

## BIOLOGICAL ESTIMATION OF WATER QUALITY OF THE BOVAN RESERVOIR

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**ABSTRACT.** Water samples for microbiological analyses, as well as material of the water community to be considered in the assessment of quantitative and qualitative composition of phyto- and zooplankton, and bottom fauna were taken in November 2005 at three profiles. According to presence of heterotrophic bacteria, water was characterized as I-II class KOHL, 1975). Also, four groups of phyto- and four groups of zooplankton were recorded. Relative abundance and qualitative composition values of plankton show that saprobic index ranged from 1.90-1.99 pointing  $\beta$ -mesosaprobic character of the accumulation. Saprobic index when oligochaetes were considered amounted up to 2.64 ( $\beta$ - $\alpha$ -mesosaprobic water).

### INTRODUCTION

Primary purpose of Bovan reservoir was arrestment of aqueous deposit sediment, irrigation and electricity (MILJANOVIĆ *et al.*, 2005). Nowadays, it serves for water supply of human population. Unplanned management with reservoir leads to influence input of great quantity of organic material that leads to trophic raise of reservoir.

### MATERIAL AND METHODS

In November 2005, the water samples were taken for microbiological analysis, as well as material for determination of quantitative and qualitative composition of phyto- and zooplankton and fauna from Bovan Reservoir on three profiles: Dam, Centre and End of Lake. Presence was investigated by proper breeding culture methods (KARAKAŠEVIĆ, 1967). Potential ability of water for autopurification was evaluated from ratio of oligotrophic and heterotrophic bacteria of surface waters. Samples for the qualitative composition of plankton were taken by planktonic net with meshes of 22 $\mu$ m, and for the quantitative composition Rutner's bottle ("Hydrobios") was used. Samples of fauna were taken from bottom by digger of Ekman-Berge type, with catch surface of 132cm<sup>2</sup>. Saprobity index is given on the basis of Pantle-Buck method (PANTLE & BUCK, 1955).

## RESULTS AND DISCUSION

### Microbiological analyses of water of Bovan reservoir

On the base of presence of heterotrophic bacterial populations, and according to the categorisation of KOHL (1975) water of the Bovan Reservoir belongs to the quality classes I and II (Tab. 1). Finding of relatively small number of saprophytes in water according to current rules has not greater sanitary or epidemic importance. However, in all investigated samples m/p ratio exceeds 0.3, what indicates that they are suspicious from epidemical aspect and suggests permanent monitoring of water state.

Most Probable Number–MPN varied from 220 to 3800, which, according to microbiological criteria, responds to water standards provided for water of I-II classes. In six, from nine investigated samples, *Escherichia coli* was detected. Nevertheless, it was determined regularity in its persistence on surface at all of three horizontal points, while some regularity in its vertical distribution does not exist.

*Clostridium perfringens* has not detected in any one sample.

Table 1. Microbiological analyses of water of Bovan reservoir during November 2005.

Sample	Heterotrophic bacteria			Enterobacteriaceae		<i>Clostridium perfringens</i>
	psihrophilic	mesophilic	m/p	MPN	Species	
Dam 0.5m	29	41	1.41	1500	<i>Escherichia coli</i>	-
Dam 15m	41	31	0.76	1500	<i>Aerobacter</i> sp.	-
Dam 33m	83	62	0.75	880	<i>Escherichia coli</i>	-
Centre 0.5m	89	33	0.37	3800	<i>Escherichia coli</i>	-
Centre 4m	119	50	0.42	3800	<i>Escherichia coli</i>	-
Centre 7m	99	98	0.99	1500	<i>Aerobacter</i> sp.	-
End of Lake 0.5m	68	24	0.35	880	<i>Escherichia coli</i>	-
End of Lake 1m	65	67	1.03	220	<i>Aerobacter</i> sp.	-
End of Lake 2m	76	55	0.72	500	<i>Aerobacter</i> sp.	-

### Phytoplankton of the Bovan reservoir

Qualitative analyses of phytoplankton samples showed presence of algae from divisions Bacillariophyta (54.16%), Chlorophyta (29.1%), Cyanophyta (12.5%) and Pyrrophyta (4.16%) (Tab. 2). The most species already were found in other lakes of Serbia. Appearance of species *Ceratium hirudinella* in encysted state (especially at localities Centre and End of Lake) is interesting.

When density is in question, i.e. production of phytoplankton, the greatest number can be observed in surface layers at localities Dam and Centre (depth of 0.5m), as well as at locality Beginning of Lake on all depths (0.5-2m) (Tab. 2). In surface layers, dominant is green desmidial alga *Closterium aciculare* (at locality Dam more than 80% of total production, and at locality Centre more than 50%). Number of this alga increases just at depth of 15m (at locality Dam) (Tab. 2). According to literature data, dense populations of this species occur in eutrophic water in spring and autumn (COESEL, P., 1991).

At localities End of lake and Centre, as dominant species was noted *Ceratium hirudinella* (about 50, and more % of total phytoplankton density at locality End of Lake).

The species is in encysted state. At locality Dam, only a small number of this species and almost absence of encysted forms were recorded.

Index of saprobity for localities Dam was 1.93, Centre 1.9 and End of Lake 2.15 (for the whole lake 1.99 in average, i.e.  $\beta$  mesosaprobic, which responds to II class of water).

### **Zooplankton of the Bovan reservoir**

Qualitative analysis of zooplankton composition in the Bovan reservoir established the presence of taxa from 4 groups: Protozoa, Rotatoria, Cladocera and Copepoda. Very rapid development of the zooplankton community of the Bovan reservoir indicates accelerated eutrophication and aging (OSTOJIC, 2006).

Saprobity analysis based on study of its zooplankton indicates that water of the Bovan reservoir belongs to the category of -  $\beta$  mesosaprobic water (1.90 in fall).

### **Structure of bottom fauna (macrozoobentos)**

On the base of results presented in table 3. it can be seen that during the investigation of bottom fauna in Bovan Reservoir 11 taxa of macroinvertebrates were recorded.

The greatest number of species (each three) was recorded for groups *Oligochaeta* and *Chironomidae*. According to their ecological features cited species of *Oligochaeta* and *Chironomidae* belong to group of eutrophic forms, which are forms acclimatized on great quantity of organic material in water, deficit of oxygen on the bottom, as well as possibly presence of toxic products of anaerobic decomposition of organic materials (before all ammonia). At another side, density of population of these eutrophic forms is small, and indicates that condition on the bottom in this period are unfavorable for their growth and development, but also that the remarkable quantity of organic material was consumed during hot period of the year, which suggests still favorable and stable processes of turnover of organic materials in the reservoir.

Index of saprobity on the base of macrozoobentos community for localities Dam was 2.55, for Centre 2.30 and End of Lake 3.38 (mean average for whole lake 2,64 –  $\beta$ - $\alpha$  mesosaprobic, which responds to II-III class of water). At another side, this water quality indicates also already established eutrophic status of this reservoir.

## **CONCLUSION**

By analysis of the results, it was determined that Bovan Reservoir is under great anthropogenic influence. Realizing the presented data, it can be concluded that quality of raw water of Bovan Reservoir, with existing technologic treatment of processing, can satisfy regular standard for water quality, i.e. it could be safe for human health.

Owing to insight in real state of water quality of lake, and with respect that the purpose of reservoir is water supply for human population, we suggest necessity to establish permanent monitoring with at least four seasonal aspects.



Table. 2. Continued

Phyllum / Species	Localities			Centre			End of Lake		
	0,5 m	15 m	33 m	0,5 m	4 m	7 m	0,5 m	1 m	2 m
<b>CHLOROPHYTA</b>									
<i>Closterium aciculare</i> T. West	637500	50000	84000	462000	164800	246400	153200	99200	168400
<i>Closterium acutum</i> (Bréb.)	800	3000		4000	1200	2800		4400	2400
<i>Closterium leibleinii</i> Kütz	16000	6000	10400	8400	3500	8400	2400	6800	9600
<i>Gonium pectorale</i> (O. F. M. )							400		400
<i>Pediastrum duplex</i> Meyen			400						
<i>Scenedesus quadricauda</i> (Turp) Bréb.		800	4000	400	400				
<i>Staurastrum paradoxum</i> Meyen		400			400				
<b>TOTAL</b>	<b>781500</b>	<b>82600</b>	<b>224400</b>	<b>820400</b>	<b>393500</b>	<b>497600</b>	<b>431200</b>	<b>882400</b>	<b>628000</b>

## References

- [1] COESEL, P., (1991): Ammonium dependency in *Closterium aciculare* T. West, a planktonic desmid from alkaline, eutrophic waters. *Journal of Plankton Research* **13**: 913-922.
- [2] KARAKAŠEVIĆ, B. (1967): *Priručnik standardnih metoda za mikrobiološki rutinski rad*. Medicinska knjiga Beograd, p.1595.
- [3] KOHL, W. (1975): Über die Bedeutung Bakteriologischer Untersuchungen für die Beispiel der Österreich Donau. *Arch Hydrobiol.*, **44**, 4, 392–461.
- [4] MILJANOVIĆ, B., ĐUKIĆ, N., PUJIN, V., IVANC, A., ŽIVIĆ, N., MILENKOVIĆ, P. (2005): Fizičko-hemijski i biološki parametri u oceni stanja kvaliteta vode akumulacije Bovan. *Zbornik radova Konferencije "Zaštita voda '05"*, 213-219.
- [5] OSTOJIĆ, A. (2006): Zooplankton of the Bovan reservoir. *Kragujevac J. Sci.* (in press)
- [6] PANTLE, R., BUCK, H. (1955): *Die Biologische Überwachung der Gewässer und die Darstellung der Ergebnisse*. Gas und Wasserfach **96**, 604.

Table 3. Structure of macrozoobentos of the Bovan Reservoir during November 2005.

TAXA	Locality	Dam			Centre			End of Lake		
		0.5m	15m	33m	0.5m	4m	7m	0.5m	1m	2m
<b>Mollusca</b>										
<i>Limnaea pereger</i>			2		1	1			1	1
<i>Planorbis laevis</i>									1	
<b>Oligochaeta</b>										
<i>Limnodrilus hofmeiesteri</i>		4							2	
<i>Limnodrilus udekemianus</i>					2					
<i>Aulodrilus pluriseta</i>		2								
<b>Hirudinea</b>										
<i>Erpobdella octocollata</i>			1	2		2	1	3	1	4
<b>Trichoptera</b>										
<i>Cyrnus trimaculatus</i>				1		3	1			
<b>Odonata</b>										
<i>Platycnemis pennipens</i>			2	1		4	1	3		1
<b>Diptera-Chironomidae</b>										
<i>Phytotendipes palens</i> tip. <i>brevistylis</i>					2	11				
<i>Polypedilum</i> gr. <i>nubeculosum</i>		3								
<i>Chironomus</i> gr. <i>plumosus</i>								2		
<b>Total ind/m<sup>2</sup></b>		<b>311,1</b>	<b>133,1</b>	<b>177,7</b>	<b>222,2</b>	<b>888,8</b>	<b>133,3</b>	<b>355,5</b>	<b>222,2</b>	<b>311,1</b>