

Analysing Long-Term Dynamics of Zooplankton Abundance in Karakalpakstan Lakes

Gulistan Ismailovna Turemuratova¹^a, Hamid Salavat ugli Nagmetov²^b

¹Karakalpak State University, Nukus, Uzbekistan

²Irkutsk State Agrarian University, Irkutsk, Russia

Keywords: Zooplankton, Reservoir, Lake, Regime, Biomass And Diversity, Habitat, Water Mineralization.

Abstract: The article presents the long-term dynamics of zooplankton abundance and the results of hydrobiological studies of the four largest lakes of Karakalpakstan.

1 INTRODUCTION


The long-term dynamics of zooplankton were analyzed, and the results showed that the period of intense agricultural water runoff pollution of the reservoir was marked by a greater amplitude of fluctuations in the community's quantitative indicators and a significantly higher number of indicators than the modern stage. A significant positive correlation between the average annual level of the lake and zooplankton biomass was revealed.


2 MATERIALS AND METHODS

The selection of hydrobiological materials was conducted from 2018 to 2022 in the waters of the lakes of Karakalpakstan. Zooplankton sampling occurred seasonally in spring, summer, and autumn. Using a small Jedi net, zooplankton samples were obtained by thoroughly fishing the water column. Multiple net lengths were established from the bottom to the surface at depths of less than 1.5–2 metres, using mill gas No. 70. Samples were fixed in a formalin solution containing 4%. The MBS-10 microscope was utilised in the lab to identify and count the zooplankton samples that had been gathered. Relevant groupings and individual genera were determined using determinants. A portion of the sample was used for the calculation of organisms under a microscope, and the remaining portion was

examined to identify big and uncommon individuals. The following groups of animals were counted and measured separately: adult females, females with egg sacs, males, copepodites at the 1-3 and 4-5 age stages, nauplii, branchious females with eggs or juveniles in a brood pouch, sterile females, males, and immature individuals. Upon examining the complete sample, the number of members of uncommon species and individuals with morphological anomalies was discovered.

Equations relating to linear weight dependency were used to determine each zooplankton's specific weight. The quantity and mass of all developmental stages of each variety of crustacean were totalled. Subsequently, the numbers and weight indices for all species in the major categories of organisms and the community at large were totalled. For one millilitre (m³) of the water column, the mass and number of zooplankton were determined. The number of dominant species (in terms of abundance and biomass), the ratio of crustacean and rotifer biomass, the proportion of rotifers, branchious, and copepods in the number and biomass of zooplankton, the proportion of cyclops in the number and biomass of copepods, the size of mature individuals, and the sex ratio in paddle head populations were all used to characterise the structure of zooplankton. Thoroughly fishing the water column. Multiple net lengths were established from the bottom to the surface at depths of less than 1.5–2 m, using mill gas No. 70. Samples were fixed in a formalin solution containing 4%. The MBS-10 microscope was utilized in the lab to identify

^a <https://orcid.org/0000-0002-5088-1294>

^b <https://orcid.org/0009-0003-3926-1232>

3 RESULTS

In the period of 2018-2022, zooplankton studies were carried out in the four largest lakes of Karateren, Atakul, Saykul, and Akshakul in Karakalpakstan. A total of 65 zooplankton species were identified in these reservoirs (rotifers - 20, branchiopods - 25, copepods - 20) (Table 1), with thicket forms accounting for 35.0% and planktonic forms for 32.2%. Eurytopic species made up 5% of the total. The remaining part consisted of benthic, benthic forms, and inhabitants of shallow reservoirs. Among the rare species, the thermophilic cyclops *Mesocyclops aequatoriales* can be noted, with its known northern border of the range being Uzbekistan and Karakalpakstan. Of the representatives of the order Calanoida, only one species has been found - the thermophilic *Sinodiaptomus arsi*.

A significant proportion of thicket forms, especially among rotifers, reflected the shallow status of the reservoir. Background species included rotifers *Asplanchna priodontata*, crustaceans *Bosmina longirostris*, *Daphnia galeata*, as well as *Euchlanis phryne*, *Alona rectangula*, *Chydorus sphaericus*, and *Cyclops vicinus*. Quantitative indicators of zooplankton were significantly lower, with rotifers and branchiopods dominating. The composition of the dominant species varied somewhat over the years of research, with the relatively constant presence of *B. longirostris*, *Thermocyclops taihokuensis*, and *D. galeata*. The population of *T. taihokuensis* was dominated by males, and *Acanthocyclops trajani* was dominated by females.

Table 1: Quantitative indicators of zooplankton in the lakes of Karakalpakstan during summer.

Lakes	Rotifera	Cladocera	Copepoda	Total
Number, thousandcopies/m3				
Karateren	10,9±6,4	9,6±2,6	7,4±0,8	27,8±5,6
Atakul	3,8±0,8	8,4±3,1	28,3±12,5	40,5±14,3
Saykul	8,9±0,7	77,5±34,9	97,7±30,8	184,1±62,2
Akshakul	18,1±7,9	15,0±13,5	11,8±8,9	44,9±30,2

Biomass, g/m3

Karateren	0,3±0,2	0,4±0,2	0,05±0,02	0,7±0,2
Atakul	0,06±0,02	0,5±0,2	0,3±0,1	0,8±0,2
Saykul	0,2±0,02	0,6±0,2	0,8±0,3	1,6±0,5
Akshakul	0,3±0,05	0,7±0,6	0,04±0,03	1,0±0,7

Quantitative indicators of zooplankton were close to those of the communities of the Karateren lakes (Table 1). Copepods dominated in number, while branchiopods dominated in biomass. The leading species included the crustaceans *Bosmina longirostris*, species of the genera *Daphnia*, and *Thermocyclops taihokuensis*. Zooplankton were represented by large individuals, with an average size-mass index of 0.026 ± 0.004 mg. Paddlefoot populations were dominated by females, and the diversity of the community by biomass was at a reduced level (1.35 ± 0.16 bits/mg).

Widespread in the water areas of the lakes were rotifers *Polyarthra luminosa*, *Asplanchna priodontata*, *A. sieboldi*, crustaceans *Moina brachiata*, *Diaphanosoma lacustris*, *Daphnia galeata*, *Bosmina longirostris*, *Thermocyclops taihokuensis*, *Mesocyclops aequatorialis*.

The diversity and abundance of zooplankton were at a relatively high level, with a moderate amount of biomass (Table 1). With a subdominant position of branchiopods, paddleheads constituted the basis of the indications. The dominant complex included the usual lake species - *B. longirostris*, *T. rylovi*, *A. priodontata*.

Zooplankton were developed to a moderate degree. The basis of the number was formed by rotifers, with branchiopods dominating in biomass. *A. priodontata* and *B. longirostris* reached high numbers. The structure of species dominance was characterized by the location of the biomass curve above the abundance curve, with their significant divergence.

Keratella quadrata, *Diaphanosoma orghidani*, *D. dubium*, *Daphnia cucullata*, *Leptodora kindtii*, *Thermocyclops taihokuensis*, *Cyclops vicinus*, *Sinodiaptomus sarsi* were most often found in Lake Karateren.

Zooplankton was the most abundant in a number of the studied lakes, dominated by paddleheads, with

a subdominant position in the biomass of branchiopods. The dominant complex included crustaceans *D. cucullata*, *T. taihokuensis*, *T. crassus*, *Acanthocyclops trajani*, *Leptodora kindtii*. Crustacean communities were at a relatively high level. The dominance of crustaceans caused a high value of the indicators of the size-mass structure - on average 0.028 ± 0.001 mg.

Studies of zooplankton in the largest lakes of Karakalpakstan have shown that the community of shallow Lake Atakul was characterized by the greatest diversity in the number of species, where a significant proportion were thicket forms. Zooplankton of lakes Karateren and Akshakul, with a sharp increase in depth from the shore, consisted mainly of pelagic species and were less diverse. The number and biomass of zooplankton in lakes Karateren, Akshakul, and Atakul were at a moderate level. Zooplankton of Lakes Karateren and Akshakul reached a relatively high abundance. The size structure of the communities was characterized by the predominance of large species in the summer, with an average individual mass of 0.018 ± 0.028 mg. Due to the pronounced dominance of several and a reduced number of species that make up the community, the diversity of zooplankton was low, especially when calculating the index value by biomass. With the exception of Akshakul, the predominant zooplankton species structure of the 2019 lake was identified by the placement of the biomass curves above the abundance curves. In populations of cyclops from Lake Akshakul, *Thermocyclops taihokuensis* *T. rylovi* *Acanthocyclops trajani* was dominated by males; in other cases, female dominance was noted. The number of zooplankton in Lake Saykul is much higher compared to the numbers of zooplankton in other lakes.

Table 2: The number of zooplankton in lakes Karateren, Atakul, Saykul, Akshakul by year.

Lakes	Years	Number, thousand copies/m3			
		Rotifer a	Cladoce ra	Copepo da	Total
Karateren	2019 - 2022	2,9±1, 9	0,4±0,3	1,6±0,5	5,2±2,1
Atakul	2019 - 2022	0,8±0, 8	0,3±0,2	0,1±0,0 3	1,6±1,2
Saykul	2019 - 2022	13,2±5, 1	55,4±14, 3	85,3±18, 4	154,0±16, 3
Akshakul	2019 - 2022	10,4±6, 2	8,5±7,5	22,6±4, 8	47,5±3,4

Table 3: The biomass of zooplankton in lakes Karateren, Atakul, Saykul, Akshakul by year.

Lakes	Years	Biomass, g/m3			
		Rotifer a	Cladoce ra	Copepo da	Total
Karateren	2019- 2022	<0,01	0,03±0, 03	0,02±0, 01	0,05±0,0 4
Atakul	2019- 2022	<0,01	<0,01	<0,01	<0,01
Saykul	2019 - 2022	0,2±0,2	0,8±0,1	0,5±0,0 6	1,6±0,1
Akshakul	2019 - 2022	0,2±0,0 6	1,0±0,9	0,3±0,1	1,4±1,1

The basis of the number was made up of paddleheads, with branched-moustached ones dominating in biomass. Dominant groups of zooplankton included: *Diaphanosoma lacustris*, *Bosmina longirostris*, *Thermocyclops scirassus*, *Mesocyclops leuckarti*, and *Asplanchna sieboldi*. Among the species were *Daphnia galeata*, *D. longispina*, *Moina brachiata*, *Ceriodaphnia quadrangula*, *Alona rectangula*, *Bosmina longirostris*, *Eucyclops serrulatus*, *Cyclops vicinus*, *Mesocyclops leuckarti*, *Thermocyclops crassus*. Previously, the lake was dominated by the cyclops *Acanthocyclops vernalis*. Currently, it turns out that *A. traiani* lives in Lake Saykul, and in Lake Karat *A. salinus*. Compared with the 80s of the XX century, the number of zooplankton in Lake Karateren was higher orders of magnitude, with a smaller amount of biomass. Currently, the dominant of the past years is *Diaphanosoma lacustris* (previously identified as *D. brachyurum*), retaining its leading position. At the same time, the dominant complex included the previously small *Bosmina* and *Thermocyclops*. Under conditions of unstable water mineralization ($3.0-6.5$ g/dm³), quantitative indicators of planktonic invertebrates varied from 234.5 thousand ex/m³ and 4.1 g/m³ in 2019 to 38.3 thousand ex/m³ and 1.1 g/m³ in 2020. This year, paddleheads attached great importance, in particular, the joint use of the species *T. crassus*, *T. vermifer*, *D. orghidani*, *D. cucullata*, *A. sieboldi* in 2019 on *A. salinus*, *C. vicinus*, *K. squares*. The variety of zooplankton dramatically declined as lake water mineralization increased. The average size of individuals increased from 0.0140 ± 0.0020 to 0.0230 ± 0.005 mg. When using *T. vermifer*, females dominated, *T. crassus* and *C. Vicinus* had large females. The number of zooplankton reached a high level, with a moderate intensity of biomass (Tables 2, 3). The paddle-legged, dominant complex included rotifers *B. calyciflorus*, *A. sieboldi*, crustacean

Thermocyclops taihokuensis, *T. vermifer*. Thus, studies have shown that in the summer period, the abundance of zooplankton in shallow and small lakes of Karakalpakstan by area was most often at a low level, which may be closely related both to their strong overgrowth (up to 40-55%), as well as to high water temperatures. Zooplankton were developed to a greater extent in mineralized lakes Atakul, as well as deeper and larger lakes Karateren, Saykul, Akshakul. Thicket species of rotifers and crustaceans formed the communities' backdrop. Some of the *Thermocyclops* genus's two-component combination ozeravid species, occasionally in conjunction with diaphanosoma. When there is a shift in the mineralization of the water, as was observed in the Atakul lakes, the composition of the dominating species completely changed. The analysis of zooplankton diversity in general for all lakes showed that with an increase in the total, average number of species per sample and the number of dominant species ($P=0.50-0.60$, $P<0.05$), the average individual weight of zooplankton ($g=-0.20$) decreased unreliably. In shallow overgrown lakes, adult individuals of paddleheads were absent. In the larger Karateren Lake, mature cyclops were recorded in single specimens. Suicidal behavior of males was observed in *Thermocyclops crassus* (Lake Akakul), etc. chervets (Lake Saykul) when dominating females or with moderately active absorption of irrigation in the population of paddleheads from other reservoirs.

4 CONCLUSIONS

Thus, studies have shown that in the summer period, the abundance of zooplankton in shallow and small lakes of Karakalpakstan by area was most often at a low level, which may be due to both their strong overgrowth (up to 40-55%) and high-water temperatures. A tendency to increase the number of planktonic animals during the high-water phase of the hydrological cycle, accompanied by irregular changes in biomass, was found in the long-term dynamics of the number of zooplankton in the lakes of Karakalpakstan. There were changes in the structure of the lake ecosystem, including the value of an individual's average mass and taxonomic relationships, as well as an increase in the amplitude of fluctuations in quantitative indicators and instability in the composition of dominant species during this period of increased anthropogenic impact.

REFERENCES

- Turemuratova, G. I., & Nagmetov, H. S. (2020). The current state of studying the ecology of Karakalpakstan. Academy: International Interdisciplinary Research Journal, 10(10), October 2020.
- Tupemuratova, G. M., Madumarov M. Dj., & Kuzmetov, A. R. (2021). Representatives of the Cladocera detachment in the lakes of the Republic of Karakalpakstan. IT in Industry, No.3.23, December 2021. USA.
- Turemuratova, G. I., & Nagmetov, H. S. (2021). Indicators of development and dynamics of zooplankton of Lake Karateren. Central Asian Journal of Medical and Natural Sciences, 02(02), March-April 2021, 83-90.
- Turemuratova, G. I., & Mirabdullaev, I. M. (1996). On ecology and biodiversity of the cyclopoids of the Aral Sea region. Sixth International Conference on Paddleheads, Oldenburg/Bremerhaven, Germany, July 29 - August 3, 1996, p. 81.
- Mirabdullaev, I. M., Sharapova, L. I., & Turemuratova, G. I. (1997). Far Eastern cyclops, *Thermocyclops taihokuensis* (Harada, 1931) in Central Asia. Turk. J. Zool., 21, 175-178.
- Mirabdullaev, I. M., & Turemuratova, G. I. (1996). On ecology and biodiversity of cyclopoids of the Aral Sea region. Sixth International Conference on Paddleheads, Oldenburg/Bremerhaven, Germany, July 29 - August 3, 1996, p. 81.
- Kuzmetov, A. R., Turemuratova, G. I., & Mirabdullaev, I. M. (1995). Cyclopoids, Microcyclops, cryptocyclops, metacyclops and apocyclops of the fauna of Uzbekistan. Organization and speed: Materials of the 2nd republican symposium, Tashkent: Fan, 103-105.
- Mirabdullaev, I. M., & Kuzmetov, A. R. (1997). Genus *Thermocyclops* (crustaceans, copepods) in Uzbekistan (Central Asia). International Review gesamt. Hydrobiol., 82, 201-212.
- Mirabdullaev, I. M., Stuge, T. S., & Kuzmetov, A. R. (1995). About *Mesocyclops ruttneri* Kiefer, 1981, a species new to Kazakhstan. Selevinia, 2, 31-33.
- Mirabdullaev, I. M., & Stuge, T. S. (1998). Re-description of *Apocyclops dengizicus* (Lepeschkin, 1900) from Central Asia (crustaceans, copepods). Spixiana, 21.
- Reed, J. W., & Kay, B. H. (1994). *Mesocyclops guanxiensis*, new species and new information about four relatives (Crustacea, Copepoda, Cyclopidae) from China, Laos, and Vietnam. Proceedings of the Biological Society of Washington, 105, 331-342.