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Types of Fish in Need of Protection in Fishing Reservoirs of Bukhara Region

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Abstract

Fishery reservoirs in Bukhara region are located in the lower reaches of the Zarafshan River and are one of the most important reservoirs in western Uzbekistan. Based on the research conducted in the natural and artificial fishery reservoirs of Bukhara region and the analysis of the literature on ichthyofauna of the region, it has been identified that 31 species of fish belonging to 6 genera and 12 families are found in the region. Of these 31 species, 23 species are listed in the Red Data Book of the International Union for Conservation of Nature (IUCN) and 5 species in the Red Data Book of the Republic of Uzbekistan.

Keywords

Aquaculture, Ichthyology, Systematics, Endemic Species, Valid Species, Invasive Species, Climate, Taxonomy

1. Introduction

Scientific classification of fish species, identification of species is important not only taxonomically, but also in determining the potential of the fishing industry, natural water resources and food composition. The species composition of the ichthyofauna of the water basin, the regular monitoring of the state of the population of these species on a scientific basis is an important task facing the sciences of ichthyology and aquaculture.

Bukhara region is located in the southwest of the Republic of Uzbekistan and along the lower reaches of the Zarafshan River. The Lower Zarafshan River started in the ancient times from the Kyzyltepa highlands, was located in the south of the Bukhara oasis, in the Karakol oasis, around Dengizkol, and flowed into the Amudarya, covering an area of yellow, red, brown sand and sandstone. As the Amudarya flows northwest (towards the Aral Sea), the Zarafshan River begins to

flow into the Amudarya. The Zarafshan River occasionally flowed into the Amudarya. However, as a result of the Kashkadarya and Sangzor rivers not flowing into Zarafshan, Zarafshan branched out and formed the Karakol delta. The Kashkadarya turns south, branches off and forms a large delta, the Sangzor River turns north and begins to flow towards Mirzachol, as a result of which the Zarafshan water decreases and does not reach the Amudarya. In the XVII-XVIII centuries, the water sources of the present-day Bukhara region were the Amudarya and Zarafshan rivers. Bukhara is the lower part of the Lower Zarafshan River and the Zarafshan Valley. The Lower Zarafshan River includes the Bukhara and Karakol oases. The length of collectors and canals flowing into the Lower Zarafshan River reaches 70 - 80 km [1]. As you can see, the Zarafshan River used to be the water supplier of Bukhara region in ancient times!

The current water supplier of Bukhara region is the Amudarya. From the Amudarya, through the pumping stations "Hamza-1", "Hamza-2" water rises to a height of 64 m and flows into the Amu-Bukhara canal, and the region is fully supplied with water.

To date, the main water supply of Bukhara region is the Amu-Bukhara canal, which is based on a single artificial irrigation system in the Republic of Uzbekistan. The water coming through the Amu-Bukhara canal is used only for irrigation of agricultural crops, winter saline washing of fields and irrigation of lands. The source of water for pond fisheries in Bukhara region is the southern, central and northern collectors and ditches. The collector in the region is a highly mineralized water of organomineral origin, formed as a result of irrigation and winter saline leaching. These effluents have accumulated to form large natural reservoirs such as Dengizkol, Karakir, Ayoqogitma, Khadija, Devxona, Zamonbobo, Zikri, Qumsultan. In Bukhara region, there are currently a total of 349 fish farms, which provide the population with quality and clean fish products. The total area of these fisheries is 34,570 hectares. Of these, 15 natural (4.29%) reservoirs (32,081 hectares), 92.8% and 334 artificial (95.7%) reservoirs (2489 hectares) 7.19% are fisheries (**Figure 1**).

The taxonomic study of fish living in the basins of Bukhara region began in the late 19th and early 20th centuries with the study of the lower reaches of the Amu Darya and the Zarafshan River. Several ichthyologists have conducted research:

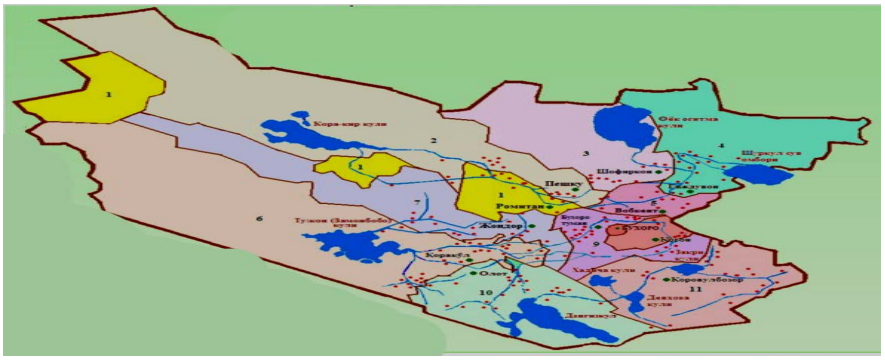

Figure 1. Map of natural and artificial fishing reservoirs in Bukhara region.

for example (1873-1940) Russian scientists N.A. Severtsov (1873), M.N. Bogdanov (1882), K.F. Kessler (1877), L.S. Berg (1905, 1948, 1949a, 1949b), F.A. Turdakov (1935, 1936), G.V. Nikolskiy (1940), R. Tleuov Tleuberganov (1974). In the course of the research, A.M. Nikolsky—14 rounds, 8 of these rounds, L.S. Berg—42 rounds, of which 26 rounds, G.V. Nikolsky and G. H. Shaposhnikova noted that 40 species, including 29 species, and B. Khakberdiev—27 species out of 36 species meet in the lower Zarafshan River [2]. Recent studies have estimated that there are 36 species of fish in the lower reaches of the Zarafshan River [3]. In 2014-2016, E.B. Jalolov noted that in addition to the economically viable fish in the Lower Zarafshan River, which flows through the Bukhara Fish Basin, there are more than 15 wild and non-wild fish [4]. E.B. Jalolov analyzed the impact of high aquatic plants on fish in the lower Zarafshan watersheds in his research on fish ponds in Bukhara region in 2016-2020 [5] [6] [7] [8]. B. Sheraliyev and E. Jalolov collected 28 species of fish samples from the middle and lower reaches of the Zarafshan River in 2017-2018 and analyzed them by DNA barcoding to create a phylogenetic pedigree of fish [9]. B. Sheraliyev and A. Ruzimov and others also conducted protected species and their current status and morphometric analysis in the lower reaches of the Amudarya and the Zarafshan River [10]-[17]. The aim of this study was to study the current taxonomic status of fish species in need of protection in the fishery basins of Bukhara region, as well as to compile a list of species listed in the International Union for Conservation of Nature (IUCN) and the Red Book of Uzbekistan.

2. Materials and Methods

This research was conducted in 2014-2021 at a total of 3839 points from all fish ponds and their tributaries in the territory of Bukhara region. Of these conditional objects, 2380 (61.99%) are located in natural fishing ponds, and 1459 (38.01%) are located in artificial fishing ponds. Fishing specimens were mesh 1 × 1 to 10 × 10 mm, 1 m high and 1.5 m wide, as well as special small mesh fishing nets and a variety of fishing gear. Fish samples were collected using the traditional method in all four seasons of the year: spring, summer, autumn and winter. Ichthyological research was based on the methodology of Kottelat and Freyhof (2006) [18]. Identifiers developed by local authors [19] and data from international fish databases were used to identify fish species [20]. The current conservation status of fish was verified through the online database of the International Union for Conservation of Nature (IUCN). The current status of fish protection in the country was checked through the Red Book of the Republic of Uzbekistan [21]-[26]. A 10% solution of formalin was used to fix the samples. Samples obtained for genetic analysis were fixed using a 96% alcohol solution to prevent denaturation of the protein. The systematic status of the fish was given on the basis of a generally accepted system [27].

3. Research Findings and Discussion

According to the 2019 list of the International Union for Conservation of Nature

(IUCN), more than 112,430 species on the planet are in need of protection. More than 30,000 of these species are endangered, accounting for 27% of the total list. If we look at this indicator in terms of individual animal classes, 16539 of them belong to the large class of fish.

If we look at the regions, we can see that more than 50 species of fish in the water basins of Uzbekistan are listed in the Red Book.

In the fish ponds of Bukhara region there are 6 species, 12 families and 31 species of fish. The latest edition of the Red Book of the Republic of Uzbekistan (2019) includes representatives of 6 species, 8 families and 18 species of fish. 1 species, 3 families, 5 species of these fish are distributed in the fishery reservoirs of Bukhara region, they are:

Category I. Cypriniformes Bleeker, 1859.

Family 1. Cobitidae Swainson, 1838.

1) *Sabanejewiaaurata* (De Filippi, 1863) [NT].

Local type. Hunting is prohibited. Occurs in the Lower Amudarya, the territory of Karakalpakstan, from the upper reaches of the Syrdarya, Zarafshan, Karadarya, Chirchik and Kashkadarya to the lower reaches. During the study, no fish were recorded in the lower Zarafshan watershed and in the Bukhara region.

Family 2. Cyprinidae Rafinesque, 1815.

2) *Luciobarbuscapito* (Güldenstädt, 1773) [VU: D]. Local type. Hunting is prohibited. The lower reaches of the Zarafshan River, which flows through the Bukhara region, prefer muddy waters and grow well in natural lake "Oyokogitma".

Family 3. Leuciscidae Bonaparte, 1835.

3) *Aspioluciusesocinus* (Kessler, 1874) [EN]. Endemic type. Hunting is prohibited. Fishing in the lower reaches of the Zarafshan River, which flows through Bukhara Province, is rare in the watersheds and was not reported during the study. Reproduction and protection measures need to be developed.

4) *Ballerussapa* (Pallas, 1814) [VU: D]. Local type. Hunting is prohibited. It is sparsely distributed in the lower Zarafshan stream flowing through Bukhara region and was not recorded during the study. Reproduction and protection measures need to be developed.

5) *Capoetobramakuschakewitschi* (Kessler, 1872) [VU: D]. Endemic type. Hunting is prohibited. It is less common in the lower reaches of the Zarafshan River, which flows through the Bukhara region, and was noted during the study.

Based on the results of ichthyological research in the fishery waters of Bukhara region and the results of previous research on fish in the region, the species composition of fish in need of protection in the fishery waters of Bukhara region was developed. The species composition of fish in need of protection in the fishery reservoirs of Bukhara region, formed during the study, is given by phylogenetic origin by category and family, and the species in their composition are given in alphabetical order:

Category I. Cypriniformes Bleeker, 1859.

Family 1. Cobitidae Swainson, 1838.

1) *Sabanejewiaaurata* (De Filippi, 1863)—[LC]. Local type. Hunting is prohibited. In the Lower Amudarya it is found mainly in the territory of Karakalpakstan, and beyond it in the area from the upper reaches of the Syrdarya, Zarafshan, Karadarya, Chirchik and Kashkadarya to the lower reaches. No fish were recorded in the Bukhara region during the study.

Family 2. Cyprinidae Rafinesque, 1815.

2) *Cyprinuscarpio Linnaeus*, 1758—[VU]. Local typw. Hunting is important. It is found in most water bodies of Lower Zarafshan, including in Bukhara region. The population has been declining recently.

3) *Luciobarbuscapito* (Güldenstädt, 1773)—[VU]. Local type. Hunting is prohibited. The lower reaches of the Zarafshan River, Bukhara region, prefer muddy water basins, it was noted during the study.

Family 3. Xenocyprididae Günther, 1868.

4) *Hemiculterleucisculus* (Basilewskiy, 1855)—[LC]. Randomly temperate, non-hunting species. All fisheries in the lower reaches of the Zarafshan River, which flows through the Bukhara region, are found in natural water bodies. It is becoming the dominant species.

5) *Hypophthalmichthys molitrix* (Valenciennes, 1844)—[NT]. Targeted climate, hunting is important. Natural water is rare in the basins, mainly in the fishing areas of the Zarafshan River. It is fed in all fish ponds of Bukhara region.

6) *Hypophthalmichthys nobilis* (Richardson, 1845)—[DD]. Incidentally adapted to the climate, hunting is important. Natural water is less common in the basins than in the white-tailed deer, and was recorded only in the fishing areas of the Zarafshan River. There is speculation that it was sent to the river by local fishermen. It is fed in all fish ponds of Bukhara region.

Family 4. Acheilognathidae Bleeker, 1863.

7) *Rhodeusocellatus* (Kner, 1866)—[DD]. Randomly temperate, non-hunting species. In the study, it was noted in the reservoirs and drainage canals that flow into the Zarafshan River.

Family 5. Gobionidae Bleeker, 1863.

8) *Pseudorasbora parva* (Temminck& Schlegel, 1846)—[LC]. Randomly temperate, non-hunting species. All fisheries in the lower reaches of the Zarafshan River, which flows through Bukhara region, are found in natural water bodies. It is becoming the dominant species.

Family 6. Leuciscidae Bonaparte, 1835.

9) *Abramisbrama* (Linnaeus, 1758)—[LC]. Local typer. Hunting is important. Fishing in the lower reaches of the Zarafshan River is very rare and was not recorded during the study. It is necessary to check the status of the population of this species in the lower Zarafshan.

10) *Alburnuschalcoides* (Güldenstädt, 1772)—[LC]. A species of local hunting importance. Widespread and studied in the watersheds of the Lower Zarafshan stream.

11) *Aspioluciusesocinus* (Kessler, 1874)—[VU]. Endemic type. Hunting is prohibited. It is sparsely distributed in the lower reaches of the Zarafshan River

and was not recorded during the study. Reproduction and protection measures need to be developed.

12) *Ballerussapa* (Pallas, 1814)—[VU]. Local type. Hunting is prohibited. Distributed in small numbers in the Lower Zarafshan stream, not recorded during the study. Reproduction and protection measures need to be developed.

13) *Capoetobrama kuschakewitschi* (Kessler, 1872)—[DD]. Endemic type. Hunting is prohibited. It is less common in the lower reaches of the Zarafshan River, it was noted during the study.

14) *Leuciscusaspius* (Linnaeus, 1758)—[LC]. The local species is of hunting importance. The lower reaches of the Zarafshan River are moderately distributed in fishery watersheds, according to the study.

15) *Pelecuscultratus* (Linnaeus, 1758)—[LC]. The local species is of hunting importance. The lower reaches of the Zarafshan River are distributed in fishing watersheds, it was noted during the study.

16) *Scardiniuserythrophthalmus* (Linnaeus, 1758)—[LC]. Indigenous species, hunting importance is not kata. Fisheries in the lower reaches of the Zarafshan River are sparsely distributed in water bodies, and were not recorded during the study.

Category II. Siluriformes Cuvier, 1816.

Family 7. Siluridae Rafinesque, 1815.

17) *Silurus glanis* Linnaeus, 1758—[LC]. The local species is of hunting importance. Most of the fisheries in the lower reaches of the Zarafshan River are distributed in water bodies.

Category III. Gobiiformes Bleeker, 1859.

Family 8. Gobiidae Cuvier, 1816.

18) *Neogobiusmelanostomus* (Pallas, 1814)—[LC]. Incidentally adapted to the climate. Hunting does not matter. The lower reaches of the Zarafshan River are fishery watersheds, which were noted during the study.

19) *Neogobiuspallasi* (Berg, 1916)—[LC]. Incidentally adapted to the climate. Hunting does not matter. The lower reaches of the Zarafshan River are fishery watersheds, which were noted during the study.

Category IV. Cyprinodontiformes Berg, 1940.

Family 9. Poeciliidae Bonaparte 1831.

20) *Gambusiaholbrooki* Girard, 1859—[LC]. It is the only non-hunting fish in Uzbekistan that is adapted to the climate to fight malaria. It is found in all fisheries in the lower Zarafshan River, especially in slow-flowing, warm and shallow water bodies.

Category V. Perciformes Bleeker, 1863.

Family 10. Percidae Rafinesque, 1815.

21) *Gymnocephaluscernua* (Linnaeus, 1758)—[LC]. The local species is not of hunting importance. Prior to the construction of the island, some fisheries in the lower reaches of the Amudarya and Zarafshan basins were sparsely distributed in the water basins, which were not recorded during the study.

22) *Percafluviatilis* Linnaeus, 1758—[LC]. The local species is not of hunting

importance. Prior to the drying up of the island, the lowest currents of the Amu-darya and Zarafshan basins were sparsely distributed in fishing watersheds, which were not recorded during the study.

23) *Sander lucioperca* (Linnaeus, 1758)—[LC]. Adapted to the climate, it is important for hunting. The lower reaches of the Zarafshan River are common in fishery watersheds and have been recorded in large numbers during the study.

Currently, 5 species (16.3%) out of 31 species of fish found in the fish ponds of Bukhara region are included in the Red Data Book of Uzbekistan. In general, 23 species (74.2%) of the region's ichthyofauna are included in the Red Data Book of endangered species. These include "Extinct" (EX; 0 species, 0%), "Species on the verge of extinction" (CR; 0 species, 0%), "Weak species" (VU; 4 species, 17.39%), "close" (NT; 1 species, 4.34%), "at risk of extinction" (LC; 15 species, 65.21%) and "Insufficient information" (DD; 3 species, 13.04%) [28] [29]. You can see these figures in the table below! (Table 1)

Table 1. Ichthyofauna of Bukhara region and protected species.

No.	Category	No.	Family	No.	Type	IUCN "Red book"	Uzbekistan "Red Book"
1	Cypriniformes Bleeker	1	Cobitidae Swainson	1	*Sabanejewiaaurata*	LC	NT
		2	Nemacheilidae Regan	2	*Dzihuniaamudarjensis*	-	-
				3	*Carassiusgibelio*	-	-
		3	Cyprinidae Rafinesque	4	*Cyprinuscarpio Linnaeus*	VU	-
				5	*Luciobarbuscapito*	VU	VU: D
				6	*Ctenopharyngodon idella*	-	-
				7	*Hemiculterleucisculus*	LC	-
		4	Xenocyprididae Günther	8	*Hypophthalmichthys molitrix*	NT	-
				9	*Hypophthalmichthys nobilis*	DD	-
				10	*Parabramispekinensis*	-	-
		5	Acheilognathidae Bleeker	11	*Rhodeusocellatus*	DD	-
				12	*Abbottinarivularis*	-	-
		6	Gobionidae Bleeker	13	*Gobiolepidolaemus Kessler*	-	-
				14	*Pseudorasboraparva*	LC	-
				15	*Abramisbrama*	LC	-
				16	*Alburnoidesholciki*	-	-
				17	*Alburnuschalcoides*	LC	-
				18	*Aspioluciusesocinus*	VU	EN
		7	Leuciscidae Bonaparte	19	*Ballerussapa*	VU	VU: D
				20	*Capoetobramakuschakewitschi*	DD	VU: D
				21	*Leuciscusaspius*	LC	-
				22	*Pelecuscultratus*	LC	-
				23	*Scardiniuserythrophthalmus*	LC	-

Continued

2	Siluriformes Cuvier	8	Siluridae Rafinesque	24	*Silurusglanis*	LC	-
3	Gobiiformes Bleeker	9	Gobiidae Cuvier	25	*Neogobiusmelanostomus*	LC	-
				26	*Neogobius pallasi*	LC	-
4	Anabantiformes Britz	10	Channidae Flower	27	*Channa argus*	-	-
5	Cyprinodontiformes Berg	11	Poeciliidae Bonaparte	28	*Gambusia holbrooki*	LC	-
6	Perciformes Bleeker	12	Percidae Rafinesque	29	*Gymnocephaluscernua*	LC	-
				30	*Percafluviatilis*	LC	-
				31	*Sander lucioperca*	LC	-

4. Conclusion

The ichthyofauna of Bukhara region currently consists of 31 species of fish. Due to the importance of endemic and endemic species in ichthyofauna, the development of conservation measures and the development of reproduction remains one of the most important tasks facing the science of zoology. In order to protect these fish species in need of protection, the introduction of special protection regimes in their habitats, *i.e.* the introduction of water reserves, the eradication of poaching, the study of fish biology and ecology and the organization of artificial reproduction. We thought it was necessary to do.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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