QUALITATIVE AND QUANTITATIVE COMPOSITION OF BENTHOS COMMUNITY IN EVALUATION OF WATER QUALITY OF NERETVA RIVER AT VISICI AND ZITOMISLICI SITES

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KVALITATIVNI I KVANTITATIVNI SASTAV ZAJEDNICE BENTOSA U PROCENI KVALITETA VODE REKE NERETVE NA LOKALITETIMA VIŠIĆI I ŽITOMIŠLIĆI

Abstract

This paper is a result of the research of the river Neretva benthos at sites Zitomislici and Visici (downstream of Mostar) from 2005. to 2010. The sampling was done once a year, and 'kick-sampling' sampling was used for macrointervertebrates, while the samples for the analysis of the phytobenthos composition were scraped from the sediment with a scalpel or run-off from the sediment (standard EN 13946: 2003 Water quality – Guidance). Results of the analysis point to 62 algae taxa at site Zitomislici and 69 at site Visici. Macrointervertebrates benthos composition points on dominance of snails and sensible groups of larvae stages of the EPT insect groups. Saprobic values of both biological factors are relatively balanced and for the river Neretva, at site Zitomislici, point to oligo/betamesosaprobe level, while at site Visici they point to betamesosaprobe level of quality.

Key words: *benthos, degradation, saprobic index*

INTRODUCTION

The Neretva river originates at the top of the mountain Lebršnik, under the montain peak Grdelj, at 1227 meter above sea level, and its total length is 230 km. The largest part of the river basin is located in Bosnia and Herzegovina (90%). Neretva river flows through the valley that is surrounded on the north by the slopes of Mts. Bitovnja (1,700 m) and Vranica (2112 m), on the south side it is surrounded by the Mts. Prenj (2103 m) and Čvrsnica (2226 m), and in the west by the Mt. Bjelasnica (2062 m). The upper part of the Neretva river running parallel to the mountains, through the canyon that make Mts. Čvrsnica and Prenj. Characteristics of the mountain river, with a big drop and large mechanical strength are retained in central part of flow that is located in Mostar field. Neretva river, by the hydromorphological characteristics of the area in which it flows, is a unique complex nature of land and water. Benthic researches in the context of water quality of freshwater ecosystems dating from the period of the 20th century and are based on the composition of benthos and plancton biocenosis. Current data on the composition of these components points on the specificity and high degree of endemism (Kaćanski, 1978, Marinković-Gospodnetić, 1978, Trožić-Borovac, 2005) in this area. Last decade of intense researches in the implementation of the provisions of the WFD (2000/06/EC) were applied at the Neretva river basin. Activities are expressed in constant biomonitoring at specific sites. The aim of this paper is to display the results of biomonitoring at sites downstream from Mostar (sites Zitomislici and Visici) in period of 2005-2010.

Visici site is located at N 43° 4,58' 0,24"and E 17° 42,4' 01" at 0 meter above sea level in the Mediterranean area. Area of research is on the left side of the Neretva river bed, and on the right side of the bed the gravel factory is located. Depth at a given site ranged from 30 to 80 cm, the bottom is covered with plants up to 40%, the sediment is argyllal (Fig. 1). The shore is covered with bushes of white willow *Salix alba*.

Zitomislici site is located on the Neretva River at N 43° 20,1' 76,9''and E 17° 78' 57.2'' at 16 meters above sea level. At this site sediment are microlital mesolital on the right side of the river bed. Overgrown sediment at the site is up to 60%, and the height of the coast is up to 40 cm. Coast on the right side is with restaurants and trees (Fig. 2). On the left side of the bed coast is the height of 150 cm with a well developed tree vegetation. Water is odorless and blue-green color. The depth of the sampling point is from 15 to 40 cm, and width of the bed is 4-5 meters.

Figure 1. Visici site

Figure 2. Zitomislici site

MATERIALS AND METHODS

Research of benthos at Visici and Zitomislici sites was made in the period from 2005.-2010., and sampling was done once in the year in June. Samples for analysis of phytobenthos. Macroscopically visible representatives of some departments of algae were determined using a binocular magnifier and removed from the sample, the remaining material was viewed under high magnification of light microscope.

Diatoms were determined from the permanent preparations that were made after the chemical processing of materials by Hustedt method (1930). Taxonomic background of microflora was determined with the help of keys and manuals for identification of diatoms: Hustedt (1930), Zabelina et al. (1950), Lazar (1960) and Hindak et al. (1978). The determination was done on light microscope *Olympus CX21FS1*, by immersing the lens (magnification 100*10). It was determined the presence of all the determined forms.

Given data were processed to determine the relative abundance of each taxon (Knopp, 1954), by which the relative frequency scale has values 1, 3 and 5, then, indicator values of species are defined by Wegl (1983). Using the following model, based on the indicator values and relative frequencies of indicator species, we calculated the Saprobic index (Pantle-Buck, 1955), at the individual study sites:

$$S = \sum_{i=1}^{n}(s_i.a_i) \Big/ \sum_{i=1}^{n}(a_i)$$

where:
S – saprobic index saprobity
s_i – saprobic value of taxon
a_i – relative abundance of taxon.

Based on saprobic indices (Pantle-Buck, 1955) the degree to saprobity was assessed (Libmann, 1962). For calculation of the saprobic index of phytobentos only the species which have saprobic value were taken into account.

For the qualitative and quantitative analysis of the macroinvertebrates, sampling of zoobenthos was performed at the same sites of the river Neretva. Sampling was performed by the "kick sampling" method (according to the provisions of the Official Journal of the European Community L 327 of 22.12.2000.). At each site was collected bulk sample with 12 subsamples. At the sites where this method could not be applied sampling was carried out according to ISO 7828-1985 (E) (International Standard 7828: Water quality - Methods of biological sampling - Guidance on handnet sampling of aquatic benthic macro-invertebrates) and ISO 8265 - 1988 (E) (International Standard: Water quality - Design and use of quantitative samplers for benthic macro-invertebrates on stony substrates in shallow freshwaters). Samples were fixed at the site by 4% formaldehyde and in the laboratory was done washing and separation of the organisms in 70% alcohol. Identification of the species was made using the keys: Aubert, 1959, Bole, 1969; Consiglio, 1980, Karaman, 1998, Eliot at all., 1988, Studemann, 1992, Waringer and Graf, 1997.

In addition to biological parameters physical/chemical parameters of water that were measured by Institute of Public Health in Mostar between 2009 and 2010 years are presented too.

RESULTS

The results of analysis of selected physical and chemical parameters of water in the localities of the Neretva River (Table 1) show elevated levels of total phosphorus at the Zitomislici site for both years. Among the other parameters at the Visici site high concentration of oxygen and saturation is measured. During 2009 the BOD_5 values show that the water is in the second category of quality. Other parameters during the two years of research have been in a category under the applicable law on the categorization of water in the FBiH (Official Papers of FBiH nr.70/06).

Table 1. Values of physical and chemical parameters of water of the Neretva River at the Zitomislici and Visici sites between 2009. and 2010.

Parameter	MDK	Neretva River - Zitomislici		Neretva River - Visici	
		2009	2010	2009	2010
TºC		13,3	13,90	17,3	16,80
Cond. µS/cm	<400	297	316	329	360
pH	6,80-8,50	8	7,7	8	7,6
O_2 mg/l	≥8,00	10,86	13,23	14,24	13,16
O_2 %	90-105	113,2	128,0	148,2	135,5
BOD_5	2	1,43	1,34	2,28	1,32
P mg/l	0,100-0,250	0,120	0,160	0,380	0,404
N mg/l	1,0	0,280	0,319	0,050	0,065

The results of the analysis of qualitative and quantitative composition of benthic organisms show a high diversity of algae from the departments of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Rhodophyceae, Xanthophxceae and Conjugatophyceae. At the site Zitomislici, during six years of study, 62 species were collected. Species belonging to department of Bacillariophyceae were dominant. At the site Visici greater diversity was registered (69 taxa), and the greatest diversity was registered in samples in 2008th (47 taxa). Within phytobenthos that belongs department of Bacillariophyceae at the site Zitomislici highest abundance show species *Cocconeis pediculus* (oligo/betamesosaprobic indicator) *Cocconeis placentula* (oligo/betamesosaprobic indicator) and *Fragilaria construens* (oligo/betamesosaprobic indicator). From the other groups of phytobenthos the greatest abundance show *Nostoc sp*. and *Oscillatoria limosa*, while other types are poorly represented. The results indicate the diversity and the unequal representation of species of lower plants during the period of research, and the increased presence of indicators of organic pollution. At the site Visici (Dračevo) species *Cocconeis pediculus* and *Cocconeis placentula* had the greatest abundance. Among the other groups *Nostoc sp*. *Chamaesiphon incrustans*, *Ulotrix zonata* in 2010. and *Vaucheria sp*. in 2006. year shows large abundance.

Whithin samples of zoobenthos from the site Zitomislici 51 taxa was identified with dominance of larval stages of orders Ephemeroptera, Plecoptera and Trichoptera. The highest diversity was registered in samples from 2005. (27 taxa) and lowest in 2010. (11 taxa). Number of snails and caddisflies that are registered stand out with nine species of snails and 16 species of caddisflies. Amphipod shrimp *Gammarus fossarum* was numerous in composition of zoobenthos at the studied sites. Samples of zoobenthos at

the site Visici was noted with 35 taxa and dominance by snails (13 species). The highest diversity was registered in samples from 2007, and the largest number of individuals of macroinvertebrates were in 2005. Saprobic index values for the phytobenthos at the site Zitomislici were between 1,68 in 2006. and 1,82 in 2009 (Table 2). Values of sapribic index for macroinvertebrates ranged from 1,53 in 2010. to 1,87 in 2005. According to the values of both parameters saprobic index ranged from 1,67 in 2010 to 1,82 in 2005. and 2008. Comparison of the values of saprobic index for both biological parameters indicates the relative uniformity (Figure 3).

Table 2. Values of saprobic index for the phytobenthos and macroinvertebrates composition sampled in the Neretva River at the site Žitomislici from 2005. to 2010.

	2005		2006		2007		2008		2009		2010	
	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.
SI	1,87	1,77	1,74	1,68	1,74	1,73	1,84	1,78	1,72	1,82	1,53	1,81
Both	1,82	II	1,71	I/II	1,74	I/II	1,82	II	1,80	I/II	1,67	I/II
Cat.	βmesosaprobna		Oligo/ βmesosaprobna		Oligo/ βmesosaprobna		βmesosaprobn		Oligo/ βmesosaprobna		Oligo/ βmesosaprobna	

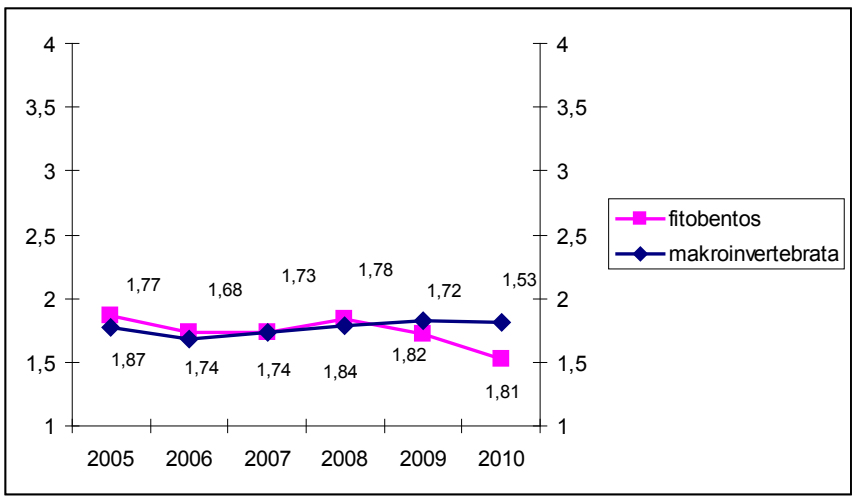

Figure 3. The ratio values of saprobic index for the composition of macroinvertebrates and phytobenthos at the site Zitomislici in the period from 2005. to 2010.

At the site Visici the values of both analyzed biological parameters show that the water is the second category of quality. The saprobic values varied from 1,84 in 2010 to 2,14 in 2009 (Table 3). Values of saprobic index for phytobenthos indicate relatively favorable conditions, while there were some significant differences in the composition of macroinvertebrates (Figure 4).

Table 3. Values of saprobic index for the phytobenthos and macroinvertebrates composition sampled in the Neretva River at the site Visici from 2005. to 2010.

	2005		2006		2007		2008		2009		2010	
	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.	Zoo.	Phyt.
SI	1,86	1,86	2,01	1,75	1,95	1,79	2,06	1,87	2,39	1,90	1,89	1,79
Both	1,86	II	1,88	II	1,87	II	1,96	II	2,14	II	1,84	II
Cat.	βmesosaprobna		βmesosaprobna		βmesosaprobna		βmesosaprobna		βmesosaprobna		βmesosaprobna	

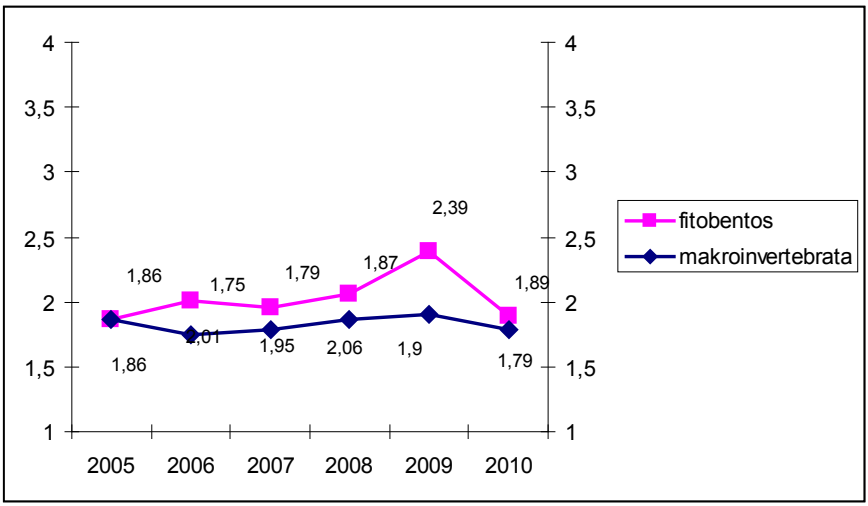

Figure 4. The ratio values of saprobic index for the composition of macroinvertebrates and phytobenthos at the site Visici in the period from 2005. to 2010.

DISCUSSION

The results of the qualitative and quantitative analysis of composition of the benthos (phytobenthos and macroinvertebrates) in the Neretva River and the Zitomislici and Visici sites, indicating a high degree of variations during the reasearch period. According to an analysis of basic chemical parameters (2009. and 2010.) the concentration of oxygen at both sites were the first category , according to BOD_5 values, waters of the Neretva River at the site Visici was in the second category 2009. (2,28 mg/l), and 2010 in the first category (1,32 mg/l). At the site Zitomislici it was registered a slight increase of total phosphorus as a result of the influx of waste water rich detergents.

During the research biological parameters showed little variations both in species composition as well as the total number of taxa identified by samples. In the past studies in Neretva River was recorded 104 species of caddisflies (Marinkovic-Gospodnetić, 1978; Trožić-Borovac, 2005), as a result of the diversity of geological and climatic characteristics of the space on which spreads the flow. Analyzed community composition illustrates overall state of watercourses, which is under direct anthropogenic influence. Variation of qualitative and qualitative composition of the benthos is caused by the ex-

istence of hydroelectric power plants upstream from the sites of investigation. During the day there is a marked variation in water levels caused by power plant operations. At the site Zitomilsići sediment shows distinct differences on the left and right side of the waterbed. On the right side of the waterbed on the coast there is a catering facility, and the left banks are covered with natural vegetation. At the site Visici on the right waterbed there is gravel factory, and the sediment on the left bank is fital and sludge (Trožić-Borovac et al., 2010).

Organisms identified in benthic communities with their presence and abundance objectively reflect the situation in the Neretva River at sites Zitomislici and Visici. By analyzing the composition of the benthos in the assessment of water quality in the area of the Vrelo Bosna and river Fojnica were obtained similar results (Trožić-Borovac, Hafner, 2005, Trožić-Borovac, Hafner, 2010). Increased use of hydropower, residential areas, unsolved treatment of the waste waters irreversibly damage aquatic ecosystems (Neumann et al., 2003a, 2003b).

CONCLUSIONS

On the basis of the analysis of quantitative and qualitative composition of river Neretva benthos, downstream of Mostar (Zitomislici and Visici) from 2005. to 2010., saprobic values point to oligo/betamesosaprobic to betamesosaprobic category of water quality. During the period of research, oscillation in abundance and species composition of benthos was expressed as a result of hydroelectric power plant work upstream of the site. The benthic organisms with their presence and abundance proved to be reliable indicators of general ecological state in the watercourse of Neretva at research sites.

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