

## ECOLOGICAL MONITORING OF THE PARVENETSKA RIVER, PART OF THE MARITSA RIVER WATERSHED

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### Abstract

*This study aims to carry out ecological monitoring of the surface water of the Parvenetska River (Eastern Aegean Sea region, Southern Bulgaria). For the study, samples of macrozoobenthos were collected in the spring of 2024 – a basic biological quality element according to the Water Framework Directive. The taxonomic affiliation of macroinvertebrates was determined, and 26 taxa were identified. The number of EPT taxa, % (Oligochaeta & Diptera), % Filtering feeders, % EPT taxa, German trophic index, and species diversity indices were calculated. As a result of the study, it was established that in the studied biotope, macroinvertebrate taxa of sensitivity group C (relatively tolerant forms) dominate, followed by taxa of group B (less sensitive forms).*

**Key words:** chemical status, ecological state, indices, metrics, river ecosystem.

### INTRODUCTION

The Parvenetska River (Tamrashka River; Dermendere River) rises from the Modar Peak in the Chernatitsa Ridge, Western Rhodopes, at 1 816 m above sea level.

The river flows in a north-northeast direction, and at the village of Parvenets, it leaves the Rhodopes and enters the Upper Thracian Lowland (Pazardzhik-Plovdiv Plain), passes through the city of Plovdiv and flows from the right into the Maritsa River at 164 m above sea level. The riverbed in the river's lower reaches (after the village of Parvenets) has been corrected with dikes. The length of the Parvenetska River is 37 km. The river passes through the lands of the villages of Hrabrino, Parvenets and the city of Plovdiv. The river's waters are used for irrigation, electricity generation and water supply to industry. The river is at its highest point in April-May (Kiradzhiev, 2013; Integrated Development Plan of Municipality of Plovdiv, 2021-2027; Integrated Development Plan of Municipality of

Rhodope, 2021-2027). According to the typology of rivers in Bulgaria, the Parvenetska River is of type R3 "Mountain Rivers" (Tamrashka River to the village of Hrabrino and tributaries - Dormushevska and Pepelasha Rivers) and of type R5 "Semi-Mountain Rivers" (Parvenetska River from the confluence of the Pepelasha River to the mouth) in Ecoregion 7 (East Aegean River Basin Directorate, 2018).

The Water Framework Directive aims to achieve good water state in Europe and reduce harmful impacts on them. The qualitative elements for assessing the ecological state of rivers are biological, hydromorphological and physico-chemical elements. The latter two elements support the biological elements. The main biological quality elements are macroinvertebrates (Directive 2000/60/EU). At present, no studies have been established on the ecological state of the water of the Parvenetska River in the area of the village of Parvenets based on biological elements (macrozoobenthos) and physicochemical quality elements. Such studies have been conducted for other rivers in the

Maritsa River basin, for example the Luda Yana River (Vidinova et al., 2008; Georgieva et al., 2014; Gartsyanova et al., 2020; Gartsyanova et al., 2021; Gartsyanova et al., 2022; Zaharieva et al., 2024), the Topolnitsa River (Gartsyanova et al., 2020; Irikov & Atanasova, 2008; Kancheva, 2016; Park et al., 2022; Varadinova et al., 2022), Sazliyka River (Vidinova et al., 2008; Park et al., 2022; Varadinova et al., 2022), Chepelarska River (Kirin, 2002; Vidinova et al., 2008; Boyanov et al., 2011a; 2011b; Park et al., 2022; Patronov & Kirin, 2024; Zaharieva et al., 2024). Data on macroinvertebrates of Ephemeroptera, Plecoptera, and Trichoptera from water bodies in the Plovdiv city region, including Parvenetska River, were given by Vidinova et al. (2018).

This study aims to conduct ecological monitoring of the surface water of the Parvenetska River, part of the Maritsa River basin in Southern Bulgaria.

## MATERIALS AND METHODS

The macroinvertebrate samples were collected in the spring of 2024 from the Parvenetska River, on the outskirts of the village of Parvenets (designated as Parvenets biotope; 42°04'53.1"N 24°39'41.1" E), Plovdiv district. The village is located at 454 m above sea level. The selected biotope is located northwest of the village and is characterized by a fast current and a rocky bottom (Figures 1 and 2).

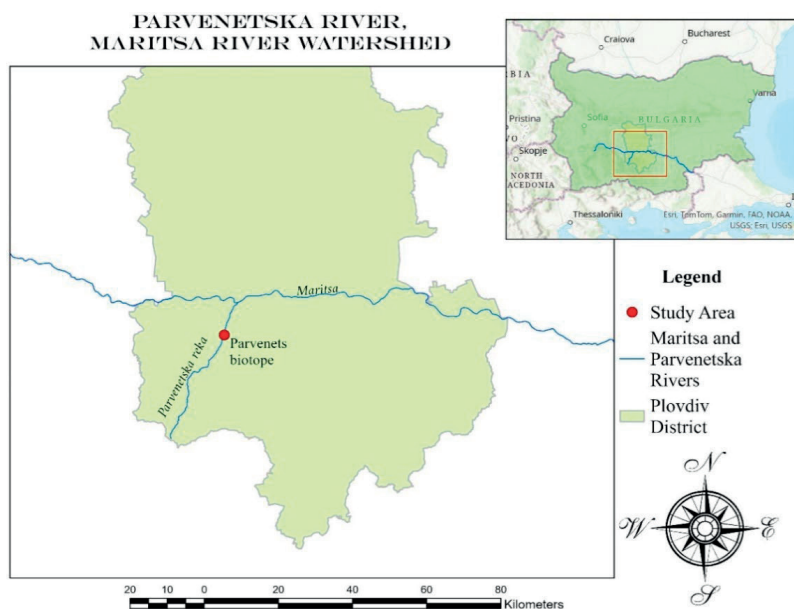


Figure 1. Researched section of the Parvenetska River

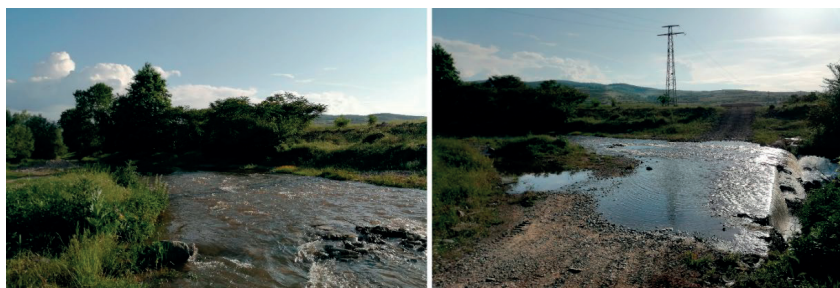


Figure 2. View from the Parvenets biotope

The studied section of the river belongs to type R5, “Semi-mountainous rivers”. Macroinvertebrate sampling was carried out by national standards (Cheshmedjiev et al., 2011; EN ISO 10870:2012; EN 16150:2012; Regulation No. H-4 of 14.09.2012; Belkinova et al., 2013).

Macroinvertebrate samples were taxonomically defined and counted. The main metrics were determined: total number of taxa, number of Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, % (Oligochaeta & Diptera), % Filtering feeders; % EPT taxa; German trophic index RETI and species diversity indices according to Cheshmedjiev et al. (2011) and Belkinova et al. (2013).

## RESULTS AND DISCUSSIONS

During the ecological monitoring of the Parvenetska River (Parvenetska biotope), 26 taxa (*Haliplus lineolatus* Mannerheim, 1844; *Oulimnius tuberculatus* (Müller, 1806); *Lumbricus rubellus* Hoffmeister, 1843; *Atherix ibis* (Fabricius, 1798), larva; Ceratopogonidae; *Chironomus plumosus* (Linnaeus, 1758), larva; *Tipula* sp., larva; *Baetis* sp., nymph; *Caenis horaria* (Linnaeus, 1758), nymph; *Ecdyonurus* sp., nymph; *Oligoneuriella rhenana* (Imhoff, 1852), nymph; *Serratella ignita* (Poda, 1761), nymph (*Ephemerella ignita* (Poda, 1761)); *Gerris* sp., nymph; *Nepa cinerea* Linnaeus, 1758, nymph; *Plea minutissima* Leach, 1818, nymph; *Physella acuta* (Draparnaud, 1805); *Bithynia tentaculata* (Linnaeus, 1758); *Aeshna* sp. larva; *Enallagma cyathigerum* (Charpentier, 1840), larva; *Gomphus* sp., larva; *Hydropsyche* sp., larva; *Hydropsyche ornatula* McLachlan, 1878, larva; *Hydroptila* sp., larva; *Limnephilus rhombicus* (Linnaeus, 1758), larvae; *Oligotricha striata* (Linnaeus, 1758) (syn. *Phryganea striata* L.); *Sericostoma personatum* (Kirby & Spence, 1826), larva) with 316 specimens of macroinvertebrates belonging to 9 orders were found.

The largest number of taxa and specimens are the macroinvertebrates belongs to the order Trichoptera (Figure 3). Due to the high number of taxa, the ecological state of the Parvenetska River in the studied biotope is very good.

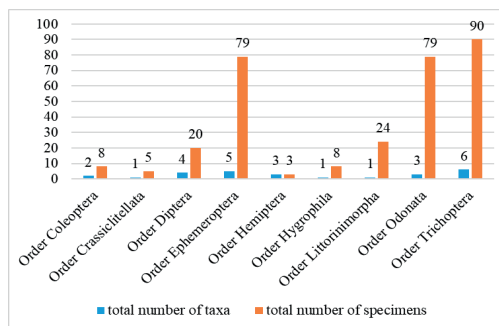


Figure 3. Total number of taxa and specimens of macroinvertebrate organisms from the Parvenetska River

Eleven EPT taxa with a total of 169 specimens of macroinvertebrates were identified in the Parvenetska biotope. Of these, 5 and 6 taxa (79 and 90 specimens) are from Ephemeroptera and Trichoptera, respectively. The ecological state of the river in the studied biotope based on the number of EPT taxa is very good. In previous studies (Vidinova et al., 2018), 9 EPT taxa were reported for the Parvenetska River (five from Ephemeroptera and four from Trichoptera). Of these, two taxa - *S. ignita* (Ephemeroptera) and *Hydropsyche* sp. (Trichoptera) were also found in the Parvenets biotope of the present study. One taxon, Oligochaeta, and four taxa, Diptera, were found, represented by 5 and 20 specimens, respectively, which represent 7.91% of the total abundance. Two taxa (with five specimens) from the ecological group of filtering feeders were found. Therefore, the filtering feeders group represents 1.58% of the total abundance. The percentage of EPT taxa is high - 53.48% of the total abundance.

According to the mode of feeding, macroinvertebrate organisms in the Parvenets biotope are distributed as follows: “scrapers (SC)” - 91 specimens (7 taxa); “collectors (CL)” - 52 specimens (2 taxa); “shredders (SH)” and “deposit feeders (DF)” - 38 specimens (4 and 3 taxa, respectively); “filtering feeders (FL)” - 5 specimens (2 taxa). The studied biotope is dominated by scrapers and collectors, typical of mountain areas without anthropogenic load. Based on the distribution of macroinvertebrates from the Parvenetska River by trophic groups, the German Trophic Index (RETI) was calculated.

The index value was 0.58, indicating that the river's ecological state in the studied biotope is good.

The Shannon-Weaver species diversity index ( $H'$ ) is 2.62 and indicates  $\beta$ -mesosaprobic

conditions for the studied section of the Parvenetska River. The Pielou's evenness index (E) is high, and the Simpson's dominance index (C) is low, indicating good environmental conditions (Table 1).

Table 1. Species diversity indices

Indices	Parvenets biotope
Species richness index of Margalef (Dmg)	4.34
Shannon-Weaver species diversity index ( $H'$ )	2.62
Pielou's evenness index (E)	0.805
Simpson's dominance index (C)	0.102

Of the 26 macroinvertebrate taxa identified, 23 belong to 9 saprobity groups. By number of taxa, macroinvertebrates dominate for 0- $\beta$ -mesosaprobic conditions (7 taxa), and by number of specimens - for  $\beta$ -mesosaprobic conditions (91 specimens) (Figure 4).

The results obtained for the value of the saprobic index (SPUB = 1.97) indicate a good state of the water of the Parvenetska River at the Parvenets biotope.

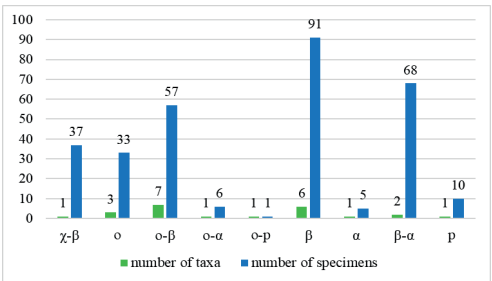


Figure 4. Number of macroinvertebrates from the Parvenetska River by saprobity groups

The bioindicator macroinvertebrate organisms from the Parvenetska River include 23 taxa belonging to the five sensitivity groups - Group A (sensitive forms), Group B (less sensitive forms), Group C (relatively tolerant forms), Group D (tolerant forms), Group E (the most tolerant forms). Group C is distinguished by the largest number of taxa and specimens and groups A and E by the smallest (Figure 5).

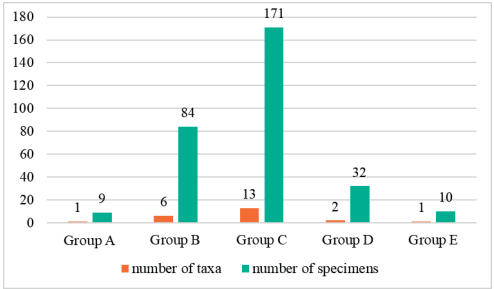


Figure 5. Number of macroinvertebrates from the Parvenetska River by sensitivity groups

The ecological state of the Parvenetska River in the studied biotope has a biotic index of 3 (nEQR=0.6) (moderate ecological state).

According to a report from the East Aegean River Basin Directorate (EARBD), by 2023, the ecological state of the section of the Tamrashka River to the village of Hrabrino and tributaries - the Dormushevskia and Pepelasha rivers is good. The ecological state is moderate in the section of the Parvenetska River from the confluence of the Pepelasha River to the mouth (Table 2).

According to the EARBD database, in the period March-June 2024, only in April was pollution with dissolved aluminium (32  $\mu\text{g/l}$ ) recorded at a maximum permissible concentration - environmental quality standards (MPC-EQSSs) of 25  $\mu\text{g/l}$ , in the section of the Parvenetska River from the confluence of the Pepelashka River to the mouth, where the studied biotope is located. In 2024, based on the study conducted, we established a deterioration of the ecological state from good (2022-2023) to moderate (2024).

Table 2. Comprehensive ecological assessment for the period 2020-2023 (EARBD) (ES - ecological state; EP - ecological potential; BQEs - biological quality elements; PQEs - physicochemical quality elements)

	Overall assessment of the ES/EP on the BQEs	Overall assessment of the ES on the PQEs	Overall assessment of the ES/EP	Chemical state
<b>Tamrashka River to the village of Hrabrino and tributaries - Dormushevskia and Pepelasha Rivers - R3</b>				
2023	good	good ES	good	good
2022			good	good
2021	good	good	good	good
2020	very good	good	good	good
	Overall assessment of the ES/EP on the BQEs	Overall assessment of the ES on the PQEs	Overall assessment of the ES/EP	Chemical state
<b>Parvenetska River from the confluence of the Pepelasha River to the mouth - R5</b>				
2023	good EII	good ES	good EP	good
2022			good EP	unknown
2021	good	moderate	moderate	good
2020	good	moderate	moderate	good

## CONCLUSIONS

During the ecological monitoring of the Parvenetska River (Parvenets biotope), 26 taxa of bioindicator macrozoobenthos were identified. Based on the determined ecological indices, the biotic index with the lowest indicators indicates a moderate ecological state.

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