ZOOBENTHOS OF THE DNIESTER RIVER ON THE TERRITORY OF THE REPUBLIC OF MOLDOVA FOR THE PERIOD 2018-2021

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Abstract. The data on the influence of dams on the structural and functional parameters of the macrobenthos of the Dniester River on the territory of the Republic of Moldova are presented. A decrease in the biodiversity and number of groups most sensitive to negative environmental changes (mayflies, stoneflies and caddis flies) was noted. The results described in this article, indicate that the total number of zoobenthos species and the number of most sensitive species to negative environmental changes can serve as suitable indicators of the impact of hydropower facilities on the Dniester River.

Introduction

The study on the influence of the regulation of the Dniester riverbed by the dams of the Dnestrovsk HPPs and Dubossary HPPs [4] on benthic communities contributes with recommendations for decision-making on the conservation of biodiversity of the river and sustainable use of aquatic ecosystems. This is especially important for transboundary rivers, of which water resources are used for hydropower, water supply, irrigation, navigation, recreation and environmental protection.

Material and methods

Samples were collected from the Dniester riverbed seasonally and monthly, from 2018 to May 2021, at 11 sampling points: Naslavcea, Vălcineţ, Sorocea, Camenca, Erjovo, Goieni, Cocieri, Vadul-lui-Vodă, Varniţa, Sucleia and Palanca. In total, more than 250 samples of benthic fauna were collected and processed. At the sampling points: Camenca, Erjovo, Goieni, Cocieri, samples were collected from both the left and right banks, at Sorocea sampling point, samples were collected downstream of the city and Sorocea 1, a few kilometers away from the city.

Quantitative samples were taken using an Ekman bottom grab with a sampling area of 0.025 m², and a rectangular dredge with a sampling area of 8 m²; for qualitative samples, a net and manual collection from various substrates were used [1, 2]. Samples were fixed with 37% formalin or 96% alcohol. The identification of species was carried out to the smallest possible taxon level in the laboratory using identification keys [5, 10]. Species were identified using an Axio Imager A.2 microscope (Zeiss) and a SteREO Discovery.V8 binocular microscope (Zeiss). The abundance and biomass were recalculated as ind./m² and g /m², respectively.

The Shannon biodiversity index and *Jaccard* coefficient for macrobenthos communities were calculated [1]. Statistical analysis was performed with the use of Excel и STATISTICA 10.1.

Results and discussion

The abundance, biomass and species composition of macrobenthos in the Dniester River and Dubăsari reservoir were determined. According to the obtained data, the average lowest multiannual (2018-2021) abundance of total zoobenthos and zoobenthos without molluscs were noted at sampling points located downstream of the dams of reservoirs, namely at Naslavcea and Vadul-lui-Vodă (Figs 1.1 and 1.2). These indices accounted for 3055 and 3461 ind./m² of total zoobenthos, and 2370 and 2585 ind./m² of zoobenthos without molluscs, respectively.

Figure 1. The mean (+ SD) density of total zoobenthos (1.1) and zoobenthos without molluscs (1.2) from Dniester River during 2018-2021

Multiannual (2018-2021) lowest average biomass of zoobenthos without molluscs was noted at Naslavcea, sampling point, located directly downstream of the dam of the Dniester cascade hydroelectric power plants, namely HPP 2, which amounted to 3.1 g/m² and Cocieri, on the dam section of the Dubossary reservoir which amounted to 3.9 g/m², respectively (figs. 2.1 and 2.2).

Figure 2. The mean ($\pm$ SD) biomass of total zoobenthos (2.1) and zoobenthos without molluscs (2.2) from Dniester River during 2018-2021. N-Naslavcea, V-Vălcineț, S-Sorocea, S*- Sorocea 1, C-Camenca, E-Erjovo, G- Goieni, Cr-Cocieri, VI-Vadul-lui-Vodă, Va-Varnița, Sa-Suceia, P-Palanca.

The lowest long-term mean biomass (2018-2021) of total zoobenthos were recorded at Soroca 1 - 27.3 g / m² and Naslavcha - 34.9 g / m².

The overall biodiversity assessment of invertebrates in Dniester River and Dubossary reservoir for the period 2018-2021, revealed a number of 259 taxa, the largest number (138) was recorded at Erjovo sampling point. The taxonomic structure and distribution of species along the river, indicated the smallest number of taxa at Soroca sampling point, downstream of the city, with only 25 taxa and at Naslavcea – with 45 taxa (fig. 3). At these sampling points, as well as at Sucleia, no representatives of the groups most sensitive to negative environmental changes such as: mayflies, stoneflies and caddis flies, the so-called EPT taxa (Ephemeroptera, Plecoptera, Trichoptera) were registered (fig. 3). This would be related to the unfavorable environmental conditions in these sections of the river.

It should be noted that in the Dniester River, the highest biodiversity of EPT taxa in 2015-2019 was recorded at Camenca and Goieni sampling points [6, 7]. At Camenca station, 7 species of Ephemeroptera and Trichoptera were recorded and at Goieni - 4 species of Trichoptera and 7 species of Ephemeroptera were found. During the period 2018-2021, 3 taxa of Trichoptera and 3 of Ephemeroptera were recorded at Camenca station and 12 taxa Trichoptera and 5 Ephemeroptera at Goieni station (fig. 3). It is important to note that on October 25, 2019, in Camenca, near the Dubossary reservoir, a new species for the fauna of Moldova the mayflies *Ephemera lineata* Eaton, 1870 (striped mayfly) was recorded [9].

Figure 3. The number of taxa of benthic invertebrates in Dniester river and Dubosari reservoir for the period 2018-2021.

Springflies (Plecoptera) were recorded only once in 2012, at the sampling point Vălcineț and in May 2021 near the village Vișcauți, in a stream, at the confluence with the Dniester River. Comparing composition of species of benthic macroinvertebrate communities using the Jaccard index, it could be seen that such sites as Naslavcea and Soroca were considerable different from other sites in terms of species composition (fig. 4). These differences, first of all, could be caused by the sharp changing water level in Naslavcea and the discharge of untreated wastewater in Soroca, which negatively affected the development of benthic invertebrates.

Figure 4. The dendrogram of species similarity between communities of benthic macroinvertebrates in the Dniester and Dubăsari reservoir for the period 2018-2021.

In accordance to Shannon index the highest indices were recorded at Erjovo, Goieni and Vălcinets, the lowest at Soroca and Naslavcea (tab.1).

Table 1. Shannon Biodiversity Index for benthic macroinvertebrate communities in the Dniester and Dubăsari reservoir for the period 2018-2021.

Index	Naslavcea	Valcinet	Soroca	Soroca*	Camenca	Erjovo	Goieni	Cocieri	V-l-V	Varnita	Sucleia	Palanca
Shannon	1,65	2,02	1,4	1,9	2	2,1	2,1	1,9	1,87	1,85	1,7	1,96

Comparing historical data on the composition of macrobenthos, it can be observed that species sensitive to negative environmental changes have disappeared, such as: *Oligoneuriella rheana* (Imhoff, 1852), *Ecdyonurus*, Dniester endemic *Behningia lestagei* Motas & Bacesco, 1937 and others. Almost complete extinction of mayfly *Palingenia longicauda* (Olivier, 1791) (Ap.II, Bern Convention, 1998) and *Unio crassus* Philipsson, 1788, a rare protected Natura 2000 species of bivalve molluscs, which is currently found only in the upper part of the Dubossary reservoir with dense overgrowth of *Dreissena* (fig.5).

Figure 5. Dense overgrowth of *Dreissena* on the rare protected Natura 2000 species *Unio crassus*

At the same time, alien species not only appeared in the macrobenthos communities, but became common: *Branchiura sowerbyi* Beddard, 1892, *Dreissena rostriformis bugensis* Andrusov, 1897, *Ferrissia fragilis* (Tryon, 1863), *Macrobrachium nipponense* (De Haan, 1849).

Artificial ecosystems such as reservoirs are most susceptible to the penetration and rapid spread of alien species [3].

Thus, the total number of species and the number of species of groups most sensitive to negative environmental changes such as mayflies, stoneflies and caddis flies (EPT) can serve as indicators of the impact of hydropower facilities on the Dniester River.

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