

# Perceptions of Pink Salmon in Norwegian Rivers

## Summary Report

### Background

Pink salmon have emerged as a significant focal point in salmonid conservation in Norway, yet there is a glaring lack of information about societal perspectives on the increasing abundance of pink salmon. Pink salmon are native to the Pacific Ocean, spending two years at sea before returning to fresh water to spawn. The species was introduced into rivers of the White Sea in Russia from which it has rapidly spread westward and became an increasingly observed incidental species in Norwegian rivers until the populations recently underwent a rapid increase and populations became established in some rivers of northern Norway. The introduced population maintains a strong biennial year class with greater abundance in odd years but increasing numbers in even years (Sandlund et al. 2018 *Biol Inv* 21:1033-1054).

In 2017, pink salmon were especially abundant in Norwegian rivers engendering concern about the impacts of establishment and continued spread on the native wild salmonids Atlantic salmon, sea trout, and Arctic charr that are significant economic drivers in rural communities (Sandlund et al. 2019 *Biol Inv* 21:1033-1054). The pink salmon invasion is the subject of scientific debate (Jonsson and Jonsson 2018 *Freshw Biol* 48:21-27) and both national authorities and local landowner groups have mobilized to conduct targeted removal of these fish from rivers during spawning season. Although introduction of pink salmon in Russia was intended to enhance the wild food supply to local communities and arrival of non-native salmonids has often been positive in other regions such as New Zealand, Patagonia, and the Laurentian Great Lakes, pink salmon may generally be disliked and disfavoured among stakeholders in Norway.

Social science surveys are useful to understand the attitudes and opinions of stakeholders about complex conservation topics (Dick et al. 2016 *Facets* 1:67-82). Recreational fishers are significant value creators in aquatic ecosystems, contributing significant sums to local economies by visiting and fishing. Based on media reports we predicted that pink salmon would generally be viewed disfavouredly by recreational fishers but that angler age, specialization, and region of origin would predict the sentiments directed towards pink salmon. We designed a survey to be distributed to recreational salmonid anglers that have visited Norway and solicited opinions about the fishing experiences and encounters with pink salmon. The survey was targeted towards recreational fishers that had purchased fishing licenses in Norway for the 2020 season. The objectives were to provide national management agencies and local fisheries management organizations with information to guide decision making about desires and demands by stakeholders for management and control measures to handle the pink salmon invasion.

### Methods

Our survey was initially distributed on November 13<sup>th</sup>, 2020 to 19,510 anglers who have paid for a fishing license in Norway and have agreed to be contacted for research purposes, which can be indicated by anglers when they purchase a license. The full list of anglers was provided by Miljødirektoratet and was randomly divided into two halves. The platform we used to create and distribute the survey was Qualtrics XM, and each respondent received a personal link to the survey to prevent duplicate responses. Three reminder emails were distributed on the following dates: December 10<sup>th</sup> 2020, December 28<sup>th</sup> 2020, and January 19<sup>th</sup> 2021. The survey closed on February 1<sup>st</sup>, 2021 with a total of 2171 responses. A subset of 1348 respondents did not answer ten questions, 865 of whom agreed to be contacted for follow up questions and 583 of these respondents answered the missed questions after following up. The survey was designed to collect about angler experience, demographic, and attitudes towards pink salmon in Norway. Data analysis is pending but will consist of regression analyses and principle components analyses to determine how angler typologies predict their responses to pink salmon management. The survey was available in Norwegian, English, Finnish, and German.

### Results

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The total number of participants who responded to our survey was 2171 anglers, providing us with a 11.13% response rate. The total number of participants who consented to our survey was 2128 anglers.

### *Demographics*

Our sample population was overwhelmingly dominated by male gendered people (96%) and residents of Norway (98%). The majority of participants (75%) were between the ages of 41 and 71, employed full-time (66%) or retired (22%), with an even distribution in education level between a high school diploma to a post-graduate degree. Exactly half of the participants lived in a household of two persons (including themselves), and 40% reported a gross annual household income between 400,001 to 800,000 NOK (before taxes).

### *Opinions of Pink Salmon*

Most anglers had not encountered pink salmon in Norway (65%). Among the 35% that had encountered pink salmon, had caught pink salmon in the same rivers where they caught Atlantic salmon (58%) and caught on average 14 pink salmon per angler (for 599 anglers) in the last four years (2017 to 2020) compared to a mean of 28 Atlantic salmon, sea trout, or sea charr per angler per year (20 released and 8 retained, on average). The most common areas reported to have caught both pink salmon as well as Atlantic salmon were: northern Norway (both eastern and western parts of Finnmark County, 39%), and Western Norway (in Sogn & Fjordane and Møre & Romsdal counties, 13%).

Our survey revealed an overall dislike of pink salmon (61%), with 82% of anglers strongly agreeing that pink salmon should not get established in Norway, and 76% strongly agreeing that pink salmon should be removed. Although 52% of the respondents reported that they would not modify their fishing habits in the presence of pink salmon, 40% stated they would modify their habits to enhance catching pink salmon. When asked why they would want to increase their pink salmon catches, 70% of those respondents stated it was because they would like to remove pink salmon from the rivers, and only 26% stated it was because they enjoy catching pink salmon or would like to eat them.

When asked what they consider an acceptable number of pink salmon caught to be satisfied with their trip, 61% reported no pink salmon at all. Having a removal program in the river, however, did not have a strong influence on an angler's desire to fish in a certain river with 34% indicating no influence. Anglers' willingness to continue fishing in their main Norwegian river despite an increase in fishing permit cost by 10% remained the same, unless the probability of catching a pink salmon were equal to, or higher than, the probability of catching other salmon, in which they would fish there less often (49% and 67% respectively). However, respondents mostly yielded that their time spent fishing, number of fishing trips in Norway, and gear selection would remain about the same independent of the presence of pink salmon.

### **Summary**

Survey-based methods provide important insight into the attitudes and perspectives of stakeholders towards natural resources and their management. We found that recreational anglers that fished in Norway generally disliked pink salmon and supported removal. There has been a consistent narrative in Norwegian media about pink salmon and most anglers tended to think that pink salmon establishment would be negative for the viability of wild salmonid populations despite a lack of scientific consensus about the likely impacts and a clear need for more research. Nevertheless, invasive species are globally one of the most urgent threats to biodiversity and valuable time would be lost if research proceeded without efforts to reduce the spread of pink salmon. Indeed, early in the invasion is the only realistic opportunity to reduce the likelihood of long-term establishment.

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Although we anticipated that anglers would have a negative view of pink salmon, we were still surprised by the consistency with which anglers had negative views of the species. Pink salmon were intentionally established in Russian rivers as a food fish but Norwegian anglers do not view this as a palatable fish. Most anglers (60%) reported that fishing to eat was important to them, yet they seem hesitant to consider eating pink salmon. How many anglers have tried to prepare pink salmon is unknown despite 510 saying they would not eat pink salmon and 452 saying that they would eat. Efforts to remove pink salmon may be enhanced if locals can be convinced that this is a good eating fish if prepared well. We did not anticipate that anglers would modify their angling behaviour to enhance pink salmon catches, but they apparently would do so to enhance removal.

Ultimately, the presence of pink salmon seems to be disliked by anglers but not to the extent that most anglers believed they would significantly alter their fishing behaviour. This suggests that the target species is the primary motivation for selecting a fishing river and that this selection is relatively robust to perturbations to the system. This suggests asking what factors would convince salmon anglers to fish less. Most anglers reported relaxing and experiencing nature as the most important motivations for fishing while relatively few stated that catching many fish or big fish was very important. Our results suggest that presence of pink salmon does not really disrupt these motivations of anglers to fish, and is therefore unlikely to affect fishing behaviour.

We suggest several avenues for further research. Comparing attitudes towards pink salmon among anglers in odd and even years is relevant given that recall bias may affect responses in even years when pink salmon catches are lower. We also believe that comparing angler attitudes towards pink salmon between Norway and the United States and Canada where pink salmon are native would provide controlled insight into how pink salmon are viewed given that pink salmon are not a popular target of recreational fishers in the native range but are not subjected to control efforts.

The results suggest support for management actions aiming to reduce pink salmon abundance in Norwegian rivers but that the recreational fishing industry is not immediately threatened by the presence of pink salmon. Angler motivations to fish seem relatively robust to the presence of the invasive species and their responses suggest that they will continue to fish whether or not pink salmon continue to be part of the species assemblage in their native rivers as long as pink salmon are less commonly captured than the native species. However, if pink salmon start to outcompete the preferred native salmonids targeted by anglers, attitudes may shift and anglers may begin to avoid rivers that seem to be overrun by pink salmon. So far, a lack of biological data precludes a conclusion about whether pink salmon may become dominant in some rivers where Atlantic salmon, sea trout, or Arctic charr presently predominate. The precautionary principle dictates that management efforts should continue to reduce pink salmon invasion pressure as much as possible to avoid establishment, but research is greatly needed to understand whether pink salmon pose a significant threat to wild salmonids and whether they could become dominant in future years without management intervention.