Genetic origin and age determination of marine caught salmon (*Salmo salar*)

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Summary

Although the Atlantic salmon is primarily a fresh water fish it spends a big part of its adult life at sea as a fast moving pelagic predator. During this part of their life-cycle Atlantic salmon swim alongside and share the same ocean environments of commercially-fished species of the pelagic complex such as herring, mackerel and blue whiting. Atlantic salmon is now threatened by problems it's facing during this ocean migration and international research is becoming more and more focused towards this phase of the salmon life-history profile. Here we present results of genetic assignment and otoliths and scale aging of marine caught salmon in Icelandic waters.

Introduction

More and more north Atlantic salmon are dying at sea during their feeding migration. This dangerous trend has been identified and indications are that this has been on-going for the at least the last two decades (Friedland *et al.* 2009). In spite of unprecedented management measures some wild salmon rivers in the southern part of its distribution range now face extinction (ICES 2012). The fishing of salmon at sea has been illegal in Iceland since 1932 (Gudjonsson 1991) and therefore very little is known about the marine life of salmon in Icelandic waters.

Materials and methods

A total of 205 samples of marine caught salmon, including post-smolts and adult fish, were collected for this study in the period from 2007 to 2010. Most of our samples were acquired as a by-catch from a number of vessels in the Icelandic fishing fleet. Age of salmon was determined by analysis of scales and otoliths. Scales were preferably sampled from the area above and close to the lateral line midway between the dorsal fin and the adipose fin (ICES 1984) and stored dry. Scales were mounted on cellulose acetate slides and plastic impressions made of both post-smolts and adult scales. Genotype information was retrieved from 15 microsatellite loci: *SsaF43, Ssa14, Ssa289, Ssa171, Ssa197, Ssa202, SSsp1605, SSsp2201, SSsp2210, SSsp2216, SsspG7, SsaD144, SsaD486, SsaD157 and SSsp3016*, as described in Olafsson et al. (2010). Assignment of individual fish to their most likely population of origin was performed using the GRAASP (Genetically-based Regional Assignment of Atlantic Salmon Protocol) derived from the SALSEA-Merge project (SALSEA-Merge 2012).

Results and discussion

Sampling salmon at sea using specific cruses is expensive and results are not always predictable. The utilization of the fishing fleet through a surveillance agency was a novel approach and yielded a good sampling coverage regarding both the number of samples and area covered.

A total of 184 samples were aged using either or both scales and otolithes. Most of the samples were of individuals at their first year at sea or 72.8 %. Multi sea winter salmon (MSW) were 23.4% and post-

smolts caught close to land were 3.8%. Freshwater age ranged from 1 to 5 years. Salmon with two years in freshwater age was most common, 42,4%, but three years in fresh water age was also substantial or 28.3%. Salmon that had stayed for 4-5 years in freshwater were 17.9 % of the total sample and salmon staying for one year in freshwater was 11.4%. The average freshwater age was 2.6 years. Smolt age in Icelandic rivers ranges between 2 – 5 years with four years freshwater age as the most common age. A total of 186 samples of marine caught salmon were assigned using GRASSP (SALSEA-Merge 2012). Of those 186 samples eight post smolts, caught close to land, were identified and were as expected assigned to Iceland. Of the remaining 178 samples the assignments using the level one baseline were: 121 individuals assigned to the Southern group (Mainland Europe and Britain and Ireland, 68.0%), 53 individuals assigned to the Northern group (Scandinavia and Northern Russia, 29.8%), and four individuals were assigned to Iceland (2.2%). The posterior probabilities of a specific origin using the first level baseline ranged from 37.27% to >99.99% with an average probability of 86.97%.

The general trend of higher freshwater age with increasing latitude (Jensen & Johnsen 1986) supports the genetic assignment results as the majority of samples has a freshwater age of one and two, indicating a southern origin. These results indicate that the sea south and east of Iceland are much more important than previously thought, especially for salmon originating from UK and Ireland and southern Europe.

References:

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