



Hydrobiological Studies of Zooplankton Lake Karateren

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ABSTRACT

The article presents the results of hydrobiological studies of zooplankton in Lake Karateren. Lake Karateren is the deepest reservoir of the Aral Sea region. According to its species composition and quantitative indicators of zooplankton, it is estimated as a food base for valuable fish.

Keywords:

Zooplankton, Reservoir, Lake, Mode, Network, Source, Cape.

Introduction

Lake Karateren is the deepest reservoir of the Aral Sea region. Over the past more than 100 years, the hydrological and hydrobiological regime has undergone significant changes. The lake is located away from the sources of anthropogenic impact. Information on the hydrofauna of the reservoir is very scarce. The published works provide data on the species composition and quantitative indicators of zooplankton, assess its value as a fish food base. Studies on the fauna of Lake Karateren were conducted by S.Embergenov, I.Zholdasova, D.Koschanov, A.Saparov.

Materials and methods

Selection of hydrobiological material in the water area of the lake. Karateren, held in 2017-2020. Zooplankton sampling was carried out 3 times in spring, summer and autumn. The total number of zooplankton samples processed was 1,120 specimens. Zooplankton samples were taken by total fishing of the water column using a small Jedi net. At depths of less than 1.5 - 2 m, several network stretches were made from the bottom to the surface. Mill gas No. 70 was used in the networks. The samples were fixed with a 4% formalin solution.



Figure 1. Map of Lake Karateren

Research results

The collected zooplankton samples in the laboratory were identified and counted using the MBS-10 microscope. We used determinants for the corresponding groups and individual genera. The calculation of organisms under the microscope was carried out in a certain part of the sample, followed by a review of the entire remainder to identify large and rare individuals. Adult females, females with egg sacs, males, copepodites at 1-3 and 4-5 age stages, nauplii were counted and measured separately for copepods, and for branchiiform crustaceans - females with eggs or juveniles in a brood pouch, sterile females, males, young individuals. The number of individuals of rare species and individuals with morphological abnormalities was found when viewing the

entire sample. When calculating the individual weight of zooplankters, linear-weight dependence equations were used. For each type of crustacean, the number and mass of all stages of development were summed up. Next, the number of individuals and the weight index of all species for the main groups of organisms and the community as a whole were summed up. The number and mass of zooplankton were calculated for 1m³ of the water column. To characterize the structure of zooplankton, the total number of species, the average number of species per sample, the value of the average individual mass of an individual (m), the number of dominant species (in terms of abundance and biomass), the ratio of crustacean and rotifer biomass, the proportion of rotifers, branchial and copepods in the

number and biomass of zooplankton, the proportion of cyclops in the number and biomass of paddleheads, the size of mature individuals and the sex ratio in populations of paddleheads were determined. If there were no females or males in some areas of reservoirs, the average value of the absolute number of individuals of both sexes was found with an error, then the average values of the ratio of males and females were found without statistical error. The selection of dominant species was carried out according to the Lyubarsky scale in modification: the absolute dominants included species that made up more than 60% of the quantitative indicators of the community, dominants - 30-60%, subdominants - 10-30%, secondary - less than

10%.64 species were identified as part of zooplankton. The maximum diversity was noted in 2018, with a four-fold selection of material within a month. During one-time hydrobiological examinations, the number of species did not exceed 5-28. The largest number of species - 7-9, were represented by the genera Lecane and Brachionus. No more than 3-4 species have been recorded in the other genera. The number and biomass of zooplankton varied by an order of magnitude, with maximum values in the high-water years (Table 1.). The basis of quantitative indicators was formed by paddleheads, with the exception of 2017, when these biomass groups occupied a subdominant position after branchial ones.

Table 1
Quantitative indicators of zooplankton of Lake Karateren

Year	Rotifera	Cladocera	Copepoda	Bcero
Number, thousand copies/m ³				
2017	1,2±0,7	1,5±0,7	37,8±11,6	40,5±11,9
2018	0,3±0,3	6,7±3,5	32,9±14,1	40,5±14,7
2019	26,3±10,6	81,1±50,9	176,0±26,4	283,5±69,8
2020	0,07±0,05	1,4±0,8	7,5±1,4	9,0±2,0
2021	0,9±0,7	9,8±5,1	40,5±8,8	51,2±13,5
Average	5,8±5,1	20,1±15,3	58,9±29,8	84,9±50,1
Biomass, g/m ³				
2017		0,06±0,03	0,7±0,3	0,8±0,3
2018		0,1±0,07	0,4±0,3	0,6±0,3
2019	0,05±0,03	2,2±1,6	1,2±0,2	3,5±1,8
2020		0,03±0,01	0,05±0,02	0,07±0,02
2021		0,3±0,1	0,6±0,1	0,9±0,2
Average	0,02±0,01	0,5±0,4	0,6±0,2	1,2±0,6

The dominant zooplankton complex included four crustacean species, with the redistribution of their role in the community by years of research (Table 2). Despite a slight increase in the mineralization of lake water, the maximum value in zooplankton of euryhaline *Arctodiaptomus salinus* was noted in 2018. In

subsequent years, the population of this species occupied a subdominant position after diaphanosoma or cyclops. After a long break, another representative of the order Calanoida, *Eudiaptomus graciloides*, began to register again in the zooplankton.

Table 2

The number of populations of dominant crustacean species Lake Karateren

View	Number, thousand copies/m3				
	2017	2018	2019	2020	2021
Arctodiaptomus salinus	14,3±3,5	9,9±5,7	54,6±11,7	4,7±2,0	11,5±4,5
Diaphanosoma lacustris	1,4±0,6	6,7±3,5	81,1±50,9	20,3±8,5	18,4±10,3
Thermocyclops crassus	9,0±1,7	15,2±5,9	82,6±17,1	6,0±1,6	8,6±2,1
Mesocyclops leuckarti	3,7±1,2	8,1±2,4	38,8±7,7	5,3±1,7	13,8±2,5

The structure of species dominance was characterized by the location of biomass curves above the abundance curves, with their weak divergence. The share of the most numerous species reached 30-50% of the population and 50-60% of the biomass of the community. During the study period, the structure of species dominance did not change significantly.

The diversity of zooplankton was at a reduced level. The average individual

zooplankton mass for the lake as a whole was 0.013±0.002 mg.

Males predominated in cyclops populations, with the largest ratio of males and females for Mesocyclops leuckarti (Table 3). The average long-term values of this indicator for Thermocyclops cassis and Arctodiaptomus salinus were close to one, with significant changes in the sex ratio over the years of research.

Table 3

Sexual structure of paddlefoot populations Lake Karateren

Type	Gender	Years					Average
		2017	2018	2019	2020	2021	
Mesocyclops leuckarti	♀♀	0,07±0,06	0,5±0,3	1,7±0,9	0,2±0,2	2,4±0,8	0,9±0,5
	♂♂	0,1±0,09	0,5±0,4	7,7±5,1	0,3±0,3	4,8±2,1	2,7±1,5
	♂♂:♀♀	1,5	1,0	4,6	1,4	1,9	3,0
Thermocyclops crassus	♀♀	0,9±0,4	2,5±1,4	21,9±6,1	1,3±1,2	2,8±1,1	5,9±4,0
	♂♂	1,5±0,6	3,2±2,2	28,4±2,4	0,4±0,3	1,9±0,5	7,1±5,3
	♂♂:♀♀	2,8	1,3	1,3	0,3	0,7	1,3
Arctodiaptomus salinus	♀♀	0,7±0,2	0,5±0,4	0,9±0,8	0,5±0,3	0,5±0,4	0,6±0,3
	♂♂	0,5±0,2	0,5±0,4	0,2±0,09	1,2±1,2	0,2±0,2	0,5±0,1
	♂♂:♀♀	0,8	1,0	0,2	2,5	0,4	1,0

Note - ♀♀, ♂♂ - the number of females and males, thousand copies/m3 ♂♂:♀♀ - the ratio of the number of males and females.

The distribution of zooplankton in the water area of the open part of the lake had a homogeneous composition of 5-8 species, with the leading position of crustaceans. In the thicket littoral, the variety expanded to 20-28 names due to rotifers and, to a lesser extent, thicket branchlets. The average number of species per sample in the littoral zone was significantly higher than in the pelagic zone (Table 4).

The greatest abundance of zooplankton was observed in the open part. In the littoral, the number and biomass of planktonic organisms were 1.6-1.7 times smaller, with a statistically unreliable difference in average values. According to the values of the Shannon-Weaver index, pelagial zooplankton, represented by a limited number of species, with a pronounced dominance of several of the crustacean plankton, was characterized by low

diversity. In the thicket littoral, due to the expansion of the species list and a decrease in

the dominance of crustaceans, the index values were significantly higher ($p < 0.01$).

Table 4

Structural characteristics of zooplankton of the littoral and pelagic parts of the lake Karateren

Indicator	Part of the lake		Average
	Littoral	Pelagial	
Average number of species per sample	15,4±2,9	8,4±1,1	17,8±3,1
Low frequency, bit/ex	2,20±0,14	1,62±0,14	1,81±0,10
Nb, bit/mg	1,98±0,12	1,34±0,15	1,54±0,10
Number of thousand copies/m ³	39,8±12,8	67,8±33,3	60,7±27,90
Biomass, g/m ³	0,5±0,2	0,8±0,3	0,7±0,2
Sr.ind.weight, mg	0,013±0,003	0,014±0,002	0,013±0,002

Note: Lf is the Shannon-Weaver coefficient, bit/mg, Nb is the Shannon-Weaver coefficient, bit/mg, m is the average mass of a person in the community, mg.

Long-term dynamics of zooplankton according to the literature data and the results of our own research, 60 species have been identified in zooplankton to date, not counting facultative plankters. The most diverse rotifers are 44 species and subspecies. In second place are branchous - 32 species. The least diverse are paddleheads – 12 species.

In the next two years, the dominant complex included rotifers *Keratella cochlearis*, *Asplanchna priodonta*, *Filinalongiseta*, *Brachionus plicatilis*, crustaceans *Mesocyclops leuckarti*, *Cyclops strenuous*, *Eudiaptomus graciloides*.

Since the 90s of the last century, *Arctodiaptomus salinus* and *Diaphanosoma lacustris* began to play a significant role in zooplankton, *Daphnia magna* reached a high number. Over the past decade, the dominant complex has remained homogeneous (*Thermocyclops crassus*, *A. salinus*, *D. lacustris*, *Mesocyclops leuckarti*), but different from the previous composition.

Significant changes in the composition of the dominant species in the zooplankton of Lake Karateren were reflected in the dynamics of the indicator of the size-mass structure. The high abundance of the large branched crustacean *D. Magna* caused the maximum values of the average individual weight of the zooplankter.

Conclusions

Thus, in 2017-2020, the number of zooplankton of Lake Karateren - 64.9±40.1 thousand copies/m³ was an order of magnitude lower than the average long-term values, with less pronounced differences in biomass values. The basis of quantitative indicators of the community was formed mainly by paddleheads, with *Mesocyclops leuckarti*, *Thermocyclops crassus* and *Arctodiaptomus salinus* playing the leading role. The branchous represented by *Diaphanosoma lacustris* were subdominated. Both in terms of the number of species and their alignment, the diversity of zooplankton in the pelagic part of the lake was at a reduced level. In the overgrown littoral, the diversity of the Shannon-Weaver community increased, the abundance and biomass values decreased. Males predominated in the population of *M. Leuckarti*, the sex ratio of *T. crassus* and *A. salinus* was approximately equal, however, according to the years of research, the sexual structure of cyclops populations changed significantly.

The analysis of the long-term dynamics of the zooplankton of the lake revealed a tendency to increase the number of planktonic animals in the high-water phase of the hydrological cycle, with an irregular change in the amount of biomass. During the period of increased anthropogenic impact on the ecosystem of the lake, there was an increase in

the amplitude of fluctuations in quantitative indicators, instability of the composition of dominant species and other changes in its structure – the value of the average mass of an individual, the relationship of taxonomic groups.

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