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BRYOPHYTE FLORA OF LAKE VLASINA AND ITS SURROUNDINGS (SE SERBIA)

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216 bryophyte taxa (38 liverworts and 178 mosses) were collected during field trips carried out in 2010 and 2011 in the surroundings of Lake Vlasina. Of these collections, four species (*Ditrichum lineare*, *Grimmia incurva*, *Physcomitrium eurystomum* and *Pohlia proligera*) were found to be new records for Serbia. Six species are included in the Red data book of European bryophytes (*Amblystegium radicale*, *Brachythecium geheebi*, *Grimmia caespiticia*, *Hamatocaulis vernicosus*, *Pseudoleskea saviana* and *Taxiphyllum densifolium*).

Key words: flora, liverworts, mosses, new records for Serbia, red-listed species in Europe

INTRODUCTION

Research of the bryophyte flora of Serbia has been a neglected discipline for a long period of time. However, recent advances in the field have been remarkable marked by a series of successful field studies and many new data (Papp *et al.* 2009). New bryophyte species records have been added continuously with every new investigation (Erzberger and Papp 2011, Papp and Erzberger 2009, Papp *et al.* 2011*a*, 2012*a*, *b*, *c*, Sabovljević *et al.* 2010). Even though the last decade was fruitful regarding novelties for the bryophyte flora of Serbia and the generally better knowledge of this field, many areas of the country remain not only under recorded but bryologically not known at all. One such area has been Lake Vlasina and its surroundings, previously only investigated really long ago. This area was visited and its bryophyte flora studied by bryologists almost 100 years ago (Katić 1910, Košanin 1910*a*, *b*). The earlier and recent knowledge about the flora (including bryophytes) was summarised in Ranđelović and Zlatković (2010). To explore and document the bryophyte flora of this place was a unique and an exciting opportunity to compare the previous and current state of the bryophyte vegetation of the area.

MATERIAL AND METHODS

The study area

Lake Vlasina is situated in the southeastern part of Serbia in the Rodopean area. Lake Vlasina is in a huge highland plateau surrounded by the peaks of the Vardenik (1,875 m), Čemernik (1,638 m), Plana (1,721 m) and Bukova Glava (1,472 m). The lake itself is of artificial origin, developed in 1949–1954 when a dam was constructed down from the largest peat bog area in the Balkans (Ranđelović and Zlatković 2010), created at the place where the Vlasinska river exited from the bog. The plateau has an average altitude above 1,200 m a.s.l.; the lake is at 1,210 m a.s.l. The adjacent hydrological network is well developed. The region is geologically characterised by metamorphic schists, silicates and many subtypes of them; also, various soil types are present (Blaženčić 1997). The climate of Vlasina area is quite severe with a yearly average of 5.7 °C. The hottest month is August (mean value 14.7 °C), and the coldest month is January (–4 °C). The average yearly precipitation is 722.9 mm. In the growing season the average temperature is 12.5 °C, and 309.1 mm of rain, respectively, with rather high averages of air humidity (79–82%). Vlasina plateau has many windy days with strong northwestern, western, northern and eastern winds.

Various vegetation types – beech and spruce forests, pine plantations, wetland vegetation, meadows from peat bogs to dry pasture and hasmophytic communities – are part of the natural diversity. The plateau with the lake and its surroundings is protected as a Nature park.

Methods

Our collecting trip to the investigated area, shown in Figure 1, was made in the month of June in both 2010 and 2011. All main bryologically important habitat types, such as wetlands, stream valleys, gorges, forests, rock formations and grasslands were investigated, and bryophytes collected from different substrates (soil, exposed and shaded rocks, tree bark, decaying wood, etc.). Almost all bryophyte collection sites mentioned in their early works by Katić (1910) and Košanin (1910*a*, *b*) were visited and thoroughly investigated.

The specimens are deposited in the bryological collection of the Hungarian Natural History Museum, Budapest (BP). Nomenclature follows Grolle and Long (2000) for liverworts and Hill *et al.* (2006) for mosses, except for *Polytrichum commune* var. *perigoniale*, in which case Koperski *et al.* (2000) is followed.

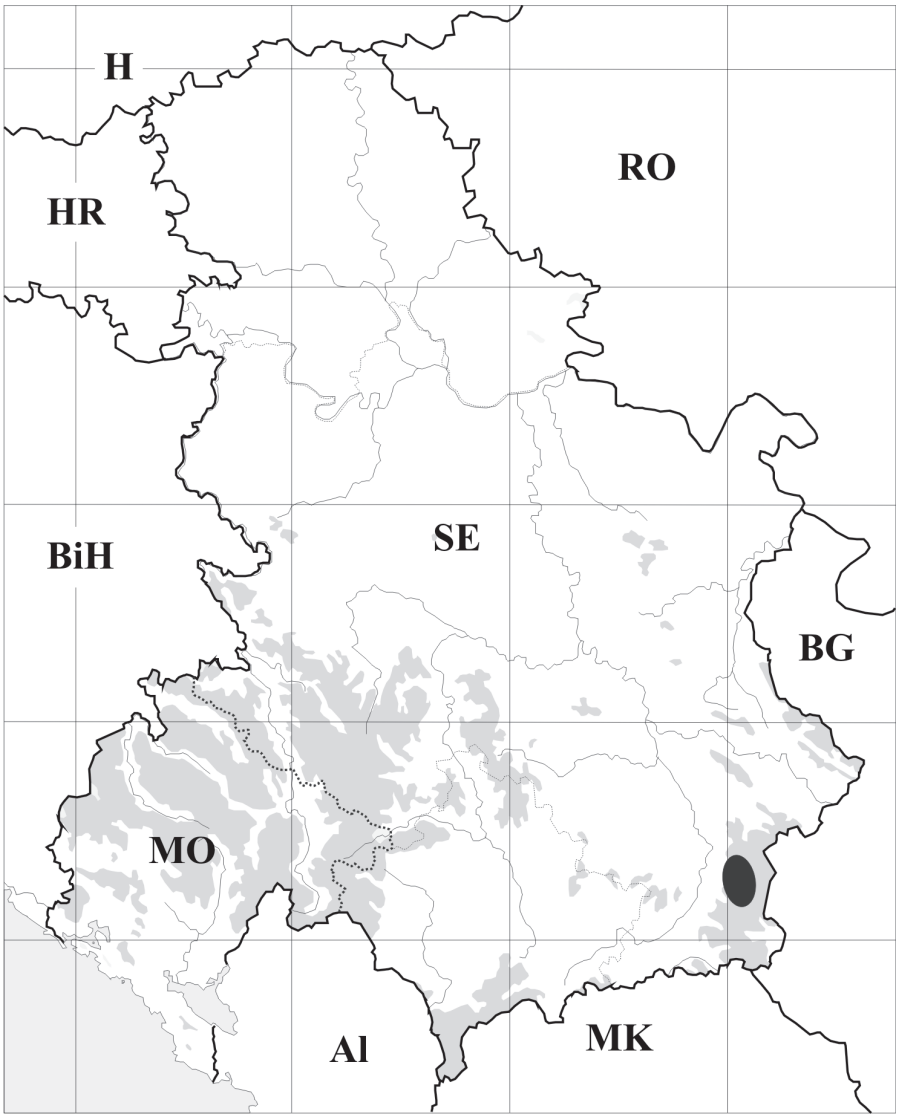

Fig. 1. Location of the investigated area. (H = Hungary, RO = Romania, HR = Croatia, BiH = Bosnia-Herzegovina, MO = Montenegro, SE = Serbia, BG = Bulgaria, MK = FYR Macedonia, Al = Albania)

Site details

1. Serbia, southeastern Serbia, Lake Vlasina, Okruglica, at hotel Vlasina, 42° 44' 17.6" N, 22° 19' 42.2" E, 1,235 m, 18.06.2010.
2. Serbia, southeastern Serbia, north of Lake Vlasina, at Vlasina reka (stream), 42° 46' 29.3" N, 22° 18' 56.4" E, 1,195 m, 19.06.2010.

3. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, Bratašnica, Bratanov dol, 42° 41' 40.8" N, 22° 19' 09.3" E, 1,245 m, 19.06.2010.
4. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, between Bratašnica and hotel Vlasina, 42° 41' 52.4" N, 22° 19' 30.7" E, 1,245 m, 19.06.2010.
5. Serbia, southeastern Serbia, at Lake Vlasina, Vlasina Stojkovićeva, at Murina dolina, floating island, 42° 42' 45.2" N, 22° 21' 34.9" E, 1,235 m, 21.06.2010.
6. Serbia, southeastern Serbia, at Lake Vlasina, Vlasina Stojkovićeva, at Murina dolina, floating island, 42° 42' 49.1" N, 22° 21' 38.0" E, 1,225 m, 21.06.2010.
7. Serbia, southeastern Serbia, at Lake Vlasina, Vlasina Stojkovićeva, at Murina dolina, at the floating islands, 42° 42' 48.5" N, 22° 21' 35.1" E, 1,230 m, 21.06.2010.
8. Serbia, southeastern Serbia, at Lake Vlasina, Vlasina Stojkovićeva, valley at Skela village, from 42° 41' 52.8" N, 22° 23' 04.8" E to 42° 41' 59.8" N, 22° 23' 21.0" E, 1,300 m, 21–22.06.2010.
9. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, Bratašnica, wetland at a spring at Bratanov dol, 42° 41' 32.8" N, 22° 19' 07.7" E, 1,250 m, 22.06.2010.
10. Serbia, southeastern Serbia, at Lake Vlasina, Blato at Okruglica, *Eriophoretum*, 42° 40' 19.8" N, 22° 20' 40.3" E, 1,235 m, 22.06.2010.
11. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, Blato at Lisinsko kanal, 42° 40' 42.2" N, 22° 21' 02.9" E, 1,225 m, 22.06.2010.
12. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, Lisinsko kanal, 42° 40' 43.4" N, 22° 21' 18.2" E, 1,230 m, 22.06.2010.
13. Serbia, southeastern Serbia, north of Lake Vlasina, Sveta Trojica sa crkvicom at Dojčinovći village, 42° 46' 00.9" N, 22° 18' 35.0" E, 1,345 m, 23.06.2010.
14. Serbia, southeastern Serbia, north of Lake Vlasina, in the valley of Vlasina reka, along the road, 42° 46' 35.6" N, 22° 18' 50.7" E, 1,185 m, 23.06.2010.
15. Serbia, southeastern Serbia, north of Lake Vlasina, in the valley of Vlasina reka, at Livade village, 42° 48' 15.2" N, 22° 18' 55.9" E, 1,180 m, 23.06.2010.
16. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, near the peak, 42° 44' 06.6" N, 22° 16' 10.6" E, 1,580 m, 20.06.2011.
17. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, spring Izvor Orlovac under the peak, 42° 44' 10.1" N, 22° 16' 33.9" E, 1,630 m, 20.06.2011.
18. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, on the southern slope under the peak, 42° 43' 30.9" N, 22° 17' 09.3" E, 1,580 m, 20.06.2011.
19. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, on the southern slope along the road going down, 42° 43' 18.5" N, 22° 17' 02.0" E, 1,580 m, 20.06.2011.
20. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, on the southern slope along the road going down towards Lake Vlasina, 42° 43' 00.3" N, 22° 17' 21.7" E, 1,460 m, 20.06.2011.
21. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, on the southern slope along the road going towards Lake Vlasina, 42° 41' 56.2" N, 22° 16' 37.0" E, 1,380 m, 20.06.2011.
22. Serbia, southeastern Serbia, Okruglica, at Lake Vlasina, Bratašnica, wetland at a spring at Bratanov dol, 42° 41' 32.8" N, 22° 19' 07.7" E, 1,250 m, 20.06.2011 and 24.06.2011.
23. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), along the road towards the peak, *Betuletum*, 42° 45' 21.0" N, 22° 20' 02.0" E, 1,305 m, 21.06.2011.
24. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), exposed siliceous rocks on the southern slope under the peak, 42° 47' 14.6" N, 22° 21' 57.9" E, 1,680 m, 21.06.2011.
25. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), along the road on the eastern slope under the peak, 42° 47' 38.7" N, 22° 22' 38.3" E, 1,680 m, 21.06.2011.

26. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), at spring Izvor Bankov on the eastern slope under the peak, 42° 47' 42.6" N, 22° 22' 37.6" E, 1,680 m, 21.06.2011.
27. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), on the peak, 42° 47' 34.1" N, 22° 22' 23.6" E, 1,730 m, 21.06.2011.
28. Serbia, southeastern Serbia, Mt Vrtop (Plana) at Okruglica (Lake Vlasina), wet meadow and rivulet on the southern slope under the peak, 42° 47' 14.6" N, 22° 21' 57.9" E, 1,680 m, 21.06.2011.
29. Serbia, southeastern Serbia, at Mt Bukova glava near Vlasina Stojkovićeva, stream valley at Skela village, 42° 41' 59.8" N, 22° 23' 21.0" E, 1,300 m, 22.06.2011.
30. Serbia, southeastern Serbia, at Mt Bukova glava near Vlasina Stojkovićeva, wet meadows along Dejanova stream at Savina mahala, 42° 41' 27.6" N, 22° 23' 23.8" E, 1,340 m, 22.06.2011.
31. Serbia, southeastern Serbia, along Vućja stream at Klisura village near Lake Vlasina, 42° 44' 25.8" N, 22° 23' 09.9" E, 1,035 m, 22.06.2011.
32. Serbia, southeastern Serbia, along the road between Klisura village and the Bulgarian border, 42° 46' 24.5" N, 22° 25' 45.7" E, 845 m, 22.06.2011.
33. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, wet meadows on the southern slope under the peak along the upper part of Plavilo stream, from 42° 43' 49.8" N, 22° 16' 56.6" to 42° 43' 35.5" N, 22° 16' 45.0" E, 1,520–1,600 m, 23.06.2011.
34. Serbia, southeastern Serbia, Mt Čemernik at Okruglica, along Plavilo reka stream, 42° 44' 08.0" N, 22° 17' 25.7" E, 1,456 m, 23.06.2011.
35. Serbia, southeastern Serbia, Vlasina Rid, in the valley of Cvetkova stream at Lake Vlasina, Okruglica, 42° 44' 43.1" N, 22° 18' 56.7" E, 1,280 m, 23.06.2011.
36. Serbia, southeastern Serbia, at Lake Vlasina, Blato at Okruglica, *Eriophoretum*, 42° 40' 17.1" N, 22° 20' 36.4" E, 1,240 m, 24.06.2011.
37. Serbia, southeastern Serbia, Mt Strešer at Ravnište near Okruglica, exposed siliceous rocks, 42° 38' 48.0" N, 22° 15' 44.0" E, 1,660 m, 24.06.2011.
38. Serbia, southeastern Serbia, Mt Strešer along the road going down to Okruglica, 42° 37' 35.5" N, 22° 16' 17.3" E, 1,710 m, 24.06.2011.
39. Serbia, southeastern Serbia, Mt Strešer along the road going down to Okruglica, 42° 36' 13.0" N, 22° 17' 20.3" E, 1,560 m, 24.06.2011.

RESULTS AND DISCUSSION

Bryophyte flora

During our field trips 216 bryophyte taxa (38 liverworts and 178 mosses) were collected. The numerals following the species names refer to the collection sites described above.

Hepaticae

Aneura pinguis (L.) Dumort. – 2: wetland at a spring
Barbilophozia hatcheri (A. Evans) Loeske – 19, 39: soil; 24: exposed siliceous rock
Blepharostoma trichophyllum (L.) Dumort. – 8: soil
Calypogeia azurea Stotler et Crotz – 33: wet meadow; Ranđelović and Zlatković (2010)
Calypogeia fissa (L.) Raddi – 8, 17: soil

Cephalozia bicuspidata (L.) Dumort. var. ***bicuspidata*** – 33: wet meadow; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Cephalozia bicuspidata (L.) Dumort. var. ***lammersiana*** (Hüb.) Breidl. – 17: soil
Cephaloziella divaricata (Sm.) Schiffn. – 2, 24, 37: exposed siliceous rock; 9: wetland at a spring; 16, 18, 19: soil
Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort. – 8: at the stream and wet meadow; 12: wet siliceous rock; 17: soil at the spring; 26: wetland at a spring; 28, 33, 34: wet meadow along a stream
Chiloscyphus polyanthus (L.) Corda – 12, 31: wet siliceous rock; 34: wetland; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Conocephalum salebrosum Szweykowski, Buczkowska et Odrzykoski – 2: wetland at a spring; 8, 15, 31: at the stream; RANĐELOVIĆ and ZLATKOVIĆ (2010, sub *C. conicum*)
Frullania dilatata (L.) Dumort. – 2: siliceous rock; 8: bark of tree; 35: bark of *Fagus*; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Jungermannia atrovirens Dumort. – 17: soil
Jungermannia gracillima Sm. – 9, 22: wetland at a spring; 29: soil; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Jungermannia hyalina Lyell – 34: wet meadow
Jungermannia leiantha Grolle – 8: soil
Lophocolea bidentata (L.) Dumort. – 33: wet meadow; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Lophocolea heterophylla (Schrad.) Dumort. – 1, 2, 16: soil; 23: decaying wood
Lophocolea minorNees – 19: soil; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Lophozia bicrenata (Schmidel ex Hoffm.) Dumort. – 16, 18: soil; 37: among siliceous rocks
Lophozia ventricosa (Dicks.) Dumort. – 17: soil; 33: wet meadow; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Lophozia wenzelii (Nees) Steph. – 17: soil
Marchantia polymorpha L. subsp. ***polymorpha*** – 2, 4: wetland at a spring; 8, 30, 33: wet meadow; 12: wet siliceous rock; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Marchantia polymorphaL. subsp. ***montivagans*** Bisch. et Boisselier – 2, 4, 17: wetland at a spring; 8, 28: wet meadow
Metzgeria conjugata Lindb. – 31: siliceous rock
Metzgeria furcata (L.) Dumort. – 8: rock and bark of tree; 11, 35: bark of *Fagus*; 15: rock; 24, 31: siliceous rock
Pellia endiviifolia (Dicks.) Dumort. – 8: at the stream and wet meadow; 12: wet siliceous rock; 15: at the stream; 17: soil at the spring; 28: wet meadow along a stream; 30: wetland
Pellia epiphylla (L.) Corda – 33: wet meadow; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Pellia neesiana (Gottsche) Limpr. – 29: soil
Plagiochila porelloides (Torrey ex Nees) Lindenb. – 2: soil and siliceous rock; 8: soil and at the stream; 31: siliceous rock
Porella cordaeana (Huebener) Moore – 8: at the stream; 11: bark of *Fagus*; 13: rock and bark of *Fagus*; 15: rock; 24: exposed siliceous rock; 29, 31: shaded siliceous rock; 35: bark of *Fagus* and decaying wood; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Radula complanata (L.) Dumort. – 8: rock and bark of tree; 11: bark of *Fagus*; 23: bark of *Populus*; 31, 37: siliceous rock; 35: bark of *Salix* and *Fagus*; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Reboulia hemisphaerica (L.) Raddi – 2: siliceous rock; RANĐELOVIĆ and ZLATKOVIĆ (2010)
Riccardia incurvata Lindb. – 26: wetland at a spring; 34: wet meadow
Riccardia multifida (L.) Gray – 9: wetland at a spring
Scapania irrigua (Nees) Nees – 9, 26: wetland at a spring; 34: wet meadow
Scapania undulata (L.) Dumort. – 8, 34, 35: at the stream; 17: soil at the spring; RANĐELOVIĆ and ZLATKOVIĆ (2010)

Musci

Abietinella abietina (Hedw.) M. Fleisch. – 2, 23: soil
Amblystegium radicale (P. Beauv.) Schimp. – 6: wetland
Amblystegium serpens (Hedw.) Schimp. – 8, 17: soil; 13: rock; 23: bark of *Betula* and *Salix*; Ranđelović and Zlatković (2010)
Amblystegium subtile (Hedw.) Schimp. – 23: bark of *Populus*; Ranđelović and Zlatković (2010)
Anomodon attenuatus (Hedw.) Huebener – 31: siliceous rock; Ranđelović and Zlatković (2010)
Anomodon viticulosus (Hedw.) Hook. et Taylor – 8: soil; 23: bark of *Populus*
Antitrichia curtipendula (Hedw.) Brid. – 29: siliceous rock; Ranđelović and Zlatković (2010)
Atrichum angustatum (Brid.) Bruch et Schimp. – 34: wet meadow
Atrichum undulatum (Hedw.) P. Beauv. – 1, 2, 8, 17, 23, 35: soil; 3, 4: wetland; 9: wetland at a spring; 33: wet meadow; Ranđelović and Zlatković (2010)
Aulacomnium palustre (Hedw.) Schwägr. – 2, 9, 26: wetland at a spring; 3, 5, 6, 10, 11, 30: wetland; 8: at the stream; 34: wet meadow; Ranđelović and Zlatković (2010)
Barbula convoluta Hedw. – 9: wetland at a spring
Bartramia halleriana Hedw. – 2: siliceous rock; 8: soil; Ranđelović and Zlatković (2010)
Bartramia ithyphylla Brid. – 1, 8, 29, 39: soil; 2: siliceous rock; Ranđelović and Zlatković (2010)
Bartramia pomiformis Hedw. – 2: siliceous rock; 25: soil; Ranđelović and Zlatković (2010)
Brachytheciastrum velutinum (Hedw.) Ignatov et Huttunen – 1, 8, 16, 17: soil; 2: soil and siliceous rock; 6: wetland; 13, 15: rock; 20: bark of *Betula*; 23: soil, bark of *Betula* and decaying wood; 24, 37: exposed siliceous rock; 35: soil, bark of *Salix* and decaying wood; Ranđelović and Zlatković (2010)
Brachythecium albicans (Hedw.) Schimp. – 2: soil; 33: edge of wet meadow; Ranđelović and Zlatković (2010)
Brachythecium geheebi Milde – 29: siliceous rock
Brachythecium glareosum (Bruch ex Spruce) Schimp. – 1, 2, 23: soil
Brachythecium mildeanum (Schimp.) Schimp. – 11: wetland
Brachythecium rivulare Schimp. – 2, 4, 9, 17, 26: wetland at a spring; 6: wetland; 8, 15, 31: at the stream; 12: wet siliceous rock; 28, 33: wet meadow along a stream; Ranđelović and Zlatković (2010)
Brachythecium rutabulum (Hedw.) Schimp. – 1, 8: soil; 6, 11, 30: wetland; 9: wetland at a spring; 15: rock; 23: siliceous rock; Ranđelović and Zlatković (2010)
Brachythecium salebrosum (Hoffm. ex F. Weber et D. Mohr) Schimp. – 1, 16, 23, 31: soil; 13: bark of *Betula*; 29: siliceous rock
Bryum alpinum Huds. ex With. – 2, 16: soil; 34: wet soil at a spring
Bryum argenteum Hedw. – 7, 37: siliceous rock; 12: wet siliceous rock; Ranđelović and Zlatković (2010)
Bryum capillare Hedw. – 12, 37: siliceous rock; 23, 25: soil; 35: bark of *Salix*
Bryum elegans Nees – 9: wetland at a spring
Bryum moravicum Podp. – 1, 8: soil; 2, 31: siliceous rock; 13: rock and bark of *Fagus*; 23: bark of *Populus*; 35: bark of *Salix*
Bryum pallens Sw. ex anon. – 4: wetland at a spring; Ranđelović and Zlatković (2010)
Bryum pseudotriquetrum (Hedw.) P. Gaertn. et al. var. ***bimum*** (Schreb.) Lilj. – 2, 9: wetland at a spring; Ranđelović and Zlatković (2010)
Bryum pseudotriquetrum (Hedw.) P. Gaertn. et al. var. ***pseudotriquetrum*** – 2, 4, 9, 26: wetland at a spring; 3, 5, 6, 10, 11, 30: wetland; 28, 33, 34: wet meadow along a stream; Ranđelović and Zlatković (2010)
Bryum rubens Mitt. – 2: siliceous rock; 16, 23: soil

Bryum schleicheri DC. – 14: wet siliceous rock; 33: wet meadow; 34: wet soil at a spring; Ranđelović and Zlatković (2010)
Bryum turbinatum (Hedw.) Turner – 4: wetland at a spring; 14: wet siliceous rock; Ranđelović and Zlatković (2010)
Calliergon cordifolium (Hedw.) Kindb. – 5, 34: wetland; Ranđelović and Zlatković (2010)
Calliergonella cuspidata (Hedw.) Loeske – 2, 9: wetland at a spring; 3, 5, 6, 10, 11, 30: wetland; 8, 33: wet meadow; Ranđelović and Zlatković (2010)
Calliergonella lindbergii (Mitt.) Hedenäs – 2: wetland at a spring
Campylium stellatum (Hedw.) Lange et C. E. O. Jensen – 2, 26: wetland at a spring; 30, 34: wetland; Ranđelović and Zlatković (2010)
Ceratodon purpureus (Hedw.) Brid. – 1, 16, 23: soil; 2, 7: soil and siliceous rock; 3, 6, 10: wetland; 9: wetland at a spring; 24, 34: exposed siliceous rock; Ranđelović and Zlatković (2010)
Cirriphyllum piliferum (Hedw.) Grout – 2: soil
Climacium dendroides (Hedw.) F. Weber et D. Mohr – 1, 31: soil; 2: wetland at a spring; 3, 6, 10, 11, 30: wetland; 8: at the stream; Ranđelović and Zlatković (2010)
Coscinodon cribrosus (Hedw.) Spruce – 2, 34: siliceous rock
Cratoneuron filicinum (Hedw.) Spruce – 2: wetland at a spring; 8, 15: at the stream; 12: wet siliceous rock; Ranđelović and Zlatković (2010)
Dichodontium pellucidum (Hedw.) Schimp. – 8, 31: at the stream; Ranđelović and Zlatković (2010)
Dicranella heteromalla (Hedw.) Schimp. – 3, 4: wetland; 8, 17, 27, 39: soil
Dicranella schreberiana (Hedw.) Dixon – 14: wet siliceous rock
Dicranum bonjeanii De Not. – 3, 10, 30: wetland; Ranđelović and Zlatković (2010)
Dicranum polysetum Sw. ex anon. – 17: soil
Dicranum scoparium Hedw. – 2, 8, 19: soil; 15: rock; 23: bark of *Populus*; 31: siliceous rock; Ranđelović and Zlatković (2010)
Diphyscium foliosum (Hedw.) D. Mohr – 8, 31: soil; 37: among siliceous rocks; Ranđelović and Zlatković (2010)
Ditrichum heteromallum (Hedw.) E. Britton – 7: siliceous rock; 16, 38: soil; Ranđelović and Zlatković (2010)
Ditrichum lineare (Sw.) Lindb. – 27: soil
Ditrichum pusillum (Hedw.) Hampe – 1, 2, 16, 23, 25: soil; 9: wetland at a spring; 24: exposed siliceous rock
Drepanocladus aduncus (Hedw.) Warnst. – 5, 6, 10, 11, 30: wetland; 9: wetland at a spring; Ranđelović and Zlatković (2010)
Eurhynchiastrum pulchellum (Hedw.) Ignatov et Huttunen – 2: siliceous rock; 8, 23: soil; Ranđelović and Zlatković (2010)
Eurhynchium angustirete (Broth.) T. J. Kop. – 29: soil
Fissidens adianthoides Hedw. – 2: wetland at a spring; 34: wetland along a stream
Fissidens bryoides Hedw. – 8, 29: soil
Fissidens dubius P. Beauv. – 29, 31: siliceous rock; Ranđelović and Zlatković (2010)
Fissidens taxifolius Hedw. – 8, 29: soil
Fontinalis antipyretica Hedw. – 12: wet siliceous rock; Ranđelović and Zlatković (2010)
Funaria hygrometrica Hedw. – 2: soil; 9: wetland at a spring; Ranđelović and Zlatković (2010)
Grimmia alpestris (F. Weber et D. Mohr) Schleich. – 2: exposed siliceous rock
Grimmia caespiticia (Brid.) Jur. – 2, 24: exposed siliceous rock
Grimmia decipiens (Schultz) Lindb. – 2: exposed siliceous rock
Grimmia hartmannii Schimp. – 15: rock; Ranđelović and Zlatković (2010)

Grimmia incurva Schwägr. – 24: exposed siliceous rock
Grimmia laevigata (Brid.) Brid. – 2, 7, 37: exposed siliceous rock; Ranđelović and Zlatković (2010)
Grimmia montana Bruch et Schimp. – 2, 7, 24, 27, 37: exposed siliceous rock
Grimmia muehlenbeckii Schimp. – 7, 24, 37: exposed siliceous rock; 29: siliceous rock; Ranđelović and Zlatković (2010)
Grimmia ovalis (Hedw.) Lindb. – 2, 37: exposed siliceous rock
Grimmia pulvinata (Hedw.) Sm. – 2, 7, 12: siliceous rock; Ranđelović and Zlatković (2010)
Hamatocaulis vernicosus (Mitt.) Hedenäs – 10: wetland; Ranđelović and Zlatković (2010)
Hedwigia ciliata (Hedw.) P. Beauv. var. ***ciliata*** – 2: exposed siliceous rock; Ranđelović and Zlatković (2010)
Hedwigia ciliata (Hedw.) P. Beauv. var. ***leucophaea*** Bruch et Schimp. – 37: exposed siliceous rock
Herzogiella seligeri (Brid.) Z. Iwats. – 35: decaying wood
Homalothecium lutescens (Hedw.) H. Rob. – 2: soil
Homalothecium philippeanum (Spruce) Schimp. – 31: siliceous rock; Ranđelović and Zlatković (2010)
Homalothecium sericeum (Hedw.) Schimp. – 12, 31: siliceous rock; 35: bark of *Salix*; Ranđelović and Zlatković (2010)
Hygroamblystegium fluviatile (Hedw.) Loeske – 12: wet siliceous rock
Hygroamblystegium tenax (Hedw.) Jenn. – 12, 31, 33: wet siliceous rock
Hygrohypnum luridum (Hedw.) Jenn. – 12: wet siliceous rock; 15: at the stream
Hylocomium splendens (Hedw.) Schimp. – 1, 2, 8, 19, 23: soil; Ranđelović and Zlatković (2010)
Hypnum cupressiforme Hedw. – 1, 19: soil; 2, 12, 31: siliceous rock; 6: wetland; 8: soil and rock; 13: rock and bark of *Fagus*; 15: rock; 20, 23: bark of *Betula*; 24, 37: exposed siliceous rock; 35: bark of *Salix* and *Fagus*; Ranđelović and Zlatković (2010)
Isothecium alopecuroides (Lam. ex Dubois) Isov. – 2, 31: siliceous rock; 8: soil; 35: decaying wood; Ranđelović and Zlatković (2010)
Leucodon sciuroides (Hedw.) Schwägr. – 13: bark of *Fagus*; 23: bark of *Populus*; 35: bark of *Salix*; Ranđelović and Zlatković (2010)
Mnium marginatum (Dicks.) P. Beauv. – 8: at the stream; 31: siliceous rock
Mnium stellare Hedw. – 1, 8, 23: soil; Ranđelović and Zlatković (2010)
Orthotrichum affine Schrad. ex Brid. – 1, 35: bark of *Salix*; 8: bark of tree; 13: bark of *Fagus*; 23: bark of *Betula* and *Salix*; 32: bark of *Populus*; Ranđelović and Zlatković (2010)
Orthotrichum anomalum Hedw. – 2, 12: siliceous rock; Ranđelović and Zlatković (2010)
Orthotrichum cupulatum Hoffm. ex Brid. – 12: siliceous rock; 13: rock
Orthotrichum diaphanum Schrad. ex Brid. – 32: margin of an asphalt road; Ranđelović and Zlatković (2010)
Orthotrichum obtusifolium Brid. – 1: bark of *Salix*; 32: margin of an asphalt road and bark of *Populus*
Orthotrichum pallens Bruch ex Brid. – 1: bark of *Salix*; 8: bark of tree; 20: bark of *Betula*; 23: bark of *Populus* and *Salix*
Orthotrichum philibertii Venturi – 35: bark of *Fagus*
Orthotrichum pumilum Sw. ex anon – 32: margin of an asphalt road; Ranđelović and Zlatković (2010)
Orthotrichum rupestre Schleich. ex Schwägr. – 2, 37: exposed siliceous rock; Ranđelović and Zlatković (2010)
Orthotrichum speciosum Nees – 1, 35: bark of *Salix*; 8: bark of tree; Ranđelović and Zlatković (2010)

Orthotrichum stramineum Hornsch. ex Brid. – 8, 11, 13, 20: bark of *Fagus*; 23: bark of *Betula* and *Populus*; 35: bark of *Salix*; Ranđelović and Zlatković (2010)
Orthotrichum striatum Hedw. – 1: bark of *Salix*; 8: bark of tree;13: bark of *Fagus*
Oxyrrhynchium hians (Hedw.) Loeske – 8, 31: at the stream; 15: rock and at the stream; Ranđelović and Zlatković (2010)
Oxyrrhynchium schleicheri (R. Hedw.) Röll – 8: soil
Oxystegus tenuirostris (Hook. et Taylor) A. J. E. Sm. – 8, 29: soil; Ranđelović and Zlatković (2010)
Palustriella decipiens (De Not.) Ochyra – 2, 26: wetland at a spring; 33: wet meadow
Paraleucobryum longifolium (Hedw.) Loeske – 29: siliceous rock; Ranđelović and Zlatković (2010)
Philonotis arnellii Husn. – 33: at the edge of a wet meadow
Philonotis fontana (Hedw.) Brid. – 2, 4, 9, 26: wetland at a spring; 3, 6, 10, 30: wetland; 8, 33, 34: wet meadow; 14: wet siliceous rock; Ranđelović and Zlatković (2010)
Philonotis seriata Mitt. – 2, 17, 26: wetland at a spring; 28, 34: wet meadow along a stream; Ranđelović and Zlatković (2010)
Philonotis tomentella Molendo – 2: wetland at a spring
Physcomitrium eurystomum Sendtn. – 2: soil
Physcomitrium pyriforme (Hedw.) Bruch et Schimp. – 14: wet siliceous rock; Ranđelović and Zlatković (2010)
Plagiomnium affine (Blandow ex Funck) T. J. Kop. – 2, 16, 23: soil; 8: soil, at the stream and wet meadow; 12: wet siliceous rock; 13: rock; Ranđelović and Zlatković (2010)
Plagiomnium cuspidatum (Hedw.) T. J. Kop. – 2: soil; 9: wetland at a spring; 15: rock; Ranđelović and Zlatković (2010)
Plagiomnium elatum (Bruch et Schimp.) T. J. Kop. – 2: wetland at a spring; 30: wetland; 33, 34: wet meadow; Ranđelović and Zlatković (2010)
Plagiomnium rostratum (Schrad.) T. J. Kop. – 15: at the stream
Plagiomnium undulatum (Hedw.) T. J. Kop. – 2: soil and wetland at a spring; 8, 15: at the stream; 12, 31: wet siliceous rock; 33: wet meadow; Ranđelović and Zlatković (2010)
Plagiothecium cavifolium (Brid.) Z. Iwats. – 1, 23: soil; 2: soil and siliceous rock; 8: soil in the forest and at the stream; 15: rock; 31: siliceous rock; 33: wet meadow; 35: bottom of *Fagus* and decaying wood; Ranđelović and Zlatković (2010)
Plagiothecium curvifolium Schlieph. ex Limpr. – 6: wetland
Plagiothecium denticulatum (Hedw.) Schimp. – 8, 16: soil; 29: bark of *Fagus*; Ranđelović and Zlatković (2010)
Plagiothecium laetum Schimp. – 26: wetland at a spring
Plagiothecium nemorale (Mitt.) A. Jaeger – 2: soil; 31: siliceous rock; Ranđelović and Zlatković (2010)
Platygyrium repens (Brid.) Schimp. – 23: bark of *Populus*
Platyhypnidium riparioides (Hedw.) Dixon – 8, 15, 34: at the stream; 12, 31: wet siliceous rock
Pleuridium acuminatum Lindb. – 2: soil
Pleurozium schreberi (Willd. ex Brid.) Mitt. – 1, 8, 19, 39: soil; Ranđelović and Zlatković (2010)
Pogonatum aloides (Hedw.) P. Beauv. – 25: soil; Ranđelović and Zlatković (2010)
Pogonatum nanum (Hedw.) P. Beauv. – 4: wetland at a spring; 10: edge of a wetland; 21, 24: soil
Pogonatum urnigerum (Hedw.) P. Beauv. – 8, 23, 37: soil; 9: wetland at a spring; Ranđelović and Zlatković (2010)
Pohlia andalusica (Höhn.) Broth. – 7: siliceous rock; 34: wet soil
Pohlia annotina (Hedw.) Lindb. – 25: soil; Ranđelović and Zlatković (2010)
Pohlia cruda (Hedw.) Lindb. – 1, 8: soil; 2, 34, 37: siliceous rock; Ranđelović and Zlatković (2010)
Pohlia melanodon (Brid.) A. J. Shaw – 29: soil

Pohlia nutans (Hedw.) Lindb. – 2, 37: siliceous rock; 18, 25, 34, 38: soil; Ranđelović and Zlatković (2010)
Pohlia proligera (Kindb.) Lindb. ex Broth. – 8, 37: soil
Pohlia sphagnicola (Bruch et Schimp.) Broth. – 3, 6, 17: wetland; 7: siliceous rock
Polytrichastrum alpinum (Hedw.) G. L. Sm. – 16, 23, 38, 39: soil; 24: exposed siliceous rock
Polytrichastrum formosum (Hedw.) G. L. Sm. – 8, 16, 23: soil; Ranđelović and Zlatković (2010)
Polytrichastrum longisetum (Sw. ex Brid.) G. L. Sm. – 6: wetland; Ranđelović and Zlatković (2010)
Polytrichum commune Hedw. var. ***commune*** – 3: wetland; 8, 34: wet meadow; 9: wetland at a spring; 16, 24: soil; Ranđelović and Zlatković (2010)
Polytrichum commune Hedw. var. ***perigoniale*** (Michx.) Hampe – 11: wetland; Ranđelović and Zlatković (2010)
Polytrichum juniperinum Hedw. – 2: soil and siliceous rock; 23: soil; Ranđelović and Zlatković (2010)
Polytrichum piliferum Hedw. – 2, 7, 24, 37: exposed siliceous rock; 9: at a spring; 10: edge of a wetland; 16, 18: soil; Ranđelović and Zlatković (2010)
Pseudoleskea saviana (De Not.) Latzel – 13: rock; 29: shaded siliceous rock; 35: bark of *Fagus*; Ranđelović and Zlatković (2010)
Pseudoleskeella nervosa (Brid.) Nyholm – 1: decaying wood; 8: soil, rock, bark of a tree and *Fagus;* 13: rock and bark of *Fagus*; 23: bark of *Betula* and *Populus*; 31: siliceous rock; 35: bark of *Salix* and *Fagus*; Ranđelović and Zlatković (2010)
Pseudoscleropodium purum (Hedw.) M. Fleisch. – 4: wetland at a spring; 33: wet meadow; Ranđelović and Zlatković (2010)
Pseudotaxiphyllum elegans (Brid.) Z. Iwats. – 37: among siliceous rocks
Pterigynandrum filiforme Hedw. – 1: bark of *Betula*; 2, 24: exposed siliceous rock; 8: soil, rock and bark of tree; 13: rock and bark of *Fagus*; 23: bark of *Populus*; 31, 34: siliceous rock; 35: bark of *Salix* and *Fagus*
Pylaisia polyantha (Hedw.) Schimp. – 13: bark of *Betula*; 23: bark of *Betula* and *Salix*; 35: bark of *Salix*
Racomitrium canescens (Hedw.) Brid. – 9: wetland at a spring; Ranđelović and Zlatković (2010)
Racomitrium elongatum Ehrh. ex Frisvoll – 2, 7: siliceous rock; 18: soil
Rhizomnium punctatum (Hedw.) T. J. Kop. – 8: at the stream; 15: rock; 17: soil at the spring; 31: siliceous rock; 33: wet meadow; Ranđelović and Zlatković (2010)
Rhytidiadelphus squarrosus (Hedw.) Warnst. – 8: soil and wet meadow; 16: soil; 33: wet meadow; Ranđelović and Zlatković (2010)
Rhytidiadelphus triquetrus (Hedw.) Warnst. – 2: soil
Sanionia uncinata (Hedw.) Loeske – 2, 8: soil; 9: wetland at a spring; Ranđelović and Zlatković (2010)
Schistidium apocarpum (Hedw.) Bruch et Schimp. – 2, 12, 15: siliceous rock; Ranđelović and Zlatković (2010)
Schistidium confertum (Funck) Bruch et Schimp. – 2, 7, 37: exposed siliceous rock
Schistidium papillosum Culm. – 2: exposed siliceous rock; 29, 34: siliceous rock
Sciuro-hypnum populeum (Hedw.) Ignatov et Huttunen – 15: rock; 23, 31: siliceous rock; Ranđelović and Zlatković (2010)
Sphagnum angustifolium (C. E. O. Jensen ex Russow) C. E. O. Jensen – 6, 10: wetland
Sphagnum centrale C. E. O. Jensen – 3, 6, 8, 10, 26: wetland; Ranđelović and Zlatković (2010)
Sphagnum contortum Schultz – 10, 26, 30: wetland; Ranđelović and Zlatković (2010)
Sphagnum flexuosum Dozy et Molk. – 5, 6: wetland; Ranđelović and Zlatković (2010)
Sphagnum platyphyllum (Lindb. ex Braithw.) Warnst. – 3: wetland; Ranđelović and Zlatković (2010)

Sphagnum squarrosum Crome – 5,6: wetland; Ranđelović and Zlatković (2010)
Sphagnum subsecundum Nees – 3, 5, 6, 8, 10, 30: wetland; Ranđelović and Zlatković (2010)
Sphagnum teres (Schimp.) Ångstr. – 10: wetland; Ranđelović and Zlatković (2010)
Straminergon stramineum (Dicks. ex Brid.) Hedenäs – 5, 6: wetland
Syntrichia ruralis (Hedw.) F. Weber et D. Mohr – 7, 12, 37: siliceous rock; 13: bark of *Fagus*; 15: rock; 35: bark of *Salix*; Ranđelović and Zlatković (2010)
Taxiphyllum densifolium (Lindb. ex Broth.) Reimers – 31: siliceous rock
Taxiphyllum wissgrillii (Garov.) Wijk et Margad. – 31: siliceous rock
Thuidium assimile (Mitt.) A. Jaeger – 1, 31: soil; 2: soil and siliceous rock; Ranđelović and Zlatković (2010)
Thuidium recognitum (Hedw.) Lindb. – 8: soil; 15: rock
Tomentypnum nitens (Hedw.) Loeske – 10, 11: wetland; Ranđelović and Zlatković (2010)
Tortella tortuosa (Hedw.) Limpr. – 8: rock; Ranđelović and Zlatković (2010)
Tortula subulata Hedw. – 8, 23, 29: soil; 12: siliceous rock; Ranđelović and Zlatković (2010)
Tortula truncata (Hedw.) Mitt. – 23: soil; Ranđelović and Zlatković (2010)
Warnstorfia exannulata (Schimp.) Loeske – 3, 10, 36: wetland; 8, 28, 30, 34: wet meadow; 9, 26: wetland at a spring; Ranđelović and Zlatković (2010)
Weissia brachycarpa (Nees et Hornsch.) Jur. – 2: soil
Weissia longifolia Mitt. – 2: siliceous rock

Four species were found to be first records for Serbia, and these were (or will shortly be) published in separate publications; *Ditrichum lineare* in Papp *et al.* (2012*b*), *Grimmia incurva* in Papp *et al.* (2012*a*), *Physcomitrium eurystomum* and *Pohlia proligera* Papp *et al.* (in press).

Ditrichum lineare (Sw.) Lindb. – It is a subatlantic, montane species (Düll 1984). In Southeast Europe it is known only from Bulgaria, Romania and Slovenia (Sabovljević *et al.* 2008).

Grimmia incurva Schwägr. – This is a subarctic, alpine species (Düll 1984). In SE Europe it is reported only from Bulgaria, the Former Yugoslav Republic of Macedonia and Romania (Sabovljević *et al.* 2008). Recently it is also recorded from Greece (Papp *et al.* 2011*b*).

Physcomitrium eurystomum Sendtn. – It is a sub-Mediterranean species (Düll 1984). In SE Europe it is reported only from Bulgaria, Romania and Slovenia (Sabovljević *et al.* 2008).

Pohlia proligera (Kindb.) Lindb. ex Broth. – It is a boreal, montane species (Düll 1985). In SE Europe it is recorded only in Bulgaria, Montenegro, Romania and Slovenia (Sabovljević *et al.* 2008).

In the comprehensive work of Ranđelović and Zlatković (2010) about the flora and vegetation of Lake Vlasina and its surroundings, 178 bryophytes (30 liverworts and 148 mosses) are mentioned. The following species (many of them old records derived from 1910) are reported in that publication, but they were not collected during our recent extensive field work.

Hepaticae: *Apometzgeria pubescens* (Schrank) Kuwah., *Blasia pusilla* L., *Frullania tamarisci* (L.) Dumort., *Jungermannia obovata* Nees, *Lejeunea cavifolia* (Ehrh.) Lindb., *Lophozia excisa* (Dicks.) Dumort., *Marsupella funckii* (F. Weber et D. Mohr) Dumort., *Nardia scalaris* Gray, *Plagiochila asplenioides* (L.) Dumort., *Porella platyphylla* (L.) Pfeiff., *Riccardia palmata* (Hedw.) Carruth., *Riccia fluitans* L., *Scapania curta* (Mart.) Dumort., *S. nemorea* (L.) Grolle, *Trichocolea tomentella* (Ehrh.) Dumort.

Musci: *Barbula unguiculata* Hedw., *Bryoerythrophyllum recurvirostrum* (Hedw.) P. C. Chen, *Bryum archangelicum* Müll. Hal., *B. caespiticium* Hedw., *B. funckii* Schwägr., *Calliergon giganteum* (Schimp.) Kindb., *Campylium protensum* (Brid.) Kindb., *Dichodontium palustre* (Dicks.) M. Stech, *Dicranella crispa* (Hedw.) Schimp., *D. rufescens* (Dicks.) Schimp., *D. subulata* (Hedw.) Schimp., *Drepanocladus polygamus* (Schimp.) Hedenäs, *D. sendtneri* (Schimp. ex H. Müll.) Warnst., *Encalypta ciliata* Hedw., *Eurhynchium striatum* (Hedw.) Schimp., *Grimmia trichophylla* Grev., *Hygroamblystegium humile* (P. Beauv.) Vanderp., Goffinet et Hedenäs, *Hylocomiastrum pyrenaicum* (Spruce) M. Fleisch., *Hypnum fertile* Sendtn., *Meesia triquetra* (L. ex Jolycl.) Ångstr., *Neckera complanata* (Hedw.) Huebener, *Orthotrichum patens* Bruch ex Brid., *O. schimperi* Hammar, *Pleuridium subulatum* (Hedw.) Rabenh., *Pohlia elongata* Hedw., *Pseudoleskea incurvata* (Hedw.) Loeske, *Rhytidium rugosum* (Hedw.) Kindb., *Sciuro-hypnum reflexum* (Starke) Ignatov et Huttunen, *Sphagnum capillifolium* (Ehrh.) Hedw., *S. cuspidatum* Ehrh. ex Hoffm., *S. fallax* (H. Klinggr.) H. Klinggr., *S. girgensohnii* Russow, *S. obtusum* Warnst., S. palustre L., *Splachnum sphaericum* Hedw., *Syntrichia virescens* (De Not.) Ochyra, *Thamnobryum alopecurum* (Hedw.) Gangulee, *Thuidium delicatulum* (Hedw.) Schimp., *Tortula muralis* Hedw., *Warnstorfia fluitans* (Hedw.) Loeske, *Weissia controversa* Hedw.

Part of the above species (such as *Barbula unguiculata*, *Bryum caespiticium*, *Neckera complanata*, *Syntrichia virescens*, *Tortula muralis*, or *Weissia controversa*) are common everywhere in the Balkans or in Serbia and so we are not worried about their lack from our collections. But several rarities, which had been reported 100 years ago from the lake (*e.g.*, *Sphagnum capillifolium*, *S. cuspidatum*, *S. fallax*, *S. girgensohnii*, *S. obtusum*, *S. palustre*, as well as *Calliergon giganteum*, *Drepanocladus sendtneri*, *Meesia triquetra*, *Warnstorfia fluitans*) are lacking from our current collection. We could not locate several sensitive rarities either, reported previously from the surrounding mountain area. These are mainly liverworts requiring constantly humid habitats typically found along streams, springs (such as *Blasia pusilla*, *Jungermannia obovata*, *Marsupella funckii*, *Nardia scalaris*, *Scapania nemorea*, *Trichocolea tomentella*). We could also mention rare mosses like *Bryum funckii*, *Hylocomiastrum pyrenaicum* or *Pohlia elongata*, which are missing from our new collections here.

Presence of European red-listed species

Within our collection at Lake Vlasina and surroundings, six species are included in the Red data book of European bryophytes (Eccb 1995), as follows.

Amblystegium radicale (P. Beauv.) Schimp. – A species of the temperate zones of Europe, occurring in wetlands and included in the rare (R) category in the Red data book of European bryophytes (Eccb 1995), in SE Europe it is known only from Bosnia-Herzegovina, Croatia, Romania, Serbia, Slovenia (Sabovljević *et al.* 2008), and Former Yugoslav Republic of Macedonia (Martinčič 2009). At Lake Vlasina it was found in the wetland on a floating island at Murina dolina near Vlasina Stojkovićeva.

Brachythecium geheebi Milde – This subcontinental-montane element (Düll 1985) and European endemism (Eccb 1995) is in the rare (R) category according to the Red data book of European bryophytes (Eccb 1995). It occurs on shaded rocks in the high mountains of Central Europe and Norway (Frey *et al*. 1995, Düll 1985). In Southeast Europe it is known from several countries including Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Montenegro, Romania, Serbia, Slovenia (Sabovljević *et al.* 2008). Here we report it from Mt Bukova glava near Vlasina Stojkovićeva growing on shaded siliceous rock in a stream valley at Skela village.

Grimmia caespiticia (Brid.) Jur. – This subarctic-subalpine element (Düll 1984) is in the rare (R) category in the Red data book of European bryophytes (Eccb 1995). It can be found on acidic rocks in the alpine mountains of Europe, Asia and Greenland (Nyholm 1998). In SE Europe it is also known from Bulgaria, Former Yugoslav Republic of Macedonia, Greece, Montenegro, Romania and Serbia (Blockeel 2010, Martinčič 2009, Sabovljević *et al.* 2008). Around Lake Vlasina it was found on exposed siliceous rock at Vlasina stream and on the southern slope under the peak of Mt Vrtop (Plana).

Hamatocaulis vernicosus (Mitt.) Hedenäs – It is a boreal element (Düll 1985) occurring in oligotrophic wet grasslands. It is included in the Bern Convention, the European Union Habitats and Species Directive, and in the Red data book of European bryophytes (Eccb 1995). At Lake Vlasina few individuals of the species were collected mixed with *Warnstorfia exannulata* in an *Eriophoretum* wetland of Blato at Okruglica village. Around Lake Vlasina it was reported almost 100 years ago by Košanin (1910*a*, *b*) and Katič (1910), from wetlands predominated by *Sphagnum*, which were more extended at that time along the lake. It was also recorded in the 1990s by Ranđelović from *Sphagnetum* wetlands (Ranđelović and Zlatković 2010). This species is reported from almost all Southeast European countries (Sabovljević *et al.* 2008) except Albania, Greece and the European part of Turkey, but it is rare and the known records are usually

old. For example, its only known locality in Montenegro is the Barno jezero in Durmitor Mts, where it was recorded for the first time by Birks and Walters (1973), then it appears in the collection of S. Jovanović, D. Lakusić, S. Pavić and V. Stevanović (Kürschner and Parolly 1997), and later the existence of the population is documented by our collection from 2004 (Papp and Erzberger 2010).

Pseudoleskea saviana (De Not.) Latzel – It is a rare, continental-subalpine species found in the Alps and other areas towards east (Düll 1985) occurring on shaded volcanic rocks, but sometimes found on tree bark mainly at the bases of trunks. It is in the regionally threatened (RT) category according to the Red data book of European bryophytes (Eccb 1995). It is known from all SE European countries except the European part of Turkey (Sabovljević *et al.* 2008). It does not appear to be rare in SE Europe, evidenced by several collections in Albania, Bulgaria, Greece, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia (Papp *et al.* 2009, 2010, 2011*b*, Papp and Erzberger 2009, 2010, 2012). At Lake Vlasina it was collected from shaded siliceous rocks from Mt Bukova glava near Vlasina Stojkovićeva and Sveta Trojica sa crkvicom at Dojčinovći village. In the valley of Cvetkova stream it was found on the bark of *Fagus*. Earlier, it was also reported by Podpera (1922) from the surroundings of the lake.

Taxiphyllum densifolium (Lindb. ex Broth.) Reimers – This pontic, montane element (Düll 1985) is rare (R) in Europe (Eccb 1995). It is sporadically found in the Czech Republic, Hungary, Poland and Russia. In SE Europe it was reported only from Romania and Serbia (Sabovljević *et al.* 2008). In Serbia it was discovered by the authors in the Djerdap National Park (Papp *et al.* 2006), and later also collected in the Suva Mts (Papp and Erzberger 2009), while previously from Turkey, in the Asian part of the Black Sea coast (Papp 2004). It has been recently published as new species for the Croatian bryophyte flora based on the revision of an old herbarium specimen (Papp and Sabovljević 2009). Around Lake Vlasina it was collected from siliceous rock along Vučja stream near Klisura village.

The bryophyte vegetation

Wetlands are the most important habitat types for bryophytes around Lake Vlasina. Most of the wetlands are predominated by *Sphagnum* species. These types of habitats are rare, sporadic in the Balkans and usually small in extension. The floating islands of the lake are inhabited by *Sphagnum* species (*S. angustifolium*, *S. flexuosum*, *S. squarrosum*, *S. subsecundum*), *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergon cordifolium*, *Calliergonella cuspidata*, *Drepanocladus aduncus*, *Pohlia sphagnicola*, *Straminergon stramineum* and the

European red-listed *Amblystegium radicale*. The wet meadows at the southern part of the lake, predominated by *Eriophorum angustifolium* and *Carex* species (*C. flava*, *C. echinata*), are also important habitats from the aspect of bryophyte conservation since they support the existence of several *Sphagnum* species (*S. angustifolium*, *S. centrale*, *S. contortum*, *S. teres*, *S. subsecundum*), also the European Union Habitats Directive species, *Hamatocaulis vernicosus*, and other rarities in the Balkans such as *Tomentypnum nitens*. Other bryophytes occurring here are also frequent and even abundant in the spring areas in the valleys within the wider surroundings of Lake Vlasina, exemplified by *Warnstorfia exannulata*, *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergonella cuspidata*, *Climacium dendroides*, *Dicranum bonjeanii*, *Philonotis fontana*, and *Polytrichum commune*. In the spring areas and along the out coming rivulets several other species are also characteristic, like *Brachythecium rivulare*, *Campylium stellatum*, *Conocephalum salebrosum*, *Cratoneuron filicinum*, *Fissidens adianthoides*, *Marchantia polymorpha* subsp. *montivagans*, *Marchantia polymorpha* subsp. *polymorpha*, *Philonotis seriata*, *Plagiomnium elatum*, and *Scapania undulata*. To these, we can add other species rare in the Balkans, such as *Bryum schleicheri*, *Calliergonella lindbergii*, *Calypogeia azurea*, *Jungermannia hyalina*, *Palustriella decipiens*, *Philonotis tomentella*, *Riccardia incurvata*, *R. multifida*, and *Scapania irrigua*.

The surrounding hills are mainly covered by beech forests. Unfortunately the decaying wood material is very few in these forests excluding the appearance of species connected to this substrate. On the forest floor common species like *Atrichum undulatum*, *Brachytheciastrum velutinum*, *Brachythecium rutabulum*, *B. salebrosum*, *Dicranella heteromalla*, *Dicranum scoparium*, *Eurhynchiastrum pulchellum*, *Fissidens bryoides*, *F. taxifolius*, *Hylocomium splendens*, *Hypnum cupressiforme*, *Oxyrrhynchium schleicheri*, *Plagiochila porelloides*, *Plagiomnium affine*, *Plagiothecium cavifolium*, *P. denticulatum*, *Pleurozium schreberi*, *Pogonatum urnigerum*, *Polytrichastrum formosum*, *Rhytidiadelphus squarrosus*, *Sanionia uncinata*, *Thuidium recognitum*, *Tortula subulata* are abundant. Also, on tree barks common epiphytes are present, including *Frullania dilatata*, *Metzgeria furcata*, *Orthotrichum affine*, *O. pallens*, *O. speciosum*, *O. stramineum*, *O. striatum*, *Pseudoleskeella nervosa*, *Pterigynandrum filiforme*, and *Radula complanata*. More remarkable are some rarities dwelling on shaded rocks under the forest including the European red-listed *Brachythecium geheebi*, *Pseudoleskea saviana* and *Taxiphyllum densifolium* or such rare (in the Balkans) species like *Antitrichia curtipendula*, *Paraleucobryum longifolium*, or *Schistidium papillosum*. The surrounding hills at higher elevations are characterised by acidophilus grasslands and exposed siliceous rocky habitats. The dry grasslands are not rich in bryophytes, only a few species occur there including *Cephaloziella divaricata*, *Lophozia bicrenata*, *Pohlia nutans*, *Polytrichum piliferum* and *Racomitrium elon-*

gatum. On the bare soil surfaces along roadsides and on soil among rocks species of *Ditrichum* (*D. heteromallum*, *D. pusillum*), *Pohlia* (*P. andalusica*, *P. annotina*, *P. nutans*) and several species of Polytrichaceae (*Pogonatum nanum*, *P. urnigerum*, *Polytrichastrum alpinum*, *P. formosum*, *Polytrichum commune*, *P. piliferum*) are abundant. The exposed siliceous rocks are the most important habitats from the aspect of bryophyte conservation. The bryoflora of these rocky places is rich in species of Grimmiaceae, such as *G. alpestris*, *G. laevigata*, *G. montana*, *G. muehlenbeckii*, *G. ovalis*, *Schistidium confertum*, among them the European red-listed *Grimmia caespiticia* and other rarities in the Balkans, *e.g.*, *Coscinodon cribrosus*, *Grimmia decipiens*, *G. incurva*, *Schistidium papillosum*.

CONCLUSIONS

Lake Vlasina area has suffered enormous changes especially in the middle of last century, when a dam was constructed, which caused major alterations in the natural environment including a dramatic decrease of peat bog surfaces. This can explain the disappearance of several rare wetland species, which were detected before. Despite a thorough search we could not locate several sensitive rarities previously reported from the surrounding mountain area. These are mainly liverworts that require constantly humid conditions and thus typically found along streams and springs. The lack of these species may reflect the level of degradation of these habitats and show a shift to drier climatic conditions in the surroundings of the lake.

In spite of these above-mentioned disadvantageous changes, the wetland remnants around the lake and the spring areas in the valleys, the hills of the surrounding area still preserve a high level of bryophyte diversity and considerable richness in rarities of the Balkans and even Europe. In the surrounding mountain areas especially the exposed siliceous rocky habitats have high importance for bryophyte conservation.

On the basis of our investigation it can be concluded that this area is worth to be listed as Important Bryophyte Area of the Balkans, as a hotspot of bryophyte diversity and rarities of Europe and the Balkan Peninsula.

* * *

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