PINK SALMON IN THE BARENTS REGION

International knowledge exchange seminar between experts, authorities and fishing rights owners in Norway, Russia and Finland

Abstracts and expert conclusions

PROGRAM AND AGENDA

Pink salmon in the Barents region

Time and venue: 7.-8. February NIBIO Svanhovd, Svanvik Norway

PROGRAM

Day 0. 6th February - ARRIVAL
~19:30 Arrival and accommodation at NIBIO Svanhovd in Svanvik in the evening
~20 light supper

Day 1. 7th February – MEETING DAY 1

7-8	Breakfast
8:30-12	Meeting (3,5h)
12-13	Lunch
13-18	Meeting (5h)
19	Dinner

coffee breaks, c. 10:30, 15 and 16:30.

Day 2. 8th February – MEETING DAY 2 AND DEPARTURE

7-8	Breakfast
8:30-11	Meeting (2,5h)
11	Lunch
	Departure

Meeting documentation
Abstract report including possible joint recommendations on the pink salmon

Seminar language is English
Simultaneous translations are arranged - Russian and English

Cover page photos:
Two Pink salmon caught in the river Neiden with käpälä- seine fishing method. Photo Eero Niemelä

Size of migrating pink salmon smolts in May month. Photo Alexey Veselov

Tail fin of male pink salmon male: in full spawning condition. Fish caught in gillnet in the Tana/ Teno river. Photo Eero Niemelä

Female Pink salmon caught with gill net in *Ailestrykene* in river Tana. Photo Eero Niemelä

AGENDA – 7th February – MEETING DAY 1

Chair: Ms Bente Christiansen

8:30 Welcome by Ms Bente Christiansen, Head of Dept. on Environmental Affairs, Office of the Finnmark County Governor, Norway

SESSION 1 – Pink salmon in the Barents region – biology and life history, background and history of transplantations and development in the catches in Russia, Norway and Finland

8:40-9:00 Pink salmon emerging in Norway and in Finnmark County – status for catches and need for knowledge in the management, in risk assessments and contingency planning. Mr Christer Michaelsen, Office of the Finnmark County Governor

9:00-9:45 From transplantations to establishment of self-reproducing stocks. Life history and migrations of pink salmon in North western Russia, Dr Alexey Veselov, Institute of Biology KarRC RAS

9:45-10:30 Why has the transplantations been successful in Russia? Which factors decide the success of the establishment of self-reproducing stocks, Dr Alexander Zubchenko, PINRO Murmansk

Questions and discussion

10:45-11:15 Salmon fisheries in Finnmark, Mr Steinar Christensen, Finnmark Estate (Finnmarkseiendommen/ FeFo)

11:15-12:00 Spawning stocks of native salmonids and pink salmon in rivers in Troms and Finnmark and methods for monitoring and reductions of Pink salmon, CEO Mr Rune Muladal, Naturtjenester i Nord/ BarentsBio

Questions and discussion
Lunch 12-13

13:00-13:45 Development in the Pink salmon catches in the transboundary rivers of Tana/ Teno and Neiden – in Norway/ Finland, Dr Eero Niemelä, Natural Resource Institute (Luke), Finland

SESSION 2 – Pink salmon and interactions – issues on competition, spawning success, parasites etc.

13:45-14:30 Pink salmon and interactions with endemic species – competition, epidemiology and other aspects, Dr Dimitry Kuzmin, PINRO Murmansk

14:30-15:15 The parasite fauna of pink salmon, *Oncorhynchus gorbuscha* (Walbaum, 1792), in rivers draining to the White and Barents seas, Dr Eugeny Ieshko, Institute of Biology KarRC RAS

Questions and discussion

SESSION 3 - Pink salmon research, mapping, monitoring and management etc.

15:30-16:00 Biochemical adaptations of Pink salmon and Atlantic salmon. Variation in relation to environment, Dr Svetlana Murzina Institute of Biology KarRC RAS

16:00-16:30 Metabolic changes in the early development of salmonid fish in the European North, Prof. Nina Nemova, Institute of Biology KarRC RAS

Questions and discussion

16:45-17:15 The Pink salmon invasion in Norway 2017, Senior researcher Dr Ingebrigt Uglem, Norwegian Institute for Nature Research (NINA)

17:15-17:30 Findings, observations and experiences from Western Norway in 2017, Mr Marius Kambestad, Rådgivende Biologer AS, Norway

17:30-18:00 "Russelaks" – Russian salmon, experiences from East-Finnmark rivers, Mr Rolf Sch. Kollstrøm, Sør-Varanger hunting and fishing association

Sea salmon fishing in Sør-Varanger, Ms Astrid Daniloff

18:00-18:15 Pink salmon emerging in Svalbard, Mr Guttorm Christensen, Akvaplan-niva

Questions and discussion

AGENDA - 8th February - MEETING DAY 2 AND DEPARTURE HOME

Chair: Mr Christer Michaelsen

8:30-9:15 The state of stocks and management of salmon fisheries in the North of Russia, Dr A. Zubchenko, PINRO-Murmansk

9:15-9:45 International collaborative research on Pink salmon, Research Director Dr Kjetil Hindar, Norwegian Institute for Nature research (NINA)

9:45-10:15 Future strategies and contingency planning for invasive species, Norwegian Environmental Agency/ Mr Christer Michaelsen, Office of the Finnmark County Governor

10:15-11:00 Summing up and concluding remarks

Lunch and departure
Media and interviews

PINK SALMON EMERGING IN NORWAY AND IN FINNMARK COUNTY – STATUS FOR CATCHES AND NEED FOR KNOWLEDGE IN THE MANAGEMENT, IN RISK ASSESSMENTS AND CONTINGENCY PLANNING

Christer Michaelsen, fmfichmi@fylkesmannen.no
Office of the Finnmark County Governor

Every year since early 1960's there has been observations and catches of pink salmon in Norwegian coastal waters and rivers. There are several documented instances of hatching and sea-migrating smolts of pink salmon in Finnmark rivers. In 2017 there were massive runs of pink salmon registered in Finnmark rivers and elsewhere in Norway. There is clearly a need for implementation of a monitoring and registration of pink salmon in many Norwegian rivers. There is also a need for more knowledge of negative effects on endemic fish species. We have sufficient knowledge about the prevalence and abundance of pink salmon to make a risk assessment. From the risk assessment, counter measures can be organized and executed.

From transplantations to establishment of self-reproducing stocks. Life history and migrations of pink salmon in North western Russia

POLYMORPHISM OF SMOLT OF A PINK SALMON *ONCORHYNCHUS GORBUSCHA* IN THE INDERA RIVER (KOLA PENINSULA)

Aleksey E. Veselov[1], veselov7771@mail.ru
Dmitry S. Pavlov[2]
[1]Institute of Biology Karelian research centre RAS
[2]A.N. Severtsov Institute of Ecology and Evolution RAS

The Pink Salmon appeared in the rivers of the Kola peninsula as a result of a deliberate introduction in the 1950-1960s. In the basin of the White Sea so far, the Pink Salmon developed practically all large and average salmon spawning rivers which average annual water discharge exceeds 25 m^3/s; in certain cases, she spawns in the small rivers with an expense from 7 m^3/s. Mass spawning of producers of a Pink salmon to the White Sea rivers of the Kola peninsula is noted since 2001. The amplifying spawning of Pink salmon in even years was added to mass spawning in odd years as showed our researches, since 2010.

Migration of juveniles of a Pink salmon in the rivers of the White Sea happens right after escaping of spawning nests in the second half of May at gradual temperature increase of water from 1.5 to 10.5 °C; its duration is from 4 to 22 days. On average the juveniles have length of 25-34 mm and weight of 200-250 mg. The long-term monitoring (2004–2015) monitoring of migration of juvenile of a Pink salmon executed by us in the Indera River showed that in this small White Sea river it is also observed in II–III to decade of May, and smolt have the identical sizes. However, in 2015 the second group of smolt which migrated for a month later – in II–III to decade of June was found. It demonstrates to emergence of an intra population polymorphism of smolt of a Pink salmon. The intra population polymorphism is topical issue of the modern ecological researches. It concerns also a migration polymorphism of both producers, and juveniles of fishes.

Pink salmon introduced in the White Sea in 20 years after emergence in the Indera River of the beginning spawns on average and top sections of the river. The path of migration of smolt was as a result extended and besides early smolt appeared late. The intra population polymorphism at smolt of a Pink salmon is confirmed by distinctions of early and late smolt longwise and to the body weight, migration terms, a range of a delivery and indexes of filling of stomachs. Coincidence of ranges of a delivery of late smolt of a Pink salmon to parrs of an *Salmo salar* and a *Salmo trout* is revealed. At increase in number of late migrants of a Pink salmon it can lead to the competition of types for food resources.

Researches are executed with financial support of the project of the Russian scientific fund "Interrelation of Migrations and Shaping at Juveniles of Fishes and Lampreys" (No. 14-14-01171).

WHY HAS THE TRANSPLANTATIONS BEEN SUCCESSFUL IN RUSSIA? WHICH FACTORS DECIDE THE SUCCESS OF THE ESTABLISHMENT OF SELF-REPRODUCING STOCKS

Dr Alexander Zubchenko, PINRO Murmansk

The main goal of the project of pink salmon transplantation into the water bodies of the Russian North was to create an additional base of raw materials for harvesting through the use of the White and Barents Seas food supplies and naturalization of the species in the new habitat.

The process of pink salmon transplantation into the new habitat may be divided into 2 stages. The first stage (1956-1984) was an active phase (regular import of eggs), and it did not reach the goal of naturalization of the species in the new habitat. In that period ca. 248 million eggs were brought, mostly from the southern parts of the native habitat (the Islands Sakhalin and Iturup). Late spawning periods are typical of the pink salmon populations from those areas. In the new habitat this resulted into mass death of the developing eggs because of early autumn frosts, and after 1979, without regular import of eggs, only single individuals of pink salmon occurred.

The second stage (1985 – until now) is the phase of adaptation to the new habitat conditions. In this period eggs from the Far East (Magadan Region) was brought only three times: in 1985, 1989, and 1998. Regularly pink salmon smolts were released into the rivers – the offspring of the fish coming in for spawning. The class of 1985 gave a start to the cycle of relatively massive returns of odd-year line pink salmon (in the recent years the number reached 100 thousand individuals and even more). The even-year line of pink salmon disappeared without fish-farming activities, and only after import of eggs from Magadan Region in1998, returns of even-year line fish was observed in 2000 and the following years (several hundred to 11 thousand).

According to N.V. Gordeeva's opinion (2002, 2003, 2010) based on genetic studies, the transplantation of the odd-year line from Magadan Region was more successful than transplantation of the even-year line, and the fish of the odd-year line demonstrate signs of adaptation to the new conditions.

So far it is not known how resilient the new population will be because the water temperature during the period of eggs and post-embryos development, as well as during feeding at sea is the main limiting factor of pink salmon adaptation in a new habitat. A direct correlation has been identified between the numbers of pink salmon and sea water temperature, and also the total water temperature in the rivers in September in the spawning year and in May next year after spawning. That is why talking about naturalization of the species in the new habitat would be prematurely.

Today's knowledge leaves no doubt that the decision to transplant pink salmon into the new habitat was a mistake. Also, the opinion of a number of researchers and managers who consider replacement of Atlantic salmon by pink salmon possible is not acceptable taking into account the incomparable value of these species. Currently, the only way to counteract the pink salmon expansion is to extract it by all harvesting methods.

SALMON FISHERIES IN FINNMARK

Mr Steinar Christensen, Finnmark Estate (Finnmarkseiendommen/ FeFo)

In 2006 the Finnmark Estate and FeFo was established thru the Finnmark Act. The Finnmark act is a recognition of Sami rights in Finnmark. Thru this Act the parliament transferred the state-owned land, 48 000 km^2, to the residents of Finnmark. This Finnmark Estate is managed by FeFo on behalf of the inhabitants.

FeFo is self-financed, so all operating costs must be covered by the revenues. FeFo is led by a board appointed by the Sami Parliament and Finnmark county council. The management of FeFo is divided into 3 departments: Real estates, Industry and Fish and game. The department of fish and game manage more than 50 salmon rivers, about 60 000 lakes and rivers with inland fish, more than 5500 inland fishermen, over 1 000 moos licenses and 2 000 hunters and more than 5 000 small game hunters.

The management of salmon fisheries is divided into fisheries in the sea and in the rivers. In the sea, FeFo manages over 1 600 net fishing locations and over 350 fishermen. In the rivers FeFo holds most of the fishing rights in all rivers except Neiden River, Tana river and Alta River. Most of the rivers are leased out on 10-year contracts to local associations. We have about 36 associations that manages the fishery.

Finnmark is the most important county for salmon fisheries in Norway. The total catch of salmon (Salmo salar) in Finnmark stands for approximately 1/3 of the total catch in Norway. In the rivers the catch in 2017 was 121 493 kg and a number of 29 740, in the sea it was 137 522 kg and 31 426. This is ca ¼ of the national catch in the rivers and ½ in the sea.

In Finnmark there has been a decline in the catches in the sea fisheries since year 2000. This is mostly due to regulations and a reduction in the number of fishermen but also a reduction in stock abundance especially for the Tana stock. In the rivers we do not see the same reduction.

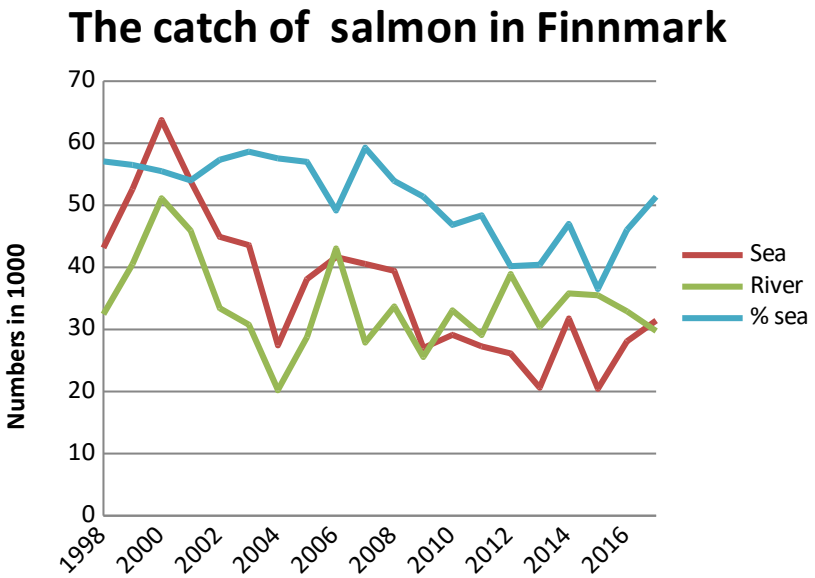

Figure 1. The number of salmon caught in the rivers and the sea in Finnmark county and the percentage caught in the sea.

Tana is by far the most important salmon river in Finnmark. Since year 2000 the catch has varied between 125 900 kg to 26 958, this year catch was 30 566 kg. This decline is

caused by overfishing. Hopefully this year's new regulations will turn the trend. In the Alta river and the Neiden River there has not been any large changes since year 2000, maybe a slight increase in the Alta river and a slight decrease in river Neiden. For most of the rivers that FeFo manages there has been a large increase in the catches since year 2000. From a combined catch of 21 571 kg in 2002 to 72 176 kg this year. This increase is due to lower fishing pressure in the rivers and the sea.

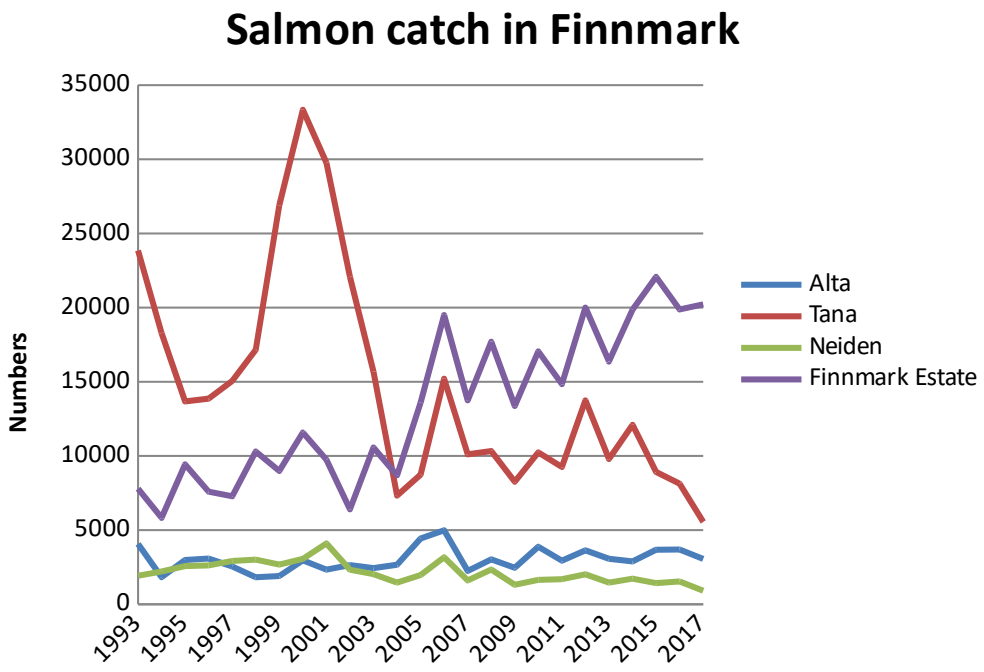

Figure 2. The numbers of salmon caught in the rivers Alta, Tana and Neiden and the combined catch for the rivers on the Finnmark Estate.

The fishing for sea trout (Salmo trutta) and seagoing arctic char (Salvelinus alpinus) is small compared with salmon. The catches of sea trout are stable and that of seagoing arctic char is declining.

THE SPAWNING STOCKS OF ANADROM SALMONIDS IN NORTHERN NORWAY WITH FOCUS ON THE PINK SALMON

CEO Mr Rune Muladal, Naturtjenester i Nord/ BarentsBio

The company Naturtjenester i Nord (Barentsbio), led by freshwater biologist Rune Muladal has systematically monitored the spawning stock of anadrom fish species in watercourses in Finnmark and Troms since 2002. In the Pasvik meeting the focus was on general results from this period 2002 - 2017 and specially the occurrence of pink salmon in the northernmost rivers of Norway. Annual 20-30 waterways are examined with snorkelling / driving counts as method. The lecture presented data from the population development in some Finnmark streams. In general, there has been pink salmon in most Finnmark streams since 2001. Especially in odd years, while also in some part-years. In the past, the years 2007, 2009, 2011, 2014 and 2015 have proved to be years with a high proportion of pink salmon on the spawning grounds in late august and September in some rivers in Finnmark.

In 2017 Finnmark and Troms were observed pink salmon in 28 of 29 investigated rivers. A total of 3500 individuals, which accounted for 46% of all salmon fish observed. And it was in many rivers several times more pink salmon than native species. In particular, this was the debt in the Varanger rivers. There is a clear tendency for the proportion and number of pink salmon to decrease from Varanger and south and west.

The record-breaking increase of pink salmon in 2017 is a result of the spawning stock in 2015. In 2015, there were relatively few spawning pink salmon in rivers of Finnmark. What is a likely scenario is that the spawning success in 2015 was very successful. This can be explained by a special long fall, and an early spring in 2016 when the smolt migrated to the sea. There has thus been a particularly good survival from the 2015 year class to return to the rivers in 2017 which resulted in a wide-scale "pink salmon invasion".

Experiences so far are that the species is highly adaptable, has potential for great propagation and can reach a high number in the rivers where it can compete with native species on spawning grounds. When environmental conditions are good, it has a huge potential for survival and for new establishments in the waterways and can quickly become the most numerous salmon in the Barents region (?).

Naturtjenester i Nord (Barentsbio) will continue the monitoring of pink salmon and the environmental factors affecting the occurrence (hatching, smolt and adults) in Barents region. Being able to anticipate the 2019 season it is now important with monitoring of the 2017 year class. In this way, we have the opportunity to predict and make forecasts with measures to be taken in 2019.

DEVELOPMENT IN THE PINK SALMON CATCHES IN THE TRANSBOUNDARY RIVERS OF TANA AND NEIDEN, IN NORWAY AND FINLAND

Dr Eero Niemelä, Esa Hassinen, Narve Johansen, Jorma Kuusela, Maija Länsman, Jari Haantie, Matti Kylmäaho/ Natural Resource Institute (Luke), Finland/ *TF, Norway*

First observations from Pink salmon in the rivers Tana and Neiden watersheds were done in late 1960s' and in early and middle 1970s' Pink salmon occurred in quite high numbers in both rivers.

During the first years of its occurrence tourist fishermen and also local fishermen did not always recognize pink salmon from small 1SW salmon (grilse) early in the summer when migratory Atlantic salmon and Pink salmon are very silvery. When the summer is turning to autumn in the end of July fishermen can identify their Pink salmon. Pink salmon population is the highest in the River Tana during the small salmon migration in the middle of July coinciding the timing of small salmon. Therefore, local fishermen using traditional fishing gears, weirs and gillnets, do not like Pink salmon in their fishing gears. Pink salmon is scaring wild salmon away from their fishing sites.

Pink salmon is distributing over the entire Tana watershed and can be find almost within the same distribution area as in Atlantic salmon, almost within 1200 kilometers in the head waters and in tributaries. Most from the catches are caught within the lowermost 150 kilometers in the River Tana mainstem. Fishermen have caught Pink salmon almost in every year since 1973, in odd and even years. Although catches have been small in many years fishermen have informed from pink salmon with full spawning condition in August. Therefore, it might be possible that spawning has resulted to successful juvenile production. In the year 1979 it was caught one pink salmon smolt in the River Tana c. 150 kilometers above the Tana river mouth. In the year 2017 pink salmon occurred in the River Tana catch statistics with c. 2500 kilos.

Also in the River Neiden in Norway Pink salmon catches increased to high historical level. In the River Neiden the catch of pink salmon was c. 175 kilos in the year 2017 and only some fish were caught above the fall, Skoltefossen. Most from the pink salmon catches in the Norwegian side of the River Tana has been caught during the latest years within the 60 kilometers river stretch in the lower areas of the river. It is important to collect ecological data in long-term from pink salmon to understand the annual variations in the sea survival. Also, the collection of pink salmon scales is important for genetic studies and growth analysis.

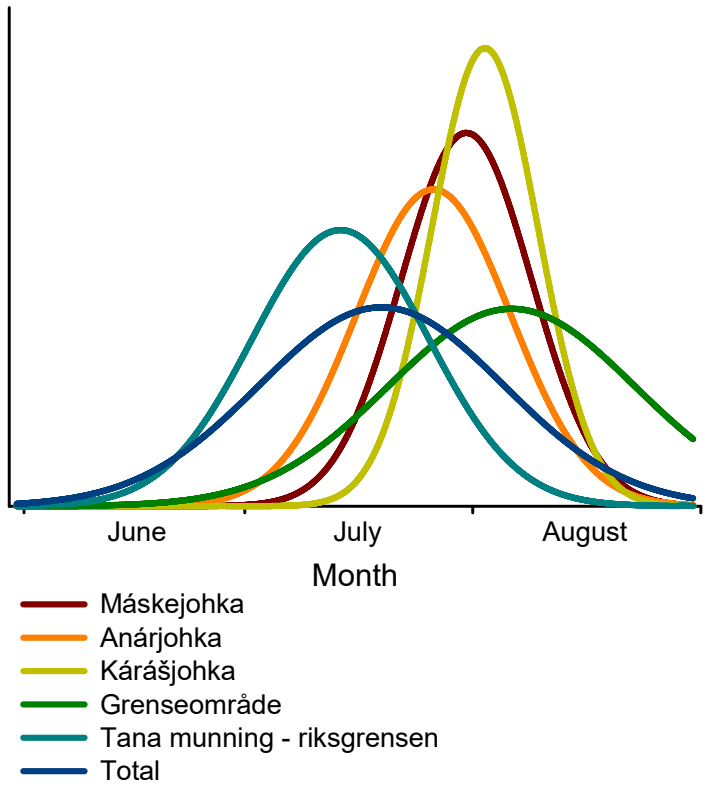

Figure 1. indicates the catch distribution of pink salmon during the summer in Norway within various areas.

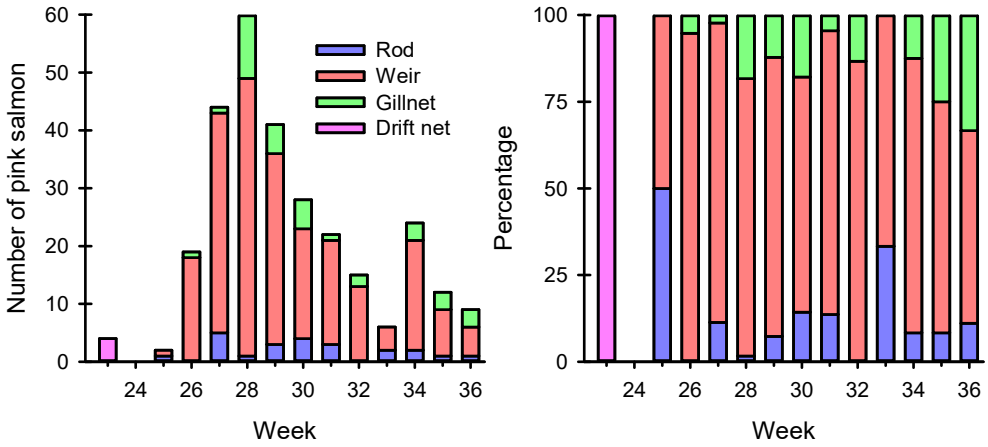

Figure 2. indicates that weir is the most important fishing method to catch pink salmon in the River Tana system in Norway.

PINK SALMON AND INTERACTION WITH ENDEMIC COMPETITIVE SPECIES, EPIDEMIOLOGY, AND OTHER ASPECTS

Dr Dimitry Kuzmin, PINRO Murmansk

The project of pink salmon introduction originally had a number of flaws. The main one was not having studied the issue of interaction between pink salmon and the aborigine of the northern rivers, the Atlantic salmon. Also, it was not taken into consideration that a less valuable species would be present in the water bodies; a possibility of disease transmitting was not considered; a possible negative reaction from international organizations and neighboring countries was not discussed. Already by the end of XX century these issues became significant, and currently when the species proliferation have become utterly important.

Atlantic salmon and pink salmon fry' diet coincide by 52.9%, and that of migrating smolts – by 22,9% (Grinyuk et al., 1981). With the high numbers of pink salmon fry, no doubt, they compete for food with young Atlantic salmon.

The analysis of spawning migration dynamics of Atlantic salmon and pink salmon shows that in the years of pink salmon's high numbers the Atlantic salmon's run shifts to a later period. Their numbers decrease, although there is no 100%-certainty in this correlation. Observations on small rivers have shown that pink salmon coming into a river earlier occupy the available pits and protected them from Atlantic salmon that came in later. Atlantic salmon's and pink salmon's redds were found 1 to 3 meters away. When opened, some redds contained eggs of both Atlantic salmon and pink salmon.

According to a number of authors (Bogdanova, 1966; Malakhova, 1972; Mitenev, 1997; Barskaya et al, 2005), no massive epizootic disease outbreaks have been observed – neither in the farm-hatched fry, no in adults. However, the risk of infectious and invasive diseases was very high.

In the acidulous and cold water in the northern rivers the process of dead fish bodies decomposition is much slower because of low temperatures and low diversity of micro-organizms, invertebrate detritus eaters and vertebrate scavengers. As a result, the rivers grow enriched with biogenic matter, and eutrophication takes place. This facilitates silting, proliferation of algae and higher vegetation on the bottom at Atlantic salmon's spawning sites, and eventually destroys the ecological balance that has been achieved in thousands of years.

Thus, the presence of considerable problems emerging in the process of pink salmon adaptation determines the need for a decision regarding the status of this fish in future.

THE PARASITE FAUNA OF PINK SALMON, *ONCORHYNCHUS GORBUSCHA* (WALBAUM, 1792), IN RIVERS DRAINING TO THE WHITE AND BARENTS SEAS

*E.P. IESHKO[*], V.K. MITENEV [**], S.G SOKOLOV[***,*] ,A.B. KARASEV[**] , B.S. SHULMAN[****], YU.YU. BARSKAYA[*]*

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[**] POLAR RESEARCH INSTITUTE OF MARINE FISHERIES AND OCEANOGRAPHY, MURMANSK
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Invasion of pink salmon *Oncorhynchus gorbuscha,* a very common commercial salmonid species in the North Pacific is an example of wide-scale bioinvasion in the north of Europe. Between 1956 and 2000 there were several introductions of pink salmon to the rivers of the Barents and White seas. Impregnated roe was used for the introductions (Karpevich, 1998; Zubchenko et al., 2004; Kuderskiy, 2005). As a result of naturalization, the invader has spread (Fig.) to rivers of Northwestern Eurasia from Yamal to the British Isles to Iceland (Danilov, Markevich, 1979; Bogdanov et al., 2000).

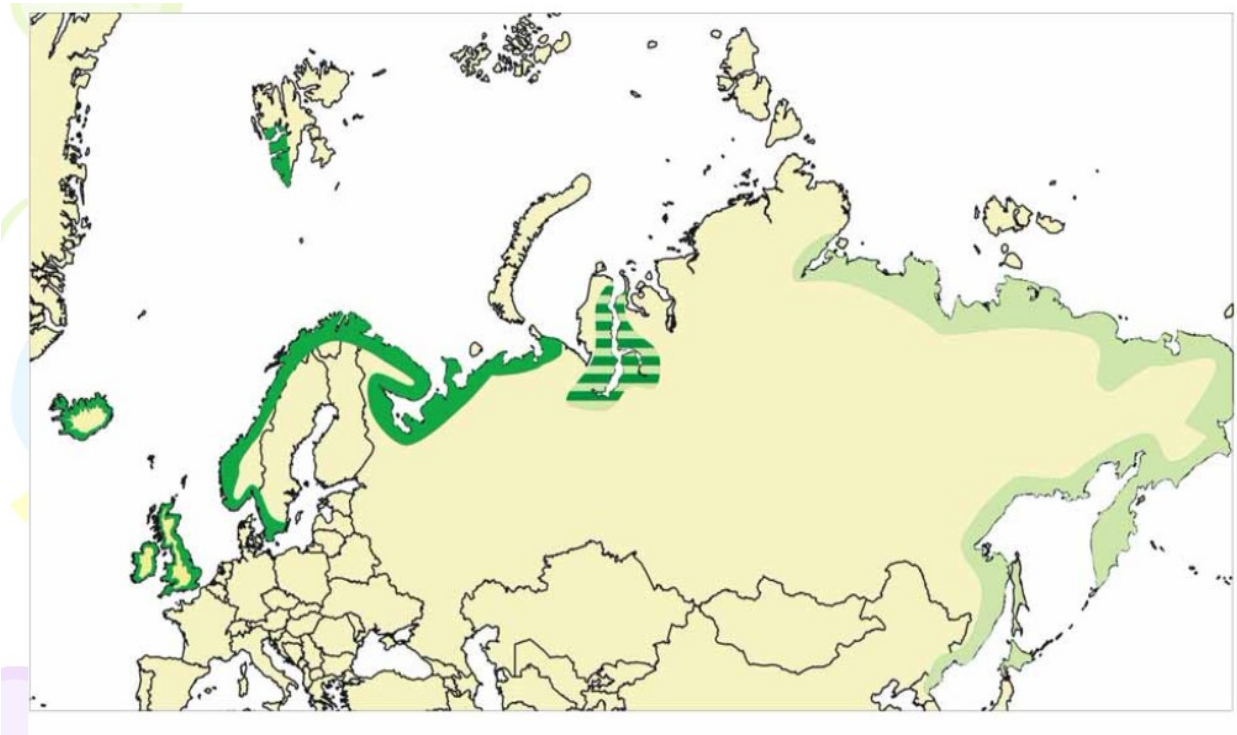

Figure 1. The distribution of pink salmon *Oncorhynchus gorbuscha* in Europe and Asia. Natural distribution range is shown in light green, established habitats are marked green, while green stripes indicate single runs, eggs do not survive.

The first data on parasites of pink salmon inhabiting the rivers of the basins of the Barents and White Seas were collected in the 1960s (Nienburg, 1963; Malakhova, 1972; Grozdilova, 1974). Later parasite species diversity in introduced pink salmon was studied by Mitenev (1993) and Barskaya et. al., 2005.

The parasite fauna of the pink salmon from rivers of the Kola Peninsula and Karelia comprises 27 species, the number varying from 8 to 17 among rivers. All the parasites, with the exception of several species that infest pink salmon during the spawning run, represented the marine fauna. The dominant ones among them were the cestode *Scolex pleuronectis,* trematodes *Derogenus varicus*, *Brachyphallus crenatus*, *Lecithaster gibbosus*, and nematodes *Hysterothylacium gadiaduncum*. The parasite fauna of pink salmon dispersed across rivers of the White and Barents Sea basins is much poorer compared to waters in the species' natural distribution range. The species composition of its parasites is similar to that in Atlantic salmon, *Salmo salar* L., indicating these fish have similar diets during the marine feeding period (Barskaya et al., 2005).

Monitoring of pink salmon in the Keret' River (the White Sea basins) has enabled an assessment of changes in its parasite fauna over a ten-year period (Barskaya et. al., 2005). The parasite fauna of pink salmon from the Keret' River comprised 17 species: Ciliophora – 1, Cestoda – 4, Trematoda – 7, Nematoda – 3, Acanthocephala – 1, Crustacea – 1. Marine taxa (13 species) constituted the bulk of the fauna (Tab). They were intestinal and coelozoic parasites, which infest the fish as they feed on benthos, zooplankton and fish in the sea. The freshwater fauna was represented by generalists (ciliates *Capriniana piscium*, parasitic crustaceans *Ergasilus sieboldi* and larvae of trematodes *Diplostomum sp., Ichthyocotylurus erraticus).* Surveys carried out in 1993 and 2003 showed that after 10 years there happened no noticeable change in the parasite fauna of pink salmon, apart from a decline in the prevalence and intensity of infection with the most common marine species.

This has to do with the degradation of "marine" communities of parasites among anadromous salmon entering fresh waters (Heitz, 1920; Dogel, Petrushevskiy, 1935; Mamaev, Oshmarin, 1963). Fish studied in September 2003 had spent more time in the river compared to fish studied in July 1993.

Table. Parasitefaunaofpinksalmon, *Oncorhynchusgorbuscha,*intheKeret' River (byBarskayaet al., 2005)

Parasite	July1993			September2003		
	Prevalence (%)	Mean abundance (ind./fish)	Intensity of infection (min – max)	Prevalence (%)	Mean abundance (ind./fish)	Intensity of infection (min – max)
1. *Caprinianapiscium*	13.3	+	+	-	-	-
2. *Eubothriumcrassum*	80.0	8.0	1-51	26	0.7	1-4
3. *Diphyllobotrium*sp.	46.6	1.1	1-5	-	-	-
4. *Scolexpleuronectis*	93.3	79.1	16-326	67	12.7	1-104
5. Cestoda gen. sp., larvae	-	-	-	87	5.7	1-92
6. *Hemiuruslevenseni*	26.6	0.4	1-3	-	-	-
7. *Brachyphalluscrenatus*	86.6	8.1	1-40	46	3.9	1-18
8. *Derogenesvaricus*	73.3	3.3	1-10	66	7.3	1-55
9. *Lecithastergibbosus*	93.3	87.6	1-519	46	3.0	1-77
10. *Podocotylereflexa*	26.6	0.4	1-2	13	0.1	1-1
11. *Diplostomumvolvens*	-	-	-	33	1	1-6
12. *Ichthyocotyluruserraticus*	-	-	-	20	0.3	1-2
13. *Anisakis simplex* s. l.	40.0	1.4	1-12	26	0.8	1-6
14. *Pseudoterranovadecipiens*es. l.	6.6	0.07	1-1	26	0.3	1-1
15. *Hysterothylaciumgadiaduncum*	86.6	6.4	1-16	40	1.3	1-10
16. *Echinorhynchusgadi*	6.6	0.07	1-1	-	-	-
17. *Ergasilussieboldi*	-	-	-	7	0.1	1-1

BIOCHEMICAL CHANGES IN THE EARLY DEVELOPMENT OF SALMONID FISH IN THE KOLA PENINSULA

N. N. Nemova, S. A. Murzina, L. A. Lysenko, N. P. Kantserova, M. V. Churova, O. V.Meshcheryakova, Z. A. Nefedova, M. Yu. Krupnova, S. N. Pekkoeva, A. E. Veselov, D.A. Efremov, M.A. Ruch'ov
Institute of Biology, Karelian Research Centre RAS, Petrozavodsk, Russia,
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Studies of salmonid fish in the European North are of particular interest for what they can offer for the understanding of the general mechanisms and specific features of adaptive responses formation during early development and their implications for further development strategies. The river life period of salmonid ontogeny is noted for significant morphological and functional transformations involving fundamental cell metabolism restructuring, modification of metabolic rate regulation and ratios between different metabolic pathways.

We studied metabolic changes in the content of lipids, fatty acids, activity of enzymes involved in energy metabolism and proteolysis during early development in salmonid fish of the family Salmonidae, genus Salmo (Atlantic salmon and brown trout) living in high latitudes. Eggs were studied prior to spawning, during embryonic development in farmed and wild fish, in juveniles aged 0+, 1+, 2+, 3+, 4+ and at different stages of the life cycle (fry, parr, smolts). Having analyzed own and published data we have assembled, substantiated and tested a system of biochemical metabolism indices covering quite comprehensively the major metabolic pathways of macromolecule transformations that maintain the requisite homeostasis in early development processes in juvenile salmonids. This system of biochemical metabolism indices includes parameters of lipid metabolism, energy and carbohydrate metabolism, intracellular proteolytic enzymes, activity of lysosomal enzymes, as well as molecular genetic indices of myosin heavy chain gene expression, MyoD, Myf-5, myogenin and COX, RNA/DNA ratio, and protein content.

We demonstrate that the mechanisms of biochemical adaptation of the investigated juvenile fish to the conditions in the habitats include changes in the energy and constructive metabolism, and that the leading role here belongs to the energy of the metabolic processes. The biochemical differentiation observed already in mature eggs and in embryosof the investigated salmonids defines how the larvae and fry will interact with the environment, their resilience, survival, physical activity, migratory behavior and adaptation to the various ecological conditions. Some differences were found in the biochemical status of salmon eyed eggs in embryos developing under artificial and natural conditions. Features of the biochemical status of young salmonids and their locomotor activity are the determinants of their future development and influence the formation of ecological groupings of juvenile fish. As a result, some newly hatched salmon fry have certain metabolic advantages for dispersal from redds, enabling them to actively colonize better nursery grounds and contributing to the formation of phenotypic groups with different timing of smoltification.

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BIOCHEMICAL STUDIES IN RESEARCH OF ECOLOGY OF PINK SALMON: LIPIDS AND FATTY ACIDS IN BIOCHEMICAL ADAPTATIONS

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Biochemical studies of lipid and fatty acid status of pink salmon, *Oncorhynchus gorbusha* (Walbaum 1792) in early stages of ontogenesis are of interest from the standpoint of finding possible indicators to evaluate the potential for their further development (especially for larvae) and survival abilities. It is a diadromous fish having the shortest life cycle of all representatives of *Salmonidae* (Zubchenko et al., 2004). Each stage of development is characterized by certain morphological and physiological changes supported by biochemical reactions and processes of different intensity.

The report presents first results of a comparative study of lipid and fatty acid status in early development stages of pink salmon taking into account environmental conditions of their natural habitat in the Indera River (Kola Peninsula).

We demonstrate that by the time of spawning pink salmon eggs accumulate a large reserve of structural and storage lipids ensuring best development of embryos. Thus, we established high content of total lipids (21% of dry mass) in ripe roe before spawning due to the domination of structural lipids (10.8% of dry mass) as well as storage lipids (8.6% of dry mass). Comparing lipid spectrum of embryos at the eye pigmentation stage and that of pre-spawning eggs of pink salmon it was established that total lipids increased 1.3 times (in August through early October) mainly due to storage lipids (2-fold growth). Metabolic processes become more active at the eye pigmentation stage and this is reflected in the changing spectrum of certain lipid classes, fatty acids and their ratios: the amount of storage and structural lipids and ω-3 family polyenoic fatty acids increased while the biomembrane viscosity index and all monoenoic and saturated fatty acids decreased with ω-6 family polyenoic fatty acids unchanged. A comparative study of lipid status of pre-spawning eggs of pink salmon, embryos at the eye pigmentation stage and hatchlings showed a decreased level of structural lipids, phospholipids, as well as cholesterol and biomembrane viscosity index, especially among prelarvae. Accumulation of minor phospholipids (phosphatidylinositol and phosphatidylserin) induces activity of membrane ferments, e.g. Na+,K+-ATPase complex related to osmoregulation, which is of importance in case of a habitat change (Boldyrev et al., 2006; Bystriansky, Ballantyne, 2007) and may manifest the start of their preparation for migration to a marine environment. Hatchlings had a higher 20:4ω-6/18:2ω-6 bioconversion intensity index and a higher level of 20:4ω-6 arachidonic acid, as a source of physiologically active endohormones. Thus, high plasticity of pink salmon is dependent on the activation and combination of complex biochemical mechanisms at early stages of development, ensuring both species sensitivity and sustainability, which establishes a high potential of the species in high latitudes.

The work is supported by the Russian Science Foundation, project # 14-24-00102.

THE PINK SALMON INVASION IN NORWAY 2017

Ingebrigt Uglem, Peder Fiske, Henrik Hårdensson Berntsen, Kjetil Hindar and Eva B. Thorstad

In 2017 the number of pink salmon captured in Norway increased significantly compared to the captures during the previous decade. Preliminary analyses indicate that at least 5500 pink salmon were captured; 3230 in recreational fisheries in rivers and in the sea, 260 in commercial marine fisheries and 2180 in extraordinary capture efforts aimed at removing pink salmon from rivers before spawning. Pink salmon catches were reported from 231 rivers, distributed from Finnmark county in the north to Østfold county in the south, with the highest numbers in the north. In addition, unusually high captures of pink salmon were reported in Sweden, Denmark, France, United Kingdom, Ireland and Iceland, as well as in Russia. The origin of the pink salmon and the cause for the unusually high numbers captured in 2017 is still unknown, but it is reason to believe that the fish comes from natural reproduction in Russian and Norwegian rivers since the releases of cultivated pink salmon in Russia ceased in 2001. It is highly likely that the pink salmon spawned successfully in many Norwegian rivers in 2017. Whether or not the pink salmon will affect other fish species and the river ecosystems in Norway is largely unknown and will obviously also depend on further permanent establishment in rivers south of Finnmark. Large captures of pink salmon in Norway is not a new phenomenon as thousands of fish were captured both in rivers and in the sea during the 1960s and 1970s. These captures were, however, most likely a result of straying from massive releases of pink salmon in Russian rivers during the same period for sea ranching purposes. Since the pink salmon captured in 2017 most likely come from natural reproduction this may indicate local adaptations and a higher risk for permanent establishment. Furthermore, more favourable conditions due to climatic changes cannot be ruled out as a cause for the large increase in the occurrence of pink salmon in 2017. The pink salmon is “black-listed” as a high-risk invasive species in Norway and the uncertainty with respect to ecological effects calls for a precautionary approach regarding potential mitigative actions, although it still not possible to predict if the increased occurrence observed in 2017 represents a permanent establishment.

PINK SALMON IN WESTERN NORWAY IN 2017

Marius Kambestad and Helge Skoglund***
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Monitoring and capture: Most or all field research on pink salmon in Western Norway in 2017 was done by Rådgivende Biologer AS and Uni Research Miljø. In Hordaland county, 22 rivers were monitored by snorkelling, and pink salmon were caught with harpoons. Pink salmon were registered in 15 out of 22 rivers, with up to 40 individuals in a single river. Harpooning success was 66 % (103 out of 156 individuals caught), but more effort could have been put into this with more funding. We have data from the regular angling fishery from 8 of the same rivers. In these, we registered catch of 17 pink salmon by angling, and 55 by harpooning. Most pink salmon did not migrate far up the rivers and mostly spawned in the lower 1-2 km. Spawning was recorded at the same time in all rivers in the region; approximately August 8th to August 18th. By late September, all pink salmon were gone from the rivers. Although the number of pink salmon registered in rivers in Western Norway in 2017 was modest, the relative increase compared to previous years was huge.

Hatching and emergence: Pink salmon eggs were dug out and destroyed in a few rivers. Some eggs were put in hatching boxes and monitored. In River Jølstra, a pink salmon smolt was captured as early as November 20th, 2017. In Rivers Daleelva and Ekso, fry were still in the gravel in early January, yolk sacks not fully absorbed. Variation in time of emergence is likely explained by differences in water temperature.

Recommendations: Snorkelling has proved efficient in registering and catching pink salmon in rivers in Western Norway and is especially important in rivers without angling. We recommend monitoring rivers by snorkelling, on a yearly basis. A large portion of pink salmon can by removed by harpooning before spawning. Genetic studies, in combination with continued monitoring in the field, could help uncover whether pink salmon establish populations in Western Norway.

Norwegian Association for Hunters and Anglers
Local department Sør -Varanger (Sør-Varanger JFF)

Mr Rolf E Sch Kollstrøm

Taken over by Pink salmon

It has previously been caught pink salmon in our fjords and rivers. However, in 2017, as local managers of 4 salmon rivers in the Sør-Varanger municipality, we were overwhelmed by a huge migration of pink salmon in our rivers. We tried on a short notice to establish extraordinary net-fishing in order to remove pink salmon in August. This was very time consuming and new questions arose. -What happens to the rivers and the local fish species when the numbers of spawning pink salmon are so high? -How do we handle large amounts of pink salmon caught by net?

As local managers and anglers, our identity and passion for the rivers are in relation to the endemic Atlantic salmon, trout and char. Sør-Varanger JFF will alone not have the capacity to effectively decimate pink salmon by similar ascent in the years ahead.
Sør-Varanger JFF believes there is a danger of establishing pink salmon in Norwegian rivers. The management lacks knowledge about effects and the development is unpredictable. The authorities have previously taken responsibility for other threats to wild salmon such as acid rain, the parasitic *Gyrodactylus salaris* and escaped farmed salmon. Now there is a corresponding need for the public to take responsibility for mapping the problem of migrating pink Salmon in order to elaborate short-term measures and preparing a long-term action plan. The action plan must describe countermeasures to save the wild Atlantic salmon, trout and char in our rivers, where public authorities take responsibility for progress and results.

THE STATE OF STOCKS AND MANAGEMENT OF SALMON FISHERIES IN THE NORTH OF RUSSIA

Dr A. Zubchenko/ Dr D. Kuzmin, PINRO-Murmansk

At the first stage – the active phase of pink salmon introduction into the North Russia water bodies, in spite of considerable amounts of imported eggs (up to 44 million units per year) the catches exceeded 100 tons only three times (in 1973, 1975, and 1977), falling down almost to zero by the mid-1980's.

Although in 1999, to recover the even-year line of pink salmon disappearing early in 1980's, 164,000 larvae (produced from hatching of 2.5 million eggs bought from the Far East) were released into the River Umba, in the following years the registered catches of the even-year line varied from several hundred kilos to 11 tons. It means that the attempt to "launch" reproduction in the even-year line failed again.

In the XXI century commercially valuable aggregations of pink salmon only were observed in odd years and only in the White Sea. The numbers of the introduced species were only formed through natural reproduction. Relatively massive spawning returns of pink salmon in odd year started from the class of 1985, as already in 1989 massive run (tens of thousands) of pink salmon from natural spawning was observed (eggs were not imported in 1987). The biggest catch (ca. 340 tons) was harvested in 2001 (see figure) and, apparently, the pre-harvesting numbers of the introduced species were the highest in that year. As the average Murmansk Region's share of the catch in those years amounted to ca. 64%, one may assume that about 2/3 of the pink salmon's reproductive potential occurred in the White Sea rivers of the Kola Peninsula. The average counted number of pink salmon spawning in the White Sea rivers of the Kola Peninsula amounted to ca. 89,000 (48,000-156,000). As pink salmon fishing is carried out in the same areas as that of Atlantic salmon, and about half of the stocks is being exploited by all methods of harvesting, the total amount of pink salmon stocks reproducing in the White Sea rivers of the Kola Peninsula, in our assessment, varied 100 thousand to 320 thousand, or, by weight, 140-460 tons. Totally, in the White Sea the pink salmon stocks reached 480-500 thousand individuals, and in the recent odd years about 300-350 thousand.

Pink salmon is caught in the coastal area of the White Sea by stationary nets. The fishing was unregulated for a long time. For the first time, it was limited in 2003 by the allowable total catch of 36.4 tons for each of the three regions, although this measure was not science-based and in conflict with the Williamsburg Resolution of North Atlantic Salmon Conservation Organization (NASCO Report…, 2003). In 2008 pink salmon was excluded from the list of species subject to allowable total catch, and its harvesting in specific water bodies and their parts, fishery areas, and locations for nets installation are set forth by regional committees for regulation of harvesting (catch) of anadromous fish species in inland waters of the Russian Federation and the territorial sea of the Russian Federation. At the current stage this is the optimal measure of regulation that allows to harvest pink salmon effectively under the Olympic system, that is, to exploit its stocks to the maximum.

INTERNATIONAL COLLABORATIVE RESEARCH ON PINK SALMON

Research Director Mr Kjetil Hindar, Norwegian Institute for Nature research (NINA)

EXPERT CONCLUSION AND FUTURE COOPERATION

From the International meeting on pink salmon in the Barents region, 6.-8.2.2018

Representatives from Russia, Finland and Norway concluded that pink salmon (*Oncorhyncus gorbuscha*) have established self-reproducing stocks of varying degree in numerous rivers in the Barents region.

Information presented at the meeting indicates that pink salmon represent a threat to endemic salmonid species.

Pink salmon might represent a threat to traditional and recreational fisheries, and marine aquaculture.

An arena of knowledge exchange on pink salmon should be established in the Barents

Participants - Pink salmon knowledge exchange seminar		
Time and venue: 6.-8. February 2018, NIBIO Svanhovd, Svanvik Norway		
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