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SRBIJA

VII INTERNATIONAL CONFERENCE

VII MEĐUNARODNA KONFERENCIJA

WATER & FISH

CONFERENCE PROCEEDINGS
June 10 - 12, 2015

ZBORNIK RADOVA
10. - 12. Jun 2015.

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WATER QUALITY ASSESSEMENT OF MLAVA RIVER BASED ON AQUATIC MACROINVERTEBRATES

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ANALIZA KVALITETA VODE REKE MLAVE NA OSNOVU VODENIH MAKROINVERTEBRATA

Apstrakt

Cilj rada je da se predstave rezultati ispitivanja kvaliteta vode reke Mlave, zasnovani na prisutnoj zajednici vodenih makroinvertebrata. Mlava, sa dužinom toka od 78 km i površinom sliva od 1885 km², jedna je od značajnijih pritoka Dunava u Srbiji. Kao najvažniji izvori komunalnog i industrijskog zagađenja mogu se izdvojiti gradovi Požarevac (70000 stanovnika; u donjem toku) i Petrovac na Mlavi (8000 stanovnika; srednji tok), kao i Žagubica (2600 stanovnika; gornji tok). Slivno područje, naročito u srednjem delu toka, je i pod uticajem spiranja sa poljoprivrednih površina, kao i komunalnih otpadnih voda iz brojnih manjih naselja.

Negativni efekti, ovih antropogenih uticaja mogu biti još izraženiji, zbog specifične hidrologije, odnosno preovlađivanja stanja niskih voda u slivu ove reke. Uzorkovanje je izvršeno u julu 2013. godine. Kao parametri za ocenu kvaliteta vode, korišćeni su sledeći pokazatelji: Saprobni indeks (SI; Zelinka & Marvan), BMWP i ASPT skorovi, broj taksona grupa Ephemeroptera, Plecoptera and Trichoptera (EPT) i indeks diverziteta (SWI; Shannon-Wiener's indeks). Ukupno 72 taksona makroinvertebrata su identifikovana. Insekti su bili najraznovrsnija komponenta, a u okviru njih najbrojnije su bile grupe Ephemeroptera (13 taksona) i Trichoptera (11 taksona). Najveća raznovrsnost zabeležena je na lokalitetu Leskovac (33 taksona). Većina taksona je tolerantna na određeni stepen organskog zagađenja (β –mezosaprobni i α–mezosaprobni organizmi), naročito u donjem delu toka (Rašanac i Požarevac). Vrednosti SI na svim lokalitetima upućuju na veoma dobar i dobar kvalitet vode (klase I i II). Vrednosti BMWP i ASPT ukazuju na veoma dobar kvalitet vode samo na lokalitetima u srednjem i donjem delu toka (Leskovac i Požarevac), dok je u gornjem delu toka, kvalitet vode, ili loš (BMWP), ili umeren do dobar (ASPT). I preostali pokazatelj (EPT), takođe, ukazuje na bolji kvalitet vode u donjem delu toka. Na osnovu svih korišćenih pokazatelja, kvalitet vode reke Mlave u julu 2013. godine se može oceniti kao dobar (klasa II).

Ključne reči: Saprobni indeksi, biotički indeksi, kvalitet vode, reka Mlava, Srbija
Key words: Saprobic indices, biotic indices, water quality, Mlava River, Serbia

INTRODUCTION

The Mlava River is one of the larger tributaries of the Danube in Serbia. The river is 78 km long, the river basin is 1885 km², and with an average annual discharge of 13,3 m³/s (maximum in April – 28,2 m³/s, minimum in September with 3,1 m³/s) at the confluence into the Danube, near settlement of Kostolac (Gavrilović and Dukić, 2002). The Mlava springs (Vrelo Mlave) in Žagubica settlement (Kučajske Mountains) in eastern Serbia is at 325 m a.s.l..

The Thermal Power Plant „Kostolac" (TPP „Kostolac") and surface coal mine "Drmno" are situated in the lower river stretch, near its confluence with Danube, affecting the river with wastewater and coal waste. The main pollution sources of communal and industrial wastewater, are the city of Požarevac (70000 inhabitants; in the lower course), the city of Petrovac na Mlavi (8000 inhabitants; middle course) and the Žagubica settlement (2600 inhabitants; upper course). Besides, the river basin and the river itself, especially in its middle course, are affected with agricultural land washout, and communal discharge from numerous smaller settlements. Such anthropogenic pressures are particularly serious because of predominance of low waters in the basin (Manojlović et al., 2003).

The aim of the paper is to present data of the water quality assessment based on present macroinvertebrate assemblages at selected sites along the Mlava River.

MATERIALS AND METHODS

The samples were collected in the July of 2013 (low water level regime) at five sampling sites (Table 1). AQEM protocol was applied (AQEM, 2001) with semi-quantitative sampling performed using a standard benthological hand net (25x25 cm, 500 μm mesh size). Samples were preserved using 60 - 80% ethanol solution and further processed in the laboratory. Identification to the species level for the main taxonomic groups was done by using appropriate taxonomic keys.

Table 1. Location of sampling sites at the Mlava River

Locality	N lat	E long	Altitude (m.a.s.l.)
Mlava Spring	44° 11.498'	21° 47.033'	325
Gornjak Gorge	44° 15.593'	21° 33.05'	192
Leskovac	44° 21.321'	21° 26.170'	128
Rašanac	44° 27.418'	21° 20.126'	103
Požarevac (downs.)	44° 41.606'	21° 12.907'	74

For the assessment of water quality following metrics were used: Saprobic Index (SI; Zelinka & Marvan, 1961), BMWP (Biological Monitoring Working Party) Score, ASPT (Average Score Per Taxon), Number of Ephemeroptera, Plecoptera and Trichoptera (EPT)

taxa (Armitage et al., 1983) and Diversity Index by Shannon-Wiener's (SWI; 1948). Saprobiological analyses were carried out using a list of bioindicator organisms according to Moog (1995). All calculations were done in AQEM software (AQEM, 2002). Water quality assessment, was performed according to the national legislation (Official Gazette 74/2011) for Type 2 (large rivers with medium grain-size mineral substrates, except Pannonian plain rivers) and Type 3 (small and medium-sized streams, altitude up to 500 m, the dominance of large substrates) rivers.

RESULTS AND DISCUSSION

A total of 67 aquatic macroinvertebrate taxa were identified. Insects were the most diverse macroinvertebrates component, with Ephemeroptera (13 taxa) and Trichoptera (11 taxa) as the most diverse groups. The highest diversity was recorded at the site Leskovac (middle course), with 33 identified taxa, while the lowest was found at the Gornjačka Gorge with only six recorded taxa. Ephemeroptera and Mollusca, with 17% and 15% participation in the community were the most abundant groups. The majority of recorded taxa at the Mlava River, could be classified as tolerant to a certain degree of organic pollution. According to the ecological classification of taxa in relation to saprobic valence (Moog, 2002), 26.7% of identified taxa belongs to β -mesosaprobic group of organisms, while 9.8% of taxa could be described as α -mesosaprobic. Relatively high proportion of taxa (22.4%.) are sensitive to organic pollution (xeno-saprobic and oligo-saprobic species). On the other hand, species adapted to the high organic load (polisaprobic taxa) are represented with only 0.37% of the total number of taxa. For 40.7% of recorded taxa there is no data in relation to its saprobic tolerance. As it could be expected, the dominance of taxa sensitive to organic pollution (xeno-saprobic and oligo-saprobic) was recorded at the sites of the upper river stretch (the Mlava Spring and Gornjak Gorge). In the lower part of the river course (Rašanac and Požarevac), the most abundant were taxa tolerant to some degree of organic pollution (α and β -mesosaprobs) (Figure 1).

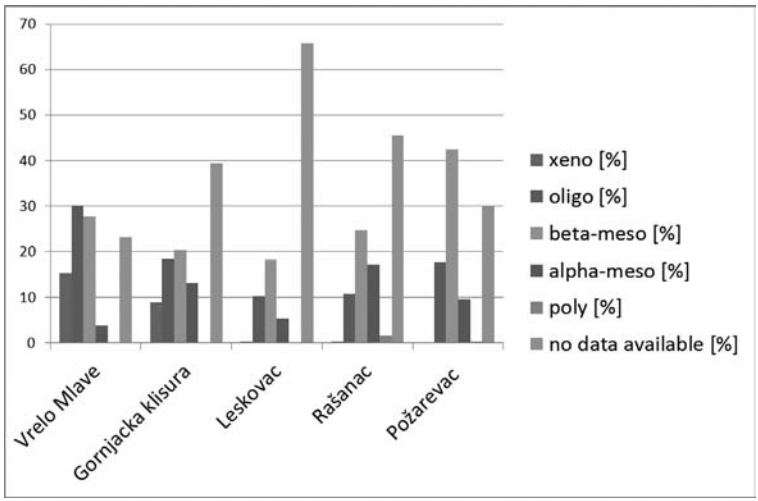

Figure 1. Percentage participation (%) of the main saprobic groups at investigated localities of the Mlava River

Saprobic index ranged from 1.304 (Gornjak Gorge) to 2.161 (Rašanac). Values of BMWP and ASPT metrics ranged from 34 (Gornjak Gorge) to 132 (Leskovac) and from 4.778 (Mlava Spring) to 7.33 (Leskovac), respectively (Table 2).

For all localities obtained values of SI indicate very good and good water quality (water quality classes I and II) (Table 2). High values of BMWP (>60) were recorded at localities situated at the lower river course (Leskovac and Požarevac), while corresponding ASPT (>6.00) were detected at the same sites and at Gornjak Gorge, as well (Table 2).

Values of BMWP and ASPT parameters indicate very good water quality at this lower river stretch (sites Leskovac and Požarevac), while the water quality, according to BMWP, in the upper stretch is poor, or moderate to good, according to ASPT (Table 2). The EPT metric, also, indicates better water quality in the lower stretch, with very good status (class I) at localities Leskovac and Rašanac, and moderate status at locality downstream of Požarevac. Contrary, at localities in the upper river course, a low number of EPT taxa indicate very poor water quality (Table 2).

According to all used biotic metrics the water quality of the Mlava River in July of year 2013 could be assessed as good (class II). Surprisingly, the water quality was better in the lower river stretch, because of higher values of BMWP, ASPT and EPT metrics.

Table 2. Values of calculated metrics and water quality classes for investigated localities

Locality	Mlava Spring		Gornjak Gorge		Leskovac		Rašanac		Požarevac (down-stream)	
Water Body	ML_7		ML_4		ML_3		ML_2		ML_1	
River Type	Type 3		Type 3		Type 2 (HMWB)		Type 2 (HMWB)		Type 2 (HMWB)	
Total No. of Taxa	12		6		33		23		16	
SI	1.507	I	1.304	I	1.825	I	2.161	II	1.864	I
BMWP	43	IV	34	IV	132	I	56	II	69	I
ASPT	4.778	III	6.8	II	7.333	I	5.091	II	6.273	I
SWI	1.953	II	1.626	II	2.866	I	2.42	I	2.49	I
EPT	2	V	4	V	15	I	12	I	3	III
Average	III		III		I		II		II	

CONCLUSIONS

During the investigation of the Mlava River 67 macroinvertebrates taxa were identified. Ephemeroptera and Trichoptera were found to be dominant groups regarding species richness. Number of taxa per sampling site varied from only 6 to 33.

Calculated saprobic index (SI) indicates very good water quality at majority of investigated localities. The resulting BMWP and ASPT scores were in compliance with the obtained SI only for the middle and the lower stretch, while for the upper course BMWP and ASPT indicated significantly lower water quality (comparing to SI). The values of used diversity index (SWI) were in accordance with SI, indicating good and very good water qu-

ality along the investigated river course. The EPT metric, on the other hand, indicates very good water quality only in the middle course, while in the upper course water quality is found to be very poor. This could be explained by the fact that springs in general are known for their lower diversity due to homogenous and oligotrophic habitat. The low quality of water at site Gornjak (low diversity) could also be consequence of above mentioned. This discordance, especially in the case of the upper river stretch (type 3, according to 74/2011), reveals need for further improvements of this evaluation system. Overall good water quality of the River Mlava in this study could be partly explained by the decreased discharge of industrial waste waters in recent years in this poorly developed part of Serbia.

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