
1968	21.6	60.3	15.2	2.7	0.3	0	0	0
1969	0	83.8	16.2	0	0	0	0	0
1970	0	90.4	9.6	0	0	0	0	0
1971	9.3	66.5	19.9	3.1	1.2	0	0	0
1972	11	71.2	16.7	1	0.1	0	0	0
1973	26	58	14	2	0	0	0	0
1974	22.9	68.2	8.5	0.4	0	0	0	0
1975	26	53.4	18.2	2.5	0	0	0	0
1976	23.5	67.2	8.4	0.6	0.3	0	0	0
1978	26.2	65.4	8.2	0.2	0	0	0	0
1979	23.6	64.8	11	0.6	0	0	0	0
1980	25.8	56.9	14.7	2.5	0.2	0	0	0
1981	15.4	67.3	15.7	1.6	0	0	0	0
1982	15.6	56.1	23.5	4.2	0.7	0	0	0
1983	34.7	50.2	12.3	2.4	0.3	0.1	0.1	0
1984	22.7	56.9	15.2	4.2	0.9	0.2	0	0
1985	20.2	61.6	14.9	2.7	0.6	0	0	0
1986	19.5	62.5	15.1	2.7	0.2	0	0	0
1987	19.2	62.5	14.8	3.3	0.3	0	0	0
1988	18.4	61.6	17.3	2.3	0.5	0	0	0
1989	18.0	61.7	17.4	2.7	0.3	0	0	0
1990	15.9	56.3	23	4.4	0.2	0.2	0	0
1991	20.9	47.4	26.3	4.2	1.2	0	0	0
1992	11.8	38.2	42.8	6.5	0.6	0	0	0
1995	14.8	67.3	17.2	0.6	0	0	0	0
1996	15.8	71.1	12.2	0.9	0	0	0	0
1997	4.1	58.1	37.8	0	0	0	0	0
1998	28.6	60.0	7.6	2.9	0.0	1.0	0	0
1999	27.7	65.1	7.2	0	0	0	0	0
2000	36.5	46.7	13.1	2.9	0.7	0	0	0
2001	16.0	51.2	27.3	4.9	0.7	0	0	0
2002	9.4	62.9	20.1	7.6	0	0	0	0
2003	16.2	58.0	22.1	3.0	0.8	0	0	0
2004	18.3	57.7	20.5	3.2	0.2	0	0	0
2005	19.2	60.5	15	5.4	0	0	0	0
2006	17.7	54.0	23.6	3.7	0.9	0	0	0
2007	7.0	48.5	33.0	10.5	1	0	0	0
2008	7.0	72.8	19.3	0.8	0	0	0	0
2009	14.3	59.5	23.8	2.4	0	0	0	0
2010	11.3	57.1	27.3	3.4	0.8	0	0	0
2011	18.3	54.9	25.4	1.4	0.0	0.0	0	0
2012	9.3	63.0	24.0	3.7	0	0	0	0
10 yr mean (2003-2012)	13.9	58.6	23.4	3.7	0.4	0.0	0.0	0.0
Overall Mean	17.6	60.9	18.5	2.7	0.3	0.0	0.0	0.0

Table 10. The sea-age (1SW – one sea-winter and 2SW – two sea-winter) composition of Atlantic salmon (*Salmo salar*) by continent of origin (NA - North American and E – European) and Northwest Atlantic Fisheries Organization (NAFO) Division caught at West Greenland in 2012. Table does not include salmon with unknown age (n=29) or origin (n=5).

		Sea-age composition (%)			
NAFO	Origin	1SW	2SW	Previous Spawners	Total No.
1B	NA	90.7	1.2	8.1	431
	E	95.5	4.5	0.0	22
		90.9	1.3	7.7	453
1C	NA	93.9	0.5	5.6	428
	E	98.7	1.3	0.0	152
		95.2	0.7	4.1	580
1F	NA	96.6	0.4	3.0	236
	E	97.3	1.3	1.3	75
		96.8	0.6	2.6	311
All	NA	93.2	0.7	6.0	1095
areas	E	98.0	1.6	0.4	249
		94.1	0.9	5.0	1344



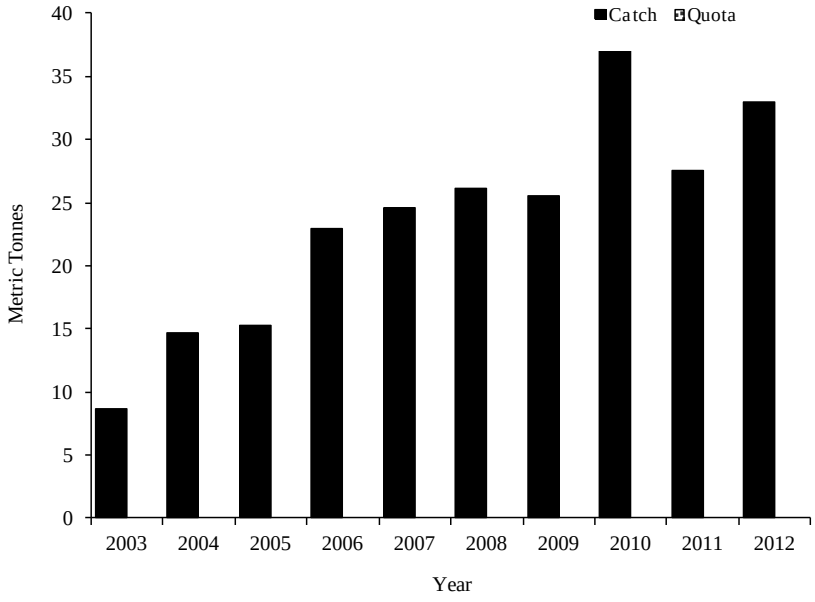


Figure 1. Reported landings and quota for the Atlantic salmon (*Salmo salar*) fishery in Greenlandic home waters for 1960-2012 (top) and 2003-2012 (bottom). 2012 reported landings were 33 metric tons.

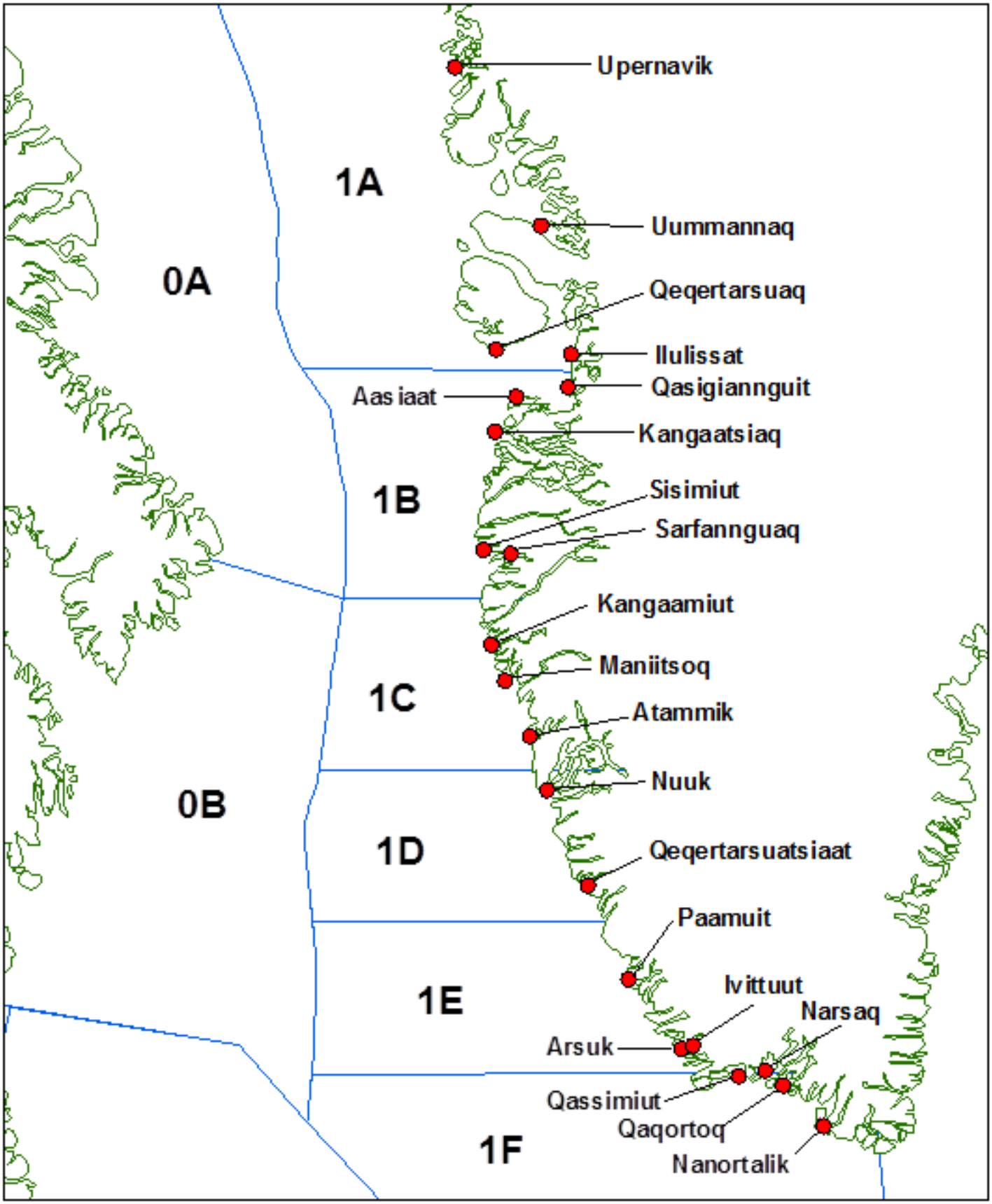


Figure 2. Map of southwest Greenland showing communities to which Atlantic salmon (*Salmo salar*) have historically been landed. Northwest Atlantic Fisheries Organization Division (NAFO) Divisions (1A-1F) are also shown

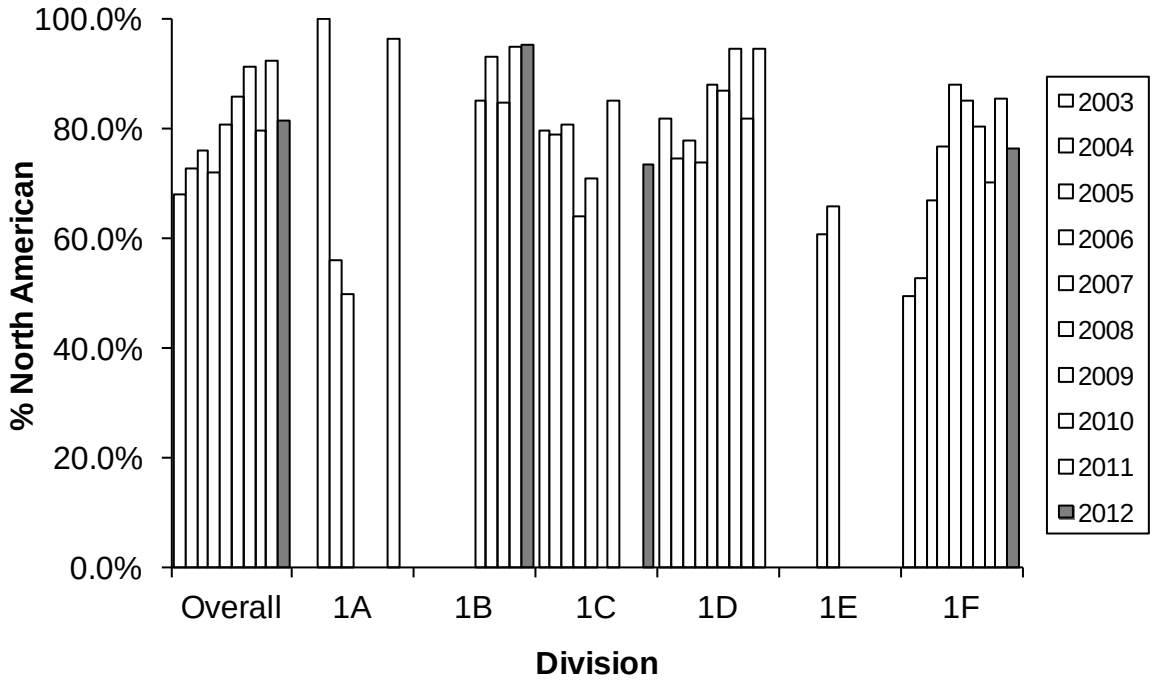


Figure 3. The non-weighted proportion of North American origin Atlantic salmon (*Salmo salar*) caught at West Greenland from 2001 – 2012 (left to right, 2012 is represented by the grey filled columns) by Northwest Atlantic Fisheries Organization Division (NAFO) Division according to the sample data. Division 1A 2005 value is based off of one sample

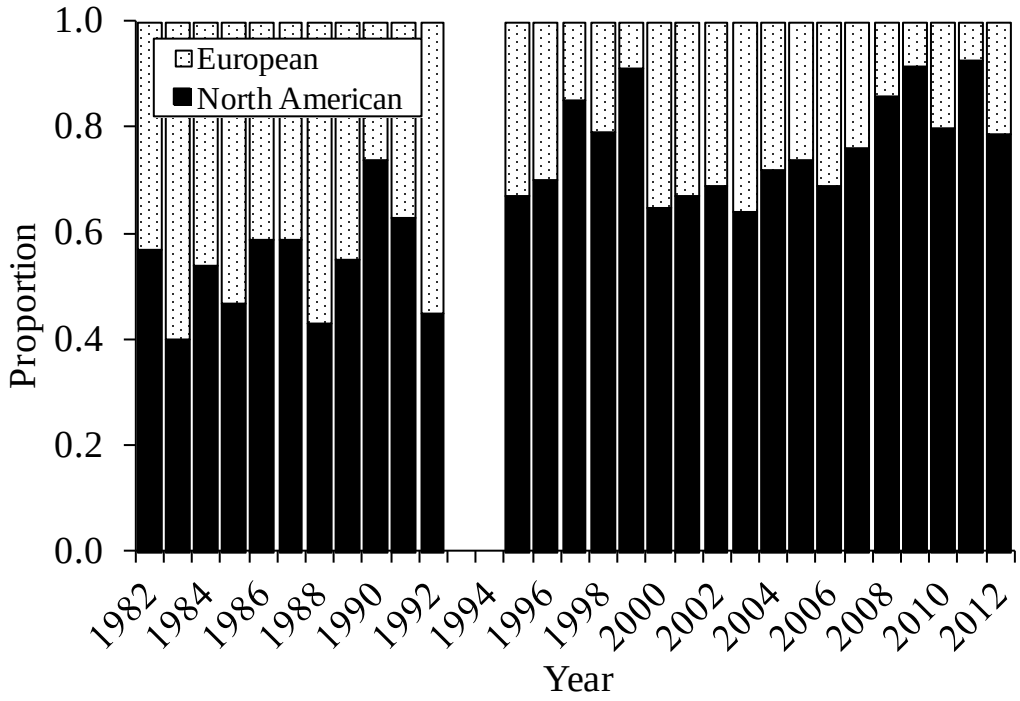


Figure 4. The weighted proportions of North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland from 1982-2012.

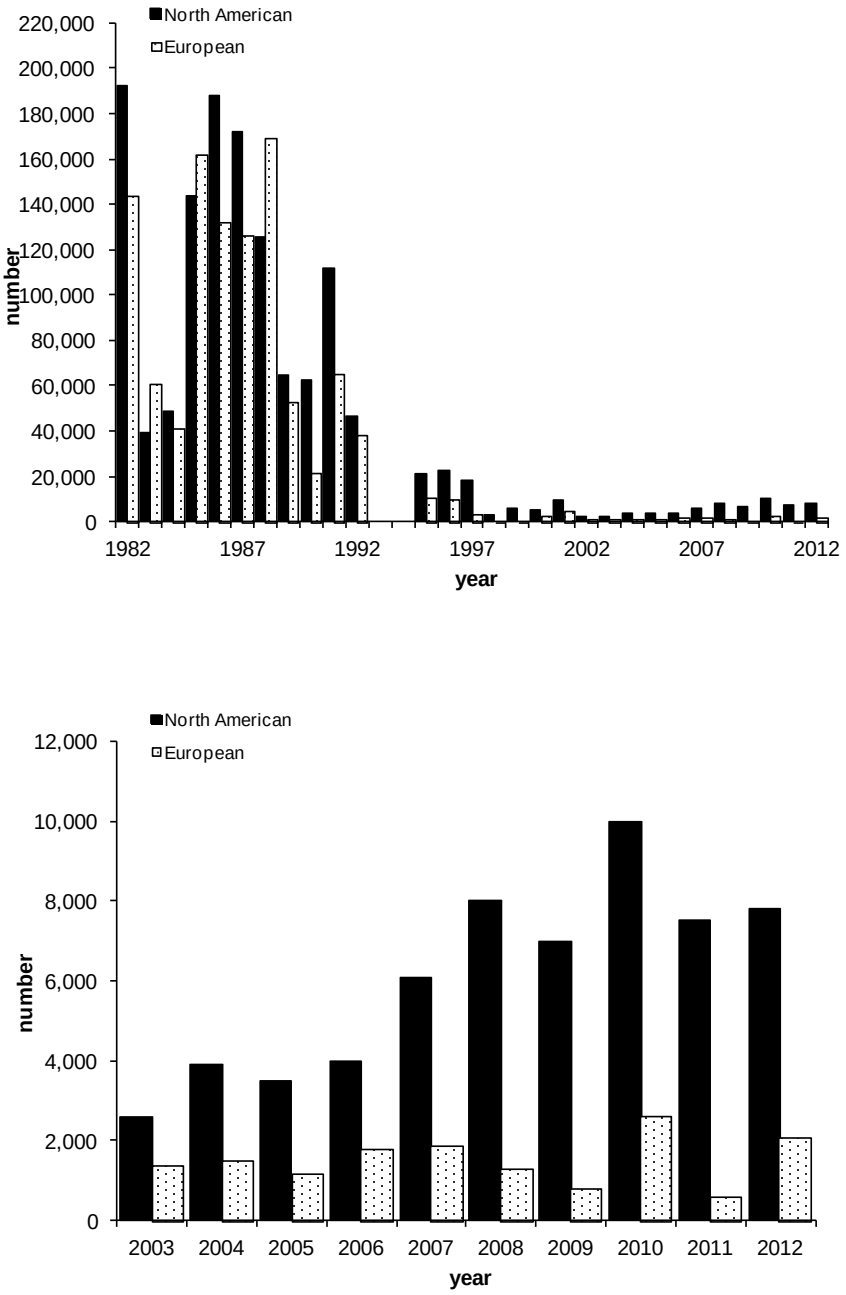


Figure 5. The weighted numbers of North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland from 1982 – 2012 (top) and 2003 – 2012 (bottom). Numbers are rounded to the nearest hundred fish. In 2012, it is estimated that approximately 7,800 and 2,100 North American and European origin fish were harvested respectively**.**

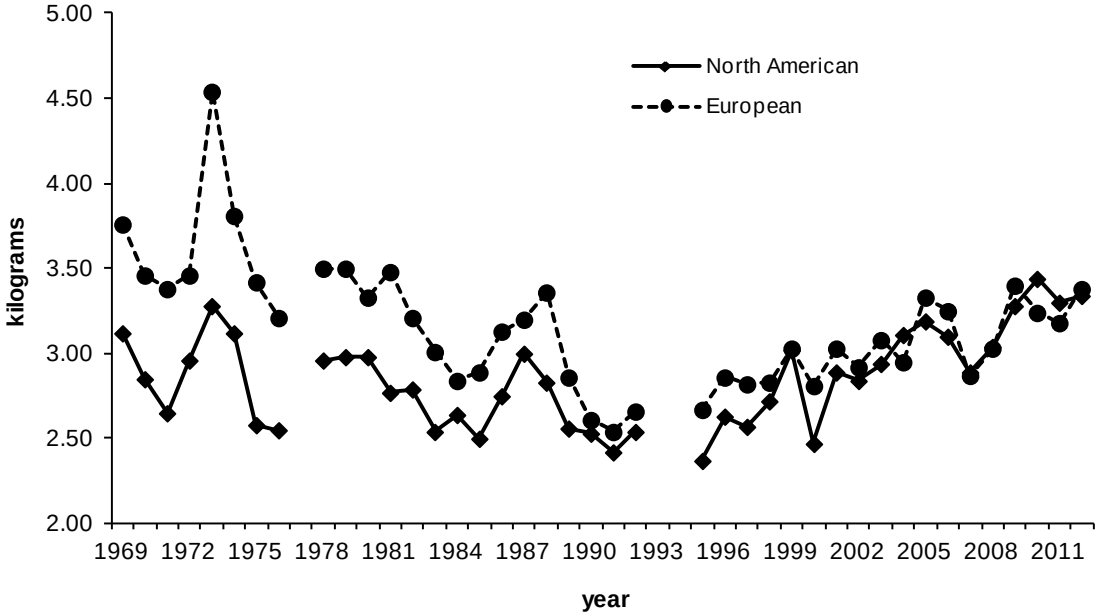


Figure 6. Mean uncorrected whole weight (kg) of European and North American 1SW Atlantic salmon (*Salmo salar*) sampled in West Greenland from 1969-2012.

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