

# Diatoms as biomarker in changes of the Lake Zapovednoye state (Evenkia, Russia)

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**ABSTRACT.** As part of a multidisciplinary study aimed at paleoclimatic reconstruction in March 2015 and June 2018 cores of bottom sediments of Lake Zapovednoye (Evenkia, Russia) were obtained. Analysis of samples of bottom sediments by the diatoms composition - one of the main biomarkers or proxy of changes in a state of the lake, showed that, in addition to short-term changes, long-term changes in the species composition of diatoms at least twice occurred. It may be associated with changes in water inflow and level of Lake Zapovednoye. It is most likely these events could occur due to climate change.

**Keywords:** paleoclimate, paleoindicators, bioindicators, proxy, bottom sediments, diatoms.

## 1. Introduction

Diatoms are one of the many bionindicators of changes in the reservoir state. Due to their silica frustules they are well preserved for many hundreds of years, especially in freshwaters lakes. On the territory of the Krasnoyarsk region there is a large number of unexplored or little studied lakes. One of these lakes is Lake Zapovednoye (60°31'N, 101°43'E) - a flowing fresh lake located on the Verkhnyaya Lakura River in the territory of the Tungusky State Nature Reserve, ≈60 km from Vanavara. The lake is a round shape, about 500 m in diameter, a depth about 47 m.

## 2. Materials and methods

In March 2015 and June 2018, cores of bottom sediments of the lake were sampled. The longest core of 124 cm was cut into 1 cm slices, which were processed with 30% hydrogen peroxide (Bolobanshchikova et al., 2018). Fixed samples were prepared using Naphrax and analyzed for diatom composition using light microscopy. (Bolobanshchikova et al., 2018).

Data on the distribution of <sup>137</sup>Cs и <sup>210</sup>Pb isotopes over core depths were used to date the upper layers of sediments corresponding to the 20<sup>th</sup> century. Samples older than the 20<sup>th</sup> century were dated using radiocarbon analysis on the distribution of <sup>14</sup>C isotope.

## 3. Results and discussion

The analysis of core samples showed that the species composition of diatoms in the thanatocenoses of Lake Zapovednoye is very diverse - about 160 taxa of diatoms were found. The cluster analysis of the quantitative distribution of diatoms helped to divide the changes in diatom assemblage into three large zones (Fig.1). Based on the boundaries of these zones, it can be concluded that at least two long-term changes have occurred in the species composition of diatoms.

The first significant change occurred at the end of the 7<sup>th</sup> century. A change in the dominant *Aulacoseira* sp. from *Aulacoseira granulata* var. *angustissima* (O.Müll.) Simonsen to a more cold-loving *Aulacoseira subarctica* (O.Müller) E.Y.Haworth, as well as a sharp decrease in the number of (benthic-planktonic, offer fouling) *Tabellaria* sp., presumably indicates cooling and a decrease in the amount of precipitation and influx of river water.

From the beginning of this period to the ≈14-15 centuries, the largest number of *Epithemia* sp. valves is observed in samples of bottom sediments. All species of this taxon are in symbiotic relationships with nitrogen-fixing cyanobacteria. This may indicate an accumulation of nutrients in the lake at that time, i.e. an increase in the concentration of Nitrogen (N) and Phosphorus (P). Nutrients could cause of surges in numbers of *Lindavia lemanensis* (Chodat) T.Nakov et al. (planktonic) and *Discostella stelligera* (Cleve and

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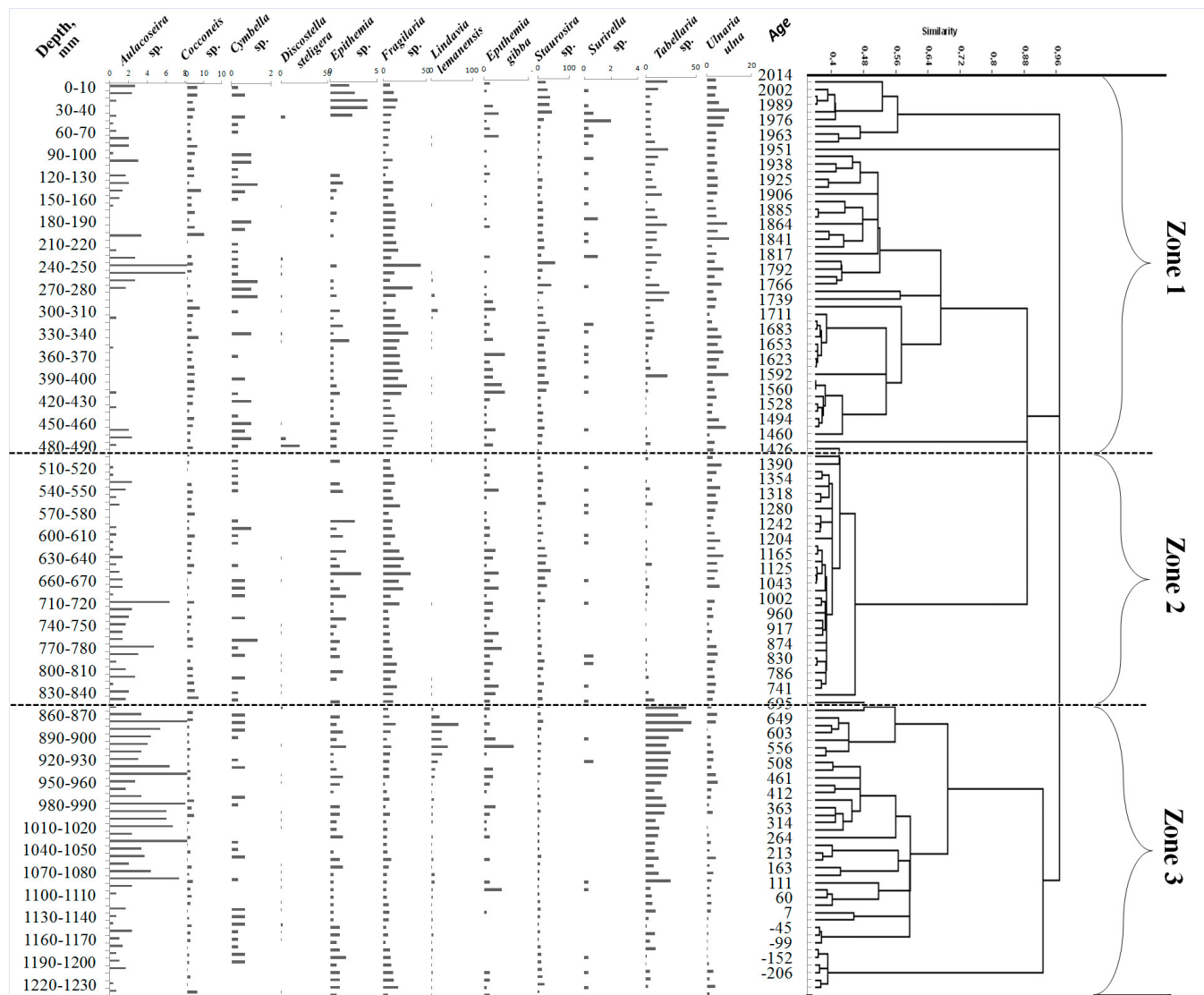


Fig.1. Percentage distribution of diatoms in the bottom sediments of the Lake Zapovednoye.

Grunow) Houk and Kle (planktonic). Since the higher the concentration of these elements in the reservoir, than higher the number of *Cyclotella sensu lato* (Saros, Anderson, 2015).

The second significant change occurred around the mid to late 15<sup>th</sup> century. Presumably, this indicates warming and an increase in precipitations and water flow. A sharp increase in the number of *Tabellaria* sp. may indicate this. Also, this is indirectly indicated by a decrease in the total number of valves of *Epithemia* sp. This may indicate that it may be associated with a decrease in the concentration of nutrients in the lake due to an increase in the level of the Lake Zapovednoye.

#### 4. Conclusions

Based on changes in the species composition of diatoms, we can conclude that in the past the state of

the Lake Zapovednoye has repeatedly changed. Presumably, changes in the species composition of diatoms were associated with climate change – conversation from from warm and humid climate to dry and cold and vice versa.

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