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"SYSTEMATIC DESCRIPTION OF ZOOPLANKTON SPECIES AND DETERMINATION OF THE SPECIES COMPOSITION OF THE DENGIZKUL WATER BODY IN THE BUKHARA REGION."

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ABSTRACT: *In this article, the species composition, density and physicochemical properties of zooplankton organisms for different types of water bodies of the Dengizkul water basin were studied. During the study, water samples were taken from 3 contours of the Dengizkul water basin, a cirrhotic channel, and collectors. Zooplankton were identified microscopically and separated into species using spectrometers. The systematic description of zooplankton species, the relative differences in the zooplankton of the water body due to the fact that samples were collected at different times and from different water depth layers, were studied in cross-sectional areas. A number of factors such as water temperature, pH level, oxygen content and degree of mineralization were identified as the main factors affecting the composition and density of zooplankton. The results obtained are of important scientific and practical importance in assessing and improving the ecological status of Lake Dengizkul.*

KEYWORDS: *Bukhara region, Dengizkul water basin, zooplankton organisms, seasonal development, succession, Classes Rotifera, Cladocera, Copepoda.*

INTRODUCTION

At present, considerable attention is being paid to conducting new research on the taxonomy of zooplankton species. In this field, in particular, systematic research methods are being applied to classify species based on their morphological characteristics, to carry out comparative evaluations among species, to study their origins, and to eliminate errors in morphological identification. These issues have been discussed in detail in the works of I.M. Mirabdullaev.

Although numerous studies have been conducted to determine the systematic position of zooplankton species from various water bodies, certain uncertainties still remain in the study of their morphological differences.

In order to effectively cultivate fish fry in fish farming enterprises, several practical measures are planned to implement local innovative technologies

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for producing live feed - such as Daphnia, Cyclops, and other promising specie

LITERATURE REVIEW

In the "Action Strategy for the Further Development of the Republic of Uzbekistan", important tasks were defined in the field of "stimulating scientific research and innovation activities and creating effective mechanisms for implementing scientific and innovative achievements into practice" [1]. Based on these objectives, the study of the ecological condition of water bodies, the species composition of zooplankton representatives, their development under various climatic conditions, as well as the exploration of possibilities for the natural reproduction of zooplankton species as a natural feed source in fish farms, are of significant scientific and practical importance. Comprehensive studies conducted by Kh.Kh. Abdinazarov on the zooplankton of the Fergana region's water bodies have great importance for understanding the hydrobiological diversity of the region. These studies identified the specific characteristics of zooplankton communities within different hydrocenoses of the valley.

In particular, both quantitative (abundance and biomass) and qualitative (species diversity) indicators of zooplankton were determined for various types of water bodies. Thus, in mountain areas, 14 species were recorded; in plain lakes, 40 species; in fish farms, 78 species; and in rice fields, 71 species of zooplankton were identified [2, pp. 7-11]. During hydrobiological research in the Aydar–Arnasay lake system, Z.A. Mustafaeva and A.R. Kuzmetov identified 45 species of zooplankton organisms. Among them were 12 species of Cladocera (branch-horned crustaceans), 6 species of Copepoda (oar-footed crustaceans), and 27 species of Rotifera (rotifers). In quantitative terms, the Copepoda were dominant, with a density ranging from 238,000 to 299,000 individuals per cubic meter and a biomass of 4.981-6.4 g/m³. The number of Cladocera ranged from 11,600 to 90,000 individuals per cubic meter, with a biomass of 0.441-0.914 g/m³. For Rotifera, these indicators amounted to 48,330 individuals per cubic meter and a biomass of 0.0145 g/m³, respectively [3, pp. 3-18].

M.A. Abdullaev, D.S. Niyozov, M.R. Ergashev, and D.U. Urchinov conducted research on the food base and fish productivity of Lake Tuzkon (Zamonbobo). In their studies, they identified 12 species of zooplankton organisms and determined that the primary biomass of zooplankton was composed of the crustaceans Diaphanosoma brachyrium, Ceriodaphnia reticulata, and Acanthocyclops viridis.

Among benthic organisms, 8 species were identified, and within the chironomid complex of Lake Tuzkon, the dominant benthic genera were Chironomus, Cryptochironomus, and Pelopia [4, pp. 208-210].

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In March 2018, studies were conducted in the coastal zone of the Bahár-Dar Bay of Lake Baikal to determine the diversity and ecological dynamics of zooplankton species. As a result, a total of 78 zooplankton species were recorded [5].

Research carried out by A.R. Kuzmetov and I.M. Mirabdullaev showed that the development of zooplankton organisms was observed in the coastal zone, the central part, and the outflow areas of the lake. A total of 9 zooplankton species were identified. During this season, the predominant groups were Copepoda (oar-footed crustaceans) and Cladocera (branch-horned crustaceans) [6, pp. 6-10].

W. Lampert, in his experiments at Lake Constance (Germany), studied the trophic interactions between zooplankton and phytoplankton, as well as their direct influence on water quality. He found that both Daphnia and young Cyclops individuals use similar food sources, which contributes to the effective assimilation of suspended organic matter and primary production by these organisms [7, pp. 49-64].

Between 2022 and 2024, research conducted in the water bodies of the Bukhara region examined the composition and seasonal dynamics of zooplankton. These studies were carried out by M.A. Yuldashev and S.B. Normurodov, who investigated water bodies in the Karakul, Alat, and Jondor districts [8, pp. 56-62].

Soonmi Lee and Sinjae Yoo, studying the trophic relationships of zooplankton in the aquatic ecosystems of the Republic of Korea, emphasized the special role of diatom algae in ensuring the optimal development of zooplankton [9, pp. 31-46].

Charles Farwell, in his research on the species composition and community structure of zooplankton along the California coast and in the central marine zone, noted significant differences between these regions. He attributed this phenomenon to the fact that coastal waters receive more direct solar radiation, resulting in higher temperatures and consequently more favorable conditions for zooplankton development compared to offshore waters [10, pp. 64-76]. In the works of V.F. Gurvich and M.V. Pavlova, data were presented on the zooplankton organisms of the Kosonsoy Reservoir, where 11 species were identified: 6 species of Rotifera (rotifers), 4 species of Cladocera (branch-horned crustaceans), and 1 species of Copepoda (oar-footed crustaceans). Among them, the most characteristic were Daphnia longispina (Müller, 1776), Ceriodaphnia reticulata (Jurine, 1820), and Cyclops lacustris [11, pp. 48-56].

N.I. Yermolayeva, Y.Y. Zarubina, R.E. Romanov, G.A. Leonova, and A.Z. Puzanov, in their studies conducted on several lakes in the Novosibirsk region, demonstrated that the biological productivity of lakes is significantly influenced by the abundance of dominant

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species, particularly zooplankton and macrophytes. Based on this, they also presented data on the biomass of these organisms [12, pp. 67-79].

T.G. Stoyko, V.A. Burdova, and Yu.A. Mazey, as a result of their research on hydrobionts of Lake Inorka located in the Moldavian State Nature Reserve, identified 49 species of zooplankton organisms. Among them, 33 species belonged to Rotifera (rotifers), 12 to Cladocera (branch-horned crustaceans), and 4 to Copepoda (oar-footed crustaceans). They also studied the distribution and development of these organisms under various environmental conditions [13, pp. 357-364].

Markus Pahlow and A.E. Friederike Prowe, based on their research conducted in Western European aquatic ecosystems, explained the seasonal developmental characteristics of zooplankton organisms [14, pp. 129-144].

RESEARCH MATERIALS AND METHODS

In 2024-2025, a series of studies were conducted to assess the hydrochemical parameters of Lake Dengizkul. Water samples were collected from the first, second, and third contours of the reservoir. The collected water samples were delivered within 12 hours to the Scientific Laboratory of Biotechnology and Ichthyology at Bukhara State University, as well as to the Water Analysis Laboratory of the Bukhara Regional Department of Sanitary and Epidemiological Welfare and Public Health. Analyses were performed following the methodological guidelines of Yu.Yu. Lure and N.S. Stroganov [15, p. 446; 11, p. 195].

The determination of the physicochemical composition of the water was carried out using two methods:

1. In the field, the mineral composition of the water was analyzed using the Pro Aquatest reagent kit (Germany).

2. In laboratory conditions, hydrochemical analyses were performed according to the methods of Yu.Yu. Lure and N.S. Stroganov, and in accordance with the GOST 31861–2012 standard [16, p. 36].

In field conditions, the color of the water was determined using the Forel–Ule color scale. The water temperature was measured both in the laboratory and directly in the reservoir using a TM-3 meteorological thermometer. The turbidity and transparency of the water were determined using a Secchi disk, while the hydrogen index (pH) was measured with a Testo 64 pH meter. All other hydrochemical indicators were measured under laboratory conditions. The dissolved oxygen concentration in the water was determined using an Oxygen Meter 8403 oximeter and by the Winkler method. Sampling of zooplankton was conducted using standard hydrobiological methods. To collect zooplankton organisms, a Djeddi net made of nylon fabric and having a conical shape was used. For collecting

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samples from deeper and central parts of the lake, a plankton sampling device (bathometer) was employed.

To obtain zooplankton samples from all water layers, the Djeddi plankton net was drawn from the bottom to the surface of the water. The collected samples were placed in containers, to which several drops of a 1% formalin solution were added, or they were fixed in a 70% ethyl alcohol solution. Samples were stored in a cool place, after which the species composition was analyzed.

During laboratory experiments, a binocular magnifying lens and microscopes of the XDS-3 and B-380 models were used. The Bogorov counting chamber played an important practical role in determining the qualitative and quantitative characteristics of zooplankton.

ANALYSIS AND RESULTS

During the course of the study, the physicochemical properties of water samples collected from the three contours of Lake Dengizkul, as well as from the Sibroz canal and collectors, were analyzed. The results of the analysis showed that the alkalinity of the water in the first, second, and third contours ranged from 4.4 mg/L to 5.8 mg/L, whereas in the Sibroz canal and collectors this indicator varied from 2.8 mg/L to 5.0 mg/L.

The degree of mineralization of the water changed proportionally with the increase in the concentrations of sulfates, chlorides, and nitrate nitrogen. In particular, in the first, second, and third contours, the concentration of chlorides ranged from 1701.0 mg/dm³ to 3327.0 mg/dm³, and sulfates from 2148.0 mg/dm³ to 4855.0 mg/dm³. In the waters of the Sibroz canal and collectors, the concentration of chlorides ranged from 2568.0 mg/dm³ to 2621.0 mg/dm³, while sulfates ranged from 2958.0 mg/dm³ to 2981.0 mg/dm³.

The dissolved oxygen content in the contour waters flowing into Lake Dengizkul ranged from 5.6 mg/L to 6.7 mg/L. The oxygen oxidizability varied between 177.5 mg/L and 256.0 mg/L, and the pH value ranged from 7.0 to 7.5. At the same time, in the Sibroz canal, the dissolved oxygen content was within 2.2-2.4 mg/L, as confirmed by analytical results. When collecting zooplankton samples, the following parameters were calculated: Number of species (S), Density (D), ind./L, percentage share (%).

The physicochemical parameters of the water were also presented in the form of a diagram, illustrating the main variations in the analyzed indicators

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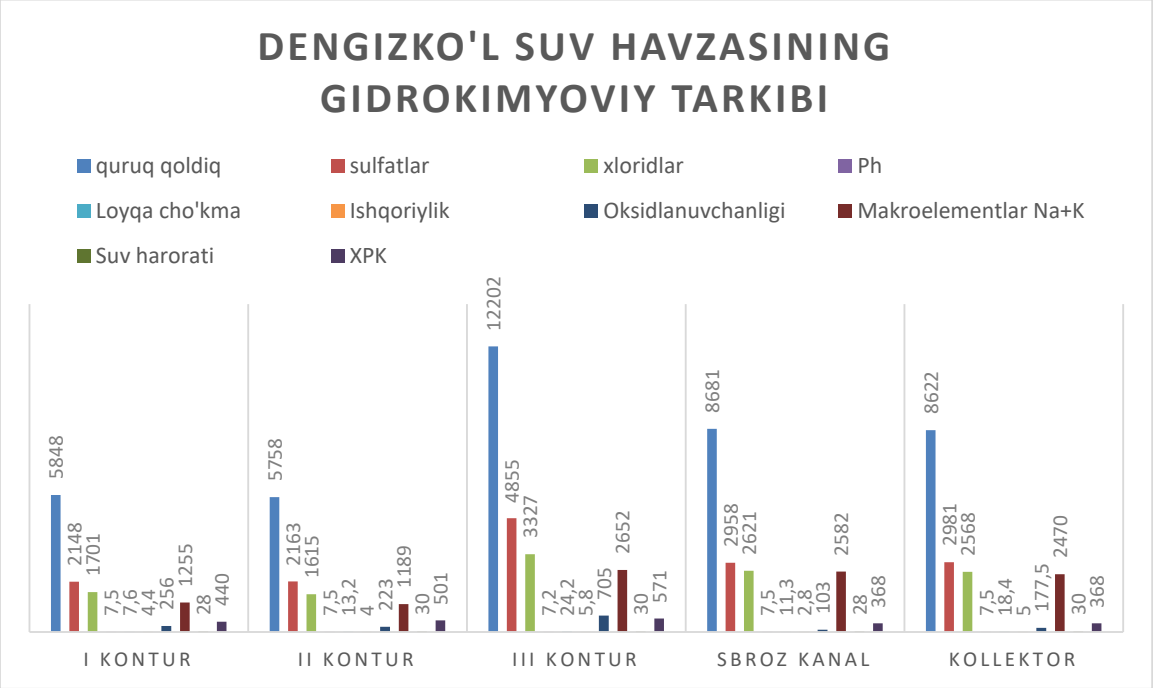

Table 1. Zooplankton species composition in Devkhona, Sariqamish, and Dengizkul Lakes.

№	Species	Devkhona Lake (Bukhara)	Sariqamish Lake (Fergana) [Abdinazarov, 2018]	Dengizkul Lake (Bukhara, 2025)
1 Rotifera (Wheel Animalcules)				
1	*Asplanchna sieboldi* (Leydig, 1854)	+	+	–
2	*Brachionus calyciflorus* (Pallas, 1766)	+	+	+
3	*Keratella quadrata* (Bory de St. Vincent, 1822)	+	+	+
4 Cladocera (Branch-horned Crustaceans)				

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1	*Daphnia longispina* (O.F. Müller, 1776)	+	–	+
2	*Daphnia magna* (Straus, 1820)	+	–	+
3	*Bosmina longirostris* (O.F. Müller, 1776)	+	+	+
4	*Daphnia pulex* (Leydig, 1860)	+	+	+
5 Copepoda (Oar-footed Crustaceans)				
1	*Cyclops sp.* (Burmeister, 1834)	+	–	+
2	*Cyclops vicinus* (Müller, 1785)	+	+	+
3	*Nauplius larva Cyclops* (Müller, 1785)	+	+	+
4	*Eucyclops serrulatus* (Fischer, 1851)	+	–	–

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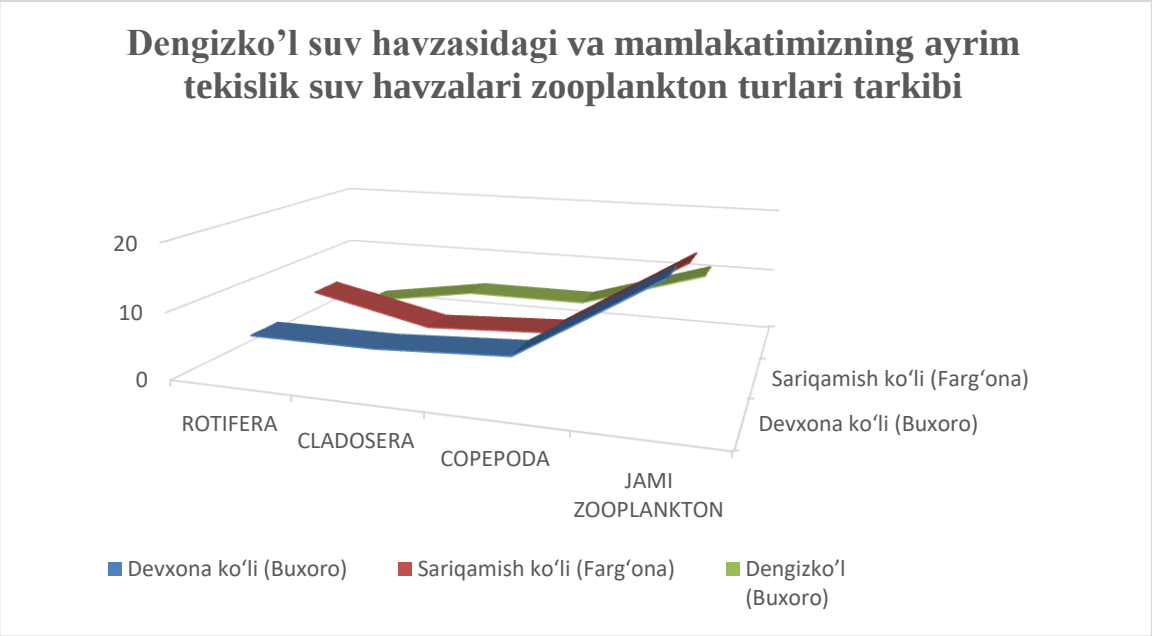
According to the data presented in the table, an analysis of water samples collected from various areas of Lake Dengizkul revealed that copepods (Copepoda) dominate in terms of species abundance, accounting for 46.45% of the total number of zooplankton organisms.



Among them, the most frequently encountered species were Cyclops sp., Cyclops vicinus, and Nauplius larva Cyclops. During the study, the occurrence and distributional differences of zooplankton species within the water body were examined. According to the data summarized in the table, Lake Dengizkul contained the following: 2 species belonging to the class Rotifera (rotifers), 5 species from the class Cladocera (branch-horned crustaceans), 5 species from the class Copepoda (oar-footed crustaceans). The analysis showed that Cladocera made up 20.18% of the total zooplankton composition; among them, the most common species were Daphnia pulex, Daphnia magna, and Daphnia longispina. Copepoda accounted for 46.45% of the total number of zooplankton organisms, with Cyclops sp., Cyclops vicinus, and Nauplius larva Cyclops being the dominant species. Across the three studied areas of the water body, the total number of species amounted to 6, representing 12.6% of all recorded zooplankton organisms. The obtained data and analytical results were documented.

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A comparison of Lake Devkhona and Lake Sarykamysh with Lake Dengizkul in terms of species richness and composition showed that their higher species diversity is associated with more intensive inflow from various water sources, relatively higher and moderate water temperatures, and lower salinity levels. The hydrochemical analysis of Lake Dengizkul indicated that the physicochemical properties of the water have a significant impact on species diversity, promoting the development of zooplankton organisms that are tolerant to elevated salinity levels. The presence of zooplankton organisms in the Dengizkul water body also confirms that they serve as the main natural food source for cultivated carp species in the areas where aquaculture activities are established, demonstrating their essential biological and economic importance.

CONCLUSIONS

1. As a result of the conducted research, it was established that zooplankton communities in lowland lakes of various regions of Uzbekistan (including Lake Dengizkul) are characterized by similar species composition, which indicates the existence of common ecological and biological patterns in their formation and distribution.

2. The study identified the species composition, density, and relationship between zooplankton organisms and the ecological condition of the lake. In total, 11 zooplankton species were recorded, belonging to the classes Rotifera, Cladocera, and Copepodae.

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3. The highest abundance of zooplankton was observed among representatives of the Copepoda group, which confirms their high ecological adaptability to various environmental conditions.

4. Optimal indicators of water temperature, oxygen concentration, and mineralization levels create favorable conditions for the survival and development of zooplankton organisms in Lake Dengizkul.

PRACTICAL RECOMMENDATIONS

The Lake Dengizkul water body differs from other lakes by its higher salinity level. The productivity and distribution of zooplankton are directly dependent on their distribution coefficient. The abundance of dominant and promising species is determined by the chemical composition and volume of water in the lake. However, the gradual decrease in water volume may lead to a reduction in zooplankton species diversity. At present, in addition to the natural development of zooplankton, it is planned to carry out laboratory cultivation and propagation of brine shrimp (Artemia salina) in the waters of Lake Dengizkul. This species is known for its high tolerance to saline environments and can serve as an effective natural feed for fish cultivated in aquaculture systems.

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