GUIDE TO HARMONIZE THE COLLECTION OF REPRESENTATIVE ADULT SALMON SCALE MATERIAL

KOLARCTIC ENPI CBC PROJECT - TRILATERAL COOPERATION ON OUR COMMON RESOURCE;
THE ATLANTIC SALMON IN THE BARENTS REGION (KO197)

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Cover pictures: Above on the left; Estuary fishery on autumn run salmon, in the White Sea area (Photo Sergey Prusov/ PINRO). Above on the right; Coastal fishery at Honningsvåg/ Kamovær, Finnmark coast (Photo Eero Niemelä/ FGFRI). Below; wild 2 SW female salmon on the way to her home river (FGFRI).

Basic information on the background and importance of harmonising sampling methodology and getting a representative picture of the salmon catches

Sea water migration is the key element in the life history of the Atlantic salmon (*Salmo salar*). After hatching, salmon juveniles reside in freshwater for 2-8 years (usually 3-5 years in the Barents region), before they enter seawater and start their long distance migrations from their river of birth to the feeding grounds in the open sea. They feed in the sea for between one to five years before returning to their natal river to reproduce. Because of their well-known characteristic to home to their natal river, salmon inhabiting different rivers are reproductively isolated from each other and, therefore, the populations may be significantly different with regards to genetics, morphology and behavior (reviewed in Garcia de Leaniz *et al*. 2007). It is this migratory phase of the life-cycle that imposes challenges in conservation and management planning. Returning salmon are exposed to diverse, intensive exploitation along their journey including coastal, estuarine and finally in-river fisheries.

Atlantic salmon return to the same river and area where they spent their early life stages, i.e. adult salmon return to the same river and even same habitat in the river where they were born. Further, since relatives, sharing similar genotypes, tend to stay within the same population, salmon tend to be genetically more similar to their counterparts within the same river, than they are to salmon in other rivers. Accordingly, salmon populations throughout the distribution range have each accumulated characteristic genotype profiles with varying levels of genetic differentiation depending on the colonization routes or population history (see Vähä et al 2007 and references therein). The corollary of each salmon population having characteristic genotypic profiles is that by looking at any salmon's genotype at a sufficient number of genetic markers and comparing this multilocus genotype to the genetic profiles of salmon from different rivers, it is possible to infer which population that individual originates from. In conclusion, by comparing the genetic profile from salmon caught in the sea fisheries with a database of genetic profiles of salmon from different rivers, the origin or home river of each salmon captured could be determined. A prerequisite for accurate and efficient determination of the source salmon population or home river, for individuals in mixed stock fisheries, is that multilocus genetic profiles (baseline) of all potential source populations is available as individuals without a baseline population data are either assigned incorrectly to genetically similar population or not assigned with high probability to any of the populations.

One of the greatest challenges in salmon management and conservation is to gain insight into the species' spatial and temporal ecological use of the marine coastal environment. Tens of different salmon river stocks migrate along the coastal areas mostly at the same time and exploitation targets two or more river stocks at a time (mixed-stock fishery). To date it has not been possible to identify the origin of wild salmon along the coast. But by the use of new genetic stock identification techniques (see above), it is now possible, with high precision; to define the home river origin of each captured salmon. For example, Vähä *et al* (2011) identified the origin of salmon in mixed-stock fisheries and showed that salmon originating from different tributaries of the Tana River actually show significant variation in run-timing (migration) to fresh water. Furthermore, it is widely acknowledged that in order to manage fisheries effectively and to optimize their yield in a sustainable manner, each contributing stock must be managed separately. While stock specific conservation and management plans can be made for each river, this may not be sufficient because of the biology and especially the migratory behaviour of Atlantic salmon.

Sampling in Norway

In order to detect the spatial and temporal use of the different Barents salmon populations along the North-Norwegian coastal areas during their spawning migration, we have to conduct a representative sampling of salmon of 1) different ages and sizes, 2) during the whole summer season, i.e. both before, during and after the ordinary fishing season, 3) along most of the coastal zone and 4) in the most important fjords (see **figure 1**). Thus, we have conducted a cost-effective sampling of adult Atlantic salmon along the whole Barents Sea coast, from western North-Norway to the Pechora area in Northwest Russia. The fish has been (2011) and will be (2012 and partly in 2013) captured/sampled by local professional fishermen using commercial fishing gear (see Svenning et al. 2010, 2011). All fish are measured and weighted, while sex, maturation, infection of parasites etc. will be registered. Scales are sampled for age and growth determination, for genetic analyses and for establishing the frequency of farmed fish in the catches.

Sampling in Russia

The Atlantic salmon (*Salmo salar* L.) occurs in the rivers of five regions of the North-western part of the Russian Federation – Murmansk region, Archangelsk region, the Karelia Republic, the Komi Republik and the Nenetz Autonomous Okrug (NAO). The most important areas for Atlantic salmon fisheries in Russia are Murmansk region and Archangelsk region where both in-river, coastal and estuary fisheries are in operation (see **figure 2 and 3**). There are no fisheries for Atlantic salmon in the Karelia Republic. Fisheries in Komi and NAO are conducted on the Pechora River and it is only an estuary fishery. Over the last two decades the effort in commercial fisheries has been reduced noticeably which aimed at conserving Atlantic salmon stocks and enhancing recreational fisheries based mostly on catch-and-release principle. Commercial coastal fishery in Murmansk region operates only along the White Sea coast – on the Tersky Bereg, there are no legal coastal fisheries in the Barents Sea area. Coastal fisheries in Archangelsk region operate also along the White Sea coast – the Zimniy Bereg and the Letniy Bereg. Fisheries in the estuaries are developed in the Severnaya Dvina River and in the Pechora River. So, the main area for coastal sampling will be three areas in the White Sea – the Tersky Bereg, the Zimniy Bereg and the Letniy Bereg where reliable number of samples can be taken from commercial catches. Sampling there is conducted by PINRO personnel. Also a small scale scientific fishery is taken in the Barents Sea along the Murmansk coast. Sampling is limited there due to accessibility of the area and by military restrictions. All sampled fish are measured and weighted, while sex, maturation, infection of parasites etc. are registered. Scales are sampled for age and growth determination. Adipose fins are preserved for genetic analyses.

Sampling procedure

The sampling of adult salmon is conducted by professional sea fishermen using commercial fishing gear, i.e. hook nets and/or bagnets (see **photo 1, 2**). The fishermen involved are given a special permission when fishing outside the ordinary fishing season or during the ordinary season if fishing is conducted with a method or gear being otherwise prohibited, showing 1) where to fish (fishing localities, see Figure 1) and when to fish (exact fishing period and week days). The special fishing permission is directly connected to the fishing person and his legal fishing site. A few fishermen may have access to two localities when fishing with the special permission, while most of them are allowed to use only one site. During the ordinary fishing season fishermen are allowed to use 1-3 sites. According to agreements between the Kolarctic project and the Sea salmon fishing organisations, the participating fishermen receive a compensation for registration of several fish parameters (see below) and especially for delivering scale samples.


Photo 1 and 2 The sampling of adult salmon is conducted by professional sea fishermen using commercial fishing gear, i.e. bag nets (left) or hook/bend nets (right). Photos: Eero Niemelä.

Each fisherman has to note (daily) when the fishing gear has been set and hauled, to estimate the number of salmon captured per unit effort (CPUE). Wind direction and other environmental conditions affecting the fishery should also be noted in this logbook. After each catch, the following data (in addition to the scale samples) should be registered/collected from each adult salmon and make a note of on the scale envelope (see **figure 4**):

Sampling site:	Number on the fishing site
Municipality:	Name of municipality and area of sampling
Running number:	1 - xx
Date:	Date of catching
Name of fisherman:	Note the name
Length:	The total body length; see photo 3 below (0, 5 cm accuracy)
Weight:	The total weight; i.e. of the whole (not gutted) fish (50 gram accuracy)
Fishing gear:	Fishing gear used (hook net, bag net)
Sex:	Note the gender (*male* or *female*) of the fish
Wild or farmed:	Fill in (cross) for either *wild* salmon or *farmed* salmon (se photos 6-9)
Maturation:	Note whether it is a *spawning* or a *non-spawning* fish
Number of lice:	Count the number of visible lice on the fish (see photo 10 and 11)
Adipose fin:	Note if it is missing
Remarks:	Note any other possible remarks f. ex seal injuries, sickness etc.
Scales:	Scales should be taken carefully (see picture below) and embedded in the scale envelope

Scale samples are taken from the left side of the body from the area between the adipose fin and the lateral line (**photo 3**). Scales from this area will give the best results in further age and growth analysis (ICES-report 2011). Scale samples from other parts of the fish are not suitable for this particular purpose. Before taking the scale samples both knife and the fish must be cleaned or flushed from other fish mucus with water, to eliminate the potential of cross contamination between different fishes, especially for the later genetic analysis (see **photo 4, 5**). Approximately 35-40 scales are needed from each fish and scales should be stored in the same scale envelope in which all other data from the same fish are marked down (see **figure 4**). The fishermen register whether they suggest the fish has a wild or farmed origin, by observing the external features i.e. eroded fins especially the tail fin and higher number of black spots on the gill covers compared to wild salmon

(see **photos 6, 7**). After opening the fish body cavity the fisherman observes the features of the intestines, i.e. the escaped salmon intestines have additional connective tissue growth between the intestine and muscles, a feature never found in wild fish (**photos 8, 9**).

Scales are used for both ageing the fish and for growth analysis, as well as for genetic analysis to detect the origin (home river) of each salmon. Before the scale envelopes are returned to the Office of the County Governor of Finnmark, they should be kept dry, i.e. they should not be frozen and/or kept at high humidity. It is important that each envelope should contain scales from only one fish and as mentioned above - the knife must be cleaned between every fish sampling. It is important to register all information asked for, and include these on the envelope. All notes should be done by a pencil (NOT by ballpoint pen).

The fishermen should also count the total number of adult lice on each fish (see **photo 10, 11**).

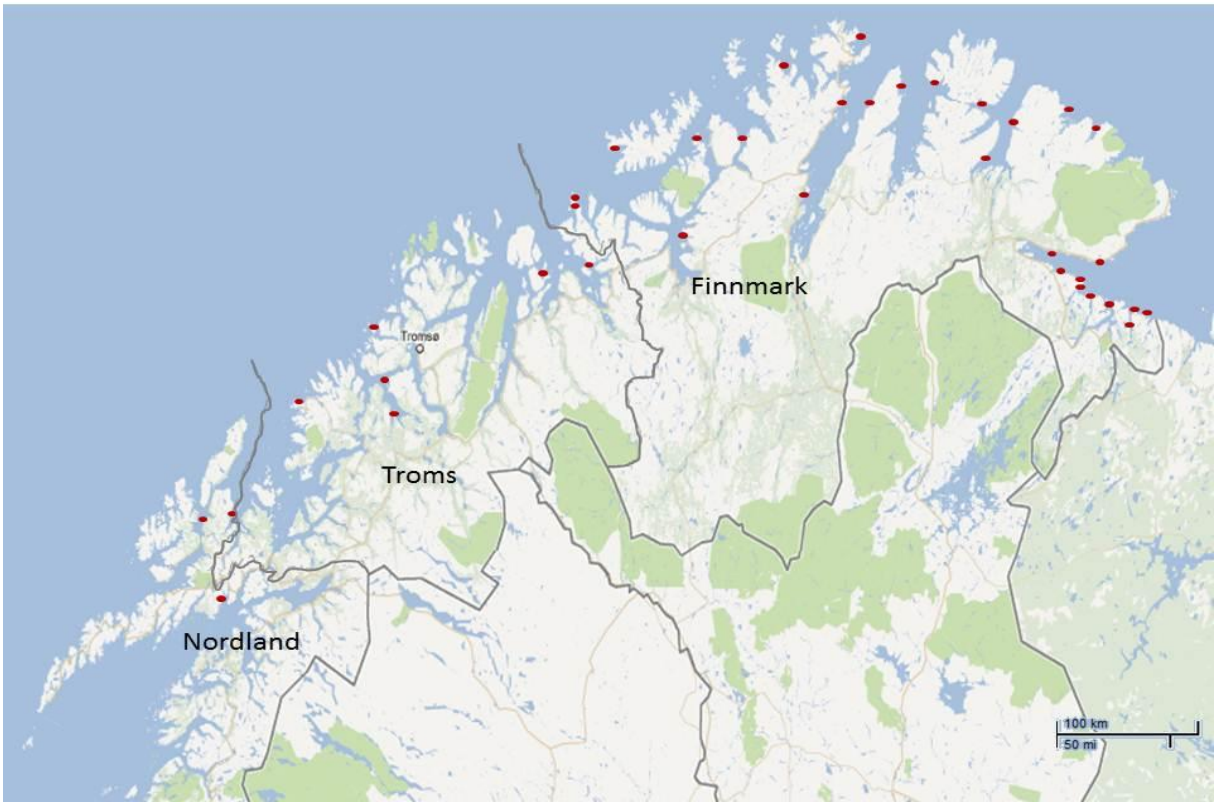

Figure 1 Map of the Nordland, Troms and Finnmark counties, showing the fishing sampling localities used by professional fishermen from early May to early September in 2011.

Figure 2 Map showing the sampling localities for adult salmon in Russia in 2011-2012.

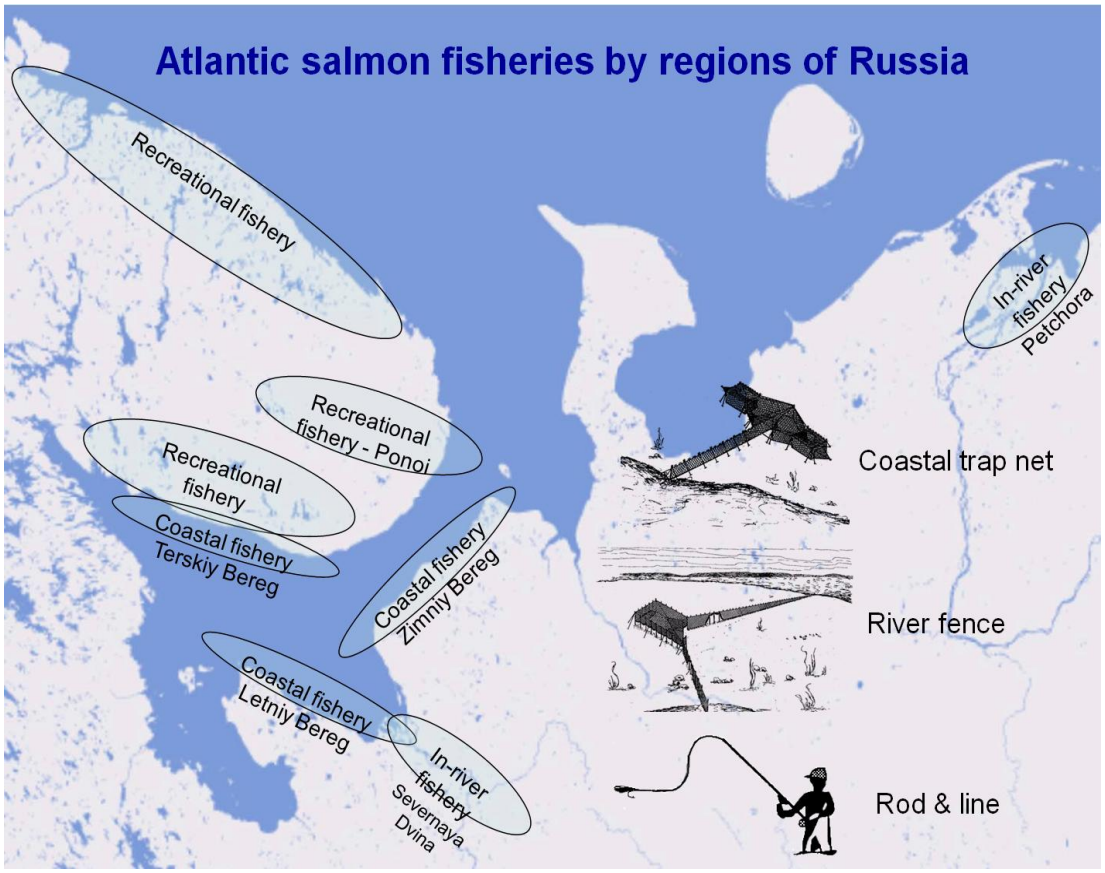

Figure 3 Map showing the Atlantic salmon fisheries by regions in Russia.

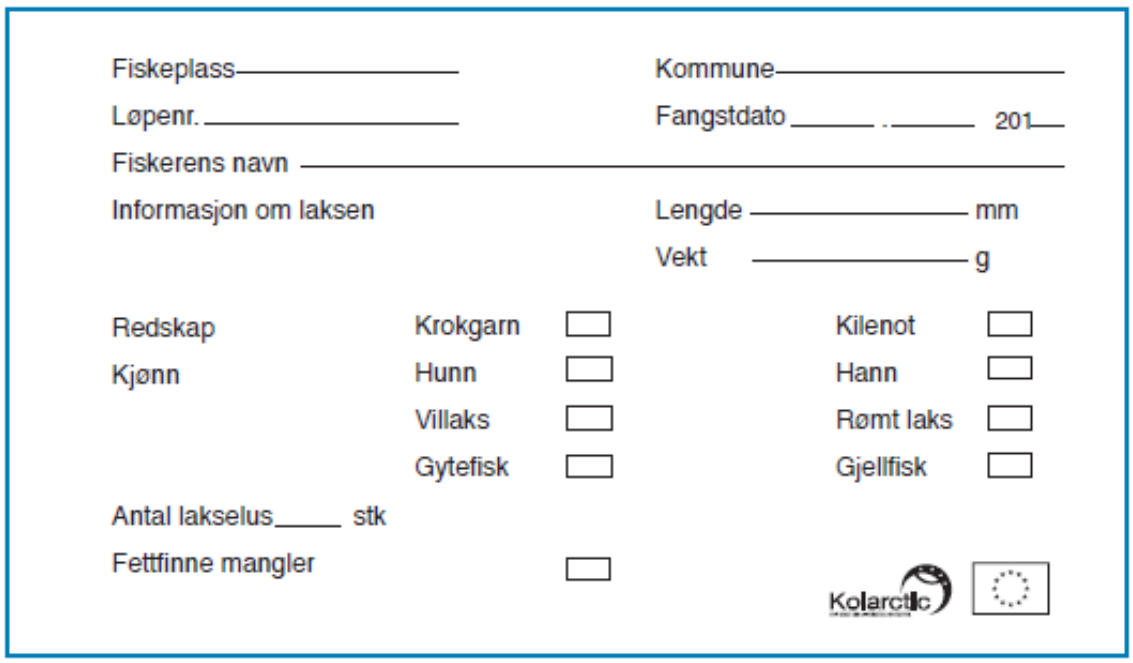

Figure 4 An image of the front page of a scale envelope, where the scales should be stored, and where several fish parameters should be taken down (in Norwegian). It is important to register all information asked for, and include these on the envelope. All notes should be done by a pencil (NOT by ballpoint pen).

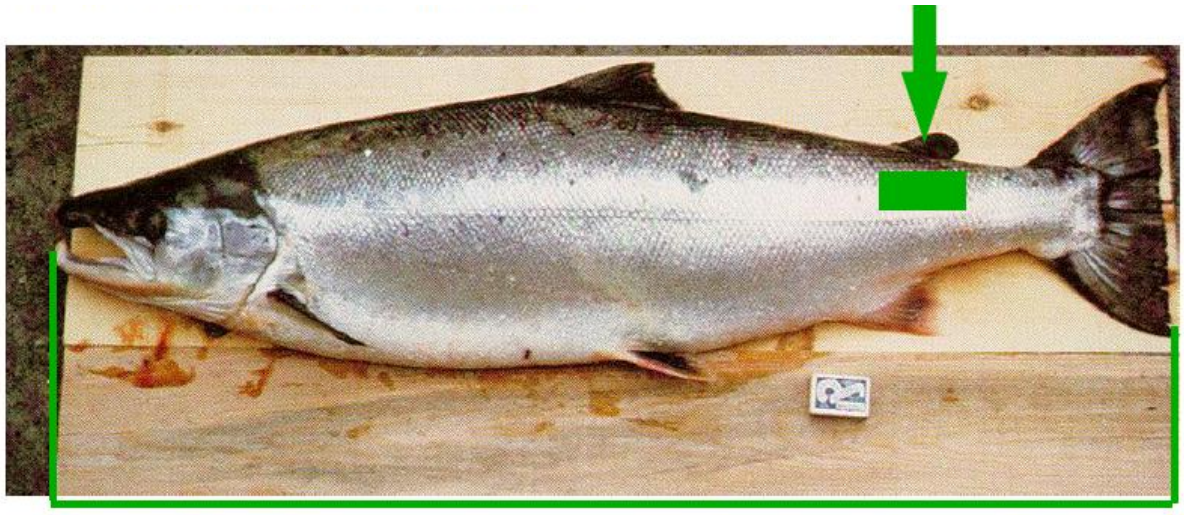

Photo 3 A photo of a wild Atlantic salmon, showing how to measure the total body length, i.e. from the nose tip to the end of the tail fin. The green area represent where to take the 35-40 scale samples, i.e. at the left side of the fish body and between the adipose fin and the lateral line.


Photo 4 and 5 It is important to clean the fish before scale sampling, to avoid cross contamination between different individuals (left photo). The knife must also be cleaned between fish scale samplings, and the scales must be sample from the correct place (right photo, see text above). Photos: Eero Niemelä.


Photos 6 and 7 Escaped salmon (left photo) have more black spots on the gill covers and under the lateral line compared to wild salmon (right photo). Note also the erosion (shortening) of the pectoral fins on the escaped salmon. Photos: Eero Niemelä.

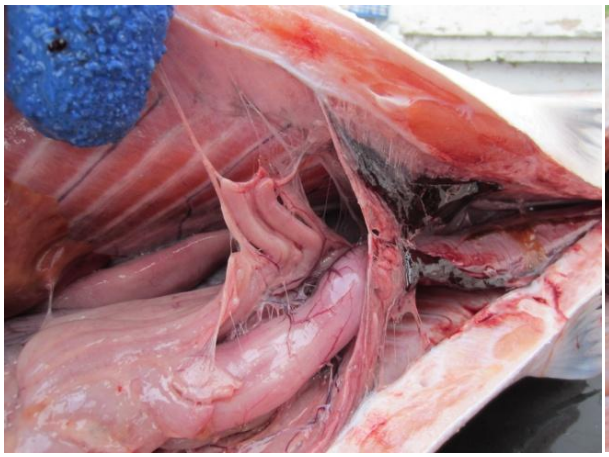


Photo 8 and 9 Escaped salmon have additional connective tissue growth between muscles and intestines (left photo). Wild salmon has never this additional tissue growth (photo on the right). Photos: Eero Niemelä.


Photo 10 and 11 The fishermen should count the total number of adult lice on each fish. Photo: Eero Niemelä.

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