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ECOLOGICAL STATUS ASSESSMENT OF MECHKA RIVER WATER (MARITSA RIVER BASIN)

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Abstract

This study assesses the ecological state of the surface water of the Mechka River from the Maritsa River Basin usingthe biological quality element macrozoobenthos. Four sampling sites (biotopes) were investigated in autumn 2024 along the Mechka River - 1) near the village of Lenovo; 2) near the village of Poroyna; 3) between the town of Parvomay and the village of Poroyna and 4) before the town of Parvomay. A total of 772 specimens of macrozoobenthos from 36 taxa were identified. The highest number of macroinvertebrate taxa was identified in the second biotope (21 taxa) and the lowest - in the first (14 taxa). The study shows that in three of the four biotopes, macroinvertebrates of Group C (relatively tolerant forms) dominate, whereas in Biotope 3) Mechka River between the town of Parvomay and the village of Poroyna, Group D (tolerant forms) dominates. Basic indices and metrics were calculated according to an established methodology.

Key words*: biological monitoring, ecological status, macrozoobenthos, Mechka River, water quality.*

INTRODUCTION

The Maritsa River originates in the Rila Mountains, Mancho Peak, at 2,378 m above sea level. The river's catchment area on Bulgarian territory is 21,084 km^2. The Maritsa River flows into the Aegean Sea. The catchment area of the Maritsa River falls into Ecoregion 7: Eastern Balkans. It includes numerous tributaries, the largest of which are the Topolnitsa River, the Luda Yana River, the Stryama River, the Sazliyka River, the Tundzha River, the Arda River and others (Belkinova et al., 2013; Kiradzhiev, 2013).

The Mechka River (43 km) is a right tributary of the Maritsa River. The river originates in the Western Rhodopes, entering the Upper Thracian Lowland in the village of Poroyna and flowing into the Maritsa River near the town of Parvomay. The river's waters are used for irrigation (Kiradzhiev, 2013). A significant part of the country's territory is occupied by agricultural lands, of which approximately 30% is irrigated (Metodieva et al., 2024; Kilifarska et al., 2025).

According to the typology of rivers in Bulgaria, the Mechka River is of type R5 "Semi-mountainous rivers" (East Aegean River Basin Directorate, 2018). The largest tributary of the river is the Chinardere River (left tributary; 31 km) (Kiradzhiev, 2013).

According to the Water Framework Directive (Directive 2000/60/EU), in the assessment of the state of surface water, biological elements (listed in Annex V) play a leading role, while physicochemical and hydromorphological elements have a complementary role.

Studies concerning the assessment of the ecological state of the water of the Maritsa River have been conducted by Vidinova et al. (2008), Park et al. (2022a), Varadinova et al. (2022). At present, no studies have been established on the ecological state of the water of the Mechka River based on the biological quality element macrozoobenthos. Park et al. (2022b) and Park et al. (2023) provide data on the taxonomic composition and structure of the macrozoobenthos from the Maritsa River. Georgiev (2012) studied the freshwater malacofauna of rivers from the Upper Thracian Lowland, including the Mechka River.

The present study aims to assess the ecological state of the surface water of the Mechka River from the Maritsa River basin based on the

biological quality element (BQE) macrozoobenthos.

MATERIALS AND METHODS

Macrozoobenthos sampling was carried out in the autumn of 2024 from four locations (biotopes) along the Mechka River - 1) near the village of Lenovo (41°57'05.7"N 25°05'48.1"E); 2) near the village of Poroyna (42°02'19.9"N 25°08'42.8"E); 3) between the town of Parvomay and the village of Poroyna (42°03'11.7"N 25°09'08.3"E) and 4) before the town of Parvomay, Debar district (42°04'27.7"N 25°11'49.1"E) (Figure 1).

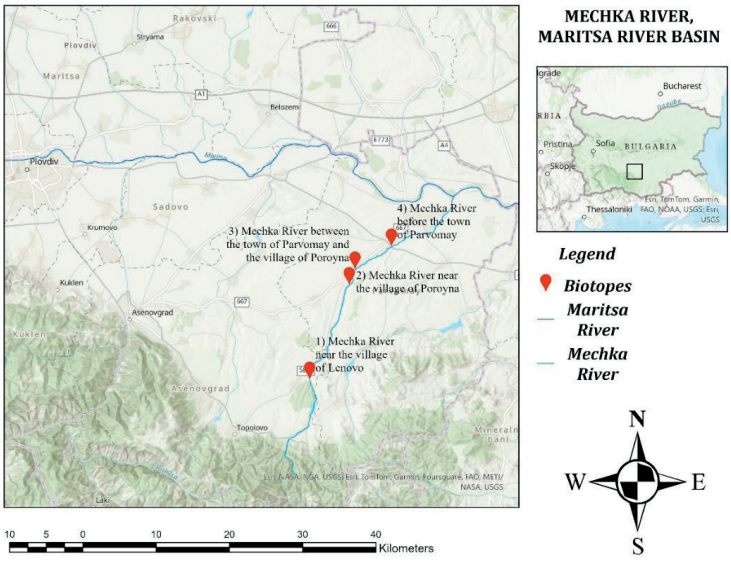

Figure 1. Map of the studied biotopes of the Mechka River

Biotope 1 is located along the Mechka River, northwest of the village of Lenovo (300 m above sea level), downstream of the Mechka Dam. The current is moderate to fast. Biotope 2 is located along the Mechka River, west of the village of Poroyna (215 m above sea level), upstream of the confluence with the Chinardere River. The current is moderate to fast. Biotope 3 is located along the Mechka River, between the village of Poroyna and the town of Parvomay (202 m above sea level), downstream of the confluence of the Chinardere River. The current is slow. Biotope 4 is located along the Mechka River, west of the Debar district, in the town of Parvomay (185 m above sea level). The current is moderate to fast. The river bed in all studied biotopes is sandy and rocky (Figure 2).

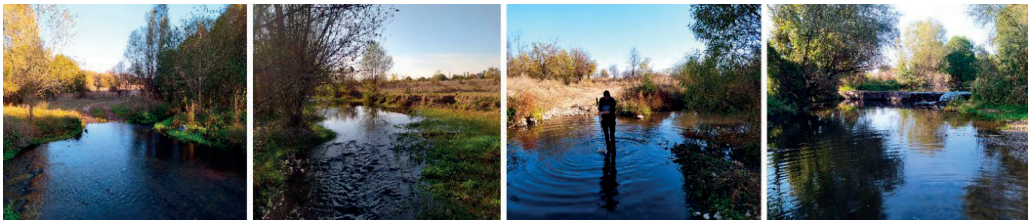

Figure 2. Views of the studied biotopes from the Mechka River (from left to right: 1) near the village of Lenovo; 2) near the village of Poroyna; 3) between the town of Parvomay and the village of Poroyna and 4) before the town of Parvomay)

Macrozoobenthos samples were collected in accordance with European and national water legislation and established methodologies (Cheshmedjiev et al., 2011; EN ISO 10870:2012; EN 16150:2012; Regulation No. H-4 of 14.09.2012; Belkinova et al., 2013). The taxonomic composition and abundance of macrozoobenthos from all biotopes were determined.

The ecological state of the Mechka River was assessed based on the following metrics: total number of taxa; number of Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa; metrics for abundance of benthic macroinvertebrate fauna; Margalef species richness index (Dmg); Shannon-Weaver species diversity index (H'); Pielou's evenness index (E); Simpson's dominance index (C); saprobic index (SPUB); trophic index (RETI) and biotic index (BI) according to Flanagan & Toner (1972), modified by Clabby & Bowman (1979), Clabby (1982) (Belkinova et al., 2013).

RESULTS AND DISCUSSIONS

In this study, 772 specimens of macrozoobenthos belonging to 36 taxa and 15 orders (Allogastropoda, Amphipoda, Arhynchobdellida, Coleoptera, Diptera, Ephemeroptera, Hemiptera, Hygrophila, Isopoda, Odonata, Plecoptera, Sphaeriida, Trichoptera, Tricladida, Tubificida) were identified.

In the study of the macroinvertebrate fauna from the four biotopes along the Mechka River, the largest number of taxa was found in Biotope 2 (21 taxa) and the smallest – in Biotope 1 (14 taxa). The highest number of specimens was recordedin Biotope 3 (273 specimens) and the lowest – in Biotope 4 (Figure 3).

In the four biotopes, different macroinvertebrate taxa dominated: *Simulium* sp., larva (221 specimens; order Diptera) in Biotope 1; *Baetis* sp., nymph (64 specimens; order Ephemeroptera) in Biotope 2; *Asellus* (*Asellus*) *aquaticus* (Linnaeus, 1758) (128 specimens; order Isopoda) in Biotope 3; *Gammarus pulex* (Linnaeus, 1758) (11 specimens; order Amphipoda) in Biotope 4.

Only in Biotope 2 is the ecological state of the river according to the metric "total number of taxa" assessed as very good. In contrast, it is assessed as good in the other three biotopes.

Georgiev (2012) studied the freshwater malacofauna of the Mechka River (at the bridge of Parvomay town) and reported the species *Planorbis planorbis* (Linnaeus 1758) and *Anodonta cygnaea* (Linnaeus 1758). These two species were not found in any of the studied biotopes in the present study.

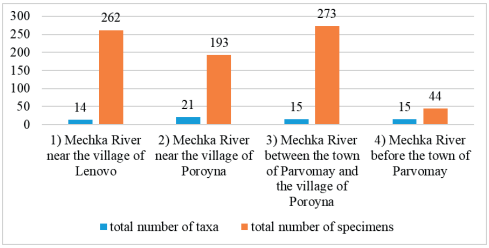

Figure 3. Taxonomic composition and abundance of macrozoobenthos in the studied biotopes

The highest number of EPT taxa was found in Biotope 2 (6 taxa with 105 specimens), followed by Biotope 1 (5 taxa with 20 specimens). An equal number of EPT taxa were found in biotope 3 (4 taxa with 53 specimens) and Biotope 4 (4 taxa with eight specimens) (Figure 4). Taxa from the orders Ephemeroptera, Plecoptera and Trichoptera are known to be sensitive to pollution. Therefore, their higher abundance in the Mechka River, Biotope 2, indicates a better ecological state of the water in this section. According to this metric, the Mechka River's ecological state ranges from good in Biotope 2 to moderate in the remaining three biotopes.

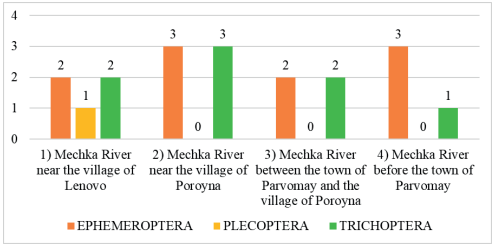

Figure 4. Number of EPT taxa in the studied biotopes

The obtained values for the Margalef species richness index (Dmg) indicate conditions that are suboptimal in all biotopes. The Shannon-Weaver species diversity index (H') indicates

better conditions in Biotopes 2 and 4 (β-mesosaprobic) compared to Biotope 1 (p-saprobic conditions) and Biotope 3 (α-mesosaprobic conditions). The Pielou's evenness index (E) and Simpson dominance index (C) indicate the most favourable conditions in Biotopes 2 and 4 and the most unfavourable in Biotope 1 (Table 1).

The highest percentage of Oligochaeta and Diptera, as well as the highest percentage of filtering feeders in total abundance was found for Biotope 1, where the percentage of EPT taxa was also the lowest. In Biotope 1, two Diptera taxa (*Simulium* sp., larva and *Chironomus plumosus* (Linnaeus, 1758), larva) represented by 234 specimens, and two filtering feeders taxa (*Simulium* sp., larva and *Pisidium* sp.) represented by 222 specimens were identified. The highest percentage of EPT taxa was recorded in Biotope 2 (Table 2).

Table 1. Species diversity indices

	Species richness index of Margalef (Dmg)	**Shannon-Weaver species diversity index (H')**	**Pielou's evenness index (E)**	**Simpson's dominance index (C)**
1) Mechka River near the village of Lenovo	2.33	0.763	0.289	0.716
2) Mechka River near the village of Poroyna	3.8	2.17	0.714	0.174
3) Mechka River between the town of Parvomay and the village of Poroyna	2.5	1.8	0.665	0.266
4) Mechka River before the town of Parvomay	3.46	2.34	0.888	0.124

Table 2. Abundance of macroinvertebrate fauna from the studied biotopes of the Mechka River

	% (Oligochaeta & Diptera)	**% Filtering feeders**	**% EPT taxa**
1) Mechka River near the village of Lenovo	89.31 %	84.73 %	7.63 %
2) Mechka River near the village of Poroyna	23.32 %	18.65 %	54.40 %
3) Mechka River between the town of Parvomay and the village of Poroyna	9.52 %	1.1 %	19.41 %
4) Mechka River before the town of Parvomay	15.91 %	4.55 %	18.18 %

To assess the ecological state of the Mechka River, the German trophic index RETI was calculated, which reflects varying levels of trophic impact across the studied sites. The index has the lowest value in biotope 1 ($RETI_{Biotope1}$ = 0.08), indicating a significant imbalance in the river ecosystem at this site. According to this index, the ecological state of the Mechka River varies from very bad in Biotope 1 to very good in Biotope 3 ($RETI_{Biotope3}$ = 0.8). The ecological state is good in the remaining two studied biotopes ($RETI_{Biotope2}$ = 0.74; $RETI_{Biotope4}$ = 0.59).

In Biotope 1, macrozoobenthos typical of 0-β-mesosaprobic conditions predominate (4 taxa). In Biotope 2, taxa indicative of β-mesosaprobic conditions predominate (4 taxa). In Biotopes 3 and 4, macroinvertebrates characteristic for β to β-α-mesosaprobic (3 taxa each) and 0-β to β-mesosaprobic conditions (3 taxa each), respectively, dominate (Figure 5).

The saprobic index (SPUB) was calculated based on the bioindicator potential of the macrozoobenthos from each biotope. A moderate ecological state was established in Biotope 3 ($SPUB_{Biotope3}$ = 2.43); good in Biotope 4 ($SPUB_{Biotope4}$ = 2.09) and very good ecological state in the remaining two biotopes ($SPUB_{Biotope1}$ = 1.68; $SPUB_{Biotope2}$ = 1.9).

The macroinvertebrate organisms found in this study belong to four groups of sensitivity: Group B (less sensitive forms), Group C (relatively tolerant forms), Group D (tolerant forms) and Group E (the most tolerant forms).

In three of the studied biotopes, the highest number of taxa and specimens belong to Group C. Only in Biotope 3 did the highest number of taxa belong to Group C, while the highest number of specimens belonged to Group D (Figure 6).

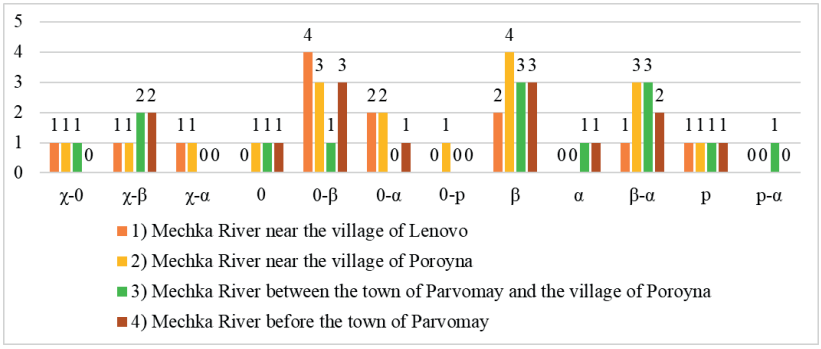

Figure 5. Distribution of macroinvertebrate taxa from the studied biotopes of the Mechka River by saprobity groups

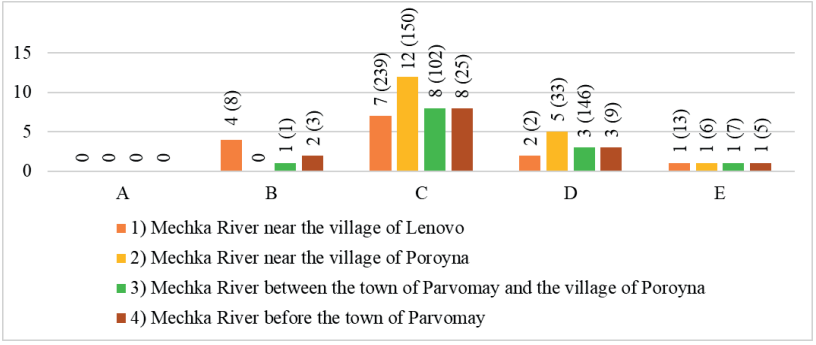

Figure 6. Distribution of macroinvertebrate taxa from the studied biotopes of the Mechka River by sensitivity groups

To determine the ecological state of the river, the biotic index (BI) was calculated, indicating a moderate ecological state in Biotopes 1 and 2 (BI (nEQR) = 2.5 (0.5)) and a bad ecological state in Biotopes 3 and 4 (BI (nEQR) = 2 (0.4)). During the period of this study, according to data from the East Aegean River Basin Directorate (2018) on deviations in the quality of surface water of the Mechka River, an exceedance of total nitrogen (2.5 mg/l at environmental quality standards (EQSs) set at 1.5 mg/l) was recorded on 12.11.2024 in the area of the town of Parvomay, Lyubenovo district. From September to November 2024, no other excesses of basic physicochemical elements and specific substances were established in the water of the Mechka River. According to the 2023 Report on the State of Water in the East Aegean Region, the ecological state of the upper section of the Mechka River (up to the confluence of Chinardere River), based on biological quality elements (BQEs), is unknown, while the ecological status of the lower reaches and tributary sections is assessed as moderate (East Aegean River Basin Directorate, 2018).

CONCLUSIONS

In the present study, 772 specimens of macrozoobenthos belonging to 36 taxa were identified. The highest number of taxa was identified in Biotope 2 near the village of Poroyna (21 taxa), and the lowest in Biotope 1) near the village of Lenovo (14 taxa). Based on the calculated metrics, the ecological state of the Mechka River is assessed as very bad in Biotope 1) near the village of Lenovo; bad in Biotopes 3 (between the town of Parvomay and the village of Poroyna), and 4 (before the town

of Parvomay, Debar district); and moderate in Biotope 2 near the village of Poroyna.

These findings indicate varying levels of ecological degradation along the river, with Biotope 1 showing the most critical conditions. We recommend that Biotope 1 be prioritized for inclusion in long-term monitoring programs to support targeted river management and conservation efforts.

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