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COMPOSITION, STRUCTURE, AND SEASONAL DYNAMICS OF MACROZOOBENTHOS IN THE TEMSKA AND VISOČICA RIVERS (SERBIA)

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Abstract - We investigated macroozobenthos communities in the Temska and Visočica Rivers at 10 localities during the summer and autumn of 2001. In 46 samplings of quantitative and 10 of qualitative analysis, 101 taxa from 17 groups of macrozoobenthos are identified. The most diverse group is the order Trichophtera (28 species from nine families). Less diverse with (only one species) are Nematomorpha, Hirudinea, Odonata, and Megaloptera. At all of the chosen localities, the most common species are *Elmis aenea* (70.00%), *Ancylus fluviatilis*, and *Baetis* sp. (60.00%). All those localities on the Visočica and Temska Rivers are very similar. The index of similarity varies from 12.5% (between Vi0 and Te0) to 70.7% (between Te1 and Te2). In the Temska River, the Shannon-Weaver diversity index varies from 1.80 (at Te3) to 2.45 (at Te0). In the Visočica River, the highest diversity of macrozoobenthos is at the Vi3 locality (2.59), the lowest at Vi0 (1.40). Less diverse macrozoobenthos communities are found at the Vi0 and Te3 localities. At the same time, these localities have the highest values of Simpson's index (0.35 and 0.34, respectively).

Key words : Macrozoobenthos, benthocenosis, diversity, similarity, Visočica, Temska River, Serbia.

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INTRODUCTION

A complex of abiotic and biotic factors is present in aquatic ecosystems. The biotic factors include all interactions between hydrobionts. The composition of hydrobionts is influenced by the complex of abiotic factors. A controlling and limiting factor in streams is water velocity. Also very important is the type of bottom, which is related to the velocity (O d u m , 1971). Hydrobionts that form biocoenoses in aquatic ecosystems are adapted to the complex of environmental factors. They are involved in interactions (actions, coactions, and reactions with the biotope). All these relations are very well harmonized and are the result of a long-term evolutionary process.

Biodiversity is the common national treasure of every country and should be explored as much as possible. Hydroecological research on highland running waters, especially if it is based on a multidisciplinary approach, is very important. Such research throws light on less investigated areas of biological phenomena and enables us to estimate the biodiversity of aquatic ecosystems, evaluate water quality, make a list of pollutants, construct a base for impact analysis, educate local communities, and raise public awareness of the need to protect these valuable resources. Those areas form part of the few oases of traditional lifestyles. Conservation of these landscapes and reduction of pollution represent a keystone in preservation of natural and cultural assets.

Hydroecological analysis of the Temska and Visočica Rivers was done as a a contribution to exploring macroinvertebrate biodiversity in highland streams. At the present times, investigations of the structure and composition of the macrozoobenthos communities of these rivers are very rare (I l i ć , 2002). The Temska and Visočica Rivers are for the most part on the territory of the Stara Planina Mountain (an internationally protected area). Geologically, the bed cover forms mosaic microhabitats that make for huge diversity of plant and animal species, which also could be expected for macrozoobenthos organisms.

MATERIAL AND METHODS

Samples of bottom fauna were collected in the

Temska and Visočica Rivers during the summer and autumn of 2001. For this hydroecological analysis of macrozoobenthos communities, 10 localities were chosen on the basis of the type of bed cover, altitude, and joinings with other streams. Sampling was done at all places where we expected to notice changes in composition of the communities. During sampling, depth and width of the river were measured, along with velocity and water temperature. Also, altitude and geographical coordinates were measured using GPS instruments. The basic characteristics and position of these localities are given on Fig. 1 and in Table 1.

The Temska River (Temštica) is a right-hand tributary of the Nišava (Fig. 1). It is formed by the confluence of the Visočica River and the Toplodolska River at 440 m a.s.l. Near the village of Staničenje (at a distance of 16 km from Pirot), this river empties into the Nišava River. With an average flow of 10.5 m^3/s at 340 m a.s.l., the river is 18 km long and has a basin area of 98.5 km^2.

The Visočica River (the spring-fed of the Temska River) arises in Bulgaria on the mountain peak Kom at 2.016 m a.s.l. This is the SE part of the main range of the Stara Planina Mountain.

The main spring stream is the Brlska River. On Bulgarian territory, it is 15 km long. The Visočica River enters Serbian territory 2 km SE of the village of Donji Krivodol. It has a length of 67.53 km, 48 km of which is in Serbia. The basin of the Visočica River has an area of 454.3 km^2. There is a dam (80 m high) with the artificial Lake Zavoj near the village of Zavoj (Fig. 1). The total volume of this lake is 170 million m^3 of water. It is 17 km long. The basic function is to generate energy, but it is also used for recreation and fishing.

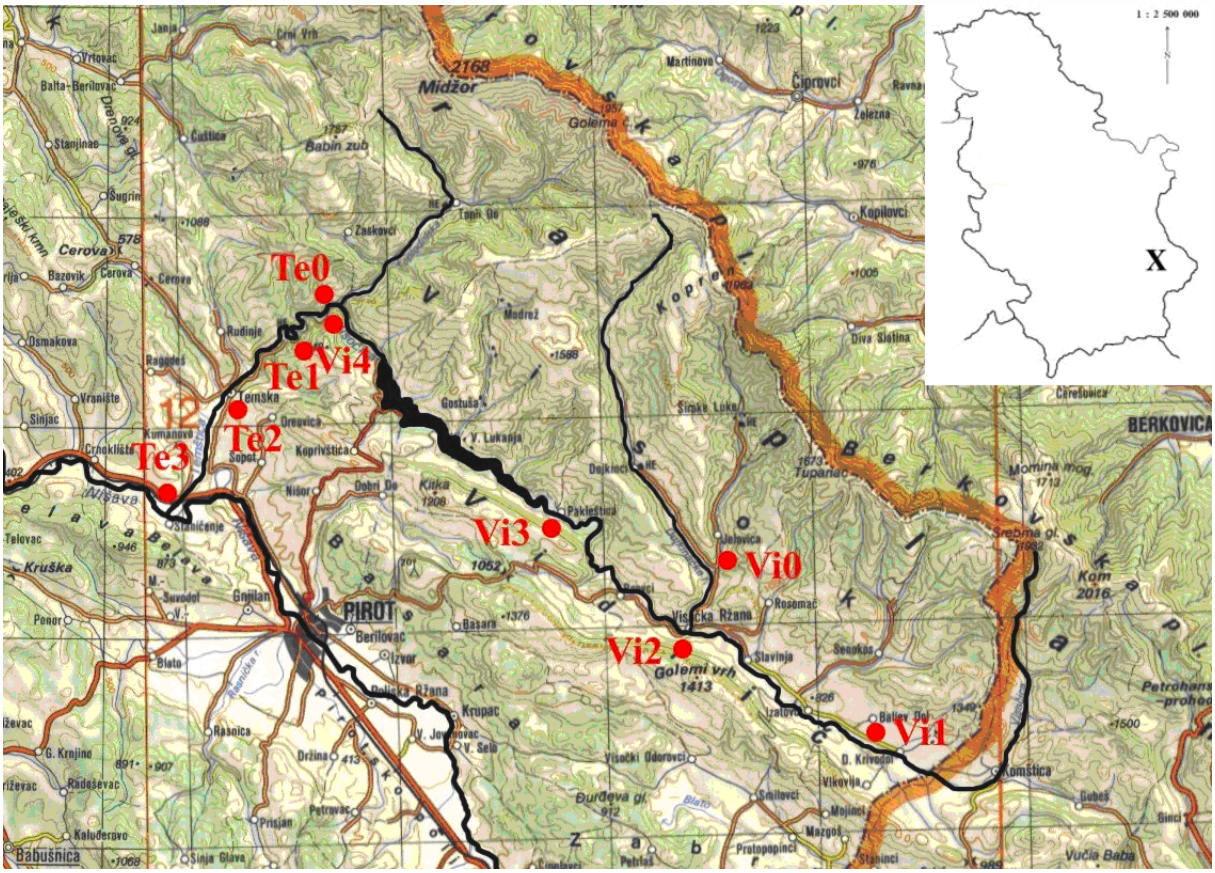

Fig. 1. Investigated localities on the Visočica and Temska Rivers. Location of the Temska and Visočica Rivers in Serbia is indicated by the letter X in the upper right-hand corner of the figure.

Table 1. Basic characteristics and position of localities on the Temska and Visočica Rivers (L - locality label; D - distance from confluence; T - type of bedcover; S - stone; t - water temperature)

			D (km)										
Temska River, right tributary of the Nišava, 18 km long. Research period: Summer 2001. Autumn 2001.	Te0	50 m after joining with the Toplodolska and Visočica Rivers	17,99	43°	17.797'	22°	36.999'	485	0,28-0,35	6,0-8,0	K	0,38-0,55	7-20
	Te1	20 m up stream from the hydroelectric power station Temac	13,52	43°	16.952'	22°	33.382'	430	10,0-12,0	0,14-0,26	K	0,51-1,05	9-25
	Te2	20 m upstream from the Temska village	8,04	43°	15.767'	22°	33.334'	370	12,0-15,0	0,18-0,20	K	0,47-0,69	9-22
	Te3	1,72 km km before joining with the Nišava river-Stojanovo village	1,72	43°	12.967'	22°	31.523'	350	8,0-10,0	0,19-0,24	K	0,69-0,75	9-25
Visočica, left tributary of the Temska River, 67,53 km long. Research period: Summer 2001. Autumn 2001.	Vi spring	Visočica spring	38,00	43°	10.946'	22°	49.063'	747	1,0-1,5	0,08-0,10	K	/	9-15
	Vi0	100 m downstream from the Visočica spring	37,90	43°	10.919'	22°	50.012'	745	5,0-6,0	0,18-0,20	K	1,28-1,39	10-13
	Vi1	46,15 km upstream from the confluence-village Ranovci	46,15	43°	06.835'	22°	55.283'	790	7,0-12,0	0,10-0,13	K	0,19-0,29	11-17
	Vi2	After joining with the Dojkinačka river -village Velika Ilinca	33,08	43°	09.246'	22°	48.919'	690	20,0-28,0	0,19-0,27	K	0,37-0,75	11-20
	Vi3	20,26 km upstream from the confluence, before Zavoj lake-the Pukošica village	20,46	43°	12.319'	22°	44.720'	612	15,0-20,0	0,12-0,21	K	0,58-0,71	10-16
	Vi4	4 km downstream from the Zavoj lake and 20m before joining with the Toplodolska River	0,10	43°	17.769'	22°	37.047'	490	3,0-4,0	0,13-0,25	K	1,13-1,30	12-16

Individuals of macrozoobenthos were collected seasonally using a Surber's net with an area of 300 cm^2. The mesh used for quantitative analysis was 250 µm. Qualitative composition of the macrozoobenthos was established by searching through material obtained from the river bed.

Forty-six samples for quantitative and 10 for qualitative analysis were collected. The material was deposited in small plastic bottles in the field. It was conserved with 96% alcohol. Separation of the material from mud, small stones, and detritus was done using binoculars and a microscope.

Identification of aquatic invertebrates was performed with the aid of keys for determination (Carausu *et al.* 1955; Hynes, 1977; Macan, 1979; Roskošny, 1980; Glöer *et al.* 1985; Edington and Hildrew, 1981, 1995; Waringer and Graf, 1997; Wallace *et al.* 2003) at the Institute of Zoology, Faculty of Biology, University of Belgrade.

Our ecological analysis involved estimation of the diversity index and the similarity index. The Shannon-Weaver index (Shannon and Weaver, 1949), Alpha index (Fisher *et al.* 1943) and Simpson's index (Simpson, 1949) were used to estimate α-diversity. The Sørensen similarity index was used to estimate β-diversity (Southwood, 1978).

RESULTS

Bottom communities of the Visočica and Temska Rivers consist of 17 macroinvertebrate groups with 101 identified taxa (Table 2). Insect larvae of the orders Trichoptera, Ephemeroptera, and Diptera are the most diverse and comprise 50% of all identified taxa (Table 2). Less diverse are Plecoptera (nine species), Coleoptera (nine species) and Mollusca (eight species), while the least diverse groups are Nematomorpha, Hirudinea, Odonata, and Megaloptera, which are represented by only one species each (Table 2).

At all investigated localities, the most frequent species are *Elmis aenea* (70.00%), *Ancylus fluviatilis*, and *Baetis* sp. (60.00%). The diversity of bottom fauna varies from 12 species at Vi0 to 40 taxa at the Vi2 locality (Table 2). The diversity of macroinvertebrate communities is greater in autumn than in summer.

The similarity of zoobenthos communities of the Visočica and Temska Rivers varies from 12.5% (between the Vi0 and Te0 localities) to 70.7% (between the Te1 and Te2 localities, Table 3). Benthocenoses of localities in the source region of the Visočica River are characterized by the least similarity with other localities on the Visočica River (values of the similarity index are lower than 30%, Table 3) and great mutual similarity (the value of similarity index between the Vi spring and Vi0 is 44.4%, Table

3). The greatest similarity (59.5%) is recorded between the second and third locality on the Visočica River (Table 3). Benthocenoses of the investigated localities on the Temska River are characterized by high values of the similarity index, which varies from 35.7 (between the Te0 and Te3 localities) to 70.7% (between the Te1 and Te2 localities, Table 3).

The lowest abundance of organisms of macrozoobenthos in the Visočica and Temska Rivers (847 ind/m^2) is recorded at the Te1 locality. The greatest number of organisms of macrozoobenthos (4.616 ind/m^2), is observed at the Vi2 locality, due to mass occurrence of Trichoptera larvae (1.994 ind/m^2, the most abundant species being *Goera pilosa* with 475 ind/m^2 and *Hydropsyche angustipennis* with 217 ind/m^2). Ephemeroptera species are also very abundant with 1.446 ind/m^2 (the dominant forms being representatives of the genus *Ecdyonurus* with 620 ind/m^2 and the species *Epeorus assimilis* with 340 ind/m^2).

On most of the investigated profiles of these rivers, the bentocenoses are dominated by Trichoptera and Ephemeroptera larvae (Fig. 2). The dominance of Ephemeroptera is most prominent at the Te0 locality (54.25%, with the eudominant species *Epeorus assimilis* accounting for 22.77%), while they are the least represented at Vi0 (5.64%). In terms of percentage, Trichoptera are most abundant at the Te2 locality on the Temska River (52.50%, with the eudominant species *Hydropsyche pellucidula* accounting for (12.81%). Apart from this locality, Trichoptera have a very significant role in formation of benthocommunities at Vi2 (42.12%) and Te1 (40.17%, Fig. 2). Gammaridae individuals are present with the greatest percentage (72.99%) at the the Vi0 locality. Mollusca are most numerous at the Te3 locality, where they comprise 68.41% (*Viviparus viviparus* being the most significant species with 45.08%) and at the Vi Spring where they represent, 47.16% (the eudominant species *Ancylus fluviatilis* accounting for 46.39%). At the Vi4 locality, Coleoptera species have the predominant role in forming benthocommunities of which they comprise 44.06%, one species (*Elmis aenea*) being markedly dominant with 37.28%. Chironomidae larvae are dominant with 33.78% at the Vi1 locality (Fig. 2). Organisms belonging to the order Coleoptera and phylum Mollusca

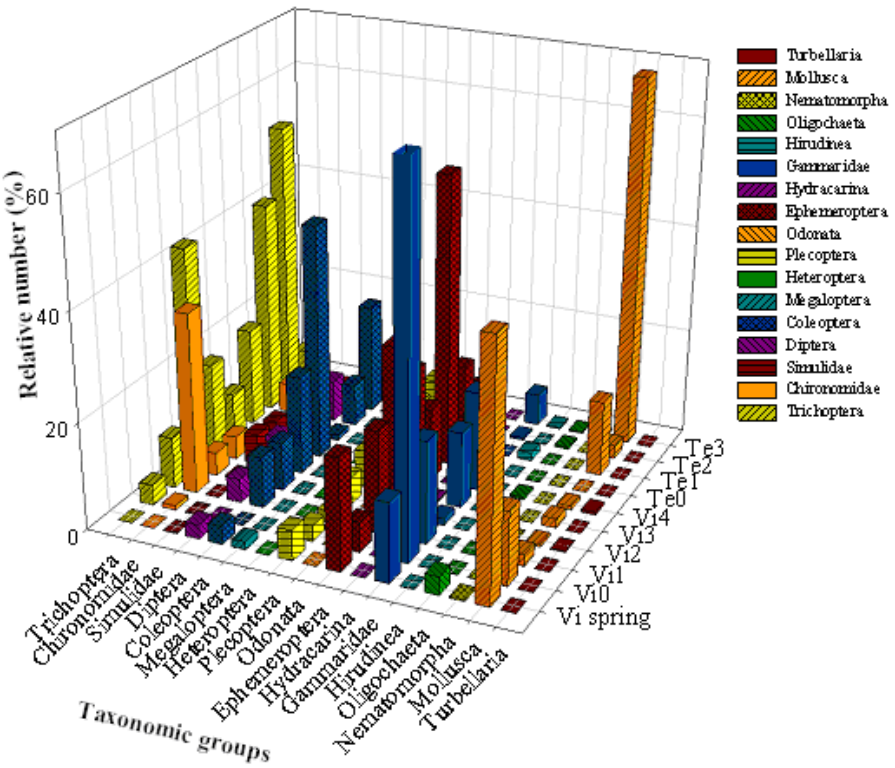

Fig. 2. Relative number of the taxonomic groups at localities on the Visočica and Temska Rivers.

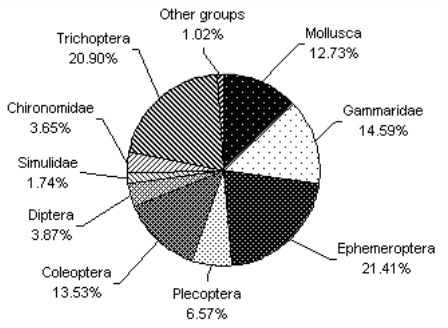

Fig. 3. Total relative number of participating taxa in bottom fauna of the Visočica and Temska Rivers.

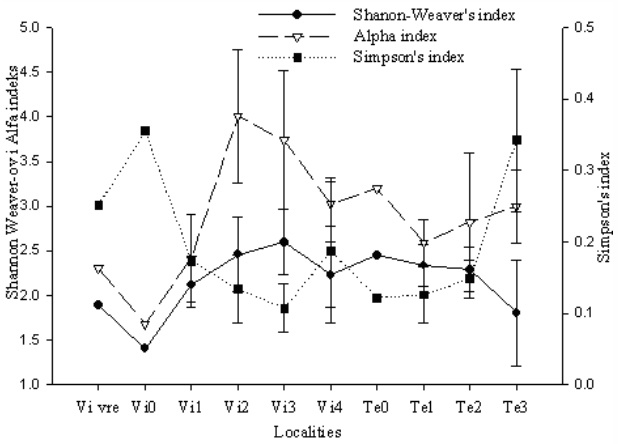

Fig. 4. Average values of Shannon-Weaver, Alpha, and Simpson's indices at investigated localities on the Visočica and Temska Rivers.

are best represented in the summer (26.41% for Coleoptera and 22.91% for Mollusca). On the other hand, Trichoptera and Ephemeroptera larvae are dominant during the autumn (27.64% for Trichoptera and 24.08% for Ephemeroptera).

In formation of the benthocenoses of the Visočica and Temska Rivers, the most important components are Ephemeroptera (21.41%) and Trichoptera (20.90%) larvae (Fig. 3). Gammaridae (14.58%), Coleoptera (13.52%), and Mollusca (12.73%) are also very significant.

Benthocenoses at the investigated localities on the Temska and Visočica Rivers are characterized by high values of the Shannon-Weaver index (Fig. 4). In the Temska River, the index of diversity varies between 1.80 (at the Te3 locality) and 2.45 (at the Te0 locality) (Fig. 4). In the Visočica River, the highest macrozoobenthos diversity is at the Vi3 locality (2.59, Fig. 4). The lowest diversity is 1.40 (on the Vi0 river profile, Fig. 4). At other localities on the Visočica River, the diversity index varies within a narrow range (1.89 at the Vi Spring to 2.45 at the Vi2 locality, Fig. 4). Although values of the Alpha index are high in both rivers, they are higher in the Visočica than in the Temska River (Fig. 4). The maximum value of this index in the Visočica River is 4.00 (at the Vi2 locality) whereas its maximum value is significantly lower in the Temska River (2.99 at Te3, Fig. 4). The lowest value of the Alpha index (1.67) is recorded at the Vi0 locality (Fig. 4). The greatest benthocenosis diversity at the Vi3 locality is confirmed by the lowest value (0.10) of Simpson's index (Fig. 4). Less diverse macrozoobenthos communities are found at the Vi0 and Te3 localities, where the highest values highest values of Simpson's index (0.35 and 0.34) are detected (Fig. 4). These high values can be attributed to mass occurrence of Chironomidae larvae (306 ind/m^2) at the Vi0 locality and Mollusca individuals (1.520 ind/m^2) at Te3 locality.

DISCUSSION

This is the first investigation of macrozoobenthos of the Visočica and Temska Rivers. Its results represent a small contribution to the better understanding of basic interactions between entire bottom fauna communities. Besides enabling us to map the ecosystems of these rivers and get a better idea of the diversity of their macroinvertebrates (101 taxa are found), these results can help us to interpret correctly the position of the Visočica and Temska Rivers within the hydrological system of Serbia.

The biocoenoses of highland running waters have high diversity that is a consequence of significant heterogeneity of habitat features such as physical and chemical characteristics of the water and the type of bedcover (Minshall and Robinson, 1998). Rivers that have greater heterogeneity of physical characteristics also have greater diversity than those with more uniform habitats (Poof and Ward, 1989).

The bottom fauna of the Temska and Visočica Rivers is characterized by huge diversity of Trichoptera, Ephemeroptera, and Plecoptera larvae, which is quite typical because these macrozoobenthos groups are dominant in highland streams (Živić, 2005). The great diversity of Trichoptera larvae is a sign that habitat conditions at the investigated localities (shallow and fast streams with a rocky and stony bed cover and minimum

Table 2. Qualitative composition of macrozoobenthos in the Visočica and Temska Rivers.

Taxonomic groups	**Species**	**Localities**									
		T0	T1	T2	T3	Vi sp	Vi0	Vi1	Vi2	Vi3	Vi4
Turbellaria Dugesiidae	*Dugesia gonocephala*								+		+
	Dugesia lugubris		+*	+*						+*	
Nematomorpha	*Gordius aquaticus*					+					
Mollusca Sphaeridae	*Pisidium* sp.								+	+	
Ancylidae	*Ancylus fluviatilis*		+*	+	+*+	+	+	+	+	+*+	+
Lymnaeidae	*Lymnaea peregra*			+*	+*	+	+	+*+	+*		
Melaniidae	*Amphimelania holandri*			+	+						
Neritidae	*Theodoxus danubialis*				+						
Planorbidae	*Planorbarius corneus*							+		+	
	Planorbis planorbis				+						
Viviparidae	*Viviparus viviparus*				+						
Oligochaeta				+*+	+	+			+	+	+
Hirudinea Erpobdellidae	*Erpobdella testacea*		+*+		+						
Gammaridae	*Gammarus* sp.							+	+		
	Gammarus balcanicus			+	+	+	+			+	+
	Gammarus pulex fossarum				+	+	+	+	+	+	+
Hydracarina Hydryphantidae	*Protizia invalvaris*									+	
Torrenticolidae	*Torrenticola anomala*									+	
Ephemeroptera Baetidae	*Baetis* sp.	+	+	+	+*+	+		+*	+	+*+	+
	Baetis alpinus	+				+	+			+*+	+
	Baetis rhodani				+						
	Centroptilum pennulatum			+							
Caenidae	*Caenis* sp.				+						
	Caenis macrura				+			+			
Ephemeridae	*Ephemera danica*		+	+	+		+	+	+*	+	
Ephemerellidae	*Ephemerella ignita*		+	+				+	+*	+*+	+
	Ephemerella krieghoffi							+	+	+	
Heptageniidae	*Ecdyonurus* sp.	+	+*	+*	+	+			+	+*+	+
	Ecdyonurus aurautiacus									+*	
	Ecdyonurus forcipula				+*+			+*+	+*	+*+	
	Epeorus assimilis	+	+*	+*					+	+	
	Rhithrogena semicolorata	+					+		+		
Leptophlebiidae	*Paraleptophlebia* sp.	+									
	Paraleptophlebia cincta	+	+	+	+*+			+	+	+	
	Paraleptophlebia werneri	+	+*		+						

Note: +*, the samples are only found in qualitative samplings.

Table 2 - Continued.

Taxonomic groups	Species	Localities									
		T0	T1	T2	T3	Vi VI	Vi0	Vi1	Vi2	Vi3	Vi4
Odonata Gomphidae	*Onychogomphus forcipatus*				+						
Plecoptera Capniidae	*Capnia* sp.	+	+	+	+	+			+		
Leuctridae	*Leuctra* sp.			+						+	+
Nemouridae	*Nemoura* sp.	+	+	+	+				+		
Perlidae	*Dinocras* sp.								+		
	Dinocras cephalotes								+	+	
	Perla burmeisteriana		+	+	+			+	+	+*+	+
Perlodidae	*Isoperla* sp.					+	+				
	Perlodes sp.	+							+	+	
Taeniopterygidae	*Taeniopteryx* sp.				+*			+		+*	
Heteroptera Aphelosheiridae	*Aphelosheirus aestivalis*				+						
Nepidae	*Nepa cinerea*								+*+		
Megaloptera Sialidae	*Sialis fuliginosa*				+	+			+		
Coleoptera Dryopidae	*Helichus substriatus*				+						
Dytiscidae	*Dytiscus marginatus*									+*	
Elmidae	**Elmis aenea**	+	+*	+	+*+	+		+	+	+*+	+ +
	Limnius sp.				+				+	+	
	Potamophilus acuminatus				+						
	Stenelmis sp.		+	+	+			+	+	+	+
Gyrinidae	*Orectochilus villosus*			+	+			+	+	+	
Haliplidae	*Haliplus lineatocolis*							+			
Hydraenidae	*Hydraena gracilis*	+	+	+				+	+		+
Diptera Athericidae	*Atherix ibis*		+	+	+*+			+*	+	+	
	Atherix marginata	+	+		+*				+	+	+
Blephariceridae	*Blepharicera fasciata*								+*		+
Ceratopogonidae	*Bezzia* sp.									+	
Empididae	*Clinocera nigra*									+	
	Hemerodromia unilineata					+		+			
Limoniidae	*Antocha vitripennis*		+*		+				+	+	+
	Dicranota bimaculata							+	+		
	Limnophila sp.			+				+		+	
	Hexatoma bicolor							+	+		+
Muscidae	*Limnophora riparia*										+
Psyhodidae	*Pericoma* sp.										+
Tipulidae	*Tipula* sp.					+		+			
Simuliidae	*Simulium* sp.			+	+*				+	+	+
Chironomidae			+	+	+		+	+	+	+	
	Dactylocladius brevipalpis		+*	+*				+*	+		

Note: +*, the samples are only found in qualitative samplings.

Table 2 - Continued.

Taxonomic groups	Species	Localities									
		T0	T1	T2	T3	Vi vr	Vi0	Vi1	Vi2	Vi3	Vi4
Trichoptera Goeridae	*Goera pilosa*						+		+		
	Lithax niger									+	
Hydropsychidae	*Cheumatopsyche lepida*	+	+*+	+*	+				+	+	
	Hydropsyche sp.									+	
	Hydropsyche angustipennis	+	+	+	+				+		+
	Hydropsyche contubernalis	+		+	+			+	+		
	Hydropsyche instabilis										+
	Hydropsyche pellucidula	+	+*	+*	+*+				+	+*+	+
Lepidostomatidae	*Lepidostoma hirtum*						+				
Leptoceridae	*Athripsodes* sp.									+	
	Athripsodes bilineatus				+						
Limnephilidae	*Allogamus* sp.										+
	Drusus annulatus		+								
	Limnephilus sp.										+
	Potamophylax cingulatus								+		
	Potamophylax latipennis		+								
Philopotamidae	*Chimarra marginata*		+*								
	Philopotamus montanus								+		
	Wormaldia occipitalis									+	+
	Wormaldia subnigra			+							
Polycentropodidae	*Neureclipsis bimaculata*			+*							
	Polycentropus flavomaculatus		+	+*	+			+*+	+	+*+	
Rhyacophilidae	*Rhyacophila nubila*	+	+*+	+					+		
	Rhyacophila dorsalis				+						
	Rhyacophila pascoei								+		
	Rhyacophila praemorsa						+		+		
	Rhyacophila fasciata	+	+	+	+*	+	+		+	+*+	+
Sericostomatidae	*Sericostoma personatum*	+	+*+	+	+			+	+*+	+*+	+

Note: +*, the samples are only found in qualitative samplings.

Table 3. Values of similarity index for localities on the Visočica and Temska Rivers.

Localities.	Vi0	Vi1	Vi2	Vi3	Vi4	Te0	Te1	Te2	Te3
Vi spring	44.4	31.8	27.6	27.1	38.0	28.5	22.2	32.0	31.3
Vi0	--	24.3	25.8	21.4	20.5	12.5	14.2	21.2	20.8
Vi1		--	55.6	49.3	32.1	20.4	44.0	53.1	43.0
Vi2			--	59.5	46.7	48.5	60.0	63.5	48.8
Vi3				--	47.8	34.3	51.3	58.2	50.0
Vi4					--	34.0	42.1	45.1	44.4
Te0						--	60.0	50.9	35.7
Te1							--	70.7	48.4
Te2								--	50.7

human impact) are more favorable for Trichoptera than for any other macrozoobenthic group. This significant diversity is matched by high values of the Shannon-Weaver index, which on the Temska River ranges from 1.80 (at the Te3 locality) to 2.45 (at the Te0 locality). In the Visočica River, the highest value of this diversity index (2.59) is at the Vi3 locality, the lowest (1.40) at the Vi0 locality.

The diversity of macrozoobenthos in the Visočica and Temska Rivers is greater than in the Lisinski Brook, with 65 taxa (Filipović, 1965); the Grošnička River, with 66 taxa (Baračkov, 1973); the Kriveljska River, with 35 taxa (Marković and Miljanović, 1995); the Lomnička River, with 74 taxa (Konta, 1997); the Jablanica River (a tributary of the Kolubara River) with 97 taxa (Marković *et al.* 1998); the Veternica River with 20 taxa (Martinović-Vitanović *et al.* 1998); the Toplica (a tributary of the Kolubara), with 85 taxa (Živić *et al.* 2002); and the Pčinja, with 80 taxa (Simić and Simić, 2003). It is lower than in the Svrljiški and Trgoviški Timok Rivers with 149 taxa (Simić, 1993); the Djetinja River with 112 taxa (Marković, 1995); the Obnica River with 104 taxa (Marković *et al*. 1997); the Kolubara River with 114 taxa (Marković *et al.* 1999); and the Southern Morava River, with 141 taxa (Živić, 2005), including all its tributaries of the first rank, namely the Pusta Reka River, with 192 taxa; the Toplica River with 163 taxa; the Vlasina River, with 145 taxa; the Moravica River, with 140 taxa; the Nišava River, with 131 taxa; the Jablanica River, with 126 taxa; and the Veternica River, with 124 taxa (Živić, 2005).

Quantitative analysis of the macrozoobenthos fauna of the Visočica and Temska Rivers reveals that there is no clearly dominant group and that moving downstream considerable changes occur in quantitative composition of the benthocenosis. The lack of a dominant group sets the Visočica and Temska Rivers apart from other rivers of the Nišava River basin, where Gammaridae are dominant (Živić, 2005). Gammaridae are significantly present in the Visočica, but they are virtually absent in the Temska River. This fact might be caused by influence of the other contributing stream, namely the Toplodolska River, where Gammaridae are almost completely absent (Živić, 2005). Strong influence of the Toplodolska River is evident in the fact that the Te0 locality has small similarity (only 34%) with the Vi4 locality, even though the distance between them is just 70 m. On the other hand, similarity with the next locality (Te1, which is located 4.7 km downstream from Te0), is very great - 60%. Apart from Te0, a specific nature of the macrozoobenthos community in terms of qualitative and quantitative structure is also characteristic of the source of these rivers. Those localities, the Vi Spring and Vi0, have the lowest values of the similarity index and diversity index and are characterized by dominance of Mollusca and Gammaridae, respectively, which is in agreement with our previous results (Marković, 1998; Strahinić, 2000; Živić, 2005).

In some investigated rivers in Serbia, a single dominant group of macrozoobenthic organisms characteristic of the entire river course can be easily distinguished, *e. g.*, the order Ephemeroptera is dominant and Plecoptera and Diptera are subdominant in the Lisinski Brook and the Grošnička River (Filipović, 1965; Baračkov, 1973). Oligochaeta are dominant and Chironomidae are subdominant in the Djetinja River (Marković, 1995). In the Pusta Reka River, Gammaridae are dominant in the source region, Chironomidae and Ephemeroptera in the region of the upper and middle course, and Trichoptera in the lower course of the river (Strahinić, 2000). On

the other hand, in the benthocenosis of some rivers in Serbia such as the Lomnička River (K o n t a , 1997), the Svrljiški and Trgoviški Timok Rivers (S i m i ć , 1993) and the Brestovačka River (R a n d j e l o v i ć , 2002), there are several equally represented groups of macrozoobenthos. In the Svrljiški and Trgoviški Timok Rivers, Gammaridae, Oligochatea, and Mollusca are dominant; larvae of Ephemeroptera, Plecoptera, and Diptera are dominant in the Lomnička River; while the most abundant groups in the Brestovačka River are Gammaridae, Trichoptera, Chironomidae, and Mollusca. Apart from that, in these rivers, unlike the Pusta Reka River, there is no regular succession of dominant groups along the river course. The quantitative composition of benthocenoses along the courses of the Temska and Visočica Rivers exhibits the same pattern (more than one dominant group along the entire course). This can be attributed to habitat heterogeneity in highland regions, which creates higher diversity at all levels of biological organization - species, ecoform, or community (H y n e s 1960; A l l a n 1995).

CONCLUSION

The bottom fauna of the Visočica and Temska Rivers is composed of 17 groups of macroinvertebrates with 101 determined taxa. The highest diversity is in the order Trichoptera, with 28 species from nine families. The least diverse groups (with only one identified species) are Nematomorpha, Hirudinea, Odonata, and Megaloptera. At all investigated localities, the most frequent species are *Elmis aenea* (70.00%), *Ancylus fluviatilis,* and *Baetis* sp. (60.00%).

The similarity of zoobenthic communities in the Visočica and Temska Rivers varies from 12.5% (between the localities Vi0 and Te0) to 70.7% (between the localities Te1 and Te2). The least abundant benthocenosis in these rivers is at the Te1 locality, with 847 ind/m^2, on the Temska River while the most abundant one is at the Vi2 locality, with 4.616 ind/m^2, on the Visočica River.

On the majority of the investigated river profiles, the greatest relative numbers are recorded for larvae of Ephemeroptera (with 54,25% at the Te0 locality) and Trichoptera (with 52,50% at the Te2 locality). The most important components in formation of the benthocenoses of the Visočica and Temska Rivers are Ephemeroptera (21.41%) and Trichoptera (20.90%) larvae. Gammaridae (14.58%), Coleoptera (13.52%), and Mollusca (12.73%) are also very significant. Organisms belonging to the order Coleoptera and phylum Mollusca are best represented in the summer (26.41% for Coleoptera and 22.91% for Mollusca), while Trichoptera and Ephemeroptera larvae are dominant during the autumn (27.64% for Trichoptera and 24.08% for Ephemeroptera).

At investigated localities in the Temska River, values of the Shannon-Weaver diversity index range from 1.80 (at the Te3 locality) to 2.45 (at Te0). In the Visočica, the highest diversity of macrozoobenthos (2.59) is at the Vi3 locality, the lowest (1.40) at the Vi0 locality. The least diverse macrozoobenthos communities are present at the Vi0 and Te3 localities.

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САСТАВ, СТРУКТУРА И СЕЗОНСКА ДИНАМИКА МАКРОЗООБЕНТОСА У ТЕМСКОЈ РЕЦИ И ВИСОЧИЦИ

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Истраживања заједнице макрозообентоса Темске реке и Височице пбављена су у лето и јесен 2001. године на 10 локалитета. У 46 проба за квантитативну и 10 за квалитативну анализу идентификован је 101 таксон из 17 група макрозообентоса.

Највећег диверзитета је ред Trichoptera (28 врста из 9 фамилија), а најоскуднијег састава (са по једном нађеном врстом) су Nematomorpha, Hirudinea, Odonata и Megaloptera. На проучаваним локалитетима најчешће се срећу врсте *Elmis aenea* (70.00%), *Ancylus fluviatilis* и *Baetis* sp. (по 60.00%).

Истраживане локалитете Височице и Темске реке одликује међусобна сличност од 12,5 % (између локалитета Vi0 и Te0) до 70 % (између локалитета Te1 и Te2).

На истраживаним локалитетима Темске реке, опсег варирања Shannon-Weaver-овог индекса диверзитета од 1,80 (на профилу Te3) до 2,45 (на Te0). У реци височици највећа је разноврсност макрозообентоса на локалитету Vi3 - 2,59, а најмања - 1,40 (на профилу Vi0).

Најмање разноврсне заједнице макрозообентоса су на локалитетима Vi0 и Te3, где су забележене највише вредности Simpson-овог индекса (0,35 односно 0,34).