Measures to Control Pink Salmon in Northern Norway

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Since 2017 the number of pink salmon in Norway have increased dramatically. The total reported catch in Norway 2017 was 6289 individuals, at that time seen as an "explosion" in the occurrence compared with previous years. In 2023, the total catch from targeted measures, coastal fishery and angling have reached 361 548 ind (miljodirektoratet.no).

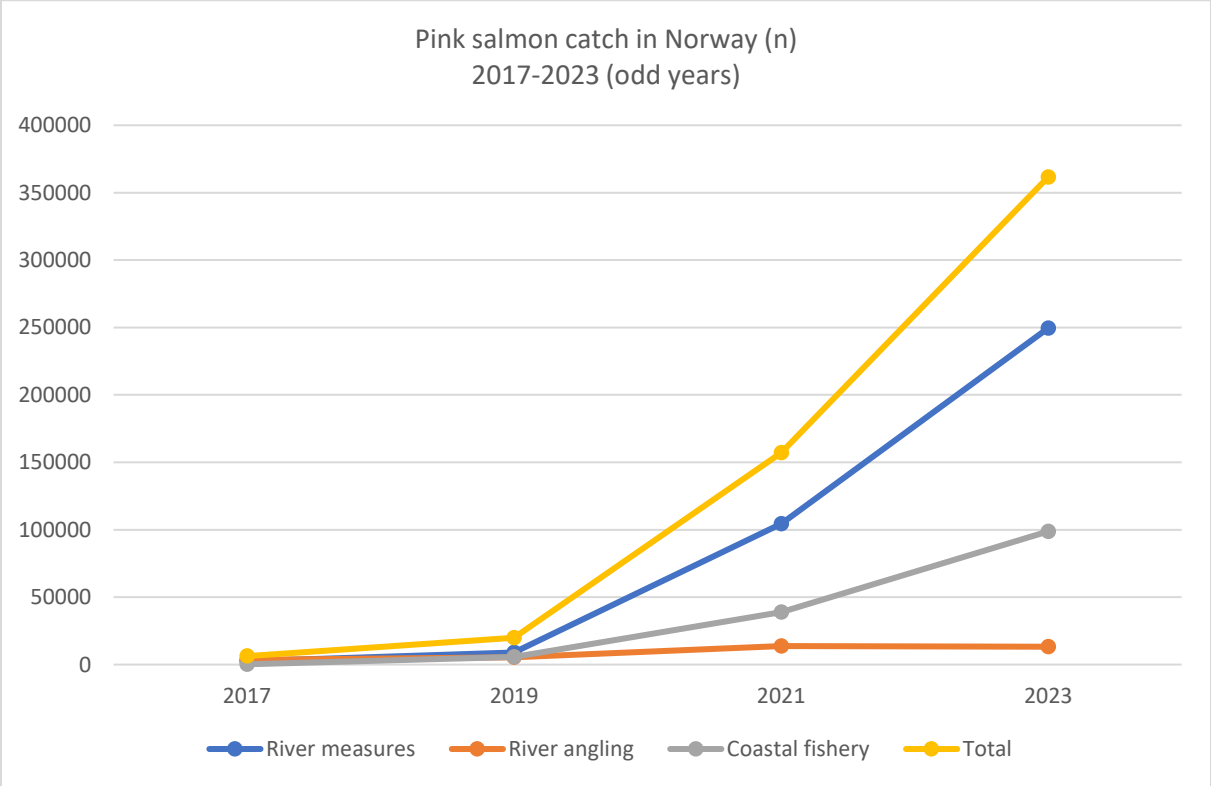

***Figure 1**: Numbers of pink salmon caught in Norway (odd years). Data from NEA (river measures, miljodirektoratet.no) and Statistics Norway (coastal bag net fishery and river angling, https://www.ssb.no/).*

Following the second large invasion in 2019, a risk assessment was performed by the Norwegian Scientific Committee for Food and Environment. Several potential threats from pink salmon were identified, towards Atlantic salmon and other biodiversity, water quality and fish health including the aquaculture industry. This was followed up by a national action plan suggested by the Norwegian Environment Agency (NEA) in 2021 (Mo *et al*. 2021). Even though there still is a lack of research and scientific knowledge on the potential adverse impacts from pink salmon, the NEA cannot see the probability of any of the individual risk factors having been reduced since 2019. Furthermore, as the consequence of each factor is related to the number of pink salmon, our assessment that there is a need for precautious action, remains.

The NEA is responsible for the measures against pink salmon in Norway. The task of implementing the measures in Northern Norway was given to The County Governor of Troms and Finnmark, as this county is most affected. The main measure in the action plan is to establish physical control of the spawning migration of all fish in all salmon rivers in a selected target area. The strategy was to use state funded temporary weirs/traps, operated by local

angler's organizations and, remove all ascending pink salmon and at the same time release all native fish with minimal harm and delay.

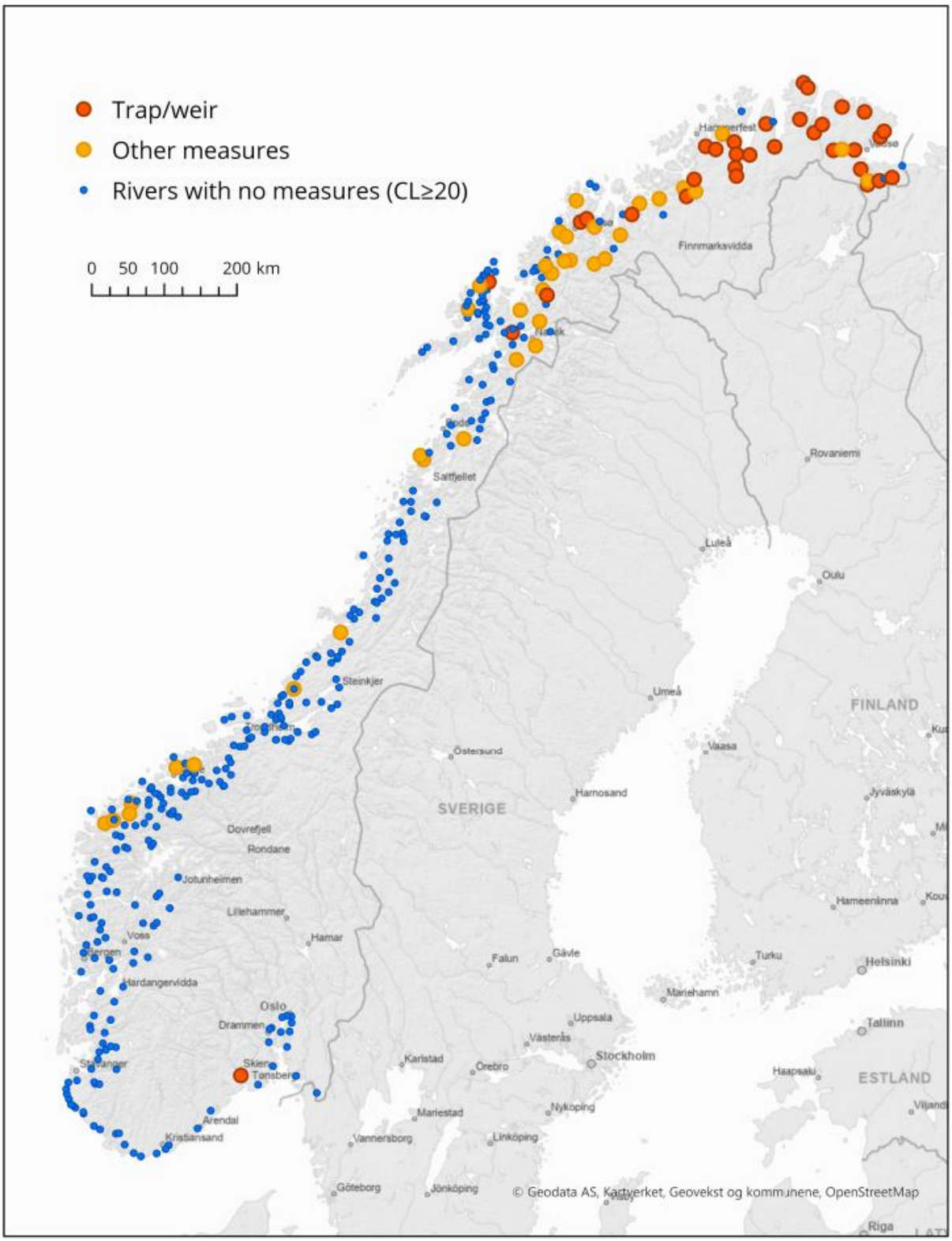

***Figure 2**: Geographical localization of the weirs (red), other methods (orange) and rives with no measures (blue) in 2023. Figure: Marianne Kvaal.*

In the summer of 2023, there were state funded weirs/traps in 32 rivers from Karpelv in eastern Finnmark to Kvalsundelva in Western Finnmark. The weirs are operated by local angler's

organizations that the County Governor made contracts with, regarding the funding and how to operate. Rivers were prioritized according to their proximity to the Russian border, as there has been a strong relationship with this localization and the occurrence of pink salmon in previous years.

The County governor has mainly funded two types of traps/weirs: Picket weir and resistance board weir. These have been almost 100% efficient in some rivers in removing pink salmon and releasing native salmonids. The total catch of pink salmon in targeted measures in 94 rivers was 249 496 ind., and 170 293 of these were caught in the traps (miljodirektoratet.no).

Some of the larger rivers had challenges regarding equipment and operation, and the efficiency of the traps was much lower than expected in some rivers. The most pronounced example is the largest river Tana, where 7666 pink salmon was caught but, an estimated 170 000 escaped. This was mainly due to a special type of guiding fence that proved to be permeable for both pink salmon and other fish (Nasjonal kompetansegruppe for tiltak mot pukkellaks 2023).

Injured native salmonids have been observed, but a low number of Atlantic salmon (101 ind.) died or had to be put down because of the trapping. In comparison, a total of 18 433 Atlantic salmon was successfully released. In some rivers, collapse of the weirs occurred during flood caused by heavy rain. We believe that most of the challenges can be solved, and a thorough evaluation of the causes and solutions have been performed by a national competence group for measures against pink salmon appointed by the NEA (Nasjonal kompetansegruppe for tiltak mot pukkellaks 2023). The report includes advice on how to improve the catch and minimize the negative impact on native fish in future operations. With our current knowledge and experience we believe that picket weirs and resistance board weirs are suitable methods to control the pink salmon invasion in most rivers. Home-made traps have been used in approx. 25 rivers, most of which were not state funded but built and operated by volunteers with permission from the County Governor's office. These weirs made from nets instead of pickets are more likely to collapse during floods, and more often cause harm to native fish in various ways. We aim to replace them with picket or resistance board weir before 2025, depending on funding from the government.

Beach seine was used in some rivers downstream the trap, with great efficiency. We assess that it is suitable as an additional measure to remove pink salmon, given that the local anglers organization have the gear, skills, capacity, and are careful enough with the native salmon so that they can be released upstream the trap (Nasjonal kompetansegruppe for tiltak mot pukkellaks 2023).

Sea salmon fishery with bag nets for Atlantic salmon is allowed on parts of Norway´s coast and has been considered to use as a measure to control the pink salmon invasion (miljodirektoratet.no). However, a field study performed by the Norwegian Institute of Nature Research in 2023 show that more than 60% of bag net caught Atlantic salmon was either dead or too injured to be released. Bag net fishing in the fjords is not suitable as a measure to control the pink salmon invasion because of the high risk of overexploitation of Atlantic salmon, except from bycatches in the coastal fishery targeting Atlantic salmon (Havn *et al.* 2023). This fishery is regulated according to the stock status of salmon in the respective areas, where some are closed for fishing whilst other had a fishing season of 8 weeks in 2023 (Lovdata.no). The total catch of Atlantic salmon in 2023 was 30 268 ind. with a bycatch of 98 770 pink salmon (https://www.ssb.no/sjofiske-etter-laks-og-sjoaure).

***Figure 3**: Picket weir in the river Máskejohka, a tributary to the Tana. Photo: Eirik Frøiland*

***Figure 4**: Resistance board weir in the river Vestre Jakobselv. Photo: Jan Harald Tomassen*

Experience shows us that the local angler's organizations must receive sufficient funding to provide a salary to their workers, to manage a weir operation throughout the run of pink salmon in a way that is both efficient and safe, for both people and fish. We are dependent on the help and cooperation, manpower, skills, and local knowledge that can only be found in the local angler's organizations to carry out this project. A salary will make the work more stable and

keep the motivation up. Relying on volunteers alone is a vulnerable strategy, as the pink salmon run may culminate at the same time as the summer holiday for students and others is over.

We had different solutions to deal with the pink salmon removed from the rivers. Agreements with local companies were made in advance of the season, to pick up pink salmon daily and provide clean boxes with ice. This pink salmon could be used as food commercially or as ensilage and biogas. Pink salmon was also donated to the local communities as food, dog food or crab bait. It is highly important to have a logistics plan for this in advance of the season, or else the removed pink salmon will become a waste problem. The preferred solution is to use the catch as food, either commercially or in private households, due to the costs imposed from other solutions and the ethical side of wasting the resource that the catch represents. However, it is important to underline that the purpose of the measures is to minimize adverse impacts of pink salmon on native fish and other biodiversity, and not to create an industry based on pink salmon as a resource (Mo *et al.* 2021). Hopefully, the number of pink salmon will not reach a level that can support a large-scale industry in Norway.

The NEA will consider the advice from the national competence group and aim to improve and expand the measures against pink salmon in 2025 (Nasjonal kompetansegruppe for tiltak mot pukkellaks 2023). Some of the home-made weirs have been substituted with PWs, and this will continue as far as funding is available. Minor changes to the design of both the PWs and the RBWs are being implemented. There is a special attention to the unsolved problems in the large rivers, like Tana and Alta. With lessons learned from 2023, new weir design will be tested on new locations in 2024 in these rivers. There is also an ongoing pre-commercial procurement of AI-based traps with automatic recognition and sorting by species. We are aiming at testing the prototypes in 2025.

In the spring of 2024, the survival of the pink salmon fry originating from the 2023 spawning season will be surveyed. The occurrence of adult spawning pink salmon will also be monitored by video and drift counting in selected rivers. The even-year population have not shown the same capability of increasing, but Norway will keep an eye on this as well, as a part of the national action plan.

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