

In some lakes at the end of the last glaciation or in more recent times, the charrs separated into several ecological forms. This process is called a 'sympatric specialization'. It occurred in parallel in at least five studied lakes resulting in specialized predators and benthophages, being the descendants of the large charrs. In one case, sympatric speciation of small charrs was revealed. No qualitative differences in nutrition were found between the latter pair of forms; however, adult fish differ in size by more than two times. In the largest Pylgyn lake system, large charrs underwent an "explosive" variant of adaptive radiation and diversified into two predatory and two benthivorous forms. The mechanisms and causes of such complex and profound evolutionary transformations remain unclear.



Lake Ujniy Gytgypelgyn

The expedition to Beringia in 2019 contributes greatly to the database necessary to analyze the evolutionary mechanisms in regions with cyclic climate changes. Nevertheless, further studies of a number of water bodies are required to trace the origins of Arctic biodiversity. In particular, the large lakes of western Chukotka – Bolshoi and Maliy Nuteneut, Ilirney and Verhniy Ilirney, Tytl remain the 'white spots' in terms of ichthyofauna. Furthermore, the data on the structure of the unique fish communities of Lake El'gygytyn – one of the oldest water bodies on the Earth and the largest lake in Chukotka – are very scarce.

CHARRS OF THE CHUKOTKA MOUNTAIN LAKES



Small-sized form



Large-sized form, anadromous fish

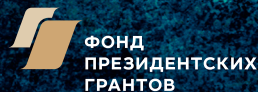


Large-sized form, piscivorous individual



Large-sized form, benthivorous individual

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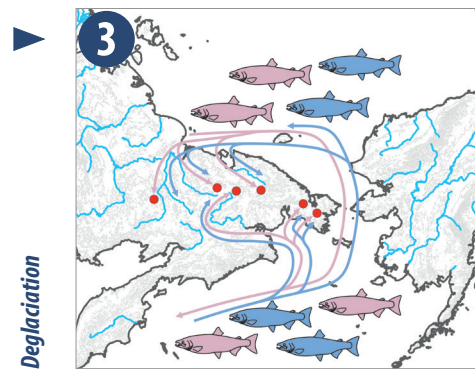
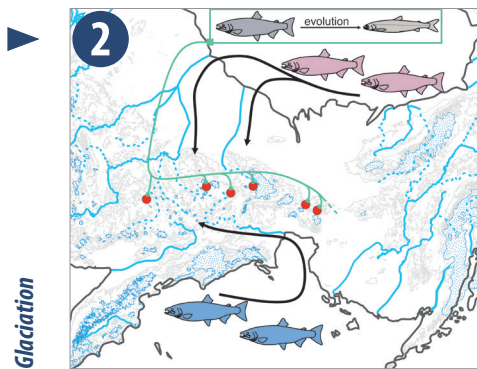
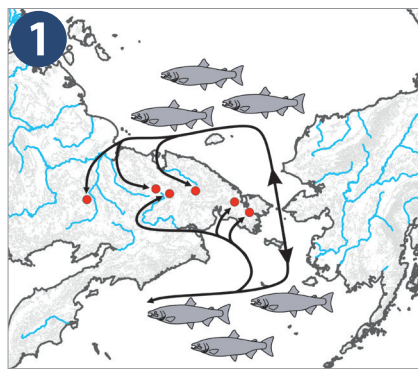
KRONOTSKY
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THE UNKNOWN FAUNA OF BERINGIAN LAKES –
THE LATEST ZOOGEOGRAPHIC DISCOVERIES



The subtle mosaic of fish diversity in northern water bodies formed vis-à-vis the climatic cycles of the Pleistocene. The ice ages and warm interglacials were taking turns at the background of global changes in the sea level and restructuring of the water network. When the ice sheets developed, the sea level lowered causing the fresh water network to merge in the drained sections of the shelf. When the glaciers melted, the sea flooded the temporary land, but at the same time the river sources were connected via temporal pathways. Geographical barriers split large fish populations and promoted local adaptation and formation of a new species (forms). When the barriers disappeared, the groups spread, and their ranges overlapped again. In the water bodies existing long enough the fishes adapted to narrow ecological niches. These processes repeated numerous times thus shaping the fauna complexes with varying degrees of isolation and overlapping ranges of groups.



The Pleistocene transformation of freshwater fish fauna is the most prominent in Beringia, comprising the north-east of Russia and Alaska. During glaciations the Bering land bridge appeared between Asia and Alaska separating the water bodies of the Arctic and the southern catchment for hundreds of thousands of years. Under these conditions, the salmonid fishes prevailing in the region formed

many new widely distributed species and forms, local endemics and relics. Reconstructing the structure of salmonid diversity as well as the routes and stages of its formation will allow us to determine the universal mechanisms of evolution in animals, as well as to clarify the history of glaciation. Moreover, due to the extremely complex transport accessibility many key water bodies of the region have remained completely unexplored until recently. In 2019, under the auspices of Kronotsky Nature Reserve and with the support of the Presidential Grants Fund a large-scale survey of the lakes of Koryakia and Chukotka was conducted. Thus, fundamentally new data on the structure of the salmonid fish fauna useful to tackle the current issues were obtained.

All mountain lakes in the region turned out to be inhabited by various charrs of the genus *Salvelinus*. In dozens of water bodies, charrs are mostly represented by two groups, small

deep-water ones and the large ones dwelling at a shallows depth and near the lake shore. These two groups are different evolutionary lines, which separated hundreds of thousands of years ago as a result of a long-term isolation in different parts of the region. Small charrs belong to the endemic fauna of central Beringia; they survived at least one glacial age in local lakes. Large charrs colonized the water bodies later; they can be anadromous as well. Small charrs in all cases feed on planktonic crustaceans, large charrs are predators or benthivorous (consumers of bottom invertebrates).

