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The Effect Of Increasing Water Temperature On The Vertical Distribution Of Zooplankton In Mesotrophic Stratified Arahley Lake (Eastern Transbaikalia).

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ABSTRACT

In recent decades, climate warming has been observed, which affects various processes occurring in aquatic ecosystems, including in zooplankton communities. The influence of water temperature on the vertical distribution of zooplankton of a mesotrophic stratified lake has been studied. Arahley in August 2011-2014 and in 2017 there was a dry period with rising water temperatures. In the summer, according to long-term observations, surface water warmed up to a temperature of 18.1-19.3° C, and in warm 2013 – the water temperature reached 21.9°C. During this period, the water level of Lake Arahley was the lowest. The average annual water level was only 35-43 cm. In the years under study, the species composition, abundance, and biomass of zooplankton were identified along horizontal layers of the water column. It is established that in August 2011-2012 dominated by copepods, by 2013-2014 – the zooplankton community has changed and consisted of branched crustaceans. They dominated both in numbers and in biomass. In 2013, the maximum number of branched crustaceans was observed in the water column from two to eight meters (up to 69.48 thousand ex./m^3), in contrast to 2011, when the crustacean Daphnia galeatadominated in all layers. In the more humid 2017, the group of copepod crustaceans dominated in terms of abundance, and in the case of biomass, branchy crustaceans. During this period, by water layer in the area of metalimnion, the maximum number reached 80 thousand ind./m^3, and biomass up to 1.3 g/m^3. Copepoda dominated in numbers, and Cladocera in terms of biomass. Thus, a vertical distribution of structural changes in zooplankton communities, associated with the transformation of the temperature factor in the horizontal layers of the water column (species composition, abundance and biomass of zooplankton), was obtained.

Keywords: zooplankton, species composition, vertical distribution, temperature, Lake Arahley, East Transbaikalia.

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INTRODUCTION

The zooplankton community is a complex and multi component system, determined by many factors. The change in its species composition, quantitative and qualitative parameters with the depth of the reservoir and the factors determining them are of great theoretical and practical interest. In recent decades, climate warming has been observed, which affects various processes occurring in aquatic ecosystems, including in zooplankton communities. In Transbaikalia, air temperature increases by 1.0-1.5°C – in winter and by 0.5-1.0 °C – in summer [1; 2]. Since 1946, the increase in surface water temperature by 1.21°C has been noted in Lake Baikal [3]. The 2011-2014 years studied are from the arid climatic period. The lake during these years, despite the large area – 59.0 km^2 and the volume of water – 0.60 km^3, had an average depth of 10.2 m and a maximum depth of 17.0 m [2]. The transition between low-water and high-water years is 2017. Temperature, dissolved oxygen concentration, food resources, etc. have a significant effect on the distribution of zooplankton organisms [4; 5; 6; 7]. But the most important factors in the regulation of zooplankton communities, in its spatial and temporal scale of lake ecosystems, affecting the abundance and structure of zooplankton communities are temperature and oxygen [8; 9; 10; 11; 12; 13]. In this regard, the question arises about the impact of climate warming, reflected in the increase in water temperature on the vertical structure of zooplankton and on subsequent changes in the ecosystem.

MATERIALS AND METHODS

Zooplankton studies were carried out in the mesotrophic lake. Arahley (52 ° 12'20 "N, lat. 112 ° 52'01" E) during the period of thermal stratification of the lake in August of different years (from 2011 to 2014, 2017)

Sampling of zooplankton was carried out at the central station of the lake using a Patalas bathometer (volume 6 liters) with triplicate from eight vertical layers every two meters of the water column. Samples were fixed with 4% formalin. Quantitative processing of the collected material was carried out in the Kolkwitz and Bogorov chambers. The calculation and measurement of organisms were carried out on LOMO Micmed-1, MBS-10 microscopes. The definition of animals is on Nicon Eclipse E200, AXIO SCOPE A1 microscopes. Quantitative accounting of the number was carried out on the basis of generally accepted methods [14]. The species composition of zooplankton was determined by the corresponding determinants [8; 15; 16; 17; 18].

The temperature of the water was measured with a mercury thermometer embedded in the bathometer. At the same time, the temperature was taken into account in parallel with the sampling of the zooplacton along the horizons of the water column — 0, 2, 4, 6, 8, 10, 12, 13.5 m. The water transparency values for the Secchi disk for these years ranged from 4.5 m to 6.4 m.

RESULTS

In dry years, the lake underwent a process of intense evaporation. Currently, the maximum depth in the center of the lake is observed within 13.5 m. In the summer, according to long-term observations, surface water in 2011 and 2012 warmed to a temperature of 18.1-19.3°C. In the warmest of 2013, the water temperature increased to 21.0°C. In the future 2014 and 2017 surface water temperature continued to rise. Thus, an increase in water temperature has been observed since 2013. At the same time, the water transparency during the investigated time at the central station ranged from 5.3 to 6.4 m. According to the data of the Transbaikal Hydro-meteorological Service, the Arakhley was the lowest and the average annual level was only 35-43 cm. The content of dissolved oxygen and temperature values in the water layers at the central station of the lake in August are presented in different years in Table1.

Table 1: Temperature distribution (T°C), oxygen (mgO_2/l) in the center of the lake Arahley

Depth,	19.08.2011		10.08.2012		10.08.2013		14.08.2014		08.08.2017	
m	T°C	O_2	T°C	O_2	T°C	O_2	T°C	O_2	T°C	O_2
0	19.3	5.7	18.1	16.0	21.0	11.6	21.9	-	21.5	10.7
2	19.2	5.3	18.0	16.2	-	-	21.6	-	-	-
4	18.9	5.0	17.7	15.6	-	9.2	21.5	-	20.4	10.6
6	18.6	5.4	17.6	15.4	-	-	20.4	-	19.9	11.0

8	18.3	5.1	17.3	12.6	-	-	20.0	-	16.2	9.8
10	13.1	3.4	16.1	11.4	-	-	19.8	-	-	-
12	10.8	0.8	13.8	7.5	-	-	16.0	-	-	-
13.5	10.6	0.5	9.1	4.4	-	6.4	10.0	-	9.5	3.0

In the high-water years of previous years (1973-1977), surface water warmed to a temperature of 17-19 °C [19]. According to the results of our data in August of dry years (2011-2017), the surface temperature tended to increase and rose to 18-21.9 °C. During these years, the bottom layers of the water also warmed from 9.1 to 10.6 °C.

In 2011, there was a deficiency of dissolved oxygen in the metalimnion zone at a depth of 10 m, and in 2012 and in 2017 – in the bottom layers. The oxygen concentration in the bottom layers in 2012 was reduced to 0.5 mg/l, which is about the threshold for the survival of many aquatic invertebrates.

For the period of studies of the vertical distribution of zooplankton at the central station of Lake Arakhley in August 2011-2014 and 2017. The following invertebrate species were identified, consisting of 24 hydrobiont species (Table 2).

Table 2: Species composition of the summer zooplankton of Arakhley Lake

ROTIFERA	CLADOCERA	COPEPODA
Asplanchnapriodonta Gosse, 1850 Kellicottialongispina (Kellicott, 1879) Keratellacochlearis (Gosse, 1851) K.quadrata (Muller, 1786) Euchlanisdilatata Ehrenberg, 1832 ConochilusunicornisRousselet, 1892 Polyarthra vulgaris Carlin, 1943 Pompholyxsulcata Hudson, 1885 Trichocercamulticrinis (Kellicott, 1897) Filinialongiseta (Ehrenberg, 1834)	BythotrepheslongimanusLeydig, 1860 Bosminalongirostris (O. F. Muller, 1785) BythotrepheslongimanusLeydig, 1860 CeriodaphniapulchellaSars, 1862 Daphnia galeataSars, 1864 Leptodorakindtii (Focke, 1844) AlonarectangulaSars, 1862 Acroperusharpae Baird, 1843	Eudiaptomusgraciloides (Lilljeborg, 1888) Cyclops vicinusUljanin, 1875 Mesocyclopsarachlensis Alekseev, 1993 Thermocyclopscrassus (Fisher, 1853) Macrocyclopsalbidus (Jurine, 1820) Eucyclopsserrulatus (Fisher, 1851)

Analysis of the vertical distribution of the abundance and biomass of zooplankton in August 2011 revealed that the maximum values of these parameters were in the four-meter layer with the dominance of copepod E. graciloides (Fig. 1). Crustaceans (mainly D. galeata) more or less evenly spread from 4 m to 10 m. Rotifers, represented by A. pridonta, K. longispina, mostly lived in the bottom layers of water (Fig. 1).

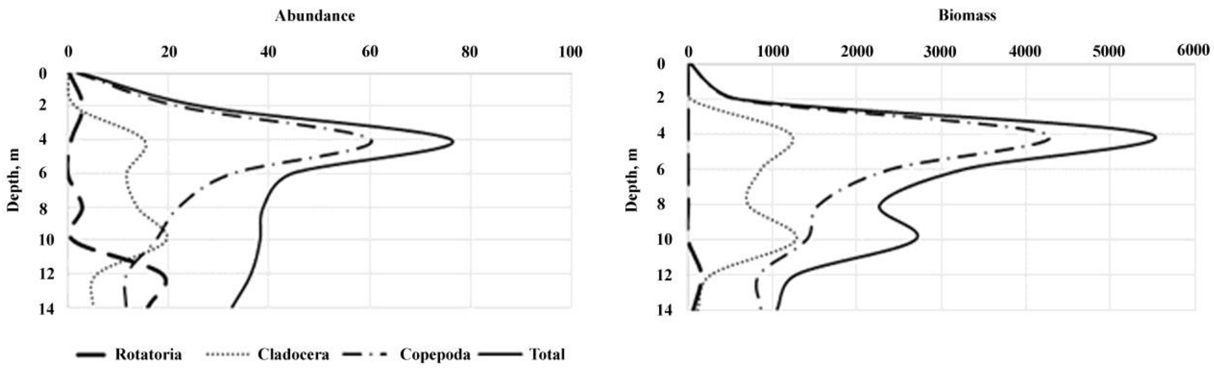

Fig 1: Vertical distribution of abundance (thousandex./m^3), biomass (mg/m^3) of taxonomic groups of zooplankton (August, 2011)

In August 2012, the curve of abundance and biomass dynamics was identical to those of 2011 (Fig. 2). The maximum abundance of zooplankton was also noted at a depth of 4 m, while the maximum biomass was concentrated at a depth of 6 meters. In 2012, as in 2011, the taxonomic group Coppoda dominated the zooplankton community, where the main dominant wasE. graciloides from the copepods.

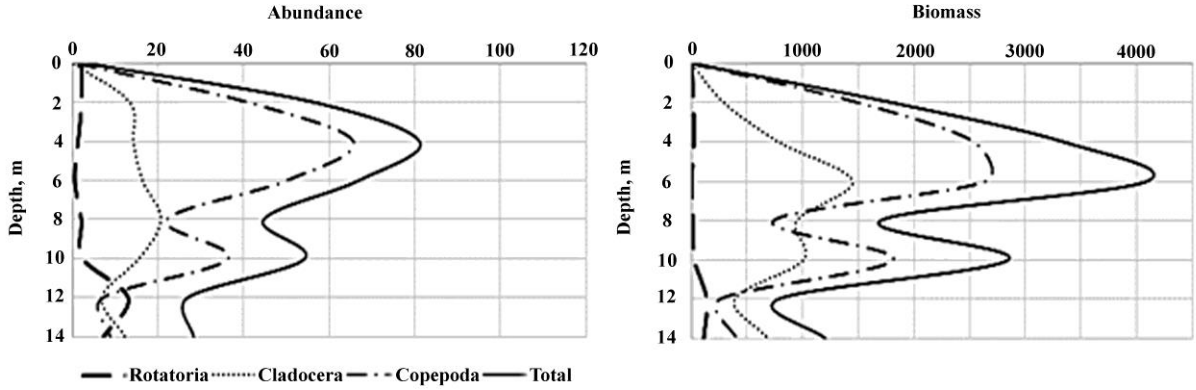

Fig 2: Vertical distribution of abundance (th.ex./m^3), biomass (mg/m^3) of taxonomic groups of zooplankton in August 2012

Thus, in 2011 and 2012, copepods (Copepoda) dominated in the zooplankton community. In arid 2013 in the community of zooplankton Lake Arakhleybegan to dominate both in numbers and biomass of the branchy crustaceans (Cladocera), and the numbers and biomass of Copepoda decreased. This year, the water temperature has increased (Table 1), while the species D. galeata dominated in the zooplankton community and its population in the surface layers of water reached 55.7 thousand ind./m^3. Basically Cladocera was concentrated both in the epilimnion and in the metalimnion (Fig. 3).

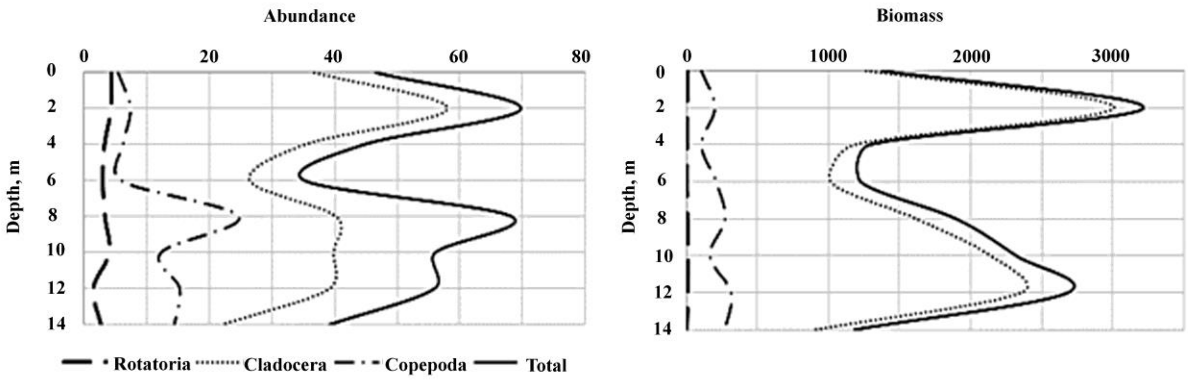

Fig 3: Vertical distribution of abundance (thousand ex./m^3), biomass (mg/m^3) of taxonomic groups of zooplankton in August 2013

In August 2014, when the temperature increased to 22 °C, the taxonomic group Cladocera also dominated in the zooplankton community with the leading species D. galeata, B. longirostris, but the maximum values of zooplankton abundance and biomass were recorded only in bottom layers (Fig. 4).

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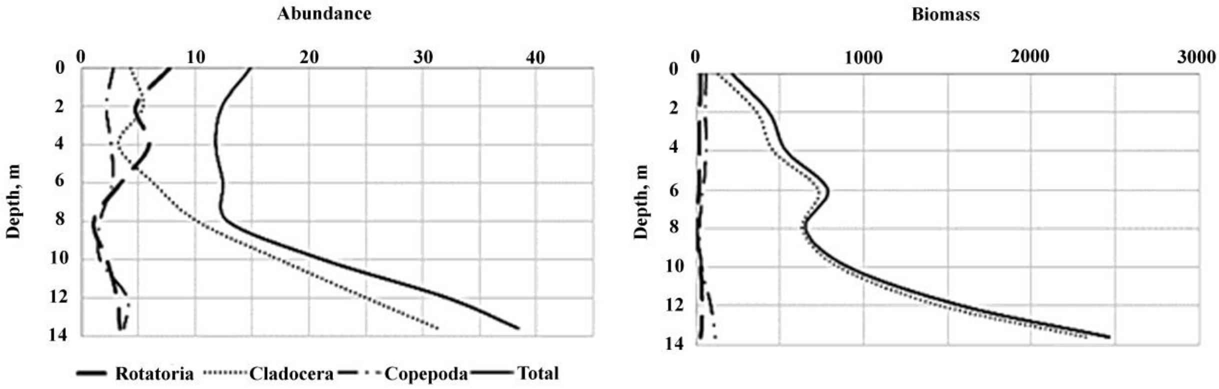

Fig 4: Vertical distribution of abundance (thousandex./m^3), biomass (mg/m^3) of taxonomic groups of zooplankton in August 2014

Thus, in the most arid years in the lake. Branched crustaceans dominated the Arahley, despite the fact that the reservoir is mesotrophic (Fig. 3, 4). We attribute such changes in the structure of zooplankton to a decrease in the level of the lake and a corresponding increase in water temperature by 1-2 °C.

In August 2017, the maximum number by layers in the metalimnion area reached up to 80 thousand ind./m^3 and biomass up to 1.3 g/m^3. Copepoda dominated in numbers, and Cladocera in terms of biomass (Table 3)

Table 3: Vertical distribution of temperature and abundance (thousand ind./m^3), biomass (mg/m^3) of zooplankton based on the results of stratified fishing at the central station of Lake Arahley in 2017

Zooplanktongroup	Depth, m				
	0	3	6	9	13
Temperature, °C	22.0	20.4	19.9	16.2	9.5
Rotifera	- -	- -	0.89 8.94	33.30 520.22	0.67 3.60
Copepoda	1.32 3.35	16.11 192.02	21.14 343.94	43.55 256.47	6.83 123.55
Cladocera	0.34 16.85	3.41 400.89	4.64 935.40	3.81 546.43	3.71 114.42
Total	1.66 20.20	19.52 592.91	26.67 1288.28	80.66 1323.12	11.21 241.57

Consequently, the climate warming observed in recent decades, affecting various processes occurring in aquatic ecosystems, is also reflected in zooplankton communities. Studies of the effect of water temperature on the vertical distribution of zooplankton of a mesotrophic stratified lake. Arakhleyshowed that in August 2011-2012Copepods dominated, by 2013-2014 (August) – the zooplankton community had changed and consisted of branched crustaceans. They dominated both in numbers and in biomass. In 2013, the maximum number of branched crustaceans was observed in the water column from two to eight meters (up to 69.48 thousandex./m^3), in contrast to 2011, when the crustacean D. galeata dominated in all layers. In the more humid 2017, changes in the quantitative indices of zooplankton took place: the group of copepods dominated in terms of abundance, and the crustaceans dominated in terms of biomass. During this period, in the water layers in the area of metalimnion, the maximum abundance of zooplankton reached up to 80 thousand ind./m^{3}and biomass up to 1.3 g/m^3.

Thus, in August 2011-2012 in the composition of the zooplankton of the mesotrophic Arakhley Lake, copepods dominated and had a density maximum either in the upper euphotic layer or in the area of the metalimnion, with a gradual decrease in the lower layers of water. By 2013-2014 the zooplankton community has changed and mainly consisted of branched crustaceans and they dominated both in numbers and in biomass. In 2017, the Copepoda group dominated in numbers, and Cladocera in terms of biomass.

The species composition, number and relevance of each species to the selected horizons are given in Table 4 and 5. In these tables from the years studied we dwell on 2011 and 2013 due to the fact that they found the most distinctive features in the distribution of zooplankton, in the number and biomass of species. Thus, in the more arid 2013, the previously unmarked rotifers of the genera Brachionus, Synchaeta appeared. At the level of identical species composition, the number of individual species, the ratio of taxonomic groups in the vertical layers of water in August 2011 and 2013 were very different.

The number of zooplankton in the surface layer of water in 2011 was small (2.6 thousand ind./m^3) and consisted mainly of nauplial, copepodite stages of diaptomus, cyclops and rotifers. The maximum number of zooplankton (76.2 thousand ind./m^3) was noted in the epilimnion at a four-meter depth with 79% dominance of the copepod crustaceans mainly E. graciloides. The number of zooplankton in the metalimnion (at a depth of 10 m) was 38.19 thousand ind./m^3. Of these, 60% of the total number was represented by branched crustaceans D. galeata. In the hypolimnion, 52% of the animals were rotifers –K. longispina, A. priodonta. Unlike crustaceans, rotifers in August were not the dominant zooplankton group in the epilimnion. However, it should be noted that a very significant increase in their share at the lower boundary of the metalimnion and in the hypolimnion. Thus, in 2011, different species dominated in numbers in different vertical layers of water (Table 4).

Table 4: Species composition and abundance (thousand ind./m^3) of zooplankton in the thickness of the Arakhley Lake in August 2011

Species	Depth, m							
	0	2	4	6	8	10	12	14
Cladocera, Crustacea								
Daphniagaleata Sars, 1864	0,06	1,56	14,76	11,34	13,08	19,56	3,54	2,76
CeriodaphniapulchellaSars, 1862			0,18		0,12			
Bosminalongirostris (O.F.Muller, 1785)	0,06				0,33		2,28	2,28
Leptodorakindtii (Focke, 1844)		0,06	0,24	0,30	0,24		0,06	
BythotrepheslongimanusLeydig, 1860			0,06		0,06		0,06	
AlonarectangulaSars, 1862	0,06							
Acroperusharpae Baird, 1843				0,06				
TotalCladocera	0,18	1,62	15,24	11,76	13,83	19,56	5,88	5,04
Copepoda, Crustacea								
naplii	1,02	3,9	0,66	0,36	0,18		0,12	
copepodit	0,42	2,64	1,44	0,45	2,04	2,34	1,8	1,86
Mesocyclopsleuckarti (Claus, 1857),Thermocyclopscrassus(Fisher, 1853)		0,54	0,06	0,06	0,78	1,47	0,18	0,15
Eudiaptomusgraciloides (Lilljeborg, 1888)								
naplii	0,36	4,44	1,02	0,72	0,36	0,06	0,78	0,12
copepodit	0,06	1,86	3,62	0,24	1,14	0,36	0,24	0,60
adults		9,0	53,1	30,84	17,6	13,26	8,46	8,76
TotalCopepoda	1,98	22,38	60,24	32,67	22,08	17,49	11,76	11,64
Rotifera								
Asplanchnapriodonta Gosse, 1850	0,06	0,12	0,12		0,24	0,18	7,92	3,18
Kellicottialongispina (Kellicott, 1879)			0,06	0,06	2,16	0,9	10,5	11,88
Keratellacochlearis (Gosse, 1851)		0,06						

K.quadrata (Muller, 1786)								
Euchlanisdilatata Ehrenberg, 1832	0,3	0,06	0,06					
ConochilusunicornisRousselet, 1892	0,06	0,66	0,33					
Polyarthra vulgaris Carlin, 1943		1,65						
Pompholyxsulcata Hudson, 1885		0,18	0,18		0,18		0,12	0,06
Trichocercamulticrinis (Kellicott, 1897)		0,3			0,36	0,06		0,06
Filinialongiseta (Ehrenberg, 1834)							0,24	0,66
Total Rotifera	0,42	3,03	0,75	0,06	2,94	1,14	18,78	15,96
Total	2,58	27,3	76,23	44,49	38,85	38,19	36,42	32,64

In 2013, the temperature rise in the surface layers of water reached up to 22 °C. Under these conditions, zooplankton animals were distributed over the vertical layers of the water column more or less evenly. The maximum number was observed in the water layer from two to eight meters (up to 69.48 thousand ind./m^3). In 2013, in contrast to 2011, the crustacean D. galeata dominated in all layers, and the situation was fundamentally different in Arahley Lake: the largest proportion of Cladocera (81%) was in the uppermost, oxygenated epilimnion layer at a temperature of 20.0-21.9 °C, in metalimnion, with a decrease in temperature to 19.8 °C, D. galeata also dominated, but already accounted for 62% of the total number of zooplankton. As the depth in the hypolimnion increases (at a temperature of 10.0 °C), the relative abundance of D. galeata continues to fall, reaching 52% in the bottom layer of water. In this year, there was a change in the percentage of taxonomic groups due to an increase in the proportion of branchy and rotifers in the total number and a decrease in the share of copepods. Thus, there is a eutrophication of the reservoir in all vertical layers of the water column (Table 5). However, it should be noted that the main species composition of zooplankton for these years almost did not change, the changes relate to the ratio of different species.

Table 5: Species composition and abundance (thousand ind./m^3) of zooplankton in the water column of Arakhley Lake in August 2013

Species	Depth, m							
	0	2	4	6	8	10	12	14
Cladocera, Crustacea								
Daphniagaleata Sars, 1864	32,52	55,74	33,46	24,96	34,02	34,98	37,38	19,92
CeriodaphniapulchellaSars, 1862					1,32	0,18		
Bosminalongirostris (O.F.Muller, 1785)	3,12	1,92	1,62	1,44	4,56	4,32	1,74	1,98
Leptodorakindtii (Focke, 1844)			0,06		0,36	0,12	0,06	
BythotrepheslongimanusLeydig, 1860			0,06					
Chydorussphaericus(O.F. Muller, 1785)	1,08	0,12						
TotalCladocera	36,72	57,78	35,20	26,40	40,26	39,66	39,18	21,90
Copepoda, Crustacea								
naplii	1,74	2,04	1,98	1,74	11,76	4,02	1,8	1,8
copepodit	1,5	2,46	1,2	1,32	6,12	5,06	5,64	8,4
Mesocyclopsarachlensis Alekseev, 1993	0,12	1,86	1,38	2,04	1,56	0,42	1,44	0,84
Thermocyclopscrassus(Fisher, 1853)	0,42			0,06	0,12	0,36	5,82	2,70
Macrocyclopsalbidus(Jurine,1820)	0,06					0,12	0,12	
Eudiaptomusgraciloides (Lilljeborg, 1888)								
naplii	0,96	0,9	0,9	0,36	5,1	2,16	0,12	0,54
copepodit								0,06

adults								0,06
TotalCopepoda	4,8	7,38	6,18	5,85	24,72	12,14	14,94	14,4
Rotifera								
Asplanchnapriodonta Gosse, 1850	0,18	0,12	0,18	0,06	0,24	0,48	0,54	0,06
Kellicottialongispina (Kellicott, 1879)	0,6	0,66	0,6		0,54	0,84	0,24	0,48
Keratellacochlearis (Gosse, 1851)	0,9	0,36	0,3	0,24	0,78		0,18	0,18
K.quadrata (Muller, 1786)	0,06		0,18		0,12	0,18		0,12
Euchlanisdilatata Ehrenberg, 1832						0,54		
ConochilusunicornisRousselet, 1892	0,06	0,06	0,12					
Polyarthra vulgaris Carlin, 1943	0,24	0,18		0,33	0,24	0,12	0,12	0,54
Pompholyxsulcata Hudson, 1885					0,06	0,3		0,18
Trichocercamulticrinis (Kellicott, 1897)	2,1	2,94	1,92	2,16	1,14	1,5	0,18	0,12
Filinialongiseta(Ehrenberg, 1834)	0,06			0,06		0,06	0,18	0,9
Synchaeta sp.					0,18			
Brachionus sp.	0,12	0,06						0,06
Total Rotifera	4,32	4,32	3,24	2,97	3,30	4,02	1,44	2,70
Total	45,84	69,48	44,62	35,22	68,28	55,82	55,56	39,10

The dominant species of zooplankton in different years are presented in Table 6.

Table 6: The dominant zooplankton complex in 2011 and 2013 in the lake Arahley

2011	% ofthetotalabundance	2013	% ofthetotalabundance
Daphniagaleata	24.0	Daphniagaleata	65.0
D. galeata	22.0	Eudiaptomusgraciloides	22.0
Kellicottialongispina	8.6	Trichocercamulticrinis	3.0

Thus, in 2011 D. galeata, E.graciloides accounted for 22-24%, in 2013 D. galeata– 65% of the total number of zooplankton.

A distinctive feature of 2014, compared with previous years, is that the values of the abundance and biomass of zooplankton were small (up to 40 thousand ind./$m^3$and 2.5 g/m^3). In August 2017, the number of zooplankton doubled (to 80 thousand ind./m^3), but their biomass decreased to 1.3 g/m^3. Nauplii and copepodite stages of cyclops dominated by number: Mesocyclopsarachlensis, Thermocyclopscrassus, Eucyclopsserrulatus.

DISCUSSION

The vertical distribution of zooplankton communities in stratified lakes during the summer period is due to temperature, abundance of food [20; 21] and the presence of oxygen [22]. These factors, affecting the state of the ecosystem, regulate the structure and abundance of zooplankton communities. Thus, an increase in temperature can cause a change in the vertical structure of zooplankton and even a change in the dominant species [7; 11]. If in August 2011-2012 the surface temperature of water ranged from 18 to 19 °C, then in 2013, 2014, 2017 water temperature rose to 21.9 °C. It was revealed that with increasing water temperature there was a change in the percentage of taxonomic groups of zooplankton in the direction of increasing the proportion of branchy and decreasing share of copepods. Thus, an increase in water temperature in low-water and high-water years affects the dominant zooplankton complex in different ways. Thus, with an increase in

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water temperature in the low-water period, branchifaceous crustaceans and rotifers dominate in the zooplankton community, and copepod crustaceans in the high-water period.

In the vertical distribution of zooplankton over the years studied, the identified features of the species composition, abundance and biomass of zooplankton show that in August 2011-2012. the copepod crustaceans of E. graciloides dominated at a water temperature of 18-19 ° C, being 16-56% in the upper layers (0-2 m), 73-75% at a depth of 4-6 m, and in metalimnion (at 8-10 m) corresponded to 49-37%, in the hypolimnion (12-14 m) the number of organisms was 26-29% of the number of zooplankton. Thus, copepod crustaceans of E. graciloides were most dominant at a depth of 4-6 m.

With a further increase in water temperature to 21.9 °C in August 2013, branching crustaceans, mainly D. galeata, dominated in the zooplankton community, accounting for 70-80% in the upper water horizons (0-6 m) with a decrease to 50-67% in the horizons of 8-14 m from the number of zooplankton in the corresponding layer of water. In 2013-2014, the zooplankton community changed from the state of previous years. The changes concerned the percentage of taxonomic groups in the direction of increasing the proportion of branched and rotifers in the total number of zooplankton and reducing the proportion of copepods.

The more humid 2017 is a transitional period between low-water and high-water years in climatic changes. This transition period is reflected in changes in the abundance and biomass of the zooplankton community. Compared with previous years, in 2017, the group of copepods dominated in terms of abundance, and in the case of biomass, crustaceans. During this period, by water layer in the area of metalimnion, the maximum number reached 80 thousand ind./$m^3$and biomass – up to 1.3 g/m^3. Copepoda dominated in numbers, and Cladocera in terms of biomass.

We have obtained a vertical distribution of structural changes in zooplankton communities associated with the transformation of the temperature factor over the horizontal layers of the water column (species composition, abundance and biomass of zooplankton). The data obtained for the time studied shows the processes of eutrophication of the reservoir.

CONCLUSION

1. The effect of water temperature on the vertical distribution of zooplankton in a mesotrophic stratified lake was studied Arakhley in the low-water period (when the water level of the lake is 0.35-0.43 m).
2. It is revealed that the surface layer of water in August 2011-2012. warmed to a temperature of 18.1-19.3 ° C, and in the warmest of 2013 – the temperature reached 21.9 °C.
3. It was found that copepods dominated in the zooplankton community in 2008-2012, and in warm 2013-2014 crustaceans were in the lead.

REFERENCES

[1] Meshcherskaya A.V., Obyazov V.A., Bogdanova E.G., Mirvis V.M., Ilyin B.M., Snitsarenko N.I., GolodMP, Smirnova A.A., Obyazova A. Trudy GGO 2009; 559; 32-57.
[2] Obyazov V.A. Dynamics of climatic and hydrological parameters.Ivano-Arakhleisky lakes at the turn of the century (state and dynamics). Novosibirsk, Publishing House of the SB RAS, 2013; 42-51.Borutsky E.V., Stepanova L.A., Kos M.S. Qualifier Calanoida fresh waters of the USSR. Leningrad, Science, 1991; 504 p.
[3] Moore M.V., Hampton S.E., Izmest'eva L.V., Silov E.A., Peshkova E.V., Pavlov B.K. BioScience2009, 59 (5): 405-417.
[4] Kiselev I.A. Plankton of the seas and continental waters. Leningrad, Science, 1980; 440 p.
[5] Ostapenya A.P., Egiyan A.L., Mikheeva TM, Nikitina L.V., Lukyanova E.V. Bulletin of the BSU 2010; 3: 56-60.
[6] Golubok O.V., Rechkalov V.V. Features of the vertical distribution of crustacean plankton of thermally stratified lakes of the Chelyabinsk region. Actual problems of studying continental crustaceans. Kostroma, Kostroma Printing House LLC, 2012; pp. 165-168.
[7] FenevaI.Yu., Razlutsky V.I., Palash A.L., Tunovsky Y., Zilitinkevich N.S. Zoological journal2016, 95(2): 153-166.

[8] Manuylova E.F. Crustaceans (Cladocera) of the fauna of the USSR. Moscow, Science, 1964; 317 p.
[9] Biological productivity of Arahleylake (Transbaikalia). Novosibirsk, Science, 1981; 144 p.
[10] Vezhnovets V.V. Features of the vertical distribution of zooplankton in dimictic lakes // Actual problems of studying continental crustaceans. Kostroma, Kostroma Printing House LLC, 2012. p. 153-155.
[11] Vezhnovets V.V., Semenchenko V.P. Reports of the National Academy of Sciences of Belarus 2011; 55(5): 72-75.
[12] Semenchenko V.P., Razlutsky V.I. Journal of Siberian Federal University. Biology2009, 2: 191-225.
[13] Rechkalov V.V., Golubok O.V., Shimanskaya M.L. Herald of the Orenburg State. University of Ecology of the Southern Urals2015, 10 (185): 112-117.
[14] Guidelines for the collection and processing of materials in hydrobiological studies on freshwater bodies. Zooplankton and its products. Leningrad,GosNIORH, 1984; 34 p.
[15] Kutikova L.A. Rotifers of the fauna of the USSR. 1970; 742 p.
[16] Borutsky EV, Stepanova LA, Kos M.S. Qualifier Calanoida fresh waters of the USSR. Leningrad, Science, 1991; 504 p.
[17] Key to freshwater invertebrates in Russia and adjacent territories. Crustaceans.SPb, Science, 1995; 617 p.
[18] The determinant of zooplankton and zoobenthos of fresh waters of European Russia. Zooplankton. Moscow, Tov-of scientific. ed. KMK, 2010; 495 p.
[19] Vologdin M.P. Thermal regime oz. Arahley. Biological productivity of the lake. Arahley (Transbaikalia). Novosibirsk, Science; 1981. pp. 5-19.
[20] Lampert W., McCauley E., Manly B.F.J. Proceedings of the Royal Society of London Series B, Biological Sciences. 2003, 270: 765-773.
[21] Kessler K., Lampert W. Freshwater Biology2004, 49: 392-401.
[22] Lasson P., Lampert W. Freshwater Biology 2012, 57: 2514-2525.