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TABLE OF CONTENTS

Introduction.....	1
International Sampling Program.....	1
Continent of Origin.....	4
Biological Characteristics of the Catches	5
Salmon at Sea: SALSEA Greenland (Enhanced Sampling).....	6
Acknowledgements.....	7
References Cited.....	8

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 an international presence developed in the fishery; in 1965, vessels from Norway, Denmark, Sweden, and the Faroes arrived and introduced an offshore drift-gillnet fishery (Jensen, 1990). Catches increased substantially to a high of 2,689 metric tons (t) reported 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 and implemented in 1976 (Colligan et al. 2008) and since 1984 these regulations have been established by the North Atlantic Salmon Conservation Organization (NASCO).

Since 1969, a coordinated international sampling program has been undertaken to obtain biological samples from this 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 or 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 individuals were scanned for fin clips, or external/internal tags. The sampling program has continually evolved, and currently tissue samples are also taken for genetic analysis. In addition, it has been possible to collect samples for ongoing international collaborations investigating the marine ecology and persistent decline in salmon abundance in recent years.

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 2011; 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 to 2012 (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 2009 to 2011 (WGC(09)7) and restricted landings in 2009 to the amount used for internal consumption in Greenland only, which in the past has been estimated to be 20 t; there would be no commercial export of salmon. The regulatory measure would also apply in 2010 and 2011 if the Framework of Indicators (FWI) developed by ICES (ICES 2007) indicated there had been no significant change in the indicators and therefore, that a reassessment of the catch advice would not be required. As the FWI did not suggest that there had been a significant change in the previously provided catch advice in 2010 or 2011, the 2009 regulatory measure was applied to the 2010 and 2011 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, there was an annual opt out date where either party could notify the other party 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 2011 commercial fishery remained closed and the quota was subsequently 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 opening date of the fishery was set at 1 August 2011 with a closing date of 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(11)4), parties to NASCO's WGC agreed to provide staff to sample catches from the internal-use-only fishery for Atlantic salmon in West Greenland during the 2011 season.

The objectives of the program were to:

- continue the time series of data (1969-2010) collected on continent of origin and biological characteristics of salmon harvested in the West Greenland Fishery;
- provide data on mean weight, length, age and continent of origin for input into the North American and European run-reconstruction models;
- collect information on the recovery of internal and external tags; and
- collect additional biological samples from fresh whole fish in support of SALSEA West Greenland or other special samples as requested.

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 four 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)
Canada	Denise Deschamps	Ministère des Ressources Naturelles et de la Faune	20 Sept – 10 Oct	Ilulissat (1A)
UK (England & Wales)	Marta Assuncao	Cefas Laboratory	29 Aug – 15 Sept	Sisimiut (1B)
Ireland	Ger Rogan	Marine Institute	14 Sept – 28 Sept	Sisimiut (1B)
USA	Timothy Sheehan	NOAA Fisheries Service	24 Aug – 10 Sept	Nuuk (1D)
USA	Mark Renkawitz	NOAA Fisheries Service	5 Sep – 29 Sept	Nuuk (1D)
UK (Scotland)	Nick Chisholm	River Annan Trust Fisheries Office	18 Aug – 30 Aug	Qaqortoq (1F)
Canada	Heather Dixon	University of Waterloo	25 Aug – 15 Sept	Qaqortoq (1F)

Individual samplers were deployed during the course of the salmon fishing season to provide the best spatial and temporal coverage of the fishery possible. 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 four communities representing four Northwest Atlantic Fisheries Organization (NAFO) Divisions (Figure 2): Ilulissat (1A), Sisimiut (1B), Nuuk (1D) and Qaqortoq (1F).

Reported landings were 27.5 t (27.4 t for West Greenland and 0.1 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 2002-2010 (with the exception of 2006), the sampling team documented more fish than were reported as being landed in at least one division (ICES 2011). A documented salmon could be one that was either sampled, checked for an adipose clip only or was 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 further assessments. In 2011 this did not occur in any of the sampled communities (Table 1). The reported landings and adjusted landings for 2002-2011 are presented in Table 2. To provide the most reliable estimate of catch and therefore the potential impact on contributing stocks, it is important to continue to improve the catch landings procedure and quality of the catch statistics.

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

A total of 1,591 salmon were seen by the sampling teams. Of these, 198 fish were only checked for an adipose clip and additional data were collected from 970 as follows:

- 967 fork lengths;
- 964 gutted weights;
- 433 whole weights;
- 965 scale samples;

- 964 genetic samples;
- 431 sex identifications from gonadal examination.

A total of 15 adipose clipped fish were documented. Of all the fish examined by the samplers, three had either an external or internal tag (two of these also had an adipose clip). There were also three additional tags submitted to the Nature Institute by local fisherman from un-sampled fish (two from fish harvested in 2010 and one from a fish harvested in 2011). The tag breakdown was as follows (Table 3):

- 4 Carlin/streamer tags;
- 1 acoustic (VEMCO) tag;
- 1 Passive Integrated Transponder tag.

Sampling for the Baseline Program in Nuuk often took place at the local market as this was a centralized location where harvested salmon were present and available. Prior to any sampling, the sampler would always obtain permission from the market manager. The arrangement was successful for the first Nuuk sampler. However, concerns that proper arrangement had not been made to allow access to the fish prevented the second Nuuk sampler from obtaining any samples from the market. No solution was agreed during the remainder of the sampling season and consequentially the Nuuk sampler was unable to collect any additional Baseline Samples in 2011. This same problem had occurred in Nuuk in previous years, but it has not occurred elsewhere. Both Nuuk samplers were able to collect Baseline and Enhanced Samples from fish purchased directly from the fishermen. The sampling program in 2012 may opt not to sample in Nuuk until this issue can be resolved. This could hinder the program's ability to accurately characterize the harvest as a large proportion of the annual landings are reported from Nuuk.

The limitation of the fishery to internal use only fishing caused 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, especially in the future once the Enhanced Sampling Program is completed, should be considered.

CONTINENT OF ORIGIN

Fin tissue samples were collected and preserved in RNA later. A total of 964 samples were collected from four communities in four NAFO divisions: Ilulissat in 1A (n=55), Sisimiut in 1B (n=272), Nuuk in 1D (n=386), and Qaqortoq in 1F (n=251). Unfortunately, only 692 samples could be processed before this document was drafted. The Sisimiut (1B) samples (n=272) were accidentally packaged in a box with the formalin preserved Enhanced Samples and were transported back to the US via marine transport. The samples will be processed in 2012 and all sampling data will be updated prior to the 2013 assessment.

DNA isolation and the subsequent microsatellite analyses were performed in the US (King et al. 2001). A database of approximately 5,000 Atlantic salmon genotypes of known origin was used as a baseline to assign these individuals to continent of origin. In total, 91.5% of the salmon sampled were determined to be of North American origin and 8.5% were of European origin. The NAFO Division-specific continent of origin assignments are presented in Table 4.

These data show sustained high proportions of fish from the North American stock complex contributing to the fishery over the past 10 years (Figure 3). The variability in the recent stock complex contributions between Divisions and the deviation from past trends (Figure 4) underscores 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 from 1987-2011 are shown in Table 5 and Figure 4. The 2011 North American weighted contribution (92.0%) to the fishery was one of the highest on record. In addition, the weighted numbers of North American and European Atlantic salmon caught at Greenland (excluding the reported harvest from ICES Area XIV) were calculated for the 2011 fishery. Approximately 6,800 fish from North America and 600 fish from Europe were harvested (Table 5 and Figure 5). The 2011 total is a decrease from 2010 and remains 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, the mean sampled fork length was 66.4 cm and the mean gutted weight was 3.00 kg across all sea ages.

There was an overall decrease in mean whole weight of both European and North American 1SW salmon from 1969–1995 (Table 6 and Figure 6). This trend was reversed in 1996 when mean weights began to increase. In 2011, the mean length of North American 1SW salmon was 66.2 cm and the mean whole weight was 3.56 kg; the mean length of European 1SW salmon was 65.0 cm and the mean whole weight was 3.24 kg. The North American whole weight estimate increased slightly over the 2010 (3.44 kg) value whereas the European estimate remained the same (3.24 kg). Both estimates are greater than the 10-year North American and European mean whole weight estimates (3.14 and 3.13 kg respectively). The North American and European fork length estimates decreased slightly over the 2010 value (66.7 and 65.2 cm respectively), but increased from the 10-year means (64.7 and 64.6 cm respectively). A breakdown of the mean fork lengths and whole weights by sea age, continent of origin and NAFO Division for the 2011 fishery is presented in Table 7. It should be noted that the weight data have not been adjusted for date of capture and may not represent a true increase 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 fishery (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 (1968-2011) are provided in Table 9.

In 2011, the proportions by smolt age by continent of origin were:

Continent of origin	Percent of continent of origin by smolt age (years)					
	1	2	3	4	5	6
North American	1.5%	36.1%	44.5%	15.1%	2.8%	0%
European	19.0%	51.7%	27.6%	1.7%	0%	0%

The mean smolt age of the 2011 North American origin samples was 2.8 years. Age 1 smolts continue to represent a small portion of the catch (1.5%, previous 10 year mean of 1.8%), which is indicative of relatively low contributions of the more southerly North American populations to the fishery. The percentage of smolt age 2 salmon of North American origin (36.1%) is an increase from 2010 value (21.7%) and the previous 10 year mean (25.2%). Age 3 and older smolts account for 62.4% of the harvest.

The mean smolt age of the European salmon in 2011 was 2.1 years. The percent of smolt age 1 (19.0%) is above the 10 year mean of 13.9% and the age 2 smolt percent (51.7%) is below the previous 10 year mean (58.3%). The contribution of age 3 and older smolts (29.3%) is slightly above the previous 10 year mean (27.8%).

As expected, the 1SW age group dominated the collection at 92.9% (Table 10). This value was a decrease from the 2010 (98.0%) value. The decreased proportion of 1SW fish was evident for both North American and European origin fish.

In 2011, 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	93.8%	1.5%	0%	4.7%
European	82.8%	10.3%	1.7%	5.2%

SALMON AT SEA: SALSEA GREENLAND (ENHANCED SAMPLING)

In addition to the Baseline Sampling Program described above, an Enhanced Sampling Program (SALSEA Greenland) was developed to conduct diverse and more detailed sampling on a fixed number of fish harvested from the waters off West Greenland. The Enhanced Sampling was designed to be integrated within the Baseline Sampling Program's infrastructure. Fresh whole fish were purchased directly from individual fishermen, and these fish underwent the Baseline Sampling Program, plus a more detailed sampling program (Enhanced Sampling). SALSEA Greenland is an integral part of the larger SALSEA research program.

The Enhanced Sampling Program was successfully undertaken in 2011. A total of 430 fresh whole fish were purchased and sampled. All carcasses, post sampling, were donated for consumption to various people within the individual communities where the sampling took place.

This was the third and final year of Enhanced Sampling Program. A total of 1200 samples were collected across 4 NAFO Divisions for this project (Table 11). Sample processing is ongoing and at various stages of completion. Continued close coordination amongst all the researchers involved in the SALSEA Greenland effort is essential to maximize the benefit gained from this research initiative. An inventory of sample types collected, their purpose, and primary Agency/Institutional contacts responsible for their processing is provided in Table 12.

As part of the sampling, sex was determined by examination of the gonads of 431 fish. The percentage by sex was 11.8% males (n=51) and 88.2% females (n=380).

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Table 1. Evaluation of under reporting in sampled communities during the 2011 Greenland salmon fishery. The total number of Atlantic salmon (*Salmo salar*) 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 guttled wt (kg)	Average converted whole wt (kg)
Ilulissat (1A)	55	20	3.94	4.37
Sisimiut (1B)	272	190	2.90	3.22
Nuuk (1D)	387	371	2.85	3.16
Qaqortoq (1F)	256	40	3.12	3.46
Total	970	621	3.00	3.33

Community	Estimated whole wt sampled/seen (kg)	Reported landings (kg)	Adjusted Landings (kg)	Difference (kg)	Difference
Ilulissat (1A)	328	1018	1018.0	0.0	0%
Sisimiut (1B)	1487	3649	3649.0	0.0	0%
Nuuk (1D)	2398	7977	7977.0	0.0	0%
Qaqortoq (1F)	1025	1039	1039.0	0.0	0%
Total	5238	13683	13683.0	0.0	0%

Table 2. Reported landings (kg) for the Greenland Atlantic salmon (*Salmo salar*) fishery (2002–2010) by 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 ICES statistical area XIV (East Greenland) are not included in this assessment, but amounted to 0.1 t in 2011.

		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							23021
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							27407

Table 3. Tag recaptures (n=6) from the 2010 (n=2) and 2011 (n=4) Greenland Atlantic salmon (*Salmo salar*) fisheries.

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	YY25,646 (blue)	Canada	Miramichi	Jun-Sep 2010	adult	Nuuk (1D)	2011	12-Aug-11	817
carlin	YY30,149 (blue)	Canada	Miramichi	Jul-Oct 2010	adult	Maniitsoq (1C)	2011	26-Oct-11	950
streamer	B-47437 (clear)	Canada	SW Miramichi	May-Jun 2009	smolt	Itissaaq (1E)	2010	19-Sep-10	640
streamer	B-19964 (clear)	Canada	Restigouche	May-Jun 2009	smolt	Paamiut (1E)	2010	Sep-10	650
acoustic	Vemco 57948	Canada	Riviere St Jean	Jun-10	kelt	Nuuk (1D)	2011	22-Sep-11	850
PIT	na					Nuuk (1D)	2011	26-Sep-11	693

Table 4. The continental proportions of Atlantic salmon (*Salmo salar*) caught in West Greenland 2011 by NAFO Division. The origin of 272 fish from NAFO Division 1B are yet to determined and six fish whose origin couldn't be determined due to poor sample quality were not included.

NAFO Div.	Fishing dates	Number		Totals	Percentages	
		NA	E		NA	E
1A	Sep 23 - Oct 9	53	2	55	96.4	3.6
1B	Sep 1 - 26			(272)		
1D	Aug 12 - Sep 28	365	21	386	94.6	5.4
1F	Aug 22 - Sep 13	215	36	251	85.7	14.3
TOTAL		633	59	692	91.5	8.5

Table 5. The catch weighted numbers of North American (NA) and European (E) Atlantic salmon (*Salmo salar*) caught at West Greenland 1971-2011 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
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	91	9	6,800	600

Table 6. Annual mean fork lengths and whole weights of Atlantic salmon (*Salmo salar*) caught at West Greenland, 1969-2011 (NA - North American and E – European).

	Whole weight (kg)									Fork length (cm)					
	Sea age & origin									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	3.56	3.24	5.48	5.18	4.53	5.11	3.67	3.82	3.69	66.2	65.0	75.6	76.3	72.5	76.3
10 yr mean (2002-2011)	3.14	3.13	7.21	5.76	4.58	4.16	3.23	3.27	3.23	64.7	64.6	83.0	78.7	74.4	73.0
Overall mean	2.85	3.16	6.62	6.30	4.09	4.73	3.00	3.26	3.12	63.3	65.3	81.9	81.5	71.7	76.1

Table 7. Mean fork lengths (cm) and whole weight (kg) by sea age, continent of origin and NAFO Division for Atlantic salmon (*Salmo salar*) caught at West Greenland in 2011 with corresponding standard deviation (SD). Table does not include salmon with no age or origin.

NAFO Div.	1 SW		2 SW		Previous spawners		All sea ages			
	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										
1A	69.6 (3.3)	4.49 (0.65)	77.5 (0.8)	5.70 (0.71)	75.9 (12.2)		70.1 (4.1)	55	4.61 (0.73)	20
1D	64.7 (2.9)	3.46 (0.63)	76.6 (8.3)	5.37 (2.21)	71.0 (6.4)	4.16 (1.42)	65.1 (3.7)	373	3.52 (0.75)	167
1F	67.4 (3.8)	3.49 (0.65)	75.5 (10.0)	5.22 (2.02)	76.3 (9.6)	5.55 (1.79)	68.5 (5.5)	244	3.75 (1.12)	150
All Areas	66.1 (3.6)	3.53 (0.68)	75.9 (8.7)	5.32 (1.79)	75.6 (8.2)	5.09 (1.73)	66.8 (4.8)	672	3.69 (0.96)	337
North American										
1A	69.6 (3.3)	4.49 (0.65)			75.9 (12.2)		69.9 (3.9)	53	4.49 (0.65)	18
1D	64.8 (2.8)	3.47 (0.64)	76.6 (8.3)	5.37 (2.21)	72.6 (7.2)	4.26 (1.48)	65.3 (3.7)	353	3.54 (0.77)	154
1F	67.6 (3.3)	3.52 (0.61)	75.2 (10.8)	5.54 (2.52)	79.1 (8.1)	5.90 (1.68)	68.5 (5.0)	208	3.72 (1.03)	132
All Areas	66.2 (3.5)	3.56 (0.67)	75.6 (9.5)	5.48 (2.19)	72.5 (7.7)	4.53 (1.61)	66.7 (4.6)	614	3.67 (0.91)	304
European										
1A			77.5 (0.8)	5.70 (0.71)			77.5 (0.8)	2	5.70 (0.71)	2
1D	63.1 (2.6)	3.31 (0.46)	-	-	67.5 -	3.31 -	63.3 (2.7)	20	3.31 (0.44)	13
1F	66.2 (5.7)	3.17 (0.96)	75.8 (10.1)	4.97 (1.81)	67.7 (7.2)	3.73 (1.49)	68.4 (7.8)	36	3.99 (1.65)	18
All Areas	65.0 (5.0)	3.24 (0.72)	76.3 (8.3)	5.18 (1.55)	76.3 (10.5)	5.11 (2.05)	66.9 (7.1)	58	3.82 (1.37)	33

Table 8. The smolt-age composition (%) of Atlantic salmon (*Salmo salar*) caught in 2011 at West Greenland (NA - North American and E – European). Table does not include salmon with no age or origin.

NAFO Division	Origin	River age (%)						Total No.
		1	2	3	4	5	6	
1A	NA	0.0	26.9	57.7	13.5	1.9	0.0	52
	E	0.0	50.0	50.0	0.0	0.0	0.0	2
		0.0	27.8	57.4	13.0	1.8	0.0	54
1D	NA	1.1	36.4	45.7	15.6	1.1	0.0	352
	E	25.0	50.0	20.0	5.0	0.0	0.0	20
		2.4	37.1	44.4	15.0	1.1	0.0	372
1F	NA	2.4	38.0	39.0	14.6	5.9	0.0	205
	E	16.7	52.8	30.6	0.0	0.0	0.0	36
		4.6	40.2	37.8	12.4	5.0	0.0	241
All Areas	NA	1.5	36.1	44.5	15.1	2.8	0.0	609
	E	19.0	51.7	27.6	1.7	0.0	0.0	58
		3.0	37.5	43.0	13.9	2.6	0.0	667

Table 9. River age distribution (%) by origin for North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland, 1968- 2011.

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	1.5	36.1	44.5	15.1	2.8	0	0	0
10 yr mean (2002-2011)	1.8	25.2	44.4	21.1	6.8	0.7	0.0	0.0
Overall Mean	2.7	31.6	39.6	18.1	6.7	1.1	0.1	0.0

Table 9, continued. River age distribution (%) by origin for North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland, 1968- 2011.

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	19.0	51.7	27.6	1.7	0	0	0	0	
10 yr mean (2002-2011)	13.9	58.3	23.2	4.2	0.4	0.0	0.0	0.0	
Overall Mean	17.8	60.7	18.4	2.7	0.3	0.0	0.0	0.0	

Table 10. The sea-age composition of Atlantic salmon (*Salmo salar*) caught at West Greenland in 2011 (NA - North American and E – European). Table does not include salmon with no age or origin.

NAFO	Origin	Sea-age composition (%)			Total No.
		1SW	2SW	Previous Spawners	
1A	NA	96.2	0.0	3.8	53
	E	0.0	100.0	0.0	2
		92.7	3.6	3.6	55
1D	NA	94.9	0.8	4.2	354
	E	95.0	0.0	5.0	20
		94.9	0.8	4.3	374
1F	NA	91.4	2.9	5.7	209
	E	80.6	13.9	5.6	36
		89.8	4.5	5.7	245
All areas	NA	93.8	1.5	4.7	616
	E	82.8	12.1	5.2	58
		92.9	2.4	4.7	674

Table 11. Inventory of 2009-2011 sampled SALSEA Greenland (Enhanced Sampled) Atlantic salmon (*Salmon salar*) by year, Northwest Atlantic Fisheries Organization (NAFO) Division and continent of origin.

2009				
	European	North American	unknown	Total
1B	4	75		79
1D	12	188	5	205
1F	26	102		128
Total	42	365	5	412
2010				
1B	12	73		85
1D	39	161	2	202
1F	13	57	1	71
Total	64	291	3	358
2011				
1A	2	18		20
1B			87	87
1D	14	159		173
1F	18	131	1	150
	34	308	88	430
Grand Total				
1A	2	18		20
1B	16	148	87	251
1D	65	508	7	580
1F	57	290	2	349
Total	140	964	96	1200

Table 12. Inventory of samples collected, focus of the sample, and primary Agency/Institute contacts for processing under the Enhanced Sampling program/SALSEA Greenland. Ovary samples were only collected in 2009.

Sample or tissue	Sample focus	Agency/Institute contact
Scales (dry)	age and growth	DFO/NOAA (Reddin/Sheehan)
Stomach (formalin)	diet	NOAA (Renkawitz/Sheehan)
Sea Lice Collection (RNALater)	Slice resistance	Univ. PEI Veterinary School (Burka)
Sea Lice Collection (ETOH)	genetic population study	Univ. of Victoria (Koop)
Muscle fillet section (frozen)	lipid analysis	NOAA (Sheehan)
Adipose tissue (ETOH)	Origin determination	NOAA/USGS/DFO (Sheehan/King/others)
Otolith (dry)	oxygen isotope analysis	Univ. of Waterloo/DFO (Power/Dempson)
Water samples (bottles)	oxygen isotope analysis	Univ. of Waterloo/DFO (Power/Dempson)
Heart and kidney (formalin and RNALater)	Ichthyophonus (parasite)	NOAA (MacLean)
pyloric caeca, gill arch, liver, spleen, kidney, and heart (formalin)	parasite	Marine Scotland (Noguera)
Intestine (formalin)	parasite	<i>to be determined</i>
Adipose and caudal fin clip, dorsal muscle and liver (frozen), Scales (dry), and Stomach (frozen)	stable isotopes	Univ. of Waterloo/DFO (Power/Dempson)
Ovary (Bouins)	sea age at maturity	DFO (Chaput)
Kidney (RNALater/frozen)	Disease (ISAv)	NOAA (MacLean)
Gill rakers, pyloric caeca, spleen, kidney (frozen)	disease	DFO (Chaput)
Vents (RVS samples)	parasite	Marine Scotland (Noguera)

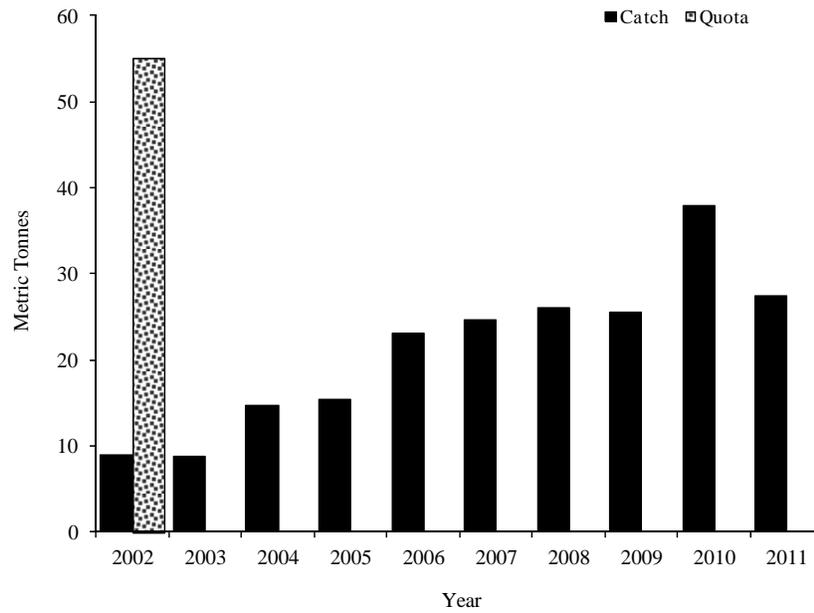
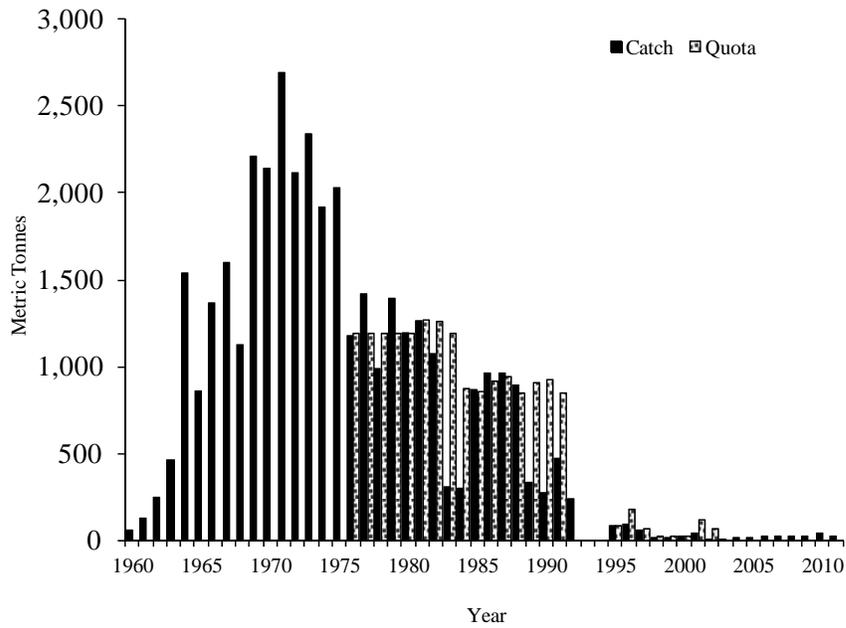


Figure 1. Reported landings and quota for Atlantic salmon (*Salmo salar*) fishery in Greenlandic home waters for (top) 1960-2011 and (bottom) 2002-2011. 2011 reported landings were 27.5 metric tons.

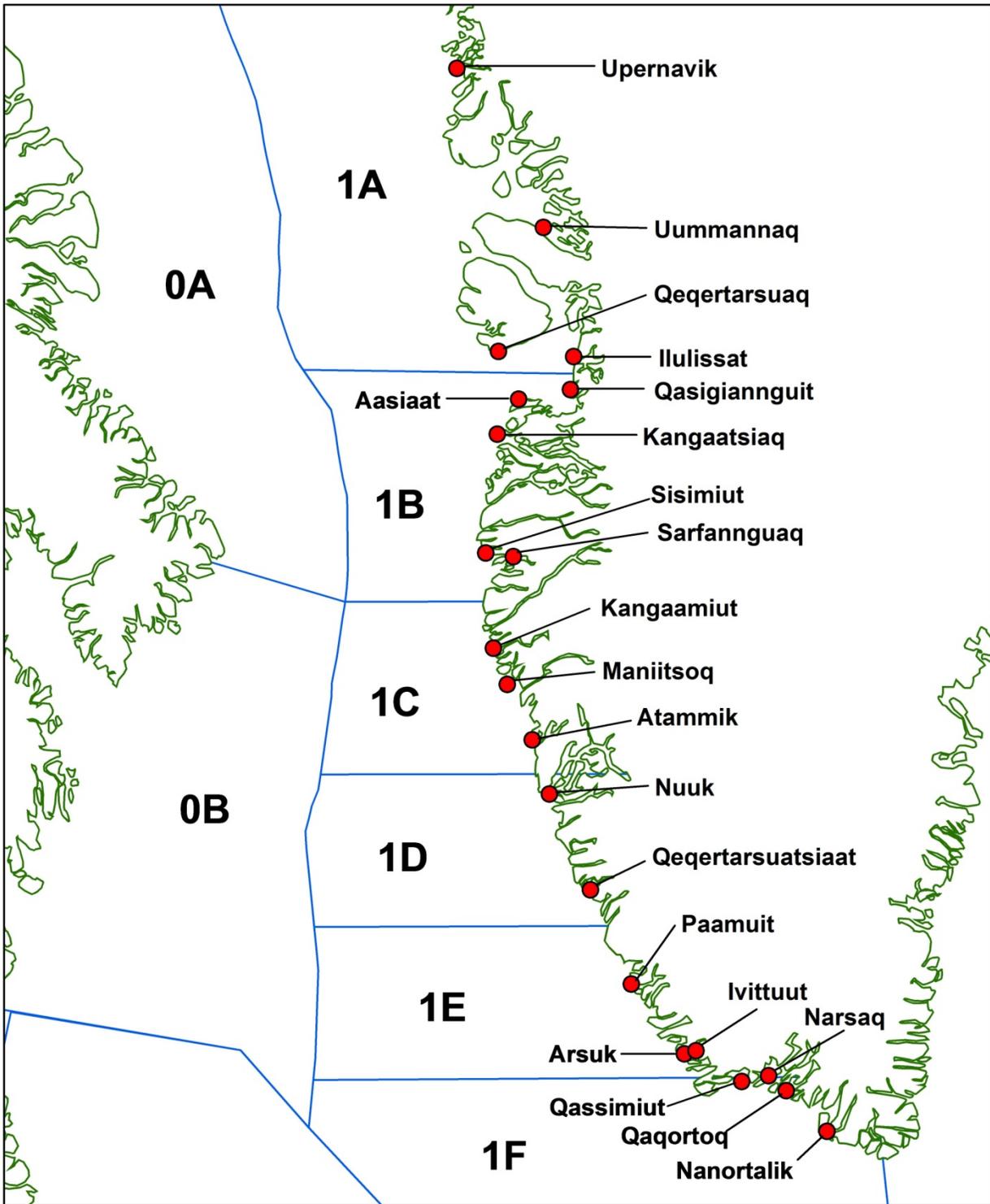


Figure 2. Map of southwest Greenland showing communities to which Atlantic salmon (*Salmo salar*) have historically been landed. NAFO Divisions are also shown.

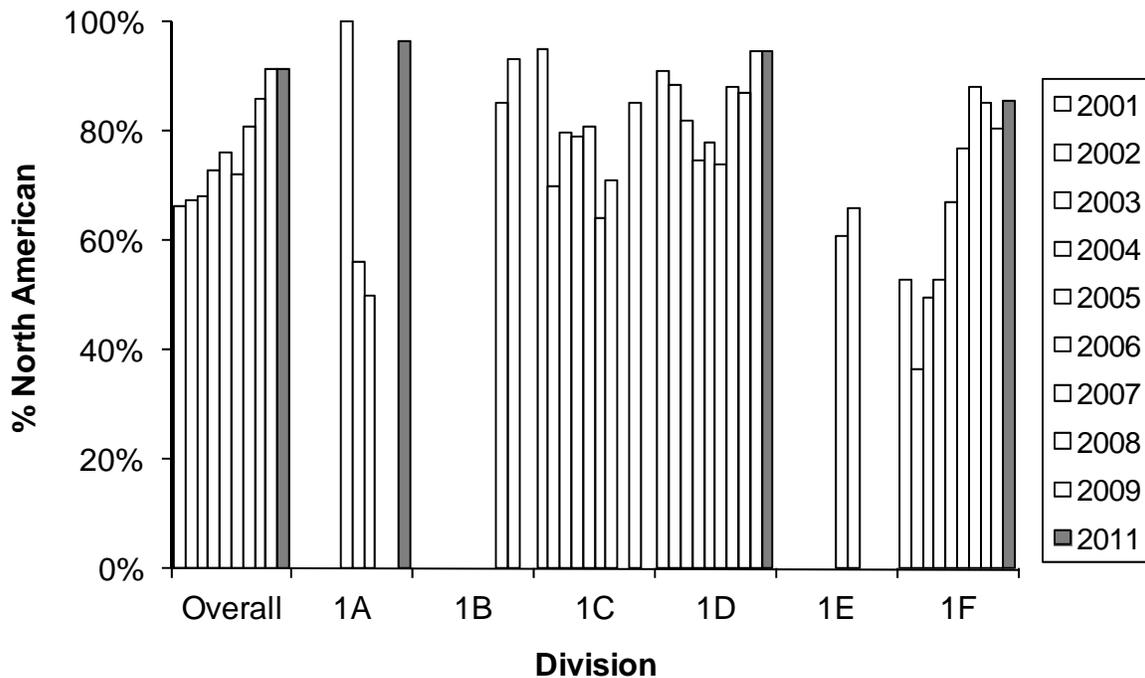


Figure 3. The non-weighted proportion of North American origin Atlantic salmon (*Salmo salar*) caught at West Greenland from 2001 – 2011 (left to right, 2011 is represented by the grey filled columns) by NAFO division according to the sample data. Division 1B 2011 data were not available and will be updated in 2012. Division 1A 2005 value is based off of one sample.

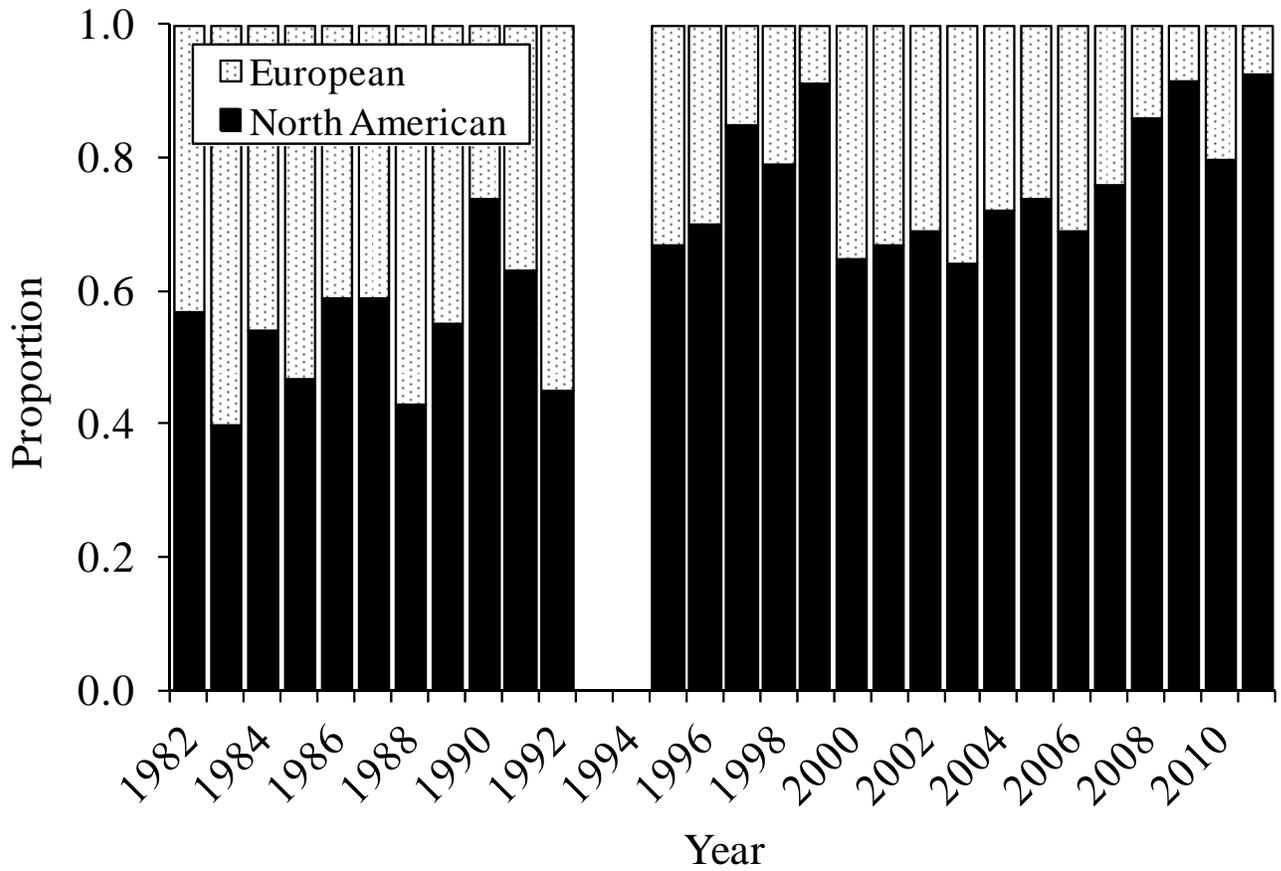


Figure 4. The weighted proportions of North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland from 1982 - 2011.

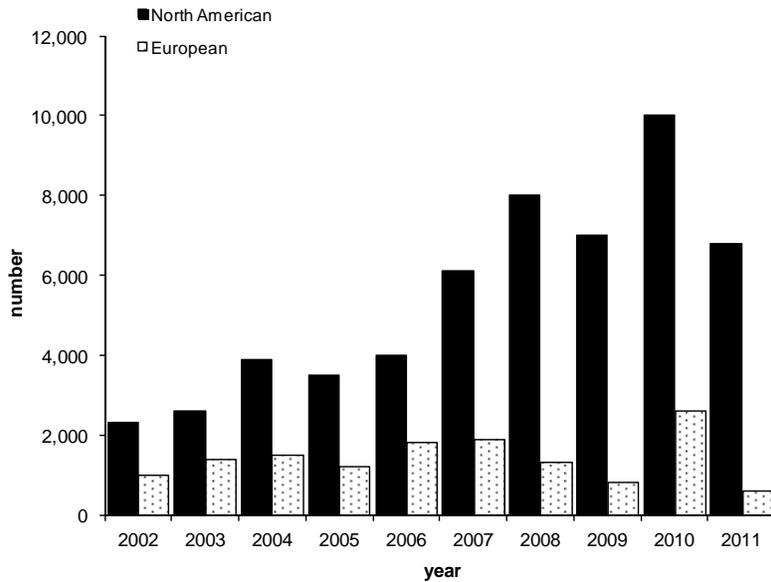
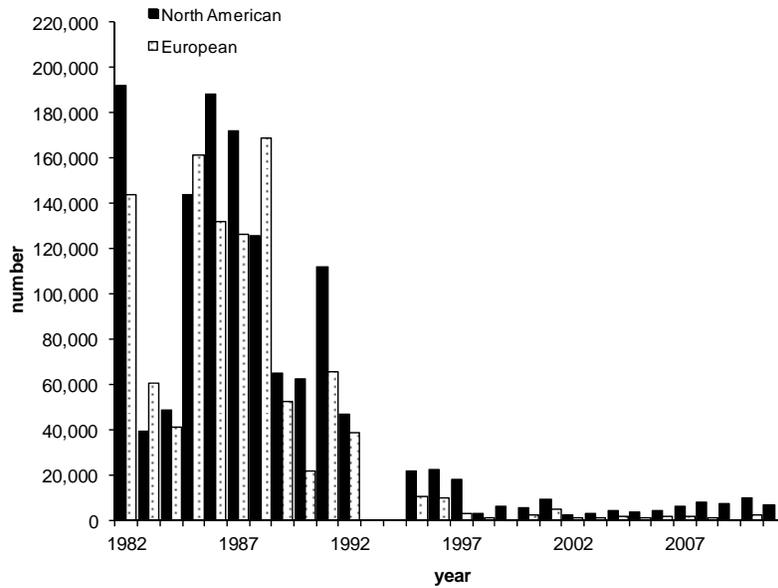


Figure 5. The weighted numbers of North American and European Atlantic salmon (*Salmo salar*) caught at West Greenland from 1982 – 2011 (top) and 2002 – 2011 (bottom). Numbers are rounded to the nearest hundred fish. In 2011, it is estimated that approximately 6,800 and 600 North American and European origin fish were harvested respectively.

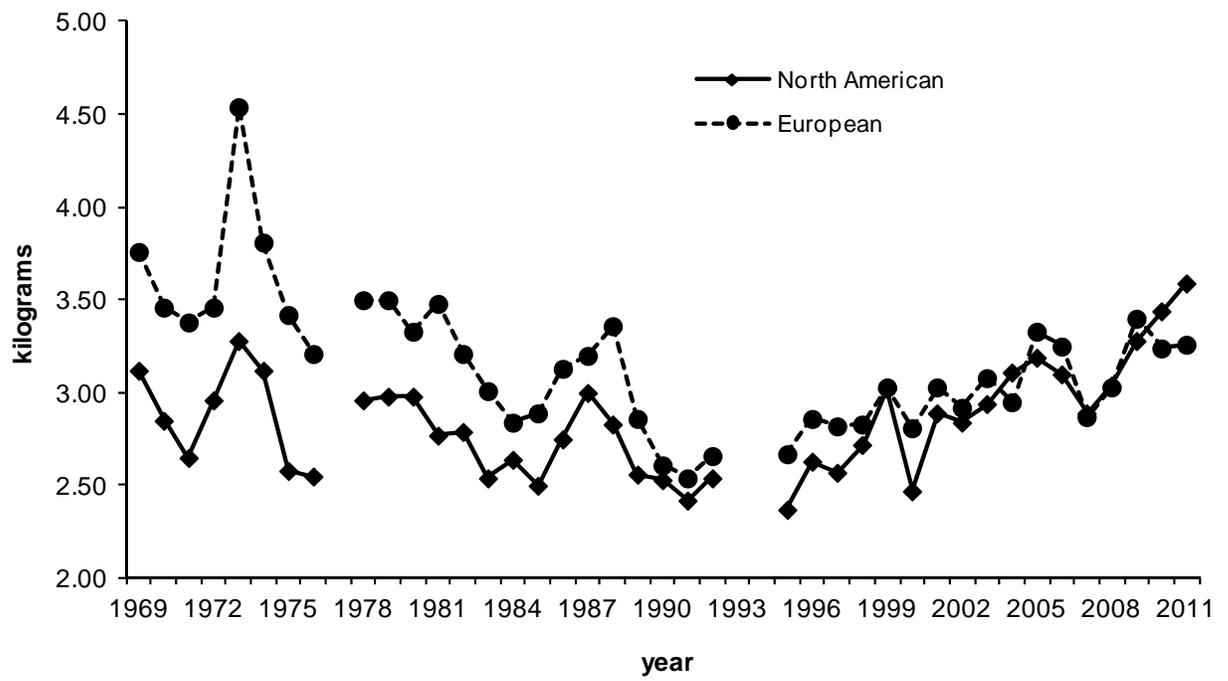


Figure 6. Mean uncorrected whole weight (kg) of European and North American 1SW Atlantic salmon (*Salmo salar*) sampled in West Greenland from 1969 – 2011.

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