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The Current Condition of Ichthyofauna of Dengizkul Natural Water Basin

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Annotation: The article describes the ichthyological study of DengizkulLake which is the largest one in Bukhara region as well as its water supply, hydrochemical composition of water, ichthyofauna and its development, its condition in different years, the importance of fishery, bioecological characteristics of fish species that are fished or not fished.
Keywords: Dengizkul, ichthyological research, formation of ichthyofauna, water supply, chemical composition of water, fish species, fishing.

INTRODUCTION.

The earlyichthyological research in the Zarafshan River began in the late nineteenth and early twentieth centuries. These studies were conducted by Russian scientists N.A. Severtsov (1873), M.N. Bogdanov (1882), K.F. Kessler (1877), L.S. Berg (1948, 1949a, 1949b), G.V. Nikolskiy (1940), R. Tleuov and Sh. Tleuberganov (1974) and by other researchers [4], [5], [6], [13], [14], [16].

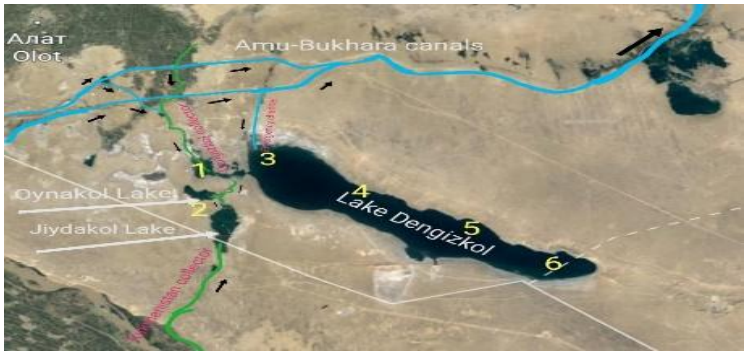
The lower course of the Zarafshanriverconsists of the main water basins such as Tudakul, Kuyimazor, Shurkul reservoirs and Dengizkul, Tuzkan, Karakir, Shurgak, Ayoqogitma lakes. The study of their ichthyofauna, its formation, the biology of fish, ecological features and other issues have been studied by a number of scientists, including M.A. Abdullaev (1989), G.K. Kamilov (1994), G.M. Sayfullaev (1995), D.S. Niyozov (2007), Z.A. Mustafoeva (2018), they studied the characteristics of different types of waters in terms of ichthyofauna and fishery management [3], [7], [12], [15], [22].

Methodology: The study and analysis of fish samples collected from the Dengizkul was conductedin accordance with generalmethods [8], [9], [10], [11], [18], [19], [20]. Combined nets of different eye sizes (№22-45) and fish samples caught in fishermen's nets were used to

catch fish. Non-fished species were caught using a 60 cm diameter net. In the process of identifying fish species and naming them, L.S. Berg [4], R. Fricke, W.N Eschmeyer [18], The Red Book of the Republic of Uzbekistan [21], I.M. Mirabdullaev, U.T. Mirzaev, A.R. Kuzmetov, Z.O. Kimsanov's determinants were used [8], [9], [10], [11]. Water samples from the Dengizkul were analyzed in the water analysis laboratory of the Bukhara Regional Department of Ecology and Environmental Protection.

Research results. The Dengizkullake system is currently a fishery due to the processes of privatization and denationalization in 2004 and has currently divided into 6 contours [17]. The first contour is an area of 534 hectares, which is connected to the Dengizkul collector and the reserve (emergency) canal of the Amu-Bukhara canal (Figure 1). The second contour covers an area of 1550 ha and consists of two (Oynakul, Jiydakul) small lakes (Fig. 1). The third contour is an area of 1000 hectares, most of which corresponds to the water intake of the large Dengizkul area.

Figure 1. Map of the sea



A branch of the Amu-Bukhara canal is connected to this contour as a storage (emergency) canal (Figure 1). The fourth, fifth, and sixth contours are in the large Dengizkul water area and have no clear boundary (Figure 1). These contours are connected to each other due to water intake networks (water inflow to each other can vary depending on the seasons and the amount of water). It is important to classify Dengizkul Lake and adjacent lakes as permanent and variable in terms of water intake sources.

This situation can be summarized as follows.

1-table

Contours	**permanent**	**Variable**

first	Dengizkol collector	Amu-Bukhara canal, Turkmen collector
second	Turkmen collector	Turkmen collector Amu-Bukhara canal,
third	Dengizkol collector	Amu-Bukhara canal, Turkmen collector
fourth	Dengizkol collector	Amu-Bukhara canal, Turkmen collector
fifth	Dengizkol collector	Amu-Bukhara canal, Turkmen collector
sixth	Dengizkol collector	Amu-Bukhara canal, Turkmen collector

The table above shows that the fish species composition of Dengizkol lake and its adjacent lakes are mainly based on the ichthyofauna of the Zarafshan River through the Dengizkul collector[33], [34], the ichthyofauna of the middle courses of the Amu Darya through the Amu-Bukhara canal [29], [30] and the ichthyofauna of the Turkmenistan collector (Table1).
It can be seen that the species composition of the lake ichthyofauna of Dengizkollake shows different indicators in different years [Table 2].

Ichthyofauna of Dengizkol natural lake in different years.

Table 2

№	FISH SPECIES	Abdullaev M.A. (1989)	Kamilov G.K (1994)	Sayfullaev G.M. (1995)	Niyozov D.S. (2007)	Mustafoeva Z.A. (2018)	Our information (2022)
Acipenseridae							
1	*Acipensernudiventris*(Lovetzky, 1828)	+	+	+	+	-	-
2	*Pseudoscaphirhynchus kaufmanni* (Kessler,1877)	+	+	+	+	-	-
Cyprinidae							
3	*Rutilus rutilus aralensis* (Berg, 1916)	+	+	+	+	+	+
4	*Leuciscus lehmani* (Brandt, 1852)	+	-	+	-	-	-
5	*Ctenopharyngodonidella*(Valencinnes, 1844)	+	+	+	+	+	+
6	*Mylopharyngodon piceus* (Richardson 1846)	+	-	+	-	-	-
7	*Aspius aspius taeniatus nation iblioides* (Kassler	+	+	+	-	+	-

	1872)						
8	*Aspiolucius esocinus* (Kessler, 1874)	+	-	+	-	-	-
9	*Gobio gobio lepidolaemus* (Kessler,1872)	+	-	+	+	-	+
10	*Capoeta Steindachneri*(Kessler, 1872)	+	-	+	-	-	-
11	*Barbuscapitoconocepnalus*(Kessler1872)	+	+	+	-	-	-
12	*Barbus brachycephalus* (Kessler 1872)	+	+	+	-	-	-
13	*Alburnuschalcoidesaralensis*(Berg, 1923)	+	+	+	+	-	+
14	*Alburnoides bipunctatus eichwaldi* (De Flippe, 1863)	+	-	+	+	-	+
15	*Alburnoides taeniatus* (Kessler, 1874)	+	-	-	-	-	-
16	*Pseudorasbora parva* (Temminck et Schlegel 1846)	+	+	+	+	+	+
17	*Abramisbramaorientalis*(Berg, 1949)	+	+	+	+	+	+
18	*Capoetobrama kuschakewitschi* (Kessler, 1872)	+	-	+	-	-	-
19	*Pelecuscultratus* (Linnaeus, 1758)	+	+	+	-	-	-
20	*Carassius auratus gibelio* (Bloch,1783)	+	+	+	+	+	+
21	*Cyprinus carpio* (Linnaeus, 1758)	+	+	+	+	+	+
22	*Hypophthalmichthysmolitrix*(Valenciennes 1844)	+	+	+	+	+	+
23	*Hypophthalmichthysnobilis* (Richardson, 1845)	-	+	+	-	-	-
24	*Noemacheilus stoliczkai* (Steindochner, 1866)	-	-	-	+	-	-
25	*Noemacheilus oxianus* (Kessler, 1877)	+	+	+	-	-	-
26	*Noemacheilus malapterus longicauda* (Kessler, 1872)	+	-	+	+	-	-
27	*Ballerus sapa* (Pallas 1814)	-	-	-	+	-	-
28	*Hemiculter leucisculus*(Basilewsky 1855)	-	+	-	+	-	+
29	*Abbottina rivularis* (Basilewskiy 1855)	-	-	-	-	+	+
	Cobitidae						
30	*Sabanejewia aurata aralensis*(Kessler,1877)	+	-	+	+	-	-
	Siluridae						
31	*Silurusglanis* (Linnaeus, 1758)	+	+	+	+	+	+
	Percidae						
32	*Perca schrenki* (Kassler 1874)	+	-	+	-	-	-
33	*Sander lucioperca* (Linnaeus, 1758)	+	+	+	+	+	+

Poecilidae							
34	*Gambusia holbrooki* (Girard, 1859)	+	+	+	+	+	+
Cobtidae							
35	*Knipowitschiacaucasica*(Berg 1916)	+	-	+	+	-	-
36	*Rhinogobius brunneus* (Temminck et Schlegel, 1845)	-	+	-	-	+	+
Channidae							
37	*Channaarguswarpachowskii* (Berg 1909)	-	+	+	+	+	+
	TOTAL:	30	23	31	22	15	17

A systematic analysis of the ichthyofauna of the Lake Dengizkul in 2022, revealed the existence of species belonging to 6 families. Including: 70% (12 species) of fish species represented Cyprinidae, 6% (1 species) Siluridae, Percidae, Poecilidae, Cobtidae, Channidae families (Fig. 2).

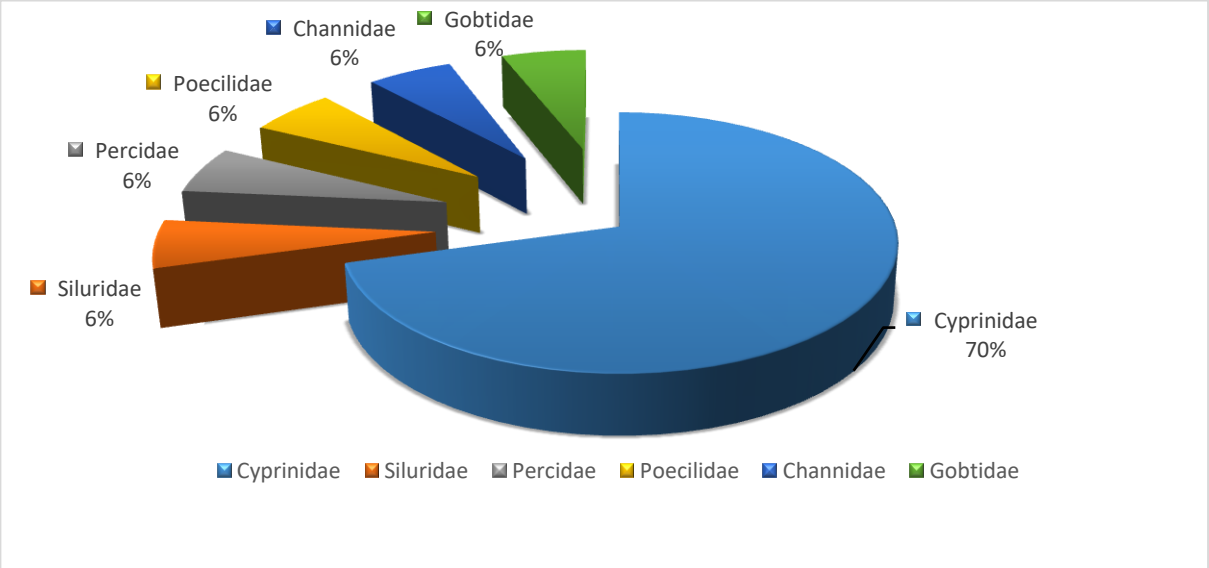


Figure 2. The ratio of species (%) of families of ichthyofauna of Dengizkul natural water basin according to families.

Diversity in the water supply of the Dengizkul natural water basin has led to some changes in its ichthyofauna, as can be seen from the data of the above authors. In particular, M.Abdullaev, who studied the Dengizkul basin for the first time, mentioned the presence of 4 species of fish (Rutilusrutilusaralensis, SapoetaSteindachneri, Carassiusauratusgibelio and

Cyprinuscarpio) (the source of water is Dengizkul collector) [1]. In his later research, he found that species composition has expanded and now includes 28 species:Ctenopharyngodonidella, Aspiusaspiusiblioides, Aspioluciusesocinus, Barbusbrachycephalus, Pseudorasboraparva, Pelecuscultratus, Hypophthalmichthysmolitrix, Hypophthalmichthysnobilis, Sander lucioperca, and Knipowitschiacaucasica which crossed the Amudarya. The research also shows that fishing in Dengizkul began in 1977, with Cyprinuscarpio (68.7%), Barbuscapitoconocepnalus and Barbusbrachycephalus (7.8%), Rutilusrutilusaralensis (6.8%) and a small amount of CapoetaSteindachneri, Hypophthalmichthys, Aspiusaspiusiblioides and Sander lucioperca (water source Amu-Bukhara machine canal reserve collector) [2]. According to another source, which analyzed the biological resources of Lake Dengizkul and other lakes of the country, the hydrochemical composition of the lake, water sources, its biotopes, hydrobionts occurring in it [25], fished and non-fished species, it can be seen that out of 16 species of fish 10 species are hunted and 6 species are non-hunted. According to this source, the chemical content of sulfate-chloride in the water of the lake is predominant and the total mineralization is 17025 mg / l [17].

Currently, 17 species of fish are found in the Dengizkul, and the main species of fish of hunting importance are Cyprinuscarpio, Silurusglanis, Channaarguswarpachowski, Carassiusauratusgibelio, Rutilusrutilusaralensis.).

Contour distribution of Dengizkolichthyofauna

Table 3

№	TYPES OF FISH	Fishing place					
		1-contour	2contour	3-contour	4-contour	5-contour	6-contour
1	**Rutilus rutilus aralensis* (Berg)	+	+	+	+		+
2	**Ctenopharyngodonidella*(Valencinnes)	+	+				
3	*Gobio gobio lepidolaemus* (Kessler)	+	+	+	+		+
4	**Alburnuschalcoidesaralensis*(Berg)	+		+			
5	*Alburnoides bipunctatus eichwaldi* (De Flippe)	+	+	+			
6	*Pseudorasbora parva* (Temminck et Schlegel)	+	+	+	+	+	
7	**Abramisbramaorientalis*(Berg)	+		+			

8	**Carassius auratus gibelio* (Bloch)	+	+	+	+	+	+
9	**Cyprinus carpio* (Linnaeus)	+	+	+			
10	**Hypophthalmichthysmolitrix*(Valenciennes)	+	+				
11	*Abbottina rivularis* (Basilewskiy)	+	+	+	+		+
12	*Hemiculter leucisculus*(Basilewsky 1855)		+	+			
13	**Silurusglanis* (Linnaeus)	+	+	+			
14	**Sander lucioperca* (Linnaeus)	+	+	+			
15	*Gambusia holbrooki* (Girard)	+	+	+	+	+	+
16	*Rhinogobius brunneus*(Temminck etSchlegel)	+	+	+	+	+	+
17	**Channaarguswarpachowskii* (Berg)	+	+	+			
	TOTAL:	**16**	**15**	**15**	**7**	**4**	**6**

Note- ** this mark is to show hunted species*

If we pay attention to the water supply of the Dengizkul, the water supply of different contours and the instability of the associated hydrochemical composition also determine the variability of the current ichthyofauna. In particular, the increase in collector water in the 1st contour of the lake lasts from late autumn to early spring and consisted of Alburnuschalcoidesaralensis, Pseudorasboraparva, Rutilusrutilusaralensis, Carassiusauratusgibelio; in the ichthyofauna formed in the first half of spring by Amu-Bukhara canal: fish such as Ctenopharyngodonidella, Abramisbramaorientalis, Hypophthalmichthysmolitrix, Sander lucioperca, Channaarguswarpachowskii fall more into the fishing nets. This condition is also characteristic of contour 3 of the natural water basin, with the exception of fish species such as Ctenopharyngodonidella and Hypophthalmichthys molitrix (Table3).

The water supply of the 2nd contour of the Dengizkul natural water basin is directly related to the collector water coming from the Republic of Turkmenistan. Also, the 2nd contour ichthyofauna was formed at the expense of the Turkmen collector. The formation of collector water, in turn, depends on the groundwater system of agricultural lands of Turkmenistan and the system of irrigation canals that supply them with water. Therefore, in this contour: Hemiculterleucisculus, Rhinogobiusbrunneus, Abbottinarivularis, Channaarguswarpachowskii, Abramisbramaorientalis are seasonally encountered.

There is also a relative variability in the formation of the 3rd contour ichthyofauna of the lake, which is of seasonal importance. In particular, due to the constant inflow of water from

contour 1, the similarity in the ichthyofauna of these contours is obvious. Due to water management in the Amu-Bukhara canal (seasonal technical training at Hamza I and Hamza II pumping stations)the composition of the ichthyofauna of the 3rd contour shows similarities with the ichthyofauna of the Amu-Bukhara canal. Accordingly, many species of fish can be found in both water basins, such as Abramisbramaorientalis, Rutilusrutilusaralensis, Carassiusauratusgibelio, Sander lucioperca, Alburnuschalcoidesaralensis [24].

Contour 4 of the Dengizkol natural water basin is a direct continuation of contour 3, and contours 5 and 6 are also connected to these contours without borders. It is also known from laboratory analysis that the water mineralization of these contours increases as they move away from the entrance to the lake (Table 4). This situation ensures the existence of fish species resistant to increasing water mineralization. Such fish species include Gambusiaholbrooki, Pseudorasboraparva, Gobiogobiolepidolaemus [31].

Seasonal average hydrochemical analysis of the contours of the Dengizkul natural water basin in 2020

TABLE 4

№	Identified measurements	Spring		Summer		Autumn		Winter	
		LakeDengizkol	Dengizkulditch	LakeDengizkol	Dengizkulditch	LakeDengizkol	Dengizkulditch	LakeDengizkol	Dengizkulditch
1	Pendentsubstances, mg / l	34	25	38	18	46	20	35	23
2	pH	8,0	7,0	8,2	7,0	8,0	7,0	7,5	7,0
3	Dryremains, g / l	29,4	8,0	29,6	8,0	28,0	9,0	29,6	5,8
4	Oxygen dissolved in water, mg / l	3,2	7,0	3,0	7,0	3,0	6,9	4,8	6,9
5	Biochemical consumption of oxygen, gO_2 / l	3,7	8,0	3,0	6,0	4,1	7,3	3,0	5,0
6	Ammoniumnitrogen, mg / l	1,7	1,8	1,2	2,0	1,8	2,3	1,6	1,8

7	Nitrites, mg / l	0,04	0,12	0,04	0,12	0,03	0,12	0,04	0,12
8	Nitrates, mg / l	6,2	8,2	5,8	8,5	5,6	8,6	6,3	8,5
9	Chlorides, g / l	21,7	2,37	22,0	3,75	20,8	4,73	14,4	1,9
10	Sulfates, g / l	6,6	3,91	6,7	1,92	6,2	2,8	7,7	3,4
11	Phosphates, mg / l	0,1	0,2	0,1	0,2	0,1	0,2	0,1	0,2
12	Sodium, mg / l	827	711	1287	1090	778	805	631	483

The specific hydrochemical composition of the water of the 5th contour of the Dengizkul natural water basin, the acidity of the water formed due to the gas-extracted pipes associated with the contour area, also caused a relative variability in the species composition of fish. Only 4 species of fish are found in this area: Gambusiaholbrooki, Rhinogobiusbrunneus, Carassiusauratusgibelio, Pseudorasboraparva.

Although the mineralization of the natural contour water of the 6th contour is higher than that of the other contours, diversity of fish species was observed relative to the contour 5. This is due to the constant inflow of water (0.5 m3 / sec) into this contour of the lake from artesian wells in the south-eastern part of the lake, the relatively low average depth of the lake, the well-developed vegetation coverage in the literal part of the lake [23], [26], [27]. Species specific to this contour ichthyofauna include: Rutilusrutilusaralensis, Gobiogobiolepidolaemus, Carassiusauratusgibelio, Abbottinarivularis.

Contours 4, 5 and 6, which make up the majority of the main water area of the Dengizkul, do not currently have fish farms and have not been fished since 1995. The Dengizkul natural water basin is also included in the list of the international RAMSAR convention as the main gathering area for water and submarine birds[32].

Based on the above, it can be said that the variability of the ichthyofauna of Lake Dengizkul in different years is directly related to the water supply of the lake, and the large discharge of water through the Amu-Bukhara canal enriches the diversity of species. This is confirmed by the predominance of local species that enter or form through the Amudarya due to the maximum inflow of canal water in the 1st and 3rd contours of Lake Dengizkul, the formation of which is closely linked to the ichthyofauna of the Amudarya. The relative increase in water mineralization has been significant over the last 5 years can be seen in our and Z.A. Mustafayeva's research. The increase in species diversity compared to the contours of the ichthyofauna species composition of the main water area of Dengizkul Lake is slightly lower

in the contours 5 and 6, where the salinity is highest, while in the areas where the lake enters the water.

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