Composition of the Macroinvertebrates of the Hilly-Mountainous Stream in South-Western Serbia

Nebojša V. Živić[1], Tatjana Babović-Jakšić[1], Nenad Labus[1], Slavica Tomić[2], Ana Atanacković[3]

[1] University of Priština, Faculty of Science and Mathematics, Serbia, Ivo Lola Ribara 29, 38220 Kosovska Mitrovica, Serbia, , Phone: +381641430812, E-mail: nebo.zivic@gmail.com

[2] „JKP“ Raška, Serbia

[3] Institute for Biological Research “Siniša Stanković”, University of Belgrade

Abstract

The aim of this paper is to present the composition and structure of aquatic macroinvertebrate fauna of the Trnavska River. The Trnavska River is a hilly-mountainous watercourse located in the south-western part of Serbia (the Ibar River drainage, the Danube Basin). It is characterized by a rocky and pebble bottom. The downstream stretch of the river is under the influence of human activities and regulated by concrete slabs down to the confluence into the Raška River. A total of 48 macroinvertebrate taxa were recorded. Insects were the most diverse taxa group with a share of 83% of all taxa recorded. Trichoptera were found to be the most diversified order of insects (11 species). Insects were found to be the principal component of the macroinvertebrate community in respect to quantitative composition, as well, with a share of 67.08% of the total community density. Amphipoda (Crustacea) were found to be the subdominant component in respect to community density. The Trnavska River is the south-western boundary of the distribution of the *Gammarus fossarum* in Serbia. Mixed populations of *G. fossarum* and *G. balcanicus* were recorded in the upper stretch of the Trnavska River (sites 1-3).

Keywords: Macrozoobenthos, hilly-mountainous stream, Gammarus.

Introduction

The aim of this paper is to contribute to the knowledge of small hilly-mountainous streams of Serbia and the Balkan Peninsula. Although research of hilly-mountainous streams and rivers in Serbia has a long term tradition (Pljakić 1952, 1962; Filipović, 1967, 1976; Marković, 1995, 1998; Simić, 1993; Živić and Marković, 2007; Živić et al., 2004, 2008), there is still a need for extensive research on the biota of these fragile habitats, in order to complete our knowledge and understanding of the functioning of related ecosystems. Ecosystems of hilly-mountainous streams are characterised by specific biodiversity (Hering et al., 2006), which should be protected. The total invertebrate diversity in small streams can be very high. For example, in the first-order streams in Germany the presence of 1,004 invertebrate taxa has been described (Wallace and Eggert, 2009). Streams and rivers are under the influence of various changes due to anthropogenic activities affecting the structure and functioning of the ecosystems (Matthews and Bao, 1991). Biological response and sensitivity of different organisms to physical and chemical changes of water are used as an indicator for assessing the habitat quality (Karr, 1991; Rosenberg and Resh, 1993). Biological indicators show the intensity of anthropogenic stress. Benthic macroinvertebrates are sensitive to environmental changes and are widely used as biological indicators of the quality of the river (Russev et al., 1981; Russev 1993; Yaneva, 1988).

Study Area

The Trnavska River is located in the southwest of the Raška District of Serbia. It is located in the central basin of the Ibar River. Its source is on the south east slope of the Golija Mountain (1833 altitude). It ensues by merging into several streams that descend from an altitude of 1100m. Its length from the place of composition is about 20km. In Raška, at 416 m above sea level, it confluences into the

Raška River on the left. The Trnavska River belongs to the Black Sea basin.

According to the hydrographic and physical properties of the Trnavska River it belongs to a group of small mountainous rivers. Based on the division of rivers, it extends from I-IV zones (Illies and Botosaneanu, 1963).

Material and Methods

The investigation was carried out during June and August 2010. Macroinvertebrate samples were collected using the Sürber net (20x20cm). Samples were collected at five sites (Figure 1).

Site 1 is about 3-4 km away from the stream source. The bottom of the river is rocky-pebble. The water is about 10 cm deep and 2m wide.

Site 2 is located 4 km from the previous one. The river bottom is rocky. The mean water depth is 20 cm, while the mean width of the watercourse is 3.20 m.

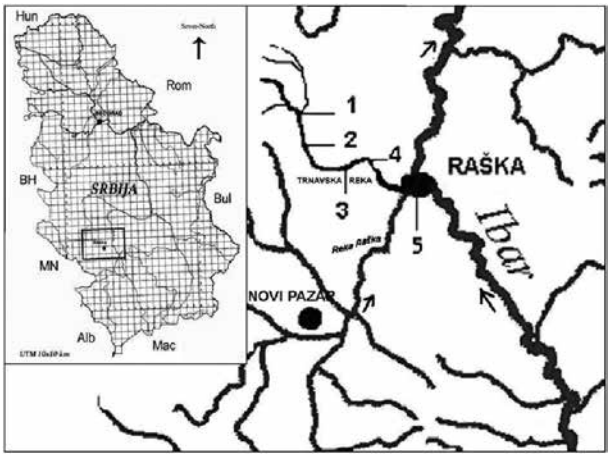

Figure 1: Position of the Trnavska River and sampling sites.

Site 3 is 6 km from the previous. The river bottom is rocky. The mean depth of the stream is 20 cm, while the mean width of the watercourse is 3.40 m.

Site 4 is 5 km from the previous. The bottom of the river is rocky, pebble. The mean depth of the river is 23 cm, while the mean width of the stream 3.50 m. The banks are covered with herbaceous and woody vegetation.

Site 5 is 20 km away from the source of the Trnavska River. The watercourse is regulated in this stretch and natural sandy substrate was replaced with rocky substrate in the length of about 2 km. The mean depth of the river is about 15 cm, and the mean width of the watercourse is 2.60 m. In this stretch, the river receives municipal wastewater from the Raška settlement.

The taxonomy and nomenclature applied herein adheres to the Fauna Europea version 2.6.2 of 29 August 2013 (de Jong, 2013).

Results and Discussion

A total of 48 macroinvertebrate taxa were recorded during the surveys (Table 1). Insects were characterised with prevalent taxa richness with a share of 83% of the total number of identified species. These are mostly larval stages and representatives of scrapers and predators (based on the classification of Cummins, 1973). As in other hilly-mountainous rivers in the region, caddis flies (Trichoptera) were a dominant component of the macroinvertebrate community in respect to the number of identified taxa with 11 species, followed by true flies (Diptera – 10 species), mayflies (Ephemeroptera – 9 species) and stoneflies (Plecoptera – 5 species).

Table 1: The structure of macroinvertebrates at sites in spring (Sp.) and summer (Sm.) season

Sites	**1**		**2**		**3**		**4**		**5**	
taxa / seasons / ind/m²	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.
Mollusca										
Radix labiata (Rossmassler 1835)										25
Ancylus fluviatilis O.F. Muller 1774									25	
Oligochaeta										
Eiseniella tetraedra (Savigny 1826)	25									25
Nais sp.	25		25					25		
Turbellaria										
Schmidtea lugubris (Schmidt 1861)	25			25		25				
Dugesia sp.	25	25								
Crustacea										
Gammarus balcanicus Schaferna 1922	50	175	75	125	100	150	75	25	150	50
Gammarus fossarum Koch, in Panzer 1835	100	125	50	50	50	100				

Sites	**1**		**2**		**3**		**4**		**5**	
taxa / seasons / ind/m²	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.	Sp.	Sm.
Austropotamobius torrentium (Schrank 1803)		25		25	25	25		25		
Diptera										
Hexatoma sp.	25	75	25	25		25				
Pedicia sp.	25	25				25				
Chironomidae	25	50	25	25		25		25	50	75
Ceratopogonidae			25							
Ibisia marginata (Fabricius 1781)		50								
Dicranota sp.				25				25		
Tipula sp.								25		
Atrichopogon sp.										25
Ephemeroptera										
Serratella ignita (Poda 1761)			25							
Ephemera danica Muller 1764	25	50	25		25		25	25	25	
Ecdyonurus venosus (Fabricius 1775)	25			25	25	50	25			
Caenis horaria (Linnaeus 1758)										50
Caenis luctuosa (Burmeister 1839)	25		25				25		25	
Baetis sp.			50		25			25		
Heptagenia sulphurea (Muller 1776)		25								
Paraleptophlebia submarginata (Stephens 1835)		25								
Oligoneuriella rhenana (Imhoff 1852)					25					
Odonata										
Cordulegaster insignis Schneider 1845	25		25							
Gomphus vulgatissimus (Linnaeus 1758)					25			25		
Ophiogomphus cecilia (Fourcroy 1785)									50	25
Coleoptera										
Gyrinus sp.	25									
Elmis aenea (Muller 1806)	25	50						25		
Orectochilus (Orectochilus) villosus (O. F. Muller 1776)				25						
Trichoptera										
Hydropsyche instabilis (Curtis 1834)	25	75	25		25	25				25
Hydropsyche pellucidula (Curtis 1834)						25			25	
Hydropsyche bulbifera McLachlan 1878									25	
Rhyacophila fasciata Hagen 1859					25	25	25			
Polycentropus flavomaculatus (Pictet 1834)								25		
Sericostoma personatum (Kirby & Spence 1826)		25	25							
Agapetus sp.				25	25	25				25
Philopotamus montanus (Donovan 1813)		25								
Limnephilus lunatus Curtis 1834				25						
Limnephilus sp.	25			25						
Odontocerum sp.	25									
Plecoptera										
Leuctra sp.		25		50				25		
Perla sp.					25					
Perla bipunctata Pictet 1833		25				50		25		
Nemoura sp				25						
Nemoura cinerea (Retzius 1783)						50				

Most of the recorded taxa are specific for fast and well-aerated water, with a stone-pebble surface (AQEM 2002).

Temporal dynamics of the qualitative and quantitative composition of the benthic macroinvertebrates was analysed. During the spring season, 28 macroinvertebrate taxa were determined, while in the summer period, 38 species were identified. The majority of stonefly taxa were recorded in the summer season, while representative of other insect orders were found in both seasons, which is determined by the life cycles of various species (Hynes, 1972; Williams, 1981; Ormerod, 1987).

The contact zone between the two gammarid species (*Gammarus balcanicus* and *G. fossarum*), previously described by Karaman (1935) and Pljakić (1952), has been confirmed for the Trnavska River by our investigation. The Trnavska River is the south-western boundary of the distribution of *G. fossarum* in Serbia. Mixed populations of *G. balcanicus* and *G. fossarum* were recorded in the upper stretch of the Trnavska River (sites 1-3). *G. fossarum* is the characteristic species for the source regions of the streams (Filipovic, 1967). The lower stretch of the Trnavska River, as well as the Raška River (Živić and Marković, 2007) is populated only with *G. balcanicus*.

As it can be seen from Figure 2, the number of recorded taxa and community density decreased along the watercourse, which was specifically pronounced at sites 4 and 5.

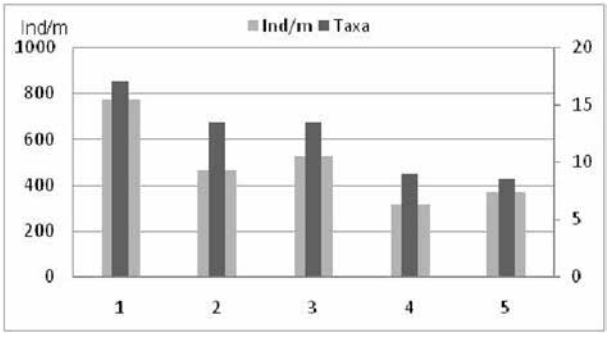

Figure 2: The average number of taxa and abundance on the sampling sites.

The decrease of the number of taxa at site 5 could be due to the river regulation in the sampling stretch and decrease of habitat diversity, but also could be related to the increased pollution as a consequence of influence of wastewater from the Raška settlement.

Insects were found to be the principal component of the macroinvertebrate community in respect to quantitative composition with a share of 67.08% of the total community density. Amphipoda (Crustacea) were found to be the subdominant component in respect to community density (Figure 3). This group had the significant abundance in both sampling occasions (Figure 4).

Mountainous streams are generally characterized by taxonomic richness and domination of insects, as well as a gradual shift of the communities along the watercourse (Miserendino and Pizzolo'n 2000; Maiolini and Lencioni, 2001), which was also confirmed by our investigation

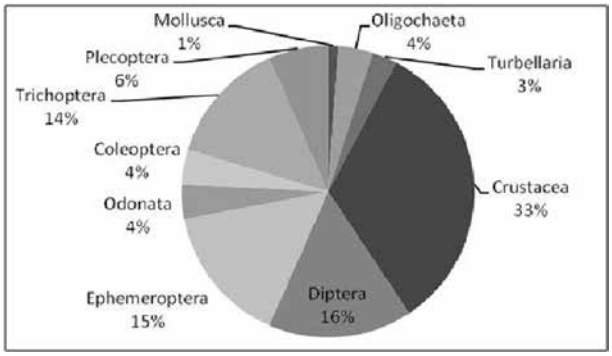

Figure 3: Share of taxa groups in the total number of macroinvertebrates.

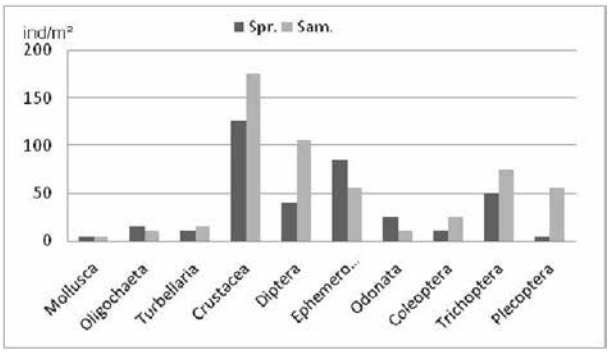

Figure 4: Seasonal dynamics of macroinvertebrate taxa groups.

During our investigation, a typical fauna for hilly-mountainous streams in the region of Balkan Peninsula was recorded (Pljakić 1952, 1962; Filipović, 1967, 1976; Marković, 1995, 1998; Simić, 1993; Živić and Marković, 2007; Živić et al., 2004, 2008).

Conclusion

The Trnavska River is a hilly-mountainous stream, with macroinvertebrate fauna typical for this river type. A total of 48 taxa were identified during our investigation, with domination of insects in respect to both, qualitative and quantitative community composition.

The knowledge on the distribution of aquatic macroinvertebrates in hilly-mountainous streams in the region of the Balkan Peninsula is of importance for establishment of an effective water management system, that includes the setting up of a successful,

type specific system for the assessment of ecological status, optimal water quality monitoring and relevant measures for water status improvement and biodiversity conservation.

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