Arch. Biol. Sci., Belgrade, 55 (3-4), 121-132, 2003.

MACROALGAE AND MACROZOOBENTHOS OF THE PČINJA RIVER

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Abstract – During autumn and spring periods of 1998, 1999 and 2000, 4 taxa of macroalgae (divisions of Cyanophyta, Rhodophyta, Chrysophyta and Chlorophyta) and 78 taxa of macrozoobenthos were found in 10 localities of Pčinja River, in a part of its watercourse through Serbia. Macroalga *Cladophora glomerata* was the most numerous among representatives. The find of red alga *Lemanea* sp., which was recorded for the first time at this biotope in Serbia, is significant. From representatives of macrozoobenthos the greatest number of species was found in the groups of Epheromeroptera, Trichoptera and larvae of Diptera. Majority of species of macrozoobenthos have wide geographic distribution, and in relation to ecological factors they are mainly eurivalent forms.

UDC582.271(28)(497.11)

INTRODUCTION

Pčinja River is a relatively small watercourse, in the outermost south of Serbia (Fig. 1). Pčinja River, together with Lepenac River and Dragovištica River, belongs to the Aegean basin, which does not reach more than 2.2% of the territory of Serbia (Rakićević 1994).

Length of the watercourse of Pčinja River in the territory of Serbia is about 30 *km*, and according to ecological characteristics a part of the course through Serbia could be marked as upper and middle ritron.

On the basis of the available literature it could be concluded that until now hydrobiological investigations of Pčinja River in the territory of Serbia were not performed. In a part of the Pčinja River watercourse, flowing through Macedonia, only a colony of macrozoobenthos was investigated, and primarily it was the group of Ephemeroptera (Ikonomov 1960).

The aim of this study was to determine qualitative and quantitative composition of macroalgae and zoobenthos communities, as well as their ecology.

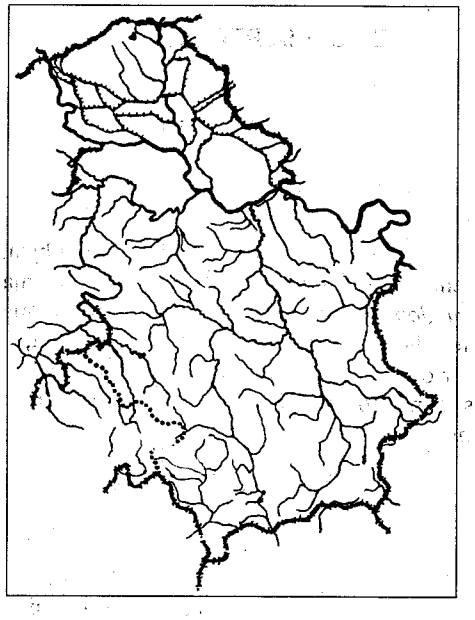
MATERIAL AND METHODS

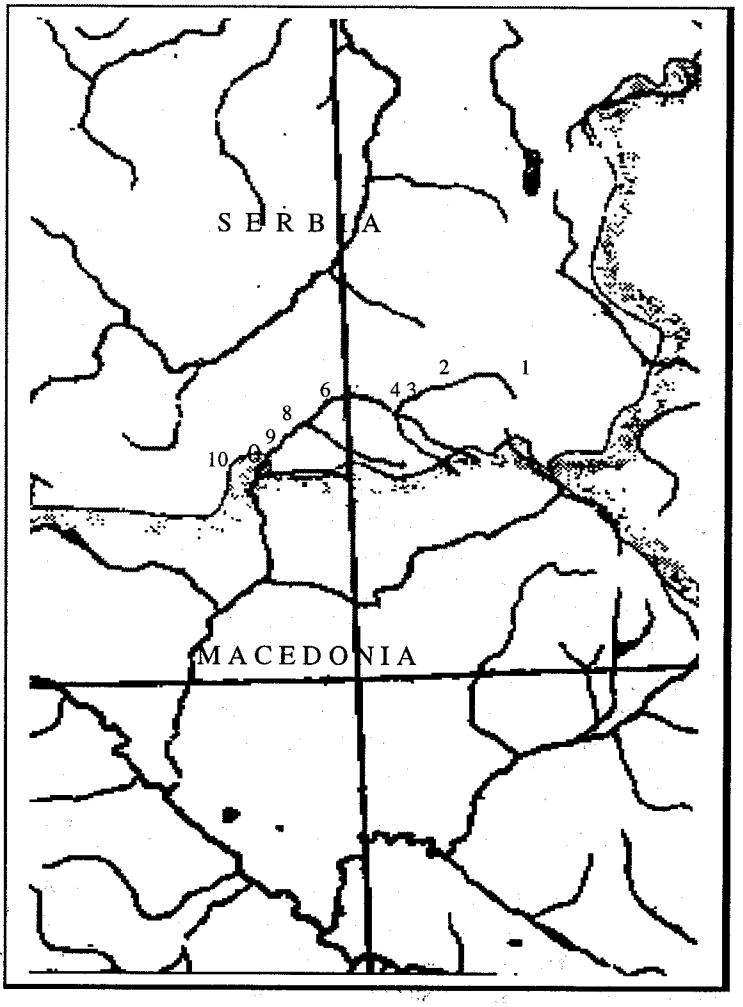
Hydrobiological studies of Pčinja River in Serbia included measurement of physical and chemical parameters, and after that, investigations of macroalgae and macrozoobenthos. Physical-chemical parameters and macrozoobenthos were examined during September, 1998 and 1999, as well as during May 2000 and macroalgae were studied during September, 1999 and May, 2000.

Mentioned investigations were performed on 10 localities: P1– source of Bele Vode, P2 – Radovnica, P3 – bridge downstream from Radovnica, P4 – Novo Selo village, P5 – Pčinja, Barbace selo village, P6 – upstream from mouth of Mala River, P7 – downstream from mouth of tributary M. River, P8 – new hotel, upstream from the accumulation, P9 – Pčinja River by the monastery Prohor Pčinjski, P10 – border area with Macedonia (Fig.1).

Physical and chemical characteristics on investigated localities were measured by field laboratory HANA INSTRUMENTS. These measurements included: temperature of water and air, pH, electroconductivity, saturation with and concentration of oxygen, concentration of biogenic salts (phosphates and nitrates) and concentration of ammonium ions. Suspended matters and values of BOD_5 were measured in hydrobiological laboratory of the Faculty of Science in Kragujevac (APHA 1985).

Macrozoobenthos samples of Pčinja River were collected by standard benthic net according to Surber, with flat side length of 30 *cm*. Samples of macroalgae were collected by scratching of substratum. Percentage cover for aggregations of algae of each taxon was estimated at 10 *m* long profile. Material of macroalgae and macrozoobenthos was fixed in 4% formalin, and the detemination was performed on the basis of dichotome keys, in hydrobiological laboratory of the Institute of Biology and Ecology, Faculty of Science in Kragujevac (Blaženčić and Cvijan 1995; Jeek *et al.* 1983; Starmach 1966, 1968, 1972, 1977).





Localities of Pčinja River

1. Source of Bele Vode (P1)
2. Radovnica (P2)
3. Bridge down from Radovnica (P3)
4. Novo Selo (P4)
5. Pčinja Barbace village (P5)
6. Upstream from mouth of Mala River (P6)
7. Down from mouth of tributary Mala River (P7)
8. New hotel, upstream from accumulation (P8)
9. Pčinja river at monastery "Prohor Pčinjski" (P9)
10. Border area with Macedonia (P10)

Fig. 1. Investigated localities of Pčinja River

RESULTS AND DISSCUSION

Abiotic characteristics

Results obtained by the measurement of physical and chemical parameters in 10 localities of Pčinja River are presented in Table 1.

Data about physical characteristics of the investigated part of Pčinja River indicates a mountain-hill watercourse, with features of upper and middle ritron. The greatest part of the investigated Pčinja River watercourse occurs at the altitude over 400 *m* a.s.l. The rate of river water flow varied from 0.7 *m*/s (localities P10 and P9) to 0.9-1.1 *m*/s (localities in the remaining watercourse). Such water flow rate predominantly originates from rocky and stony substratum in the upper watercourse and rocky and partly gritty substratum in lower parts.

Temperature of Pčinja River water is mainly moderately high, in profiles P10, P9, P8, and also P6, where it amounts about 19 ^{0}C with small variations. In the upstream localities, water temperature is lower and ranging from 11 to 16 ^{0}C in the average.

During the autumn, the water was mainly transparent to the bottom, while during the spring period it was somewhat turbid.

In all localities, concentration of oxygen was relatively high (the lowest values of about 6.8 *mg*/L were measured on localities P6 and P5, during the autumn period). All this indicates a favorable oxygen regime and good aeration of river water.

Also, a relatively low presence of organic matters contributed to a favorable oxygen regime which is supported by low BOD_5 values (Table 1). Thus, the value of this parameter varied from 0.5 (locality P1), to maximally 3.52 *mg*/L (locality P6) during the autumn period. However, value of this parameter in all localities was usually up to 2 *mg*/L, corresponding to water quality of I class (Službeni glasnik SRS No. 5/68). It can be observed that the values of this parameter were higher during the period of low water level (autumn), and in localities P10 to P6, to be decreasing in localities towards the upper watercourse.

The pH value of the water was weekly alkaline and electroconductivity was slightly decreasing from profile P10 to P1. Values of the latter parameter were relatively low (from 90 to maximally 330 $\mu S/cm$), indicating a small mineralization of the water.

Concentration of biogenic salts (N and P) was mainly low, but in localities P9, P6 and P5, increased values were recorded, indicating a more expressed production relations in these sectors of the river. Since mentioned localities are situated directly by smaller or bigger human settlements, it is also possible that a greater influx of organic matters after mineralization results in an increased content of biogenic salts, which can be the cause of more extensive eutrophication. Stated values of ammonium ion concentration did not indicate loading of water by fresh organic pollutants and only during the autumn in localities P6 and P5 its concentration reached a maximum of 3.3 *mg*/L very probably due to vicinity of rural settlements.

Suspended particles in the water of Pčinja River were found in variable amounts, but still above the values corresponding to water of I class (Službeni glasnik SRS br. 5/68). This is the most likely the consequence of floody character of Pčinja River in the investigated part of the watercourse.

Biotic characteristics

The lists of stated taxa of macroalgae and macrozoobenthos are given in Tables 2-8. Also, in the same tables, quantitative characteristics of macroalgae (cover for aggregations of algae expressed in %) are shown, together with the number of individuals of macrozoobenthos *per* 1 m^2 of the bottom surface.

On the basis of the results presented in Table 2, it is evident that during investigation of macroalgae, altogether 4 taxa from four divisions were recorded: Cyanophyta, Rhodophyta, Chrysophyta and Chlorophyta. In the running waters of mountain-hill areas, macroalgae from these divisions were largely recorded, but also those from divisions Xanthophyta and Charophyta (Simić 2002). During investigations of macroalgae in the streams and rivers of different regions in the world, green algae (Chlorophyta), as well as blue-green algae (Cyanophyta) have been separated as dominant in relation to the other groups of algae. Appearance of species of other divisions varied (Necchi *et al.* 2000). Similar situation is in the rivers of Serbia (Simić 2002).

In the localities along the investigated part of Pčinja River, *Cladophora glomerata* (L.) Ktz. was the most frequent species appearing almost in all localities (with the exception of localities P1 and P2) (Table 2). Also, it was dominant in relation to percentage cover. It had the greatest percentage cover in the localities P4, P6 and P9, where the thali of this alga covered up to 50% (Table 2). The localities P6 and P9 are downstream from settlements, and locality P4 is downstream of a fishpond. Increased percentage cover of this alga on the mentioned localities suggests its increased productivity in these parts of watercourse that receives rural waste waters. Species *C. glomerata* is geographically widespread in the entire world, especially in Europe. This species was recorded in 60% of papers reported in Europe (Sheath

Table 1. Physical and chemical characteristics of the investigated part of Pčinja River.

Localities[a]	P5			P4			P3			P2			P1		
Month/Year															
	IX	IX	V	IX	IX	V	IX	IX	V	IX	IX	V	IX	IX	V
Parameters	98	99	00	98	99	00	98	99	00	98	99	00	98	99	00
Altitude (*m*)		700			700			850			1000			1100	
Max. bed width (*m*)		12			7			5			2.5			1.5	
Max depth (*m*)		0.3			0.5			0.30			0.20			0.15	
Rocks and stones (%)		10			50			50			60			60	
Rocks (%)		40			30			30			20			20	
Gravels (%)		30			10			10			5			5	
Sand (%)		10			5			5			5			5	
Sludge (%)		5			2.5			2.5			5			5	
Detrite (%)		5			2.5			2.5			5			5	
Macrophytes (%)		0			0			0			5			10	
Velocity (m/s)	0.8	0.9	1.1	0.8	0.9	1.3	0.9	0.9	1.3	1.1	1.1	1.2	0.9	0.9	1.1
Temperat.of water(^{0}C)	19	17.1	17.6	19	18.7	16.8	17.2	16.9	14.8	16	15.6	14	14.6	13.4	11.1
Dissolved oxygen (*mg*/L)	6.80	8.09	7.86	7.77	9.78	10.04	11.4	11.78	8.73	10.45	12.45	9.05	12.4	11.68	10.23
O_2 (%)	84.4	97.9	94.0	97.2	99.3	99.8	100.3	99.9	97.4	100.2	103.5	95.4	101.5	100.0	101.8
BOD_5 (*mg*/L)	3.52	0.68	1.87	0.84	0.98	0.76	0.81	0.56	0.65	0.68	0.88	0.87	0.50	0.89	0.66
pH	8.2	8.1	7.4	7.8	7.6	7.5	7.8	7.9	8.5	7.3	7.6	8.4	6.8	6.9	7.1
Conductivity (S/*cm*)	330	140	170	160	240	210	180	210	170	130	140	140	120	120	90
Phosphate (P) (*mg*/L)	0.41	0.031	0.03	0.05	0.12	0.09	0.08	0.12	0.14	0.012	0.07	0.04	0.013	0.09	0.02
Nitrate (N) (*mg*/L)	4.8	3.1	4.1	3.7	3.5	2.5	3.1	3.0	3.1	2.1	2.5	2.4	1.7	1.9	1.4
Ammonium (*mg*/L)	3.30	0.04	0.56	0.31	0.09	0.08	0.07	0.11	0.12	0.001	0.001	0.04	0.001	0.001	0.012
Suspend. matters (*mg*/L)	4.7	1.5	14	2.7	17	18	16	12	16	3	5	8	1.2	3	6

Localities[a]	P10			P9			P8			P7			P6		
Month/Year															
	IX	IX	V	IX	IX	V	IX	IX	V	IX	IX	V	IX	IX	V
Parameters	98	99	00	98	99	00	98	99	00	98	99	00	98	99	00
Altitude (*m*)		400			420			460			540			600	
Max. bed width (*m*)		7			8			7			12			10	
Max depth (*m*)		0.5			0.4			0.4			0.4			0.4	
Rock blocks and stones (%)		30			10			30			40			50	
First size rocks (%)		40			50			40			30			30	
Gravel (%)		10			20			25			20			10	
Sand (%)		10			10			5			5			5	
Sludge (%)		5			5			5			2.5			5	
Detrite (%)		5			5			2.5			2.5			5	
Macrophytes (%)		0			0			0			0			2	
Velocity (m/s)	0.7	0.7	0.8	0.8	0.7	0.8	0.9	0.9	1.1	0.9	1.0	1.1	0.8	0.9	1.1
Temperature of water (^{0}C)	22.4	16.9	19.7	21.2	16.5	19.9	20	16.1	19.3	18	15.8	17.9	21.2	20.6	17.7
Dissolved oxygen (*mg*/L)	9.21	9.93	8.89	9.51	9.78	9.56	8.14	8.10	7.98	8.85	9.67	8.56	6.82	7.89	8.00
O_2 (%)	102.3	110.2	98.4	115.1	102.0	98.5	97.4	97.2	93.5	106.4	97.4	90.6	91.9	90.4	95.4
BOD_5 (*mg*/L)	2.73	1.89	2.32	2.49	2.45	2.31	0.60	0.89	1.23	2.05	1.78	1.56	3.29	1.89	2.56
pH	8.3	7.9	7.9	8.0	7.9	8.1	8.1	8.2	8.3	8.1	8.1	7.6	8.3	7.7	7.4
Conductivity (S/*cm*)	230	170	240	180	190	200	220	130	160	180	170	200	230	230	150
Phosphate (P) (*mg*/L)	0.015	0.09	0.07	0.09	0.12	0.13	0.02	0.05	0.23	0.08	0.07	0.04	0.14	0.17	0.16
Nitrate (N) (*mg*/L)	4.1	4.3	4.3	6.2	5.6	5.0	4.3	3.7	3.5	4.1	4.2	3.6	4.1	3.7	4.0
Ammonium (*mg*/L)	0.001	0.03	0.05	0.091	0.078	0.03	0.05	0.03	0.04	0.001	0.03	0.01	2.28	0.65	0.56
Suspend. matters (*mg*/L)	13	16	15	12	14	14	8	9	10	8	10	11	6	14	15

[a] Sampling localities codes as indicated in Material and methods

Table 2. Qualitative and quantitative composition of macroalgae of the investigated part of Pčinja River

Taxa / localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/ Year	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**	**IX 99/V00**
Cyanophyta									20/0	
Nostoc linckia										
Rodophyta										
Lemanea sp.										1/0
Chrysophyta										
Hydrurus foetidus		30/0[b]								
Chlorophyta										
Cladophora glomerata			5/0	50/40	30/10	50/50	10/10	10/10	30/20	10/20

[b]percentage cover (%)

Table 3. Qualitative and quantitative composition of Turbellaria, Mollusca, Oligochaeta, Amphipoda and Hydroacarina of the investigated part of Pčinja River

Taxa / localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**	**IX98/IX 99/V00**
Tricladida - Turbellaria										
Dugesia alpina	9/12/10	1/3/2	0	0	0	0	0	0	0	0
ind/m²	100/133/ 111	11/33/22	0	0	0	0	0	0	0	0
mean value ind/*m²*	114	22	0	0	0	0	0	0	0	0
Molusca Gastropoda										
Ancilus fluviatilis	0	0	3/1/2	0	1/2/0	0	0	0	0	0
ind/m²	0	0	33/11/22	0	11/22/0	0	0	0	0	0
mean value ind/*m²*	0	0	22	0	11	0	0	0	0	0
Oligochaeta										
Stilodrilus heringianus	0	0	0	0	0	4/12/3	0/2/3	11/2/0	0	0
Nais sp.	0	0	0	0	0	1/0/0	1/0/0	1/0/0	0	0
Ophidonais serpentina	0	0	0	0	1/0/0	2/0/0	0	0	0	0
Eiseniella tetraedra	0	0	2/1/0	1/2/1	2/0/1	0	0	0	0	0
Dero sp.	0	0	0	0	1/0/0	0	0	0	0	0
Total number	0	0	2/1/0	1/2/1	4/0/1	7/12/3	1/2/3	12/2/0	0	0
Ind/*m²*	0	0	22/11/0	11/22/11	44/0/11	77/133/ 33	11/22/33	133/22/0	0	0
Mean value ind/*m²*	0	0	11	14	17	81	22	51	0	0
Amphipoda										
Rivulogammarus balcanicus	6/5/7	7/8/9	10/12/11	12/14/12	0	0/3/5	3/4/5	2/2/7	0	0
ind/*m²*	66/55/77	77/88/ 100	111/133/1 22	133/155/1 33	0	0/33/55	33/44/55	22/22/77	0	0
mean value ind/*m²*	66	88	122	140	0	29	44	40	0	0
Hydracarina	0	0	0/1/0	1/1/2	3/2/1	4/3/2	0	2/3/8	0	0

Table 4. Qualitative and quantitative composition of Plecoptera of the investigated part of Pčinja River.

Taxa/localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX9/ V00**	**IX98/IX99/ V00**
Plecoptera										
Leuctra nigra	0	0	1/0/0	1/0/1	0/1/0	2/1/0	0/0/1	12/7/1	126/45/4	2/1/1
Leuctra inermis	24/12/9	1/12/23	0/1/0	0/1/2	0	0/1/1	0	0	0	0
Leuctra hippopus	0/2/1	23/18/6	14/16/18	0/3/12	24/12/13	0/4/5	10/12/23	3/5/2	0	0
Leuctra fusca	0	0	0	0	5/0/0	0/1/2	3/1/0	1/2/4	4/2/0	0
Leuctra bronislavi	0	0	0	1/0/0	1/0/0	2/10	0	0	0	0
Capnia sp.	0	0	0	0	1/2/5	0/1/1	5/4/4	2/1/3	2/2/1	0
Perla pallida	0	0/1/0	3/2/0	11/0/1	0	0	0	0	0	0
P. burmeiesteriana	18/12/11	1/2/13	11/12/3	2/1/1	0/1/1	0	0	0	0	0
Total number	41/15/22	25/33/12	29/20/21	15/6/14	31/15/19	4/9/9	18/17/27	18/15/10	132/49/5	2/1/1
Ind/m^2	455/166/ 244	277/366/ 133	322/222/ 233	166/66/ 144	344/166/ 211	44/100/ 100	200/188/ 300	200/166/ 111	1466/544/ 55	22/11/11
Mean value ind/m^{2+}	288	258	259	125	240	81	299	159	688	14

Table 5. Qualitative and quantitative composition of Ephemeroptera of the investigated part of Pčinja River.

Taxa/localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**
Ephemeroptera										
Baetis rhodani	0	0	0	0	8/1/12	0/0/5	2/6/4	12/15/8	4/5/7	3/12/4
B. meridionalis.	1/2/1	3/1/2	0/1/0	2/1/1	6/2/0	1/0/0	0	4/5/0	0	0
Baetis sp.	0	0	34/6/0	0	1/0/0	3/0/0	0	2/0/0	0	0
Betis sp. (nympha kozufensis) ?	1/2/0	0	0	0	0	0	0	0	0	0
B. sp (nympha vardarensis)?	0	0	0	0	0	0	0	0	0	2/1/0
B. gemellus	11/12/8	2/5/6	0	0/1/2	0	0/1/2	3/12/1	0/1/3	0/1/0	1/1/2
Ecdyonurus venosus	0	0/1/0	12/15/17	1/5/12	4/5/7	0/2/7	1/0/3	45/7/0	3/0/16	2/11/3
E. insignis	0	0	0	0/2/0	0/1/0	4/12/23	0/12/11	45/30/12	0/2/4	0
E. epeorides	15/12/2	7/2/1	2/1/3	0	0	0	0	0	0	0
Caenis macrura	0	0	0	0	0	0	0	2/0/0	1/3/1	2/6/4
Caenis sp.	0	0	0	0	2/2/0	0	0/1/0	23/2/3	0	0
Ephemerella ignita	0	0	0	0	1/0/0	1/3/2	0	5/12/6	0	0
Ephemerella sp.	5/0/2	6/0/0	5/0/0	4/0/0	2/0/0	0	1/0/0	3/0/0	0	0
Ephemerella sp.	0	15/0/2	12/1/0	2/0/0	0	0	0	1/0/0	0	0
Ephemerella spinosa (=E. Ikonomovi)	0	0	0	0	0	1/0/0	3/0/1	1/2/3	0	0
Ephemerella notata	0	0	14/10/5	0/2/1	0/1/0	0/1/2	2/2/4	1/2/2	1/0/3	2/1/3
Torleya major	0	0	0	0	0	4/0/0	0	0	0	0
Oligoneuriella rhenana	0	0	2/1/0	0/3/0	1/0/0	0/12/3	12/23/0	0/12/0	0	0
O. poecile	0	0	0	0	0	0	0	2/0/0/34	0/2/1	0
Centroptilum sp.	0	2/0/0	1/0/0	9/0/0	0	0	0	0	0	0
Ephemera helenica	0	0	1/0/0	5/5/0	0	0	0	0	0	0
Paraleptophlebia submarginata	4/1/0	2/2/5	1/3/5	0	0	0	0	3/2/0	0	0
Total number	36/27/13	35/10/16	84/38/25	23/19/16	25/12/19	14/30/44	24/44/21	149/79/63	9/12/31	10/31/16
Ind/m^2	400/300/ 144	388/111/ 177	933/422/ 277	255/211/ 177	277/133/ 211	144/333/ 488	271/488/ 233	1655/877/ 703	100/133/ 344	111/344/ 177
Mean value ind/m^2	281	255	544	214	227	321	330	1078	148	210

and Cole 1992). Appearance of this alga was observed in many rivers of Serbia (Laušević 1993; Obušković 1993; Obušković *et al.* 1994; Simić 1996; Veljić and Cvijan 1997; Obušković and Obušković 2000, 2002; Nikitović and Laušević 2000), where dominance of this species in relation to other macroalgae is expressed in eutrophic parts of rivers (Ranković *et al.* 1995, 1996; Ranković and Simić 1997; Simić 2002). Appearance of species *C. glomerata* is related to water rich in HCO_3^- originating from carbonates (Entwisle 1989).

Other species appeared only sporadically, and in small number of localities (Table 2.) From algae of Cyanophyta division, the species *N. linckia* (Roth) Born. et Thur. was found in locality P8 and P9, in September. During investigations of mountain-hill rivers of Serbia, dominance of blue-green algae species in relation to macroalgae species of other divisions was observed (Simić 2002). Dominance of algae from the class of Hormogoniophyceae, and genera *Phormidium* and *Oscillatoria* was observed, while genus *Nostoc* was very rarely recorded (Nikitović and Laušević 1999; Fojkar *et al.* 2000; Simić 1996, 2002).

Thali of *Lemanea* sp. (Rhodophyta) was recorded in locality P10, in September, with small percentage cover (about 1%)(Table 2) This is new find of genus *Lemanea* for Serbia. This is an important find, because until now this genus was represented only by *L. fluviatilis* (Linné) C. Ag., species in just a few localities in the basin of Timok River, in two localities of Mlava River, and only one locality of Studenica River (Simić 2002).

Thalus of the species *H. foetidus* (Vill.) Kirch. (Chrysophyta) was found only in locality P2 in September, in fast, cold, well aerated water, poor with organic materials (Tables 1 and 2). Ward (1994) described this species as a typical cold stenothermic species of mountain streams, and our results are in a good agreement. Up to date, this alga was recorded relatively rarely in the rivers of Serbia, in a small number of localities, in Crnovrška River, Trgoviški Timok River (Simić 1996), Vlasina River (Nikitović and Laušević 2000), Duboka River and Samokovska River in Kopaonik mountain (Simić 2002), and also, in Muržica River and smaller streams in šar mountain (Simić 1996).

During investigations of macroozoobentos in the part of Pčinja River watercourse through Serbia, althogether 80 taxa were recorded from the following animal groups: Tricladida-Turbellaria (1 species), Mollusca (1 species), Oligochaeta (5 species), Amphipoda (1 species), Plecoptera (8 species), Ephemeroptera (22 species), Trichoptera (13 species), Diptera (20 species), Odonata (1 species) and Coleoptera (8 species). Also, species from group Hydroacarina were stated, but their determination was not performed.

From the previous review, it is evident that the greatest number of species belongs to the insect genera: Ephemeroptera, Diptera and Trichoptera, while the other groups are represented by a relatively small number of species (Tables 5 - 7).

The greatest number of species found in the investigated part of Pčinja River has a wide geographical range of distribution. Only two species were recorded in the territory of Serbia, for the first time: *Oligoneuriella poecile and Ephemerella spinosa (= E. ikonomovi),* while the find of the species *Hydropsiche peristerica* and *Rhiacophila balcanica* is new for the territory of Serbia.

According to the number of species found in the investigated part of Pčinja River it is obvious that it has a relatively rich macrozoobenthos fauna. Comparing the number of species recorded in Pčinja River to rivers in Serbia with similar morphological and hydrographical properties, relative abundance of species can be discussed (Table 9) (Simić 1993; 1996, Marković 1995; Marković and Živić 2002).

Reasons for a relatively lower number of species in relation to above mentioned rivers are a relatively short period of investigations (seasonal), but to a greater extent uniformity of conditions of habitats in most of localities of the investigated watercourse. The highest number of species was recorded in localities above the Prohor Pčinjski Monastery (33 species in locality P7, to maximally 48 species in locality P3). In two localities downstream from the dam, the number of species was lower, especially in locality P10. This situation is primarily the consequence of variable hydrographical circumstances, and somewhat slower water flow rate and a higher water temperature in the average.

The highest number of Plecoptera species was found in profiles P6, P7 and P4, where water flow rate is relatively greater, while the biotope is richer with microhabitats. Also, similar situation is with the group of Ephemeroptera, while Trichoptera larvae were the most abundant with regard to the species in the upper part of the watercourse (localities P4, P2 and P1). Here, coldstenothermic species *Rhiacophila montana* and *Rhiacophila sp.* dominated. In the upper part of the watercourse, groups of Coleoptera and Diptera were the most numerous according to the number of species, and in the family of Chironomidae, coldstenothermic larvae from genera *Diamesa, Orthocladius* and *Eukiefferiela* dominated. Oligohaeta were the most numerous with regard to the number of species in localities 5 and 6, where somewhat increased eutrophication was recorded.

Table 6. Qualitative and quantitative composition of Trichoptera of the investigated part of Pčinja River.

Taxa/localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**
Trichoptera										
Hydropsiche angustipenis	0	0	0	5/0/0	4/0/1	3/10/8	31/45/23	5/12/6	6/14/7	5/12/3
H. peristerica	0	0	0	0	0	0	0	0	0/1/0	0/1/0
Hydropsiche sp. juv.	1/0/0	1/0/0	13/0/0	0	0	0	0	2/0/0	0	0
Rhiacophila vulgaris	0	0	0	0/1/0	0/1/2	3/2/3	2/3/7	2/1/0	1/5/1	0/1/3
Rhiacophila sp.	1/0/0	2/0/0	2/2/0	0	0	0	0	0	0	0
R. tristis	3/3/5	2/0/3	1/7/4	0	0	0	0	0	0	0
R. montana ?	8/2/4	0/1/2	0	0	0	0	0	0	0	0
Rhiacophila sp.(balcanica)	0	0	12/1/2	0	2/0/0	1/0/0	0	0/2/0	1/0/0	0
Glossosomma boltoni	0	0/1/0	1/3/15	0/2/4	0	0/1/0	0	1/5/6	1/1/2	0
Oligoplectrum maculatum	0	0	0	0	0/12/0	7/12/143	0/12/0	34/12/0	0	0
Sericostoma personatum	0	0	2/3/5	1/2/1	0	0/1/0	0/3/1	1/2/4	0	0
Philopotamus montanus	5/2/1	4/2/0	3/4/1	0	0	0	0	0	0	0
Allogamus auricollis	7/2/1	3/2/1	0	0	0	0	0	0	0	0
Total number	25/9/11	12/6/6	34/20/27	6/5/5	6/13/3	14/25/154	33/63/31	45/22/20	9/21/10	5/14/6
Ind/m^2	277/100/ 122	133/66/66	377/222/ 300	66/55/55	66/144/33	155/277/ 1711	366/760/ 344	500/244/ 222	100/233/ 111	55/155/66
Mean valueind/m^2	166	88	299	51	81	714	470	322	148	92

Table 7. Qualitative and quantitative composition of Diptera of the investigated part of Pčinja River

Taxa/localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**
Diptera										
Eusimulium sp.	0	22	12	2/0/3	3/2/5	0/0/2	0/2/1	0/1/1	1/2/4	3/1/12
Cricotopus sp.	0	0	2/0/0	1/3/2	0/1/0	2/3/6	3/4/7	12/2/1	0/1/2	2/4/1
Orthocladius sp.	1/12/3	12/13/10	3/6/7	3/6/9	3/4/7	2/4/2	2/2/0	2/3/8	10/16/2	2/4/8
Dicronata bimaculata	0	1/0/0	2/3/2	1/2/0	0/2/1	0/2/1	1/2/3	1/2/1	1/1/2	1/2/0
Tanypus sp.	0	0	0	1/0/0	1/0/0	0/1/2	0	0	1/0/0	0
Diamesa sp.	14/12/9	12/22/13	1/12/6	0	0	0	0	0	2/0/0	0
Brillia sp.	3/1/0	4/23/12	1/9/6	0	0/1/0	0	0/3/1	2/0/0	2/0/0	0
Simulium sp.	0	0	0	0	0/3/1	2/4/8	0/3/7	45/54/12	1/13/23	0/3/0
Limonia sp.	0	0	0	0	0	0	0	0	1/0/0	0
Orthocladius sp.	12/10/5	9/7/1	11/1/3	0	2/0/0	2/0/0	0	2/0/0	0	0
Hybomitra sp.	0	0	0	0	0	0	2/0/0	0	0	0
Psesctrocladius sp.	0	0	1/0/0	5/0/0	1/0/0	1/0/0	0	7/1/0	0	0
Orthocladius sp.	1/0/0	2/1/0	2/0/0	2/0/0	2/2/1	3/0/0	1/0/2	1/0/0	3/0/0	0
Eukiefferiela sp.	13/12/10	9/2/12	7/3/6	2/2/3	1/0/0	0	0	1/0/0	0	0
Tanypus sp.	0	0	1/0/0	1/0/0	0/1/0	0	2/2/0	1/0/1	0	0
Orthocladius sp.	0	2/0/0	1/0/0	2/0/0	1/0/0	2/0/0	1/0/0	1/0/0	0	0
Cricotopus inaequali	0/3/0	1/0/0	1/0/0	0	0	0	0	0	0	0
Diamesa sp.	25/18/6	23/27/12	2/22/13	0	0	0	0	0	0	0
Cricotopus versicololor	5/8/2	1/5/1	1/4/0	0	0	0	0	0	0	0
Tipula autumnalis	4/0/0	2/0/0	0	0	0	0	0	0	0	0
Total number	77/76/35	99/99/61	48/58/43	20/13/17	14/13/15	14/14/21	12/18/21	75/63/24	12/18/33	8/14/21
Ind/m^2	855/844/388	1100/1100/777	533/644/677	222/144/188	155/144/166	155/155/233	133/200/233	833/700/266	244/200/366	88/155/233
Mean value ind/m^2	695	959	618	184	177	181	188	599	270	158

Coldstenothermic species of Turbelaria - *Dugesia alpina* inhabited only the coldest part of the upper watercourse of the Pčinja River.

According to quantitative structure, taxa from the group of Plecoptera were the most numerous during the autumn period, and a greater density average was observed in localities of the upper watercourse. At the same time, here the settlement of this group was more varying. Species of *Leuctra nigra* was recorded in the very numerous population in locality P9, during the autumn period. Otherwise, the mentioned species has a very wide distribution, and it is eurivalent for a great number of ecological factors (Dauti 1986).

In the upper parts of the watercourse, cold stenothermic species such as *Leuctra inermis, Leuctra hipopus, Perla palida* and *Perla burmeisteriana* were more numerous. Also, investigating Plecoptera of Nerodimka River (Kosovo and Metohija), Dauti (1986) reported a similar distribution of Plecoptera.

During the present study, larvae of Ephemeroptera were the least numerous in localities downstream from dam (P10 and P9), while in the localities upstream from dam, the number and variety of Ephemeroptera was increased (Table 5).

Group of Trichoptera was less numerous in average in relation to Plecoptera and Ephemeroptera, and the highest density populations were recorded in smooth parts of the watercourse and more trophical conditions of habitats (localities P8, P7 and P6) (Table 6). On the localities in the upper watercourse, larvae of coldstenothermic species of Trichoptera such as *Rhiacophila montana, Rhiacophila balcanica, Philopotamus montanus* and *Allogamus auricollis* were more numerous.

Diptera, and especially larvae of Chironomidae, were largely dominant in benthos of the Pčinja, in all localities. Especially numerous populations were recorded in localities of the upper watercourse (localities P3, P2 and P1), and before all oligotrophic, oxyphilic and coldstenothermic species of the genera: *Eukiefferiella, Orthocladius i Diamesa* (Table 7).

During the investigations of the middle and upper watercourse of Pčinja River, the other groups of macrozoobenthos were less numerous in average. Thus, Coleoptera were more numerous in the upper parts of the watercourse, while Odonata and Oligochaeta were more significantly represented in the lower and middle part of investigated section of Pčinja River (Table 8).

The number of amphipodic crawfish *Gammarus balcanicus* was higher in the upper, colder parts of the watercourse, while this species did not occur in localities downstream from dam (Table 3).

The coldstenothermic species of Turbellaria *Dugesia alpina* was found only in the upper watercourse, at the greatest altitude in locality P1 (Table 3).

On the basis of the investigations of macrozoobenthos, some particular specificities of settlements in relation to the rivers of similar type in the Balkans (Filipović 1975) have not been observed. According to its qualitative and quantitative structure, the settlement was the most similar to those in the rivers in Macedonia, and partially to the settlement of macrozoobenthos in the rivers of Greece and Bulgaria, as well as of Southeast Serbia. A relatively greater density of some species in relation to density of settlements of these species in other areas of Serbia, *e.g.: Rhiacophila montana, Rhiacophila balcanica, Oligoneuriella poecile, Ephemerella spinosa (= E. ikonomovi), Baetis meridionalis* and *Hydropsiche peristerica* can be emphasized. Also, quoted species, *Oligoneuriella poecile* and *Ephemerella spinosa,* Ikonomov (1962) were reported as frequent and numerous in running waters of Macedonia. This fact can indicate a greater similarity of macrozoobenthos fauna of Pčinja with that in south parts of the Balkans. In addition to above mentioned species and larvae from the Baetidae family, which were impossible to determine to the level of species, according to their characteristics the species described here mostly correspond to those found in running waters of Macedonia (Ikonomov 1960). This holds true especially for the larval stages of the species *Baetis sp. nympha kozufensis,* recorded in the locality P1 and *Baetis sp. nympha vardarensis,* found in locality P10.

The quoted species of macroalgae and macrozoobenthos indicate some specificities of benthos settlement of the investigation part of Pčinja River (before all, they reflect a more prominent presence of South Balkan forms of larvae from the group of Ephemeroptera). For more details on the situation and a more reliable evaluation, more frequent sampling in the investigated localities of Pčinja River is necessary.

Acknowledgements - Data presented in this study are part of the results obtained after complex hydrobiological investigations of Pčinja River, organized by the Institute of Protection of Nature, and under leadership of Dr. Draga Janković, senior research member emeritus. We express our gratitude to the esteemed Dr. Janković and colleagues from the Institute for collaboration. This work was partly supported by the Ministry for Science, Technologies and Development of the Republic of Serbia (Contracts Nos. 1575 and 1252).

Table 8. Qualitative and quantitative composition of Coleoptera and Odonata of the investigated part of Pčinja River

Taxa/Localities	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Month/Year	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**	**IX98/IX99/ V00**
Coleoptera										
Limnius sp.	0	0	0	0	0	0	0/1/1	2/2/1	0	0
Oilimnius sp.	4/1/2	0/0/1	2/1/0	5/2/0	0	0	0	1/1/0	0	0
Elmis aenea	2/2/4	0/2/1	2/1/0	6/3/1	1/1/2	2/1/3	0	0	0	0
Stenelmis sp.	1/2/1	0/1/2	1/4/7	6/2/3	0/1/1	1/0/0	0	0	0	0
Girinus sp.	0	0	0	0	2/0/0	0/1/0	2/2/3	3/2/3	0	0
Hydraena gracilis	2/2/2	1/0/1	3/1/2	5/0/1	0	0	0	0	0	0
Limnius volckmari	2/2/4	4/2/1	5/2/1	1/02	0	0	0	0	0	0
Elmis maugeotti	1/3/7	3/2/1	1/2/3	1/1/2	0	0	0	0	0	0
Total number	11/12/18	8/7/7	13/11/13	18/6/6	3/2/3	3/2/3	2/3/4	6/5/4	0	0
Ind/m^2	133/133/ 233	88/77/77	144/122/144	200/66/66	33/20/33	33/22/33	22/33/44	66/55/44	0	0
Mean value ind/m^2	166	80	136	110	28	29	33	55	0	0
Odonata										
Onisogomphus forcipatus	0	0	0	0	1/0/0	3/0/0	3/2/0	17/12/1	0	2/3/1
ind/m^2	0	0	0	0	11/0/0	33/0/0	33/20/0	144/133/11	0	22/33/11
mean value ind/m^2	0	0	0	0	3.6	11	18	96	0	22

Table 9. Number of recorded taxa of macrozoobenthos in the investigated part of Pčinja River and other similar rivers in Serbia

River	Pčinja	Svrljiški Timok (Simić 1993)	Trgoviški Timok (Simić 1993)	Vlasina (Simić 1996)	Đetinja (Marković 1995)
Number of taxa	80	99	104	134	117

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МАКРОАЛГЕ И МАКРОЗООБЕНТОС РЕКЕ ПЧИЊЕ

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Током јесењег и пролећног периода 1998, 1999 и 2000. године на 10 локалитета реке Пчиње (на делу тока кроз Србију) константовано је 4 таксона макроалги (из раздела Cyanophyta, Rhodophyta, Chrysophyta и Chlorophyta) и 80 таксона макрозообентоса. Од представника макроалги најзаступљенија је *Cladophora glomerata*. Значајан је налаз црвене алге *Lemanea* sp. која је на овом станишту први пут констатована у Србији. Од представника макрозообентоса највећи број врста среће се у групи Ephemeroptera, Trichoptera и ларви Diptera. Већина врста макрозообентоса има широко географско распрострањење, а у односу на еколошке факторе ради се углавном о еуривалентним формама.