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*Article*

# Macrozoobenthos of the Saratov Reservoir during cyanobacteria blooms

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**Abstract**. In the Saratov Reservoir, 49 macrozoobenthos species and taxa of higher systematic rank were recorded in July and September 2023. Mollusks of the genus *Dreissena* dominated both by abundance (more than 80% of total macrozoobenthos abundance) and biomass (98%). Maximum chlorophyll concentration in July reached 29.4 µg/L, in September, 6.4 µg/L. In autumn, both abundance and biomass of macrozoobenthos increased mainly due to the development of the filter feeders. The number of other trophic groups, as well as sestonophagous mollusks and detritivorous filter feeders *Dreissena bugensis* did not depend on cyanobacteria bloom. In the lower section of the reservoir, characterized by abnormally high cyanobacterial biomass (up to 9.37 mg/L), minimal abundance and biomass of the filter feeders was registered. As cyanobacteria biomass exceeded 4 mg/L, and chlorophyll *a* concentration, 10.5 mg/L, no filter feeders were found. Species diversity of benthic communities, calculated using the Shannon index, was generally low during the study period (0–2.08 bits/ind.), with its maximum values occurring in September, when a decrease in cyanobacterial biomass was observed. However, species richness of benthic communities was higher in the summer. Berger-Parker index values were the highest in July and reflected a significant degree of dominance of individual species, primarily mollusks of the genus *Dreissena.*

**Keywords:** Volga River, benthic communities, chlorophyll *a,* biodiversity, filter feeders, *Dreissena polymorpha*, *Dreissena bugensis*

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*Научная статья*

# Макрозообентос Саратовского водохранилища в период массового развития цианобактерий

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**Аннотация**. В результате исследований макрозообентоса Саратовского водохранилища в июле и сентябре 2023 г. зарегистрировано 49 видов и таксонов более высокого систематического ранга. Основную долю в общей численности (более 80%) и биомассе (98%) макрозообентоса составляли моллюски рода *Dreissena*. Максимальные значения концентрации хлорофилла *a* в июле – 29.4 мкг/л, в сентябре – 6.4 мкг/л. Выявлено, что увеличение численности и биомассы макрозообентоса в осенний период происходит в основном за счет массового развития трофической группы фильтраторов. Численность остальных трофических групп, а также моллюсков сестонофагов + детритофагов-фильтраторов *D. bugensis* практически не зависела от развития цианобактерий. Фильтраторы имели минимальную численность и биомассу в нижнем участке водохранилища, характеризующемся аномально высокой биомассой цианобактерий (до 9.37 мг/л). Отмечено, что при увеличении биомассы цианобактерий выше 4 мг/л и концентрации хлорофилла *a* выше 10.5 мг/л фильтраторы не встречаются. Видовое разнообразие бентоценозов, рассчитанное на основе индекса Шеннона, было в целом низким в период исследований (от 0 до 2.08 бит/экз.), при этом максимальные его значения были характерны для сентября, когда наблюдалось снижение биомассы цианобактерий. Вместе с тем видовое богатство донных сообществ оказалось выше в летний период. Величины индекса Бергера–Паркера были наиболее высокими в июле и отражали значительную степень доминирования отдельных видов, преимущественно моллюсков рода *Dreissena*.

**Ключевые слова:** река Волга, донные сообщества, хлорофилл *a*, биоразнообразие, фильтраторы, *Dreissena polymorpha*, *Dreissena bugensis*

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## Introduction

The reservoirs of the Volga River cascade differ in their morphometric, hydrological and hydrochemical characteristics (Rivers..., 2009; Volga..., 1978). The Saratov Reservoir is characterized by significant water exchange rate and biotope diversity, lower degrees of pollution, trophicity, and sediment siltation compared to other Volga River reservoirs (Popchenko, 2001; Selezneva, 2007). As a result, specific conditions are formed here for the development and functioning of benthic communities. However, all reservoirs of the cascade are characterized by the mass development of cyanobacteria in the summer, to a greater or lesser extent (Mineeva et al., 2020). On one hand, cyanobacteria blooms lead to a rapid deterioration in the ratio of dissolved gases and hydrochemical regime, accompanied by a decrease in dissolved oxygen concentration, the accumulation of large amounts of particulate organic matter at different stages of destruction, and increase in the dissolved carbon dioxide concentration; changes in ammonia and hydrogen sulfide concentrations are also registered (Lukyanenko, 1987). The above factors have a strong adverse effect on the living conditions of all aquatic organisms and of macrozoobenthos in particular. It is also known that cyanobacteria are capable to produce toxic metabolites (cyanotoxins). On the other hand, cyanobacteria are an important source of nutrition for many groups of benthic communities: mayflies, oligochaetes, dipterans, etc. (Makhutova et al., 2016; Monakov, 1998).

The macrozoobenthos of the Saratov Reservoir has been studied from the moment the reservoir was formed to the present day (Borodich, 1978; Filinova, 2021; Malinina et al., 2007; Nechvalenko, 1973; Volga..., 1978; Zinchenko and Kurina, 2011; etc.). However, a study of benthic communities considering the effect of cyanobacteria has not been carried out previously.

The study aims to assess the current species composition, abundance, and biomass of the main taxonomic groups of macrozoobenthos, and to identify if the dynamics of quantitative characteristics and biodiversity of benthic communities are affected by the development of cyanobacteria in the summer-autumn period of 2023.

## Materials and methods

The Saratov Reservoir has an area of 1830 km$^2$; it was formed by regulating the Volga River flow near the town of Balakovo. The reservoir is located between the dams of the Kuibyshev and Saratov hydroelectric power stations. It was filled in two stages in 1967–1968. The reservoir is of the valley-channel type (Volga..., 1978). Based on geomorphological and hydrological features, there are three reservoir sections (Popchenko, 2001):

upper section, characterized by the river type and extending from the hydroelectric dam near the city of Tolyatti to the city of Samara;

central section, with a lotic water regime, extending from the city of Samara to Oktyabrsk town, and lake-river conditions in the Oktyabrsk-Syzran section;

lower section, characterized by lake-type water mass, extending from the city of Syzran to the Balakovo hydroelectric power station.

The Saratov Reservoir is a part of the Lower Volga River; it borders the Kuibyshev Reservoir to the north and the Volgograd Reservoir to the south.

The lower section of the reservoir is characterized by maximum depth of 30 m, located in the former riverbed of the Volga River. The upper and central sections are represented by shallow, well-warmed waters, the depth here rarely exceeds 10 m, and shallow waters occupy 71.9% of the reservoir area: 0–2 m, 21.1%; 2–5 m, 25.5%; 5–10 m, 25.3% of the total area (Sidenko, 1973). The water is mainly characterized as "polluted" (quality class 3A) in all sections of the reservoir (Ekologicheskiy..., 2024; Obzor..., 2024).

The macrozoobenthos was sampled at 20 stations located both in the deep-water and shallow ($h$ > 3.0 m) sections of the Saratov Reservoir in July and September 2023. In total, 40 sampled were obtained. In the upper section of the reservoir, samples were collected at 5 stations, in the central section, at 6 stations, and in the lower section, at 9 stations. The characteristics of the sampling sites are presented in our earlier publication (Zinchenko and Kurina, 2011). Quantitative samples were collected in duplicate with an Ekman-Birge bottom grabs with capture areas of 1/40 m$^2$ and 1/25 m$^2$. Collection and processing of the material was carried out using standard hydrobiological methods (Bakanov, 2000; Metody..., 2024; Rukovodstvo..., 1992). The collected sediments were washed through a sieve, then placed in a cuvette, from which organisms were taken out with tweezers under a binocular microscope MBS-9. Samples were fixed with 70% ethanol. The organisms were identified under a Bresser Researcher Trino microscope to the lowest possible taxonomic level according to the accepted taxonomic keys (Atlas..., 1968; Copilaș-Ciocianu and Sidorov, 2022; Opredelitel'..., 1995, 2000, 2001, 2004; Uryupova, 2008; etc.), counted, and weighed on a VT-200 torsion scale with an accuracy of 0.010 g. Small mollusks (up to 1.0 cm) were included into the group of unarmored benthos. Large unionids, viviparids, and dreissenids were considered separately.

To determine the chlorophyll *a* concentration, 0.2–1.0 L of water was filtered through FPSV-293 glass fiber filters (Vladisart, Russia) with a nominal retention threshold of 1.2 μm. Seston collected on the filters was extracted with 90% acetone in the dark at 4 °C for 24 hours. The concentration of pigments in acetone extracts was determined according to standard methods (Jeffrey and Humfrey, 1975). The concentration of chlorophyll *a* was estimated using a Specord M-40 spectrophotometer (Karl Zeiss JENA, Germany).

Phytoplankton samples (0.5 L) were filtered down to 10-mL volume through membrane filters with a pore diameter of 0.8 μm using a vacuum pump (Metodika..., 1975). The material was preserved with a 4% formaldehyde solution. To estimate abundance, algal cells were counted in an 0.01-mL Uchinskaya-2 chamber (Guseva, 1959). Biomass was determined using the geometric similarity method.

Seven trophic groups of benthic invertebrates were identified in the Saratov Reservoir: omnivorous collector-gatherers, collector-gatherers and collector-filterers, phytophagous collector-gatherers (shredders), predators, collector-gatherers and subsurface deposit feeders, and collector-filterers (Izvekova, 1975; Konstantinov, 1967).

The obtained data was processed statistically using STATISTICA v. 12.5 software (StatSoft Russia).

## Results

Cyanobacteria biomass and chlorophyll *a* concentration in the Saratov Reservoir were estimated in summer and autumn in order to assess their impact on benthic communities (Table 1). In July, the average cyanobacteria biomass was 2.29 mg/L with a maximum chlorophyll *a* concentration of 29.36 µg/L. In September, the first decreased by almost 6 times, the second, by 4.6 times. In both periods, the values of these parameters increased non-monotonously downstream, reaching maximum values in the lower section of the reservoir. In July, the average chlorophyll *a* concentration in the riverine part of the reservoir corresponded to the mesotrophic productivity level, in the lacustrine part, to the eutrophic one. In September, the chlorophyll *a* concentration throughout the reservoir corresponded to the mesotrophic level.

In July and September 2023, 49 species and taxa of higher systematic rank of macrozoobenthos were registered in the riverbed part of the Saratov Reservoir. The most represented groups were chironomids (16 species, larval stages), crustaceans (14 species), and mollusks (11 species). Oligochaetes were not identified down to the species level, but were taken into account when assessing the abundance and biomass of benthic communities. Twenty-two species were recorded in the upper section, 30 species, in the central section, and 23 species, in the lower section. The number of species varied from 0 to 15 at the station, with minimal diversity near the city of Samara and in the immediate vicinity of the Volga Hydroelectric Power Station dam. The Ponto-Caspian polychaetes *Hypania invalida* (Grube, 1860) were found most frequently (frequency of occurrence 45–47%), as well as bivalves *Dreissena bugensis* (Andrusov, 1897) (35–60%) and amphipods *Dikerogammarus haemobaphes* (Eichwald, 1841) (25–53%). Rare species of Ponto-Caspian crustaceans, corophiids *Chelicorophium maeoticum* Sowinsky, 1898 and cumaceans *Schizorhynchus bilamellatus* Sars, 1900, were also found in the Saratov Reservoir. It should be noted that the Ponto-Azov mollusk species *Lithoglyphus naticoides* (Preiffer, 1828) was not discovered. The share of alien species in the macrozoobenthos fauna reached 40%.

A decrease in taxonomic richness was observed in September 2023 (28 macrozoobenthos species) compared to July (35 species). For example, leeches *Helobdella stagnalis* (Linné, 1758), *Piscicola geometra* (Linne, 1761), *Erpobdella octoculata* (Linné, 1758), as well as 8 chironomid species were not observed in September. However, the number of Malacostraca species has increased in September, these were *Paramysis lacustris* (Czerniavsky, 1882), *Pterocuma sowinskyi* (G.O. Sars, 1894), *Dikerogammarus villosus* (Sowinsky, 1894) *Pontogammarus robustoides* (G.O. Sars, 1894), *P. maeoticus* (Sowinsky, 1894), *Chaetogammarus warpachowskyi* (G.O. Sars, 1894), and *Chelicorophium maeoticum* (Sowinsky, 1898).

The total macrozoobenthos biomass was quite similar in summer and autumn (818–688 g/m$^2$), but both biomass and abundance of the unarmored benthic species had increased threefold from July to September (Table 1). The share of alien species (including large mollusks) in the total macrozoobenthos abundance was 90–98%, in the total biomass, 99.8%. The share of Ponto-Caspian mollusk species of the genus *Dreissena* accounted for more than 80% of total benthos abundance and about 98% of total biomass.

The dynamics of abundance (Fig. 1**A**) and biomass (Fig. 1**B**) of major taxonomic groups of unarmored benthic species had a clear pattern in the Saratov Reservoir in the summer and autumn of 2023. In July, during the cyanobacteria bloom, low quantitative indicators of biomass of all unarmored benthic species groups were observed in communities dominated by mollusks. In September, the biomass of oligochaetes, polychaetes, mollusks, and Malacostraca increased by 1.5–22 times; the biomass of chironomids remained virtually unchanged and decreased in other groups (Fig. 1**B**), so crustaceans became the dominant group. The dynamics of abundance of the main taxonomic groups generally follows the biomass trends, except that in oligochaetes, which abundance decreased by 3.6 times in September (Fig. 1**A**).

The increase in the average abundance and biomass of macrozoobenthos in September was primarily due to the mass development of the trophic group of the filter feeders (Figs. 2, 3). These included detritivorous amphipods (collectors and filter feeders) of the genera *Dikerogammarus* and *Chelicorophium* and seston-feeding bivalves (detritivorous filter feeders). Among the latter, dreissenids were considered separately due to their high abundance and biomass.

**Table 1.** Concentration of chlorophyll *a* and dissolved oxygen, biomass of cyanobacteria and macrozoobenthos in the Saratov Reservoir in July and September 2023. The macrozoobenthos abundance (ind./m$^2$) is indicated above the line, biomass (g/m$^2$), below the line.

| Parameter | July 2023 | | | |
|---|---|---|---|---|
| | upper section | central section | lower section | average for reservoir |
| Average biomass of cyanobacteria, mg/L | 2.21 ± 0.75 | 1.26 ± 0.28 | 3.11 ± 1.05 | 2.29 ± 0.48 |
| Minimum and maximum concentration of chlorophyll *a*, μg/L | 3.49–10.04 | 4.40–8.09 | 3.91–29.36 | 3.49–29.36 |
| Minimum and maximum oxygen concentration, mg/L | 7.2–8.3 | 7.3–8.8 | 8.5–11.5 | 7.2–11.5 |
| Average abundance and biomass of filter feeders (excluding zebra mussels) | 14 ± 7.5<br>2.57 ± 2.55 | 72 ± 34.0<br>0.3 ± 0.12 | 6 ± 6.3<br>0.08 ± 0.08 | 31 ± 13.6<br>0.78 ± 0.63 |
| Average abundance and biomass of unarmored benthic species | 133 ± 89.0<br>2.93 ± 2.64 | 576 ± 212.6<br>1.03 ± 0.40 | 861 ± 355.4<br>1.69 ± 0.64 | 579 ± 174.9<br>1.77 ± 0.75 |
| Average abundance and biomass of *Dreissena bugensis* | 2724 ± 2063.2<br>871.8 ± 727.04 | 1319 ± 964.8<br>611.64 ± 398.09 | 2225 ± 1217.9<br>1062.94 ± 434.45 | 2033 ± 749.6<br>815.0 ± 272.73 |
| Average abundance and biomass of *Dreissena polymorpha* | 31 ± 23.9<br>3.16 ± 2.29 | 0 | 6 ± 6.7<br>2.00 ± 2.41 | 10 ± 6.6<br>1.70 ± 1.05 |

**Табл. 1 (continuation).**

| Parameter | September 2023 | | | |
|---|---|---|---|---|
| | upper section | central section | lower section | average for reservoir |
| Average biomass of cyanobacteria, mg/L | 0.30 ± 0.19 | 0.26 ± 0.14 | 0.54 ± 0.09 | 0.40 ± 0.08 |
| Minimum and maximum concentration of chlorophyll *a*, μg/L | 0.66–2.49 | 1.44–3.10 | 1.91–6.40 | 0.66–6.40 |
| Minimum and maximum oxygen concentration, mg/L | 7.3–10.7 | 8.7–13.1 | 5.8–13.8 | 5.8–13.8 |
| Average abundance and biomass of filter feeders (excluding zebra mussels) | 680 ± 412.4<br>26.97 ± 22.59 | 443 ± 349.5<br>3.78 ± 2.01 | 60 ± 35.9<br>1.19 ± 0.82 | 400 ± 187.3<br>9.84 ± 6.78 |
| Average abundance and biomass of unarmored benthic species | 1660 ± 1042.9<br>29.66 ± 22.68 | 904 ± 361.6<br>6.64 ± 2.85 | 365 ± 154.84<br>1.66 ± 1.11 | 968 ± 34.8<br>12.24 ± 6.87 |
| Average abundance and biomass of *Dreissena bugensis* | 4165 ± 4084.2<br>438.82 ± 435.05 | 989 ± 640.3<br>428.11 ± 424.32 | 770 ± 479.5<br>354.29 ± 375.75 | 1859 ± 1202.4<br>472.1 ± 228.77 |
| Average abundance and biomass of *Dreissena polymorpha* | 13380 ± 12788.4<br>528.90 ± 469.02 | 329 ± 312.2<br>117.10 ± 117.0 | 0 | 4071 ± 3781.3<br>203.8 ± 145.56 |

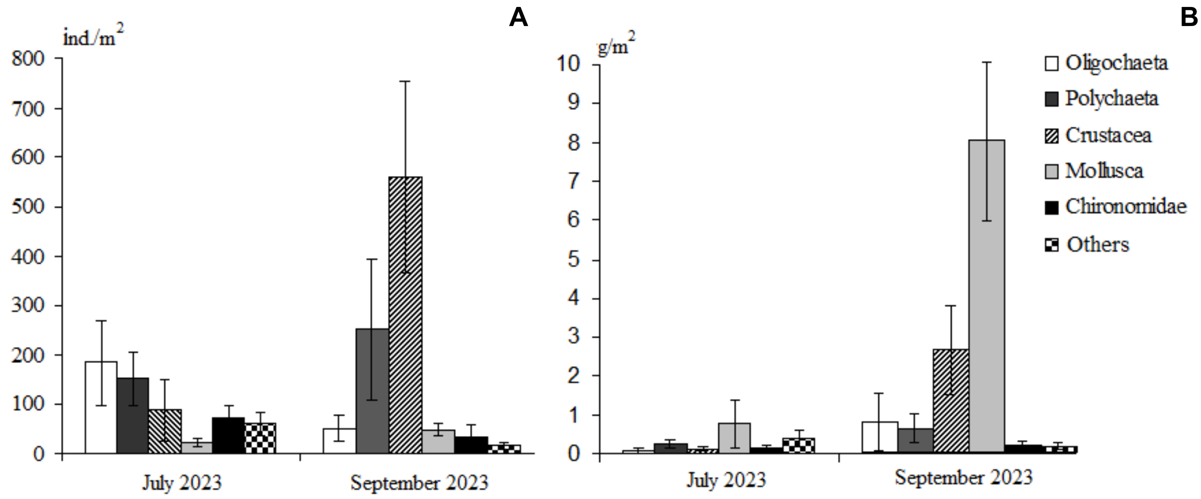


**Fig. 1.** Dynamics of abundance (**A**) and biomass (**B**) of taxonomic groups of unarmored benthic species in the Saratov Reservoir in July and September 2023. Vertical bars indicate standard error.

It should be noted that both abundance and biomass of *Dreissena polymorpha* (Pallas, 1771) increased in September, while that of *D. bugensis* decreased. In the other taxonomic groups, detritivorous collectors and seston-feeders (oligochaetes and polychaetes), phytophagous collector-gatherers (gastropods), omnivorous collectors and predators (most crustaceans), and predators (leeches, some species of dipterans, caddisflies, dragonflies, etc.) predominated.

In both July and September, filter feeders were characterized by minimal abundance and biomass in the lower section of the reservoir, where abnormally high cyanobacteria biomass (up to 9.37 mg/L) and chlorophyll *a* concentration were observed (Table 1). When cyanobacterial biomass increased above 4 mg/L, and chlorophyll *a* concentration, above 10.5 mg/L, filter feeders were not found, except *D. bugensis,* recorded at chlorophyll *a* concentrations exceeding 13 mg/L. However, no direct relationship was found between the biomass of the remaining macrozoobenthos trophic groups and cyanobacteria abundance and biomass along the longitudinal profile of the reservoir (Table 1). The species diversity of benthic communities, calculated using the Shannon index, was generally low during the study period, from 0 to 2.08 bits/ind. ($p < 0.005$), with its maximum values observed in September (Fig. 4).

Macrozoobenthos species diversity based on the Berger-Parker index was the highest during the cyanobacteria bloom period, reaching the maximum possible values at some stations (Fig. 5).

## Discussion

The Saratov Reservoir differs significantly from other Volga River reservoirs. Considering its appearance and surface configuration, it resembles more closely a sluggish river rather than a lentic water body. This results in a high taxonomic diversity of macrozoobenthos. In 2009–2023, the species list of the Saratov Reservoir comprised 40 more species than in the neighboring Kuibyshev Reservoir and 25 more species than in the Volgograd Reservoir located much southwards (Kurina, 2014; Kurina and Seleznev, 2019; Melnikova and Gvozdareva, 2024). In the Kuibyshev Reservoir, a typical lowland water body, the unarmored benthic species biomass is mostly formed by chironomid larvae, oligochaetes, and polychaetes (Kurina, 2014; Melnikova and Gvozdareva, 2024), while the Saratov Reservoir has a high proportion and diversity of Malacostraca and small mollusks. Due to the proximity of the donor reservoir, the Caspian Sea, alien species of amphipods, mysids, and cumaceans have penetrated into the Saratov Reservoir. In 2023, 14 species of Malacostraca were recorded here; since 2009, 25 species have been recorded (Kurina and Seleznev, 2019). Most of them inhabit the coastal areas of the reservoir and thickets of higher aquatic plants.

The decrease in species richness in September 2023 compared to July 2023 is mainly due to the emergence of chironomid larvae in the second half of summer.

The Ponto-Azov mollusk *Lithogliphus naticoides* was not registered in 2023. In 2009–2011, its share in the unarmored benthic species biomass was 1/3 in the deep-water areas of the reservoir (Kurina,

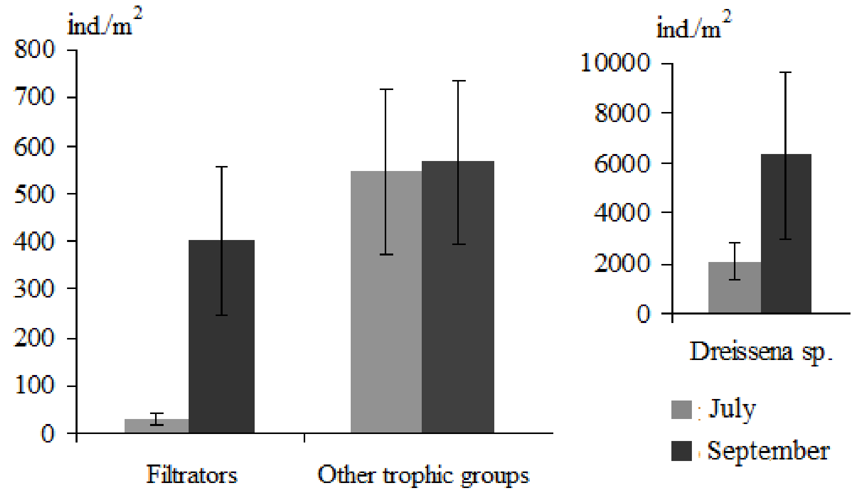


**Fig. 2.** Abundance dynamics of mollusks belonging to the genus *Dreissena*, of the filter feeders, and of the other trophic groups in the Saratov Reservoir in July and September 2023. Vertical bars indicate standard error.

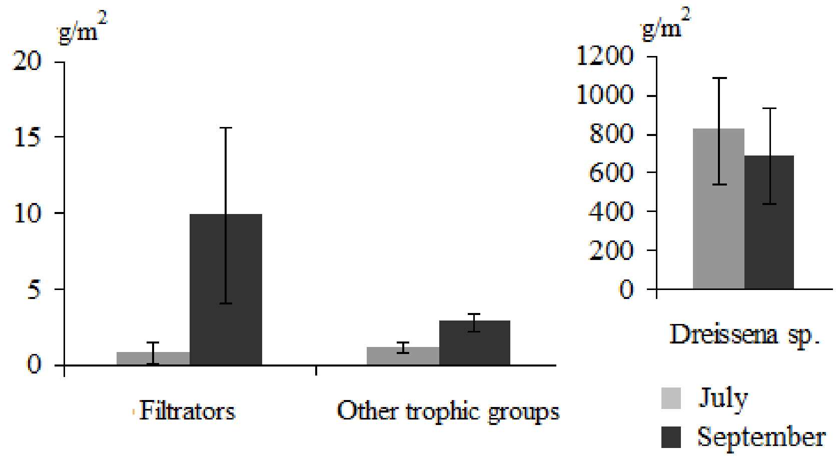


**Fig. 3.** Biomass dynamics of mollusks belonging to the genus *Dreissena*, of the filter feeders, and of the other trophic groups in the Saratov Reservoir in July and September 2023. Vertical bars indicate standard error.

2014). In 2016, during a survey of both deep-water and shallow areas of the reservoir, the mollusk was already absent. Since *L. naticoides* prefers coastal areas of the reservoir ($h$ < 3.0 m), where it can become the dominant species in terms of abundance and biomass (Kurina, 2014; Yakovlev et al., 2009), further examination of the shallow water zone will allow us to identify trends in the dynamics of quantitative indicators of this species under conditions of cyanobacteria blooms.

The average abundance of macrozoobenthos in the Saratov Reservoir increased threefold by September compared to July, when the cyanobacteria biomass decreased and dissolved oxygen concentration increased in the near-bottom water layer (Table 1).

It is known that an increase in the biomass of phytoplankton and microphytobenthos does not affect benthic communities or has an insignificant positive effect on the abundance and biomass of macrozoobenthos and an insignificant negative effect on its species richness and diversity (Dewenter et al., 2023; Drent, 2010). According to our studies, a decrease in cyanobacteria biomass in September has a significant positive effect on the abundance and biomass of filter feeders (except *D. bugensis*). Large

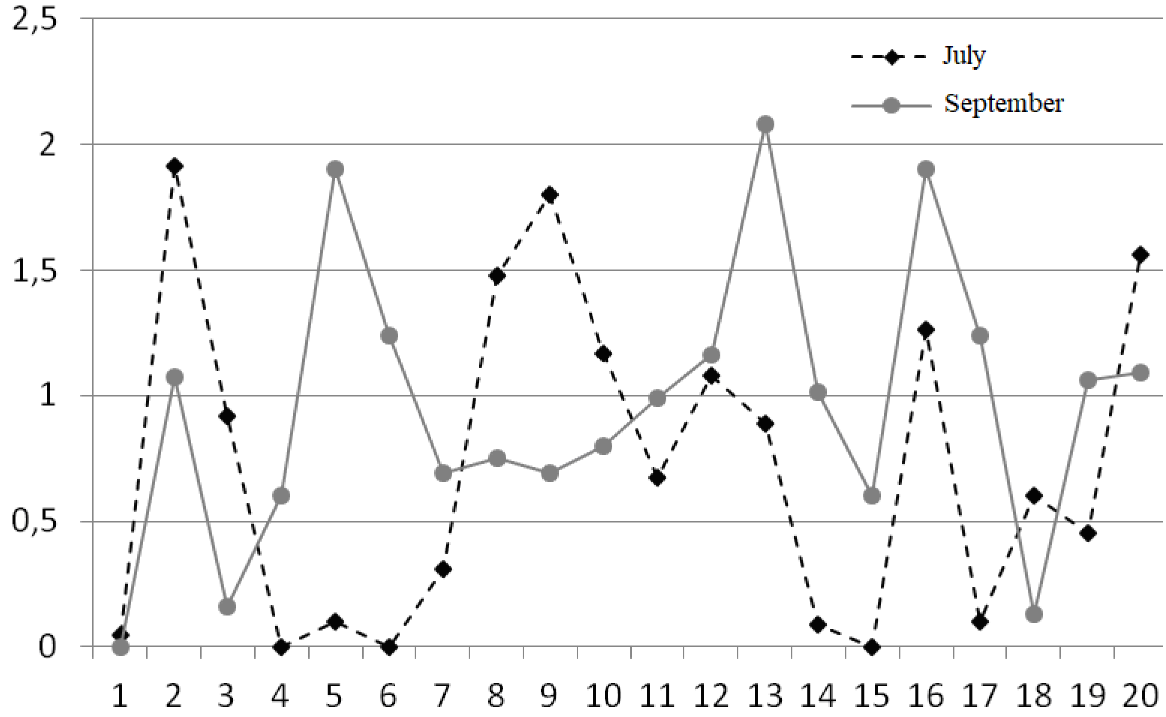


**Fig. 4.** Species diversity of benthic communities based on the Shannon index (bits/ind.) in the deep-water and shallow areas of the Saratov Reservoir in July and September 2023.

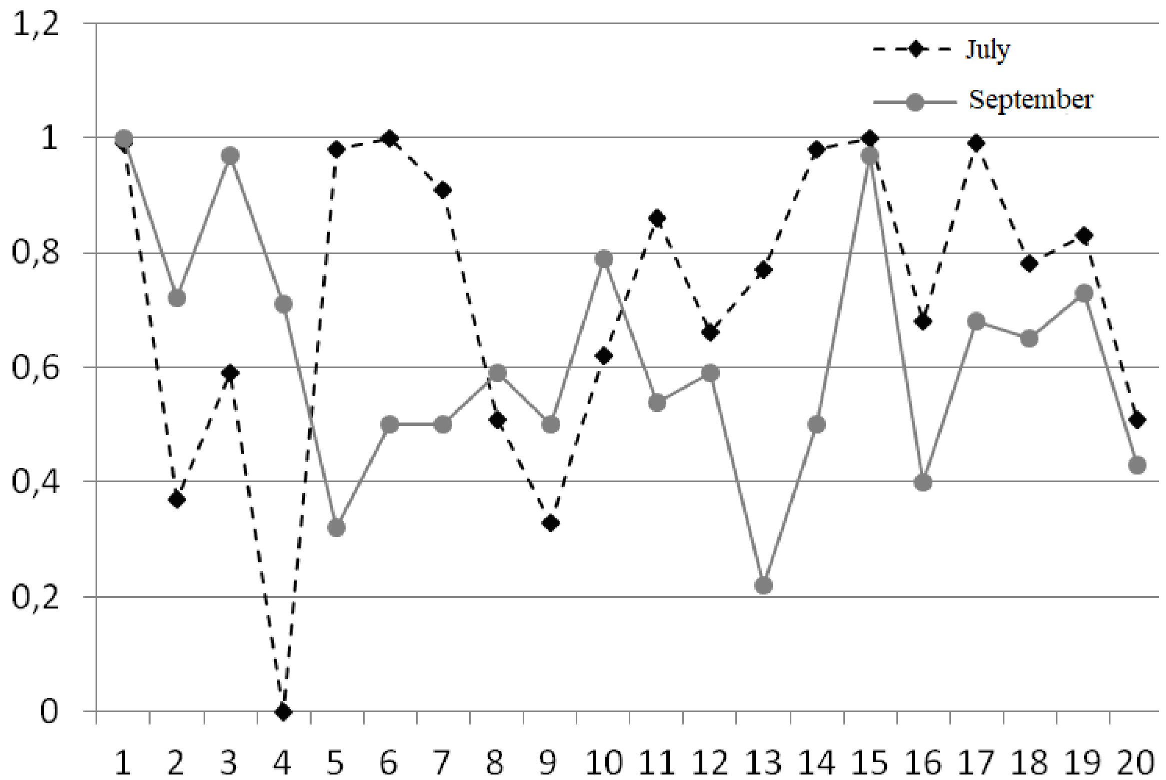


**Fig. 5.** Macrozoobenthos species diversity based on the Berger-Parker index in the deep-water and shallow areas of the Saratov Reservoir in July and September 2023.

colonies of cyanobacteria at high concentrations probably clog mechanically the filtering apparatus of mollusks, this may decrease growth and survival rates of the latter. At the same time, the effect of a decrease in cyanobacteria biomass on the quantitative indicators of the remaining trophic groups is insignificant (Fig. 2), which is also consistent with published data. Relative biomass of other trophic groups increases in September due to the development of large oligochaete species.

Among the filter feeders, widespread amphipods of the genera *Dikerogammarus* and *Chelicorophium* are of particular importance, they form local significant accumulations of up to 14.5 g/m$^2$. Bivalves *Monodacna colorata* (Eichwald, 1829) also play significant role in sandy biotopes of lentic areas of the coastal zone and bays of the reservoir, where their biomass reached 115 g/m$^2$. Species of this group are classified as alien species of the Ponto-Caspian and Ponto-Azov faunal complexes.

The question if the dynamics of abundance and biomass of *Dreissena* mollusks depend on the development of cyanobacteria still remains controversial. On one hand, large colonies of cyanobacteria can interfere the filtration process; on the other, the intense filtration activity of *D. polymorpha* and the release of waste products into the water column, including biogenic elements, contribute to changes in the composition and biomass of phytoplankton (McEachran et al., 2019; Pillsbury et al., 2002; Vanderploeg et al., 2017; etc.). When *D. polymorpha* is introduced into a reservoir, abundance of cyanoprokaryotes decreases at low values of the nitrogen-to-phosphorus ratio and increases at higher values (Sakharova et al., 2021).

Species diversity of benthic communities, assessed by the Shannon index, is slightly affected by cyanobacteria development. However, maximum values of Shannon index were observed in September, when cyanobacteria biomass decreased. Conversely, macrozoobenthos species diversity indicators, assessed using the Berger-Parker index, were highest in July, reflecting the significant dominance of certain species, primarily invasive mollusks of the genus *Dreissena.*

## Conclusions

During the period of cyanobacteria bloom in July 2023, macrozoobenthos community development was suppressed. This was largely due to a decrease in the abundance and biomass of the trophic group of filter feeders, which was particularly pronounced in the lower section of the reservoir, where cyanobacterial biomass and chlorophyll *a* concentration were extremely high. Among the representatives of this group, alien amphipods of the genera *Dikerogammarus* and *Chelicorophium*, as well as the bivalves *M. colorata*, were of particular importance. Quantitative indicators of the remaining trophic groups, as well as seston-feeding mollusks and seston filter feeder *D. bugensis*, did not depend on the cyanobacteria abundance dynamics.

A decrease in chlorophyll *a* concentration, accompanied by a significant decrease in cyanobacteria biomass, affected negatively macrozoobenthos species richness in autumn. However, maximum values of the Shannon diversity index were recorded in September. This indicated a nonlinear effect of chlorophyll *a* concentration and cyanobacteria biomass on the diversity of benthic communities in the Saratov Reservoir.

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