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Microorganisms as water quality indicators for the Lim river

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Abstract: Microbial indicators of the water quality of the Lim River were analysed to assess its potential use for sports, recreational and agricultural activities. Testing was conducted at six locations (Plav, Andrijeva, Skakavac, Zaton, Bijelo Polje, Dobrakovo), four times (June, July, August, October) in 2005. Total counts of aerobic mesophilic bacteria, coliforms and faecal coliforms were determined. Aerobic mesophilic counts were highest in the water samples taken from the Bijelo Polje location in July, and lowest in the samples collected from the Plav location in August. The same tendency was observed for coliforms, whose total count, however, was lower in June. Faecal coliform counts were highest in the water samples collected from the Skakavac site in August and lowest in those taken from the Plav location in the same month.

Key words: bacteria, quality, water.

Introduction

Water pollution is a major cause of reduced biological diversity in aquatic ecosystems. Preservation of both water resources and the environment underlies sustainable development in the 21st century.

The European Union decision to build a coherent harmonised water protection strategy instead of allowing autonomous decision-making by EU member states is completely justified and necessary (Radulović 2005).

Given the highly specific biology of microorganisms that rarely live under optimal environmental conditions due to the susceptibility of aqueous ecosystems to the periodicity of biological processes, induced by both the seasonal dynamics of a complex of environmental factors and internal factors in biological systems, any major disturbance in the physiology (biology) of microorganisms is also an indicator of environmental disturbance (Đukić 1996, Đukić *et al.*, 1997, Crowther *et al.*, 2001).

Microbial indicators of water quality indicate the type and intensity of pollution, as well as the type of effect (permanent or temporary effect) of certain pollutants. These indicators include total coliform and faecal coliform counts (Petrović *et al.*, 1998, Fries *et al.*, 2006).

Microbial indicators of the water quality of the Lim River were analysed to assess its potential use for sports, recreational and agricultural activities.

Materials and Methods

Water samples for microbiological analysis were collected at six locations (Plav, Andrijevac, Skakavac, Zaton, Bijelo Polje, Dobrakovo), four times in 2005 (in June, July, August, October), in the Lim River Basin (Fig. 1). The samples were analysed for total counts of aerobic mesophilic bacteria (in 1 cm³ of water sample, grown on an adequate culture medium incubated for 48 hours at 37 °C) and total counts of coliform and faecal coliform bacteria (in 100 cm³ water sample, grown on Endo-agar incubated for 48 hours at 44 °C and 37 °C, respectively). The results obtained were subjected to statistical analysis.

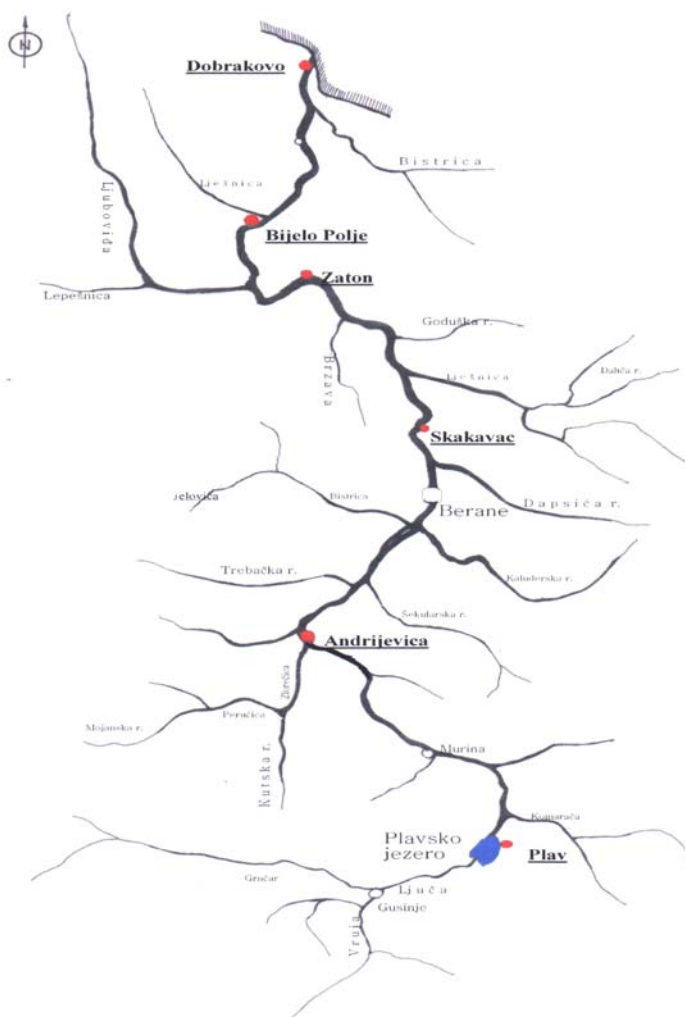


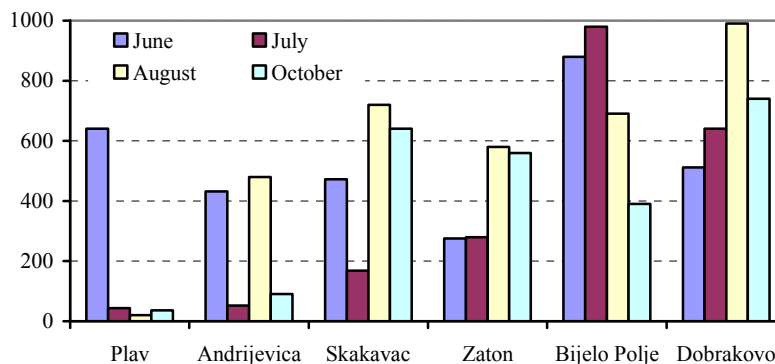
Fig. 1. Lim River research locations

Results and Discussion

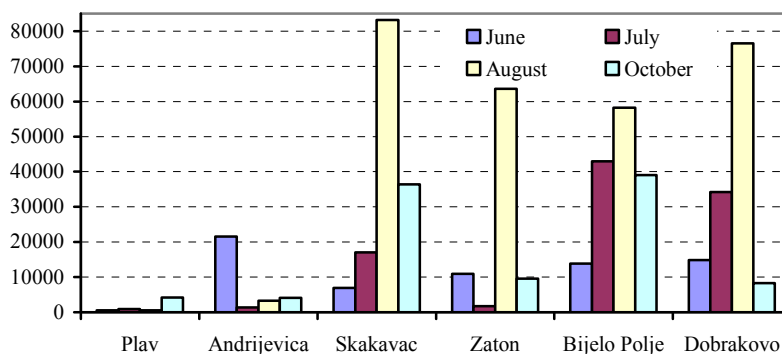
In 2005, total aerobic mesophilic counts (Graph 1) were highest in the water samples collected from the Bijelo Polje location in July - 980 cells/cm³, and lowest in those taken from the Plav location in August – 20 cells/cm³. The same tendency was observed for coliform bacteria (Graph 2), whose total counts were lower in June – 13,800 cells/cm³ and 520 cells/cm³, respectively. As regards faecal bacteria (Graph 3), their total counts were highest in the water samples

collected from the Skakavac locality – in August (14800 cells/cm³), and lowest in the Plav samples in the same month (4 cells/cm³). A higher presence of the test bacteria was measured downstream of the Plav and Andrijevica profiles, as also illustrated by their average individual values and total average values for the test period (June-October) – Tab. 1. This change is consistent with changes in some physicochemical parameters. Brković-Popović and Popović (1977) observed a high degree of correlation between log total bacterial count and organic matter content expressed through BPK₅ and KMnO₄. Under dry conditions, including extremely high temperatures, low oxygen content and maximum phyto- and zooplankton growth rate, microorganisms undergo a substantial change in composition. The increase in total counts of the test bacteria in downstream profiles, particularly the Bijelo Polje profile, as induced by industrial and municipal wastewaters was also reported by other authors (Lazić 1979, Radonjić 2007).

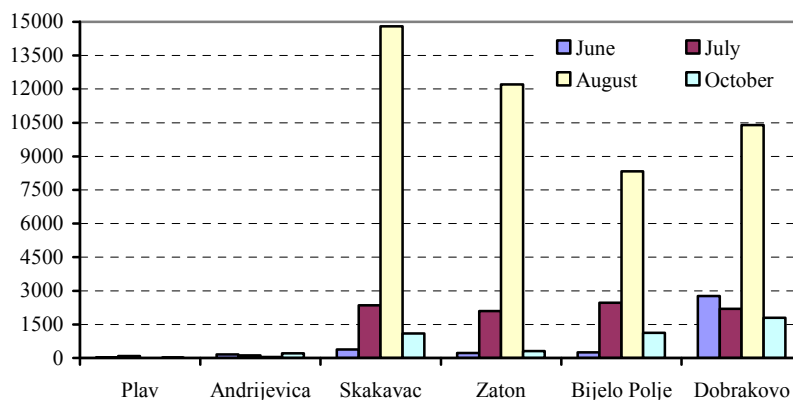
In accordance with the Regulation on Surface and Ground Water Classification and Categorisation (Official Gazette of the Republic of Montenegro, issue 2/07), based on microbial parameters, the waters of the Plav and Andrijevica profiles are grouped into Category I, class A1, S, K1 (preserved natural value), whereas the waters of the other test profiles are classified into Category II, class A2, C, K2 (altered natural value), which altogether does not have a significant effect on the final environmental status of the river and the potential use of its waters.



Graph 1. Total aerobic mesophilic bacteria counts in the Lim River during the period (in 1 cm³ water)



Graph 2. Total coliform bacteria counts in the Lim River during the test period (in 100 cm³ water)



Graph 3. Total faecal bacteria counts in the Lim River during the test period (in 100 cm³ water)

Table 1. Average counts of the test bacteria in the Lim River during June-October 2005

Location	Aerobic mesophilic bacteria (in 1 cm ³)	Total faecal bacteria (in 100 cm ³)	Total coliform bacteria (in 100 cm ³)
Plav	185.00	35.25	1550
Andrijevisa	236.50	137.00	7585
Skakavac	500.00	4657.50	35875
Zaton	424.00	3712.50	21450
Bijelo Polje	735.00	3038.25	3580
Dobrakovo	720.50	4290.00	33455

Conclusion

The present study suggests the following:

Total aerobic mesophilic counts were highest in the water samples collected from the Bijelo Polje location in July, and lowest in Plav waters sampled in August;

The same tendency was observed for total coliforms, whose count was lowest in June;

Total faecal bacteria counts were highest in the water samples from the Skakavac location in August, and lowest in Plav waters in the same month;

Based on microbial analysis, the water samples collected from the Plav and Andrijevisa locations are classified into class A1, S, K1, suggesting their environmentally preserved status, whereas the waters from the other downstream locations are grouped into class A2, C, K2, indicating a partially disturbed environmental status, which does not make them unsuitable for use for sports, recreational and agricultural purposes.

References

- Petrović, O., Gajin, S., Matavulj, M., Radnović D., Svirčev Z. (1998): Mikrobiološko ispitivanje kvaliteta površinskih voda. Institut za biologiju, PMF, Novi Sad.
- Đukić, D. (1996): Heterotrofne bakterije kao indikatori kvaliteta vode reke Zapadne Morave. *Poljoprivreda i šumarstvo*, **1-4**: 85-90.
- Đukić D., Mandić L., Simović S., Marković G. (1997): Biological assessment of the Zapadna Morava River water used for integral food production. *Acta Agriculturae Serbica*, II (4): 11-22.
- Fries J.S., Gregory W., Characklis G.W., Rachel T., Noble R.T. (2006): Attachment of Fecal Indicator Bacteria to Particles in the Neuse River Estuary, N.C.. *Envir. Engrg.* Vol. 132, **10**: 1338-1345.
- Crowther J., Kay D., Wyer M. (2001): Relationships Between Water Quality and Environmental Conditions in Coastal Recreational Waters: The Fylde Coast, United Kingdom. *Water Research* 35 (17): 4029- 4038.
- Radonjić, D (2007): Utvrđivanje kvaliteta vode na nekim lokalitetima Skadarskog jezera i rijeka Morače i Bojane. Magistarski rad, Pogorica, 2007, 66str.
- Brković-Popović, I., Popović, M. (1977): Zavisnost broja bakterija od količine organske materije pri ispitivanju kvaliteta površinskih voda. *Mikrobiologija*, Vol. 14, **2**: 117-129.
- Lazić, Lj. (1979): Izvještaj o naučno-istraživačkom radu: "Uticaj industrijskog zagađivanja na mikroorganizme u vodi i njihova uloga u prečišćavanju". Rudarski institut-prolj. Istraživanje zagađivanja površinskih i podzemnih voda i mjere zaštite.
- Radulović, S. (2005): Specijalni rezervat prirode Stari Begej – Carska Bara. U: Stevanović, V. Ed. (2005): Botanički značajna područja u Srbiji (IPA - *Important Plant Areas in Serbia*).

Službeni list Republike Crne Gore, Uredba o klasifikaciji i kategorizaciji površinskih i podzemnih voda ("Službeni list RCG,"br.2/07od 29.oktobra 2007).

MIKROORGANIZMI KAO INDIKATORI KVALITETA VODA RIJEKE LIM

- originalni naučni rad -

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Rezime

Mikrobiološka indikacija kvaliteta vode rijeke Lim vršena je radi procjene mogućnosti njene primjene za potrebe sporta, rekreacije i poljoprivrede. Proučavanja su obavljena na šest lokaliteta (Plav, Andrijevisa, Skakavac, Zaton, Bijelo Polje, Dobrakovo), četiri puta (jun, jul, avgust, oktobar) tokom 2005. godine. Određivana je ukupna brojnost aerobnih mezofilnih bakterija, ukupna brojnost koliformnih i koliformnih bakterija fekalnog porijekla. Najveća brojnost aerobnih mezofilnih bakterija utvrđena je u vodi lokaliteta Bijelo Polje u julu, a najmanja u vodi lokaliteta Plav u avgustu. Ista zakonomernost važi i za ukupnu brojnost koliformnih bakterija, s tim što ih je najmanje bilo u junu. Ukupna brojnost fekalnih bakterija bila je najveća u vodi lokaliteta Skakavac u avgustu, a najmanje u vodi lokaliteta Plav – u istom mjesecu.

Ključne reči: bakterije, kvalitet, voda.