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The status of Atlantic salmon stocks in Iceland Post and present management actions to mitigate the effect of climate change on Atlantic salmon

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MARINE & FRESHWATER RESEARCH INSTITUTE Iceland was a full member of NASCO from 1984 to 2009 when the country withdraw due to financial crises.

Iceland has participated in the ICES WGNAS providing data on Icelandic salmon stocks.

The Icelandic Minister of Food, Agriculture, and Fisheries made the announcement on March 16 that Iceland would become a full member of NASCO again from 2024.

Before the announcement from Iceland to rejoin NASCO we had been invited to give a presentation in this Theme-based Special Sessions (TBSS).

Management structure of freshwater fisheries in IcelandFishing rights go with adjacent land, can not be sold separately.

• Landowners of each river have (by law) to form a Fisheries Association that manages the fishing rights within the frame of the law - sustainable.

•Gear types other than rod and line can only be operated by landowners.

•Fishing rights are usually leased for rod and line fishery.

•The price of rod fishing licences is decided on an open market, with licences going to syndicates, anglers or angling clubs paying the highest bid.

•Cost and benefit from the fishery is divided between owners by their part of the river based on their shear of land length, size of nursery area and catch.

•No fishing fee is paid to the state.



•Ocean fishery for salmon was banned in 1932, with the exception of five coastal nets at the west coast of Iceland that were permanently bought out in 1997. Now, all salmon fishery takes place in freshwater.

•Limited number of rods are allowed in each river.

• At the average one fish/rod/day (Historic conservation limit from 1970).

•Fishing season for Atlantic salmon is maximum of 105 days

•Rod fishery is only allowed for 12 hours a day (7AM – 10PM) with a midday break.

•Net fishery is operated in Glacial rivers where angling is difficult due to turbidity of the water. These fisheries have decreased due to lease of net fishing rights.

In 2006, a change was made to the salmon trout and charr fishing act.

River fishery association of each river are responsible for sustainable to management of their fish stock.

Each river needs to have a harvest plan accepted by the Directorate of Fisheries after a review by the Marine and Freshwater Research Institute.

By this the fishery association needs to **take management action** if the fishery does not meet the requirement of being sustainable.

The Directorate of Fishery can also take **management actions** if needed.

The question asked by NASCO regarding <u>management actions undertaken to</u> <u>mitigate the negative impacts of climate change</u> was a wakeup call for the parties involved in research and management of Atlantic salmon in Iceland.

The reason: Large scale changes on the status of salmon stocks in Iceland have not been related to water temperature fluctuation.



Average summer temperature June-August. River Laxá NE-Iceland Average summer temperature April - June. River Laxá NE-Iceland In later years there has been a decline in the pre fishery abundance of salmon in Iceland. There has also been greater changes between adjacent years than previously seen.



There have been great changes in sea-age composition of salmon: In the 1970's there were similar numbers of 1SW and 2SW salmon in the catches in Icelandic rivers.

- Decline in both stock components in the early 1980's.
- The 1SW recovered but the 2SW continued to decline until the early 2000.



In 2000 a **management action was taken** in cooperation between the Institute of Freshwater Fisheries, the Federation of Icelandic River Owners and the Association of Angling Clubs to encourage catch and release of 2SW salmon. The management action involved changing the fishing regulations to mandatory release of large salmon (>69 cm) a size group which is almost entirely comprised of 2SW salmon. Along with a delay of the opening of the net-fishery to the end of June.

It needs to be noted that the genetic inheritance of sea age, as later described by Barson *et al.* (2015), was not known at that time.

In the light of Barson *et al.* (2015) findings these actions can be regarded as successful and a clear sign of recovery of the 2SW can be seen from 2010 to 2020.

Management action taken: Delay of the opening of the net-fishery to the end of June, and C&R of large salmon



The proportion 2SW salmon is increasing in the rod catches

Management action taken: Delay of the opening of the net-fishery to the end of June, and C&R of large salmon

Case study on rivers in NE-Iceland show that the after catch and release commenced the juvenile densities has increased. The juvenile abundance and smolt production has increased and helped to keep the number of migrating adult fish stable despite the increase of ocean mortality of salmon in the North Atlantic (ICES 2023).



The proportion of catch and release and densities of juvenile salmon in river Selá in NE Iceland.

Ice-free winters – higher predation pressure

Warmer winters has led to longer ice-free periods of rivers in Iceland. This opens for predation on salmon juveniles.

Less snow fall during winter can also result in less river runoff during vulnerable periods in the life-cycle of salmon such as during the smolt runs and it can even end with a severe drought in smaller rivers.

The **management action** taken by some river fishery associations to overwatch the rivers especially during the smolt run and scare away bird predators and to minimize the abundance of the introduced American mink (*Mustela vision*) which is an invasive alien species in Icelandic environment.

Pink salmon

From 2015 the number of pink salmon caught in Icelandic rivers has been increasing and are now being reported in many Icelandic rivers. Furthermore, pink salmon smolts have been caught indicating successive spawning and reproduction. The impacts of pink salmon on the ecology of Icelandic salmon rivers are still not known. It is likely that the sudden increase in number and distribution of pink salmon may be related to climate change (Irvine and Fukuwaka 2011).

It is also a burning question why pink salmon is doing well in the North Atlantic at the same time the Atlantic salmon is struggling as the two species reside in the same marine area and are utilizing to large extent the same food items.

Local fishery associations are willing to remove pink salmon from their rivers and by that delay the colonisation of pink salmon in their rivers.

A management action has been taken by the Ministry of Food, Agriculture and Fisheries to give the fishing associations permit for fishing pink salmon in rivers with seins and nets, an equipment that otherwise would be illegal to use. A proposed change to the Salmon, Trout and Charr fishing act is now going through parliamentary procedure in the Icelandic parliament.

Iceland is in the center of the migration route for Atlantic salmon in the North Atlantic







- Increasing Mackerel in Icelandic waters
- By-catch of salmon in Mackerel fisheries 5.5/ 1000 t Mackerel

Origin of the salmon caught as by-catch in the Mackerel fishery based on microsatellites



Figure 3. A schematic representation of the individual assignment to origin, where red indicates a Southern Group origin (mainland Europe, UK, and Ireland), green a Northern Group origin (Scandinavia and Northern Russia), and yellow an Icelandic origin. Samples with an assignment score lower than 70% have a black fill.

Total 178 analysed 121 (68%) Southern Europe 53 (30%) Norhern Europe 4 (2%) Iceland

8 Post-smolts from Iceland

Ólafsson et al. 2015

Future concerns

Recently we have seen plans for construction of off-shore windmill farms south off Iceland.

There are also plans for high seas aquaculture in the area.

This could affect salmon stocks from the southern NEAC area.

Thank you for the attention