

## Brief information about the project

Name of the project	AP19674623 «Innovative multi-spatial integrated approach to biomonitoring of saline ecosystems of Lake Alakol»
Relevance	On global scales, decreasing the inland waters relation with salinization is primarily caused by the combination of climate change and human activities, which is a significant ongoing threatening environmental factor in the extremely arid Kazakhstan. The process of environmental change can significantly be measured by species, guilds and community level of structure and diversity of ecosystems. The measuring and monitoring of environmental change is very difficult in vast geographical regions with large functioning ecosystems as in Kazakhstan. Consequently, to solve and manage these problems needs such innovative approaches by combination of macroecological methods with remote sensing techniques and GIS databases.
Purpose	To develop innovative approach to biomonitoring by combination of macroecological methods with remote sensing techniques and GIS databases in representative saline ecosystems of the Alakol lake
Objectives	<ul style="list-style-type: none"> <li>- To study some basic physical and chemical parameters of the Alakol lake system and its tributaries;</li> <li>- To study the species composition of higher aquatic and semi - aquatic plants of Lake Alakol. To identify the points of growth of rare and endangered species using GIS technologies;</li> <li>- To determine the content of heavy metals in the selected samples of higher aquatic and semi - aquatic plants;</li> <li>- To study the composition and structure of the algocenosis of Lake Alakol and assess the state of the water by the composition of algoflora, saprobic-indicator microalgae, as well as to identify promising crops for assessing aquatic ecosystems contaminated with various types of pollutants;</li> <li>- To survey the species composition and density of the nutrient cycling and transporting waterbird guilds. To tag some characteristic waterbird species with GPS transmitters, and follow their habitat selection, activity by high resolution time cover on large spatial scale both within Kazakhstan and outside the country during the migration route and wintering sites.</li> <li>- To built a high resolution time-series remote sensing mapping GIS database based on LANDSAT and MODIS satellite images. To integrate the complex macroecological field and GPS transmitter data into the GIS database and run the series of multivariate analysis with the variables of collected field and remote sensing data.</li> </ul>
Expected and achieved results	Getting environmental monitoring data of the basic physical and chemical factors from various characteristic inland waters along a saline to hypersaline salinity gradient on large spatial scale of Alakol lake-system and its

	<p>tributaries. These environmental monitoring provides the essential background variables for the multivariate analyses and evaluation of the macroecological field and the remote sensing data on multi-spatial scale. Biomonitoring data on the species composition of higher-aquatic and semi-aquatic plants around water sampling points will allow assessing the level of biodiversity, as well as identifying the distribution points of rare and endangered plant species using GIS. These results will serve as a basis for the interpretation of vegetation maps and the development of other vegetation diversity indices. The content of heavy metals will be determined in the selected samples of higher aquatic and semi - aquatic plants. The composition and structure of algocenoses of Lake Alakol will be studied and the state of the waters of Lake Alakol will be assessed according to the composition of algoflora, saprobic-indicator microalgae, promising crops will also be identified to assess aquatic ecosystems contaminated with various types of pollutants. The species composition and density of the nutrient cycling and transporting waterbird guilds will be studied. Some characteristic waterbird species with GPS transmitters, and follow their habitat selection, activity by high resolution time cover on large spatial scale both within Kazakhstan and outside the country during the migration route and wintering sites will be tagged. A GIS database will be created for mapping time series of remote sensing with high resolution based on LANDSAT and MODIS satellite images. Complex macroecological field and GPS transmitter data will be integrated into the GIS database and a series of multidimensional analysis with variables of collected field data and remote sensing data will be performed.</p>
<p>Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles</p>	<ol style="list-style-type: none"> <li>1. Inelova Zarina, Cand.Biol.Sc., associate professor: H-index – 5. Scopus: 57196243758. ORCID: 0000-0001-8778-5848.</li> <li>2. Bolatkhon Zayadan, D.Biol.Sc., professor: H-index – 17. Scopus: 6504770922. ORCID: 0000-0002-4572-2416.</li> <li>3. Boros Emil, PhD: H-index – 15. Scopus: 12767542500. ORCID: 0000-0001-6226-1757.</li> <li>4. Gavrilov Andrey, Cand.Biol.Sc., H-index – 6. Scopus: 57206225034. ORCID: 0000-0002-6808-1949.</li> <li>5. Yerubayeva Gulzhan, Cand.Biol.Sc., associate professor: H-index – 4. Scopus: 56226637900. ORCID: 0000-0001-9038-8616.</li> <li>6. Akmukhanova Nurziya, Cand.Biol.Sc., associate professor: H-index – 5. Scopus: 57190071427. ORCID: 0000-0002-9274-807X.</li> <li>7. Mukhitdinov Azamat, H-index – 2. Scopus: 57215721488. ORCID: 0000-0001-9066-6639.</li> <li>8. Aitzhan Mengtay, H-index – 2. Scopus: 57205245815. ORCID: 0000-0002-5945-7406.</li> </ol>

	9. Zaparina Yelena, H-index – 1. Scopus: 57202987631. ORCID: 0000-0001-6191-3573.
List of publications with links to them	1. Ye. Zaparina, Z. Inelova, E. Boros, B.Shimshikov Soils state analysis in the semi-aquatic zone of saline and soda lakes in Zhetysu (by the example of lake Alakol, Sasykkol, Zhalanashkol, Balkhash and Ushkol) // Tom 76 № 3 (2023): Eurasian Journal of Ecology DOI: <a href="https://doi.org/10.26577/EJE.2023.v76.i3.04">https://doi.org/10.26577/EJE.2023.v76.i3.04</a> <a href="https://bulletin-ecology.kaznu.kz/index.php/1-eco/article/view/1532">https://bulletin-ecology.kaznu.kz/index.php/1-eco/article/view/1532</a>
Patents	-