Action #1 Rebuild local salmon stocks
Action Goal: Rebuild wild Kunashir Island pink and Chum Salmon stocks within five years
PIs 1.1.1, 1.1.2

Pacific salmon populations in the Southern Kurils in 2024 demonstrate unstable indicators, reflecting the influence of both natural and anthropogenic factors. The data indicate a decline in Pink and Chum Salmon returns compared to forecasts. Annual data indicate a reduction in the number of spawners, as well as a decrease in the number of smolts, which negatively affects the subsequent returns of adults.

Figure 32 from Tatiana Tochilina's report shows data on the population size of Pink Salmon and Chum Salmon in Kunashir over the past 24 years:

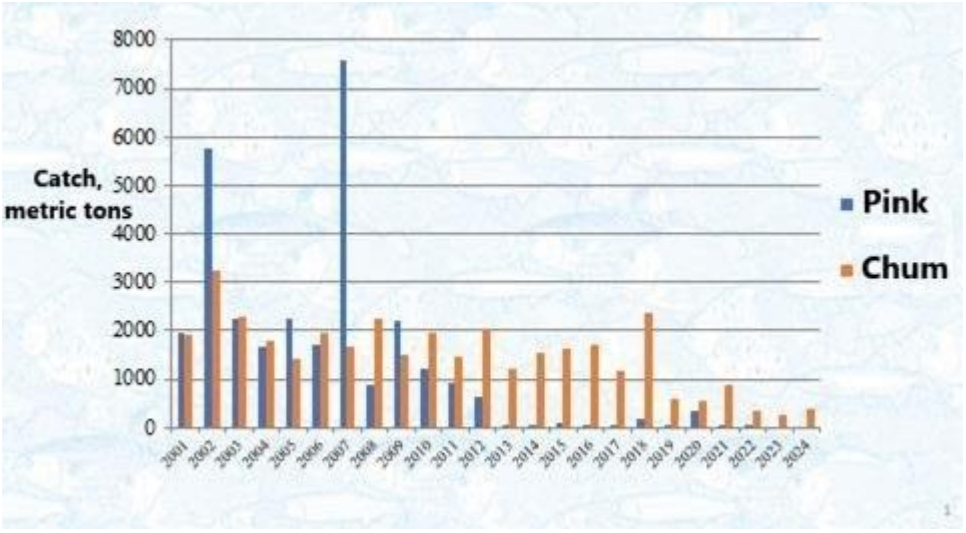

Fig. 1. (Figure number according to Tatiana Tochilina's report – 32). Pink and Chum Salmon catch on Kunashir Island using trap nets from 2001 to 2024

1. Kunashir Pink Salmon population dynamics and stock status

Pink Salmon fishing on Kunashir Island has a history of more than 60 years. In the early 1950s there were low catches, with odd-numbered years dominating. However, since the mid-1990s, the situation has changed: since 1994, in even-numbered years, catches have become significantly higher. In the mid-2000s a shift in dominance became apparent again, and odd-numbered years catches became higher. Despite these fluctuations, the overall level of Kunashir Pink Salmon stocks shows a downward trend.

In recent years, the number of Kunashir Pink Salmon has decreased significantly. In 2024, during the Pink Salmon run (from August 07 to September 20), ten Kunashir watercourses were surveyed and the Ilyushina River was surveyed three times during the season (Table 2 from Tatiana Tochilina's report). **The average escapement rate** in the spawning grounds in the studied watercourses was **0.54%** (with the standard value of 2 fish/m^2).

It can be seen from Table 1 and Figure 2 that the optimal escapement rate over 70% was observed only twice over the past eight years: in 2018 and 2020. There have been almost no even or odd generations of Pink Salmon in the last two years.

Table 1. Average **Pink Salmon** spawner density and escapement to spawning grounds in 2016 - 2024.

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total examined spawning area, m^2	38,727	26,816	42,157	67,376	53,566	70,860	59,880	91,248	46,514
Cumulative number of spawners, N of fish	20,962	single	65,346	10,100	80,105	5,598	26,999	3,708	500
Average density of spawners on spawning grounds, fish/m^2	0.54	-	1.55	0.15	1.50	0.08	0.45	0.04	0.01
Escapement - according to the SakhRybVod's standard of 2 fish/m^2, in %	27.1	single	77.5	7.5	74.8	4.0	22.5	2.0	0.54

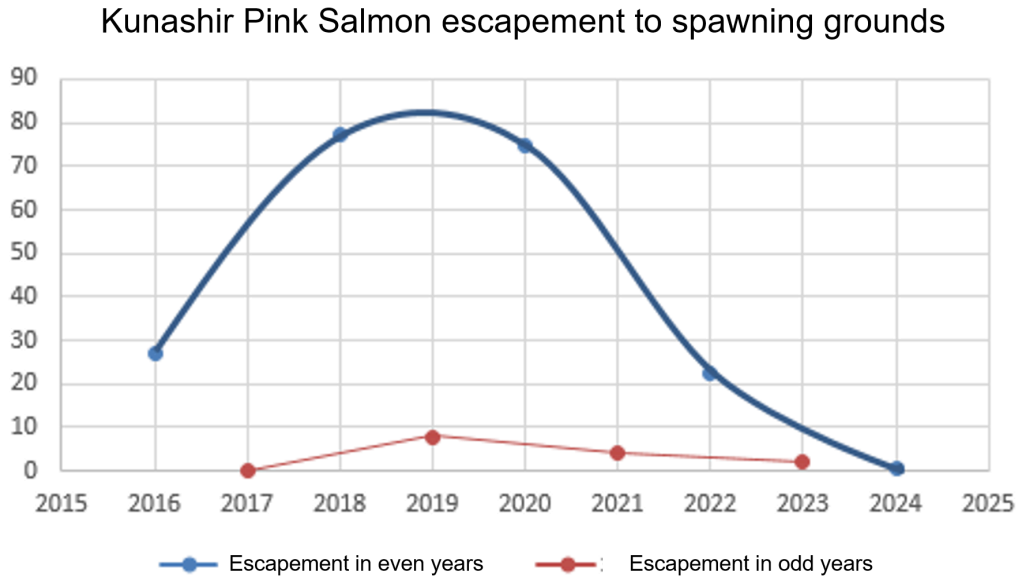

Fig. 2. Pink Salmon spawners escapement to spawning grounds (%) by even and odd generations (with the standard value of 2 fish/m^2)

There was no Pink Salmon fishing on Kunashir Island in 2024. Due to the extremely low abundance of Pink Salmon, no catch of this species for scientific purposes or biological analysis was carried out in 2024. At the initiative of PCF Yuzhno-Kurilsky Ryibokombinat Co., Ltd. (hereinafter – YKRK) the Anadromous Fish Commission (hereinafter – the Commission) decided to introduce passing days from August 28 to September 10, which essentially meant a complete suspension of Pink Salmon fishing.

A similar situation was observed in 2023. Pink Salmon did not return to the island – by the middle of the August river escapement was close to zero. Also, at the initiative of YKRK the Commission introduced passing days from August 23, 2023 (Tochilina et al., 2024).

It should be noted that Pink Salmon fishing on Iturup Island was also extremely low. According to VNIRO for the South Kuril fishing zone, which includes Kunashir Island, **only 2,444 metric tons** out of the allowable 10,142 metric tons on Iturup Island, **were caught** (http://vniro.ru/ru/nauchnaya-deyatelnost/lososevaya-putina), which amounted to **24.1% of the forecast volume.**

2. Kunashir Chum Salmon population dynamics

The number of Kunashir Chum Salmon also shows negative dynamics. Over the past five years, its number has decreased fourfold. This decline is due to various factors, including environmental changes and human impacts.

Fourteen Kunashir rivers and lakes were surveyed in 2024. The **average escapement** rate in the spawning grounds in the studied watercourses **was 6.35%** (with the standard value – 1.6 fish/m^2) (Table 4 from Tatiana Tochilina's report). Similarly, in 2023 the Chum Salmon escapement to spawning grounds was also low – from 0% to 12.5%, and the overall values did not exceed 10.55% (Tochilina et al., 2024).

Table 2. Average density and **Chum Salmon** escapement rate in the spawning grounds from 2016 to 2024.

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total number of surveyed spawning areas, m^2	19,930	17,410	16,770	18,755	6,455	6,455	42,550	37,440	62,205	44,895
Total number of counted spawners, fish	12,580	5,059	887	4,160	310	574	1,294	2,500	11,287	4,208
Average density of spawners, fish/m^2	0.63	0.29	0.05	0.22	0.05	0.09	0.03	0.06	0.18	0.09
Escapement rate (according to the SakhalinRybVod standard of 1.6 fish/m^2), %	39.5	18.2	3.3	13.9	3.0	5.6	1.9	4.2	11.3	6.35

The following information for 2023 and 2024 extends the table. Figure 23 in Tatiana Tochilina's report shows these data graphically.

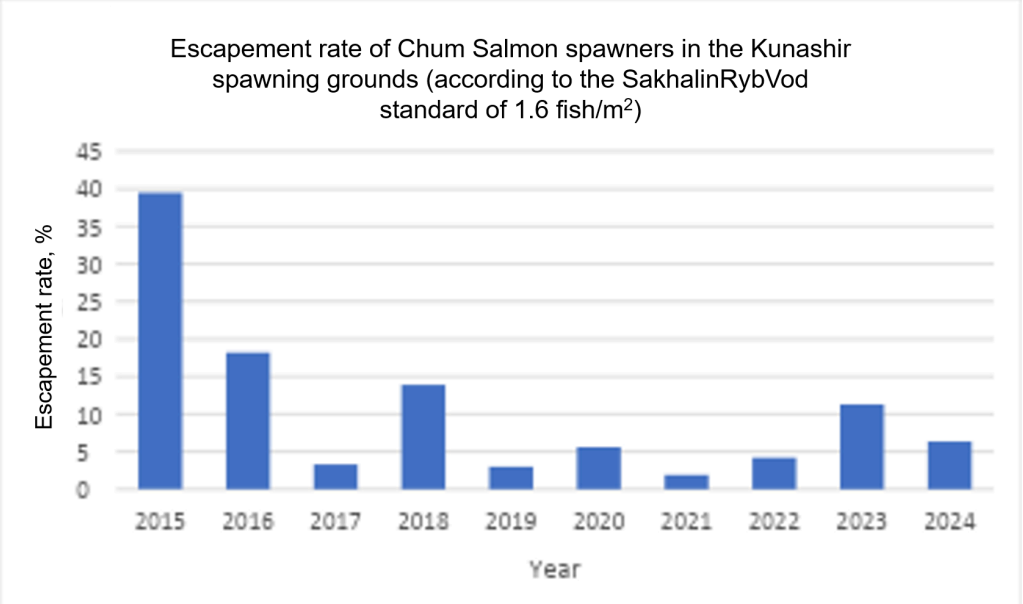

Figure 23. Chum Salmon escapement in the Kunashir spawning grounds (according to the SakhRybVod standard of 1.6 fish/m^2 in the period from 2015 to 2024

3. Studying current Pink and Chum Salmon populations status

The decline of Pink and Chum Salmon abundance in the southern Kuril Islands is under comprehensive study. Both local freshwater and large-scale regional marine studies are carried out.

In 2024, biological data collection on Kunashir Island continued during the salmon spawning period. However, **due to the extremely low number of Pink Salmon, fishes were not caught even for biological analyzes**.

To assess the biological condition of **Chum Salmon** spawners 727 fish were analyzed from various sites: Pervukhina Bay (coastal trap nets), Pervukhina River (Lagunnoye Lake Salmon Hatchery), Ilyushina River and Sernovodka River.

If we average the weight of females and males, we get the average weight of one fish in 2024 – **2,437.9 g.**

Most Chum Salmon spawners enter rivers with developed spawning changes and gonads with IV, IV-V and even V maturity stages. This is explained by the location of spawning grounds in the lower and middle streams of the island's short rivers.

Particular attention was paid to the collection of data to determine the age of Chum Salmon. The age composition of Chum Salmon (Kaev, Romasenko, 2017) on Kunashir Island is usually represented by four groups: from 2+ to 5+ with dominance of the 4+. However, in the last three years, **four-year-olds (3+)** dominated in numbers (data from table 8 of Tatiana Tochilina's report).

There are a number of publications devoted to the Kunashir Pink Salmon and Chum Salmon studies. A paper by Tochilina et al. published data from expeditionary research on Kunashir Island in 2023 (Tochilina et al., 2024). Elnikov with co-authors published data on Kunashir Pink Salmon, which showed **that there has been a decrease in female's body weight over the past 15 years.** (Elnikov et al., 2024).

Most authors associate fluctuations in Pink Salmon numbers **with climate change**, affecting spawning conditions and survival of juveniles.

In the report prepared by an international team led by the Institute of Atmospheric Physics (Chinese Academy of Sciences), scientists note the highest sea surface temperature and heat content of the upper 2,000 meters. The largest anomalies were also recorded in the North Pacific Ocean. http://vniro.ru/files/news/20250305.pdf

Changes in ice cover, temperature and salinity in the Arctic and nearby seas are being extensively researched. Studies have shown a significant impact of climate change on the distribution of temperature, salinity and nutrients in the Barents and Kara Seas (Artamonova et al., 2024), a steady decrease in ice cover in the Barents Sea and the Arctic over the past 40 years. The duration of the ice-free period in the Barents Sea has increased **from one to three months.** Key climatic factors influencing this process have been identified, with air temperature playing a leading role (Trofimov, 2024).

But it is also indicated that salmon numbers **are decreasing not only in the Sakhalin Region, but also in other areas of the Northern Pacific** (Canada, Alaska) (Makoedov, Zhivoglyadov, 2023).

Large-scale studies of fish communities in the Sea of Okhotsk and Pacific waters continue. A study conducted by Ivanov with co-authors (Ivanov et al., 2024) states that in recent decades, significant changes have occurred in the epipelagic fish community of Russian Pacific waters, where Sardine and Mackerel have become the dominant species. At the same time, the role of Pink Salmon has significantly decreased, despite it previously having high biomass. It is said that the total list of species in 2019-2023 included 65 fish, which is less than in 2004-2018 (88 species).

Studies on the Pacific salmon **food base** are carried out. Changes in the structure and abundance of zooplankton in the upper epipelagic zone of the Pacific Ocean near the Kuril Islands and Kamchatka are analyzed. Naidenko and co-authors come to the conclusion that **zooplankton consumption by fish and squid is only 1/27 of its output** for the summer season. Despite the

structural changes in planktonic communities, the authors did not reveal a significant impact of these changes on resource availability for commercial fish (Naidenko et al., 2024).

There is ongoing **genetic research**, including juvenile Chum Salmon feeding in the Sea of Okhotsk (Denisenko et al., 2023). Particular attention is paid to juvenile Chum Salmon with otolith tags from Japanese salmon hatcheries. The authors identified genetic similarities between Japanese and Iturup Chum Salmon.

The work of Denisenko with co-authors confirms the assumption made by Zhivotovsky with co-authors (Zhivotovsky et al., 2022), which proposes to use **ecogeographical units** to separate Chum Salmon populations ***(Oncorhynchus keta)*** **of the Russian Far East.** They identify five clusters based on geographic, environmental and genetic criteria. Kunashir Chum Salmon belongs to the so-called "Southern Chum Salmon" cluster which also includes Primorye and the southern Kuril Islands. This work provides the basis for rebuilding Kunashir Pink Salmon and Chum Salmon populations, and it is possible to use broodstocks from Iturup and Hokkaido islands for this purpose.

4. Factors influencing the decline in salmon numbers on Kunashir Island

The vast majority of experts note that the abundance and distribution of fish are significantly influenced by **climate change.** Warming waters, shifts in the Kuroshio Current and changes in the structure of the food base affect the migration routes of Pink Salmon and Chum Salmon. This leads to time shifts in the escapement to spawning grounds and to changes in migration routes (Tochilina et al., 2024; Ivanov et al., 2024; Elnikov et al., 2024).

In 2012, it was mentioned **the influence of climatic conditions on the Pink Salmon population, which may be manifested** in changes in oceanographic conditions, especially temperature anomalies in the Sea of Japan (Romasenko, 2012). An increase in water temperature in spawning areas in certain years reduces the survival of larval fish and fry.

Fishing pressure can be another factor. Although Pink Salmon and Chum Salmon catch in the Southern Kuril Islands remains an important part of the region's economy, the fishing pressure creates additional difficulties for the population's restoration. Back in 2012, scientists pointed out that the yield of young Pink Salmon is directly dependent on the number of spawners, i.e. more spawners lead to more smolts and the larger generation size (Romasenko, 2012). However, fisheries continue to catch individuals that could participate in spawning, thereby giving impetus to the population's restoration.

There was no degradation of Pacific Salmon spawning grounds or other hydrological factors preventing spawner escapements during the survey of water bodies on Kunashir Island. Therefore, the **absence of spawners on spawning grounds** remains the main reason for the low reproductive rate of Kunashir Pink and Chum Salmon and, consequently, the absence of smolts that could be the basis for future generations.

5. Proposed recovery measures

An integrated approach is proposed to stabilize and increase the population size of Kunashir Pink Salmon and Chum Salmon, which combines scientific research, effective fisheries management and ecological methods of artificial reproduction, taking into account the genetic structure of the population. Such measures include:

Monitoring and scientific research: Constant populations monitoring and studying their biological characteristics will allow to develop effective strategies for their conservation and restoration. Regular recording of the spawners and smolts will allow to evaluate the effectiveness of measures taken and adjust management strategies.

Conservation and restoration of spawning grounds: Measures to improve conditions on spawning grounds, including clearing river channels and estuaries and monitoring water quality, increase reproductive success.

Fishing regulation: Quotas implementation and seasonal restrictions on the Pink Salmon and Chum Salmon catch help to reduce anthropogenic pressure on populations and to create the basis for the unimpeded escapement to natural spawning grounds.

Breeding programs that take into account the species' genetic characteristics (Zhivotovsky et al., 2022) and the environmental requirements will not only create additional fishery raw products, but also start population rebuild programs in other Kunashir water bodies.

The management and specialists of the PCF Yuzhno-Kurilsky Ryibokombinat Co., Ltd. implement all these methods in their practice. Additional scientific research is carried out at the expense of the company's own funds. The initiatives taken by the management of the company during the fishing season have led to changes in the fishery management system. The ban on Pink Salmon fishing, adopted at the Anadromous Fish Commission (AFC) in the Sakhalin Region in 2023 and 2024, has now been included in the draft Fishery Strategy for 2025! In 2025, it is planned to continue optimization of Pacific salmon stocks management, including enhanced monitoring and the introduction of adaptive approaches to fishery regulation.

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