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# About Littoral Macrozoobenthos Communities of Cheboksary Reservoir.

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**ABSTRACT**

This work analyzed the qualitative and quantitative characteristics of zoobenthos communities of coastal shallow zone at Cheboksary reservoir during the vegetation period of 2014. In this regard, three sampling stations were provided, differing by soil, biotic and abiotic environmental conditions. Each station consists of two sections of reservoir shallow coastal area, where the research was performed: directly in the water line area, as well as at various depths of shallow water. The species composition of macrozoobenthos, the number and biomass indicators, the leading groups and organism taxa were specified. 41 taxa of aquatic invertebrates were revealed, 17 of which (41.5% of the total amount) occurred in the water line area and in littoral zone. The observed taxa belong to Mollusca, Arthropoda, Plathelminthes, Annelida types. The greatest species diversity was observed among insects (mainly Diptera representatives), as well as among mollusks. The high amount and biomass indices were observed among gastropods and bivalves, the invasive species *Lithoglyphus naticoides* (Pfeiffer, 1828), *Dreissena polymorpha* (Pallas, 1771), which play an important role in the communities of zoobenthos of the Volga-Kama reservoir system. High biomass indices were observed among gastropods, especially *Viviparus viviparus* (L., 1758). The water edge zone with high levels of biomass had a large amount of pond snails *Lymnaea auricularia* (L., 1758) and *L. stagnalis* (L., 1758) and the shallow water zone had a large amount of *Unio longirostris* (Rossmaessler, 1836) bivalves.

**Keywords:** Zoobenthos, littoral, Cheboksary water basin, coastal-shallow area

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## INTRODUCTION

Volga-Kama multireservoir system of water power plants (WPP) includes many reservoirs, the youngest of them is Cheboksary reservoir, established in the autumn of 1980 by regulation of Volga river at Cheboksary WPP. This reservoir is located between Gorky and Kuibyshev reservoirs on the territory of the Republic of Chuvashia, Mari El and Nizhny Novgorod region [1].

One of reservoir features is the formation of shallow water areas, which differ significantly from the deep ones by the interaction of processes which affect water masses, a bottom and a shore. In this regard, deep water community fauna may differ significantly from the shallow water one [2]. Shallow water zone develops a coastal-water ecotone, which is exposed by land and the deep water area influence [3].

Benthos are the organisms which live on the surface of the ground, and in its column. Benthic organisms have a number of features that facilitate their use in various fields of science and industrial sector: large sizes, high life expectancy, ease of collection and processing, the confinedness to a specific biotope. Moreover, benthic communities form the food reserve for many fish, including commercial ones [4.5].

The studies of macrozoobenthos at Cheboksary Reservoir were started since its establishment and continue till now. However, the study of benthic communities affects mostly deep water areas [5-7]. That is why the shallow water area, being the least mastered one, needs more qualitative monitoring. Also a great interest to this water body is caused by a planned increase of flood-control storage level to 68 m [1], which will affect the quality and quantity of invertebrate communities in the littoral zone.

## MATERIALS AND METHODS

Zoobenthos samples were collected during the summer - autumn period of 2014 within water edge area and in the shallow coastal waters (at the depths of 0.1 m, 0.5 m, 0.7 m) of Cheboksary reservoir near Sosnovka village from three stations with different types of soil. The soil at the station 1 was silty-sandy, the soil at the station 2 was sandy, and the soil at the station 3 was sandy with the presence of vegetation residues in the water edge zone and submerged vegetation on coastal shallow water. Besides, the station 1 and the station 3 were located in the bay, sheltered from wind and waves. Station 2 was opened and exposed to wind and wave action [8].

The collection of samples from soil surface (0.2-0.5 m from the water edge) was performed by hand by the frame with the area of 0.0625 m2. The recovered upper layer of soil (5 cm) was washed through the net by portions. Invertebrate left directly near the water line area, as well as in littoral zone were taken with a hand net. The selection of the zoobenthos at the coastal shallow water was also carried out using a hand a net, in accordance with standard techniques [5,9,10]. Subsequently, the selected material was fixed in 4% formalin solution. The processing of material was carried out on the basis of Zoology and General Biology Department of Kazan (Volga) Federal University in accordance with standard techniques [11-13]. All invertebrates were classified down to species, except for chironomid, beetle and mayfly larvae (they were classified down to subfamily and genus).

The reliability of obtained results was assessed using the method of multiple comparisons (H Kruskal-Wallis criterion) and the method of paired comparisons (U-Mann-Whitney criterion) in the Past software package (version 3.08) (Paleontological Statistics) [14].

## RESULTS AND DISCUSSION

41 taxa of benthic invertebrates, which belong to 4 types of zoobenthos were revealed during the study period: Mollusca (Bivalvia and Gastropoda classes), Arthropoda (Amphipoda, Isopoda, Diptera, Heteroptera, Ephemeroptera, Coleoptera order), Plathelminthes (Turbellaria class) and Annelida (Oligochaeta and Hirudinea class). Arthropods were characterized by the highest number of taxa (25 taxa). Diptera (14 taxa) were the most widely represented ones. Shellfish were represented by 11 taxa, 5 are classified to bivalve, 6 belong to gastropods. Other groups of zoobenthos are represented more weakly.

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The species composition of coastal shallow zone is largely influenced by deeper parts of the reservoir [2,3]. However, the species composition of coastal aquatic ecosystems is much inferior to deep water reservoirs [5.8]. Such species as the clams *V. contectus* (Millet, 1813), *V. viviparus* (L., 1758), *L. naticoides* (Pfeiffer, 1828), *D. polymorpha* (Pallas, 1771), the representatives of Diptera *Chironomus plumosus* (L., 1758) and *Cricotopus* gr. *algarum* (Kieffer, 1911), the bug *Aphelocheirus aestivalis* (Fabricius, 1794) were found as in the studied areas, so as in the deeper parts of the reservoir [5-7].

The compared study areas were characterized by the following features (Fig. 1): in the water edge zone were identified 31 taxa of aquatic invertebrates, 27 taxa in the coastal shallow waters, and 17 (41.5% of the total number of taxa) were found in both areas of research. The greatest variety of taxa number was presented among Diptera (34.1%), bugs (14.6%), gastropods (14.6%) and bivalve clams (12.2%). Both areas of study had individual meetings of a widespread planarian *Dendrocoelum lacteum* (L., 1758) [15], as well as the findings of *Nepa cinerea* bugs (L., 1758), widely distributed in Europe.

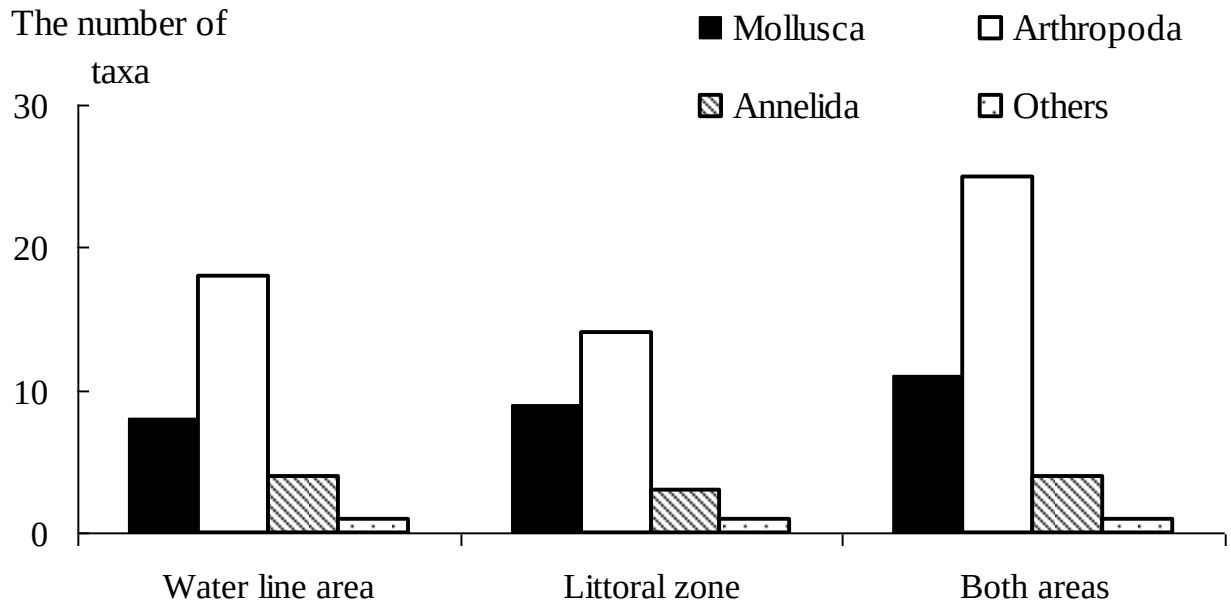


**Fig. 1. The ratio of taxonomic groups of littoral zoobenthos communities of Cheboksary reservoir**

Taxa were found in the water line area, not found in littoral zone: *Asellus aquaticus* (L., 1758), *Haliplus* sp. (Latreille, 1802). Besides, Diptera were wide represented there: *Parametriocnemus stylatus* (Kieffer, 1924), *Polipedilum* sp. (Kieffer, 1912), etc. In contrast, the fauna of Diptera in littoral zone was represented more weakly: almost all caught organisms belonged to *Chironomus* sp. (Meigen, 1803) and *Monodiamesa* of *batyphila* gr. (Kieffer, 1911). Mayflies and bugs *Notonecta* sp. (L., 1758) and *Micronecta* sp. (Kirkaldy, 1897) were found only in littoral zone.

The diversity of species at the station 3 on both sections of the study was higher than at the station 1 and 2 due to their protection from the negative impact of external factors [3,8]. Phytophilous insect species prevailed here, the mayflies *Siphlonurus* sp. (Eaton, 1868), *N. cinerea* bug (L., 1758) were found. On the contrary the representatives of psammophilous fauna such a chironomid larvae and oligochaetes were found at the station 1 and 2. *Caenis* sp. mayflies (Stephens, 1833), preferring muddy bottoms [16], were found only on at station 1.

The average value of the abundance (with the mean standard error) was 113 ± 27 spec./$m^2$. Significant differences between the medians of two studied area stations, confirmed by multiple comparisons ($H = 26,52$, $p < 0,001$) were revealed. The method of paired comparisons showed the presence of significant differences between water edge stations and coastal shallow waters (Table 1).

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**Table 1. Probability value (*p*) and values of Mann-Whitney U test of macrozoobenthos abundance of investigated areas (St. is station; *p* value is located above the line inside of the cell; Mann-Whitney U values are located under the line inside of the cell)**

| Research area | | Water line area | | | Littoral zone | | |
|---|---|---|---|---|---|---|---|
| | | St. 1 | St. 2 | St. 3 | St. 1 | St. 2 | St. 3 |
| Water line area | St. 1 | - | >0,05<br>331 | >0,05<br>319 | <0,01<br>209 | <0,05<br>229 | >0,05<br>267 |
| | St. 2 | >0,05<br>331 | - | >0,05<br>353 | <0,001<br>175 | <0,01<br>190 | <0,05<br>227 |
| | St. 3 | >0,05<br>319 | >0,05<br>353 | - | <0,001<br>164 | <0,001<br>178 | <0,01<br>205 |
| Littoral zone | St. 1 | <0,01<br>209 | <0,001<br>175 | <0,001<br>164 | - | >0,05<br>322 | <0,05<br>237 |
| | St. 2 | <0,05<br>229 | <0,01<br>190 | <0,001<br>178 | >0,05<br>322 | - | >0,05<br>276 |
| | St. 3 | >0,05<br>267 | <0,05<br>227 | <0,01<br>205 | <0,05<br>237 | >0,05<br>276 | - |

The main contribution to the abundance was introduced by invasive species *L. naticoides* (Pfeiffer, 1828) and *D. polymorpha* (Pallas, 1771), currently playing a significant role in the benthic communities of Volga-Kama multireservoir system. The latter species, *D. polymorpha* (Pallas, 1771) and the related species *D. bugensis* (Andrusov, 1847) forms massive fouls, participating in the self-purification processes of water bodies [17-21].

The average indicators of studied areas were significantly reduced in comparison with the data from the deep parts of reservoirs, where the abundance was 600-800 spec./$m^2$ in some areas [6]. At the same time, these indicators were slightly higher than the indicators of littoral zone in the Kuibyshev Reservoir [22,23].

In the water edge zone the average values of the abundance were 63 ± 12 spec./$m^2$. The highest average value of the abundance was observed at the station 1 and it was 87 ± 29 spec./$m^2$. The minimum value was revealed at the station 3 (47 ± 15 spec./$m^2$), where the abundance of clams was lower. An average abundance of littoral macrozoobenthos was 163 ± 33 spec./$m^2$, which was higher than the same indicators of littoral zone of Kuibyshev Reservoir (no more than 140 spec./$m^2$) [22,23]. The highest average of the abundance were also observed at the station 1 (218 ± 40 spec./$m^2$), which exceeded the values of the station 2 (167 ± 29 spec./$m^2$) and the station 3 (103 ± 16 spec./$m^2$). This is due to the fact that the main contribution to the abundance on both sites of the study was made by the previously mentioned bivalve *D. polymorpha* (Pallas, 1771) and gastropod *L. naticoides* (Pfeiffer, 1828). The last one prefers enclosed areas of water bodies without thickets, protected from damaging wave action [24]. Therefore, the medium indices of zoobenthos at the station 1 were higher than at the station 2, prone to the negative effect of wind and waves. Few phytophilous species dominated at station 3. The role of mass species was lower than at the station 1.

An average biomass value was 14,33 ± 5,46 g/$m^2$. The method of multiple comparisons revealed significant differences between the medians of different stations of both study areas ($H = 29,49$, $p<0,001$). Biomass indicators were higher at coastal shallow waters than in the water edge zone (22,17 ± 9,33 g/$m^2$ and 6.49 ± 0.62 g/$m^2$, respectively). The main contribution to the biomass on both areas of research was made by the representatives of gastropods with high individual weight, such as *V. viviparus* (L., 1758), *L. auricularia* (L., 1758), as well as numerous shellfish with little individual weight of *D. polymorpha* (Pallas, 1771) and *L. naticoides* (Pfeiffer, 1828). These types of shellfish are also make a major contribution to the biomass of littoral zone of the Kuibyshev Reservoir [22-24].

At all stations of water edge zone the main contribution in biomass was made by *V. viviparus* (L., 1758) (32.14%, 29.32% and 36.71% of the total biomass at the station 1, 2 and 3, respectively). Besides, a significant contribution at the station 1 to the biomass was made by *L. naticoides* (Pfeiffer, 1828) (22.13%) and

by *L. auricularia* (L., 1758) (17.48%) and by *Pisidium amnicum* (Muller, 1774) (16.66%) at the station 3. The role of other groups of zoobenthos wasn't significant.

In shallow water zone *V. viviparus* (L., 1758) made a major contribution to the station 1 and station 2 (50.75% and 36.43%, respectively). Besides, the role of *V. contectus* (Millet, 1813) at the station 1 and 2 (16.31% and 14.89%, respectively), as well as *L. naticoides* (Pfeiffer, 1828) (20.85%) at the station 1 and the role of large bivalve *U. longirostris* (Rossmaessler, 1836) (32.30%) at the station 2 was a great one. The main contribution into the biomass was made by *L. naticoides* (Pfeiffer, 1828) (25.80%), as well as by mollusks *L. auricularia* (L., 1758) and *L. stagnalis* (L., 1758) (18.98% and 12.91%, respectively) at the station 3 with submerged thickets of vegetation.

## CONCLUSION

According to work results, the main groups of zoobenthos at the coastal shallow water zone of the reservoir were bivalves, gastropods and Diptera (mainly larvae of buzzers), bugs and others. Station 3 had the highest species diversity. This was conditioned by its protection from the harmful effects of abiotic factors, as well as by the presence of plant residues in water edge zone and the thickets of submerged vegetation in the shallow water zone.

The average values of zoobenthos abundance were expectedly lower in coastal shallow zone than in the deep water parts of reservoir. The high values of abundance were found among the gastropods and bivalves, especially among invasive mollusks *D. polymorpha* (Pallas, 1771) and *L. naticoides* (Pfeiffer, 1828). Biomass indicators were higher among gastropods *V. viviparus* (L., 1758), *L. auricularia* (L., 1758) and *L. stagnalis* (L., 1758), as well as among bivalves *U. longirostris* (Rossmaessler, 1836).

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