

# Ecosystem features and environmental problems of lake Teletskoye (Republic of Altai)

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**ABSTRACT.** Lake Teletskoye is located in the north-eastern part of the Altai Mountains. This is a deep, dimictic, cold-water, ultra-fresh, oligotrophic reservoir with slow water exchange, high oxygen content and low amount of biogenic elements and organic substances. Aquatic communities of the lake are characterized by fairly rich species diversity, a few endemics, low abundance. Major environmental problems of lake Teletskoye are caused by the development of wild tourism. Construction of tourist facilities in the coastal zone as well as oil products from water transport lead to local pollution of the lake. Natural landscapes of its catchment area also undergo changes, in part due to falling of separable parts of carrier rockets launched from the Baikonur spaceport.

**Keywords:** lake Teletskoye, limnology, environmental problems, Altai, tourism industry

## 1. Introduction

Lake Teletskoye is located in the north-east of Altai at 434 m above sea level, i.e. in Turochak and Ulagan administrative regions of the Republic of Altai. For indigenous smaller peoples, the lake and its surrounding territories are the place of traditional nature use. The eastern shore and partly water area of the lake is included in the Altaysky state natural biosphere reserve and incorporated (in 1998) in the UNESCO list of World Heritage Sites as a part of the complex "The Golden Mountains of Altai". Lake Teletskoye is the deepest fresh waterbody in the south-west of Siberia; it ranks 39th among the deepest lakes of the world (Herdendorf, 1990).

Since 1987, IWEP SB RAS is involved in the interdisciplinary complex studies of the ecosystems and catchment basin of lake Teletskoye. Original data on hydrophysics and hydrochemistry of the reservoir as well as composition, structure and functional characteristics of its ecosystem were obtained. The water quality was assessed using bioindication methods. The diatoms of bottom sediments were studied as indicators of climate change (Teletskoye ozero, 2012).

## 2. Ecosystem features

Lake Teletskoye is a deep, dimictic, cold-water, ultra-fresh, oligotrophic reservoir with slow water exchange and high oxygen content. The average annual

sum of ions in the lake water is within 0.075 mg/m<sup>3</sup>. Nutrient content is low: Si – 1–5 g/m<sup>3</sup>, N – 0.3–0.8 g/m<sup>3</sup>, P – 0.005–0.070 g/m<sup>3</sup>, and Fe does not exceed 0.12 g/m<sup>3</sup>. Organic matter content in the lake is low as well.

The lake morphometric characteristics: length – 77.8 km, width – 0.6–5.2 km, water area – 223 km<sup>2</sup>, volume – 40 km<sup>3</sup>, maximum depth – 325 m, average depth – 174 m, catchment area – 19500 km<sup>2</sup>. The Chulyshman River is the largest among 70 tributaries contributing up to 70–75 % of the total inflow to the lake. Mineralization and organic matter concentrations in the tributaries are low (Selegei and Selegei, 1978). The Biya River, which joins the Katun and thus creates the Ob, is the only outflow of lake Teletskoye.

The composition of hydrobionts from lake Teletskoye is characterized by cosmopolitanism, endemism is insignificant. The algal flora consists of three endemics, or neoendemics, namely *Cymbella kolbei* Sheshukova, *Surirella lepnevae* Poretzky et Sheshukova and *S. pusilla* Sheshukova, typically bottom inhabitants. The endemic species among macrophyte and zooplankters (including protistoplankton) were not found. Three endemic species are prominent in the zoobenthos of lake Teletskoye, *Rhyacodrilus lepnevae* Malevich (fam. Tubificidae), *Pelodrilus ignatovi* Michaelson (fam. Haplotaxidae) and *Stygobromus pusillus* (Martynov) (fam. Crangonyctidae). They do not contribute greatly to total number and biomass of bottom invertebrates. The fauna of lake Teletskoye is represented solely by stenothermal cold-water forms

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dwelling in mountain streams and deep parts of the lake. The ichthyofauna include 13 species, with high share (5 species and subspecies) of salmon and sigs, among which *Coregonus pravdinellus* Dulkeit is endemic (Teletskoye ozero, 2012). Aquatic communities of the lake are rich (near 800) in species composition but poor in abundance. Littoral algal communities dominate in primary production of the ecosystem (Kirillov et al., 1999).

By taxonomic diversity and abundance of bacterio-, pico-, phyto-, protisto- and zooplankton, phyto- and zoobenthos, macrophytes and fish, biological production level, lake Teletskoye was and still remains typical oligotrophic and even the ultra-oligotrophic water body with elements of mesotrophy in shallow waters. Ecosystems of cold-water oligotrophic lakes have low potential for biological self-purification; they are most vulnerable to external effects.

### 3. Environmental problems

Deposits, manifestations and zones of scattered mineralization of non-ferrous, noble and rare metals (sources of heavy metals) as well as forested areas (sources of phenols from wet rot and forest fires) in the lake catchment are natural factors differed in a degree of negative effect (pollution) on the chemical composition of lake waters. Typical for this basin mountain-forest sod-podzolic, mountain-forest grey podzolized and mountain-forest brown with a strong acid medium reaction soils in combination with a large amount of precipitation contribute to removal of trace elements and their migration to the ecosystem of lake Teletskoye.

Nowadays, the central problem is the use of the oligotrophic lake as a recreational object. Onrush and wild development of tourism as the main economic activity has sharply increased the local anthropogenic load in the basin. The increased transport availability of the Chulyshman River is a contributing factor of catchment area pollution with petroleum products, nitrogen and phosphorus compounds. About 30 holiday camps have been created in the coastal zone, mainly in the northern part (nearby villages of Artybash and Iogach) and to a lesser extent in the southern tail of the lake. Motor vehicles ferry from the southern to

the northern part of the lake and intensive (up to 500 people daily during summer months) delivery of tourists to the waterfall Korbu (central part of lake) by ship and numerous small vessels are available. As a result, untreated wastewater from tourist facilities and households, including petroleum products from water transport, make for lake pollution.

Construction of tourist infrastructure, vegetation disappearance induced by its trampling down, leaving litter around, deforestation, and animals' disturbance transform natural unique (in biodiversity) mountain landscapes of the catchment. In addition, worthy of mention is falling of separable parts of "Proton" carrier rockets launched from the Baikonur spaceport causing noise, pyrogenic, mechanical and chemical impacts in this area (Puzanov et al., 2019).

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