

4th International Seminar on Pink salmon in the Barents region and in Northern Europe 2025

Abstract report

October 21st and 22nd | NIBIO Svanhovd, Norway



Statsforvalteren i Troms og Finnmark
County Governor of Troms and Finnmark



**Norwegian
Environment
Agency**

The County Governor of Troms and Finnmark/ Statsforvalteren i Troms og Finnmark Statens hus, PB 700, 9815 Vadsø Norge https://www.statsforvalteren.no/troms-finnmark/	Date: 12.11.2025 Miljødirektoratet/ Norwegian Environment Agency M-3051 2025
Title: 4th International Seminar on Pink salmon in the Barents region and in Northern Europe 2025 Authors: The paragraphs are written by the participants and listed in the report Edit: Tiia Kalske, County Governor of Troms and Finnmark	
Summary: The topics in this seminar report are related to the recent development of the invasion, monitoring, research and actions on removal of pink salmon, and effects on other fish and organisms after the increasing invasion of pink salmon. The report with paragraphs is a collection of the topics presented during the two-day seminar 21.-22.10.2025. The 4th International Seminar on Pink Salmon at NIBIO Svanhovd provided valuable insights and strengthened collaboration between researchers and management authorities. The spread of pink salmon continues in Norway, with increased presence in western and southern regions, while numbers have declined in Varanger region. Similar developments in Iceland confirm the species' strong colonizing ability. The seminar emphasized the need for knowledge-based management and the precautionary approach. Discussions highlighted ecological risks of mitigation measures, the impact of spring floods on control efforts, and the importance of long-term monitoring. Despite limited funding for ecological research, the commitment among researchers remains strong. Progress is evident compared to earlier years, with more effective and professional measures in place. The establishment of NASCO's standing working group on pink salmon marks a step forward in international cooperation. Past successes in combating other environmental threats give hope that the pink salmon challenge can also be addressed effectively. The next seminar in 2027 will be an important opportunity to follow up on developments and research findings.	
Key words: Pink salmon, <i>Oncorhynchus gorbuscha</i>, international seminar 2025	

Front and back cover photo credits: Malin S. Høstmark/ Statsforvalteren i Troms og Finnmark

Disclaimer:

The meeting has been implemented with the support from the Norwegian Ministry of Climate and Environment. The contents of this publication can in no way be taken to reflect the views of the financier. Each author and contributor are solely responsible for their own views.

Contents

Preface	5
Program and Agenda	6
Abstracts.....	9
Session 1: Pink salmon in the Barents region and in the Norwegian Sea - overview of status per 2025	9
1. Pink salmon occurrence in Northern Norway, incl. border rivers.....	9
2. Research publications so far and research GAPs in the Nordic region	10
3. Monitoring the abundance and distribution of pink salmon in the rivers Teno and Näättämojoki.....	11
4. Situation in Ireland	12
5. Situation in Scotland.....	12
6. Situation in Iceland	13
7. Pink salmon in Sweden, Nordic collaborations, and the NASCO pink salmon special session.	14
Session 2: Traps and fences and their effect on native salmonids.....	15
8. Evaluation of the traps in the removal fishery for pink salmon in Norway in 2023: Catch of pink salmon and effects on native salmonids.	15
9. Pink salmon invasion; feeding ecology, species interspecies interactions and fish trap interactions in juvenile salmonids.	16
Part 1: The feeding ecology of pink salmon juveniles in northern Norwegian rivers and their role as prey to native salmonids.....	16
Part 2: Tana smolt telemetry 2025.....	17
10. Traps and fences, handling and nets: What are the effects on native salmonids?.....	18
11. Status of development of automatic sorting of fish by the use of AI.	19
Session 3: Measures to control the invasion of pink salmon.....	20
12. Preliminary evaluation of the fish trap in Tana River 2025.....	20
13. Pink salmon invasion in River Teno 2025: A Finnish perspective.....	21
14. Measures to control pink salmon in Northern Norway – 2025.....	22
Session 4: Perspectives from North Pacific Ocean	23
15. Overview of pink salmon effects on North Pacific ecosystems: implications for Northern Europe.....	23
Session 5: The impacts of pink salmon on native species and ecosystems	24
16. Dinner is served: decomposition and release of nutrients from decaying pink salmon carcasses.....	24
17. Water quality monitoring and interactions between pink salmon and freshwater pearl mussels.....	25
18. Metabolic shift and migration patterns in juvenile pink salmon in the River Teno/Tana.....	26

19. Occurrence and distribution of pink salmon (<i>Oncorhynchus gorbuscha</i>) spawning in selected rivers in eastern Finnmark.....	27
20. The invasion of the pink salmon (<i>Oncorhynchus gorbuscha</i>) in the North Atlantic/Arctic region.....	28
Session 6: Methodologies for detecting and monitoring pink salmon	29
21. Genetic and geochemical tools to study the homing of invasive pink salmon.	29
22. eDNA monitoring of pink salmon in Norway and Europe, including molecular methods studying pink salmon infections.	30
23. Using 3RADseq-Based Invasion Genomics to Uncover the Expansion Dynamics of Pink Salmon in Northern Norwegian Rivers.....	31
24. Pink salmon research at IMR: Current status and future plans.	32
Session 7: Pink salmon and socio-ecological studies	33
25. Impacts of pink salmon on the social-ecological system: Tana river community survey.	33
Session 8: Research gaps and funding – “Menti meter session”	34
Most critical research gaps in pink salmon studies today?	34
The biggest challenges in securing funding for pink salmon research?	35



Photo 2. Pink salmon in Sultan River, Washington State. Photo: Greg Ruggerone.

Preface

The 4th International seminar on pink salmon in the Barents Region and in Northern Europe 2025, has once again proven to be a valuable arena for knowledge exchange, collaboration, and reflection. With new insights and renewed inspiration for future research and management efforts.

The seminar highlighted the evolving nature of the pink salmon invasion in Norway, with increasing spread westward and southward, and a notable decline in numbers in Finnmark, especially in the Varanger region. Status reports from other territories in general shows relatively low occurrence, though Iceland's emerging pattern reinforces the species' reputation as a resilient and capable colonizer.

A major part of the presentations was related to Norwegian policy, strategy and the extensive measures carried out in 2023 and 2025 to control pink salmon. But the seminar also addressed the ecological risks of mitigation measures, with new results that serves as a reminder of the potential for damaging the species that we aim to protect.

This year's challenges posed by prolonged spring floods show that technology proven to be robust and effective in one region can fail when implemented in a new area with different natural conditions. It remains to be seen if this can be overcome. However, we are still in an early stage of a presumably long battle, and the technological improvements presented in these seminars from 2019 to 2025 gives hope that we will be able to control the number of pink salmon entering the rivers.

The presentations on species interactions and ecological effects showed that there has been some progress since the previous seminar in 2023. Still, significant knowledge gaps remain. Lack of scientific data on the various hypothetical effects of the invasion can be used as an argument against action. Despite limited funding for ecological research, the resilience and dedication of the research community were evident during these two days. Looking ahead to 2027, continued collaboration and scientific inquiry will be essential to inform effective and sustainable management.

We would like to thank you all for contributing; presenters, organizers, and participants, asking good questions and offering comments.

Anders Tandberg
County Governor of Troms and Finnmark

Eirik Frøiland
Norwegian Environment Agency

Program and Agenda

AGENDA

4th International Seminar on Pink salmon in the Barents region and in Northern Europe 2025

Time: 21.-22.10.2025

Venue: NIBIO Svanhovd, Svanvik Norway + online

Day 1 – Tuesday 21.10.2025 (09:00- c. 18:15)

09:00-09:15	Welcoming words and opening the seminar <i>Anders Tandberg, Office of the County Governor of Troms and Finnmark</i>	5 min
	Introduction <i>Julie Gjerttz Howden, Norwegian Ministry of Climate and Environment</i>	10 min

09:15-11:35	Session 1: Pink salmon in the Barents region and in the Norwegian Sea - overview of status per 2025	
09:15-09:45	Pink salmon occurrence in Northern Norway, incl. border rivers. <i>Eirik Frøiland, Norwegian Environment Agency</i>	10 min
	<i>Henrik Berntsen, Norwegian Institute for Nature Research (NINA)</i>	20 min
09:45-10:00	Research publications so far and research GAPs in the Nordic region <i>Tom Staveley, Swedish University of Agricultural Sciences/ SLU</i>	15 min
10:00-10:20	Monitoring the abundance and distribution of invasive pink salmon in two Finnish Norwegian transboundary rivers: the River Teno and River Näätämöjoki. <i>Panu Orell, Natural Resources Institute Finland (Luke)</i>	20 min
	<i>Short break (10 min)</i>	
10:30-11:15	Summary of status from other countries, 2025: ➤ Situation in Ireland: <i>Michael Millane, Inland Fisheries Ireland (online)</i> ➤ Situation in Scotland: <i>Colin Bean, University of Glasgow (online)</i> ➤ Situation in Iceland: <i>Hlynur Bardarson, Marine and Freshwater Research Institute (MRFI)</i>	15 min/ presentation/ country
11:15-11:35	Pink salmon in Sweden, Nordic collaborations, and the NASCO pink salmon special session. <i>Tom Staveley, Swedish University of Agricultural Sciences/ SLU</i>	20 min
	<i>Questions and comments to session 1</i>	

11:40-14:15	Session 2: Traps and fences and their effect on native salmonids	
11:45-12:00	Evaluation of the traps in the removal fishery for pink salmon in Norway in 2023: Catch of pink salmon and effects on native salmonids. <i>Henrik Berntsen, Norwegian Institute for Nature Research (NINA)</i>	15 min
	LUNCH 12:00-13:00	
13:00-13:30	Pink salmon invasion; feeding ecology, species interspecies interactions and fish trap interactions in juvenile salmonids. <i>Karl Øystein Gjelland Norwegian Institute for Nature Research (NINA)</i>	30 min
13:30-13:50	Traps and fences, handling and nets: What are the effects on native salmonids? <i>Jenny Jenssen, Akvaplan-niva AS, Norway</i>	20 min
13:50-14:10	Status of development of automatic sorting of fish using AI. <i>Jan Grimsrud Davidsen, Norwegian University of Science and Technology/ NTNU</i>	20 min
	<i>Questions and comments to session 2</i>	

14:15-15:55	Session 3: Measures to control the invasion of pink salmon	
14:15-14:45	Preliminary evaluation of the fish trap in Tana River 2025. <i>Sturla Brørs, Norwegian Environment Agency and</i> <i>Roar Sandodden, Norwegian Veterinary Institute</i>	15 min 15 min
14:45-15:00	Pink salmon invasion in River Teno/ Tana, Finnish measures in 2025 <i>Tapio Hakaste, Ministry of Agriculture and Forestry Finland</i>	15 min
	Coffee break 15:00-15:30 (30 min)	

15:30-15:50	Measures to control pink salmon in Northern Norway – 2025. <i>Eirik Frøiland, Norwegian Environment Agency.</i> <i>Camilla Lehne and Sonja Kimo-Halvari, County Governor of Troms and Finnmark</i>	20 min
Questions and comments to session 3		

15:55-16:30	Session 4: Perspectives from North Pacific Ocean	
15:55-16:25	Overview of pink salmon effects on North Pacific ecosystems: implications for Northern Europe. <i>Greg Ruggerone, Natural Resources Consultants, Seattle USA</i>	30 min
Questions and comments to session 4 – North Pacific Ocean		

16:30-18:15	Session 5: The impacts of pink salmon on native species and ecosystems	
16:30-16:50	Dinner is served: decomposition and release of nutrients from decaying pink salmon carcasses. Results of a manipulative study. <i>Aino Erkinaro, University of Oulu, Finland</i>	20 min
16:50-17:10	Water quality monitoring and interactions between pink salmon and fresh-water pearl mussel. <i>Runar Kjær and Hallvard Jensen, Norwegian Institute for Bioeconomy Research (NIBIO Svanhovd)</i>	20 min
17:10-17:30	Migration patterns and metabolic shift in juvenile pink salmon in the River Teno/Tana. <i>Jaakko Erkinaro Natural Resource Institute Finland (Luke)</i>	20 min
Short break (c. 15 min)		
17:45-17:55	Occurrence and distribution of pink salmon spawning in selected rivers in eastern Finnmark. <i>Felix Bolle, University of South-Eastern Norway/ USN</i>	10 min
17:55-18:05	Establishing the extent of the pink salmon (<i>Oncorhynchus gorbuscha</i>) invasion in the Arctic. <i>Michał Skora, Queen Mary University of London/ University of Gdansk</i>	10 min
Questions and comments to session 5		

Day 2

Day 2 – Wednesday 22.10.2025 (08:30 – c. 12:00)		
	Introduction to day 2 <i>Anders Tandberg, County Governor's office</i>	5 min
08:35-10:30	Session 6: Methodologies for detecting and monitoring pink salmon	
08:35-09:05	Genetic and geochemical tools to study the homing of invasive pink salmon. <i>Sebastian Wacker and Malte Willmes, Norwegian Institute for Nature Research (NINA), Norway</i>	30 min
09:05-09:35	eDNA monitoring of pink salmon in Norway and Europe, incl. molecular methods studying pink salmon infections. <i>Frode Fossey, Norwegian Institute for Nature Research (NINA), Norway</i>	30 min
09:35-09:55	Using 3RADseq-Based Invasion Genomics to Uncover the Expansion Dynamics of Pink Salmon in Northern Norwegian Rivers. <i>Snorre Hagen, Norwegian Institute for Bioeconomy Research (NIBIO Svanhovd)</i>	20 min
10:00-10:30	Pink salmon research: Current status and future plans. <i>Per Gunnar Fjelldal, Institute of Marine Research (IMR), Norway</i>	30 min
Questions and comments to session 6		
Short break (c. 10 min)		

10:40-11:00	Session 7: Pink salmon and socio-ecological studies	
10:40-11:00	Impacts of pink salmon on the social-ecological system: Tana river community survey. <i>Solvår Tørres Berntsen, UiT/ The Arctic University of Norway (online)</i>	20 min
<i>Questions and comments to session 7</i>		

11:05-11:45	Session 8: Research gaps and funding – Menti meter	
	Research gaps and research funding – “Menti meter session” <i>Menti meter and short discussion on Menti results – coordinated by Yara Nieuwenhuis, Office of the Troms and Finnmark County Governor</i>	40 min

11:45-12:00	Closing remarks and closing the seminar	
	Eirik Frøiland, Norwegian Environment Agency	10 min
	Anders Tandberg, Office of the County Governor of Troms and Finnmark	5 min
LUNCH 12:00-		

The seminar is partly funded by Norwegian Climate and Environment Ministry and arranged by the County Governor of Troms and Finnmark, Environmental Department and the Norwegian Environment Agency.

Abstracts

Session 1: Pink salmon in the Barents region and in the Norwegian Sea - overview of status per 2025

1. Pink salmon occurrence in Northern Norway, incl. border rivers

*Eirik Frøiland, eirik.froiland@miljodir.no
Norwegian Environment Agency*

*Henrik Berntsen, henrik.berntsen@nina.no
Norwegian Institute for Nature Research (NINA)*

Data on pink salmon occurrence in Norway is collected from various sources. All organizations involved in pink salmon removal measures are obliged to report catches daily to the Norwegian Environment Agency. Combined with snorkelling counts in selected rivers this yields information on how many pink salmon are removed and how many escapes to spawn in the area with organized control measures. In two large rivers, the Tana and Neiden, sonar counting is combined with video to calculate the total run of each species of anadromous fish. In some fishways stereo video cameras are used to count, identify species, size distribution and even gather statistics on wounds and other fish health characteristics. In Norway it is also mandatory to report all catch of anadromous salmonids in rod fishing and bag net fishing.

Since 2017, the number of pink salmon observed in Norwegian rivers and coastal waters has increased dramatically, from around 12,000 individuals to just under 600,000 in 2023. Initially concentrated in eastern Finnmark near the Russian border, pink salmon have in recent years steadily expanded their geographical range westward and southward along the Norwegian coast.

Preliminary data from Norwegian rivers in 2025 indicate a decline compared to 2023. Approximately 300,000 pink salmon have been recorded either captured in targeted removal fishery or angling or observed during drift counts, representing a 38% decrease from the 480,000 individuals that were registered in 2023. Although the total number of pink salmon observed decreased from 2023 to 2025, this decline was primarily concentrated in Finnmark, while numbers increased in Troms. In Finnmark, observations show a 54% decrease compared to 2023, whereas Troms experienced a 347% increase in the number of pink salmon during the same period. The exact cause of the change in both the total number and the geographical distribution of pink salmon is not yet known, but it is currently believed to be independent of fishing effort.

2. Research publications so far and research GAPS in the Nordic region

Tom Staveley, tom.staveley@slu.se

Swedish University of Agricultural Sciences

Through a recent Nordic collaboration, we conducted a comprehensive literature review to collate the knowledge status of pink salmon in the Nordic region by examining English-language, peer-reviewed studies published internationally. Using the Web of Science Core Collection (searched on March 7, 2025, covering 1945–2025), we identified 50 unique publications related to pink salmon and Nordic countries. After applying relevance criteria, 22 studies were selected, supplemented by four additional key papers identified through expert knowledge and reference screening. These 26 relevant publications were categorized based on their study objectives, providing a focused overview of invasive pink salmon research in the Nordic region.

Among published studies on pink salmon in the Nordic region, eleven focus on the freshwater life cycle, five on the marine phase, and ten cover both habitats. Research objectives primarily include mapping population numbers and distribution, studying biology and life history, summarizing existing knowledge, and assessing risks and consequences. However, only a few studies (6 of 26) have investigated the impacts of pink salmon on other salmonids and ecosystems. Research on disease agents (2 of 26), toxicology (1 of 26), genetics (1 of 26), aquaculture interactions (0 of 26), and social or economic aspects (2 of 26) remains scarce. Most publications (88%) have appeared since 2018, with only three studies dating from 1961 to 1980.

Despite the massive invasion of pink salmon in northern Norway and Finland and the risk of further spread in the Nordic region, the knowledge of impact on other salmonids and ecosystems is still very poor. This huge knowledge gap hampers the understanding of the consequences of the invasion on other species, ecosystems, ecosystem services and aquaculture.

3. Monitoring the abundance and distribution of pink salmon in the rivers Teno and Näätämöjoki

Panu Orell, panu.orell@luke.fi

Natural Resources Institute Finland (Luke)

Panu Orell¹, Jaakko Erkinaro¹, Mikko Kytökorpi¹, Frode Fossøy², Karl Gjelland², Narve Johansen², Sigurd Domaas², Jorma Kuusela¹, Pierre Fagard³, Eirik Frøiland⁴, Morten Falkegård²

¹*Natural Resources Institute Finland (Luke)*

²*Norwegian Institute for Nature Research (NINA)*

³*Tanavassdragets Fiskeforvaltning*

⁴*County Governor of Troms and Finnmark*

Extensive and long-term Atlantic salmon monitoring programmes have been conducted in the Finnish Norwegian border rivers flowing the Barents Sea, the rivers Teno and Näätämöjoki. Recently these monitoring programmes, together with additional eDNA sampling, have enabled tracking the development in abundance and distribution of the invasive pink salmon in different parts of the watersheds.

Pink salmon have been observed in both river systems in low numbers for decades. In 2017 their numbers suddenly increased compared to earlier years and an increasing trend in odd-year population continued until 2023. In the Teno system, pink salmon numbers reached roughly 200 000, and in the River Näätämöjoki, at least 20 000 individuals in 2023. In both rivers pink salmon numbers, however, decreased considerably in 2025. Even-year pink salmon are annually observed in both rivers, but in very low quantities so far.

In addition to the increasing trend in abundance also the distribution area has clearly expanded in the Teno system since 2017. The species is currently observed in the Teno main stem and in most of the tributaries except some smaller ones. The main spawning areas, however, seem still to be concentrated in the Teno main stem and one large headwater tributary, the River Inarijoki. In the River Näätämöjoki a waterfall together with removal efforts in the fishway have restricted pink salmon distribution mainly to the lower 10 km of the river.

4. Situation in Ireland

Michael Millane, michael.millane@fisheriesireland.ie
Inland Fisheries Ireland

Pink salmon were first recorded in Ireland in August 1973 in the River Moy when a single specimen was caught by an angler. Until 2017, pink salmon have been rarely observed in Irish waters. Between 2017 to 2021, pink salmon were recorded in unprecedented numbers in odd years (2017, n=36; 2019, n=11; 2021, n=45; 2023, n=1; and 2025, n=1) in a number of river systems throughout Ireland. In 2025 to date, only a single pink salmon has been recorded in Ireland, in the River Moy.

Since 2017, in advance of the main fishing season in odd years, anglers have been requested by the competent State Authority, Inland Fisheries Ireland (IFI) to report observations and catches of pink salmon in Irish river systems to assist with monitoring of the occurrence and distribution of the species and enable the collection of specimens for verification and examination. Overall, the level of impact is likely to be predicated on the extent of establishment and local abundance of pink salmon in Ireland. If pink salmon become a regular feature in Irish rivers, better understanding of their lifecycle will be required to evaluate their potential for long-term establishment and concomitant impacts.

Inland Fisheries Ireland is currently involved in a number of pink salmon related projects. This includes the PinkSIES project which aims to assess potential impacts on native salmonids both at sea and in recently invaded rivers throughout the North-east Atlantic. In addition, in 2023, IFI initiated an eDNA surveillance project for pink salmon in Irish rivers which continued in 2025. The latter is part of the EU-funded PINKTRACK project evaluating eDNA approaches to detect pink salmon as part of an EU network for monitoring.

5. Situation in Scotland

Professor Colin Bean, colin.bean@glasgow.ac.uk
University of Glasgow, Institute of Biodiversity, One Health & Veterinary Medicine

Pink salmon were first recorded in the UK in 1960, and in the 56 years which followed that initial capture, only 16 more were ever recorded. In 2017, due to unknown factors but probably linked to climate change, Pink salmon, originating from newly established Russian populations, showed an unprecedented rise in numbers and distribution across western Europe. This initially led to fears that Pink salmon will continue to arrive in UK rivers in significant numbers but, whilst numbers have remained comparatively high, they have not yet reached the very high levels observed in those Scandinavian countries which border Russia. This talk aims to provide an update on the situation in Scotland following the summer of 2025 and provide some insight into the monitoring programme which was used to assess Pink salmon distribution there.

6. Situation in Iceland

Hlynur Bardarson, hlynur.bardarson@hafogvatn.is
Marine and Freshwater Research Institute (MFRI), Iceland

Pink salmon (*Oncorhynchus gorbuscha*) was first caught in Iceland in 1960 and has since occasionally been registered in the catch. The species richness of the Iceland freshwater fishes is relatively poor with Pink salmon being the seventh species joining the five species that are considered native (Atlantic salmon, Brown trout, Arctic charr and Three spined Sticklebacks) and Flounder which is a relatively new species in the fauna. In the past ten years the number of pink salmon in the catch has grown extensively with six being registered in 2015, followed by 79 in 2017, 251 in 2019, 339 in 2021 and 703 in 2023. The spread has been across Iceland with most rivers registering less than 10 in their catch with only a handful of rivers that are experiencing bigger runs of more than 30 fish and up to 80+ salmon. The number of rivers has grown from six in 2015 to 71 in 2023. The preliminary statistics of the pink salmon catch this summer (2025) indicates a mixed picture which indicates that some rivers have less than in the previous odd-year and that there might be a reduction in the total number between years, but this remains to be seen. In this talk we will give an overview of the status of pink salmon in Iceland; the efforts being made to mitigate this alien species and the newest research project.

7. Pink salmon in Sweden, Nordic collaborations, and the NASCO pink salmon special session.

Tom Staveley, tom.staveley@slu.se

Swedish University of Agricultural Sciences

In Sweden, pink salmon populations remain low relative to Norway and Finland. However, this early stage of invasion presents a critical window for proactive detection and management before large-scale establishment occurs. Here, we present results from environmental DNA (eDNA) methodologies to detect both juvenile and adult individuals in river systems. These approaches have revealed previously undocumented occurrences and likely establishment, suggesting that pink salmon are on the verge of colonising the Baltic Sea. Although no verified records exist from the Baltic Sea over the past four decades, we discuss potential ecological implications based on ecosystem modelling and ongoing surveillance efforts.

Aiming to understand the status and future perspectives of pink salmon across the Nordic region, we established a network of researchers from all the Nordic countries. During online and in-person workshops in 2024, we addressed the following: (i) report the distribution, abundance and spread of pink salmon in the Nordic countries of Norway, Denmark, Iceland, the Faroe Islands, Finland, Greenland and Sweden; (ii) map the knowledge status of pink salmon in the Nordic countries; and (iii) assess the current pink salmon monitoring, management and awareness in the Nordic countries. Together, this has given a thorough insight into the current knowledge and research needs for future science and management strategies relating to pink salmon in this region.

The North Atlantic Salmon Conservation Organization (NASCO) is a Regional Fisheries Management Organization focused on conserving and managing Atlantic salmon through international cooperation. In 2024, NASCO held a Theme-based Special Session (TBSS) on pink salmon to provide an overview of its distribution, biology, impacts on native Atlantic salmon, and management actions in the North Atlantic. The session addressed four objectives: (1) describing pink salmon's natural distribution and range expansion; (2) reviewing interactions and disease transfer risks with Atlantic salmon; (3) assessing management strategies; (4) and introducing NASCO's new Working Group on Pink Salmon. The newly formed NASCO Working Group on Pink Salmon aims to improve information exchange, identify knowledge gaps, and promote best practices to mitigate pink salmon's impact on wild Atlantic salmon populations.

Session 2: Traps and fences and their effect on native salmonids

8. Evaluation of the traps in the removal fishery for pink salmon in Norway in 2023: Catch of pink salmon and effects on native salmonids.

*Henrik Berntsen, henrik.berntsen@nina.no
Norwegian Institute for Nature Research (NINA)*

A trap constitutes a physical barrier that may restrict the movement or alter the timing of upstream migration for native salmonids, and it also has the potential to cause injuries. For a removal fishery using traps to be effective, it must therefore prevent as many pink salmon as possible from entering the rivers (and thus from spawning), while at the same time allowing native salmonids to pass unharmed and with minimal disruption to their natural behaviour.

In 2023, fish traps were installed in 51 rivers across Finnmark, Troms, and Nordland. Most traps were operated during periods when pink salmon were expected to be present. The majority of traps were effective in stopping pink salmon from migrating upstream, where some prevented as much as 90% of the incoming fish.

Only minor injuries or mortality were observed among native salmonids, either from contact with the traps or from handling during trap operations. However, little is known about potential delayed effects of handling.

Drift counts conducted during trap operation revealed that not all traps successfully prevented pink salmon passage. In most such cases, the reason was flood damage that rendered traps non-functional or delayed deployment late in the season.

Additional surveys conducted in Kongsfjordelva and Vestre Jakobselv found no strong evidence that the traps affected Atlantic salmon, either in terms of the spatial distribution of spawners in the river or in reaching spawning targets. However, in Kongsfjordelva, there were indications of temporary crowding effects, as Atlantic salmon appeared to experience delays in passing the trap when large numbers of pink salmon were present in or below the trap. In both rivers, the number of returning Atlantic salmon in 2023 was low, but this was unlikely to be caused by the presence of traps.

For traps to be effective in controlling pink salmon, they must be deployed and operated throughout the entire migration period, as timing is crucial to their success. To maximize interception, traps should be positioned as close to the river mouth as possible, preventing pink salmon from entering the river system and reaching spawning grounds. Furthermore, comprehensive surveys employing multiple methods, and conducted over several years both with and without traps, are essential to evaluate potential negative effects of trap use on the behaviour of native salmonids.

9. Pink salmon invasion; feeding ecology, species interspecies interactions and fish trap interactions in juvenile salmonids.

*Karl Øystein Gjelland, karl.gjelland@nina.no
Norwegian Institute for Nature Research (NINA)*

This presentation has two parts; the first considering juvenile pink salmon ecology in northern Norway, the second considering seaward migration in Atlantic salmon juveniles and interactions with a fence associated with the fish trap in the Tana river.

Part 1: The feeding ecology of pink salmon juveniles in northern Norwegian rivers and their role as prey to native salmonids

Authors: Katherine Dunlop, Antti P. Eloranta, Karl Ø. Gjelland, Sigurd Slåteng, Jenny Jensen, Rune Knudsen, Mikko Kiljunen, Hallvard Jensen, Martin Svenning, Vegar Seljestokken, Rune Muladal, André Frainer

During spring and early summer 2022, ten rivers in northern Norway were sampled for juvenile pink salmon. A few of these rivers were sampled twice. The pink salmon developmental stage supported predictions from fry emergence time modelling based on river temperature and spawning in mid-August. Predicted fry emergence timing corresponded with the rise of water temperatures in spring. Nearly all salmon fry containing visible yolk sac remnants had empty stomachs, whereas the percentage of fry with stomach content increased with increasing size for individuals without yolk sac remnants. This pattern was accompanied by decreasing $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values with increasing body length, indicating an ontogenetic niche shift from marine to freshwater energy resources. Chironomids constituted approximately 60% of the diet, the remaining diet parts mostly other insect groups. Individuals feeding on pink salmon fry were observed both among sampled juvenile Atlantic salmon and brown trout. Our results shows that pink salmon may survive and be ready for smolt migration in a wide range of northern Norway rivers, that pink salmon juveniles are potential competitors for food, as well that pink salmon may be potential prey items for native salmonids. The strength of these interactions will follow the amount of pink salmon juveniles that remain in the river to start feeding, which largely depends on the pink salmon smolt migration timing and pattern. This is a field where we have very little knowledge and data from northern Norway.

Part 2: Tana smolt telemetry 2025

Authors: Karl Ø. Gjelland, Panu Orell, Finn Økland, Henrik Baktoft, Mikko Kytökorpi, Sigurd Domaas, Narve Johansen, Riina Huusko, Nicolas Pohjanheimo, Jaakko Erkinaro

The stock size of Atlantic salmon populations in the Tana watercourse has been deteriorating in recent years, accompanied by a concern for the survival of juvenile Atlantic smolts during the seaward migration. Observations of smolts hesitating to pass the fences associated with the fish trap during the pink salmon invasion in 2023 further increased this concern. Here, we report from a study addressing the smolt migration and losses from Utsjok to the sea during the smolt run in 2025, using acoustic telemetry. During 26th June till 4th July, at the time when the fences at the fish trap at Seida were finished, 195 Atlantic smolts were tagged and released in batches of 45-50 smolts at the outlet of the Utsjok tributary to river Tana. The smolts were tracked at three fixed double receiver lines between Utsjok and Seida and one double receiver line (Rustefielbma) downstream to Seida. At Seida, the smolts were tracked by a double receiver line on the upstream side of the fence, as well as a double receiver line on the downstream side of the fence. In addition, two paddling surveys were performed over the migration distance, to look for locations of tags that did not arrive at Seida and Rustefielbma.

The preliminary results indicated large losses all the way from Utsjok to the sea. During the manual tracking surveys, the signals from predation sensors (50% of tags were equipped with such) indicated that at least 40% of the smolts that halted migration was lost to predation. At the trap site, median smolt retention time at the fence was 1 h 39 mins (range 16 mins – 31 days), 25 % of the smolts were held back more than 3 h 10 mins. Analyses of the two-dimensional swimming trajectories of the tagged smolts revealed that smolt tended to swim along the fence instead of passing directly through between the fence bars. The fence appeared to cause an additional 12-25 % loss in addition to the overall migration losses. We did not find any clear effect of smolt size nor smolt index on the probability of migration success. We emphasise that the results presented here are preliminary, but that the pattern of large losses during smolt migration in Tana is real and needs further attention.

10. Traps and fences, handling and nets: What are the effects on native salmonids?

Jenny Jenssen, jen@akvaplan.niva.no
Akvaplan-niva AS, Norway

The findings are part of the BLUSH project funded by FHF, led by Stein Harris Olsen at Nofima, and results are preliminary as they were collected just before the seminar. Detailed statistical analyses were not performed. The upstream migratory behaviour and arrival time on spawning grounds of 21 Atlantic salmon (*Salmo salar*) caught in a drag net was compared to the behaviour of 38 salmon caught in a wire trap, with the purpose of documenting if handling of native fish during the national large-scale pink salmon (*Oncorhynchus gorbuscha*) removal efforts affects their behaviour. The fish caught in the net was handled and injured to a larger extent than fish caught in the trap. Acoustic telemetry was used for the studies, which were conducted in Vesterelva in the innermost part of the Varangerfjorden in eastern Finnmark. The fishes were tagged over a three-day period, and the fish caught in the net had to pass the trap before reaching pure riverine habitats.

The upstream migration of the fish caught in the net was 9-12 days later than the trapped fish on the first 9 km of river. The reasons for this may be delay passing the trap, acclimation to freshwater in the estuarine habitat or effects from handling. There is a fish ladder located ca. 9 km upstream from the sea that was not functioning until 3-4 weeks after tagging, meaning that the study had a small reset in this area since all fish had to wait. After repairs of the ladder, the fish tagged in the net was 3-9 days delayed compared to fish from the trap. They were also registered to arrive 2-3 weeks later at known spawning grounds compared to fish from the trap. Fortunately, they were registered together with fish from the trap on known spawning grounds during the spawning period with seemingly normal behaviour.

The data from the project needs further statistical analyses and the sample sizes are quite low, However, the findings strongly indicate that the relationship between fish handling and behaviour/reproductive success should be studied further. The national effort to remove pink salmon will most likely continue on a large scale and in larger parts of Norway in the years to come, and more detailed knowledge on the cost of removal for our native salmonids should be collected.

11. Status of development of automatic sorting of fish by the use of AI.

Jan Grimsrud Davidsen, jan.davidsen@ntnu.no

Norwegian University of Science and Technology/ NTNU University Museum

Jan Grimsrud Davidsen, jan.davidsen@ntnu.no NTNU University Museum

Vidar Hellum, vidar.hellum@uia.no University of Agder

Kjell Gunnar Robbersmyr kjell.g.robbersmyr@uia.no University of Agder

Mette Mo Jakobsen mette.mo.jakobsen@uia.no/ mette.m.jakobsen@hiof.no University of Agder/Østfold University College

Aslak Darre Sjursen, aslak.sjursen@ntnu.no NTNU University museum

Eirik Frøiland, eirik.froiland@statsforvalteren.no County Governor of Troms and Finnmark

Erik Drivdal, erik.drivdal@statsforvalteren.no The Shared Services of the County Governor

In 2023, the Shared Services of the County Governor initiated a Research Council of Norway (RCN) project aimed at the pre-commercial procurement of automated sorting traps for pink salmon (*Oncorhynchus gorbuscha*). Project partners include the County Governors of Finnmark and Troms, the Norwegian Environment Agency, the NTNU University Museum, and the University of Agder.

The objective of the project is to support commercial enterprises in developing sorting systems capable of automatically identifying and removing pink salmon during their upstream migration in rivers.

During the first phase of the project, six distinct concepts were evaluated. Four of these advanced to phase two and received funding to further develop their proposals. Following a subsequent evaluation in autumn 2024, one concept was excluded, while the remaining three were granted additional funding to refine and test their prototypes in river environments during the summer of 2025.

The three remaining concepts share a common approach: identification of pink salmon through automated image recognition powered by artificial intelligence (AI), combined with a capture system involving a guiding fence that directs fish into a tunnel. Within the tunnel, all migrating fish are filmed and identified to species level. Native species are allowed to pass freely, while a gate system diverts pink salmon into a holding cage. Although the three concepts are based on the same fundamental idea, they differ in their technical implementations, and the image recognition algorithms vary in terms of maturity and sophistication.

The prototypes were tested between August and September 2025 in Skallelva, Vestre Jakobselv, and Repparfjordelva, respectively. Evaluation of the prototypes is currently underway, with final conclusions and recommendations expected in spring 2026.

Session 3: Measures to control the invasion of pink salmon

12. Preliminary evaluation of the fish trap in Tana River 2025.

*Sturla Brørs, sturla.brors@miljodir.no, and Roy Malvin Langåker
Norwegian Environment Agency*

*Roar Sandodden¹, roar.sandodden@vetinst.no
Norwegian Veterinary Institute*

Roar Sandodden¹, Pål Adolfsen¹, Rune Pedersen, Roy Langåker² and Sturla Brørs².

¹ Norwegian Veterinary Institute.

² Norwegian Environment Agency.

Removing pink salmon from River Tana 2025.

This presentation describes the main measure taken to remove pink salmon from the Tana River in 2025. Due to a late spring flood and some delays in equipment deliveries, the project was somewhat delayed. Once the barrier was sealed and the traps were installed at Seida, about 4 km downstream Tana bru, the capture worked very well. In total, 28,000 pink salmon were harvested and utilized for human consumption. Special attention was given to ensuring good fish welfare in all parts of the work and to secure that native fish was able to pass up- and downstream the weir. Furthermore, we point out possible improvements for similar future concepts for catching pink salmon in River Tana. The experiences and knowledge from Tana are useful when planning and implementing measures in other large rivers.

Besides the technical solution, management steps have been implemented to anchor the project bilaterally, both at the national, regional and local level. A coordination group was established in winter/spring 2023, with the participation of national, regional and local authorities, as well as fishing right holders in both Norway and Finland. The aim of the group has been to inform about the measures, and to discuss technical solutions and management actions, to achieve as good anchoring of measures as possible. From late 2024 there has also been a tight cooperation between Norwegian and Finnish authorities and researchers to jointly prepare an action plan with pre-agreed action rules that should be implemented at certain risk scenarios, and eventually trigger measures like improvements or make opening(s) in the trap to ensure native fish migration and/or reduce the risk of damage to local fish stocks. There were arranged weekly digital meetings between Norwegian and Finnish authorities during the summer for status updates and to assess whether certain scenarios were present, and so to implement eventual action rules.

A comprehensive system of operational support and monitoring activities was implemented at the project. Sonars, drones, snorkelling and video systems were tested and used by the trap, making it possible to follow fish numbers and behaviour very thoroughly. Furthermore, researchers from Norway and Finland collaborated on a Atlantic salmon smolt telemetry project, studying migration patterns, predation and behaviour of tagged smolts at the outlet of tributary Utsjoki, all their way down to the River Tana mouth and especially the behaviour near the barrier fence.

13. Pink salmon invasion in River Teno 2025: A Finnish perspective

Tapio Hakaste, tapio.hakaste@gov.fi

Ministry of Agriculture and Forestry Finland

On the Finnish side of the River Teno/Tana, pink salmon fishing in 2025 was carried out through 16 organized projects. Fishers employed drift nets, standing nets, and rod fishing, with careful planning to minimize by-catch of Atlantic salmon. Traditional knowledge guided the selection of suitable fishing locations and times. In total, 2,049 pink salmon were caught, while 73 Atlantic salmon were released. Low water levels at the end of July posed challenges, as shallow areas—typically chosen to avoid Atlantic salmon—became too shallow for the gear used. Some projects were advised to relocate or halt operations due to increased Atlantic salmon by-catch.

Cross-border cooperation between Finland and Norway focused on the Norwegian Teno pink salmon weir. Efforts included developing pre-agreed measures for different risk scenarios and conducting research on Atlantic salmon migration patterns at the weir. Weekly meetings between administrative bodies improved situational awareness and operational efficiency compared to 2023, enhancing information flow. However, timely updates did not easily reach local fishers.

Pink salmon has attracted significant public and fisher interest. Many fishers were curious to catch pink salmon at least once and explore its taste and appearance. Stakeholder views varied: while Atlantic salmon fishing has been prohibited for several years and strong eradication measures for pink salmon are in place, commercial use of pink salmon is gaining attention—though the true costs of harvesting remain unclear. The border river context adds complexity, with stricter permit requirements for small versus large projects.

Looking ahead, greater emphasis on stakeholder engagement and public participation is needed. Although pink salmon fishing measures were included in the Teno fishing rules, the process lacked meaningful involvement, and the tight 2025 timetable limited participation. Overly restrictive regulations may have contributed to pink salmon being perceived less as an invasive species and more as a “forbidden fruit.” Applying an international Environmental Impact Assessment (EIA) process under the Espoo Convention could broaden participation and strengthen local commitment.

14. Measures to control pink salmon in Northern Norway – 2025.

*Eirik Frøiland, eirik.froiland@miljodir.no
Norwegian Environment Agency*

*Camilla Lehne, camilla.lehne@statsforvalteren.no and Sonja Kimo-Halvari,
sonja.pedersen@statsforvalteren.no. County Governor of Troms and Finnmark*

The Norwegian strategy for control of pink salmon is the same as in 2023, and the main measure is to fence off as many of the salmon rivers as possible with different types of temporary weirs. All ascending fish is led into a trap box where local associations are hired to sort the fish by species. Native fish are released upstream while pink salmon are removed. Compared with 2023, the number of rivers with state funded measures have been doubled. There are also improvements on the equipment, based on findings in the evaluation process after 2023, targeting observed problems with maintaining physical integrity of the weirs and animal welfare issues.

Norway has spent around NOK 73 million on measures against pink salmon in 2025. The measures in Troms and Finnmark included 41 picket weirs, 6 resistance board weirs and 33 other measures. The total catch is approximately 160 000 individuals of pink salmon, and 44 000 individuals of native fish (salmon, sea run brown trout and arctic char) was released.

Preliminary results indicate that progress has been made in the largest river, where the success rate was the lowest in 2023. More efficient weirs were built in rivers Tana and Reisa, but in both cases the installation must be finished earlier in the season to stop most of the pink salmon. In river Alta there is still no functional weir, and in Målselv the pink salmon is removed in the fish ladder but can spawn downstream. Problems with late and long-lasting spring flood seems to be a general explanation for low success rate in 2025, especially in Troms County. In the eastern part of the operation area, especially the Varanger region, the high efficiency of the traps seen in 2023 was maintained in 2025 with few exceptions. In this area there was also a marked decrease in the number of pink salmon, whilst there seem to be a substantial increase in Troms County.

Reports from each individual river is expected within 1st of November. A national expert group for measures against pink salmon will write an evaluation report of all measures with advice for improvements to the Norwegian Environment Agency.

Session 4: Perspectives from North Pacific Ocean

15. Overview of pink salmon effects on North Pacific ecosystems: implications for Northern Europe.

Gregory T Ruggerone, GRuggerone@nrccorp.com
Natural Resources Consultants

For the past 25 years we have used the unique and extreme biennial pattern of pink salmon abundance in marine and freshwater habitats to test for their interactions with other species of Pacific salmon and other marine species. This approach is robust because oceanographic conditions and other potential drivers are not known to vary biennially. Additionally, numbers of pink salmon returning from the North Pacific Ocean in odd years have quadrupled since the early 1970s in response to ocean heating, leading to record-high annual abundances in 2021 and 2023 (~800 million adult pink salmon each year). Evidence indicates that predation by maturing pink salmon in odd years can initiate a trophic cascade in the North Pacific by reducing herbivorous zooplankton abundance sufficiently that phytoplankton densities increase, with opposite patterns in even years. Widespread interspecific competition for common-pool prey resources can be dominated by pink salmon, as indicated by numerous and typically consistent biennial patterns in the diet, growth, survival, abundance, age-at-maturation, distribution, and/or phenology of forage fishes (4 species), squid, Pacific salmon (5 species) and steelhead trout, seabirds (11 species), and the critically-endangered Southern Resident Killer Whale. In aggregate, the evidence from approximately 100 peer-reviewed publications indicates that open-ocean marine carrying capacity in the northern North Pacific Ocean and Bering Sea can be mediated by top-down forcing by pink salmon. Evidence also indicates pink salmon in freshwater and nearshore marine habitats may benefit other species (e.g., marine derived nutrients and prey as fry), but new evidence shows that abundant adult pink salmon on the spawning grounds can disrupt redds and the spawning distribution of Chinook salmon, leading to reduced reproductive success and lower odd-year adult abundances of this iconic and threatened salmon species. In turn, this interaction appears to have contributed to biennial patterns (body condition, mortality, and births) observed in the Southern Resident Killer Whale population that targets these Chinook salmon for prey. In conclusion, we encourage northern European scientists and managers to search for biennial patterns in Atlantic salmon and other species that might interact with the increasingly abundant and invasive pink salmon, especially in freshwater habitats where adverse interactions might begin at much lower abundances of pink salmon than in the open ocean.

Ruggerone, G.T., A. Springer, G.B. van Vliet, B. Connors, J.R. Irvine, L.D. Shaul, M.R. Sloat, and W.I. Atlas. 2023. From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems. *Marine Ecology Progress Series* 719:1-40. <https://www.int-res.com/abstracts/meps/v719/p1-40/>

Ruggerone, G.T., L. Lowe, K. Binkley, and A. McDonnell. 2025. Long-term biennial patterns in Puget Sound Chinook salmon and Southern Resident killer whales: the role of pink salmon and implications for ecosystem management. *Canadian Journal of Fisheries and Aquatic Sciences*. 82: 1-16. <https://doi.org/10.1139/cjfas-2024-0262>

Session 5: The impacts of pink salmon on native species and ecosystems

16. Dinner is served: decomposition and release of nutrients from decaying pink salmon carcasses.

Aino Erkinaro, aino.erkinaro@oulu.fi
University of Oulu, Finland

Aino Erkinaro¹, Hannu Marttila², Sami Kivelä¹, Timo Muotka³, Kaisa-Leena Huttunen^{1,4}

¹ Ecology and Genetics Research Unit, University of Oulu, Finland

² Water, Energy and Environmental Engineering Research Unit, University of Oulu, Finland

³ Oulanka Research Station, University of Oulu, Finland

⁴ Nature Solutions Unit, Finnish Environment Institute, Finland

Pink salmon (*Oncorhynchus gorbuscha*), an alien species in northern Europe, has over the past few years experienced dramatic growth in numbers and in distribution. The 2-year lifecycle of pink salmon ends in mass death of all spawning individuals. Nutrients and other resources provided by decaying pink salmon carcasses are expected to have various direct and indirect ecological effects in its non-native distribution area. So far, little is known about the rate of carcass decomposition in northern Europe, and consequent release, concentrations, and storage of nutrients, all partly affected by decomposer community compositions. In 2023 we monitored pink salmon carcass decomposition and nutrient release for 9 weeks in six Barents Sea catchment rivers in an experimental set-up mimicking hotspots of carcass accumulation sites. While pink salmon carcasses on shore disappeared in a few days, carcasses in stream were decomposed notably slowly, still present and releasing nutrients even after 9 weeks. Decomposing carcasses had no significant effects on water chemistry in free-flowing stream water compared to control areas. However, in hyporheic zone water, nutrients accumulated into the sediment in considerable amounts, and, on average, we observed 18 times higher nitrogen and 25 times higher phosphorous values in carcass compared to control areas, although there was high among- and within-sites variation. Biofilm bacterial community composition changed throughout the decomposition process from mostly aerobic to mostly anaerobic communities, indicating a formation of a local oxygen depletion around the carcasses. These results indicate that pink salmon carcasses have potential to affect nutrient availability and benthic communities in invaded areas, but the effects may be habitat specific.

17. Water quality monitoring and interactions between pink salmon and freshwater pearl mussels.

Runar Kjær, runar.kjaer@nibio.no and David Kniha, david.kniha@nibio.no

*Hallvard Jensen (hallvard.jensen@nibio.no) and Paul Eric Aspholm
Norwegian Institute of Bioeconomy Research, Svanhovd*

The freshwater pearl mussel (*M. margaritifera*) in Grense Jakobselv represents Norway's easternmost population and are restricted to a very small part of the watercourse. No traps or other efforts for removal of pink salmon are being implemented in the watercourse because of the Russian situation. We assumed that the freshwater pearl mussel population could be threatened by the pink salmon directly through digging in the colonies for spawning, and more indirectly as the pink salmon may negatively affects the Atlantic salmon, which serves as the host fish for the mussel's parasitic stage. In 2021, we observed for the first time several pink salmon spawners in the upper parts of the habitat for the mussel population, and this continued with repeated intensity in 2023 and 2025. In the lower part of the study site, increasing number of pink salmon redds were observed for the 2023 and 2025. Notably, we observed and overall reduction in the mussel population size in 2025 (n=524) compared to 2021 and 2023 (n=633 and 657, respectively). The lowering number of mussels was mostly found in the downstream part of the study site, corresponding with increasing spawning activity of pink salmon these years. The upper part of the mussel habitat covers less suitable spawning areas (i.e. large stones and some bedrocks) for the pink salmon and considered as a small refuge area for the mussels. We described the population of freshwater pearl mussel as critically endangered in Grense Jakobselv, and further research and monitoring should be used as a basis for sustainable management.

There is an ongoing debate about the extent to which decomposing carcasses of invasive pink salmon (*Oncorhynchus gorbuscha*) affect water quality in northern rivers. As fish decompose, nutrients and bacteria are released to the surrounding water, potentially altering riverine biogeochemistry. Since 2021, we have sampled water from five rivers across a broad temporal and spatial scale—Grense Jakobselv, Karpelv, Munkelv, Neiden, and Tana. Sampling has been conducted monthly during the open-water season, and biweekly from the onset of pink salmon migration. Water samples are analyzed for nutrients, bacteria, and heavy metals (including phosphate, ammonium, organic carbon etc), as well as chemical and biological oxygen demand, and more.

Preliminary results indicate differences in nutrient and organic matter levels between odd and even years, corresponding to the presence and absence of pink salmon. Further analyses will examine the influence of precipitation, discharge, and temperature to assess how large inputs of decomposing fish may affect nutrient dynamics and overall water quality in Arctic river ecosystems.

18. Metabolic shift and migration patterns in juvenile pink salmon in the River Teno/Tana.

Jaakko Erkinaro, jaakko.erkinaro@luke.fi
Natural Resources Institute Finland (Luke)

Jaakko Erkinaro¹, Nicolas Pohjanheimo¹, Panu Orell¹, Mikko Kytökorpi¹, Linus Lähteenmäki², Aino Erkinaro³, Michael Power⁴

¹*Natural Resources Institute Finland (Luke)*

²*Åbo Akademi University, Finland*

³*University of Oulu, Finland*

⁴*University of Waterloo, Canada*

Since the recent, rapid increase in pink salmon populations in the Barents Sea area, two spawning years (2021, 2023) have resulted in significant production of juvenile pink salmon in the large River Teno/Tana catchment in northernmost Finland and Norway. In 2022, juvenile pink salmon were sampled on few occasions between April and June by digging the spawning redds and electrofishing in the river, and with a beach seine in the estuary of the Teno river. In 2024, more systematic sampling of migrating juveniles was carried out by fyke nets, both in the Teno main stem and in a major tributary, the Utsjoki river, and also with a beach seine in the estuary. Pink salmon juveniles migrated between early May and early to mid-June with peaks in mid- and late May and June varying between areas. Migration activity was significantly affected by peaks in discharge. Furthermore, activity peaked at cold temperatures and decreased with increasing temperatures.

Juvenile pink salmon showed active feeding behaviour in the river with increasing stomach fullness index and proportions of feeding juveniles towards later migration period (0-30% in early mid-May; 50-100% in late May-June). The most important prey items were larval stages of Diptera, Ephemeroptera and Plecoptera. Pink salmon showed somewhat more specialized prey selection compared to juvenile Atlantic salmon of similar size sampled correspondingly in spring and early summer.

In addition to data on feeding and prey use, stable isotope analysis ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$) indicated a metabolic shift from parental marine feeding to active freshwater feeding by juveniles. The ratio of freshwater sourced nutrients increased with fish length; individuals > c. 38 mm in length showing full reliance on external nutrients. Juvenile pink salmon showing strong reliance on freshwater reliance had significantly similar isotopic space with juveniles of native Atlantic salmon and also to lesser extent with juvenile brown trout.

A methodological comparison examining the effects of preservation methods (ethanol and freeze-drying) on the stable isotope values of juvenile pink salmon samples revealed shifts in the $\delta^{13}\text{C}$ value but not the $\delta^{15}\text{N}$ value. Shifts in $\delta^{13}\text{C}$ have the potential to compromise understanding of resource use and estimation of the competitive risks posed by juvenile pink salmon to native juvenile salmonids. Accurate conversion equations should be developed for all populations being studied.

19. Occurrence and distribution of pink salmon (*Oncorhynchus gorbuscha*) spawning in selected rivers in eastern Finnmark.

Felix Bolle, felix.bolle98@yahoo.no

MSc at University of South-Eastern Norway/ USN

This project mapped the occurrence and distribution of pink salmon (*Oncorhynchus gorbuscha*) spawning in selected rivers of eastern Finnmark. Drone surveys were used to detect and geolocate redds. In Kongsfjordelva and Storelva, in-water verification by snorkeling/diving was also conducted, along with targeted excavation of selected redds to confirm roe. Kongsfjordelva showed extensive spawning below the trap (~25 redds), including four in the tidal zone; two excavations confirmed eggs. Additional redd excavations are planned for October and, if possible, in spring. Syltefjordelva had two redds below the trap while substantial numbers of fish were removed by netting. In Storelva (Berlevåg), three redds were observed; excavation was attempted but failed due to high discharge. Vesterdalselva had no redds observed and largely unsuitable habitat below the trap, where Julelva had no observed redds but some locally suitable patches. In an untrapped system, Østre Risfjord, both Atlantic salmon and pink salmon were observed; 11 redds and one larger spawning area were mapped (likely >11 in total). In the rest of the untrapped systems, Skånsvika, Løkvika, Sandfjorden, and Vestre Risfjord, no pink salmon or spawning was detected.

The findings confirm that pink salmon are successfully establishing spawning sites in several rivers in eastern Finnmark, with Kongsfjordelva and Østre Risfjord being the most significant. Spawning was also documented in tidal zones, highlighting the species' adaptability. Continued monitoring is needed to evaluate population dynamics and potential ecological impacts in the region.

20. The invasion of the pink salmon (*Oncorhynchus gorbuscha*) in the North Atlantic/Arctic region.

Michał E. Skóra, m.skora@qmul.ac.uk / michal.skora@ug.edu.pl

Queen Mary University of London, School of Biological and Behaviour Sciences/ University of Gdańsk,
Faculty of Oceanography and Geography

Michał E. Skóra, J. Iwan Jones, Jaakko Erkinaro, Guðni Guðbergsson, Rasmus B. Lauridsen, Rasmus
Nygaard, Sean Robertson, Jamie Urquhart, Alan F. Youngson, Gordon H. Copp

Pink salmon have been recorded sporadically around the North Atlantic since initial attempts to stock the species in tributaries of the White Sea in the late 1950s. Yet it wasn't until 2017 that numerous intrusions of pink salmon spawners into North Atlantic rivers were observed. Since then, a continuous increase in odd-year populations of pink salmon in the North Atlantic has been recorded. In 2017, spawning of pink salmon was observed in Scottish rivers, and spent fish were also reported in Iceland. However, it was not known if these spawnings, outside the core area of invasion, were successful. Given the scale of the expansion of pink salmon, it is important to understand where they can successfully complete the freshwater phase of their life cycle. Hence, we decided to take a closer look at potential spawning sites and to compare juveniles caught at different latitudes.

The outcomes of our PinkSIES project provided evidence that pink salmon juveniles successfully complete their life cycle in Scottish rivers. We recorded their descent to the sea in mid-March 2022. Another survey was undertaken to capture pink salmon smolts in Iceland, and our fishing confirmed a mass migration in mid-May 2022. In 2024, under another project – Establishing the extent of the pink salmon (*Oncorhynchus gorbuscha*) invasion of the Arctic – we tested the nets previously employed in Scotland and Iceland in new locations in Finland, Iceland, Greenland, and Svalbard. The results of net testing in different locations were presented, highlighting the main problems encountered during their deployment, such as damage caused by polar bears in Svalbard. Observations on differences in the fork length and $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ content of pink salmon juveniles were also provided.

The forthcoming months will provide further investigation into the pink salmon invasion. In a new project – Establishing the origin of the invasive pink salmon spawning in Icelandic rivers – we are studying whether the adult pink salmon caught in Icelandic rivers originate from Icelandic pink salmon smolts.

This study was carried out under the PinkSIES project which has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie grant agreement No 101026030 and was supported by the UK Arctic Office – Supporting Impactful UK Arctic Science Engagement 2024-2025.

Session 6: Methodologies for detecting and monitoring pink salmon

21. Genetic and geochemical tools to study the homing of invasive pink salmon.

*Sebastian Wacker, sebastian.wacker@nina.no, Malte Willmes, Henrik H. Berntsen and Sten Karlsson
Norwegian Institute for Nature Research, Trondheim, Norway.*

Understanding how Pink salmon (*Oncorhynchus gorbuscha*) is invading new rivers is a prerequisite for effective mitigation to preserve native salmonid populations. The degree of natal homing is a key factor for the spreading and establishment of populations in new rivers. Here we present a case study from northern Norway as a proof of concept of using complementary genetic and geochemical tools to quantify natal homing.

Kinship analysis of spawners collected in 2019 identified half- and full-sibling pairs within rivers at frequencies higher than expected by chance, consistent with natal homing. In parallel, strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) from otoliths of juvenile and adult Pink salmon sampled in Kongsfjordelva provided geochemical confirmation of individuals returning to their natal river. While most returning adults displayed signatures inconsistent with Kongsfjordelva, a subset matched local isotope baselines, providing evidence for homing.

Our findings provide the first direct evidence of homing behaviour in invasive Pink salmon in northern Norway and demonstrate the utility of combining kinship and geochemical approaches to disentangle the invasion dynamics of Pink salmon. Establishing a comprehensive isotopic baseline and expanding genetic sampling across rivers and cohorts will enable robust estimates of homing rates, dispersal, and straying. In addition, kinship analysis of juveniles will allow us to estimate the number of local breeders and to understand the spawning behaviour of Pink salmon.

22. eDNA monitoring of pink salmon in Norway and Europe, including molecular methods studying pink salmon infections.

Frode Fossøy, frode.fossoy@nina.no

Norwegian Institute for Nature Research (NINA)

Analyses of environmental DNA (eDNA) is a cost-efficient method for detecting rare and invasive species. In the river Tana, eDNA has been used to monitor the invasion of pink salmon (*Oncorhynchus gorbuscha*) since 2019. Currently, 24 locations representing different tributaries are sampled in both even and odd years in an attempt to assess changes in distribution and biomass of both pink and Atlantic salmon (*Salmo salar*) in the Tana watershed. The temporal variation in eDNA water concentration reflects the difference between odd and even years, and there is a clear increase in the number of locations with positive detection of pink salmon with time. For Atlantic salmon there is however little change in eDNA concentrations among years within the study period. The massive run of pink salmon in 2023 is reflected by record high levels of eDNA-concentration in the lower half of the Tana watershed. In the upper half, however, eDNA concentrations were similar to 2021. The spatial distribution of pink salmon eDNA suggests a hotspot close to the lower parts of the Anarjohka tributary, where pinks are detected every year, including even years. However, the lowermost part of Tana shows the highest concentration of pink salmon eDNA in most years. The results suggest that eDNA represents a cost-effective method which can track both the temporal and spatial variation of the pink salmon invasion.

Pink salmon can potentially represent a new vector for transfer of pathogens and infections among Atlantic salmonids. Here, we tested a new method for screening multiple infections using high-throughput qPCR based on Fluidigm chip technology. This technology allowed us to test 47 assays in 50 samples in one single run. We included gill, heart and kidney as well as scale and skin samples from both pink and Atlantic salmon. We detected 14 infective organisms where 6 were found in both species, 4 were only found in pink salmon and 4 were only found in Atlantic salmon. The results suggests that this method can detect a range of infections, and that non-invasive sampling using scales is sufficient for detecting some of the pathogens, but not all.

23. Using 3RADseq-Based Invasion Genomics to Uncover the Expansion Dynamics of Pink Salmon in Northern Norwegian Rivers.

Snorre Hagen, snorre.hagen@nibio.no

Norwegian Institute for Bioeconomy Research (NIBIO Svanhovd)

Simo N. Maduna, Paul Eric Aspholm, Runar Kjær, Cornelya F. C. Klutsch

This presentation explored how 3RADseq-based invasion genomics can illuminate the expansion dynamics of invasive pink salmon (*Oncorhynchus gorbuscha*) in northern Norwegian rivers. By integrating high-resolution genomic data with invasion ecology frameworks, the study provides new insights into dispersal pathways, adaptive genetic variation, and evolutionary mechanisms driving invasion success. The rationale for employing 3RADseq as a cost-effective and reliable SNP genotyping approach was outlined, alongside the development and implementation of a customized workflow at NIBIO Svanhovd. Analyses revealed multiple genetic clusters, clear evidence of ongoing range expansion, and the presence of first-generation migrants across distant river systems. Both homing and straying behaviours were detected, underscoring complex reproductive and dispersal dynamics. Gene flow analyses further identified key source populations disproportionately contributing to secondary expansion and colonization. The presentation concluded by emphasizing the critical role of genomic monitoring in managing biological invasions and highlighted how genomic insights can inform targeted interventions and adaptive management strategies for invasive species control.

24. Pink salmon research at IMR: Current status and future plans.

Per Gunnar Fjelldal, pergf@hi.no

Institute of Marine Research, Norway

Kjell Rong Utne¹, Katherine Dunlop¹, Lucilla Giuliatti¹, Julia Storesund¹, Lucia Drabikova¹, Thomas Fraser¹, Rosa Maria Serra Llinares¹, Rune Nilsen¹, Malthe Hvas¹, Frode Oppedal¹, Beatriz Diaz Pauli², Odd-Børre Humborstad¹, Monica Solberg¹

¹*Institute of Marine Research, Norway*

²*Fiskeridirektoratet, Norway*

Off-shore trawling catches showed higher number of post-smolt pink salmon in the Barent Sea in 2024, and lower number of adult pink salmon in the Norwegian Sea in 2025 compared to earlier years. Newly developed costal salmon trap nets tested in Finnmark in June-July 2025 trapped blemish free pink and Atlantic salmon with estimated good fish welfare. The Atlantic salmon were released back into the sea. The pink salmon were suitable for human consumption.

The results from the national surveillance program on salmon lice infections on wild salmonids NALO showed low lice numbers (salmon lice < sea lice) on pink salmon. Screening for diseases in pink salmon revealed occurrence of suspected *Kudoa thyrsites* infection (soft flesh), and vertebral deformities. Occurrence of vertebral deformities tended to decrease between the 2020, 2022 and 2024 year-classes. Meristic analysis of wild pink salmon and hatchery reared hybrids between Atlantic salmon ♀ x pink salmon ♂ showed significant lower total vertebrae numbers in the 2024 compared to the 2020 and 2022 year-classes among wild pink salmon and total vertebrae numbers that were intermediate between Atlantic and pink salmon among their hatchery reared hybrids. Applying triploidy gave a maternal dosage effect, moving total vertebrae numbers in the hybrids towards Atlantic salmon. We were not able to produce viable offspring when crossing pink salmon ♀ x Atlantic salmon / Arctic char / brown trout / rainbow trout ♂. Hatchery reared pink salmon post-smolts preferred a water temperature of 14C over 8, 11, 17 and 20C when tested in a laboratory preference chamber system.

Session 7: Pink salmon and socio-ecological studies

25. Impacts of pink salmon on the social-ecological system: Tana river community survey.

Solvår Tørres Berntsen, solvar.torres.berntsen@miljodir.no

UiT – The Arctic University of Norway

Invasive alien species are major drivers of change in social-ecological systems in the world, causing changes not only in ecosystems but also affecting human systems and ecosystem services. In recent years, the Pacific pink salmon (*Oncorhynchus gorbuscha*) have invaded Norwegian rivers in numbers of thousands, increasing the concerns among managers regarding the impact on Norwegian ecosystems and biodiversity. Pink salmon as an invasive species has the potential to cause serious changes for both people and nature within the social-ecological system. Exploring insights from the community closest to these changes is essential for a complete understanding of this footprint. This study, based on an online survey in the Tana River community in Northern Norway, has collected knowledge and opinions of people in the community regarding impacts of pink salmon in the large Tana River and pink salmon management. Using a systems thinking approach, methods of visualizing the respondents' answers in a cognitive map, and applying the concept of social-ecological systems, this work showcases nuanced concerns related to how pink salmon and pink salmon management may impact both ecosystems and human systems in the Tana River social-ecological system. The survey responses reveal concerns related to how Atlantic salmon may be negatively affected by the invasion of pink salmon, such as increased competition for resources and spawning grounds, and how this can cause cascading effect on the human systems, considering the importance of the Atlantic salmon for cultures and human well-being along the Tana River. In contrast, the results also show how the respondents think of pink salmon as a possible food source, further underscoring the multifaceted impact of this invasive species on the social ecological system. The study demonstrates how involvement of communities and system thinking can create a more holistic understanding of the complexity regarding invasive species impacting social-ecological systems. Future studies and management are therefore encouraged to engage the local communities and promote system thinking when addressing the impacts of pink salmon and pink salmon management in the Tana River and Norway in general.

Session 8: Research gaps and funding – “Menti meter session”

Moderated by Yara Nieuwenhuis

Office of the Troms and Finnmark County Governor

Most critical research gaps in pink salmon studies today?

Ecological Impacts

- **Expansion & Abundance:** Likelihood of continued spread and population growth in northern Norway.
- **Ecosystem Functioning:** Bottom-up effects on food webs, prey availability, and nutrient cycling.
- **Competition:** With native species like Atlantic salmon (*Salmo salar*) and trout, both in freshwater and marine environments.
- **Disease & Parasites:** Transmission risks to native salmonids and other fish.
- **Impact on Invertebrates:** Effects on juvenile freshwater pearl mussels and aquatic insect communities.
- **Terrestrial Effects:** Nutrient transfer from carcasses and potential changes in riparian ecosystems.

Species Interactions

- **Atlantic Salmon:** Competition in rivers, spawning interference, and habitat overlap.
- **Odd vs. Even-Year Lines:** Potential negative interactions or competition between pink salmon cohorts.
- **Homing vs. Straying:** Origins of pink salmon in Norway and factors influencing extreme straying events.
- **Impact of Removal Measures:** Effects of traps and eradication efforts on native fish communities.

Environmental Drivers

- **Temperature Effects:** Influence on egg survival, alevin development, marine survival, and spawning success.
- **Barriers:** Impact on migration and reproduction of native anadromous salmonids.

Human & Cultural Dimensions

- **Local Communities:** Effects on traditional fishing practices and ecosystem services.
- **Adaptation Strategies:** How communities can respond to pink salmon presence and ecological changes.

The biggest challenges in securing funding for pink salmon research?

Funding Gap Between Research and Management

- Research Council sees it as management; Environment Agency sees it as research → no funding from either.

Political Prioritization of Economic Value

- Pink salmon viewed as a resource, not an environmental threat.

Lack of Long-Term Commitment

- Basic ecological and genetic research underfunded; short-term management prioritized.

Government Focus on Eradication

- Most funding (e.g., fences costing 74 million NOK) goes to mitigation, not research.

Regional Bias

- Issue perceived as relevant only to northern Norway, limiting national attention.

Insufficient Collaboration and Coordination

- Need for better cooperation between research institutes and international partners.

Limited Understanding of Ecosystem Impacts

- Lack of knowledge on long-term effects and competition with native species.

Policy Misalignment

- Research Council priorities don't reflect ecological urgency; politicians underestimate research costs.

Funding Competition

- High competition among researchers; wild fish research generally underfunded.

Risk of De-prioritization

- If pink salmon numbers decline, topic may lose urgency and funding.

Three relatively recent review papers, each of them examines and lists knowledge gaps and research needs related to understanding and responding to the pink salmon (*Oncorhynchus gorbuscha*) invasion. All papers are Open Access and available via the provided links.

Lennox, R. J., Berntsen, H. H., Garseth, Å. H., Hinch, S. G., Hindar, K., Ugedal, O., Utnie, K.R., Vollset, K.W., Whoriskey, F.G. & Thorstad, E. B. 2023. Prospects for the future of pink salmon in three oceans: From the native Pacific to the novel Arctic and Atlantic. *Fish and Fisheries*, 24: 759-776. <https://doi.org/10.1111/faf.12760>

Dunmall, K.M., Bean, C.W., Berntsen, H.H., Ensing, D., Erkinaro, J., Irvine, J.R., Kendall, N.W., Kitching, T., Langan, J.A., Millane, M., Oxman, D.S., Radchenko, V.I., Thorstad, E.B. & Utne, K.R. 2025. Invading and range-expanding pink salmon inform management actions for marine species on the move. *ICES Journal of Marine Science* 82, fsae199 <https://doi.org/10.1093/icesjms/fsae199>

Staveley, T.A.B., Ahlbeck Bergendahl, I., Bårðarson, H., Berntsen, H.H., Eliassen, K. Erkinaro, J., Nygaard, R., Sivebæk, F. & Thorstad, E.B. Status and future perspectives of pink salmon in the Nordic region. *Boreal Environmental Research* 30: 149–162. <https://doi.org/10.60910/ber2025.wt02-y377>



Troms and Finnmark County Governor/
Statsforvalteren i Troms og Finnmark

Phone: +47 78 95 03 00
E-mail: sftfpost@statsforvalteren.no

Norwegian Environment Agency/
Miljødirektoratet

Phone: +47 73 58 05 00
E-mail: post@miljodir.no