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AQUATIC MACROINVERTEBRATES OF THE JABLANICA RIVER, SERBIA

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Abstract — Research on the community of aquatic macroinvertebrates was carried out during 2005 and 2006 at four sampling sites along the Jablanica River, a right-hand tributary of the Kolubara River. Fifty-seven taxa were recorded in the course of the investigation. The most diverse group was Ephemeroptera, followed by Trichoptera and Plecoptera. Members of the *Rhitrogena semicolorata* group were the most abundant. Our results could be the basis for evaluation of the influence of damming of the Jablanica River on the status of its water and can serve as a model for studying the influence of hydromorphological degradation of aquatic ecosystems.

Key words: Aquatic macroinvertebrates, community composition, Jablanica River, Kolubara River, Serbia

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INTRODUCTION

The aim of this work is to present the community of aquatic macroinvertebrates at investigated localities on the Jablanica River and to estimate the status of the river. The results are of special interest because of construction of a dam on the Jablanica River, near the settlement of Rovni. Creation of the reservoir will alter the aquatic biota and the water status. Together with previous investigations (summarized in Miljanović, 2001), the data presented constitute the basis for evaluation of the type and level of these changes.

The Jablanica is a right-hand tributary of the Kolubara River. The river is formed by numerous mountain brooks flowing from the north slope of Mt. Jablanik (1,274 m) and from the east side of Mt. Medvednik (1,244 m). The river is 20 km long, with a drainage area of 157.7 km^2.

The investigated drainage area of the Kolubara River (3,638.6 km^2, according to Studija WFD, 2005) lies between Mts. Povlen, Maljen, and Suvobor (in the south); Rudnik (in the southeast); Kosmaj and Bukulja (in the east); and Vlašić, Cer, and Medvednik (in the west). As one of the largest right-hand tributaries of the Sava, the Kolubara River is formed near Valjevo by the confluence of the rivulets Obnica and Jablanica (at an elevation of 190 m above sea level) (Miljanović, 2001). The Kolubara empties into the Sava (the latter into the Danube at Belgrade) and belongs to the watershed of the Black Sea.

MATERIAL NAD METHODS

Material was collected during 2005 and 2006 at four sampling sites (Fig. 1), as follows:

Site No. 1 - the Jablanica, upstream from Bebića Luka, elevation of 490 m above sea level, coordinates of 44° 12’ 42.3” N latitude and 19° 43.04’ 4” E longitude. The substrate is mainly composed of stones, predominantly large. Small stones are found to participate with not more than 10% of the stretch area. A small amount of gravel and fine sediment is also present.

Site No. 2 - the Jablanica, hamlet of Mijači, elevation of 390 m above sea level, coordinates of 44° 11’

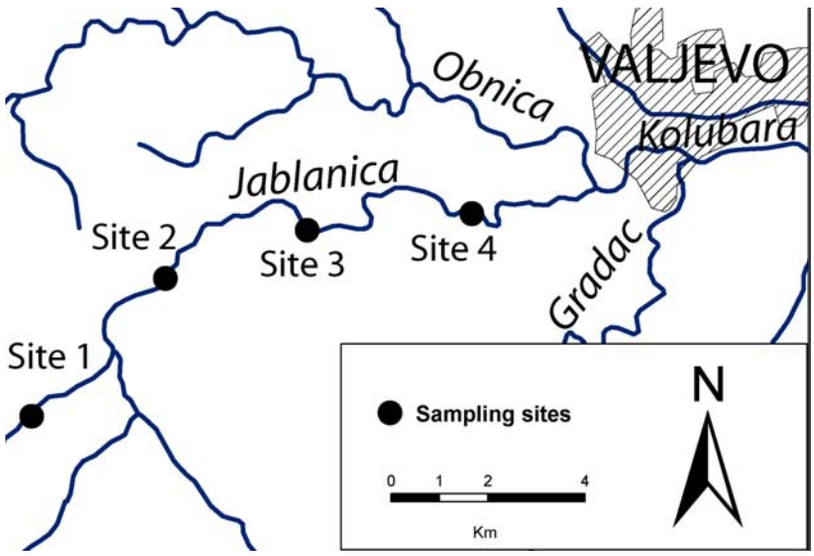

Fig. 1. Sampling sites.

25" N latitude and 19° 41' 43.5" E longitude. The substrate is composed of small and large stones, gravel, and fine sediment.

Site No. 3 - the Jablanica, near Rovni Dam, elevation of 340 m above sea level, coordinates of 44° 14' 22.9" N latitude and 19° 41' 43.5" E longitude. The substrate is composed of large stones. Small stones, gravel, and fine sediment are present on a limited surface area (up to 15%).

Site No. 4 - the Jablanica, 10 km upstream from Valjevo (Malinovići), elevation of 310 m above sea level, coordinates of 44° 15' 35.0" N latitude and 19° 48.51' 5" E longitude. The substrate is composed of small and large stones, the rest consisting of gravel and fine sediment.

Aquatic macroinvertebrate samples were taken with a benthological hand net (mesh size 500 μm; kick and sweep technique) and a Sürber net (mesh size 250 μm). Samples were taken from all available habitats represented with more than 5% of total habitat area on the sampling stretch (multi-habitat sampling procedure).

The community was analyzed using Shannon-Weaver diversity index (Shannon and Weaver, 1949).

Estimation of the saprobic level was based on the Pantle-Buck method (Pantle and Buck, 1955).

In order to determine the relation between sampling sites in regard to the observed macroinvertebrate fauna, cluster analysis was carried out. The analysis was performed on the correlation coefficient obtained by Pearson product-moment correlation analyses (Rodgers and Nicewander, 1988). In addition, correspondence (reciprocal averaging) analyses (Pielou, 1984), based on data on the relative abundance of taxa at the sampling sites, was used in order to define the relation of sampling sites and faunistic assemblages. Statistica for Windows 5.1 (Edition '97) was used for statistical processing of the data.

RESULTS

A total of 57 taxa belonging to eight groups were recorded (Table 1). The most diverse group was Ephemeroptera, with a total of 19 species, followed by Trichoptera (14 species) and Plecoptera (eight species). In the sense of species richness, Oligochaeta, Diptera, Coleoptera, and Crustacea were less significant. The number of recorded taxa per sampling site fluctuated between 105 (sampling site 4) and 270 (sampling site 2).

Table 1. Macroinvertebrate community of the Jablanica River – 2005-2006 investigation.

Taxa/Sampling site	1	2	3	4
OLIGOCHAETA				
Eiseniella tetraedra (Savigny, 1826)	+		+	
Nais pseudobtusa Piguet, 1906		+		
Enchytraeidae		+		+
Lumbriculidae		+		+
Haplotaxis gordioides Hartmann, 1821				+
CRUSTACEA				
Gammarus balcanicus Schäferna, 1922	+		+	
ODONATA				
Gomphus vulgatissimus (Linnaeus, 1758)		+	+	+
EPHEMEROPTERA				
Acentrella sp.	+		+	
Baetis rhodani (Pictet, 1843)		+	+	+
Baetis lutheri (Müller-Liebenau, 1967)	+			
Baetis pavidus (Grandi, 1949)	+	+	+	
Baetis vardarensis (Ikonomov, 1962)	+	+	+	
Baetis muticus (Linnaeus, 1758)	+			
Caenis horaria (Linnaeus, 1758)		+		+
Ecdyonurus sp.		+		
Ecdyonurus venosus Fabricius, 1775	+	+	+	+
Epeorus sylvicola (Pictet, 1865)	+	+		
Ephemera danica (Müller, 1764)	+	+	+	
Ephemera vulgata Linnaeus, 1758		+		
Ephemerella ignita (Poda, 1761)	+	+		+
Heptagenia flavipes (Charpentier, 1825)		+		
Heptagenia sulphurea (Müller, 1776)				+
Oligoneuriella poecile (Ikonomov, 1962)		+		
Paraleptophlebia submarginata (Stephens, 1835)	+	+	+	
Rhitrogena fiorii Grandi, 1953	+		+	
Rhitrogena semicolorata Gr.	+	+	+	
TRICHOPTERA				
Athripsodes sp.	+			
Glossosoma sp.	+	+	+	
Goera sp.		+		
Hydropsyche angustipennis (Kurtis, 1834)	+	+	+	
Hydropsyche instabilis (Kurtis, 1834)		+		+
Hydroptila sparsa (Kurtis, 1834)				+
Limnephilus sp.	+	+	+	
Glyphotaelius pellucidus (Retzius, 1783)	+			
Philopotamus montanus (Donovan, 1813)				+
Polycentropus flavomaculatus (Pictet, 1834)		+		
Rhyacophila dorsalis (Kurtis, 1834)		+		+
Rhyacophila phylopotamoides McLachlan, 1879	+		+	
Sericostoma personatum (Kirby & Spence, 1826)			+	
Silo nigricornis (Pictet, 1834)	+	+		
PLECOPTERA				
Amphinemura sulcicollis (Stephens, 1835)	+	+		
Brachyptera risi (Morton, 1896)	+	+	+	
Capnia bifrons (Newman, 1839)	+			
Siphonoperla torrentium (Pictet, 1834)	+			
Isoperla grammatica (Poda, 1761)	+	+	+	+
Leuctra hippopus Kempny, 1899	+	+		+
Perla bipunctata (Pictet, 1833)	+	+	+	
Protonemura meyer (Pictet, 1841)	+	+	+	
DIPTERA				
Chironomidae	+	+	+	+
Limoniidae	+		+	
Antocha sp.		+	+	
Tipulidae		+		
Ibisia marginata (Fabricius, 1781)		+	+	
Simuliidae	+		+	+
COLEOPTERA				
Elmis sp.		+	+	+
Limnius volckmari (Panzer, 1793)	+	+	+	
Riolus sp.		+		+
Number of taxa/Sampling site	**209**	**270**	**242**	**105**

Table 2. Percentage participation of macroinvertebrate groups at the sampling sites.

Taxa group/Sampling site	**1**	**2**	**3**	**4**
Oligochaeta	0.92%	2.10%	25.70%	10.28%
Crustacea	14.68%	0%	2.17%	0%
Odonata	0%	1.05%	0.31%	6.54%
Ephemeroptera	48.62%	49.30%	58.20%	28.97%
Trichoptera	19.72%	17.13%	4.02%	5.61%
Plecoptera	12.84%	10.49%	4.95%	9.35%
Diptera	2.29%	15.38%	4.02%	35.51%
Coleoptera	0.92%	4.55%	0.62%	3.74%

The percentage participation of macroinvertebrate groups at the sampling sites is presented in Table 2. Insects were the most important component of the community, participating with from 72.14% (sampling site 3) to 97.90% (sampling site 4). Ephemeroptera were found to be dominant component within the insects, followed by Diptera and Trichoptera (Table 2). The mean percentage participation of Ephemeroptera in the total macroinvertebrate community was found to be 46.28%. Taxa of the *Rhitrogena semicolorata* group were the most abundant, with 171 specimens.

At sampling site 4, in contrast to the other sites, the group Diptera was found to be the most important component of the community (35.51% of the total community). Within the group, the principal component in regard to relative abundance was the family Chironomidae.

The mean percentage participation of Diptera at all investigated sites was 14.30%.

Representatives of Trichoptera also made up a significant part of the macroinvertebrate community at sites 1 and 2 (19.72 and 17.13%, respectively).

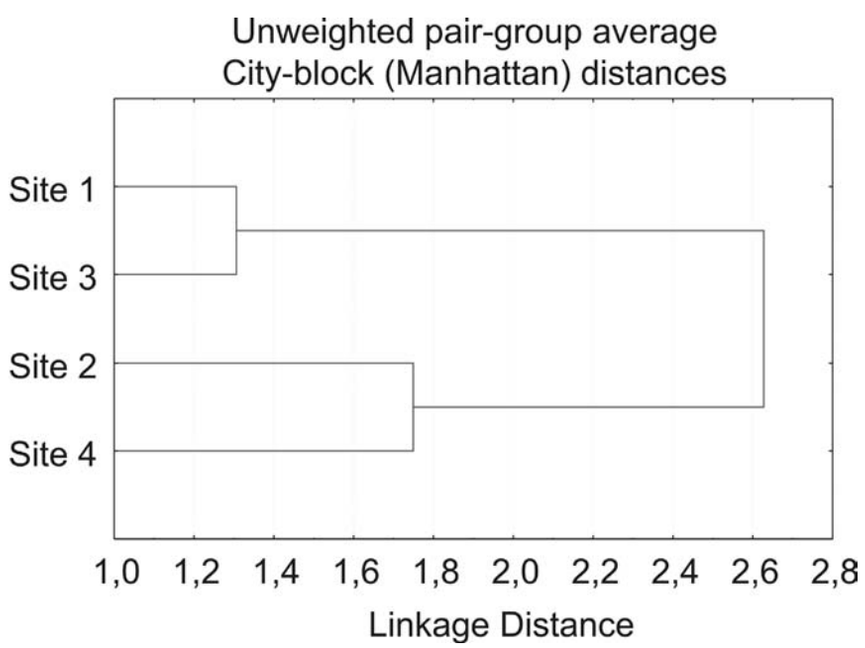

Fig. 2. Cluster analyses based on correlation matrices - Pearson product-moment correlation coefficients (Rodgers and Nicewander, 1988).

Oligochaeta were represented with 25.70% at site 3, while at the other sites this group was found to be less abundant. The order Plecoptera was evenly distributed at sites 1 (12.84%), 2 (10.49%), and 4 (9.35%), while Crustacea were one of the principal components only at site 1, with 14.68%.

Sites 2 and 4 on the one hand and sites 1 and 3 on the other are characterized by faunistic similarity, which is shown in Fig. 2. According to the results of Pearson product-moment correlation analyses (Rodgers and Nicewander, 1988), there is significant correlation between data on relative abundance of taxa at sites 1 and 3, as well as 2 and 4. According to our results, 13 taxa are common to sites 2 and 4 and among them seven were found only at those sites. Sites 1 and 3 are characterized by 20 common taxa, five of which were found only at those sites. Only three taxa (*Ecdyonurus venosus*, *Isoperla grammatica*, and Chironomidae) out of 57 were present along the entire course of the river, at all four localities. The recorded distribution of the macroinvertebrate community could be connected with substrate type. A predominance of large stones was observed at sites 1 and 3, while sites 2 and 4 are characterized by a higher participation of small stones, gravel, and fine sediment.

In order to present the main faunistic features that characterize the sampling sites, correspondence

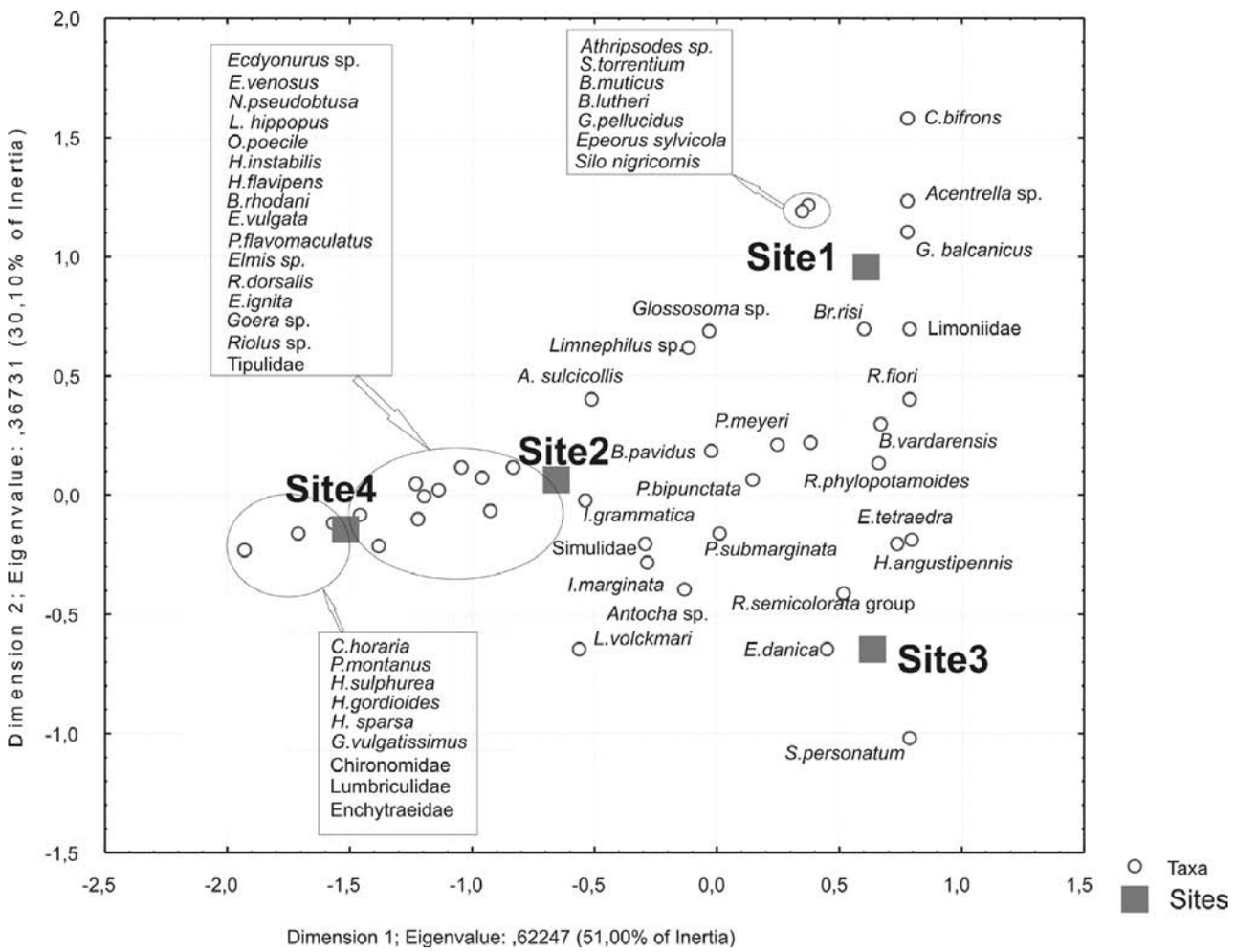

Fig. 3. Results of correspondence analyses - relative abundance of taxa at the sampling sites.

analysis was carried out. The sampling site's position on the resultant graph and the faunistic assemblage that most influences such a position are shown on Fig. 3.

The saprobic index (SI) (Pantle and Buck, 1955) ranged between 1.46 (site 2) to 1.80 (site 4). This result indicates that water quality varies between categories I and II, according to national standards (YUFROW, 1985).

The Shannon-Weaver (H') diversity index (Shannon and Weaver, 1949) ranged from H' = 3.1766 (site 2) to H' = 2.2288 (site 3).

DISCUSSION

Fifty-seven taxa of aquatic macroinvertebrates were recorded in the course of the investigation. The community structure was found to be typical for highland rivers in the region (Filipović, 1954, 1957, 1967, 1969, 1975, 1976; Jakovčev, 1983; Simić, 1996; Konta, 1997; Marković et al., 1997a, 1997b; Miljanović, 2001).

According to the results presented, the number of species and Shannon-Weaver (H') index decrease along the longitudinal profile, from upper locations toward the confluence. This situation is connected with decline of habitat diversity and increase of anthropogenic influence in the same direction.

The Jablanica River was studied in detail by Miljanović (2001), with special emphasis on the Oligochaeta fauna. Along the entire course between 1991 and 1994, Miljanović detected 109 macroinvertebrate taxa at three localities. The dominant group was found to be Chironomidae, followed by Ephemeroptera. Oligochaeta was present with 22 taxa belonging to five families. In comparison with the results presented by Miljanović (2001), our investigation revealed a less diverse macroinvertebrate community. Mollusca, Collembola, Turbellaria, Nematoda, Hydracarina, Aranea, and Hymenoptera – which were detected by Miljanović (2001) – were not found during our study. This could be a result of deterioration of the environmental status.

The building of a dam on the Jablanica near the settlement of Rovni is now in the final phase, so the results presented by Miljanović (2001), together with our results, could be the basis for evaluation of the influence of damming of the river on the status of its water during filling of the reservoir, as well as in the following years. The results can also be used as a model for studying the influence of hydromorphological degradation on aquatic ecosystems. In addition, the region of the Kolubara catchment area is under the high influence of gravel extraction, so the relation of different types of hydromorphological pressures and aquatic biota could be analyzed in order to define a sound system for evaluation of degradation of freshwater ecosystems. Hydromorphological degradation has been recognized as one of four water management issues of basin-wide significance for the Danube Basin (Schwarz and Kraier, 2008). The lack of standard, harmonized methodology for hydromorphological survey and assessment has been underlined before (Schwarz and Kraier, 2008), and this is an additional challenge for anyone organizing multidisciplinary investigations in the region of the Kolubara Basin.

In the present paper, the crucial influence of substrate composition on macroinvertebrate fauna is underlined. Thus, the obtained data could be used for identification of the main typological parameters and for compilation of a type-specific index of ecological status for running waters in Serbia.

CONCLUSIONS

Fifty-seven taxa were recorded in the course of the investigation. The most diverse group was Ephemeroptera, followed by Trichoptera and Plecoptera. In the sense of species richness, Oligochaeta, Diptera, Coleoptera, and Crustacea were less significant. The group Chironomidae (Diptera) was not identified to the species level, which means that species richness is probably higher than represented.

Composition of the community is typical for highland rivers such as the Jablanica.

Along the river, in the downstream direction, the number of recorded species and Shannon-Weaver

index (H') decrease, while the saprobity index (SI) increases, indicating rising antropogenic influence, especially organic pollution, as well as decline of habitat diversity.

The presented results indicate that water quality varied between categories I and II (national standards), which testifies to a good water status along the investigated stretch.

The presented data can serve the basis for further evaluation of the status of the Jablanica River in light of the building of a dam along its course, near the settlement of Rovni. The planned reservoir is sure to influence the status of the river and its aquatic macroinvertebrate community. Evaluation of the level of this influence will be possible on the basis of information from this and previous investigations.

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АКВАТИЧНИ МАКРОБЕСКИЧМЕЊАЦИ РЕКЕ ЈАБЛАНИЦЕ У СРБИЈИ

КАТАРИНА С. СТЕФАНОВИЋ[1], ВЕРА П. НИКОЛИЋ[2], БОЈАНА П. ТУБИЋ[1], ЈЕЛЕНА М. ТОМОВИЋ[1], АНА Д. АТАНАЦКОВИЋ[1], В. М. СИМИЋ[3] и М. М. ПАУНОВИЋ[1]

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Истраживања заједнице акватичних макробескичмењака вршена су током 2005. и 2006. године на четири локалитета реке Јабланице, десног саставка Колубаре. Укупно је забележено 57 таксона. Најразноврсније групе су биле Ephemeroptera, Trichoptera и Plecoptera. Најбројнији таксон је *Rhitrogena* ***semicolorata*** Gr. Добијени резултати представљају основу за процену утицаја изградње бране на статус воде реке Јабланице и могу бити коришћени као модел за испитивање утицаја хидроморфолошких промена на водене екосистеме уопште.