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PERIPHYTON BIOINDICATORS IN THE SITNICA RIVER (KOSOVO)

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ABSTRACT

Periphyton consists of benthic algae that grow attached to surfaces of rocks or larger plants. The aim of the study was to investigate the periphyton of the Sitnica River between Kuzmin and Lumëmadhë (Kosovo). Altogether, 37 algal taxa were determined. *The dominating group consists of diatoms (Bacillariophyta). According to bioindicators in Sitnica water, the examined parts could be classified into quality categories III – II and III; they belong to the alpha – beta mesosaprobic and alpha-mesosaprobic levels.*

Key words: Sitnica River, periphyton, algae, Bacillariophyta, water saprobicity

PERIFITON QUALE BIOINDICATORE NEL FIUME SITNICA (KOSOVO)

SINTESI

Il perifiton è composto da alghe bentoniche che crescono attaccate a substrati rocciosi o piante più grandi. Scopo dello studio era quello di studiare il perifiton del fiume Sitnica fra le località di Kuzmin e Lumëmadhë (Kosovo). Sono stati determinati 37 taxa, fra i quali dominavano le diatomee (Bacillariophyta). In base ai bioindicatori nel fiume Sitnica, i siti campionati possono venir classificati come categorie di qualità III – II e III, il che significa che appartengono ai livelli alfa-beta-mesosaprobici ed alfa-mesosaprobici.

Parole chiave: fiume Sitnica, perifiton, alghe, Bacillariophyta, saprobia dell'acqua

INTRODUCTION

Periphyton is the mixture of algae, bacteria and fungi that grows on rocks, snags, macrophytes and man-made structures in streams (Rutherford & Cuddy, 2005). It is an important food source at the base of the food web and makes a positive contribution to the ecosystem health. However, it can adversely affect aesthetics and ecosystem health if its biomass is excessive and/or its metabolism causes very large diurnal fluctuations of pH and dissolved oxygen concentration (Rutherford & Cuddy, 2005).

Aquatic organisms can serve as indicators of the properties of the surrounding environment. They are applied mainly in the field of water quality and in its central part saprobity (Sladeckova & Sladecek, 1993). Saprobity describes the effects of the content of putrescible organic matter undergoing microbial decomposition. The common processes of eutrophication, pollution, degradation and selfpurification can be damaged or destroyed by toxic, radiochemical and some physical factors interfering with saprobity. Biological indicators enable us to distinguish individual saprobic levels by microscopical analysis (Sladeckova & Sladecek, 1993).

The Sitnica River flows through Kastriot (Obilic), where thermo power plants are located. Sitnica is the main collector for pollution, derived from the "Kosova" power plant, the town of Kastriot, and from some villages situated along or near the Sitnica River. Suspended crumbs like carbonic dust, which is released from "Kosova" power plant, silt up the bottom of the river and causes transformation not only in the structure of substrate but also in the biocenosis.

The aim of this investigation was to analyze the periphyton (phytobenthos) in the Sitnica River in order to determine the level of organic pollution in it, which develops under the influence of specific environmental factors.

MATERIAL AND METHODS

Study site

The Sitnica River is 154 km long, with its source located near the village of Vragolia (Fig. 1). The Sitnica joins the Ibri River in the northern part of Kosovo. Summers are warm and dry, while winters are cold and rainy. Annual average air temperature reaches 16.7 °C.

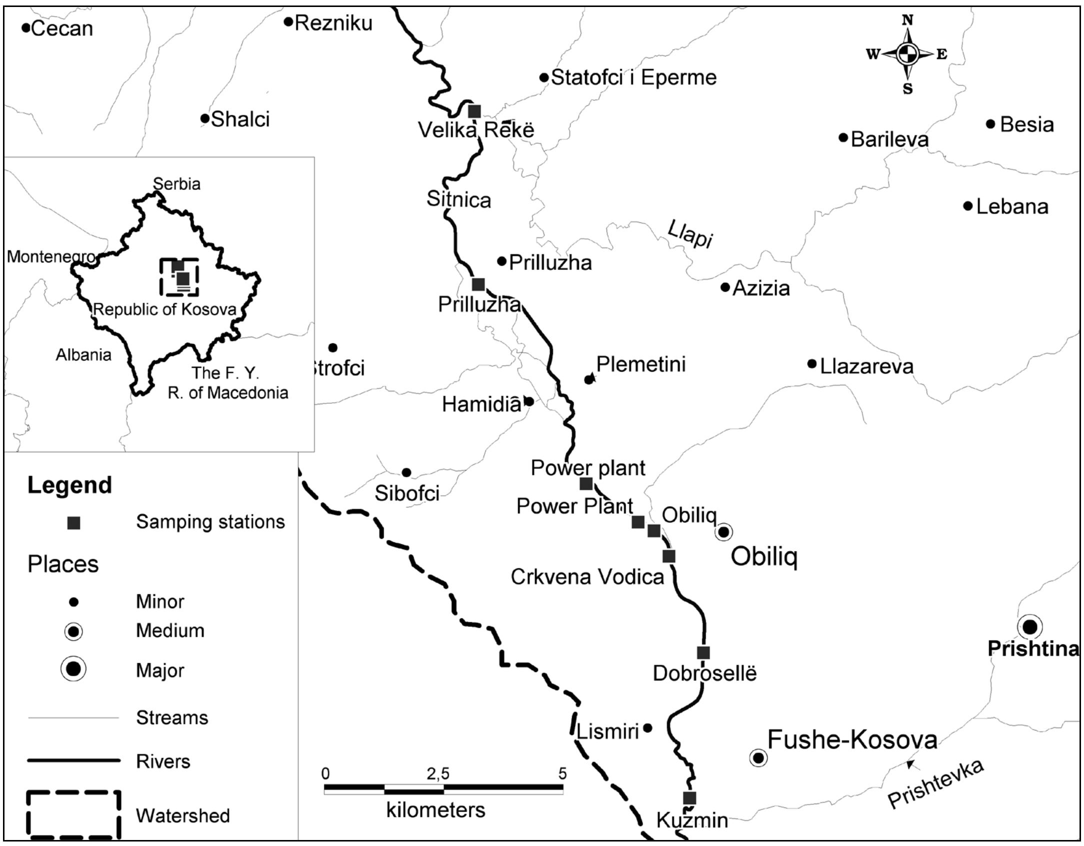

Fig. 1: The map of the Sitnica River with sampling stations.
Sl. 1: Zemljevid reke Sitnice z vzorčišči.

Average temperature during the coldest month (January) is 2.3 ºC and 23.2 ºC during the warmest month (July). The highest rainfall is recorded between October and March (data from the Meteorological and Hydrological Service of the Republic of Kosova), the lowest between June and August. The water level of the Sitnica River varies from 45–90 cm.

Sampling localities:

1 - Right bank of the Sitnica River after the village of Kuzmin, ahead of the flow of effluents from the "Kosova "power plant;

2 - Right bank of the Sitnica River, downstream of the inflow of the effluents from the "Kosova" power plant at Kastrioti;

3 - Right bank of the Sitnica River under the bridge leading to Dobro Selo;

4 - Right bank of the Sitnica River downstream of the inflow of fenolic waste waters from the "Kosova" power plant;

5 - Opposite to locality 4;

6 - Right bank of the Sitnica River at the bridge leading to Crkvene Vodice;

7 – Right bank of the Sitnica River near the village of Prilluzh;

8 - Right bank of the Sitnica River downstream of the village of Lumëmadhë, 600 m after joining the Llap River.

Experimental procedure

Material was obtained by collecting sediments and stones taken from the river bottom (10–30 cm deepness) at five stations between Kuzmin and Lumëmadhë. The collected material was fixed with 4% formaldehyde. Phytomicrobenthos was examined with Leica microscope. Determination of algae protocol followed Geitler (1932), Gollerbah *et al.* (1935), Zabelina *et al.* (1951) and Lazar (1960). The saprobity levels were determined by Sladecek (1973). Evaluation of saprobity was carried out on the basis of indicator species and standard procedure of Pantle & Buck (1955), Knopp (1954–1955) and Krammer & Lange Bertalot (1986–1991).

The relative abundance of phytoplankton was determined according to the modified sixth degree scale (Kawecka, 1980).

Cleaning of diatoms

Cleaning of diatom frustules, preparation of permanent slides and determinations follow Krammer &Lange-Bertalot (1986–1991). The analyzed water was put into a 600 ml glass beaker with 20 ml of concentrated HNO_3. The beaker was placed on a hotplate and heated until the volume of liquid was reduced to about 20 ml. From time to time, the particles of $K_2Cr_2O_7$ were added. The samples were finally rinsed with tap water, until reaching 7 pH.

RESULTS AND DISCUSSION

The greatest numbers of algal taxa were registered at localities 6 and 8 (20 species each) (Tab. 1). Locality 6, which was 1 km downstream of locality 4, was relatively unpolluted, especially in comparison with locality 4 (where toxic phenol waters are released), perhaps as the result of high level of water that diluted the waters with high concentration of phenol from the "Kosova" power plant. When the water level was low, the influence of sewage with phenol on development of phytomicrobenthos was noticed much further down the stream, as shown by some earlier investigation (Maloseja & Gecaj, 1984). 600 m above locality 8, the Llap River joins the Sitnica, which helps in the regeneration of ecological condition in the Sitnica River and improves its algal richness.

At localities 2 and 4, low numbers of algae and their dead cells were perceived (Tab. 1), since the "Kosova" power plant spills the effluent waters into the Sitnica River (Mackenthun, 1970; Burrous, 1971; Ivora *et al.*, 2000; Megharaj *et al.*, 2004).

The phytomicrobenthos conditions at locality 3 indicate weakness of toxic effect of high alkaline water (pH 12), lodges of ash and furnace after 600 m. We found some diatoms that dominate nearly in the entire part, particularly the following species: *Navicula viridula, Navicula exigua, Nitzschia aciculari, Nitzschia palea, Nitzschia paleacea, Nitzschia terminalis var. minor* and *Suirella ovata*. Their occurrence could be explained by optimal light rate and temperatures of Sitnica water in the summer, which are between 18–25 ºC and represent an optimum for the growing and development of this group of algae (Whitford, 1968; Habdija, 1970; Grin, 1971; Oksijuk, 1973; Maloseja, 1979). At nearly all localities, the presence of green flagellate alga of the genus *Euglena* was noticed, which is a sign of high organic load through the entire research area.

The use of bioindicator species is considered to have advantages over intermittent chemical analyses, as organisms integrate environmental influences. The qualitative and quantitative composition of biocenosis varied depending on organic pollution, toxic substance and locations.

The fact is that in the examined part of Sitnica, life is developing under the influence of specific ecological factors. According to the saprobiological analysis on the basis of indicator species of "lower plants" in phytobenthos, the researched part of the Sitnica river belongs to quality classes III – II, respectively alphamesosaprob and alpha – beta – mesopsaprob (Tab. 2).

Tab. 1: List of the algal taxa determined in the Sitnica River during the summer of 2005. 37 species of cyanobacteria and algae from divisions Cyanophyta (1), Euglenophyta (2) and Bacillariophyta (34) are listed.
Legend: o – oligosaprobic level; β – beta-mesosaprobic level; α – alpha-mesosaprobic level; p – polisaprobic level; 1, 2, 3, 4, 5, 7 – relative abundance. The relative abundance of the phytoplankton has been determined according to modified sixth degree scale by Kawecka (1980).
Tab. 1: Seznam taksonov alg, ugotovljenih poleti 2005 v reki Sitnici (Kosovo): 37 vrst cianobakterij in alg iz oddelkov cianofitov (1), evglenofitov (2) in bacilariofitov (34).
Legenda: o – oligosaprobna stopnja; β – beta-mezosaprobna stopnja; α – alpha-mezosaprobna stopnja; p – polisaprobna stopnja; 1, 2, 3, 4, 5, 7 – relativna abundanca. Relativna gostota fitoplanktona je bila ugotovljena v skladu z modificirano lestvico šeste stopnje (Kawecka, 1980).

Taxa	**Saprobic level**	**Locality**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
No. species per locality		29	10	11	5	20	24	24	33
Cyanophyta									
Oscailatoria putrida (Smith)	p	-	-	-	-	1	-	-	-
Bacillariophyta									
Caloneis amphisbaena (Cl.)	β-α	1	-	-	-	-	2	2	3
Cymbela austriaca (Grun)	-	2	-	-	-	-	1	1	3
C. ventricosa (Kütz)	β	1	1	-	-	-	1	-	2
C. affinis (Kütz)	o-β	1	-	-	-	-	-	-	1
Cymatoplura solea (W. Smith)	β-α	1	-	-	-	-	-	-	1
Diatoma vulgare (Bory)	β	-	-	-	-	1	1	1	1
D. elongatum var. *tenuis*	-	1	-	1	-	-	1	-	1
Gyrosigma acuminatum (Raben.)	β	1	-	-	-	1	1	1	1
G. scalproides (Cleve)	-	-	-	-	-	-	-	1	1
Gomphonema olivaceum (Kutz)	β	1	-	-	1	1	-	-	1
Hantzschia amphioxis (Grun)	α	-	-	1	-	-	1	1	-
Navicula gracilis (Ehr)	β-o	-	-	-	1	-	1	2	3
N. cryptocephala (Kütz)	α	2	-	1	-	1	-	1	3
N. exigua (Muller)	β	5	-	4	-	5	3	3	2
N. radiosa (Kütz)	o-β	1	-	-	-	-	-	-	1
N. rhynchocephala (Kütz)	α	-	1	-	-	-	-	-	1
N. viridula (Kütz)	α	3	1	5	1	2	2	5	7
Nitzschia acicularis (W. Smith)	α	3		5	-	2	2	-	3
N. gracilis (Hatzsch)	-	2	-	-	-	-	-	-	1
N. hungarica (Grun)	α	1	1	-	-	-	-	1	2
N. palea (W. Smith)	α	7	-	7	1	3	3	5	5
N. paleacea (Grun)	-	3	-	-	-	2	3	3	-
N. recta (Hatzsch)	β-α	-	-	-	-	1	-	-	1
N. stagnorum (Raben)	β	5	-	-	-	5	5	5	7
N. sigmoidea (W. Smith)	β	1	-	-	-	1	-	1	1
N. termalis var.minor (Hasle)	-	3	1	3	-	3	3	3	5
N. vermicularis (Grun)	β	2	1	-	-	3	3	3	1
Pinnularia microstauron var. *brebissoni* (Kütz)	-	3	3	-	-	1	3	3	5
Roichosphaenia curvata (Gr)	β	-	-	-	1	-	-	-	1
Stauroneis anceps (Ehr.)	-	1	-	-	-	-	1	1	1
S. smithi (Grunow)		1	-	-	-	-	1	1	3
Synedra ulna (Her)	-	1	-	1	-	-	1	1	2
Surirella ovata (Kütz)	-	2	1	1	-	1	2	1	1
S. linearis (W. Smith)		1	3	-	-	1	1	1	2
Euglenophyta									
Euglena viridis (Ehr)	β-p	5	1	5	-	5	5		5
E. sanguinea (Ehr)	β	5	-	-	-	5	3	1	-

Tab. 2: The evaluation of the saprobity of Sitnica waters. The saprobic index and saprobic level are according to the Pantle-Buck criteria (Pantle & Buck, 1955).
Tab. 2: Ocenjevanje saprobnosti vode v reki Sitnici. Saprobni indeks in saprobna stopnja sta v skladu s kriteriji Pantle-Buck (Pantle & Buck, 1955).

Parameter	Locality							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Saprobic index	2.73		2.83		2.83	2.61	2.80	2.65
Saprobic level	a-b		a		a	a-b	a	a-b
Quality class	III-II		III		III	III-II	III	III-II

The low quality classes stated on the basis of algological analyses correspond to class IV class determined by bacteriological and hydrochemical parameters for the same part of Sitnica (Plakolli *et al.*, 1988).

Aquatic communities, both plant and animal, integrate and reflect the effects of chemical and physical disturbances occurring over extended periods of time.

CONCLUSION

In the researched part of the Sitnica River, 37 algal taxa were determined. The highest number of taxa was found at localities 6 and 8 (20 species each). The dominating group consists of diatoms (Bacillariophyta). Based on the presence of species as saprobiologic bioindicator and saprobic level, the researched part of the Sitnica River could be classified into quality categories III – II and III.

PERIFITONSKI BIOINDIKATORJI V REKI SITNICI (KOSOVO)

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POVZETEK

Perifiton sestoji iz bentoških alg, ki poraščajo kamne, skale in večje rastline. Glavni namen pričujoče študije je bil preučiti perifiton reke Sitnice med krajema Kuzmin in Lumëmadhë (Kosovo). Skupaj je bilo ugotovljenih 37 taksonov. Prevladujočo skupino so oblikovale kremenaste alge (Bacillariophyta). Glede na bioindikatorje v reki Sitnici lahko njene pregledane dele vključimo v kakovostne razrede III – II in III, kar pomeni, da pripadajo alfa-beta-mezosaprobnim in alfa-mezosaprobnim stopnjam.

Ključne besede: reka Sitnica, perifiton, alge, Bacillariophyta, saprobnost vode

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