

ECOLOGICAL AND ECONOMIC SIGNIFICANCE OF NON-COMMERCIAL FISH SPECIES IN THE WATER BODIES OF BUKHARA REGION: AN OPEN-DATA-BASED ANALYSIS

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ABSTRACT. The aquatic ecosystems of Bukhara Region comprise rivers, canals, reservoirs, collectors and lakes, and their hydrological regime is strongly connected with the irrigation system. Available regional sources report 15 non-commercial fish species in the waters of Bukhara Region and adjacent water bodies, belonging to Cypriniformes, Perciformes and Cyprinodontiformes. According to official statistics, fish catch in Bukhara Region increased from 433 tonnes in 2010 to 6,376 tonnes in 2024, while the national figure reached 199,431 tonnes in 2024. Thus, Bukhara Region accounted for approximately 3.20% of the national catch in 2024. The analysis shows that low market value does not necessarily mean low ecological importance. Small fishes contribute to energy transfer within food webs, provide prey for larger fishes and support biodiversity. *Gambusia* is significant as a biological agent used for mosquito control. At the same time, some introduced species may compete with economically valuable fish. Therefore, regular and digital monitoring of these species is recommended.

KEYWORDS: Bukhara Region; non-commercial fish; ichthyofauna; aquatic ecosystems; fisheries; *Gambusia*; biodiversity; monitoring; Uzbekistan

1. INTRODUCTION

Bukhara Region is located in the lower part of the Zarafshan basin, and its aquatic system is closely connected with irrigation networks. The present hydrological system is linked with the Amu Darya through the Amu-Bukhara and Amu-Karakul canals. Collectors, canals, lakes and reservoirs provide additional habitats for fish.

Historically, connectivity among water bodies has significantly influenced fish dispersal and the formation of the regional ichthyofauna.

The importance of a fish community cannot be assessed only by the amount of fish that is sold or harvested. Small fishes with low commercial value may occupy important positions in food webs, serve as prey for larger fishes and aquatic birds, regulate the abundance of invertebrates and participate in nutrient cycling. Some introduced species may have dual effects: they may provide useful ecosystem services while also competing with economically valuable species.

Previous studies of fish in the water bodies of Bukhara Region have recorded a diverse ichthyofauna. A 2022 study reported 31 fish species belonging to 12 families in natural and artificial fishery water bodies and analyzed species requiring protection. The economic importance of fisheries is also increasing. According to official statistics of Uzbekistan, national fish catch increased from 8,784 tonnes in 2010 to 199,431 tonnes in 2024. In Bukhara Region, the figure increased from 433 to 6,376 tonnes over the same period. This highlights the need to study small and low-commercial-value fish occurring in the habitats of commercially important species.

2. MATERIALS AND METHODS

The study is based on a comparative analysis of secondary data rather than new field observations. Scientific articles on the fish fauna and fisheries of Bukhara Region, FAO materials, official data from the National Statistics Committee of Uzbekistan, and publicly available environmental documents were reviewed. The principal statistical series was the “Caught fish” indicator for regions for 2010–2024. According to the official methodology, this indicator is measured in tonnes and covers carp, pike-perch, bream, crucian carp, snakehead, roach, catfish, grass carp, silver carp, trout, sturgeon and other fish.

Open regional sources concerning non-commercial fish in Bukhara Region and adjacent waters were analyzed. Species were grouped by order and family, and their

direct commercial significance, ecological role and potential effects on fisheries were described. No unverified abundance or density values were invented. Where official numerical data were available, they were reported with their corresponding period; otherwise, the information was described qualitatively.

Bukhara Region's share of national fish catch was calculated as: Bukhara Region value / Uzbekistan value $\times 100$. Growth from 2023 to 2024 was calculated as: (2024 value – 2023 value) / 2023 value $\times 100$.

3. RESULTS

3.1. MAIN WATER BODIES OF BUKHARA REGION

Important aquatic systems for fisheries include the lower Zarafshan, irrigation networks connected with the Amu Darya, the Amu-Bukhara Main Canal, the Amu-Karakul Canal, collectors, lakes and reservoirs. Regional literature reports water bodies such as Dengizkul, Karakyr, Ayoqogitma, Khadicha, Devkhona, Zamonbobo, Zikri and Qumsultan. Public environmental documents also identify the Zarafshan River, Amu Darya, Amu-Bukhara Main Canal and Karakul Canal as major water bodies of the region.

The hydrological conditions of these water bodies are not uniform. Lakes and reservoirs provide relatively extensive habitats, whereas canals and collectors are more strongly affected by flow, salinity and seasonal water management. Consequently, Bukhara's waters can support both flow-adapted species and species tolerant of warm, slow-moving or anthropogenically modified habitats.

3.2. COMPOSITION OF NON-COMMERCIAL FISH SPECIES

An open regional source reports 15 non-commercial fish species in Bukhara Region and adjacent waters. Eleven species (73%) belong to Cypriniformes, three (20%) to Perciformes and one (7%) to Cyprinodontiformes. Thus, the reported non-commercial assemblage is dominated by small cypriniform and benthic forms.

Taxonomic note: nomenclature in older regional sources may differ from current catalogues. The names used in the source are retained in the table to preserve traceability to the evidence. Before final journal submission, all scientific names should be checked against a current taxonomic catalogue.

3.3. FISH CATCH DYNAMICS IN UZBEKISTAN AND BUKHARA REGION

Official data demonstrate substantial long-term growth. Fish catch in Uzbekistan increased from 8,784 tonnes in 2010 to 199,431 tonnes in 2024, more than twenty-two-fold. In Bukhara Region, it increased from 433 to 6,376 tonnes, approximately 14.7-fold. In 2024, Bukhara's share of the national total was approximately 3.20%, compared with 3.04% in 2023. The regional increase from 2023 to 2024 was approximately 7.2%.

However, growth was not linear. After 10,877 tonnes were recorded in Bukhara in 2021, the value declined in 2022 and 2023 and partially recovered to 6,376 tonnes in 2024. Such changes may be influenced by water regimes, aquaculture activity, stocking, fishing pressure, management practices and changes in statistical reporting. The statistical series alone, however, does not establish causation.

4. DISCUSSION

4.1. WHY ARE NON-COMMERCIAL FISH IMPORTANT?

The term “non-commercial” refers to low direct market value rather than biological insignificance. Small fishes use plankton, benthos, detritus and other food resources and transfer energy to larger fish and aquatic birds. Excluding them from monitoring can therefore prevent a complete assessment of aquatic ecosystem condition.

From a fisheries perspective, small species should not be treated uniformly. Some are simply components of natural food webs, whereas some introduced species

may compete with cultured fish for food and habitat. Management should therefore be species-specific.

4.2. THE DUAL SIGNIFICANCE OF GAMBUSIA

Gambusia provides a useful example. Regional sources report that it was introduced into Uzbekistan, used for biological control of mosquitoes, and occurs in warm, shallow and slow-moving waters. Its practical significance is therefore not as a fishery product but as an ecosystem service. At the same time, its effects on native aquatic communities should be monitored as an introduced species.

This example shows why industrial significance should be divided into direct and indirect components. Direct significance concerns saleable biomass, processing and aquaculture products. Indirect significance includes biological control, food-web functions, biodiversity and ecosystem stability. A species with low commercial value may therefore still affect the fishery system.

4.3. RELATIONSHIP WITH COMMERCIAL FISHERIES

Official statistics demonstrate substantial expansion of fisheries in Uzbekistan. National fish catch reached 199,431 tonnes in 2024. A separate government report stated that 5,367 fish-farming enterprises were operating and that fish-product production was expected to reach about 650,000 tonnes in 2024. However, the 650,000-tonne figure differs from the “caught fish” indicator because it has a different definition and coverage.

The 6,376 tonnes caught in Bukhara in 2024 demonstrate the region’s meaningful contribution to national fisheries. FAO’s historical analysis also showed substantial differences in productivity among water bodies in the Zarafshan basin: Tudakul historically reached up to 160 t/year, whereas other reservoirs generally had much lower yields. This supports water-body-specific rather than uniform regional fisheries management.

Non-commercial species may affect commercially important fish through food relationships, competition, predation, disease-vector interactions or habitat use. Including them in monitoring can therefore improve interpretation of changes in valuable fish populations. Practical monitoring should record species presence, relative abundance, size structure, seasonal distribution and co-occurrence with juveniles of commercial species.

4.4. OPPORTUNITIES FOR DIGITAL AND DATA-DRIVEN MONITORING

Because the journal announcement identifies digital technologies and innovation as a major direction, this ecological problem can be connected with digital fisheries management. However, this study does not claim that digital tools were experimentally tested. A future monitoring system could integrate georeferenced observations from reservoirs, canals and collectors with fish identification, water quality, catch statistics and seasonal sampling in a unified database.

Photo-identification, standardized electronic forms and mapping tools could improve consistency in species records. Time-series dashboards could compare non-commercial fish abundance with commercial fish catch, salinity, temperature and water flow. Such an approach may be particularly useful in a strongly modified aquatic system such as Bukhara.

5. CONCLUSION

Analysis of open sources shows that Bukhara Region supports a community of fish that are ecologically important but have low direct market value alongside commercially important fishes. Regional sources report 15 non-commercial fish species in Bukhara and adjacent waters: 73% belong to Cypriniformes, 20% to Perciformes and 7% to Cyprinodontiformes. Although their direct commercial value is low, their roles in food webs, biodiversity and ecosystem functioning may be important.

According to official statistics, fish catch in Bukhara Region increased from 433 tonnes in 2010 to 6,376 tonnes in 2024. In Uzbekistan as a whole, it increased from 8,784 to 199,431 tonnes over the same period. In 2024, Bukhara's share of the national total was approximately 3.20%. Because the statistical data also show substantial year-to-year variation, fisheries should be evaluated not only by total catch but also in relation to hydrological and ecological conditions.

The main practical conclusion is that non-commercial fish should be included in fisheries monitoring. Their presence, abundance and seasonal distribution provide information on aquatic ecosystem condition and interactions with commercial fish. The *Gambusia* example shows that useful ecosystem services and potential ecological risks of an introduced species should be considered together. In the future, combining field observations, standardized taxonomic identification, water-quality data, catch statistics and georeferenced digital records can support biodiversity conservation and sustainable fisheries development in Bukhara Region.

1-jadval. Tanlangan suv havzalari va ularning baliqlar uchun ahamiyati	Hydrological character	Significance for fish
Quyi Zarafshon	River/regulated flow	Tarqalish, oziqlanish, ko'payish; ekologik koridor
Amu-Buxoro magistral kanali	Artificial canal	Suv ko'chirish va baliqlar tarqalish yo'li
Amu-Qorako'l kanali	Artificial canal	Sug'orish va suv organizmlari uchun muhit
To'dako'l suv ombori	Reservoir	Historically important fishery site
Shurko'l suv ombori	Reservoir	Fishery habitat
Dengizko'l	Lake	Wetland and fish habitat

Qorakir	Lake	Kollektor-sug'orish tizimi bilan bog'liq baliq muhiti	
Oyoqog'itma	Lake	Regional fish habitat	
Xadicha, Devxona, Zamonbobo, Zikri, Qumsulton	Ko'llar/kollektor bilan bog'liq suvlar	Biodiversity and fish habitat	
2-jadval. Buxoro va unga tutash suvliklarda qayd etilgan ov ahamiyatiga ega bo'lmagan baliqlar	Order	Family	Main significance
Hemiculter leucisculus	Cypriniformes	Cyprinidae	Low direct value; food-web component
Alburnoides bipunctatus eichwaldi	Cypriniformes	Cyprinidae	Low direct value; prey for larger fish
Alburnoides taeniatus	Cypriniformes	Cyprinidae	Low direct value; food-web role
Rhodeus ocellatus	Cypriniformes	Cyprinidae	Small ecological component
Pseudorasbora parva	Cypriniformes	Cyprinidae	Low direct value; potential competition
Leuciscus lehmanni	Cypriniformes	Cyprinidae	Biodiversity component
Abbottina rivularis	Cypriniformes	Cyprinidae	Food-web and benthic-ecosystem component
Gobio gobio lepidolaemus	Cypriniformes	Cyprinidae	Benthic feeding; food-web role

Nemacheilus oxianus	Cypriniformes	Cobitidae	Benthic ecosystem component
Nemacheilus stoliczkai	Cypriniformes	Cobitidae	Benthic ecosystem component
Nemacheilus malapterurus longicauda	Cypriniformes	Cobitidae	Benthic ecosystem component
Knipowitschia caucasica	Perciformes	Gobiidae	Small predator/prey component
Rhinogobius bruneus	Perciformes	Gobiidae	Food-web component
Micropercops cinctus	Perciformes	Odontobutidae	Small predatory component
Gambusia affinis	Cyprinodontiformes	Poeciliidae	Low fishery value; biological mosquito control

3-jadval. Rasmiy ma'lumotlarga ko'ra ovlangan baliq, 2010–2024-yillar (tonna)	Uzbekistan	Bukhara
2010	8 784	433
2011	17 235	569
2012	25 885	870
2013	37 505	1 321
2014	46 392	1 571
2015	59 852	1 951
2016	65 322	2 813
2017	83 900	3 400
2018	90 984	3 738

2019	121 717	5 798
2020	144 103	7 082
2021	171 933	10 877
2022	185 274	10 043
2023	195 883	5 950
2024	199 431	6 376

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