

Monitoring of the polygonal reservoir of the Kytalyk reserve (Indigirka river)

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ABSTRACT. Diatom analysis is one of the methods of paleolimnological research, with the help of which it is possible to determine the state and development of aquatic ecosystems in the past and present. Assessment of the current state of reservoirs is of great importance in paleolimnology, it will allow to obtain results about temperature regime, mineralization, pH environment and water quality. The research area is a region with a lot of small polygonal reservoirs that react quickly enough to external environmental changes that are formed during the cracking of re-vein ice and may form large reservoirs in the future. In this work, the IP-1 monitoring reservoir of the Kytalyk locality was studied for 10 days (every three days) during the expedition work carried out in 2011 using standard methods and a set of field equipment. The material of the study was phytoplankton samples, as a result of which the taxonomic composition of the diatom flora was investigated and the water quality of the Kytalyk monitoring site located in the basin of the Berelyakh river, the left tributary of the Indigirka, was determined.

Keywords: polygonal reservoirs, diatoms, saprobity, Indigirka, Yakutia, Arctic

1. Introduction

Diatoms are often used as indicators in biogeographic studies of water bodies due to the fact that this group of algae is distinguished by the presence of a kind of “shell” consisting of silicon dioxide in cells (Belyakova et al., 2006). Diatoms in aquatic ecosystems dominate other microscopic algae all year round. They are abundant in plankton, periphyton and benthos. The reservoir under study lies within a typical tundra, is characterized by a very shallow depth of 0.5 m, the shape of the mirror is close to rounded (elongation coefficient = 1.6). Water is ultra-fresh (with a total mineralization of 15 mg/l), pH av. 6.3, total hardness av. 0.4.

The aim of the work is to assess the condition of the monitoring reservoir located in the basin of the Indigirka river with the use of diatom indicator species. The results of this study can be used as data on the current state of natural reservoirs for the purposes of background environmental monitoring, as well as for information support of stakeholders in the implementation of economic and water management measures in the arctic region of the Republic of Sakha (Yakutia).

2. Materials and methods

The material of the study is diatom complexes of the selected IP-1 monitoring reservoir located at the upper level of the alas of the Kytalyk resource reserve. The territory of the studied reservoir located on the Nizhneindigirsky lake-thermokarst province of continuous distribution of permafrost rocks within a typical subzone of the tundra zone of Northeastern Siberia (Nekrasov and Melnikov, 1989). The actual material was collected during field expedition work in 2011 using standard sampling and material processing methods described in the authors' works (Gorodnichev et al., 2015). Diatom analysis of phytoplankton samples was performed according to the generally accepted quantitative methodology (Obshchiye zakonomernosti..., 1986).

To assess the current state, the Pantle-Bukka method was used in the modification of Sládeček (Sládeček, 1973; 1986), the affiliation of diatoms-indicators to a particular zone of saprobity was determined by the lists of saprobic organisms (Makrushin, 1974; Unifitsirovannye metody..., 1976; 1977; Denus, 1991; Barinova and Medvedeva, 1996).

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HOBO loggers were used to measure the physical parameters of the reservoir. Phytoplankton collection using a mesh (diameter 5 microns) and measurements of water parameters were carried out simultaneously every 3-4 days.

3. Results and discussion

According to the results of the study, 41 species (including 1 variety) of diatoms belonging to 16 genera, 13 families and 2 classes of the Bacillariophyta division were found in the surface sediments of the studied reservoirs, as described earlier. Of these, the most numerous class of Bacillariophyceae includes 39 species out of 41 (which is 95% of the entire flora), the class Coscinodiscophyceae includes only one genus *Aulacoseira*, represented by two species. The largest number of species has been recorded in the genus *Eunotia* of 14 species and varieties, which is 34.1% of the total number of species. Then the genus *Neidium* and *Pinnularia* are represented by 4 species, the genera *Gomphonema* and *Stauroneis* are represented by 3 species. The remaining genera are represented by two or single species, which is 34.1%. The list of mass forms (more than 5%), which was identified using a percentage of the total number, has 11 species, including dominant (more than 10%) 6 species, subdominants (more than 5%) 5 species. Among them, it is worth highlighting the species *Eunotia bilunaris* and *Tabellaria flocculosa*, which are absolute dominants in all the samples studied, ranging from 8.5% to 23% and from 15 to 30%, respectively, with the maximum values of *Eunotia bilunaris* at points IP1-2, IP1-4 and IP1-7 and *Tabellaria flocculosa* in IP1 and IP1-8. The species *Pinnularia brevicostata* (27% in IP1-6), *Stauroneis phoenicenteron* (16% in IP1-6), *Eunotia paludosa* (11%

in IP1-5), *Eunotia septentrionalis* (15% in IP1-9) are dominant and subdominant in most of the samples studied. By number (by the number of valves in 1 liter of water), the species *Tabellaria flocculosa* absolutely dominates in the studied reservoirs, which is found in all 10 samples studied.

An analysis of the comparison of the ratios between the concentration of diatom flaps in phytoplankton with the physical parameters of water (water temperature, pH, electrical conductivity and oxygen concentration) of a model reservoir, measured in the field using loggers, is shown in figure 1. Judging by the graphs, all the measured indicators are fairly evenly correlated with each other. It can be seen that the value of the concentration of the flaps reacts relatively well to changes in water temperature – with a decrease in the temperature index, the number of registered flaps increases. This may indicate that mainly cold-water species live in polygonal reservoirs of the Arctic, at a water temperature of 7.2 °C (one of the minimum values for the entire sample), the concentration of flaps reached 50.9 million/l, while at the highest temperature up to 19 °C, the concentration of flaps was equal to 2.8 and 1.8 million/l.

In order to determine the water quality of the studied lakes, saprobity indices were calculated using 41 types of diatoms-saprobity indicators. Of these, 9 species characterize the oligosaprobic zone, 5 – beta-mesosaprobic, 4 – xenosaprobic and 1 – alpha-mesosaprobic. Calculated indices of saprobity by diatoms for the studied lakes range from 0.6 to 1.1, i.e. in terms of pollution they belong to class I “very clean” and class II water quality “clean” (Fig. 2). At the same time, a relatively high saprobity index was noted on 09.08, when all measured water parameters were high.

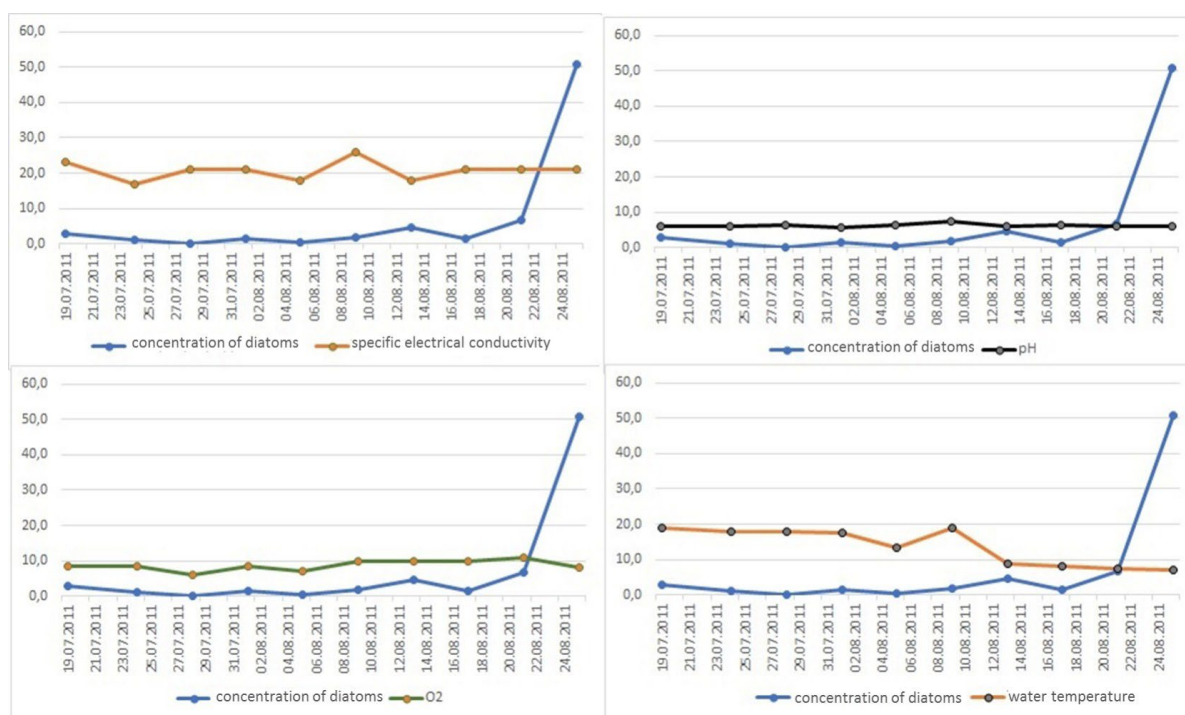


Fig.1. The ratio of physical parameters of water and concentrations of diatoms in the phytoplankton of the model reservoir.

4. Conclusions

Thus, the paper describes the taxonomic composition of the diatom flora, to determine the water quality of reservoirs, a saprobiological analysis of surface waters was carried out, which occupies one of the main places among the biological methods of surface water analysis. Since diatoms are found almost everywhere where there is water, and always prevail in biomass, they are good indicator species.

According to the results of the research, the following conclusions can be drawn:

- the diatom flora of the studied lakes, which represent an important group of environmental indicators, includes 41 species (including 1 variety) belonging to 16 genera, 13 families, 8 orders and 2 classes of Coscinodiscophyceae and Bacillariophyceae;
- small thermokarst reservoirs are represented by fairly young reservoirs of waterlogged (due to low evaporation) territories. The main source of their nutrition is the low mineralized waters of the ground ice. Excess of the input part of the component of the water balance contributes to maintaining low mineralization;
- according to the degree of organic load of water, the reservoir belongs to the category of very clean and pure (I and II class of water quality);
- the concentration of diatom flaps (million/g) is affected by the water temperature, in polygonal water reservoirs, cold-loving species prefer low water temperatures prevail.

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Conflict of interest

The authors declare no conflict of interest.

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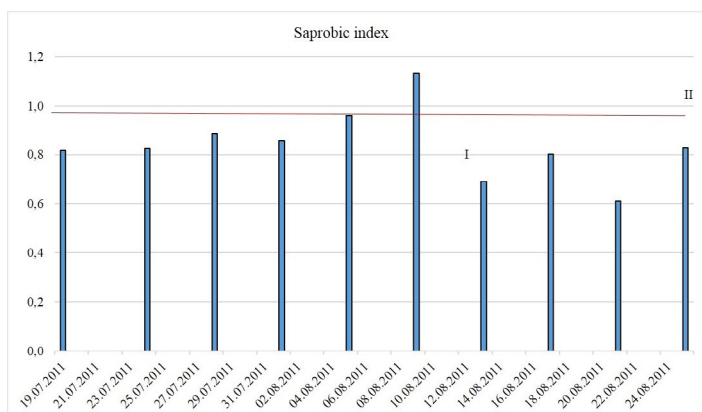


Fig.2. Integral saprobity index and the degree of contamination of the model reservoir water.

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