

The title of project: Environmental monitoring of water bodies in Northern Kazakhstan

The relevance: The relevance of this theme is explained with the need of a constant monitoring of dynamically changing condition of water ecosystems. Different level contaminations are taken place in progressing eutrophication of hydrosystems, in accumulation of chemical toxicants in different environments, in reduction of productivity of water ecosystems.

The research will be addressed to the study of contemporary condition of water ecosystems in North Kazakhstan and to the establishment of ecological consequences of contaminations.

The aim of the project is a complex ecological evaluation of current state of North Kazakhstan's water ecosystems.

Expected and achieved results:

As a result of the research, priority groups of pollutants will be identified, the impact of anthropogenic factors on water quality and specific types of bioresources, the state and functional integrity of the studied reservoirs will be assessed, and specific and general reactions of hydrobionts to pollutants determined depending on water quality will be highlighted. Cause-and-effect relationships between recorded biological effects and exposure factors. An information system has been created with databases of water platoon quality based on hydrobiological indicators and physical and chemical data on the current state of reservoirs in Northern Kazakhstan.

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Main results (2021):

1. Research work was carried out to determine water quality, priority groups of pollutants and to study the biodiversity of reservoirs in Akmola, North Kazakhstan, Pavlodar and Kostanay regions. Permits for research fishing were obtained to carry out research work in the reservoirs of Northern Kazakhstan. The physicochemical properties of 14 reservoirs of Northern Kazakhstan were studied. 120 hydrobiological, 117 hydrochemical and 42 ichthyological samples were selected and examined.

2. The data of Kazhydromet on the reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions for 2010-2020 were evaluated. During the last 10 years from 2010 to 2020, the quality of surface water in rivers, reservoirs and lakes of Northern Kazakhstan has not changed significantly, but in some years indicators of deterioration or improvement of water quality in individual reservoirs have been recorded. In the reservoirs of the Akmola region in the studied periods of time, the water quality was mainly characterized as a "moderate level of pollution", but in some years cases of high pollution were recorded. In comparison with three other

regions of Northern Kazakhstan, cases of high and extremely high pollution of water bodies (Lake Maybalyk, river Kylshakty, Shagalaly, etc.) were more common in Akmola region. Observations of surface water pollution in the territory of the North Kazakhstan region were carried out on the Yesil River and the Sergeyevskoye reservoir. Over the past 10 years, the state of the waters has been assessed as a "moderate level of pollution", in 2015-2016. the water quality in the Sergeyevskoye reservoir deteriorated compared to the previous ones and was labeled as "high level of pollution", significant (3.1 and 3.9 times) exceedances of MPC were recorded for biogenic substances (iron) and heavy metals (copper). The water quality of the Yesil River for the specified period was assessed as "moderate pollution level". In 2020, the condition of the waters of the studied reservoirs improved somewhat. In the period from 2010 to 2013, the water quality in the Ertis River was assessed as "normatively clean", in subsequent years as a "moderate level of pollution", i.e. there was a deterioration in the condition of the waters. In general, an excess of MPC by 1.3-1.6 times was recorded for substances from the group of heavy metals (copper (2+), petroleum products by 1.9 times. In the Lakes of Jasybai, Sabyndykol, Toraigyr, an excess of MPC by 1.1-3.0 times was observed for substances from the group of major ions (sulfates, magnesium, sodium), biogenic substances (fluorides). Thus, in recent years, the quality of surface waters in the Pavlodar region has been assessed as a "moderate level of pollution". In 2017, there was significant pollution of one of the major waterways of the Tobyl River region and large reservoirs created in its bed (Karatomar, Amangeldinskoe) compared to other years. The water quality of the Tobyl River in 2015-2017 was assessed as water of a "high level of pollution", although according to certain indicators, for example, biochemical oxygen consumption for 5 days, it was at the level of "normatively clean". In subsequent years, the water quality improved somewhat and was assessed as "moderate pollution level" and "normatively clean" according to certain indicators.

3. According to the results of scientific research on the characteristics of water by color, Lake Zharken and the Tobol River belong to reservoirs with medium color, the rest of the studied reservoirs belong to reservoirs with weak color. The smell of water in all reservoirs at the time of our research was equal to 1 point. The transparency of the water in Lake Kostomar was 0.8 m, while in other reservoirs it was lower than this indicator. The content of biogenic elements (NO_3^- , NO_2^-) did not exceed the norms of maximum permissible concentrations. Depending on the pH level, Lake Malaya Saryoba, Zharlykol, the Koyandinsky reservoir and the Bobrovsky zaton can be conditionally attributed to the neutral group of waters, and the rest of the studied reservoirs to the reservoirs of the slightly alkaline group of waters (Lakes Maybalyk, Balyktykol, Kondratievskoe, Zharken, Solontsy, Kostomar, Rivers Freshwater, Shidertinka, Tobol). According to the oxygen content of the waters of Lake Maybalyk, Lake Zharlykol, the Koyandinsky reservoir, Lake Kondratyevskoye, the Shidertinka River, Lake Kostomar, the Tobol River, Lake Solontsy can be classified as "moderately polluted waters". Scientific research was carried out to study the biodiversity of the reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions, the

species composition of the hydrobionts of the studied reservoirs was determined. Zooplankton of reservoirs of Northern Kazakhstan is represented by 71 taxa. The greatest species richness was characterized by the rotifers and branchiops (24 taxa each). Copepods were represented by 21 taxa, facultative inhabitants of the water column - by 3 taxa. The highest diversity of zooplanktonocenoses (22-25 taxa) was found in the lake. Solontsy and Zharken of the North Kazakhstan region, lake. Kondratyevskoye of Pavlodar region. In other reservoirs, the number of taxa in zooplankton varied from 7 to 15. Most often there were branched *Bosmina* (*Bosmina*) *longirostris*, *Ceriodaphnia reticulata* and *Chydorus sphaericus*. The ichthyofauna of the Akmola region was distinguished by species diversity: Lake Maybalyk (7 species), Koyandy reservoir (4 species), Lakes Saryoba and Balyktykol (6 species), 2-3 species of fish were found in other reservoirs. Priority groups of pollutants (pollutants) of reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions have been identified. It was found that in the organisms of the studied fish samples (crucian carp, roach) caught in the early summer and post-summer periods of 2021, the content of toxic elements (lead, cadmium) and radionuclides (cesium – 137, strontium 90) were found in significantly smaller quantities than the established regulatory indicators, violations of veterinary and sanitary rules and safety requirements were not revealed. The data obtained indicate a low content of these toxic and harmful elements in the waters of the studied reservoirs. Nitrites and nitrates are biogenic elements and an important source of nitrogen for plants and complex organisms that consume them. The data on these indicators also did not exceed the norms of maximum permissible concentrations.

4. The condition and functional integrity of ecosystems of reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions are assessed. The data obtained show a fairly stable state and functional integrity of the ecosystems of the studied reservoirs. This is evidenced by the state of morphophysiological parameters of the ichthyofauna, the species diversity of the forage base (zooplankton) of the lakes and rivers studied. It is known that the study of the patterns of variability of fish and intraspecific groupings is of great importance in ecology. The main type of fish in the reservoirs of Northern Kazakhstan is crucian carp. An ecological population of crucian carp with morphobiological characteristics is formed in each reservoir, which provide a more stable type of ontogenesis in these environmental conditions. In particular, in the freshwater Lake Solontsy, located in the North Kazakhstan Region, the dominant species are silver carp (84.4%) and golden carp (14.7%). The captured fish specimens had morphometric indicators corresponding to the type and age (size and age composition, weight class, sexual structure and other biological indicators), samples with abnormal morphobiological signs were not found. It is known that the formation of fish hybrids in reservoirs is one of the indicators of the ecosystem state that does not correspond to this type. Hybrid forms of carp were not found in the catches in the studied reservoirs, which also confirms the good ecological condition of the aquatic ecosystems of the region.

Information for potential users:

The results obtained will make it possible to gain a deeper understanding of the ongoing processes in water bodies, make timely decisions to improve water quality and preserve individual components of natural ecosystems in order to fully utilize stable communities, develop fisheries and aquaculture.