

The title of project: № AP09259969 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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Key results (2023):

1. Kazhydromet's data on the reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions for 2021-2022 were evaluated.

Surface water quality monitoring in Akmola region and Astana was carried out on 59 sites of 25 water bodies (rivers Yesil, Akbulak, Sarybulak, Bettybulak, Zhabai, Silety, Aksu, Kilshykty, Shagalaly, Nura and Nura-Yesil canal, lakes Zerendy, Kopa, Burabai, Ulken Shabakty, Shchuchye, Kishi Shabakty, Sulukol, Karasye, Zhukey, Katarkol, Tekekol, Maybalyk, Lebyazhye, Vyacheslavskoye reservoir). In 2021, the quality of surface waters in the Akbulak, Sarybulak, Zhabai, Aksu, Kylshykty rivers, on the Nura-Yesil canal and the Vyacheslavskoye reservoir did not change significantly. The water quality in the Yesil rivers from above grade 5 moved to above grade 4, Bettybulak from grade 4 to grade 1, Silety, Shagalaly from above grade 5 moved to grade 4 – improved. In the Nura River, it went from grade 4 to above grade 5 - it worsened. In 2022, the water quality in the Yesil River improved, and in the Bettybulak River deteriorated sharply. No significant changes were observed in other reservoirs. Surface water quality monitoring in the North Kazakhstan region was carried out at 2 water bodies (the Yesil River, the Sergeyevskoye reservoir) in 6 sites. The quality of the surface waters of the Yesil River and all the studied 5 strata deteriorated in 2021, moved from grade 3 to grade 4, the Sergeyevskoye reservoir did not change significantly. In 2022, the situation with the water condition of the Sergeyevskoye reservoir improved, while the water quality of the Yesil River did not change. The main pollutants in the water bodies of the North Kazakhstan region were magnesium, phenols in 2021, and mainly magnesium in 2022. Surface water quality monitoring in the Pavlodar region was carried out in 16 sites on 5 water bodies (the Yertis, Usolka Rivers, Sabyndykol, Zhasybai, Toraigyr lakes). In 2021-2022, the surface water quality of the Yertis and Usolka rivers has not changed compared to previous years. The water quality belongs to the best quality class (Grade 1*). Visual observations also showed that the Sabyndykol, Zhasybai, and Toraigyr lakes are

quite clean and do not exceed the standard water quality indicators (34 indicators). In 2021-2022, there were no cases of high pollution and extremely high pollution in the surface waters of the Yertis and Usolka rivers, as well as on the three lakes studied. Surface water quality monitoring in Kostanay region was carried out at 16 sites of 11 water bodies (the Tobyl, Ayet, Togyzak, Uy, Obagan, Zhelkuar, Torgai rivers, the reservoirs of Shortandy, Amangeldy, Karatomar and Zhogargy Tobyl). In 2021, the quality of surface waters of the Tobyl, Obagan, Zhelkuar, Torgai, Togyzak rivers, Karatomar reservoirs did not change significantly compared to the previous year. The quality of the surface waters of the Uy and Ayet rivers from grade 4 passed to grade 5, the Zhogargy Tobyl reservoir from grade 5 passed to above grade 5 - deteriorated. The surface water quality of the Amangeldy reservoir from above grade 5 has moved to Grade 5, and the Shortandy reservoir from above grade 5 has moved to Grade 3 has improved. In 2022, the surface water quality of the Torgai River, Amangeldy and Shortanda reservoirs deteriorated. On the contrary, the quality of the surface waters of the Uy River and the Karatomar reservoir has improved.

2. Research work has been carried out to determine the productivity of reservoirs in Akmola, North Kazakhstan, Pavlodar and Kostanay regions. It was found that zooplankton of the surveyed reservoirs of Northern Kazakhstan was represented by 93 taxa. The background species were branched *Bosmina* (*Bosmina*) *longirostris*, *Ceriodaphnia reticulata* and *Chydorus sphaericus*, found in all types of reservoirs. The maximum number of planktonic invertebrates was recorded in the lake. Kondratievskoe – 190.5 thousand copies/m³. The number of planktonic invertebrates of the Bobrovskoye lakes was an order of magnitude lower – 5.0 thousand copies/m³, Freshwater – 5.2 thousand copies/m³ and the Tobol River – 7.4 thousand copies/m³. The minimum number of planktonic invertebrates was recorded in the Shchiderty River – 0.3 thousand copies/m³. The largest biomass of zooplankton was recorded in Lake Solontsy – 19615.1 mg/m³. Significantly lower was the biomass of zooplankton communities in lakes Maybalyk – 2025.4 mg/m³, Kostomar – 2363.3 mg/m³ and Zharkent – 3458.6 mg/m³. The lowest zooplankton biomass was found in the Shchiderty River – 1.54 mg/m³. The basis of abundance and biomass was almost universally formed by branchous and copepods. They accounted for up to 66.6-96.3% of the total indicators of zooplanktonocenoses. The exception was the Shiderty River, where the basis of quantitative indicators of zooplankton was formed due to rotifers.

3. The assessment of the maximum anthropogenic load on the aquatic ecosystems of the reservoirs of Akmola, North Kazakhstan, Pavlodar and Kostanay regions was carried out. Scientific research has been carried out to determine water quality, priority groups of pollutants and to study biodiversity. Priority groups of pollutants (pollutants) in the 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) the content of toxic elements (lead, cadmium) and radionuclides (caesium - 137, strontium 90) were found in significantly smaller quantities than the established regulatory indicators, violations of veterinary and sanitary rules and requirements no safety has been

identified. 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 the complex organisms that consume them. The data on these indicators also did not exceed the norms of maximum permissible concentrations. According to the results of scientific research on the characteristics of waters 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, Koyandinsky reservoir and 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, Kondratievskoye, Zharken, Solontsy, Kostomar, Rivers Freshwater, Shchidertinka, 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". It was found that the water quality of the analyzed water bodies of these regions did not change significantly during 2021-2023.

4. As part of the project, an information system has been created using the Microsoft Access environment. This information system with databases contains the results of scientific research in the reservoirs of Northern Kazakhstan. The information system contains the following information in the database: location of the reservoir (region, district, coordinates, type); sampling location; research methods used; physico-chemical data on the composition of water (including the concentration of pollutants, etc.); hydrobiological indicators of the reservoir (about the place, date and conditions of sampling, taxonomic affiliation, numbers, biomass, number of species of all ecological groups of aquatic organisms); species composition of ichthyofauna; morphometric indicators of fish; species composition of parasitofauna. Since the number of reservoirs in Northern Kazakhstan is limited, the amount of analyzed data will not grow. The proposed information system is justified in use. The reliability of the information system meets all modern requirements of such systems. Compared with other types of information systems, where there may be secret or particularly significant data from the point of view of confidentiality, this system contains experimental data that can be published in open sources. The main requirement is related to the reliable storage of the received data. The experimental data, performed using measurements and observations with different parameters, are well structured and presented in a Microsoft Access relational database in the form of tables. This form of data storage will allow for analytical conclusions and take into account the mutual influence of various indicators on reservoirs. The need for automated pollution control systems is quite high in the Republic of Kazakhstan. This is due to the

expansion of production in the raw materials industries, as well as the ever-increasing man-made burden on the natural environment.

5. The basics of ecological forecasting of the state and productivity of reservoirs, practical recommendations for conducting an environmental assessment of the current state of reservoirs in Kazakhstan and bioindication methods have been developed, which are being tested on the basis of the S. Seifullin Kazakh Agrotechnical Research University. After testing, the methodological recommendations developed within the framework of the project will be offered to biologists, ecologists and specialists in the field of aquatic and fisheries management.

Published works

Based on the results of the research work carried out in 2023, published:

- 1 article in a peer-reviewed scientific publication with a CiteScore percentile in the Scopus database – 76:

Gulmira Satybaldiyeva, Nazym Sapargaliyeva, Sayat Sharakhmetov, Zarina Inelova, Emil Boros, Elena Krupa, Aizhan Utarbaeyva and Kazbek Shupshibayev Species diversity of zooplankton of small steppe lakes of the Northern part of Kazakhstan// Water, 2023. Volume 15. Issue 23. P.1-16. <https://doi.org/10.3390/w15234054/> (Q1, Web of Science)

- 1 article in the journals of KOKSNVO RK:

Барбол Б.І., Сатыбалдиева Г.К., Шарахметов С.Е., Аубакирова М.О., Кабдолов Ж.Р., Джусупбекова Н.М., Жанабергенов А.О., Шупшибаев К.К., Утарбаева А.Ш., Бекпергенова Ж.Б. Солтүстік Қазақстан су қоймаларының кәсіптік балықтарының паразитофаунасы// Вестник КазНУ им. Аль-Фараби, Серия биологическая, № 3(96)2023. – С. 113-122.

- 2 articles in international conferences

1) Бекпергенова Ж.Б., Сатыбалдиева Г.К., Утарбаева А.Ш. Анализ экологического состояния водоемов Северного Казахстана за 2010-2022 гг. //Материалы международной научно-практической конференции «Сейфуллинские чтения - 19», посвященной 110-летию М. А. Гендельмана. I том, IV часть. – Астана, 2023. С. 232 -235.

2) Satybaldiyeva G.K., Sharakhmetov S.E., Zhanabergenov A.O., Utarbayeva A.SH., Bekpergenova Zh.B., Shupshibayev K.K., Aubakirova G.A., Krupa E.G., Barbol B.I., Sapargaliyeva N.S. Environmental assessment of the state of water bodies in Pavlodar region (Republic of Kazakhstan)// International Conference on Microbial Technology and Ecology (ICMTE - 23), Berlin, 2023. P. 1-6.

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.