Short communication

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Hydro-optical method for assessing geoecological state of reservoirs

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ABSTRACT. The paper presents the data on geoecological state of lake Krasilovskoye and its area ranking using geoindication methods. The developed and tested method for rapid determination of geoecological state of freshwater reservoirs using hydro-optical characteristics (i.e. the optical index of geoecological state (OIGS)) is described.

Keywords: geoecological state, spectral transparency, spectral light attenuation.

1. Introduction

The conservation of aquatic ecosystems of freshwater basins for further reproduction, development and maintenance of biological diversity as well as the provision of population with clean water and sound recreation are currently topical problems in modern hydrological and hydrobiological research. Among the solutions is the rapid assessment of geoecological state of reservoirs and their ranking based on geoindication methods.

The geoecological state of reservoirs largely depends on the catchment area impact, which, in turn, is divided into natural and anthropogenic ones manifested in changes of hydrochemical, hydrophysical and hydrobiological parameters of water at various depths. Highly susceptible to changes in different seasons of the year, natural and anthropogenic processes in the catchment area can occur both jointly and separately in different water areas of the reservoir. To assess changes in geoecological state of the reservoir, the indicators sensitive to relevant water parameters are needed.

Khuan Zh.-Zh. (2014) and Zhidkova A. Yu. (2017) defined geoecological state of reservoirs in the context of spatial-temporal dynamics of trophic status. Zhidkova A. Yu. made the geoecological spatial-temporal assessment of the Taganrog Bay waters (Sea of Azov) and developed the statistical model to determine the trophic index change. In addition, she calculated the external anthropogenic load on the Bay waters, the environmentally allowable concentrations of nutrients and the ecological water reserve in the water area.

A common disadvantage of the previously proposed methods for assessing geoecological state of freshwater reservoirs is impossibility of their prompt use because of much time needed for determining the species composition of microorganisms and hydrochemical analysis of water (Abakumov,1987; Frumin, 1998; Menshutkin et al., 2004).

2. Materials and methods

The researchers from IWEP SB RAS developed and tested the method for rapid determination of geoecological state of freshwater reservoirs using hydro-optical characteristics, namely the optical index of geoecological state (OIGS). After sampling water and its placing (a volume of 50 ml) in cuvettes, we measured spectral transparency at a wavelength of 430 nm using a spectrophotometer with distilled water as the reference liquid (Shifrin, 1983). Further, spectral light attenuation in water (that is the value of OIGS) was calculated. The impact of the catchment on the reservoir was ranked due to numerical values of OIGS.

3.Results and discussion

The ranges of OIGS values were determined based on the correlation between the light attenuation index and the Carlson trophic index given in the Table (Sutorikhin and Frolenkov, 2019).

According to the Table, OIGS may be of low level 1: 0 m^{-1}, low level 2 :1 to 2 m^{-1}, moderate level 1: 2 to 2.5 m^{-1}, moderate level 2: 2.5 to 3 m^{-1}, mean level 1: from 3 to 11 m^{-1}, mean level 2 from 11 to 23 m^{-1}, high level of 23 m^{-1} and more.

In September 2019, the OIGS gradation-based ranking of geoecological state of the surface water of lake Krasilovskoye was made (see Fig.).

4. Conclusions

Thus, the proposed rapid method is quite

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Table. Correlation between OIGS and trophic level calculated from spectral light attenuation

Carlson trophic index (TSI)	Trophic level of the reservoir	Spectral light attenuation $\varepsilon(\lambda)$, m^{-1}	OIGS
0-30	Oligotrophic	0-1	low level 1
		1-2	low level 2
40-50	Mesotrophic	2-2,5	moderate level 1
		2,5-3	moderate level 2
60-70	Eutrophic	3-11	mean level 1
		11-23	mean level 2
80 and higher	Hypereutrophic	23 and higher	high level

applicable for assessing geoecological states of reservoirs.

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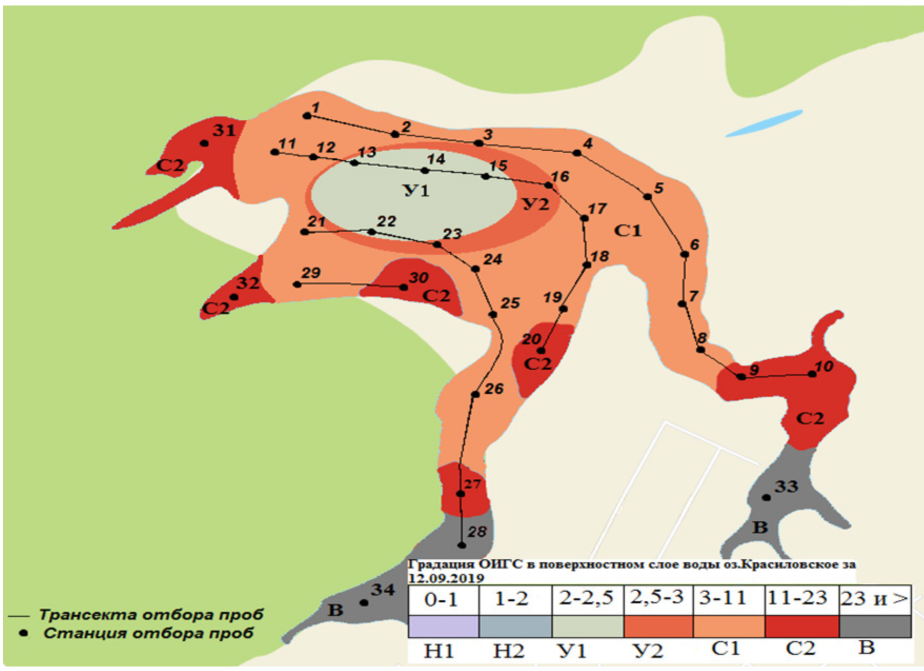

Fig. OIGS interpolation in the surface layer of lake Krasilovskoye (September 12, 2019).