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Diatoms of wet habitats in the subalpine belt of Mt. Vranica (Bosnia and Herzegovina)

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INTRODUCTION

Different wet habitats developed around springs and brooks in the subalpine belt of Mount Vranica (Central Bosnia). Plant communities of *Montio–Cardaminetea* Br.-Bl.et Tx. ex Klika 1948*, Scheuchzerio-Caricetea fuscae* R.Tx. 1937 and *Phragmito-Magnocaricetea* Klika in Klika et Novak 1941 vegetation classes establish a very narrow syndynamic and syngenetic relation, cover relatively small areas and have high biodiversity value (glacial/relict origin). Dominant silicate substrate geologically distinguishes Mount Vranica from the other Dinaric Mountains. In previous studies no attention was paid to algae, therefore this study presents the first systematic algological study on this heterogeneous area in Bosnia and Herzegovina.

MATERIAL & METHODS

Sampling was carrying out at the following dates: July 2002 (7/02), June (6/03) and September 2003 (9/03) in the area of Prokoško Lake at an altitude from 1650 to 1850 m (East/Northeast slopes of the Nadkrstac peak). 72 Samples were taken at 24 sampling sites from 8 localities (Glavica 1, Glavica 2, Jezero 3, Zavol 4, Točilo 5, Suhoperka 6, Potok 7 and Podovi 8) by squeezing water from aquatic vegetation and taking sluggy material from the surface (fixation in 4% formaldehyde). Sampling sites are noted in a text as 1/1 (as first sampling site of first locality),1/2, 1/3, 2/1 etc.

Conductivity, pH, and temperature were measured in the field for every sampling site. For multivariate statistical analysis PRIMER 5 (Clarke & Warwick 2001) was used. Permanent slides were prepared according to Hustedt (1930). Determination was based on Hustedt (1930) and Zabelina et al. (1951). Synonomy was checked according to Krammer & Lange-Bertalot (1986, 1988, 1991a, b). Micro photographs were taken with a Zeiss microscope with DIC and an AXIOAM MRc camera at the BGBM, Berlin-Dahlem.

RESULTS

In total, 221 taxa were determined, with taxa from the genera *Eunotia*, *Navicula* s.l. and *Cymbella* s.l. being the most represented. *Caloneis silicula* (Ehrenb.) Cleve*, Cymbopleura naviculiformis* (Auersw.) Krammer*, Cymbella ventricosa* (C.Agardh) C.Agardh*, Diatoma mesodon* (Ehrenb.) Kütz., *Diploneis ovalis* (Hilse) Cleve*, Pinnularia microstauron* (Ehrenb.) Cleve*, Pinnularia viridis* (Nitzsch) Ehrenb. were present in all samples. The majority of the taxa are alkaliphilous and oligotraphentic, but there were a significant number of acidophilous taxa.

Sites directly influenced by springs (1/1, 1/2, 2/1) have lower temperature values compared to those which are not near springs or have a thick layer of mosses (2/2, 2/4, 3/2,

3/3, 4/1, 4/2). Localities Glavica 1, Glavica 2 and Jezero (1, 2 and 3) are weakly alkalic, Zavol and Podovi (4, 8) circumneutral and Točilo, Suhoperka and Potok (5, 6, 7) are weakly acidic. Due to a period without precipitation, pH value was significantly lower in September 2003 (Fig. 1). Localities on slopes with running water and inaccessible to grazing (5, 6, 7 and 8) show lower values of conductivity compared to plain localities on lower altitudes which are exposed to grazing such as 1, 2, 3 and 4 (Fig. 2)

Localities with more mineralized water and higher pH (Glavica 1, Glavica 2) have the highest number of diatom taxa. The most abundant are alkaliphilous and circumneutral taxa: *Fragilaria leptostauron* (Ehrenb.) Hust., *Fragilaria pinnata* Ehrenb., *Diatoma mesodon*, *Achnanthidium minutissimum* (Kütz.) Czarn., *Gomphonema angustatum* (Kütz.) Rabenh. More or less the same species are characteristic for localities Jezero and Zavol with *Cymbella austriaca* Grunow and *Cymbella norvegica* Grunow becoming more abundant on dryer sampling sites. Samples from localities with lower pH and conductivity (Točilo, Suhoperka and Potok) have few codominant taxa: *Brachysira brebissonii* R.Ross, *Eunotia incisa* W.Greg., *Tabellaria flocculosa* (Roth) Kütz. Taxa of the genera *Neidium* and *Eunotia* become more abundant on these localities compared to the previously described four sites. *Tetracyclus rupestris* (A.Braun) Grunow (acidophilous and aerophilous) was found only on sampling site 8/2 (Podovi, vegetation *Glycerietum fluitantis*).

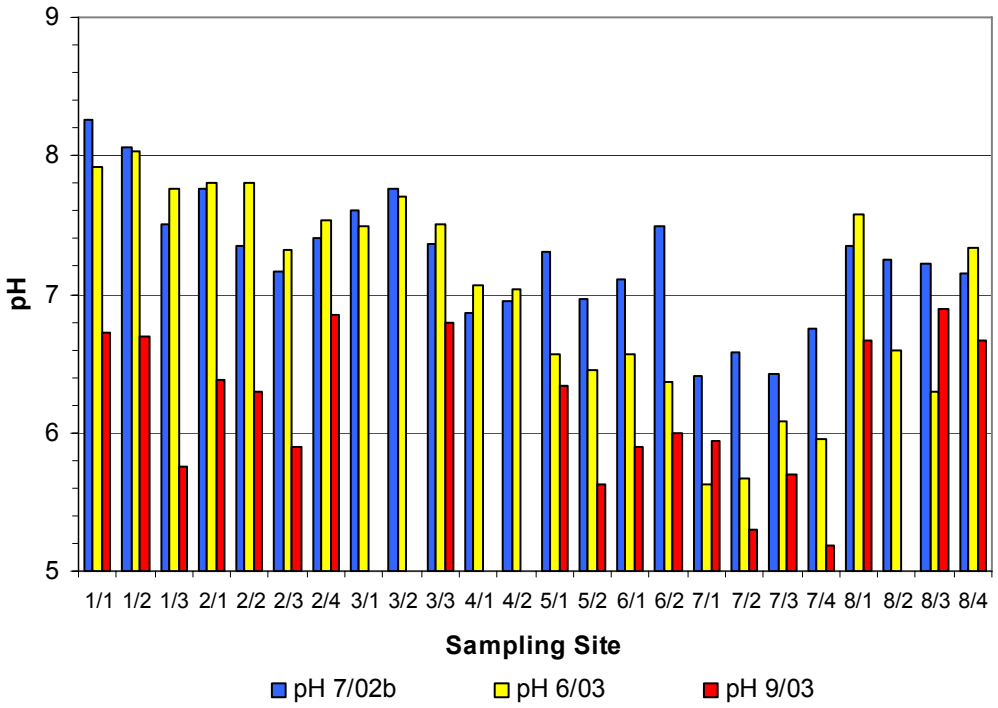

Fig. 1. Values of pH at the sampling sites.

According to the Bray-Curtis Similarity Analysis of the samples, there are two significantly different groups of localities (similarity 20 %). (Fig. 3)

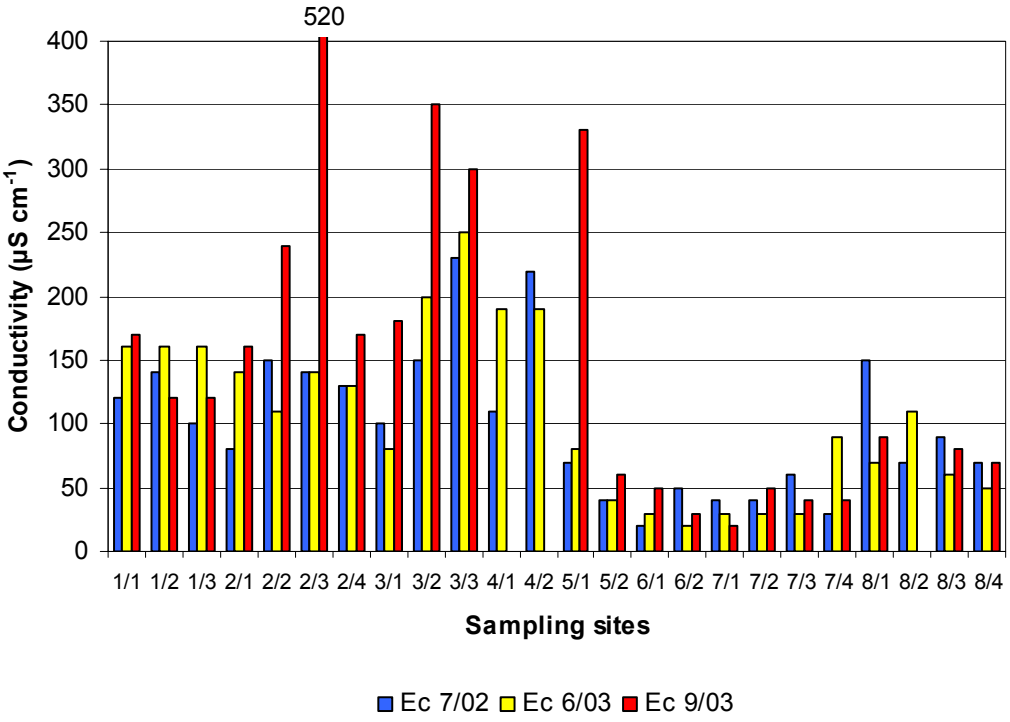

Fig. 2. Values of conductivity at the sampling sites.

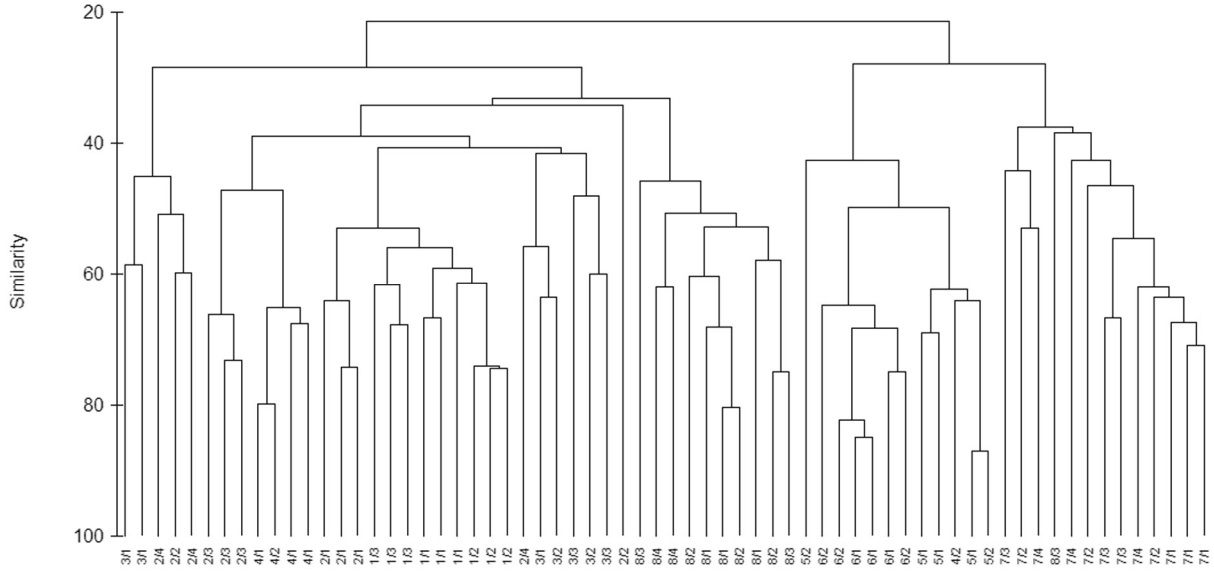

Fig 3. Dendrogram of the cluster analysis of the 72 studied samples.

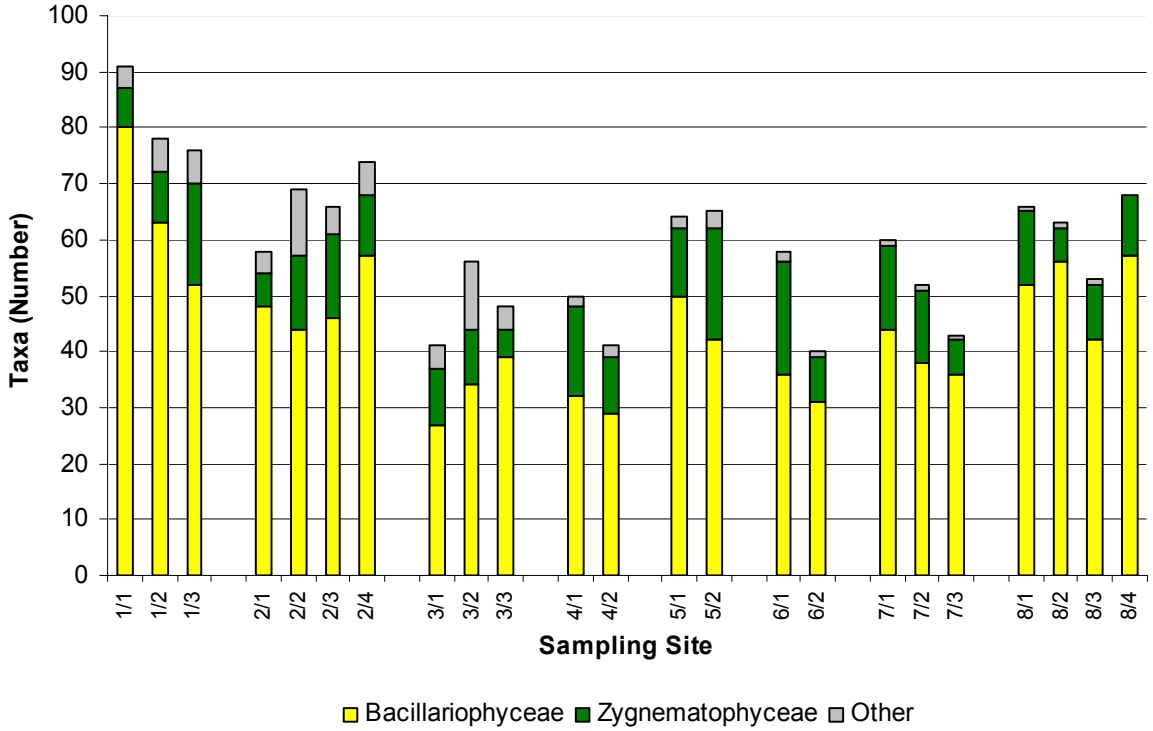

Fig. 4. Number of algal taxa in the pytobenthos of the sampling sites.

In all samples, diatoms are dominant with respect to species number (60–80 %). Weakly acidic localities show significant portion of desmids in total number of taxa (25–34 %). (Fig. 4)

DISCUSSION

Localities with lower pH and conductivity (5, 6, 7) in this study are mostly lotic, very small habitats, usually with higher inclination and can be recognized as poor fens. There are some differences within a same locality if a sampling site has specific physio-chemical and vegetational properties so we can talk about rich and poor parts of the locality. In previous studies of similar habitats, pH and conductivity were found as the most important ecological variable influencing diatom distribution (Aboal et al. 1998, Cantonati 1998, Novakova 2002, Poulíčková et al. 2003.)

Species from springs and those from fens coexist in bryophyte localities around springs with more mineralized water and higher pH (Glavica, Glavica 2) and these have the highest number of diatom taxa. Slow flow of water on these sites enables colonization of more habitats. Results of other authors can be applied on this study: diversity and species richness grow with a higher minerotrophy (Kingston 1982) and the number of diatoms grows with the amount of water/humidity in microhabitats (Poulíčková et al. 2005).

Alkaliphilous and circumneutral taxa, such as *Fragilaria leptostauron*, *Achnanthidium minutissimum*, *Diploneis ovalis*, *Cymbopleura subaequalis* (Grunow) Krammer s.l. seem to be characteristic for relatively rich minerotrophic localities around springs. *Brachysira brebissonii*, *Eunotia incisa*, *Tabellaria flocculosa* and *Frustulia crassinervia* (Bréb.) Lange-Bert. & Krammer are taxa characteristic for relatively poor minerotrophic localities with lower pH and conductivity.

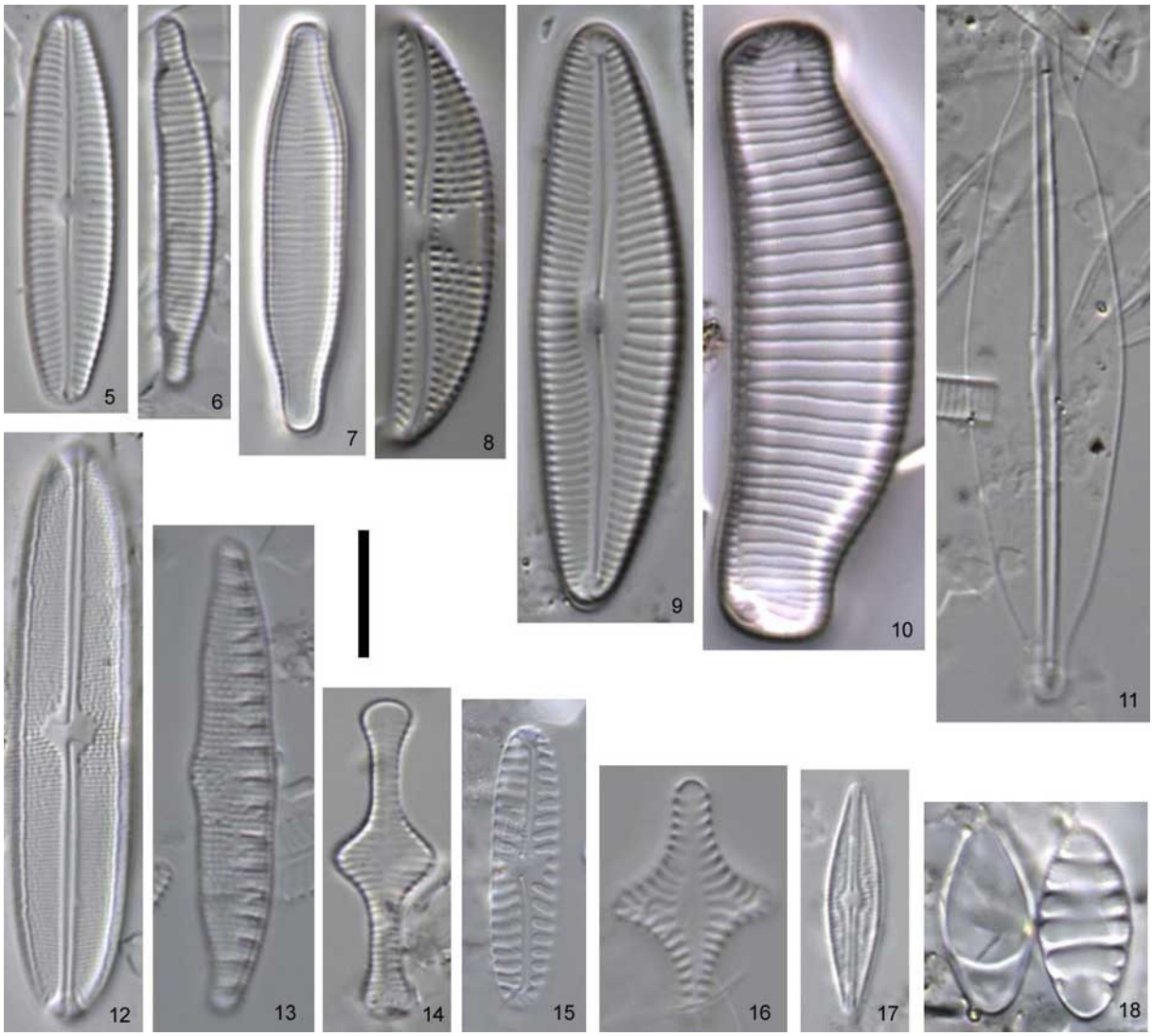

Fig. 5-18. LM micrographs. – 5. *Cymbella subaequalis.* – 6. *Eunotia incisa.* – 7. *Fragilaria virescens* Ralfs. – 8. *Amphora copulata* (Kütz.) Schoeman & R.E.M. Archibald. – 9. *Cymbella austriaca.* – 10. *Eunotia praerupta* Ehrenb. – 11. *Frustulia crassinervia.* – 12. *Neidium bisulcatum* (Lagerst.) Cleve. – 13. *Nitzschia sinuata* (W.Sm.) Grunow. – 14. *Tabellaria flocculosa.* – 15. *Pinnularia borealis* Ehrenb. – 16. *Fragilaria leptostauron.* – 17. *Brachysira brebissonii.* – 18. *Tetracyclus rupestris.*

OUTLOOK

This study is a contribution to phycological studies in Bosnia and Herzegovina which have been scarce in the past fifteen years. It also presents the first systematic phycological data on habitats around mountain springs and brooks in Bosnia and Herzegovina.

Further research will include resolving some taxonomic questions and intensifying ecological research of similar habitats in the wider area of Bosnia and Herzegovina. Results contribute to an evaluation of the algological communities and can be used for conservational purposes of these sensitive habitats.

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