

## ASSESSMENT OF SEASONAL CHANGES IN LEADING ZOOPLANKTON SPECIES OF LAKE ZAMONBOBO

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### **Abstract**

This scientific article analyzes the results of hydrobiological studies of the zooplankton community in Lake Zamonbabo in the Bukhara region, conducted between April and October 2024. During the study, 33 species of zooplankton were identified, of which 51.5% belonged to the Rotifera, 27.3% to the Cladocera, and 21.2% to the Copepoda groups. The highest levels of species diversity were recorded in May (28 species) and September (30 species). The dominance of rotifers indicates the meso-eutrophic state of the lake. Seasonal analyses also showed that zooplankton population dynamics are directly related to environmental factors such as water temperature, hydrochemical parameters, and water level. The research results provide valuable information about the biodiversity and ecological status of the Lake Zamonbobo ecosystem and serve as an important scientific basis for developing future watershed management and protection strategies.

### **Keywords**

Lake Zamonbabo, zooplankton, Rotifera, Cladocera, Copepoda, biodiversity, seasonal dynamics, Uzbekistan.

**Introduction.** In the study of the biodiversity of water bodies, planktonic organisms, in particular zooplankton, are recognized as an important ecological component. They play a special role in ensuring the balance of matter and energy cycles in aquatic ecosystems, as well as as organisms that serve as intermediate links in the trophic chain. In addition, zooplankton species are used as bioindicators in environmental monitoring, allowing us to determine the trophic state of water bodies, the level of pollution, and their sensitivity to natural changes. Lake Zomonbobo is a natural reservoir characterized by its hydrological and ecological characteristics, and studying the species composition of plankton communities and their seasonal dynamics in this area is of scientific and practical

importance. Changes in the number and species composition of zooplankton during the season are closely related to factors such as water temperature, light regime, nutrient content, and physicochemical properties of water. This article aims to identify the leading species of zooplankton found in Lake Zomonbobo, assess their seasonal variability, and determine the relationship of these changes to key ecological factors. The results of the study are important for assessing the state of the Lake Zomonbobo ecosystem, improving the ecological monitoring system, and developing scientifically based recommendations for the rational use of water resources.

The taxonomic composition and seasonal changes of zooplankton in the Celtic Sea have been studied. The study focuses specifically on the composition, biomass and trophic position of zooplankton in the Celtic Sea. In spring, mainly small-sized copepods dominated, while in summer, larger zooplankton species (e.g., euphausiids) increased. The role of zooplankton in the food chain and its importance in energy flow have been thoroughly evaluated. The data obtained have been interpreted as important for the health of aquatic ecosystems and the management of fisheries resources, as zooplankton are reported to be the main food source for many commercial fish species [1].

V.N. Podshivalina, analyzed changes in the composition and quantitative development of zooplankton in small steppe rivers inhabited by beavers depending on the phases of the hydrological cycle. The main conclusion is that zooplankton dynamics in these rivers differ from those in rivers in southern taiga regions. Beaver activity significantly affects the composition and dynamics of zooplankton communities by altering the hydrological conditions of small river ecosystems. This leads to an increase in species such as Cladocera and a decrease in other groups[2].

A study by Narasimhan Manickam and co-authors analyzed seasonal changes in zooplankton biodiversity in Lake Ukkadam, India. The main result of the study shows that zooplankton productivity increased significantly when air temperatures rose during the summer season. This study confirms that temperature is a determining factor for zooplankton populations in lake ecosystems. Researchers say that rising temperatures could accelerate the growth of phytoplankton (the main food source for zooplankton), thereby creating favorable conditions for zooplankton to multiply. However, it has been suggested that the continued increase in temperature due to climate change may have a negative impact on the number and composition of zooplankton species, as well as their productivity [3].

This study, conducted by Okechukwu I. Okogwu on the zooplankton of Lake Ehoma, located in the Mid-Cross River Valley of Nigeria, provides important initial information on the lake's biodiversity. They analyzed the composition and

quantitative changes of zooplankton in Lake Ehoma under the influence of seasonal factors (drought and rainy seasons) and spatial factors (from the shore to the middle of the lake). This lake is important as a breeding ground for large fish, and zooplankton is the main food source for their larvae. During the study, 67 species of zooplankton were identified, most of which are rotifers (42 species) and cladocera (19 species). This indicates that the lake has a high zooplankton diversity. Also, 6 species of zooplankton (including *Daphnia obtusa* and *Keratella valga*) were recorded as new records for Nigeria[4].

Maria Tagieвна Syarki reviewed new approaches and methods aimed at studying the seasonal dynamics of zooplankton under climate change. The main goal of the study is to quantitatively identify and formalize changes in seasonal processes. The author conducted an analysis based on 33 years of data (1988-2021) on zooplankton in Kondopoga Bay, Lake Onega. The author's study offers powerful mathematical and statistical methods for analyzing long-term seasonal changes in zooplankton dynamics. These methods, in the case of Lake Onega, help to objectively and quantitatively assess the response of the zooplankton community to climate change. Such analyses are important for monitoring the health of aquatic ecosystems in the future and developing strategies for their protection[5].

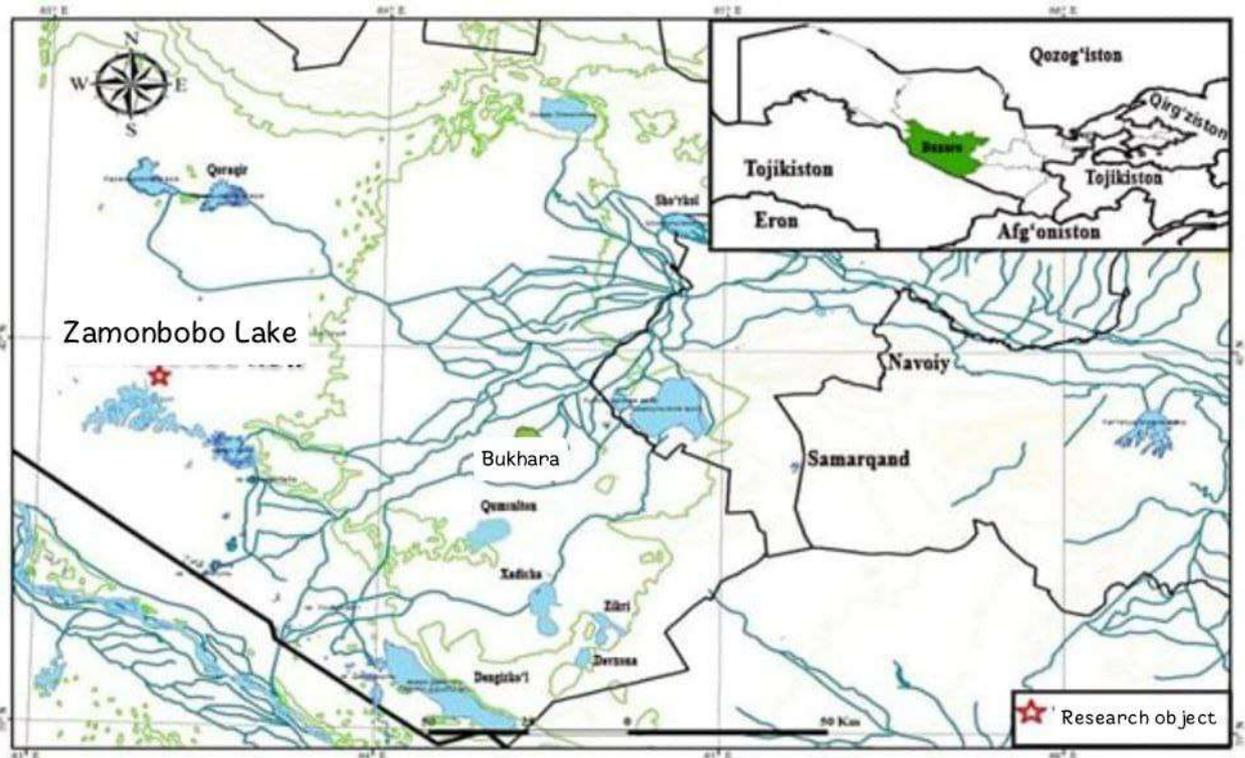
**Materials and methods:** Lake Zamonbobo and the zooplankton living in it were chosen as the object of research. The lake was described in terms of its geographical location, morphological, and hydrological characteristics. The study was conducted in the spring, summer, and fall of 2024. Sampling: The following methods were used to collect zooplankton samples: Plankton net: Samples were taken from a depth of 0.5–1.0 m of water using a plankton net with a mesh size of 64  $\mu\text{m}$  (micrometers). Water samples were taken from 4 replicate points (center of the lake, near-shore zone, and inlet and outlet collector flow locations) in each season. 1 liter of water was taken from each sample and preserved with a 4.0% formalin solution. Laboratory analyses: Zooplankton species were identified under a microscope (using a Leeuwenhoek 670 T microscope, 100–400x magnification). For species determination, classical zooplankton identifiers such as Kutikova L.A. (1970)[6], Dussart B. (2024)[7] were used. For each sample, the leading species were identified in terms of number (ind./l) and biomass (mg/l).

Seasonal comparison: The number of zooplankton species, the most abundant species, and the dominant species were determined for each season. Seasonal changes in species composition were assessed in percentage terms and using the Shannon diversity index. Excel, PAST (Paleontological Statistics Software), and SPSS 22.0 were used for statistical analyses. Climatic and hydrochemical conditions were monitored: Water temperature, pH, dissolved oxygen, electrical conductivity

(EC), and transparency (via Secchi disk) were measured at each point. The relationship between these parameters and zooplankton species was assessed through correlation analysis.

**Research and results:** The total area of water bodies in the Bukhara region in the 1960s was 112.5 thousand hectares. They are as follows: Dengizkul - 35 thousand hectares, Kara-Kyr - 27 thousand hectares, Agitma - 14.5 thousand hectares, Zamonbobo - 12.5 thousand hectares, Tuzkon (Zamonbobo) - 8.5 thousand hectares, Devkhona - 11.3 thousand hectares, Zikri Lake - 2.5 thousand hectares, Kumsultan - 11.5 thousand hectares. In addition, there is one reservoir called Shurkul, with an area of 2.5 thousand hectares. The total water volume in all natural and artificial reservoirs was 11–13 billion cubic meters (Figure 1).

As a result of the current global warming of the climatic conditions of the Bukhara oasis, the area covered by water in most water bodies has sharply decreased. For example, a number of scientists have studied the area of the Dengizkul watershed as 26.5 thousand hectares [8], [9]. However, Lake Zamonbobo stands out among the natural lakes in the Bukhara region for its relatively low mineralization level and constant water level. The total area of the water basin, located on the right bank of the Amu Darya River to the northwest of the Bukhara oasis, has remained unchanged to this day, covering 7,900-8,100 hectares. The average depth of the lake is 3-4.5 m, and the maximum depth is 7.5-8.0 m. In spring, the water level rises to 8.5-9 m. From the beginning of April to the end of October 2024, zooplankton species and their composition by group and their numerical density were determined. A total of 33 species of zooplankton were recorded during research conducted in Lake Zamonbobo.



**Figure 1. Map of water bodies of Bukhara region**

They were divided into three main groups: Rotifera were observed to comprise 17 species, Cladocera 9 species, and Copepoda 7 species. Seasonal changes in the number of zooplankton species were observed during the study (see Table 1). 17 species were detected in April, 28 species in May, and up to 23 species of zooplankton in June, July, and August. The number of species increased to 30 species in September and decreased to 20 species in October. May and September were the months with the highest diversity of zooplankton species.

**Table 1**

**Seasonal distribution of zooplankton species in Lake Zamonbobo**

S/n	Types	Distribution of species by month in 2024						
		April	May	June	July	August	September	October
<b>Rotifera</b>								
1	<i>Aplanchna priodonta</i> (Gosse, 1850)	+	+	+	+	+	+	+
2	<i>Asplanchna seiboldii</i> (Leydig, 1854)	+	+	+	+	+	+	+
3	<i>Brachionus calyciflorus</i> (Pallas, 1766)	-	+	+	+	+	+	+
4	<i>Brachionus quadridentatus</i> (Hermann,	-	+	+	+	+	+	-
5	<i>Brachionus angularis</i> (Gosse 1851)	-	+	+	+	+	+	+
6	<i>Filinia longiseta</i> (Ehrenberg, 1832)	+	-	-	-	-	-	+
7	<i>Keratella tropica</i> (Apstein, 1907)	-	+	+	+	+	+	-

8	<i>Keratella quadrata</i> (Müller, 1786)	-	+	+	+	+	+	-
9	<i>Lecane luna</i> (Muller, 1776)	+	+	-	-	-	+	+
10	<i>Lecane bulba</i> (Gosse 1851)	-	+	-	-	-	+	-
11	<i>Lecane quadridentata</i> (Ehrenberg 1830)	-	+	-	-	-	+	+
12	<i>Proales Theodora</i> (Gosse 1887)	-	+	+	+	+	+	-
13	<i>Synchaeta sp.</i> (Ehrenberg 1832)	-	+	+	+	+	+	-
14	<i>Synchaeta stylata</i> ( Wierzejski, 1893)	-	-	+	+	+	+	-
15	<i>Testidunelle patina</i> (Hermann 1783)	-	-	+	+	+	-	-
16	<i>Euchlanis dilatata</i> (Ehrenbreg, 1832)	-	+	+	+	+	+	-
17	<i>Polyarthra vulgaris</i> (Carlin, 1943)	-	-	+	+	+	-	-
<b>Cladocera</b>								
18	<i>Bosmina longirostris</i> (Müller, 1776)	+	+	-	-	-	+	+
19	<i>Ceriodaphnia turkestanica</i> (Berner&matullaeva, 2001)	+	+	-	-	-	+	+
20	<i>Ceriodaphnia reticulata</i> (Jurine, 1820)	+	+	-	-	-	+	+
21	<i>Chydorus sphaericus</i> (Müller, 1776)	+	+	-	-	-	+	+
22	<i>Daphnia longispina</i> (Müller, 1776)	+	+	-	-	-	+	+
23	<i>Daphnia pulex</i> (Leydig, 1860)	+	+	-	-	-	+	+
24	<i>Diaphanosoma brachyurum</i> (Liévin, 1848)	-	-	+	+	+	+	-
25	<i>Moina restirostris</i> (Leydig, 1860)	+	+	+	+	+	+	+
26	<i>Moina micrura</i> (Kurz, 1874)	+	+	+	+	+	+	+
<b>Copepoda</b>								
27	<i>Arctodiaptomus salinus</i> (Daday, 1885)	+	+	+	+	+	+	+
28	<i>Mesocyclops crassus</i> (Fischer, 1853)	+	+	+	+	+	+	+
29	<i>Mesocyclops ogunnus</i> (Onabamiro, 1957)	+	+	+	+	+	+	+
30	<i>Microcyclops pachyspina</i> (Lindberg, 1937)	+	+	+	+	+	+	+
31	<i>Paracyclops sp.</i> (Claus, 1893)	+	+	+	+	+	+	+
32	<i>Thermocyclops vermifer</i> (Lindberg, 1935)	-	+	+	+	+	+	-
33	<i>Thermocyclops Dybowski</i> (Lande, 1890)	-	+	+	+	+	+	-
	Total types	17	28	23	23	23	30	20

In water samples taken from various points of Lake Zomonbobo, rotifers dominated the number of zooplankton organisms. 1. Rotifera: This group was the most abundant group in the lake, accounting for 51.5% (17 species) of the total zooplankton species. Among the rotifer species, species such as *Aspanchna priodonta*, *Aspanchna seiboldi*, *Brachionus angularis*, *Brachionus calyciflorus*, *Keratella quadrata*, *Synchaeta sp.* were the most common and showed stable presence throughout the season. In particular, *Aspanchna priodonta* and *Aspanchna seiboldi* were observed continuously from April to October (Figure 2).

2. Cladocera (Crustaceans with horned whiskers): 9 species belonging to the Cladocera group were identified, accounting for 27.3% of the total zooplankton composition. Among the species in this group, *Daphnia pulex*, *Daphnia longispina*,

*Diaphanosoma brachiurum*, *Moina restirostris*, and *Moina micrura* were most frequently observed. Many Cladocera species (e.g. *Bosmina longirostris*, *Ceriodaphnia turkestanica*, *Ceriodaphnia reticulata*, *Chydorus sphaerius*, *Daphnia longispina*, *Daphnia pulex*) were observed to be more abundant in April and May and in September and October, with a decrease in their numbers during the summer months. Only the species *Diaphanosoma brachiurum*, *Moina restirostris*, and *Moina micrura* were active during the summer months.

3. Copepoda (Crustaceans): 7 species were recorded from the Copepoda group, accounting for 21.2% of the total species. The main species were *Arctodiaptomus salinus*, *Mesocyclops ogunnus*, *Thermocyclops vermifer* and *Thermocyclops Dybowskii*. Most Copepoda species were present in the lake throughout the study period (April–October).

The number, species composition, and seasonal occurrence characteristics of zooplankton organisms were formed based on studies. Zooplankton are widespread in the pelagic part of Lake Zamonbobo, and their growth rate varies depending on seasonal changes. In the fall, the growth rate of zooplankton slows down significantly. With the arrival of autumn, a decrease in the number of all species was observed. This phenomenon was found to be directly related to the decrease in water temperature.

The zooplankton of Lake Zamonbobo is based on species that are resistant to lake conditions and relatively mineralized lake water. These include *Arctodiaptomus salinus* (Daday, 1885) and *Brachionus calyciflorus* (Pallas, 1766) from the Kolovratkas, indicating that Lake Zamonbobo is a meso-eutrophicated water body. This species is mainly adapted to organic matter and high levels of pollution, and is found in many polluted waters. Thus, zooplankton productivity is mainly due to Cladocera and Copepoda.



**Figure 2. Seasonal distribution of zooplankton in Lake Zamonbobo. (2024)**

The amount of zooplankton is closely related to the volume of water.

In lake conditions, a decrease in the volume of water leads to an increase in the concentration of mineral salts in the water. As a result, higher aquatic plants develop strongly. At the same time, the decrease in lake water affects the growth of zooplankton organisms, because when the volume of water decreases, their volume increases. Maximum development in a lake ecosystem is related to water temperature, water volume, the concentration of mineral substances in the water, and the amount of biogenic substances, and the interaction between these factors directly affects the growth rate of zooplankton.

**Conclusion:** Studies on the composition, species diversity, and seasonal dynamics of the zooplankton community of Lake Zamonbobo revealed important information about the hydrobiological state of the lake. As a result of monitoring conducted throughout 2024, a total of 33 species of zooplankton were identified, which were mainly divided into three groups: Rotifera (51.5%), Cladocera (27.3%), and Copepoda (21.2%). The dominance of rotifers indicates that the lake ecosystem is meso-eutrophic, indicating that it is enriched in nutrients and organic matter.

Seasonal analyses showed that the highest diversity in the number of zooplankton species was observed in May and September, periods that coincided with times when water temperatures and nutrient levels were optimal. Some species, such as *Aplanchna priodonta* and *Aplanchna seiboldi*, had stable distributions throughout the season, while other species were more sensitive to seasonal changes. For example, most Cladocera species declined during the hot

summer months, indicating the effect of temperature on their populations. As a result of research, it was found that the zooplankton population of Lake Zamonbabo is closely related to the level and volume of water mineralization.

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