

## ANNOTATION

dissertation work on the topic: "Assessment of the current state of ichthyofauna of the southwestern Karatau macroslope rivers" for the degree of Doctor of Philosophy (PhD) in the educational program "8D08401 – Fisheries and industrial fishing"

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**General characteristics of the work.** The thesis examines fish communities and the state of their populations, the dynamics of ichthyofauna, genetic diversity and morphological features of native and alien fish species in small reservoirs of the southwestern macroslope of the Karatau ridge of the Syrdarya basin. The research work was carried out according to the IRN AP26100721 project "Study of the taxonomic and functional diversity of the Alatau ichthyofauna" approved by the Science Committee of the Ministry of Higher Education and Science of the Republic of Kazakhstan.

**Relevance of the research topic.** Fish are the final link in the trophic chain of reservoirs that regulate the flow of matter and energy and thus ensure the sustainable functioning of aquatic ecosystems. The species composition and abundance of fish in reservoirs serve as reliable indicators of the general state of the ecosystem. In recent decades, monitoring of aquatic ecosystems has become particularly relevant due to the increased anthropogenic impact on the environment. Effective management of fish resources and maintenance of ecosystem services in reservoirs is impossible without a detailed study of the ecological features of aquatic organisms. This problem is especially acute in the Aral Basin, where an environmental crisis has occurred as a result of irrational human activity. In this regard, a comprehensive study of fish communities in the basins of the Syrdarya river is of particular importance.

In the 20th century, the irrational use of water led to an environmental disaster in the Aral Sea basin. Over the past two decades, much attention has been paid to the condition of the small islands and the Syrdarya River, although the condition of other reservoirs in the basin remains poorly understood. In conditions of increasing anthropogenic impact on aquatic ecosystems, it is necessary to have accurate information about the state of organisms living in reservoirs. This makes it possible to identify trends in changes, take timely measures to prevent environmental damage and ensure sustainable fishing. Therefore, studying the ecology of fish and identifying the causes of changes in their species composition and abundance are urgent tasks.

The study of the composition and distribution of fish communities in the reservoirs of the Syrdarya is of both scientific and practical importance.

**The purpose of the study.** To study the diversity of fish communities and assess the state of their populations in the reservoirs of the southwestern macroslope of Karatau (basin of the Syr Darya).

**Research objectives.** In accordance with the purpose of the work, the following tasks were formulated:

1. To study the physico-chemical properties of river water in the southwestern Karatau macroslope;
2. To study the distribution and dynamics of changes in the diversity of ichthyofauna in small rivers and tributaries of the southwestern slope of the Karatau ridge in a temporal aspect;
3. To analyze the morphological and biological variability of fish living in small reservoirs of the southwestern macroslope of Karatau, and to determine the state of fish populations.
4. To investigate the genetic diversity of some native and alien fish species of the Syrdarya basin.
5. To assess the prospects for the conservation of native fish species under increasing anthropogenic pressure.

**The object of the study** is the fish population of the tributaries of the Syrdarya River and small reservoirs of the southwestern macro slope of Karatau.

**Subject of research:** physico-chemical parameters of reservoirs, distribution, taxonomic composition, abundance, biological and morphological parameters of fish, molecular and genetic features of mitochondrial DNA of some fish species.

**Research methods.** The thesis used classical methods of biological and morphometric studies

of fish and their statistical processing, molecular genetic methods for studying mtDNA, methods of systemic ecological analysis and multidimensional mathematical analysis.

**Scientific novelty of the dissertation work.**

The dynamics of the diversity of ichthyofauna and the density of fish populations in connection with the main abiotic parameters of reservoirs have been studied for the first time.

For the first time, the morphobiological variability and genetic features of the zeravshan dace *Leuciscus lehmanni*, turkestan gudgeon *Gobio lepidolaemus*, tashkent riffle bleak *Alburnoides oblongus*, golden spined loach *Sabanejewia aralensis*, tersky loach *Triplophysa coniptera*, Kuschakewitsch loach *Iskandaria kuschakewitschi* and spotted thicklip loach *Triplophysa strauchii* were studied.

For the first time, the effect of habitat fragmentation on the genetic structure of populations (zeravshan dace, sattar snowtrout, turkestan gudgeon, tashkent riffle bleak, golden spined loach, tersky loach, Kuschakewitsch loach and spotted thicklip loach) of fish has been established.

For the first time, comparative morphological and biological characteristics of populations of various fish species living in the Syrdarya River basin have been studied using multidimensional statistical methods.

For the first time, based on the study of the mitochondrial COI gene, the relationship between native (*Leuciscus lehmanni*, *Schizothorax intermedius*, *Alburnoides oblongus*, *Sabanejewia aralensis*, *Triplophysa coniptera*, *Iskandaria kuschakewitschi*, *Gobio lepidolaemus*) and one alien species (*Triplophysa strauchii*) fish has been clarified.

For the first time, the impact of the ecological crisis in the Aral-Syrdarya basin on the state of the ichthyofauna of the Syrdarya River tributaries has been established and a forecast of further changes has been given (the most vulnerable species have been identified).

**The theoretical significance of the work.** As part of the study, morphological and genetic analyses of microevolutionary processes were carried out in populations of 7 native and 1 introduced alien fish species into the basin. The results showed that the high morphological variability of isolated populations is largely due to environmental conditions rather than genetic differences.

**The practical significance of the work.** The study of the taxonomic composition and systematics of fish on the southwestern slope of the Karatau Ridge in the Syrdarya River basin revealed the dynamics of diversity and the current state of populations of native species. The data obtained helps to prevent the loss of unique species and minimize the economic costs of preserving temporary forms. The analysis of the external functional characteristics of fish in the context of their habitat allows for early diagnosis of changes in aquatic ecosystems. A comprehensive assessment of the state of aquatic ecosystems and fish populations inhabiting them provides an opportunity to rank the problems of their conservation in order to develop the most effective socio-economic measures for the conservation and rational use of existing fish biodiversity, as well as to prevent significant economic losses associated with the loss of environmental sustainability in the Syrdarya River basin.

**The main provisions submitted for protection:**

1. As a result of increased anthropogenic impact and climatic changes, significant transformations of the abiotic characteristics of the aquatic environment have occurred in most of the studied reservoirs of the Syrdarya River basin, including water level, turbidity, temperature and mineralization.

2. Currently, 21 species of native fish and 8 species of fish introduced from other regions live in the reservoirs of the southwestern slope of Karatau (Syrdarya River basin). In the conditions of artificial regulation of the Syrdarya River, the depletion of fish diversity affected the main stream to a greater extent than the tributaries. The tributaries of the Syrdarya River represent the last significant place where endemic fish species of the Syrdarya ichthyogeographic province are preserved.

3. The fragmentation of the habitats of local fish species and the homogenization of the composition of the ichthyofauna occur. Due to changes in habitat conditions and disruption of communication with tributaries, the gray stone loach *Triplophysa dorsalis* (Kessler, 1872), the minnow *Phoxinus phoxinus* (Linnaeus, 1758), the southern ninespine stickleback *Pugitius platygaster* (Kessler 1859), the Chatkal bullhead *Cottus jaxartensis* Berg, 1916, sawbelly *Hemiculter leucisculus*

(Basilewsky, 1855), sabrefish *Pelecus cultratus* (Linnaeus, 1758) disappeared from the rivers of the southwestern macroslope of the Karatau.

4. Compared to the period before the crisis, there was a decrease in the maximum size of five native fish species. At the same time, the variability of most morphometric indicators remains within the known values.

5. Isolation of populations of *Leuciscus lehmanni*, *Schizothorax intermedius*, *Alburnoides oblongus*, *Gobio lepidolaemus*, *Sabanejewia aralensis*, *Triplophysa coniptera*, *Iskandaria kuschakewitschi* and *Triplophysa strauchii* from the Syrdarya basins in individual rivers has led to the appearance of genetic features.

#### **Main results and conclusions of the study:**

1. Fluctuations in the water level in the studied area of the Syrdarya River in 2022-2024 differed from the natural regime, there was a low water level in the river during the flood period, and mineralization and turbidity increased during the summer period. Most of the rivers of the southwestern macroslope of Karatau do not reach the Syrdarya River due to irrigation use in the foothill zone. Increased nitrate ion content was observed in most rivers, including those located within protected areas. The Oyik, Boraldai and Arystandy rivers remained relatively clean.

2. In the long-term aspect, there is a tendency in the reservoirs of the southwestern slope of Karatau to decrease the number of native and increase the number of alien fish species. According to the results of our research, it has been established that the diversity and abundance of native species have significantly decreased. During the period of our research, the ichthyofauna was represented by one class, six orders, seventeen families, and 29 species. Representatives of the order Carpiiformes dominate in terms of taxonomic diversity. Most native fish species are still preserved in the Syr Darya basin. However, they were not found at the same time in any of the studied places. Many native species have significantly reduced their ranges compared to previously known data. The fish community changes from source to mouth. The most common fish species were the *Leuciscus lehmanni*, *Schizothorax intermedius*, *Gobio lepidolaemus* and *Triplophysa strauchii*.

3. The Oyik and Sarybas rivers are characterized by relatively stable physico-chemical parameters, which makes them favorable for the habitat of the native Sattar snowtrout. At the same time, the Karashik River, which is subject to significant anthropogenic stress, is a more suitable environment for the alien short-cycle topmouth gudgeon, stone moroko. For the first time, studies of biological parameters of both native and alien fish species have been conducted in the Syrdarya basin. (*Leuciscus baicalensis*, *Leuciscus lehmanni*, *Petroleuciscus squaliusculus*, *Gobio lepidolaemus* and *Triplophysa stolickai*) have been studied among the native species. The alien species included the (*Triplophysa strauchii* and *Oryzias sinensis*). The results of the study showed a decrease in the species diversity of fish in the region, especially native species, due to the combined effects of anthropogenic, biotic and abiotic factors. This has led to a decrease in the habitats of these species. The biological parameters of most native species corresponded to the data from the scientific literature.

4. To analyze the molecular diversity of native fish species in the Syrdarya basin, a fragment of the CO1 mitochondrial DNA gene was studied in *Triplophysa strauchii*, *Triplophysa coniptera*, *Iskandaria kuschakewitschi*, *Schizothorax intermedius*, *Leuciscus lehmanni*, *Sabanejewia aralensis*, *Alburnoides oblongus* и *Gobio lepidolaemus*. The results showed that the *Schizothorax intermedius* from the Syrdarya basin has a genetic uniqueness, which indicates its genetic isolation from populations in other bodies of water. A genetic division into two groups has been established for two species of char in the Syrdarya basin – *Triplophysa strauchii* and *Triplophysa coniptera*. Thus, it was found that the sattar snowtrout of the Syrdarya basin are noticeably more diverse than previously thought. Phylogenetic position and taxonomy of the *Schizothorax intermedius* in the revision.

5. The gray stone loach *Triplophysa dorsalis* (Kessler, 1872), the minnow *Phoxinus phoxinus* (Linnaeus, 1758), the southern ninespine stickleback *Pugitius platygaster* (Kessler 1859), the Chatkal bullhead *Cottus jaxartensis* Berg, 1916, *Barbus brachycephalus* Kessler, 1872, sawbelly *Hemiculter leucisculus* (Basilewsky, 1855), and sabrefish *Pelecus cultratus* (Linnaeus, 1758) disappeared from the rivers of the southwestern macroslope of Karatau. The continued stable existence of populations of carp *Cyprinus carpio* Linnaeus, 1758, Asp *Leuciscus aspilus* (Linnaeus, 1758), Freshwater bream

*Abramis brama* (Linnaeus, 1758), Prussian carp *Carassius gibelio* (Bloch, 1782), Pike-perch *Sander lucioperca* (Linnaeus, 1758), Wels catfish *Siluris glanis* Linnaeus, 1758 seems problematic due to the growing the population in the region. Under these conditions, compliance with the protection regime in the Karatau State Nature Reserve and rational water consumption throughout the region are of great importance for the preservation of the native ichthyofauna and the well-being of the region.

**Personal contribution of the author.** During the research, the author was directly involved in the collection of field data, conducted biological, morphometric and molecular genetic analyses of fish, followed by statistical processing using methods of univariant and multidimensional statistics. In addition, the author carried out bioinformatic analysis and compiled maps. Based on the analysis, generalization and interpretation of the results, the author has formulated the relevant conclusions. The structure of the dissertation corresponds to the approved plan agreed with the scientific supervisors. The author's personal contribution to joint publications consists in collecting materials, their primary processing, developing the concept, preparing and designing manuscripts.

**Approbation of the work.** The research results and the main provisions of the dissertation were reported and presented at various international scientific conferences: 11th International Conference: achievements & challenges in biology dedicated to the 120th anniversary of professor Mirali Akhundov on October 13-14, 2022 (Baku state University Baku. Azerbaijan abstract book Baku–2022). International Conference "Zoological Research in Kazakhstan in the 21st Century: Results. problems and prospects" dedicated to the 90th anniversary of the RSE "Institute of Zoology" of the National Academy of Sciences of the Republic of Kazakhstan. April 13-16, 2023 (Almaty. Republic of Kazakhstan). "Modern achievements in biomedicine and ecology" Proceedings of the International Scientific and Practical Conference dedicated to the 70th anniversary of the Doctor of Biological Sciences, Professor T.M. Shalakhmetova on April 20, 2023. (Almaty, 2023), BIO Web of Conferences 100, 04027 (2024) IFBioScFU 2024.

**Publications.** 8 scientific papers have been published on the topic of the dissertation, including 3 abstracts in the materials of International scientific and practical conferences, 3 articles in scientific journals on the specialty profile included in the KKSON RK list, and 1 article in the journal "Ecologica Montenegro" included in the Scopus database (Q 2) and the Web of Sciences (Q 2) + Amur chebachok BIO Web of Conferences.

Published materials (2022-2025):

1. International Conference:

1. Sapargaliyeva Nazym, Mamilov Nadir, Ibrayeva Gulmira. Diversity of fishes in the tributaries of the Syrdarya river within the Republic of Kazakhstan //11th International conference: achievements & challenges in biology devoted to 120th anniversary of professor Mirali Akhundov 13-14 october. 2022 Baku state university Baku. Azerbaijan abstract book Baku–2022. -p.277-278.

2. Ибраева Г.С., Мамилов Н.Ш., Беккожаева Д.К., Амирбекова Ф.Т., Кожабаева Э.Б., Сапаргалиева Н.С., Хабибуллин Ф.Х. Динамика разнообразия фауны рыб р.Карашик (бассейн р.Сырдарья) в условиях меняющейся антропогенной нагрузки //Междунар. конференция «Зоологические исследования в Казахстане в XXI веке: Итоги. проблемы и перспективы» посвященная 90-летию РГП «Институт зоологии» КН МНВО РК. 13-16 апреля 2023 года г. Алматы. Республика Казахстан. -с.233-238.

3. Ибраева Г.С. Қаратау оңтүстік-батыс еңісіндегі өзендердің қазіргі экологиялық жағдайын бағалау (Орталық Азия; Арал-Сырдария бассейні) //Биология ғылымдарының докторы. профессор. ҚЖМ ҰҒА корреспондент-мүшесі Тамара Минажқызы Шалахметованың 70-жылдығына арналған «Биомедицина мен экологиядағы заманауи жетістіктер» Халықаралық ғылыми-практикалық конференцияның материалдары. -Алматы, 2023. -280-285 бет.

1. Articles:

1. Ибраева Г.С. Первое описание пятнистого губача *Triplophysa strauchii* из Казахстанской части бассейна реки Сырдарья //Вестник КазНУ им. Аль-Фараби. серия биологическая. - Алматы "Қазақ университеті"-2023.- №2(95)7- с.116-127. DOI: <https://doi.org/10.26577/eb.2023.v95.i2.011>.

2.Ибраева Г.С., Сапаргалиева Н.С., Мамилов Н.Ш., Кожабаева Э.Б., Зияева Г.К. Морфологическая изменчивость и состояние популяции зеравшанского ельца *Leuciscus lehmanni* (Cypriniformes; Actinopterygii) из р.Шаян (бассейн р.Сырдарьи) //Вестник КазНУ им. Аль-Фараби. серия экологическая -Алматы “Қазақ университеті” -2023.- -№2(75).- с.-78-90. DOI: <https://doi.org/10.26577/EJE.2023.v75.i2.07>.

3.Ибраева Г.С. Чужеродные виды рыб в р. Карашик (Бассейн р. Сырдарьи) //Вестник КазНУ им. Аль-Фараби, серия биологическая. -Алматы “Қазақ университеті” -2023.- -№4(97).- с.96-106. <https://doi.org/10.26577/eb.2023.v97.i4.09>.

4.Nadir Shamilevich Mamilov, Gulmira Saifullaevna Ibrayeva, Eleonora Birlikzhanovna Kozhabaeva, Gulsum Zhumanovna Bilyalova, Gulnar Kerimbekovna Ziyayeva. A good word on topmouth gudgeon *pseudorasbora parva* in small impoundments in the Aral sea watershed (Central Asia, Kazakhstan) BIO Web of Conferences 100, 04027 (2024) IFBioScFU 2024. Doi.org/10/1051/bioconf/202410004027.

5.Nadir S. Mamilov, Gulmira S. Ibrayeva, Fariza T. Amirbekova, Dinara K. Bartunek, Nazym S. Sapargaliyeva, Eleonora B. Kozhabaeva, Gulsum Z. Bilyalova1, Gulnar K. Ziyayeva, Boris A. Levin. Recent changes in fish diversity in the ancient oases of the Syr Darya River (Central Asia) //Ecologica Montenegrina 86: 119-134 (2025) This journal is available online at: [www.biotaxa.org/em](http://www.biotaxa.org/em) <https://dx.doi.org/10.37828/em.2025.86.5>.

**The structure of the dissertation.** The thesis consists of an introduction, 3 main chapters, a conclusion, and a list of 436 references. The volume of the work is 134 pages and includes 56 tables, 53 figures and 3 appendices.