West Greenland Commission

WGC(03)4

Report on North American/European Union Participation in the NASCO West Greenland Sampling Agreement in 2002

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1. Summary

An international sampling program was instituted in 2001 which continued into 2002 to sample landings at West Greenland. The sampling program included sampling teams from Greenland, United Kingdom, Ireland, United States, and Canada. Teams were in place at the start of the fishery on August 12 and continued until 28 September. In total, about 1,300 specimens were sampled for presence of tags, fork length, weight, scales, and tissue samples for DNA analysis. Samples were obtained from four landing sites, Qaqortoq and Narsaq (NAFO Division 1F), Nuuk (1D) and Maniitsoq (1C). The sampled salmon were measured, scales were removed for ageing, and gutted weight recorded and tissue samples were removed and preserved for DNA analysis. The Working Group recommends that the sampling program continue in 2003.

2. Objectives

Under the NASCO West Greenland Sampling Agreement, 2002 (WGC(02)14) Parties to the NASCO West Greenland Commission agreed to provide staff to sample catches of Atlantic salmon in the West Greenland fishery during the 2002 fishing season. The objectives of the sampling program were to:

- Obtain biological data including lengths and weights of landed fish,
- Examine fish for tags, fin clips and other marks,
- Collect scale samples to be used for age and growth analyses,
- Collect tissue samples to be used for genetic analysis and disease screening, and
- Collect other biological data as requested by ICES scientists.

Samplers from both North America and Europe were deployed during the course of the salmon fishing season, as much as possible covering the whole fishery both temporally and spatially. Samplers worked throughout the course of the season in Nuuk, Maniitsoq and Qaqortoq (a few samples were collected in the nearby community of Narsaq) (Figure 1). The EU agreed to provide a minimum of six person weeks, Canada three person weeks and the United States four person weeks in support of the programme. Staff from various countries were involved in the program as follows:

Country	Institute	Period	Location
UK-1	CEFAS, Lowestoft	1 – 14 September	Maniitsoq/Sisimiut
UK-2	FRS, Montrose	15 – 28 September	Maniitsoq/Sisimiut
ROI	Marine Institute	8 – 21 September	Nuuk
Canada	DFO, NF Region	12 – 31 August	Nuuk
USA-1	Woods Hole	12 – 24 August	Qaqortoq
USA-2	Woods Hole	25 August – 7 September	Qaqortoq
Greenland	Natural Resources	All of above dates	All above locations

The deployment of the staff contributing to the sampling program was co-ordinated by Canada/Greenland. The Greenland Institute also provided staff to assist with the sampling and to act as translators at all of the above locations and times.

3. Quotas, catches and fishing periods

Under the *NASCO Ad hoc* Management Programme for the 2002 Fishery at West Greenland (WGC(02)13), the season for the commercial fishery was divided into two periods, with the continuation of the fishery into the second period dependant on sufficiently high catch per unit effort (CPUE) being obtained in the first period. The potential seasonal quota for three levels of CPUE would be 20, 38 and 55 tonnes, respectively.

Shortly before the opening of the fishing season the Organisation of Fishermen and Hunters in Greenland (KNAPK) and the North Atlantic Salmon Fund (NASF) agreed to suspend the commercial fishery for salmon in Greenland. The non-commercial fishery for personal and local consumption was not affected by this agreement. As in the past the non-commercial fishery was without a quota limit, and there was no closing date set.

Reports from the fishery were received from the opening date (August 12) to late in the year. Total reported landings amounted to 9.0 tonnes by the end of the year. A breakdown of the landing information into landing sites and market categories is given in Table 1. Figure 1 shows a map of southwest Greenland with the main communities where salmon is normally landed. As in preceding years some unreported catch is likely to occur; however, there is presently no quantitative approach to estimate the magnitude of this catch, but it is thought to be at the same level as estimated for recent years (about 10 tonnes).

4. Samplers' observations on the fishery

During their stay in Greenland, the samplers also made observations of the fishery and the way that catches were handled. These observations were based upon occurrences in a small number of locations during a limited part of the fishing season. They may not, therefore, be typical of the whole fishery.

The vessels operating in the salmon fishery were small (only vessels less than 10m are allowed to fish for salmon) with some having wheelhouses but many being open dinghies about 6 or 7m in length. Vessels were normally operated by two people fishing set nets and drift nets. Sometimes when fishing deep within a fjord, drift nets were anchored at one end to prevent them from drifting into shore. Fish were landed gutted to avoid pollution in the coastal harbours; however, calculated whole weight is used throughout this report derived from the measured gutted weight raised by a factor of 1.11.

Salmon are landed in the small fishing harbours by local inshore fishers who sell their catch in local markets ("braettet" in Danish), to restaurants and institutions such as hospitals and old-age homes. Other species landed by local inshore fishers included cod, birds and halibut, with some harbour porpoise and catfish. Salmon were purchased after being landed in a gutted state with heads on. Although the price per kilogram for cod was less than that for salmon, the average cod catch was greater. It was, therefore, more profitable for fishermen to fish for cod than salmon. There are also other more profitable fisheries in operation in West Greenland, in particular the snow crab and shrimp fisheries. Fishermen from communities in

northern areas mainly target snow crab and shrimp, as in southern areas such as Qaqortoq there were no processing facilities for these species. As a result of these market forces, effort directed at the salmon fishery was low, particularly in communities from which snow crab and shrimp were fished, but would likely have increased for salmon had catches and prices been higher. The influence of caribou hunting is also important, especially in the north. Local residents and fishers pursuing fish for food or for sale locally will typically switch to caribou when the caribou season opens. Income from the sale locally of caribou meat is typically higher than for fish.

5. Sampling programmes

Landed fish were sampled at random and where possible the total catch was examined. Fish were measured (fork length) and weighed (gutted weight). Scales were taken for ageing and tissue for DNA analysis; both scale and tissue analyses contribute to assigning continent of origin. In addition, fish were examined for external tags, brands or elastomer marks and adipose clipped fish were sampled for microtags.

Maniitsoq

In Maniitsoq (a city of less than 4,000 people), there are probably between 100 and 150 people sustained by fishing and hunting (i.e. commercial fishers). However, many of these are employed on cod trawlers/whalers, and in the snow crab, shrimp, and halibut fisheries. Almost every physically able person in Maniitsoq fishes (nets and longlines) or hunts (rifles), or most often does both, either for their own use or for sale. The commercial fishers' livelihoods are protected as the private fishers and hunters cannot land to the local market. Maniitsoq's small size and closely dependent communities appear to confer some degree of 'local' regulation.

There are in excess of 200 boats in the harbour and approximately a third of these are capable of acting as drift net boats (~5 metre GRP or fibreglass boats with usually 40HP Yamaha/Mariner outboard engines). They are either fully open boats and the outboards are hand-steered or have small cuddys (cabins) with steering consoles.

Only approximately 20 individuals regularly fished for the local market and of these only five or six were primarily concerned with netting for salmon. They usually fished alone or occasionally in pairs. The other fishermen are primarily longliners, fishing chiefly for catfish, or hunting seals and porpoises with rifles. The porpoise is not capable of breaking the monofilament nets and are, therefore, occasionally landed together with salmon.

There is a profusion of unused drift nets (~4 inch stretch diamond mesh) lying in piles around the city, an indication of the potential effort that could be employed during a commercial fishery, although the advent of cheap imported frozen farmed salmon (readily available in both the city's two supermarkets) presumably acts as a disincentive for the fishermen to target salmon. The drift nets are of a standard design, a marker buoy with a red flag and occasionally a radar reflector at one end, and a float at the other. They vary in length from less than 100m to less than 200m. There are four or five boats that regularly carry drift nets.

The half dozen netsmen at Maniitsoq, fishing primarily for salmon, do not always carry drift nets. It is usual for a fisherman to have several nets, both fixed and drift. The fisherman will have more than one fixed net station, usually either anchored on shore and in the sea or

anchored solely on-shore with the free end attached to a buoy. These nets seem to be left to fish continuously throughout the available fishing season and are checked periodically (often daily). The fixed nets reportedly are more effective in the colder months when salmon move closer to the shore. Drift nets are often set (unattended) for less than four hours, in order to maintain the condition of the fish and to prevent seals tracking the net. The nets are often set in shallow water (less then 15m) around congregations of feeding seabirds, which are thought to act as an indication that salmon are feeding and forcing fish to the surface. Most of the salmon landed at Maniitsoq for the local market were caught in drift nets.

The average catch was extremely small, with many fishers landing between one and ten fish (often together with porpoise or seals) and the effort appeared to be very low, with most boats tied up at the market for the majority of the day. On many days no salmon were landed to the market at all. However, when the season opens in August, the effort directed at salmon is greater, as people wish to stock their freezers for winter; there is also more interest in salmon as fresh table food. By September, most people have the supplies of salmon they need and the absence of a commercial fishery inhibits fishers from targeting salmon, as the local market appeared to be easily saturated (many salmon appeared on the market for several consecutive days, despite the very low catch levels). The reindeer and musk ox hunting seasons finish at the end of September and many hunters were reportedly away and would return to the fishery in October. The reindeer herds are very substantial and people can make more money in August by hunting rather than by fishing. The lack of effort also reflects the fact that fishers are aware that salmon are considerably less abundant than in the past. Fishing does seem to be in decline in Maniitsoq, as many young people have moved to Denmark and the average age of fishers is consequently increasing. Maniitsoq's fish processing plant (Greenland Ocean, formerly Royal Greenland) was due to close in October 2002, as catches of commercial fish species were inadequate to sustain it.

At Maniitsoq, similar to other communities, the local market was open seven days a week from 08:30 until 16:30. It appeared to serve as a social as much as a commercial function. All species could be landed at any time, including before the market opened. The most popular species on the market were porpoise, fresh and dried whale, and catfish. Reindeer and cod also sold reasonably well, but salmon only sold well on the day of capture. Salmon were landed gutted for hygiene reasons and were then thoroughly cleaned, occasionally including the removal of scales with hoses. Fish were on the market floor within half an hour of landing. Prime salmon were selling for only 40 DKr per kg, i.e. an average 2.5 kg salmon would sell for 100 DKr (~£10 or $16 US). Any unsold fish were placed, without ice, in a shipping container overnight for sale the next day (or later). Although ascertaining precise details on the capture location of individual fish was problematic (due to the language barrier), it is believed that all of the catches were made within close proximity to Maniitsoq.

Qaqortoq/Narsaq

The fishers in both Qaqortoq and Narsaq were very helpful and readily accepted the sampling program. At Qaqortoq, sampling in 2002 was very different from 2001. In 2001, there was a very large commercial fishery in NAFO Division 1F as the majority of the catch for the entire coast was landed here. In 2002, fishermen all reported that fishing was only good for a couple of weeks with nothing before and nothing after. Prices for salmon at the local market were highly variable but in the beginning were about 80 DKr (~£ 8 and $13 US) per kg.

In total, only two fish were observed with a clipped adipose and no tags were detected or observed on these fish. No tags were found on the other fish sampled either. On some days the number of fish at the market were very low, making sampling difficult as sometimes the fish were sold before they could be sampled. This resulted in no samples from those days.

All fish looked really good, healthy with no outstanding deformities/scars or weaknesses. All the salmon sampled appeared externally to be wild fish. Fishermen used gill nets in this area. The average size of most salmon landed was from 2-4 kg and 50-70 cm fork length. The fishers in both Qaqortoq and Narsaq were very helpful and accepting of this program.

Fishermen all reported to the sampling team that fishing was only good for a couple of weeks. At Narsaq, fishers commented that they never catch a lot of salmon, the main landings being shrimp and other fish species in that area. In fact, when the Qaqortoq market was too full with salmon, the fishermen went to Narsaq. Dolphins were sometimes caught as by-catch in salmon nets and sold in the local market along with salmon.

Fishermen use gill nets in this area. All fish caught appeared to be in good condition with no obvious deformities/scars or weaknesses. All the salmon sampled appeared, from external observation, to be wild fish. Most salmon landed were 2-4 kg in weight and 50-70 cm fork length. Only two fish were observed with a clipped adipose and no tags were detected or observed on any sampled fish.

Nuuk

At Nuuk, the buy-out of the commercial fishery caused a decline in the availability of fish to sample over what was the case in 2001 and consequently overall numbers declined. As a result, the first sampling team found the sampling program in Nuuk was very difficult in 2002. Fortunately, the local market was a ready source of salmon for samples but also the local hospital, restaurants and the old-age home were visited to obtain potential specimens for inclusion in the sampling program.

The second team, in Nuuk, found on arrival that most restaurant and institutional sales were already made. This meant the sampling programme was a little more challenging than was the case for the first team. Trying to be in the right place at the right time was never easy but great exercise brought the sampling team into close contact with meat and fish merchants at the city's local market Kalaaliaraq. During the period, salmon or Kapisilit ("Laks" in Danish) sold at about 50 DKr (~ $8 US or £5) per kg gutted, head on. Despite the cold and curtailment of their commercial catch, the men at the market were always kind and helpful and, like all Inuit, show a genuine interest in conservation and careful exploitation of their natural resources.

6. Sampling practicalities

In 2002, the commercial fishery was subject to an agreement between the Greenlandic salmon fishermen's representative organisation KNAPK and the North Atlantic Salmon Fund (NASF) that will close the commercial portion of the fishery for the next three years but will not include sales within Greenland. This means that sales to restaurants, institutions and individuals from local markets will still continue and only sales to fish plants will not be permitted. Catches in food fisheries are typically low and broadly distributed, posing many sampling problems. This occurred also in 1998-1999 as a result of a NASCO agreement to

have only a subsistence fishery; however, participants in the sampling program did succeed in obtaining about 600 samples although the distribution could have been better (only one active sampling team) but it was still a success. It is very difficult to sample this type of fishery adequately as the fishery can be spread out over 1000 km of coastline and several weeks or even months in extent. The advent of the caribou-hunting season in August/September also needs to be factored in as people generally switch to caribou hunting when the season opens, making salmon more difficult to find. The major difference between the sampling programs in 2001 and 2002 was the effect of this 'buy-out' agreement between the Greenland authorities and the North Atlantic Salmon Fund. Therefore, instead of having salmon readily available at a central and common point, typically the local fish plant, salmon had to be vigorously searched out in local markets, homes, on the wharf, in restaurants, and at public institutions and hospitals.

As an example of the difficulties of sampling a local-use fishery, the following was reported by the sampler in Maniitsoq as an example applicable to all sites. In communities outside of Nuuk, most older Greenlanders do not speak English and, at Maniitsoq, two students from the fishing technology school were assigned to help make contacts in the city. It emerged that many of the institutions (e.g. hospital, hotel and restaurants) which had been sampled in previous years now used frozen farmed salmon, thus most sampling had to be done via the market or through contact with individual fishermen. To facilitate this, notices were placed, in Greenlandic, at the market and elsewhere describing our intentions; and as many fishers as possible were contacted in person. At one point, it was suggested that the presence of samplers had stopped fishermen landing much, if not all, of their catch to the market. This was based on the belief that samplers were either involved in fishery control or were working for Greenpeace. To help alleviate any such concerns and prevent the situation from deteriorating, it was arranged for a message to be broadcast over the local radio to explain the presence of the samplers. Despite some initial antagonism to sample fish, many fishers were eventually happy to co-operate, although most remained bemused that no compensatory payment was made for the samples taken. On balance, the small numbers of salmon landed at the market appeared to reflect limited effort (and perhaps low abundance) rather than as a result of fishers avoiding the market.

7. Summary of results to date

An international sampling program requested by NASCO was instituted in 2001 to sample landings at West Greenland, and repeated in the 2002 fishing season. The sampling program included sampling teams from Greenland, United Kingdom, Ireland, United States and Canada. Teams were in place at the start of the fishery and continued to the end of September although landings continued until December.

In total, 1,374 specimens, representing 44 % by number of the landings, were sampled in 2002 for presence of tags, fork length, weight, scales, and tissue samples for DNA analysis. The limitation of the fishery to subsistence fishing caused severe practical problems for the sampling teams; however, the sampling program was successful in adequately sampling the Greenland catch temporally and spatially.

The sampled salmon were measured, scales were removed for ageing, tissue for analysis, and gutted weight recorded. No disease sampling was conducted in 2002 because of logistical difficulties; however, the Working Group thinks that disease sampling is important and recommends that it be undertaken in 2003.

Continent of Origin

A total of 501 tissue samples have been genotyped at 11 microsatellite DNA loci for assignment to continent of origin. The analysis, using a Bayesian maximum likelihood algorithm, is based on a reference data set of 4,373 Atlantic salmon individuals of known origin: 459 from Europe and 3,914 from North America and is estimated to give an almost 100% correct assignment to continent of origin. In total, 338 (67.5 %) of the salmon sampled from the 2002 fishery were of North American (NA) origin and 163 (32.5 %) fish were determined to be of European origin (Figure 2).

Differences among the continental percentages in the three NAFO divisions (see table below) means that catch sampling must be undertaken in all areas to obtain an accurate estimate of the contribution of fish from each continent to the mixed fishery.

NAFO	**North America**		**Europe**	
Division	**Number**	**%**	**Number**	**%**
1C	102	69.9	44	30.1
1D	181	88.7	23	11.3
1F	55	36.4	96	63.3

Applying the continental percentages for reported catch by NAFO Division results in estimates of 6.4 t (2,200 salmon) of North American origin and 2.6 t (900 salmon) of European origin fish landed in West Greenland in 2002. Changes in the estimated catch in numbers of North American and European salmon are shown in Figure 3.

Biological characteristics of the catches

Biological characteristics (length, weight, and age) were recorded from 1,297 fish sampled in 2002. There has been a general downward trend in mean weight (also reflects in means lengths) of both European and North American 1SW salmon from 1969–1995 (Figure 4). This reversed in 1996, when mean lengths and weights began to increase again, although there was a sharp drop, mainly for the North American component, in 2000. In 2001 and 2002, mean lengths and mean weights increased again to a level close to the overall average for the recent decade.

The river age of fish in the catch was determined from scale samples. The mean river age of the European salmon in 2002 (2.2 years) was slightly above the overall average (1968-2002) of 2.0 years. The percentage that was river age-1 fish has been quite variable in recent years, and the percentage in 2002 (10 %) was among the lowest in the time series. A low percentage of this group suggests a lower contribution from the most southerly European stocks. Percentages of river age-3 fish have also been very variable but were close to the long-term mean of ~17 % in 2002.

The mean river age of the North American origin samples has varied throughout the last 10 years, but in 2002 was slightly above age 3.0, the overall mean. The percentage of river age-2 salmon of North American origin was close to the average (~34%) in 1998, at its lowest recorded level (15%) in 2001 but back up to 27% in 2002.

The sea-age composition of the samples collected from the West Greenland fishery showed no significant changes in the percentages in the North American component of fish from 1998 to 2002. The percentage of 1SW salmon in the European component has been very high since 1997 (99.3 %), and was 100 % from 1999 to 2000.

8. Acknowledgements

The financial contribution by the Atlantic Salmon Federation to Department of Fisheries and Oceans Canada so that DFO staff could take part in the sampling program is gratefully acknowledged. The cooperation and assistance of fishers and residents in Greenland who provided access to their fish for samples is appreciated.

9. References

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(WGC(02)5) 2002. *Report on European Union Participation in NASCO West Greenland Sampling Agreement in 2001*. NASCO Report of the Annual Meetings of the Commissions, p. 139-146.

(WGC(02)14) 2002. *West Greenland Fishery Sampling Agreement, 2002*. NASCO Report of the Annual Meetings of the Commissions, p. 148-150.

Table 1. Reported landings of Atlantic Salmon in Greenland 2002 by landing site and market category.

NAFO Division	Landing site	Reporting persons	'Sold'	Private	Total
1A	Ilulissat	1	0	14	14
1A total		**1**	**0**	**14**	**14**
1B	Sisimiut	1	78	0	78
1B total		**1**	**78**	**0**	**78**
1C	Maniitsoq	9	1158	942	2100
1C total		**9**	**1158**	**942**	**2100**
1D	Nuuk	13	3478	275	275
1D total		**13**	**3478**	**275**	**3752**
1E	Ivituut	2	0	180	180
1E	Paamiut	7	371	866	1237
1E total		**9**	**371**	**1046**	**1417**
1F	Nanortalik	1	0	6	6
1F	Narsaq	4	999	305	1304
1F	Qaqortoq	3	312	39	351
1F total		**8**	**1311**	**350**	**1661**
Total		**41**	**6395**	**2626**	**9022**

Figure 1. Map of southwest Greenland showing communities to which salmon have regularly have been landed. NAFO Divisions are also shown.

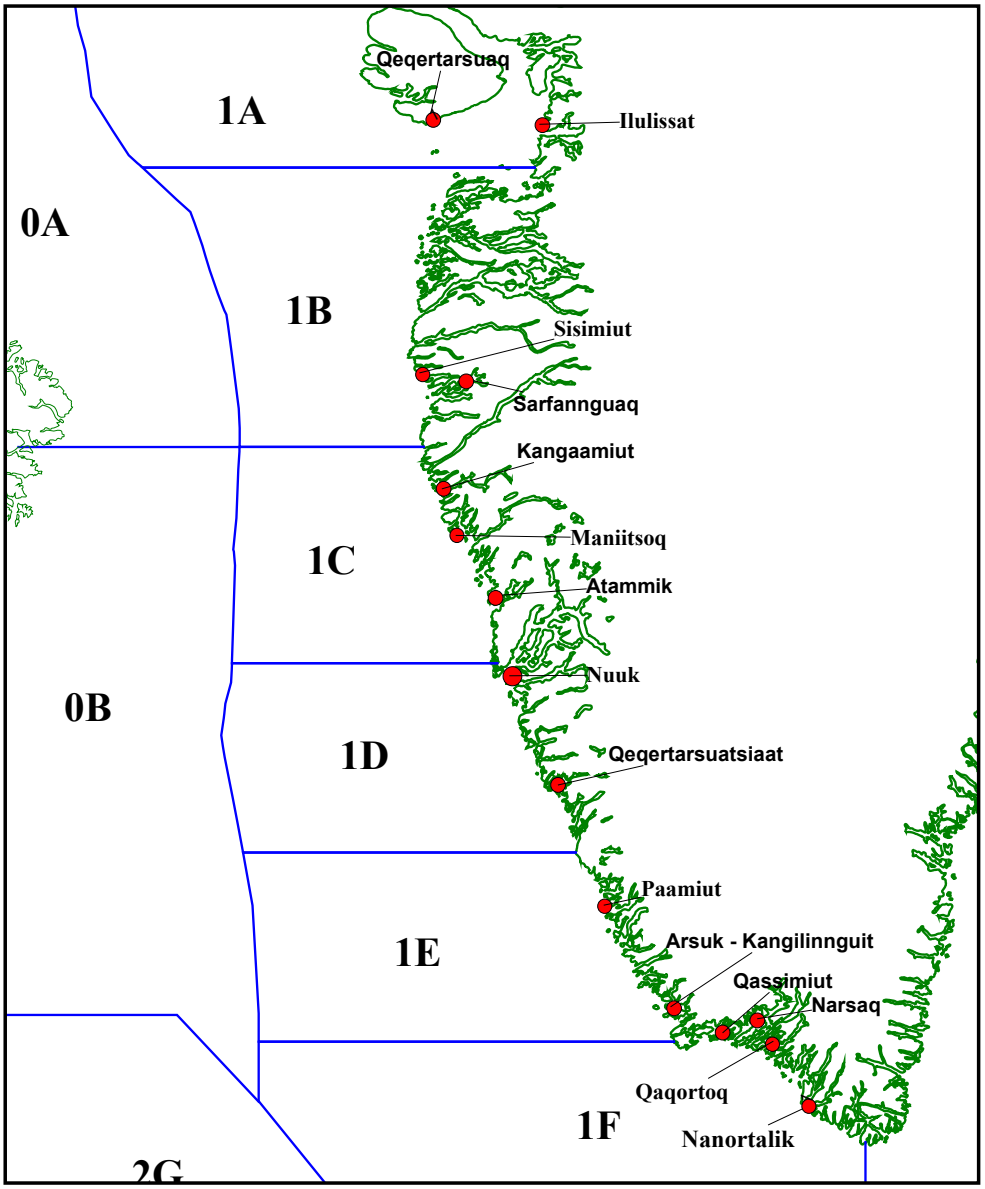

Figure 2. The proportion of North American salmon sampled in the sampling programs at west Greenland, 1969-2002.

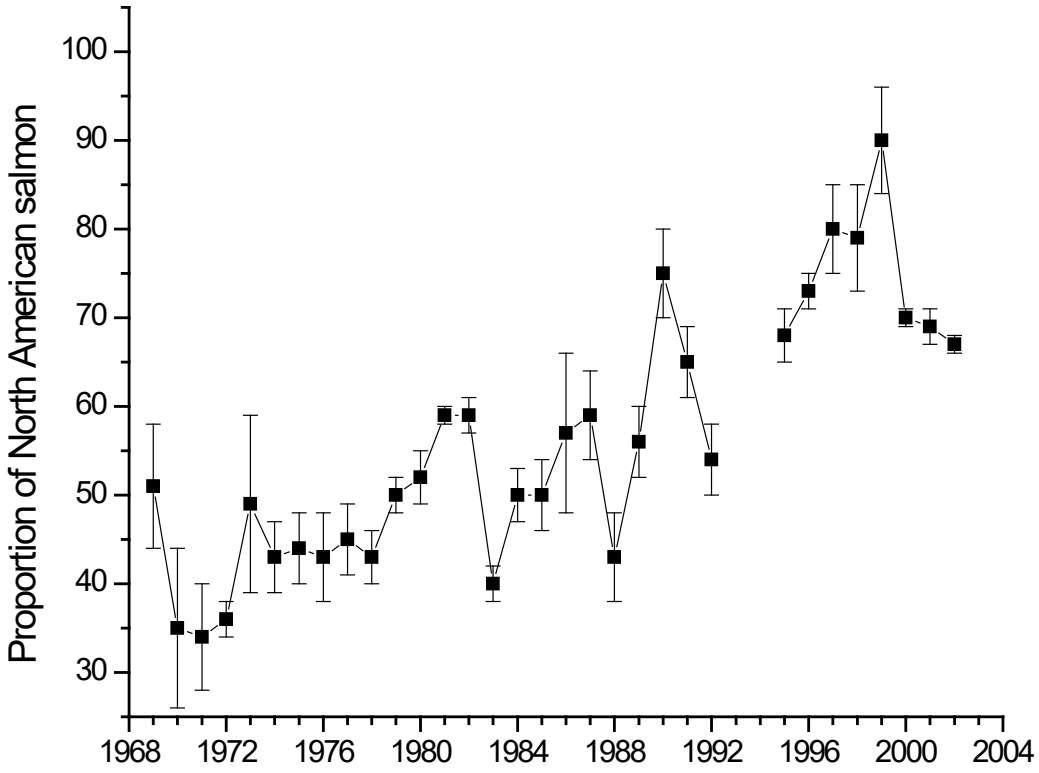

Figure 3. Numbers of North American and European salmon caught at West Greenland 1982-1992 and 1995-2002 derived from catch information and results on mean weights from the sampling programs.

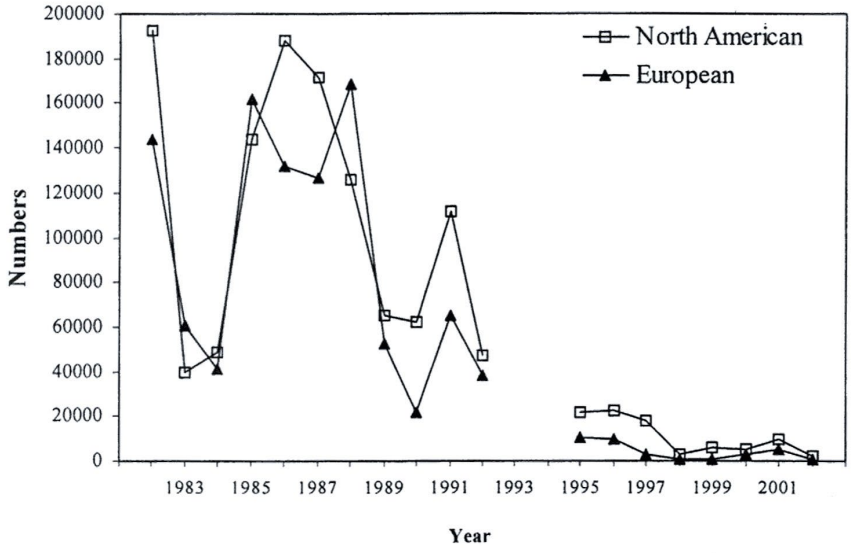

Figure 4. Mean weights of one sea-winter North American (bottom line) and European salmon (top line) sampled from landings in the fisheries at west Greenland, 1969-2002.