

STRUCTURAL ORGANIZATION OF ECOSYSTEMS AND PATTERNS
OF THEIR DISTRIBUTION

UDC 574.58 (282.247.431.2)

FUNCTIONAL FEATURES OF THE STRUCTURAL ORGANIZATION
OF PLANKTON AND BOTTOM COMMUNITIES IN HIGHLY MINERALIZED
RIVERS OF THE HYPERHALINE LAKE ELTON BASIN (RUSSIA)

© 2021. T.D. Zinchenko*, L.V. Golovatyuk*, O.G. Gorokhova*, E.V. Abrosimova*,
M.V. Umanskaya*, T.V. Popchenko*, V.K. Shitikov*, V.I. Gusakov**, S.E. Bolotov**,
V.I. Lazareva**, E.A. Selivanova***, A.S. Balkin***, A.O. Plotnikov***

**Institute of Ecology of the Volga Basin of the Russian Academy of Sciences
Russia, 445003, Samara Region, Togliatti, Komzina Str., 10. E-mail: zinchenko.tdz@yandex.ru*

***I.D. Papanin Institute for Biology of Inland Waters of the Russian Academy of Sciences
Russia, 152742, Yaroslavl Region, Nekouz District, Borok, 109. E-mail: protoz@mail.ru*

****Institute of Cellular and Intracellular Symbiosis
of the Ural Department of the Russian Academy of Sciences
Russia, 460000, Orenburg Region, Orenburg, Pionerskaya Str., 11.*

Received February 09, 2021. After revision February 25, 2021. Accepted March 01, 2021.

Saline rivers of Elton Lake Region (N49° 13', E46° 40') are highly productive systems. The flow of energy and nutrients can go beyond the hydroecosystem into the surrounding landscape, which is facilitated by the high diversity and quantitative development of the fauna. For the first time, field and experimental studies of planktonic and bottom communities of rivers with different levels of mineralization made it possible to reveal their high production potential. The summer values of the ratio of mineral forms of nitrogen and phosphorus (N:P) in polyhaline rivers change from 100.7 to 186.9, and in mesohaline rivers they change from 0.6 to 32.9, which indicates a specific type of river functioning, where a high ratio of nutrients reflects a significant input of nitrogen associated, including with the processes taking place in cyanobacterial communities.

Phytoplankton production (in terms of chlorophyll "a" content) in the long-term series of studies varied from 2.8 to 535 mg/m³, determining the trophic status of saline rivers from mesotrophic to hypertrophic levels. The daily bacterial production in the bottom sediments of the estuarine sections of the rivers was 101-740 mg C/(m²·day).

The authors used the method of high-throughput sequencing of the 16S rRNA gene in cyanobacterial mats of rivers and for the first time revealed a high level of taxonomic diversity of prokaryotes belonging to 20 phyla, of which Cyanobacteria, Proteobacteria, and Bacteroidetes were dominant. The authors established differences in the taxonomic composition of prokaryotic communities formed at different salinity levels.

The composition of planktonic and benthic communities in saline rivers is evolutionarily adapted to the effects of extreme conditions.

Phytoplankton of saline rivers is represented by more than 130 species and taxa of algae; phytobenthos by 144, and epiphyton by 42. The species diversity of algocenoses is created mainly by Bacillariophyta and Cyanoprokaryota.

The taxonomic composition of zooplankton communities is represented by 29 species and taxa. In the communities of meio- and macrozoobenthos, 73-93 taxa and species have been identified. The planktonic and benthic communities contain halophilic and halotolerant species that were not previously recorded in the basin of the hyperhaline Elton Lake.

The gradient of abiotic factors largely determines the dynamics of diversity, abundance, biomass, and production of planktonic and benthic communities in saline rivers. The

calculated values of the production of communities of zooplankton, meiobenthos and macrozoobenthos are given.

High production of zooplankton in mesohaline rivers is provided by euryhaline rotifers *Brachionus plicatilis*, and in polyhaline ones – by populations of halophilic chironomids *Cricotopus salinophilus*.

Significant production of meiobenthos communities in mesohaline rivers (1.86-51.71 g/(m²·month) dry weight) is due to the development of Harpacticoida dominated by *Cletocamptus retrogressus* and *C. confluens*. At salinity above 20 g/l, high production of meiobenthos is provided by Turbellaria and Ostracoda (*Cyprideis torosa*).

The production of macrozoobenthos, calculated in the mesohaline river Bolshaya Samoroda during the growing season (117 g/m²) is due to the development of populations of mass euryhaline chironomids *Microchironomus deribae*, *Tanytarsus kharaensis*, *Chironomus salinarius* in feeding areas of migratory and waterfowl birds, 5-29 times higher than the production of benthos of fresh water.

The polyvalent nature of the populations of mass chironomids, a short life cycle, high values of abundance, biomass, and growth rates determine their high production potential.

The high functional activity of Diptera larvae dominating in benthic communities determines their population resistance to extreme factors.

The results of the taxonomic assessment of the microbiome of chironomid larvae are presented, which indicate the specificity of the dominant microorganisms for different species.

The article shows the main regularities of changes in plankton and bottom communities along the gradient of abiotic and biotic factors of saline rivers, carried out as a result of many years of research.

A close relationship has been established between planktonic and benthic communities using the methods of multidimensional statistics, due to both biotic interactions and the mutually coordinated response of species to changes in environmental conditions. The results obtained allow us to consider the planktonic and bottom communities of saline rivers as a kind of consortium, representing a structural unit of the saline river ecosystem.

Keywords: saline rivers, planktonic, bottom, microbial communities, taxonomic diversity, abiotic factors, functional features, multivariate link analysis, Elton Lake basin (Russia).

DOI: 10.24411/2542-2006-2021-10077