

Current status of the Sakhalin taimen, *Parahucho perryi* (Brevoort), on the mainland coast of the Sea of Japan and the Okhotsk Sea

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Abstract. Sakhalin taimen, *Parahucho perryi* (Brevoort), is considered one of the most ancient and largest salmonids in the world. Unlike Pacific salmon, *Oncorhynchus tshawytscha* (Walbaum), Sakhalin taimen do not migrate far out to sea. These fish adopt a K-selected life history strategy that is characterized by late age at maturity and iteroparity. This life history type makes them unusually vulnerable, especially in the face of unsustainable harvesting pressure. In Russia, the threats Sakhalin taimen face are anthropogenic, and stem largely from direct catches of fish and not the degradation of their habitats. The main reason is excessively high mortality caused either by commercial fishing (bycatch take and related fishing infrastructure, including nets and weirs) and recreational fishing. Trappers and fishermen usually do not release captured Sakhalin taimen.

Keywords: Sea of Japan, Sea of Okhotsk, catch, distribution, fishing, Sakhalin taimen

Introduction

Sakhalin taimen, *Parahucho perryi* (Brevoort), is considered one of the most ancient salmonids in the world. This fish is thought to have separated from the general line of ancient salmonids about 40 million years ago. Along with the taimen, *Hucho taimen* (Pall.), Sakhalin taimen is the largest of the salmonids, and one of the largest freshwater fishes on the planet (Holčík et al. 1988). The largest recorded length of Sakhalin taimen is over two meters. A fish measuring 210 cm was captured in 1937 in the Tokatsugawa River in Hokkaido, Japan. The weight of largest fish can reach up to 100 kg, and age can exceed 30 years (Holčík et al. 1988); however, no such records were noted by fish biologists during the 1980-2012 period, and the data remains anecdotal only. The objective of this paper is to present an overview of the habitat, status, and conservation of Sakhalin taimen.

Material and methods

All of the material for this overview was obtained from published papers, official catch statistics, and

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Habitat

The Sakhalin taimen range is relatively restricted, and includes river basins and estuaries in the northern Sea of Japan and the southern part of the Okhotsk Sea (Fig. 1). Throughout the evolutionary period of the species, its range has remained restricted by the nature of its habitat requirements, which means it does not stray far from estuaries in natal river systems. Unlike Pacific salmon, Sakhalin taimen do not migrate far out to sea. It is believed that high salinity is a significant obstacle for colonizing new habitats. As a rule, the species inhabits coastal areas. Large specimens remain in brackish lakes to a greater extent than those closely associated with the sea (Zavgorodnyaya et al. 1964). These fish adopt a K-selected life history strategy, which is characterized by late age at maturity and iteroparity (Parpura 1991, Zolotukhin et al. 2000). This life history type makes them unusually vulnerable, especially in the

face of unsustainable harvesting pressure. Throughout its range, the species has three ecological forms (Zolotukhin and Semenchenco 2008, Nikitin 2012): 1) anadromous – with marine migration limited to estuaries and coastal shelves in close proximity to natal river mouths; 2) amphidromous – with migration limited to fresh and brackish waters, with returns to freshwater that are not necessarily related to reproduction; 3) adfluvial – with migration contained entirely within fresh waters typically in large river systems. There are also purely freshwater populations that live in reservoirs created by dams (Edo et al. 2000, Fukushima et al. 2007, Zolotukhin and Semenchenco 2008). Perhaps only in the Russian part of its range are populations naturally restricted to lakes (e.g., near Kholmok in southwestern Sakhalin). Sakhalin taimen prefers river basins with a gradual slope and deep river channels with overhanging trees and abundant woody debris. The species is typically found in brackish lakes, estuaries, and tributaries of low salinity bays. In many rivers, juveniles prefer downstream habitats. In general, Sakhalin taimen rely initially on stream invertebrates for prey, later shifting their prey preference to juvenile salmonids, including Dolly varden, *Salvelinus malma* (Walbaum), whitespotted char, *Salvelinus leucomaenis* (Pall.), masu salmon, *Oncorhynchus masou* (Brevoort), and coho salmon, *Oncorhynchus kisutch* (Walbaum) (Gritsenko 2002). In the southern Kurile Islands, Sakhalin taimen are confined exclusively to lake and lagoon systems, and are generally not found in pink salmon, *Oncorhynchus gorbusha* (Walbaum) rivers with steep channel slopes that flow directly into the sea.

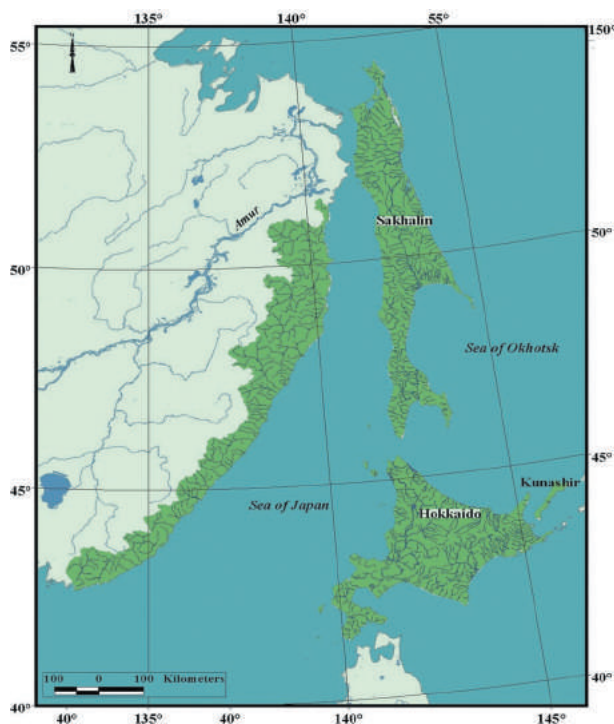


Figure 1. Geographical distribution of Sakhalin taimen (*Parahucho perryi*).

Trends in the region

Sakhalin taimen is recognized as a declining species. In Japan, it is found currently only on Hokkaido. The species has almost disappeared in 57% of the river basins (Edo 2001). The species had an almost continuous range in Primorye, Russia, but this range has become fragmented in recent decades. The species is now only found in ten rivers in Primorye (Zolotukhin

et al. 2000, Zolotukhin and Semenchenko 2008). The situation is better on the mainland coast of the Tatar Strait in the Sea of Japan within the Khabarovsk Territory, where its range has been preserved. There are relatively large populations extant in several rivers in this region, including the Tumnin and Koppi (Zolotukhin et al. 2000, Zolotukhin and Shishaev 2004). Many experts believe the range of the species has narrowed (Gritsenko 2002, Safronov 2004, Semenchenko and Zolotukhin 2011, Nikitin 2012). It has been estimated that the species is found in a total of 128 rivers and 20 reservoirs on Sakhalin. Several populations, confined mainly to lakes, exist on the islands of Kunashir (a total of five lake systems) and Iturup (a total of three lake systems). Sakhalin taimen individuals have been observed there at least once in the last 50 years, but it is unclear if some populations have become extinct. There are total of 217 river basins on Sakhalin, divided into six separate ecoregions (Springmeyer et al. 2007). Recently, we characterized the status of Sakhalin taimen river populations into three distinct groups according to the Red Book of the Russian Federation: 0 – disappeared, 1 – threatened, 2 – declining in numbers (Table 1). It was concluded that Sakhalin taimen are only found in approximately half of the rivers of Sakhalin.

Table 1

Rivers on Sakhalin Island which are known to support Sakhalin taimen (*Parahucho perryi*)

Ecoregion	Total rivers	With taimen occurrence	0 or 1 2	
			0 or 1	2
North	11	3	2	1
Northwest	10	6	6	0
West	73	36	31	5
Aniva Bay	23	20	18	2
Southeast	46	32	27	5
Northeast	54	31	18	13
TOTAL	217	128	102	26

Number of specimens and current trends

The number of Sakhalin taimen has always been relatively small. The low abundance status is natural considering the ecological niche the species occupies

in nature. In the Khabarovsk Territory, the largest populations are in the Tumnin and Koppi rivers, which are home to thousands of adult Sakhalin taimen. In neighboring small rivers, the adult Sakhalin taimen populations likely do not exceed 100 individuals. In the late 1970s, Sakhalin taimen abundance decreased, probably because of the presence of two negative factors: reductions in river flow and increased fishing. Statistics show a sharp decline in commercial catches during this period (Fig. 2). However, it is believed that the number of Sakhalin taimen remained at a relatively high level. For example, in 1972, when the commercial catch of salmon

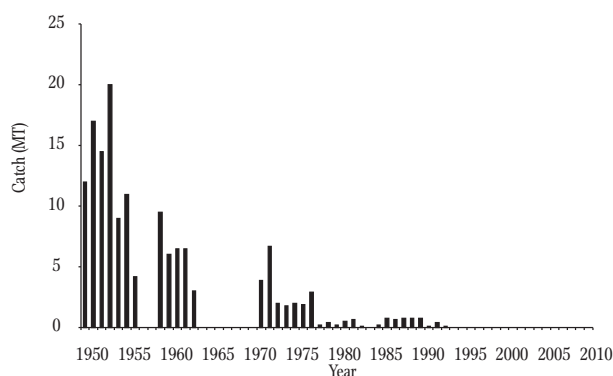


Figure 2. Commercial catches of Sakhalin taimen (*Parahucho perryi*) (in metric tons) in the Sea of Japan coastal rivers (Khabarovsk Territory).

was about five tons, hunters Misha Ivanov and a local, native Orochi guide harpooned and landed 22 adult Sakhalin taimen in one day in a 20-km stretch of river. Commercial fishing of Sakhalin taimen was permitted there until the 1990s. The level of catches in the 1980s fell to one to two tons year⁻¹, and then official logging of catches ended (Fig. 2). Starting in the 2000s, Sakhalin taimen became a desirable target for recreational fishers, but no data are available on sport fishing efforts or catches during this decade. Based on some data of Sakhalin taimen juveniles test fishing with beach seines, the abundance of Sakhalin taimen has been increasing since 2007 at least in the two major rivers Koppi and Tumnin.

Sakhalin taimen never contributed significantly to commercial catches in this region. During the

1950-1960 period, commercial catches in Primorye ranged from approximately five to 27 tons year⁻¹. In Sakhalin during this same period, catches were 20-30 tons year⁻¹. Total catches in the Far East of the USSR at the time was on the order of 45-50 tons year⁻¹ (Nikanorov 1960, Kryhtin et al. 1964). After the Sakhalin taimen was categorized as a specially protected species, estimates of catches of this species were no longer reported (Zolotukhin and Semenchenko 2008). Edo (2007) estimated the abundance of Sakhalin taimen in Hokkaido to be approximately 2,000 individuals. The adult population estimate published by Nikitin (2012) for all the rivers of Sakhalin was approximately 10,000 individuals. Zolotukhin (unpublished data) estimates approximately 8,000 adults currently inhabit the rivers north of the mainland coast of the Sea of Japan (Khabarovsk region). Semenchenko (unpublished data) estimates that there are approximately 4,000 individuals in the rivers south of the Sea of Japan (Primorye). Thus, the total range-wide abundance of the species might be roughly 24,000 adults. In addition, Nikitin (2012) estimated the total number of juvenile *P. perryi* in Sakhalin rivers to be approximately 500,000 individuals. It is important to note that none of these estimates are based on rigorous, scientific surveys or sampling of any kind; therefore, these estimates are highly uncertain.

Determining the main limiting factors

In Japan, there are thought to be a number of causes that have led to extinction of local salmonid populations, including the following: dams on rivers resulting in habitat fragmentation, high density human populations, the presence of invasive species (specifically rainbow trout), deforestation, and intense agricultural development (Fukushima et al. 2011). Many large dams in Hokkaido impede migration of anadromous salmonids, which has led to the extinction of populations on a regional scale. Fortunately, Sakhalin taimen inhabit streams in wetlands with low gradients, so this type of habitat has not been directly impacted by large dams (Fukushima and

Kameyama 2006). For *P. perryi* in Hokkaido, however, one of the most significant threats is the construction of small-scale engineering structures on watercourses such as check dams and drainage pipes, which are meant to control erosion and accompany the construction of roads. Although the sizes of these structures individually are insignificant, their cumulative impact across the Hokkaido landscape is quite large (Fukushima et al. 2007). Research results demonstrate the importance of maintaining connectivity across river sections, so that Sakhalin taimen do not encounter obstacles to their movement to optimal habitats (Honda et al. 2012). To protect *P. perryi*, migratory routes should be maintained or restored in river systems. Further, river banks and substrates should be conserved or restored to encourage production of benthic invertebrates and natural, native vegetation (Sagawa et al. 2003). Channelizing and channel armoring reduces river complexity and profoundly degrades salmonid habitats (Fukushima 1994).

In Russia, the threats Sakhalin taimen face are anthropogenic, and in large part, are caused by direct catches of this fish, and not the degradation of their habitats. The main reason is excessively high mortality caused either by commercial fishing (bycatch take and related fishing infrastructure, including nets and weirs) and recreational fishing. Based on casual observations and anecdotal reports, trappers and fishers usually do not release captured taimen (Zolotukhin et al. 2000, Zolotukhin and Semenchenko 2008, Nikitin 2012). In certain parts of the Russian range, habitat conditions for Sakhalin taimen have deteriorated following infrastructure development for the growing oil and gas industry, including pipeline construction, and road building. Additional impacts occur from timber harvesting and forest fires, which are relatively common in parts of the Sakhalin taimen range during the summer dry season. Some have conjectured that extirpated populations of Sakhalin taimen resulting from localized impacts in Russia will be "rescued" by individuals straying from neighboring populations, which is akin to the recolonization exhibited by Pacific salmon species in this region. Judging from the rapid and

complete disappearance of Sakhalin taimen in many small rivers in Sakhalin, this species does not exhibit this high level of anadromy and straying, and any exchange occurring between river basins is probably exceedingly small. This suggests that these small, local populations are very vulnerable to extinction.

Protection

Sakhalin taimen have disappeared from many rivers, and this has led to the species being listed as endangered in different parts of its range. Sakhalin taimen were first listed in the Red Book of the Russian Federation under Category 2 – decline in the population size of an endemic species of the Far East (Red Book of the Russian Federation 2001). The number of Sakhalin taimen in the Kuril Islands in recent years has also declined sharply. The species was included in the Red Data Book of the Sakhalin region under Category 3 with the status of local endemic species of the Far East with declining abundance in need of protection (Red Book of Sakhalin Region 2000). The species was added to the Red Book of Primorye under Category 2 with the status of diminishing in numbers. This category is meant for taxa and populations with steadily declining abundance, which upon further exposure to threat factors that reduce their size, may soon fall into the category of endangered species (Red Book Primorsky Krai 2002). In the Khabarovsk Territory, there is no particular reason to include it in the list of protected species. In the 2000s, its population increased two-fold compared to that in the 1990s.

The species has been included on the Red List of the Ministry of the Environment in Japan (1999 edition), and the Red Book of Hokkaido (2001) referred to the Sakhalin taimen as a species at risk of extinction. In 2006, Sakhalin taimen was included on the Red List of the International Union for Conservation of Nature (IUCN), based on expert assessments conducted by a team of specialists. The assessment placed the species in the IUCN category of Critically Endangered (A4abcd criteria, Rand 2006). In 2012, the IUCN and the Zoological Society of London

profiled Sakhalin taimen as one of the hundred most threatened species on the planet.

Two important, recent conservation successes deserve mention here. A precedent-setting decision was made by the Khabarovsk Regional Government in 2011 to protect critical habitats in the headwaters of the Koppi River, a large river in this region. This new protected area of more than 40,000 acres is now being patrolled intensively to reduce illegal fishing within its boundaries. Conservation efforts are now being governed by a newly-created watershed council. New research is also underway to tag Sakhalin taimen to provide a more direct, scientifically-defensible estimate of adult abundance in this river system, and provide some new data on migration patterns for this species. Another precedent-setting conservation decision was made in the Japanese area of the species range in recent years. A freshwater protected area of over 2,000 acres was created in critical riparian and floodplain habitat of the Sarufutsu River by Oji Paper, a private company in Japan. This river is thought to support one of the largest river populations of the species in Japan. These two new protected areas provide some much-needed optimism for the future of this species.

Despite repeated pleas, dedicated funding to study and protect Sakhalin taimen in Russia has never materialized. Strategies for the conservation of Sakhalin taimen based on a solid framework of biological knowledge have been discussed and debated now for over a decade. Despite some recent successes in creating protected areas, research and conservation work necessary to protect the species has only just begun. Scientists and representatives of social organizations created the „Conservation Network for Sakhalin Taimen“ in 2012 to finalize a strategy for the conservation of the species in the Russian part of the species range. This is an innovative, collaborative partnership, and could serve as a successful model for a Russian national program dedicated to the conservation of biodiversity.

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