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Diatoms of the Dojkinci River (Stara Planina Nature Park, Serbia)

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Abstract – Diatom samples were collected during July 2010 at 15 localities from different types of substrate (stone surfaces, sand, mud, filamentous algae and submerged mosses) from the Dojkinci River. During the research period, 124 taxa were determined within 43 genera. Among numerous common diatoms we recorded three taxa for the first time in Serbia: *Brachysira intermedia* (Øst.) Lange-Bertalot, *Chamaepinnularia mediocris* (Krass.) Lange-Bertalot and *Navicula tridentula* Krass. Also, we observed 21 taxa which are rarely recorded taxa for Serbia. The most interesting was *Diatomella balfouriana* Grevill. that was previously known only from the River Tisa near Titel. In the studied material, it was identified only in samples collected from the surface of boulders with mosses at the third locality. Their morphology, distribution and ecology are presented in this paper.

Key words: *Brachysira intermedia*, *Chamaepinnularia mediocris, Diatomella balfouriana*, diatoms, distribution, Dojkinci River, *Navicula tridentula*.

Introduction

In lotic ecosystems, diatoms are considered to be the most diverse group of algae (Round et al. 1990). Regularly found diatom species in European freshwater habitats have well known ecological preferences (Van Dam et al. 1994, Coste et al. 2009). However, data about the distribution and ecology of diatom species that are rarely observed may be incomplete (e.g. Wojtal 2001, 2004, Szabo et al. 2007, Van de Vijver and Lange-Bertalot 2009, Kelly et al. 2009, Andrejić et al. 2012). As diatoms are very important indicators of

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environmental changes and for the biological monitoring of lotic ecosystems (Stevenson and Pan 1999, Bere and Tundisi 2010), it is of great significance to describe their prevalence and ecology as well as possible.

The mountain Stara planina (Balkan mountain) belongs to the system of Balkan mountains which ranges from Black Sea in the east to Vrška Čuka in the west (Marković 1980). It is one of the floristically and faunistically most diverse parts of Serbia and the entire Balkan Peninsula. The overall richness and diversity of species, as well as the presence of numerous endemic and relic forms point to a specific genesis that influenced the remarkable diversity of this mountain, which makes it distinct from other parts of the Balkans and Europe from the biogeographical aspect.

In 1997, at the suggestion of the Institute for Nature Conservation of Serbia, the Government of the Republic of Serbia adopted the Regulation on the Protection of Stara Planina Nature Park which put Stara Planina under protection as a natural resource of great importance, and led to its being placed within the first category of protection (Mijović 2001). The total protected area of Stara Planina Nature Park is about 114.332 ha and it has a three-level system of protection (the first degree of protection is applied to an area of 3.680 ha, or 3.23%; the second degree of protection applies to an area 20.159 ha, or 17.63%, and the third degree of protection to an area 90.493 ha, or 79.14%) (Official Gazette RS, 2009). Stara Planina Nature Park is a protected natural resource nominated for the Program »Man and the Biosphere« (UNESCO-MAB) (Ivančević et al. 2007).

The Dojkinci River is formed by the merging of two streams: Belčin Dol and Tri kladenca. It is about 25 km long and ends in its confluence with the Jelovička River. This way the Visočica River is formed which belongs to the Black Sea basin. The substrate through the longest part of the Dojkinci River runs is red fine-grained sandstone, whose color comes from the large amount of Fe_2O_3 and is extremely rich in quartz sand (Andjelković 1958), as opposed to most of rivers in Serbia, which have their beds made dominantly of carbonate (Marković 1980). These siliceous, low-conductivity mountain habitats are currently being shown to host benthic diatom communities of high species richness (Cantonati and Lange-Bertalot 2011, Cantonati et al. 2011, Liu et al. 2011).

The morphology, distribution and ecology of algal flora of Stara planina is poorly known (Simić 1995, 1996, 2002), especially for diatoms from Dojkinci River (Obušković 1993, Obušković et al. 1994).

In this paper, we present the results of a floristic study of the diatoms of the Dojkinci River (Stara planina, Serbia). Among numerous common diatoms three new taxa for Serbia were identified, as well as 21 taxa that are rarely recorded in Serbia.

Materials and methods

During July of 2010 the material which is used in the present study was collected from 15 localities along the Dojkinci River. From the gravel surface and boulders epilithic samples were scraped by scalpel blade and brush. Epipsamic samples were collected from the surface of sand and mud substrates, while the epiphyton was taken from mosses *Plagiomnium* sp. and *Philonotis* sp. and liverwort *Marchantia polymorpha* Line subsp. *polymorpha*. Samples were immediately fixed with formaldehyde to a final concentration of 4%. In order to remove organic matter, field samples were treated with concentrated acid (H_2SO_4) and

$KMnO_4$, and then washed several times with distilled water in a laboratory. Afterwards the material was airdried on cover glasses and mounted in Naphrax®. Permanent slides, prepared material and aliquots of the samples were deposited in the diatom collection of the University of Belgrade, Faculty of Biology. Light microscope observations and micrographs were made using a Zeiss AxioImagerM.1 microscope with DIC optics and AxioVision4.8 software. Conductivity, oxygen, pH and water temperature were measured with a Lovibond Multimeter WTW 340i at each sampling site. Ammonium ions, nitrates, phosphates, alkalinity and total hardness were measured using a Lovibond MultiDirect Photometer.

Terminology of valve morphology is based according Barber and Haworth (1981) and Round et al. (1990). The abundance was estimated by counting 400 valves of each taxa present on a slide.

Sampling sites along with levels of protection in Stara Planina Nature Park are presented on the map (Fig. 1).

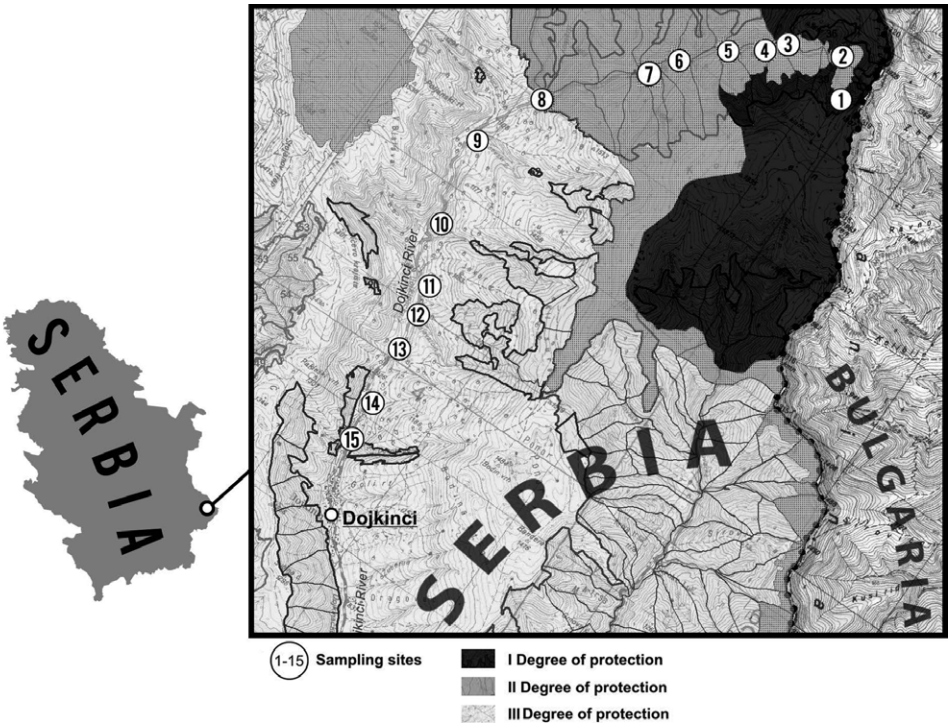

Fig. 1. Sampling sites along the Dojkinci River with levels of protection in Stara Planina Nature Park.

Results

A total of 125 diatom taxa (Tab. 1) belonging to 43 genera were determined in material from the Dojkinci River. The genus with the highest number of species was *Eunotia* Ehrenberg with 18 taxa. *Eunotia paludosa* was the dominant taxon with an abundance of as much

Tab. 1. Diatom species list from Dojkinci River.

Achnanthes coarctata (Brébisson) Grunow	*Frustulia saxonica* Rabenhorst
Achnanthidium exile (Kützing) Heiberg	*Frustulia vulgaris* (Thwaites) De Toni
Achnanthidium lineare W. Smith	*Geissleria decussis* (Østrup) Lange-Bertalot & Metzeltin
Achnanthidium microcephalum Kützing	*Gomphonema acuminatum* Ehrenberg
Achnanthidium minutissimum (Kützing) Czarnecki	*Gomphonema exilissimum* (Grunow) Lange-Bertalot & E. Reichardt
Amphora sp.	*Gomphonema gracile* Ehrenberg
Aulacoseira sp.	*Gomphonema micropus* Kützing
Aulacoseira granulata (Ehrenberg) Simonsen	*Gomphonema parvulius* (L.-B. & Reichardt) Lange-Bertalot & Reichardt
Brachysira brebissonii R. Ross	*Gomphonema parvulum* (Kützing) Kützing
Brachysira intermedia (Østrup) Lange-Bertalot	*Gomphonema pumilum* (Grunow) E. Reichardt & Lange-Bertalot
Caloneis silicula (Ehrenberg) Cleve	*Hantzschia amphioxys* (Ehrenberg) Grunow
Chamaepinnularia mediocris (Krasske) Lange-Bertalot & Krammer	*Humidophila contenta* (Grunow) Lowe et al.
Cocconeis pediculus Ehrenberg	*Humidophila ingeae* (Van de Vijver) Lowe et al.
Cocconeis placentula Ehrenberg	*Humidophila perpusilla* (Grunow) Lowe et al.
Cocconeis placentula var. *lineata* (Ehrenberg) van Heurck	*Luticola mutica* (Kützing) D.G. Mann
Cocconeis placentula var. *pseudolineata* Geitler	*Melosira varians* C. Agardh
Cymatopleura solea (Brébisson) W. Smith	*Meridion circulare* (Greville) C. Agardh
Cymbella compacta Østrup	*Navicula* sp.
Cymbella parva (W. Smith) Kirchner	*Navicula angusta* Grunow
Cymbella perparva Krammer	*Navicula cryptocephala* Kützing
Cymbopleura anglica (Lagerstedt) Krammer	*Navicula cryptotenella* Lange-Bertalot
Cymbopleura naviculiformis (Auerswald ex Heiberg) Krammer	*Navicula exilis* Kützing
Diatoma ehrenbergii Kützing	*Navicula gregaria* Donkin
Diatoma ehrenbergii f. *capitulata* (Grunow) Lange-Bertalot	*Navicula lanceolata* Ehrenberg
Diatoma hyemalis (Roth) Heiberg	*Navicula recens* (Lange-Bertalot) Lange-Bertalot
Diatoma mesodon (Ehrenberg) Kützing	*Navicula reichardtiana* Lange-Bertalot
Diatoma moniliformis (Kützing) D.M. Williams	*Navicula tridentula* Krasske
Diatomella balfouriana Greville	*Navicula tripunctata* (O. F. Müller) Bory de Saint-Vincent
Diploneis sp.	*Neidium* sp.
Encyonema lunatum (W. Smith) Van Heurck	*Neidium subampliatum* (Grunow) Flower
Encyonema silesiacum (Bleisch) D.G. Mann	*Nitzschia* sp.
Encyonema ventricosum (C. Agardh) Grunow	*Nitzschia acicularis* (Kützing) W. Smith
Encyonopsis falaisensis (Grunow) Krammer	*Nitzschia alpina* Hustedt

Encyonopsis microcephala (Grunow) Krammer
Epithemia adnata (Kützing) Brébisson
Eunotia sp.
Eunotia bilunaris (Ehrenberg) Schaarschmidt
Eunotia boreoalpina Lange-Bertalot & Nörpel-Schempp
Eunotia circumborealis Lange-Bertalot & Norpel
Eunotia diodon Ehrenberg
Eunotia exigua (Brébisson ex Kützing) Rabenhorst
Eunotia fallax A. Cleve
Eunotia flexuosa (Brébisson ex Kützing) Kützing
Eunotia groenlandica (Grunow) Nörpel-Schempp & Lange-Bertalot
Eunotia minor (Kützing) Grunow
Eunotia nymanniana Grunow
Eunotia paludosa Grunow
Eunotia paratridentula Lange-Bertalot & Kulikovskiy
Eunotia praerupta Ehrenberg
Eunotia rhomboidea Hustedt
Eunotia subherkiniensis Lange-Bertalot
Eunotia tetraodon Ehrenberg
Eunotia trinacria Krasske
Eunotia valida Hustedt
Fallacia subhamulata (Grunow) D. G. Mann
Fragilaria arcus (Ehrenberg) Cleve
Fragilaria biceps (Kützing) Lange-Bertalot
Fragilaria capucina Desmazières
Fragilaria capucina var. *gracilis* (Oestrup) Hustedt
Fragilaria ulna (Nitzsch) Lange-Bertalot
Fragilaria vaucheriae (Kützing) J. B. Petersen
Fragilariforma virescens (Ralfs) D. M. Williams & Round
Frustulia crassinervia (Brébisson) Lange-Bertalot & *Krammer*
Nitzschia fonticola (Grunow) Grunow
Nitzschia linearis W. Smith
Nitzschia palea (Kützing) W. Smith
Nitzschia recta Hantzsch ex Rabenhorst
Orthoseira sp.
Pinnularia sp.
Pinnularia acoricola Hustedt
Pinnularia borealis Ehrenberg
Pinnularia borealis var. *rectangularis* Carlson
Pinnularia microstauron var. *nonfasciata* Krammer
Pinnularia subcapitata var. *subrostrata* Krammer
Pinnularia viridiformis Krammer
Placoneis sp.
Planothidium sp.
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot
Planothidium lanceolatum (Brébisson ex Kützing) Bukhtiyarova
Psammothidium sp
Psammothidium subatomoides (Hustedt) L. Bukhtiyarova & Round
Reimeria sinuata (Gregory) Kociolek & Stoermer
Rhoicosphenia abbreviata (C. Agardh) Lange-Bertalot
Stauroneis anceps Ehrenberg
Stauroneis gracilis Ehrenberg
Stauroneis smithii Grunow
Staurosirella pinnata (Ehrenberg) D. M. Williams & Round
Surirella brebissonii var. *kuetzingii* Krammer & Lange-Bertalot
Surirella linearis W. Smith
Surirella minuta Brébisson
Tabellaria flocculosa (Roth) Kützing
Tetracyclus rupestris (Braun) Grunow

as 80% and was found on all types of substrates. Subdominant taxon was *Achnanthidium minutissimum* with the abundance of 9.28–42.13%. Of these identified taxa, three were new records to Serbia: *Brachysira intermedia*, *Chamaepinnularia mediocris* and *Navicula tridentula*. They were rarely distributed with very low abundance in samples. Twenty one rarely observed taxa were: *Achnanthes coarctata* (Brébisson) Grunow, *Achnanthidium exile* (Kützing) Heiberg, *Brachysira brebissonii* R. Ross (Pl. 2, Figs. 13–18), *Humidophila ingeae* (Van de Vijver) Lowe et al. (Pl. 1, Figs. 18–24), *H. perpusilla* (Grunow) Lowe et al. (Pl 1,

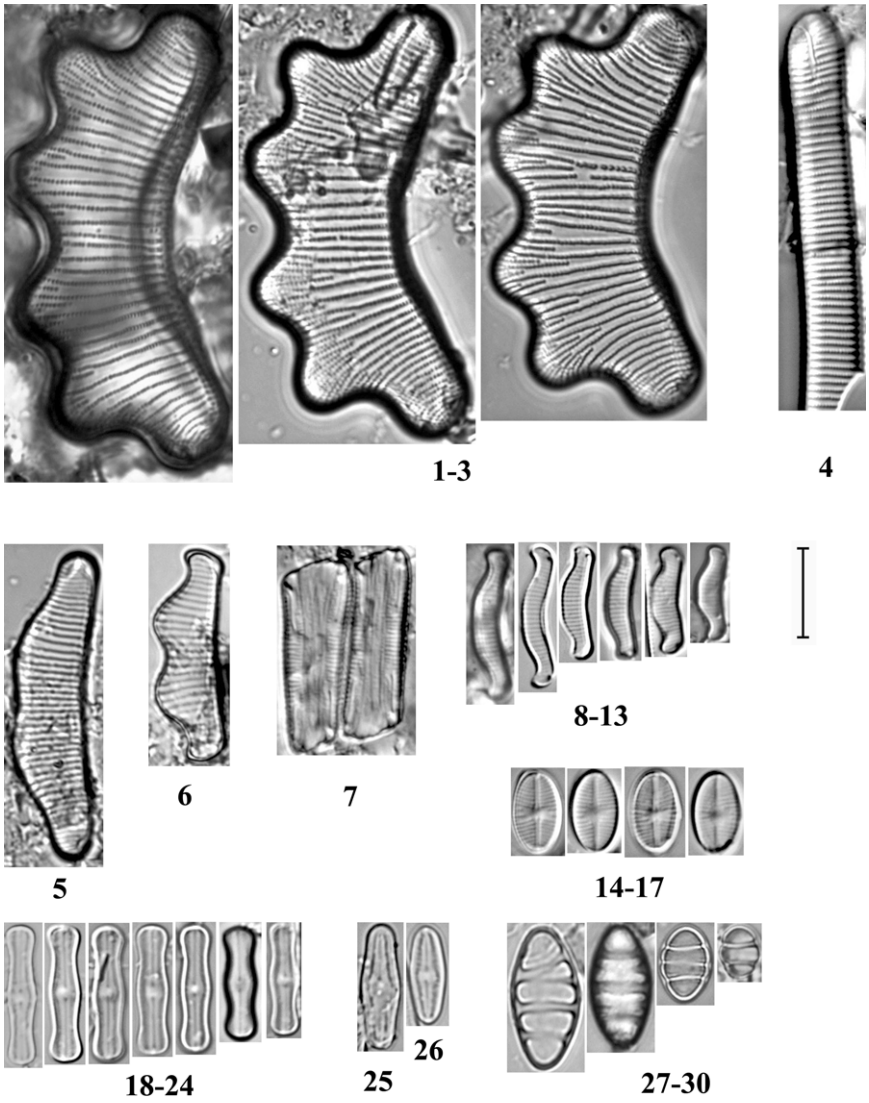

Plate 1. Light microscope micrographs. *Eunotia tetraodon* (Figs. 1–3); *E. flexuosa* (Fig. 4); *E. diodon* (Fig. 5); *E. subherkiniensis* (Fig. 6); *E. rhomboidea* (Fig. 7)*; E. exigua* (Figs. 8–13); *Psammothidium subatomoides* (Figs. 14–17); *Humidophila ingeae* (Figs. 18–24); *H. perpusilla* (Figs. 25–26); *Tetracyclus rupestris* (Figs. 27–30). Scale bar = 10 µm.

Figs. 25–26), *Diatomella balfouriana* Greville (Pl. 2, Figs. 21–30), *Eunotia diodon* Ehrenberg (Pl. 1, Fig. 5), *E. exigua* (Brébisson ex Kützing) Rabenhorst (Pl. 1, Figs. 8–13), *E. flexuosa* (Brébisson ex Kützing) Kützing (Pl. 1, Fig. 4), *E. praerupta* Ehrenberg, *E. rhomboidea* Hustedt (Pl. 1, Fig. 7), *E. subherkiniensis* Lange-Bertalot (Pl. 1, Fig. 6), *E. tetraodon* Ehrenberg (Pl. 1, Figs. 1–3), *Fallacia subhamulata* (Grunow) D.G. Mann, *Frustulia crassinervia* (Brébisson) Lange-Bertalot & Krammer (Pl. 2, Fig. 1–4), *F. saxonica* Rabenhorst, *Navicula angusta* Grunow (Pl. 2, Fig. 5–6), *Nitzschia alpina* Hustedt (Pl. 2, Fig. 8),

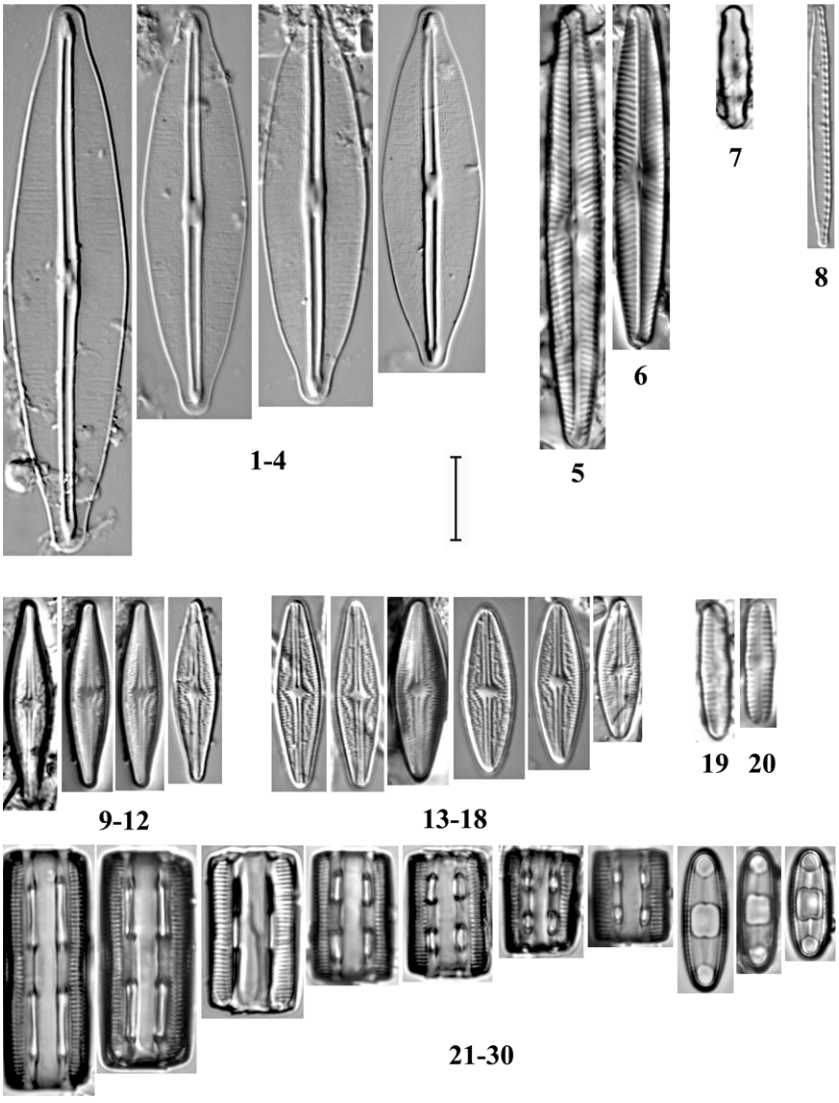

Plate 2. Light microscope micrographs. *Frustulia crassinervia* (Figs. 1–4); *Navicula angusta* (Figs. 5–6); *Navicula tridentula* (Fig. 7); *Nitzschia alpina* (Fig. 8); *Brachysira intermedia* (Figs. 9–12); *B. brebissonii* (Figs. 13–18)*; Chamaepinnularia mediocris* (Figs. 19–20)*; Diatomella balfouriana* (Figs. 21–30). Scale bar = 10 µm.

Pinnularia acoricola Hustedt, *Psammothidium subatomoides* (Hustedt) L. Bukhtiyarova & Round (Pl. 1, Figs. 14–17) and *Tetracyclus rupestris* (Braun) Grunow (Pl. 1, Figs. 27–30). The most interesting was *Diatomella balfouriana*. The paper presents the description and distribution of four species and their ecology. Main valve measurements of the populations in the Dojkinci River are shown in Tab. 2, and chemical analyses of the water in Tab. 3.

Tab. 2. Main valve measurements of the four species in the Dojkinci River.

Taxon	Length (µm)	Width (µm)	Striae in 10 µm
Brachysira intermedia	22.13–27.3	5.18–6.26	26–27
Chamaepinnularia mediocris	10.26–12.74	2.81–3.02	17–20
Navicula tridentila	15	4.1	
Diatomella balfouriana	13.6–23.86	4.97–5.83	19–20

Tab. 3. Physico-chemical parameters of the water during sampling period.

Variable	Values
Water temperature (°C)	6.4–12.5
Altitude (m)	924–1723.5
Conductivity (µS cm^{-1})	213–302
pH	5.46–6.5
Hardness (mg L^{-1})	25–67
Total alkalinity (mg L^{-1})	0.1
Alkalinity P (mg L^{-1})	0.1
NO_3-N (µg L^{-1})	0.635
PO_4-P (µg L^{-1})	1.45

Description of the three new taxa for Serbian diatom flora and one rarely observed taxon

Brachysira intermedia (Østrup) Lange-Bertalot in LANGE-BERTALOT and MOSER (1994) (Pl. 2, Figs. 9–12*)*

Description: Valves are lanceolate, gradually narrowed and at the ends almost pointed, length 22.13–27.3 µm, breadth 5.18–6.26 µm. The axial area is narrow linear near the apices, small and rhombic at the central area. The raphe is filiform. The striae are parallel, at the ends sometimes parallel to slightly convergent, 26–27 in 10 µm.

Ecology: Water temperature range from 6.4 °C to 12.5 °C, pH varied from 5.46 to 6.5 and concentrations of other nutrients were low.

Distribution (Serbia): along the upper course of the Dojkinci River (locality 1–5), on the surface of boulders, mud and on the mosses, with low abundance (0.23–0.61%), at the altitude from 1442.5 to 1723.5 m a.s.l.

Chamaepinnularia mediocris (Krasske) Lange-Bertalot and Krammer in Lange-Bertalot and Metzeltin (1996) (Pl. 2, Figs. 19–20)

Description: Valves are linear to broadly oval, with rounded apices and a gibbous middle, length 10.26–12.74 μm, breath 2.81–3.02 μm. The axial area is narrow near the apices, becoming wider near the central area. The central area is a transverse fascia. The raphe is filiform and slightly arched. The striae are parallel, 17–20 in 10 μm.

Ecology: Water temperature 12.5 °C, pH 6.5 and concentrations of other nutrients were low.

Distribution (Serbia): in the upper course of the Dojkinci River at only one locality (4) with very low abundance (0.12%), on surface of mud, at the altitude 1432 m a.s.l.

Navicula tridentula Krasske (1923) (Pl. 2, Fig. 7)

Description: Valve is linear, triundulate, with capitate ends, length 15 μm, breath 4.1 μm. The axial area is very narrow, linear, central area is variables size, often difficult to see. The raphe is filiform.

Ecology: Water temperature 12.5 °C, pH 6.5 and concentrations of other nutrients were low.

Distribution (Serbia): in the lower course of the Dojkinci River at locality 11, only one specimen, on surface of sand at the altitude of 1015.5 m a.s.l.

Diatomella balfouriana Greville (1855) (Pl. 2, Figs. 21–30)

Description: Valves are linear with rounded apices, lenght 13.6–23.86 μm, breath 4.97–5.83 μm.The axial area is wide. The raphe is filiform, with dilated external proximal raphe ends that terminate relatively distant from one another. The striae are short and parallel to radiate, 19–20 in 10 μm. The general character of this species is a septum which is present on each valvocopula. The septum extends the entire length of the valve and has three large openings, the largest in the center and two smaller at the ends.

Ecology: Water temperature 12.5 °C, pH 6.5 and concentrations of other nutrients were low.

Distribution (Serbia): in the upper course of the Dojkinci River at only one locality (3) with an abundance of 23.78%, on surface of boulders with mosses, at the altitude 1503.5 m a.s.l.; Tisa River at Titel (Szabados 1966).

Discussion

The main purpose of the study was to collect records on diatom assemblages from the Dojkinci River, which has a bottom substrate (red sandstone) unusual when compared with the substrates of other rivers in Serbia.

In many mountainous areas of the word the highest elevations are reached on siliceous crystalline mountain ranges. These sites are often pristine, relatively remote, and included in nature preserves because of their value for biodiversity conservation, recreation, and as storages of good-quality water (Cantonati and Lange-Bertalot 2011). Stara Planina Nature Park has similar characteristics and very rich valuable flora and fauna with an important role in biodiversity conservation in Serbia, as well as, in the Balkan Peninsula.

The diatom flora of Dojkinci River was mainly formed by acidophilic, limno-terrestial, moss-inhabiting, widely distributed species. The large development of acidophilic species is related to siliceous riverbed rocks of the Dojkinci River. The dominant diatom genus in the Dojkinci River was *Eunotia*, with 18 taxa. According to Lange-Bertalot et al. (2011) the genus *Eunotia* is mainly restricted to freshwater oligotrophic and oligosaprobic habitats, which enables it to play an important role as indicator in water monitoring (Alles et al. 1991, Kwandrans 2007). Physico-chemical conditions of the Dojkinci River are suitable for dominance of different *Eunotia* species. According to Pavlov and Levkov (2013) and Wojtal et al. (1999) *E. paludosa* was established as dominant taxon in the samples taken from the mud substrates and from mosses.

Achnanthidium minutissimum is one of the most frequently occurring diatoms in freshwater benthic samples globally (Patrick and Reimer 1966; Krammer and Lange-Bertalot 1991; Potapova and Hamilton 2007; Hofmann et al. 2013). This species has been reported from different type of waters, alkaline and acidic, oligotrophic and hypertrophic (Van Dam et al. 1994; Potapova and Hamilton 2007).

A *Brachysira intermedia* is widespread in waters of mountain regions on silica surfaces with low electrolyte content and in oligo- to dystrophic waters. According to Lange-Bertalot and Moser (1994) and Hofmman et al. (2013), valve length is 25–33 μm, valve breadth 5–6.5 μm, striae 26–30 in 10 μm. Valve measurements in our samples were similar to those in the literature.

Chamaepinnularia mediocris can be found in oligo- to dystrophic freshwaters of mountain regions (springs, streams and lakes) on silica substrates. According to Van Dam et al. (1994), *C. mediocris* is an acidophilic species, mainly occurring at pH < 7. Hofmman et al. (2013) state that this species prefers moderately acidic waters. Our results showed that the water of the Dojkinci River is moderately acidic (pH was 6.5) at the site at which this alga was recorded. *C. mediocris* mainly occurs on wet and moist or temporarily dry places. Fránková et al. (2009) found *C. mediocris* in *Sphagnum* fens, as did Kapetanović et al. (2011). Also, Buczkó and Wojtal (2005) and Van de Vijver and Beyens (1997) found this species on different type of mosses. In our sample *C. mediocris* was found on a mud substrate, at an altitude of 1432 m a.s.l., which is higher than that shown by Kapetanović et al. (2011) (at an altitude 930 m a.s.l.). Researches of Buczkó and Wojtal (2005) noted *C. mediocris* along with *Eunotia exigua* which is complementary with our findings. Morphological data show that the valve is 9–16 μm long, 2–3 μm wide and has 20–30 striae in 10 μm (Hofmman et al. 2013). According to Vesela and Johansen (2009), valve length is 10–12 μm, valve breadth 2.7 μm, striae 18–21 in 10 μm. Valve measurements in our samples were similar those in literatures.

Chamaepinnularia mediocris is known from: Strømness Bay area, South Georgia, Antarctica (VandeVijver and Beyens 1997); Laurentian Great Lakes (Stoermer et al. 1999); Hungary (BuczkÓ and Wojtal 2005, BuczkÓ 2006); Great Smoky Mountains National Park, USA (Johansen et al. 2007); Penza oblast, European Russia (Kulikovskii 2008); Elbsandsteingebirge region, Czech Republic (Vesela and Johansen 2009); Western Carpathian spring fens, between the Czech Republic and Slovakia (Fránková et al. 2009); Mt. Zvijezda near Sarajevo, Bosnia and Herzegovina (Kapetanović et al. 2011); lakes in the Azores archipelago, Portugal (Pereira et al. 2014).

Navicula tridentula has cosmopolitan widespread, sporadically at typical habitat, such as springhead of stream, peat bogs, swamp. Krammer and Lange-Bertalot (1986) state that the species prefers fresh water with low concentrations of electrolytes. According to Van Dam et al. (1994), *N. tridentula* is an alcalophilic species, mainly occurring at pH < 7, in wet and moist or temporarily dry places. In the Dojkinci River *N. tridentula* was found at one locality at pH 6.5, on a sandy surface. In Thailand (Leelahakriengkra 2013) the species was recorded at an altitude 478–489 m a.s.l., but in Dojkinci River the same species was recorded on higher altitude (1015.5 m a.s.l.). Valve measurements of the population from the Dojkinci River had similar values, as well as, values according to Krammer and Lange-Bertalot (1986): valve length 11–19 μm, breadth 3.5–4 μm, striae are not visible on LM.

Navicula tridentula is known from: north western United States (Bahls 2009); western Carpathian spring fens, between the Czech Republic and Slovakia (Fránková 2009); Chiang Dao District, Thailand (Leelahakriengkra 2013).

New species for diatom flora of Serbia recorded at localities of the Dojkinci River were found with very low abundances, although they were on substratum typical for them.

A cosmopolitan species, *Diatomella balfouriana* is widespread from the Arctic to Antarctica. It is characteristic for oligo- to dystrophic boreo-alpine mountain freshwaters, with low conductivity and nutrient poor (Krammer and Lange-Bertalot 1986). However, *D. balfouriana* was recorded in temporary pools of brackish water, as well as in moist soil near the ocean round Antarctica (Van de Vijver et al. 2012). Until now, there is only one published record about *D. balfouriana* for Serbia, in the Tisa River (plain river in northern part of Serbia, pH mainly occurring about 7) (Szabados 1966). This can be considered poorly reliable information, because there are no microphotographs which can confirm the finding. In addition, the type of substrate (mud at the bottom of the river) and pH are not typical of *D. balfouriana*. Our findings are complementary with literature data: oligo- to dystrophic freshwater, low-conductivity and nutrient-poor, boreo-alpine mountain habitats. Krammer and Lange-Bertalot (1986) states that the valve is 12–52 μm long, 6–8 μm wide and 18–21 striae in 10 μm. According to Kociolek (2011), valve length is 12–40 μm, breadth is 3.5–6 μm and there are 18–22 striae in 10 μm. Valve measurements of the population from the Dojkinci River had values similar to those given by Kociolek (2011), but the breadths of the valves reported here are smaller than those given by Krammer and Lange-Bertalot (1986).

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