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CONTRIBUTIONS TO THE BRYOPHYTE FLORA OF WESTERN STARA PLANINA MTS (E SERBIA)

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During the bryophyte investigation carried out in July 2005 in Western Stara Planina Mts (E Serbia) altogether 322 bryophytes (62 liverworts and 260 mosses) were recorded. Among them 27 are reported for the first time in Serbia (*Gymnocolea inflata, Gymnomitrion concinnatum, Jungermannia pumila, Marsupella emarginata, Radula lindenbergiana, Riccia gougetiana, Tritomaria exsecta, Bryum neodamense, Cynodontium gracilescens, C. strumiferum, Dicranum spadiceum, Encalypta microstoma, Grimmia elatior, G. torquata, G. unicolor, Hypnum cupressiforme* var. *subjulaceum, H. hamulosum, Lescuraea saxicola, Orthotrichum urnigerum, Paraleucobryum sauteri, Philonotis arnellii, Pohlia bulbifera, P. longicolla, P. nutans* var. *schimperi, Racomitrium lanuginosum, Schistidium papillosum, Timmia bavarica*); one species (*Cynodontium tenellum*) collected on the Bulgarian side of Midžor peak is new record for Bulgaria. 7 species from the Western Stara Planina Mts are included in the Red data book of European bryophytes (ECCB 1995), *i.e. Brachythecium geheebii, Bryum neodamense, Encalypta microstoma, Grimmia caespiticia, Lophozia ascendens, Paraleucobryum sauteri, Pseudoleskea saviana*. All of these but the last one (being in the regionally threatened (RT) category) are rare (R). Furthermore, 12 liverwort and 34 moss species are of national conservation and protection interest in Serbia or Bulgaria.

Key words: bryophyte flora, Bulgaria, new and redlisted species, Serbia, Western Stara Planina Mts

INTRODUCTION

Although the checklists of the bryophytes of Serbia (SABOVLJEVIĆ 2000*a*, SABOVLJEVIĆ and STEVANOVIĆ 1999) were published only very recently, thanks to intensive field work conducted in the country, mainly in protected areas, many new records have been revealed (*e.g.* SABOVLJEVIĆ 2000*b*, 2003*a*, *b*, 2006, SABOVLJEVIĆ and STEVANOVIĆ 2000, BLOCKEEL *et al.* 2003, PAPP and SABOVLJEVIĆ 2001, 2002, PAPP and ERZBERGER 2005, PAPP *et al.* 2004, 2006, SABOVLJEVIĆ and CVETIĆ 2001, 2003, VELJIĆ *et al.* 2001, PÓCS *et al.* 2004, CVETIĆ and SABOVLJEVIĆ 2005). As to the present

knowledge, the bryophyte flora of Serbia comprises 118 hepatics and 527 mosses. 36 species of the European red list occur in the country (ECCB 1995, PAPP *et al.* in press).

Following is a new contribution based on comprehensive work done in the Western Stara Planina Mts (E Serbia) with the aim of the better knowledge of the Serbian bryoflora and provide new data on European redlisted species.

MATERIALS AND METHODS

The investigated area

Stara Planina Mts ("Old Mountain" or the Balkan mountain range) are an extension of the Carpathian mountain range, separated from the latter by the Danube River. It runs 560 km from eastern Serbia eastward through central Bulgaria to the Black Sea.

In Serbia, Stara Planina Mts cover 1,800 km of mountainous region; 150 km along the border of Serbia and Bulgaria. The highest peak of this western part of the range, situated on the borderline between Serbia and Bulgaria, is Midžor at 2,168 m a.s.l.

The overall climate is continental with clear montane characteristics above 1000 m on the northern and above 1,500 m on the southern slopes. The mean temperature in January is –2, –9 °C depending on altitude and exposure, whereas the mean temperature in July is 10–22 °C. The precipitation reaches its maximum in May–June, and the minimum is in February, with the mean annual precipitation 1,300 mm. The snow cover lasts for 7–8 months in the areas above 2,000 m, and 120–130 days at 1,500–2,000 m a.s.l. (VOYNIKOV 1989).

The bedrock consists mostly of Paleozoic, weakly metamorphic and intrusive siliceous rocks and mainly Permian red sandstone in the surroundings of Midžor peak. The soils are brown-forest soils in the forested areas, which form a relatively thick layer, and dark peaty mountainous soils at higher elevations (VOYNIKOV 1989).

The vegetation consists mainly of beech forests (*Fagus sylvatica*) with scattered remnants of spruce (*Picea abies*) on the northeastern slopes.

The timberline runs at about 1,550–1,600 m a.s.l. and is formed by beech. As a result of human influence in the past, the timberline is lower than would naturally be. The higher altitudes, formerly covered by dwarfed subalpine spruce stands, are presently dominated by *Juniperus communis* subsp. *saxatilis* and subalpine pastures with *Poa media*, *Poa alpina*, *Sesleria coerulea*, *Festuca valida*, *Phleum alpinum*, etc. Small fragments of orophytic subalpine vegetation on bare rocks and "stone rivers" are found just below Midžor peak, dominated by *Saxifraga* spp. (*S. pedemontana*, *S. paniculata*, *S. bryoides*), *Cerastium alpinum*, *Juncus trifidus*, *Sedum alpestre* (BONDEV 1966).

On the proposal of the Institute of Nature Protection of Serbia, in 1997 Stara Planina was placed under strict protection as "natural merit of first class" and a strategy for ecotourism development was developed.

METHODS

The collecting trip to the investigated area shown in Figure 1 was made in July 2005. Most collecting places are situated in Serbia, but one locality lies on the eastern side of Midžor peak on the territory of Bulgaria. All main habitat types, such as forests, grasslands, stream valleys and fens were visited, and bryophytes were collected from different substrates (soil, exposed and shady rocks, tree barks and decaying wood).

The specimens are deposited in the Hungarian Natural History Museum, Budapest (BP) and in the Botanical Museum, Berlin Dahlem (B).

Nomenclature of the species follows GROLLE and LONG (2000) and HILL *et al.* (2006). New floristical results for Serbia are analysed according to the checklists of Serbia-Montenegro (SABOVLJEVIĆ 2000*a*, SABOVLJEVIĆ and STEVANOVIĆ 1999) and updated by the new records (see the citations in introduction), while for Bulgaria according to the checklists of Bulgaria (GANEVA and NATCHEVA 2003, NATCHEVA and GANEVA 2005).

Site details

1. Serbia, Stara Planina Mts, Babin Zub, at great rock walls in *Fagetum*, boulder scree and crevices of great rocks, Permian red sandstone, 1,581 m, 43° 22' 28.8" N, 22° 36' 59.1" E, 25.06.2005.

2. Serbia, Stara Planina Mts, Babin Zub, open subalpine grassland and rock outcrops, Permian red sandstone, 1,751 m, 43° 22' 16.8" N, 22° 36' 45.7" E, 25.06.2005.
3. Serbia, Stara Planina Mts, Babin Zub, Zubska reka stream, Permian red sandstone rocks in *Fagetum*, 1,536 m, 43° 22' 28.8" N, 22° 36' 59.1" E, 26.06.2005.
4. Serbia, Stara Planina Mts, valley of Zubska reka stream, wet meadows, 1,361 m, 43° 22' 42.7" N, 22° 37' 11.8" E, 26.06.2005.
5. Serbia, Stara Planina Mts, Babin Zub, road to Jabučko ravnište, sandstone rocks, *Fagetum*, 1,581 m, 43° 22' 28.8" N, 22° 36' 59.1" E, 27.06.2005.
6. Serbia, Stara Planina Mts, valley of Crnovrska reka stream, above Balta Berilovac, black schistose sandstone rocks, 488 m, 43° 24' 03.3" N, 22° 29' 44.0" E, 27.06.2005.
7. Serbia, Stara Planina Mts, valley of Crnovrska reka stream, above Balta Berilovac, 510 m, 43° 24' 07.0" N, 22° 30' 34.9" E, 27.06.2005.
8. Serbia, Stara Planina Mts, valley of Crnovrska reka stream above Mezdreja village, 643 m, 43° 24' 55.8" N, 22° 33' 04.4" E, 27.06.2005.
9. Serbia, Stara Planina Mts, valley of Crnovrska reka stream at Zubska reka stream at Kozarnica village above Golema reka village, wet meadow, 1,003 m, 43° 23' 42.9" N, 22° 36' 17.4" E, 27.06.2005.
10. Serbia, Stara Planina Mts, between Babin Zub and Midžor peak, subalpine grassland with sandstone rock outcrops and small temporary streams, 1,593 m, 43° 22' 45.1" N, 22° 37' 39.5" E, 28.06.2005.
11. Serbia, Stara Planina Mts, between Babin Zub and Midžor peak, sandstone rock outcrops at wind-swept mountain ridge, 1,812 m, 43° 23' 59.4" N, 22° 38' 00.4" E, 28.06.2005.
12. Serbia, Stara Planina Mts, between Babin Zub and Midžor peak, at the peak of Tupanar, subalpine grassland with sandstone rock outcrops, 1,693 m, 43° 23' 59.4" N, 22° 39' 21.0" E, 28.06.2005.
13. Serbia, Stara Planina Mts, valley between Babin Zub and the village Topli Do, Rekitska gora, sandstone rocks, *Fagetum*, 1,396 m, 43° 22' 05.6" N, 22° 37' 50.3" E, 29.06.2005.
14. Serbia, Stara Planina Mts, valley between Babin Zub and the village Topli Do, Rekitska reka stream, Permian red sandstone rocks, 1,100 m, 43° 22' 16.9" N, 22° 38' 39.1" E, 29.06.2005.
15. Serbia, Stara Planina Mts, between Babin Zub and Midžor peak, at the peak of Tupanar, temporary small pool in subalpine grassland, 1,903–1,933 m, 43° 24' 00.9" N, 22° 38' 55.5" E and 43° 24' 03.5" N, 22° 39' 30.4" E, 30.06.2005.
16. Serbia, Stara Planina Mts, valley of Temstica reka stream above Temska village, 401 m, 43° 15' 56.9" N, 22° 33' 21.2" E, 01.07.2005.
17. Serbia, Stara Planina Mts, valley of Temstica reka stream above Temska village, at Bukovački do stream, Permian red sandstone schist, 457 m, 43° 16' 44.5" N, 22° 34' 18.1" E, 01.07.2005.
18. Serbia, Stara Planina Mts, valley of Temstica reka stream at Temska village, wet Permian red sandstone rock wall, 507 m, 43° 17' 36.7" N, 22° 35' 23.6" E, 01.07.2005.

19. Serbia, Stara Planina Mts, valley of Temstica reka stream between Temska and Topli Do villages, 525 m, 43° 17' 47.7" N, 22° 36' 23.6" E, 01.07.2005.
20. Bulgaria, Stara Planina Mts, Midžor peak, Permian red sandstone rocks and rock cervices, 2,169 m, 43° 23' 42.7" N, 22° 40' 39.4" E, 30.06.2005.

RESULTS AND DISCUSSION

Altogether 322 bryophyte taxa (62 liverworts and 260 mosses) were collected during our field trip. The following 27 taxa are recorded for the first time in Serbia: *Gymnocolea inflata*, *Gymnomitrion concinnatum*, *Jungermannia pumila*, *Marsupella emarginata*, *Radula lindenbergiana*, *Riccia gougetiana*, *Tritomaria exsecta*, *Bryum neodamense*, *Cynodontium gracilescens*, *C. strumiferum*, *Dicranum spadiceum*, *Encalypta microstoma*, *Grimmia elatior*, *G. torquata*, *G. unicolor*, *Hypnum cupressiforme* var. *subjulaceum*, *H. hamulosum*, *Lescuraea saxicola*, *Orthotrichum urnigerum*, *Paraleucobryum sauteri*, *Philonotis arnellii*, *Pohlia bulbifera*, *P. longicolla*, *P. nutans* var. *schimperi*, *Racomitrium lanuginosum*, *Schistidium papillosum*, *Timmia bavarica*.

Gymnocolea inflata (Huds.) Dumort. is a northern sub-Atlantic species (DÜLL 1983). It was recorded in SE Europe from Bulgaria, Greece, Macedonia, Romania and Slovenia (SABOVLJEVIĆ and NATCHEVA 2006).

Gymnomitrion concinnatum (Lightf.) Corda is a subarctic, alpine species (DÜLL 1983). It is known in SE Europe only from Romania, Slovenia and Bulgaria (from adjacent Western Stara Planina) (SABOVLJEVIĆ and NATCHEVA 2006, GANEVA and NATCHEVA 2003).

Jungermannia pumila With. is a montane species of the European temperate zone (DÜLL 1983). It was reported in SE Europe from Bulgaria, Bosnia-Herzegovina, Romania and Slovenia (SABOVLJEVIĆ and NATCHEVA 2006).

Marsupella emarginata (Ehrh.) Dumort. is a montane species of the European temperate zone (DÜLL 1983). It was reported in SE Europe from Greece, Bulgaria, Romania, Bosnia-Herzegovina, Macedonia, Croatia and Slovenia (SABOVLJEVIĆ and NATCHEVA 2006).

Radula lindenbergiana Gottsche ex C. Hartm. is a montane element of the sub-Mediterranean zone (DÜLL 1983). This species is known from all SE European countries except Macedonia (SABOVLJEVIĆ and NATCHEVA 2006).

Riccia gougetiana Durieu et Mont. is a sub-Mediterranean species (DÜLL 1983). It is recorded in several SE European countries as Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Macedonia, Romania (SABOVLJEVIĆ and NATCHEVA 2006).

Tritomaria exsecta (Schmidel) Loeske is a montane species of the European temperate zone (DÜLL 1983). It was reported in SE Europe in Bulgaria, Bosnia-Herzegovina, Croatia, Romania and Slovenia (SABOVLJEVIĆ and NATCHEVA 2006). In Bulgaria it was known only from Pirin Mts (GANEVA and NATCHEVA 2003), now it was also collected on the Bulgarian side of Midžor peak.

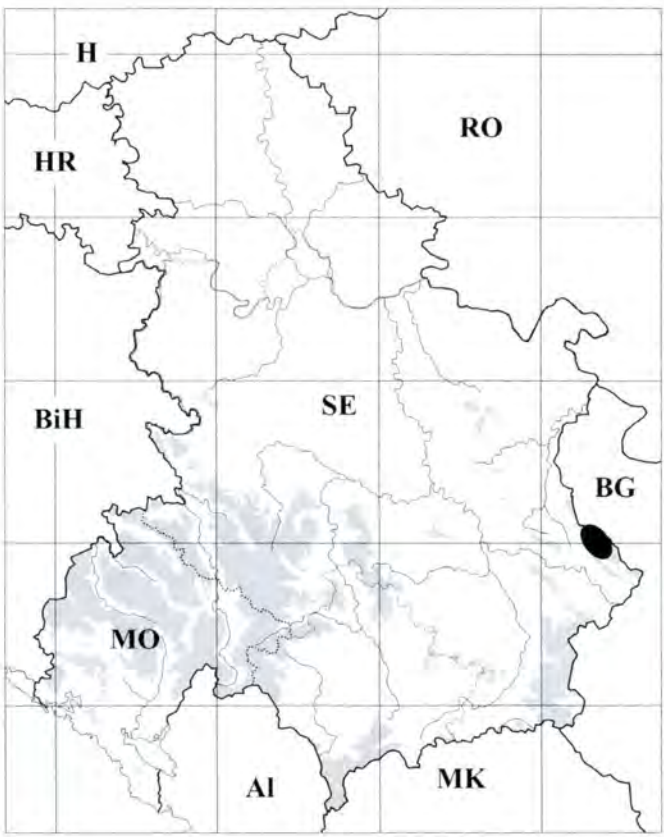

Fig. 1. Location of the investigated area. (H = Hungary, RO = Romania, HR = Croatia, BiH = Bosnia-Herzegovina, MO = Montenegro, SE = Serbia, BG = Bulgaria, MK = FYR Macedonia, Al = Albania)

Bryum neodamense Itzigs. is a subarctic element (DÜLL 1985). In SE Europe it is known from Romania (SABOVLJEVIĆ *et al.* in press), Croatia, Slovenia (DÜLL *et al.* 1999) and Bulgaria (NATCHEVA and GANEVA 2005). In Bulgaria it is known only from the Vitosha Mts.

Cynodontium gracilescens (F. Weber et D. Mohr) Schimp. is a subarctic, subalpine species (DÜLL 1984). In SE Europe this species is only known from Romania (SABOVLJEVIĆ *et al.* in press).

Cynodontium strumiferum (Hedw.) Lindb. is a boreal, montane element (DÜLL 1984). In SE Europe it is known from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria (Rila Mts) (NATCHEVA and GANEVA 2005) and Slovenia (MARTINČIČ 2003).

Dicranum spadiceum J. E. Zetterst. is a subarctic, alpine element (DÜLL 1984). In SE Europe it is recoded only in Bulgaria (Rila Mts) (NATCHEVA and GANEVA 2005) and Slovenia (Julijske Alpe) (MARTINČIČ 2003).

Encalypta microstoma Bals.-Criv. et De Not. is a subarctic, subalpine species (DÜLL 1984). In SE Europe it is known only from Bulgaria (Rila Mts) (NATCHEVA and GANEVA 2005). According to NYHOLM (1998) it is a very rare species occurring in the higher mountains of Europe.

Grimmia elatior Bruch ex Bals.-Criv. et De Not. is a subarctic, subalpine element (DÜLL 1984). In SE Europe it is reported from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria (Western Stara Planina) (NATCHEVA and GANEVA 2005), Bosnia-Herzegovina and Slovenia (DÜLL *et al.* 1999, MARTINČIČ 2003).

Grimmia torquata Drumm. is a subarctic, subalpine moss (DÜLL 1984). It is recorded in SE Europe from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria (Central Stara Planina, Rila Mts) (NATCHEVA and GANEVA 2005) and Greece (DÜLL 1995).

Grimmia unicolor Hook. is a subarctic, alpine species (DÜLL 1984). It is known in SE Europe from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria (Central Stara Planina, Rila Mts) (NATCHEVA and GANEVA 2005) and Bosnia-Herzegovina (DÜLL *et al.* 1999).

Hypnum cupressiforme Hedw. var. *subjulaceum* Molendo is a boreal, montane taxon. In SE Europe it is known from Bulgaria (DÜLL 1985), Bosnia-Herzegovina, Montenegro, and Slovenia (PAVLETIĆ 1955).

Hypnum hamulosum Schimp. is a subarctic, subalpine moss (DÜLL 1985).

In SE Europe it is mentioned only from Romania (SABOVLJEVIĆ *et al.* in press) and Slovenia (MARTINČIČ 2003).

Lescuraea saxicola (Schimp.) Molendo is a subarctic, subalpine moss (DÜLL 1985). It is reported by MARTINČIČ (2006) from Prokletije Mts (Serbia, Montenegro), but it is not clear, whether it was found on the territory of Serbia or Montenegro. In SE Europe it is reported from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria (NATCHEVA and GANEVA 2005) and Slovenia (MARTINČIČ 2003).

Orthotrichum urnigerum Myrin is an Atlantic, montane species (DÜLL 1985). In SE Europe it is reported from Romania (SABOVLJEVIĆ *et al.* in press), Bulgaria, where it has only a pre-1956 literature record from the Vitosha Mts (NATCHEVA and GANEVA 2005), and from Greece (DÜLL 1995).

Paraleucobryum sauteri (Bruch et Schimp.) Loeske is a sub-Atlantic, montane moss (DÜLL 1984). In SE Europe it is reported from Bulgaria, where it has only a pre-1956 literature record from the Vitosha Mts (NATCHEVA and GANEVA 2005), and from almost all former Yugoslavian countries such as Bosnia-Herzegovina, Montenegro, Croatia, Slovenia (DÜLL *et al.* 1999, MARTINČIČ 2003).

Philonotis arnellii Husn. is a sub-Atlantic, montane moss (DÜLL 1985). In SE Europe it is reported from Bulgaria (NATCHEVA and GANEVA 2005), Romania (SABOVLJEVIĆ *et al.* in press) and from almost all former Yugoslavian countries (DÜLL *et al.* 1999, MARTINČIČ 2003).

Pohlia bulbifera (Warnst.) Warnst. is a sub-Atlantic species (DÜLL 1985). In SE Europe it is mentioned as doubtfully recorded from Croatia (DÜLL *et al.* 1999), and it is reported from Romania (SABOVLJEVIĆ *et al.* in press) and Slovenia (MARTINČIČ 2003).

Pohlia longicolla (Hedw.) Lindb. is a subarctic, subalpine moss (DÜLL 1985). In SE Europe it is reported from Bulgaria, where it has only a pre-1956 literature record from the Vitosha Mts (NATCHEVA and GANEVA 2005), and from Montenegro and Slovenia (DÜLL *et al.* 1999, MARTINČIČ 2003). It is also doubtfully recorded from Greece (DÜLL 1995).

Pohlia nutans (Hedw.) Lindb. subsp. *schimperi* (Müll. Hal.) Nyholm was a neglected taxon in Central Europe, but has recently been published from Poland, Czech Republic and Austria (KÖCKINGER *et al.* 2005). Being new to the Balkan Peninsula, it represents a considerable extension of its range of distribution.

Racomitrium lanuginosum (Hedw.) Brid. is a boreal, montane species (DÜLL 1984). In SE Europe it is known from Bulgaria, Greece, Bosnia-Herzegovina, Montenegro, Slovenia (NATCHEVA and GANEVA 2005, DÜLL 1995, DÜLL *et al.* 1999, MARTINČIČ 2003).

Schistidium papillosum Culm. is a boreo-arctic, montane species (SMITH 2004). Apart from a doubtful record in Slovenia (MARTINČIČ 2003), in SE Europe it is known from Romania (SABOVLJEVIĆ *et al.* in press) and Bulgaria (Rila Mts) (BLOM 1996).

Timmia bavarica Hessl. is a subcontinental, dealpine element (DÜLL 1984). It is reported by MARTINČIČ (2006) from Prokletije Mts (Serbia, Montenegro), but it is not clear, whether it was found on the territory of Serbia or Montenegro. It is known from many SE European countries such as Albania (COLACINO and SABOVLJEVIĆ 2006), Bulgaria (NATCHEVA and GANEVA 2005), Greece (DÜLL 1995), Bosnia-Herzegovina, Montenegro, Croatia, Macedonia, Slovenia (DÜLL *et al.* 1999, MARTINČIČ 2003).

One species, *Cynodontium tenellum* (Schimp.) Limpr., collected on the Bulgarian side of Midžor peak is a new record for Bulgaria (NATCHEVA and GANEVA 2005). It is a boreal, montane species (DÜLL 1984). In SE Europe it is reported from Bosnia-Herzegovina (DÜLL *et al.* 1999) and Slovenia (MARTINČIČ 2003). It was reported by us (PAPP and ERZBERGER 2005) for the first time in Serbia from the Golija-Studenica Biosphere Reserve.

List of taxa collected in the Serbian side of the Stara Planina Mts

Species names are followed by the locality numbers and the substrates.

Hepaticae

Anastrophyllum minutum (Schreb.) R. M. Schust. – 1, 2, 11, 12: sandstone rocks, rock crevices
Aneura pinguis (L.) Dumort. – 9: on wet soil
Apometzgeria pubescens (Schrank) Kuwah. – 1, 3, 12: sandstone rocks, rock crevices
Barbilophozia floerkei (F. Weber et D. Mohr) Loeske – 1, 15: sandstone rocks, rock crevices
Barbilophozia hatcheri (A. Evans) Loeske – 1, 2, 10, 11: sandstone rocks, rock crevices; 4: at the edge of the forest

Barbilophozia lycopodioides (Wallr.) Loeske – 11, 15: sandstone rocks, rock crevices
Bazzania tricrenata (Wahlenb.) Lindb. – 1, 12: sandstone rocks, rock crevices
Blepharostoma trichophyllum (L.) Dumort. – 11, 12: sandstone rocks, rock crevices
Cephaloziella divaricata (Sm.) Schiffn. – 2, 6, 10, 12: sandstone rocks, rock crevices; 4: at the edge of the forest; 15: on soil
Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort. – 4: on wet soil; 19: sandstone rocks at the stream
Chiloscyphus polyanthus (L.) Corda – 3: wet sandstone rocks; 8: at the stream
Conocephalum conicum (L.) Dumort. – 1: sandstone rocks, rock crevices; 3, 19: wet sandstone rocks; 8: at the stream
Diplophyllum albicans (L.) Dumort. – 1: sandstone rocks, rock crevices
Frullania dilatata (L.) Dumort. – 1, 3, 5: on the bark of *Fagus*; 7: on the bark of *Juglans*; 8: on the bark of *Quercus*; 16: on the bark of *Populus*
Frullania tamarisci (L.) Dumort. – 1: sandstone rocks, rock crevices
Gymnocolea inflata (Huds.) Dumort. – 1: sandstone rocks, rock crevices (det. Váňa)
Gymnomitrion concinnatum (Lightf.) Corda – 1, 2: sandstone rocks, rock crevices
Jungermannia hyalina Lyell – 17: on soil near waterfall (det. Váňa)
Jungermannia pumila With. – 3: wet sandstone rocks (det. Váňa)
Leiocolea badensis (Gottsche) Jörg. – 16: limestone rocks (det./conf. Váňa)
Leiocolea collaris (Nees) Schljakov – 1, 3: sandstone rocks, rock crevices
Leiocolea heterocolpos (Thed. ex Hartm.) H. Buch – 1, 3, 11: sandstone rocks, rock crevices (det./conf. Váňa)
Lejeunea cavifolia (Ehrh.) Lindb. – 1, 3, 10, 12: sandstone rocks, rock crevices
Lophocolea bidentata (L.) Dumort. var. ***bidentata*** – 18: wet sandstone rocks
Lophocolea heterophylla (Schrad.) Dumort. – 1: sandstone rocks, rock crevices; 1, 3: on the bark of *Fagus*; 1, 3: on decaying wood; 13: on soil; 16: limestone rocks at the stream
Lophocolea minor Nees – 1, 3: sandstone rocks, rock crevices; 16: limestone rocks; 17: on soil
Lophozia ascendens (Warnst.) R. M. Schust. – 3: on decaying wood
Lophozia bicrenata (Schmidel ex Hoffm.) Dumort. – 17: on soil (conf. Váňa)
Lophozia excisa (Dicks.) Dumort. – 10: sandstone rocks, rock crevices (det. Váňa)
Lophozia incisa (Schrad.) Dumort. – 12: sandstone rocks, rock crevices
Lophozia longidens (Lindb.) Macoun – 1, 2, 12: sandstone rocks, rock crevices
Lophozia obtusa (Lindb.) A. Evans – 10: sandstone rocks, rock crevices
Lophozia sudetica (Nees ex Huebener) Grolle – 1, 15: sandstone rocks, rock crevices (det./conf. Váňa)
Lophozia ventricosa (Dicks.) Dumort. – 1, 10, 11, 12: sandstone rocks, rock crevices; 18: wet sandstone rocks (det./conf. Váňa)
Marchantia polymorpha L. subsp. ***polymorpha*** – 4, 7: at the stream; 9: on wet soil; 19: sandstone rocks at the stream
Marchantia polymorpha L. subsp. ***montivagans*** Bisch. et Boisselier – 3: wet sandstone rocks; 4, 9: on wet soil
Marchantia polymorpha L. subsp. ***ruderalis*** Bisch. et Boisselier – 3, 4: on wet soil

Marsupella emarginata (Ehrh.) Dumort. – 18: wet sandstone rocks (det. Váňa)
Marsupella funckii (F. Weber et D. Mohr) Dumort. – 1: sandstone rocks, rock crevices (det. Váňa)
Metzgeria conjugata Lindb. – 1, 3: sandstone rocks, rock crevices
Metzgeria furcata (L.) Dumort. – 1, 10, 14: sandstone rocks, rock crevices; 3: on the bark of *Fagus*
Pellia endiviifolia (Dicks.) Dumort. – 4: bank of stream; 6: sandstone rocks, rock crevices; 8: at the stream; 16: limestone rocks at a waterfall; 17, 19: sandstone rocks at the stream
Plagiochila porelloides (Torrey ex Nees) Lindenb. – 1, 2, 3, 10, 11, 16: sandstone rocks, rock crevices; 5: on the bark of *Fagus*; 17, 18: sandstone rocks at the stream
Porella cordaeana (Huebener) Mohr – 1, 10: sandstone rocks, rock crevices; 3, 14: wet sandstone rocks, 3, 5: on the bark of *Fagus*; 19: on the bark of *Salix*
Porella platyphylla (L.) Pfeiff. – 3: shaded sandstone rock
Preissia quadrata (Scop.) Nees – 1, 3: sandstone rocks, rock crevices
Radula complanata (L.) Dumort. – 1, 3, 10, 11, 12: sandstone rocks, rock crevices; 3: on the bark of *Fagus*
Radula lindenbergiana Gottsche ex C. Hartm. – 1: sandstone rocks, rock crevices (conf. Váňa)
Reboulia hemisphaerica (L.) Raddi – 6: sandstone rocks, rock crevices
Riccia glauca L. – 17: on soil
Riccia gougetiana Durieu et Mont. – 10: sandstone rocks, rock crevices (det./conf. Váňa)
Riccia sorocarpa Bisch. – 10: sandstone rocks, rock crevices
Scapania aequiloba (Schwägr.) Dumort. – 1, 3: sandstone rocks, rock crevices (conf. Váňa)
Scapania lingulata H. Buch – 17: sandstone rocks at the stream (conf. Váňa)
Scapania nemorea (L.) Grolle – 18: wet sandstone rocks
Scapania undulata (L.) Dumort. – 3: wet sandstone rocks
Tritomaria exsecta (Schmidel) Loeske – 1, 2, 11: sandstone rocks, rock crevices
Tritomaria quinquedentata (Huds.) H. Buch – 1, 2, 11, 12: sandstone rocks, rock crevices; 18: wet sandstone rocks

Musci

Abietinella abietina (Hedw.) M. Fleisch. – 4: on soil at the edge of forest, 16: on soil
Aloina aloides (Koch ex Schultz) Kindb. – 6: on basic soil over black schistose rock
Aloina rigida (Hedw.) Limpr. – 6: sandstone rocks, rock crevices
Amblystegium serpens (Hedw.) Schimp. – 3: at the base of *Fagus*; 16, 17: limestone rocks at the stream; 19: on the bark of *Salix*
Amblystegium subtile (Hedw.) Schimp. – 3: on the bark of *Fagus* (conf. Klawitter)
Amphidium mougeotii (Schimp.) Schimp. – 1, 3, 5, 10, 11, 12: sandstone rocks, rock crevices
Andraea rupestris Hedw. – 1, 2: sandstone rocks, rock crevices

Anomodon attenuatus (Hedw.) Huebener – 3, 13: sandstone rocks, rock crevices
Anomodon longifolius (Schleich. ex Brid.) Hartm. – 3: sandstone rocks, rock crevices
Anomodon rugelii (Müll. Hal.) Keissl. – 1, 3: sandstone rocks, rock crevices
Anomodon viticulosus (Hedw.) Hook. et Taylor – 16: limestone rocks at the stream; 19: on the bark of *Salix*
Antitrichia curtipendula (Hedw.) Brid. – 1, 3: sandstone rocks, rock crevices
Atrichum undulatum (Hedw.) P. Beauv. – 1: sandstone rocks, rock crevices; 3: wet sandstone rocks; 17: on soil
Aulacomnium palustre (Hedw.) Schwägr. – 15: on soil
Barbula unguiculata Hedw. – 6: sandstone rocks, rock crevices, 16: calcareous soil
Bartramia halleriana Hedw. – 1, 2, 3, 11: sandstone rocks, rock crevices
Bartramia ithyphylla Brid. – 1, 2, 5, 10, 11, 12, 18: sandstone rocks, rock crevices
Bartramia pomiformis Hedw. – 5, 17: sandstone rocks, rock crevices; 18: wet sandstone rocks
Brachytheciastrum velutinum (Hedw.) Ignatov et Huttunen – 1, 3, 5, 10, 14: sandstone rocks, rock crevices, soil, base of *Fagus*
Brachythecium albicans (Hedw.) Schimp. – 8: at the stream; 12: sandstone rocks, rock crevices
Brachythecium geheebii Milde – 1, 10: sandstone rocks, rock crevices
Brachythecium glareosum (Bruch ex Spruce) Schimp. – 1, 3: sandstone rocks, rock crevices; 4: on soil at the edge of forest; 16: limestone rocks at the stream
Brachythecium rivulare Schimp. – 1: sandstone rocks, rock crevices; 3, 14, 19: wet sandstone rocks; 4: on wet soil; 8: at the stream; 16: on wet calcareous rock
Brachythecium rutabulum (Hedw.) Schimp. – 14: sandstone rocks, rock crevices; 17: on soil and sandstone rocks at the stream; 19: on the bark of *Salix*
Brachythecium salebrosum (Hoffm. ex F. Weber et D. Mohr) Schimp. – 3: shaded boulder
Brachythecium tommasinii (Sendtn. ex Boulay) Ignatov et Huttunen – 3: sandstone rocks, rock crevices
Bryoerythrophyllum recurvirostrum (Hedw.) P. C. Chen – 3, 10, 12: sandstone rocks, rock crevices; 6: on basic soil over black schistose rock; 17: sandstone rocks at the stream; 19: on the bark of *Salix*
Bryum alpinum Huds. ex With. – 2, 6, 10: sandstone rocks, rock crevices
Bryum argenteum Hedw. – 6: sandstone rocks, rock crevices
Bryum caespiticium Hedw. – 1: on soil; 6, 12: sandstone rock crevices
Bryum capillare Hedw. – 1, 6: on base-rich soil; 16: limestone rocks; 18: on wet rocks
Bryum dichotomum Hedw. – 5, 6: on soil
Bryum elegans Nees – 1: sandstone rock crevices
Bryum moravicum Podp. – 1, 3, 5, 10, 14: sandstone rocks, rock crevices; 1, 3, 4, 5: on the bark of *Fagus*; 16: limestone rocks at the stream
Bryum neodamense Itzigs. – 15: on soil
Bryum pallens Sw. ex anon. – 4: on wet soil; 6: sandstone rocks, rock crevices
Bryum pallescens Schleich. ex Schwägr. – 3: sandstone rock crevices (det. Schröder)

Bryum pseudotriquetrum (Hedw.) P. Gaertn. *et al.* – 4, 9: on wet soil; 6, 10: sandstone rocks, rock crevices; 7: at the stream; 16: limestone rocks at the stream

Bryum rubens Mitt. – 9: on wet soil

Bryum schleicheri DC. – 4: on wet soil

Calliergonella cuspidata (Hedw.) Loeske – 4, 8, 9: on wet soil; 6: sandstone rocks, rock crevices; 16: on moist calcareous soil

Campyliadelphus chrysophyllus (Brid.) R. S. Chopra – 10, 12: sandstone rocks, rock crevices

Campylium stellatum (Hedw.) Lange et C. E. O. Jensen – 1, 3: sandstone rocks, rock crevices; 4: on wet soil

Campylophyllum calcareum (Crundw. et Nyholm) Hedenäs – 17: sandstone rocks at the stream

Ceratodon purpureus (Hedw.) Brid. – 1, 2, 10: sandstone rocks, rock crevices; 4: at the edge of the forest; 5, 6, 15: on soil; 8: at the stream

Cinclidotus fontinaloides (Hedw.) P. Beauv. – 19: sandstone rocks at the stream

Cirriphyllum crassinervium (Taylor) Loeske et M. Fleisch. – 14: sandstone rocks, rock crevices

Climacium dendroides (Hedw.) F. Weber et D. Mohr – 7: at the stream; 9: on wet soil; 17: on soil

Coscinodon cribrosus (Hedw.) Spruce – 6: schistose rock (conf. E. Maier)

Cratoneuron filicinum (Hedw.) Spruce – 3, 6: sandstone rocks, rock crevices; 16: moist calcareous rock; 17: sandstone rocks at the stream

Crossidium squamiferum (Viv.) Jur. – 6: sandstone rocks, rock crevices

Ctenidium molluscum (Hedw.) Mitt. – 1, 3: sandstone rocks, rock crevices; 16: limestone rocks

Cynodontium bruntonii (Sm.) Bruch et Schimp. – 18: wet sandstone rocks

Cynodontium gracilescens (F. Weber et D. Mohr) Schimp. – 5: sandstone rocks, rock crevices

Cynodontium polycarpon (Hedw.) Schimp. – 11: sandstone rocks

Cynodontium strumiferum (Hedw.) Lindb. – 1, 11: sandstone rocks

Cynodontium tenellum (Schimp.) Limpr. – 5, 10: sandstone rocks, rock crevices

Dichodontium pellucidum (Hedw.) Schimp. – 3: wet sandstone rocks, rock crevices

Dicranella heteromalla (Hedw.) Schimp. – 1: sandstone rocks, rock crevices; 18: wet sandstone rocks

Dicranella schreberiana (Hedw.) Dixon – 9: on wet soil

Dicranella staphylina H. Whitehouse – 17: on soil

Dicranella varia (Hedw.) Schimp. – 16: limestone rocks

Dicranodontium denudatum (Brid.) E. Britton – 18: wet sandstone rocks

Dicranoweisia crispula (Hedw.) Milde – 1, 2, 3, 5, 11, 12, 15: sandstone rocks, rock crevices

Dicranum scoparium Hedw. – 1, 2, 3, 10, 11, 12, 18: sandstone rocks, rock crevices

Dicranum spadiceum J. E. Zetterst. – 11: sandstone rocks, rock crevices

Didymodon fallax (Hedw.) R. H. Zander – 16: on soil; 17: sandstone rocks at the stream

Didymodon luridus Hornsch. – 6: sandstone rocks, rock crevices; 17: sandstone rocks at the stream

Didymodon rigidulus Hedw. – 6: sandstone rocks, rock crevices; 16: limestone rocks at the stream
Didymodon tophaceus (Brid.) Lisa – 6: sandstone rocks, rock crevices
Didymodon vinealis (Brid.) R. H. Zander – 17: sandstone rocks at the stream
Distichium capillaceum (Hedw.) Bruch et Schimp. – 1, 3, 12: sandstone rocks, rock crevices
Ditrichum flexicaule (Schwägr.) Hampe – 12: sandstone rocks, rock crevices, 16: on soil
Ditrichum gracile (Mitt.) Kuntze – 3, 11, 12: sandstone rocks, rock crevices
Ditrichum heteromallum (Hedw.) E. Britton – 1: sandstone rocks, rock crevices
Ditrichum pusillum (Hedw.) Hampe – 1, 2: sandstone rocks, rock crevices
Drepanocladus aduncus (Hedw.) Warnst. – 15: on soil
Encalypta ciliata Hedw. – 3, 5, 10: sandstone rocks, rock crevices
Encalypta microstoma Bals.-Criv. et De Not. – 10, 11: sandstone rocks, rock crevices
Encalypta rhaptocarpa Schwägr. – 12: sandstone rocks, rock crevices
Encalypta streptocarpa Hedw. – 3, 6, 10: sandstone rocks, rock crevices; 16: limestone rocks
Encalypta vulgaris Hedw. – 6: sandstone rocks, rock crevices
Eucladium verticillatum (With.) Bruch et Schimp. – 1, 6: sandstone rocks, rock crevices; 16, 17: limestone rocks at waterfalls
Eurhynchiastrum pulchellum (Hedw.) Ignatov et Huttunen var. ***diversifolium*** (Schimp.) Ochyra et Zarnowiec – 1, 10, 15: sandstone rocks, rock crevices
Fissidens crassipes Wilson ex Bruch et Schimp. subsp. ***warnstorfii*** (M. Fleisch.) Brugg.-Nann. – 17: sandstone rocks at the stream
Fissidens dubius P. Beauv. – 1: sandstone rocks, rock crevices; 16: limestone rocks at the stream
Fissidens gracilifolius Brugg.-Nann. et Nyholm – 16: limestone rocks at the stream
Fissidens pusillus (Wilson) Milde – 19: sandstone rocks at the stream
Fissidens taxifolius Hedw. – 9: on wet soil; 17: on soil
Fontinalis antipyretica Hedw. – 8: at the stream
Funaria hygrometrica Hedw. – 5: sandstone rocks, rock crevices
Grimmia alpestris (F. Weber et D. Mohr) Schleich. – 2, 6, 10, 15: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia caespiticia (Brid.) Jur. – 6, 15: sandstone rocks, rock crevices
Grimmia elatior Bruch ex Bals.-Criv. et De Not. – 1, 2, 10, 11: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia funalis (Schwägr.) Bruch et Schimp. – 1, 2, 3, 11: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia hartmannii Schimp. – 1, 2, 3, 5, 10, 14: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia laevigata (Brid.) Brid. – 6, 10, 18: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia longirostris Hook. – 5: sandstone rock outcrops (det. E. Maier)
Grimmia muehlenbeckii Schimp. – 1, 2, 10: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia ovalis (Hedw.) Lindb. – 2, 5, 10, 11, 18: sandstone rocks, rock crevices (conf. E. Maier)
Grimmia pulvinata (Hedw.) Sm. – 6, 18: sandstone rocks, rock crevices; 16: limestone rocks
Grimmia tergestina Tomm. ex Bruch et Schimp. – 6: on basic rocks (rev. E. Maier)

Grimmia torquata Drumm. – 1: sandstone rocks, rock crevices

Grimmia unicolor Hook. – 12: sandstone rocks, rock crevices

Gymnostomum calcareum Nees et Hornsch. – 3, 6: sandstone rocks, rock crevices; 16: limestone rocks

Hedwigia ciliata (Hedw.) P. Beauv. var. ***ciliata*** – 1, 5, 7, 9, 10, 11: sandstone rocks, rock crevices

Hedwigia ciliata (Hedw.) P. Beauv. var. ***leucophaea*** Bruch et Schimp. – 5, 10, 14: sandstone rocks, rock crevices

Herzogiella seligeri (Brid.) Z. Iwats. – 1: sandstone rocks, rock crevices; 1, 3: on decaying wood

Heterocladium dimorphum (Brid.) Schimp. – 1, 10, 11, 12: sandstone rocks, rock crevices

Homalia trichomanoides (Hedw.) Brid. – 1: sandstone rocks, rock crevices

Homalothecium lutescens (Hedw.) H. Rob. – 1, 10, 16, 17: on soil

Homalothecium philippeanum (Spruce) Schimp. – 1, 2, 3, 10, 14: sandstone rocks, rock crevices

Homalothecium sericeum (Hedw.) Schimp. – 6, 10: sandstone rocks, rock crevices; 16: limestone rocks; 19: on the bark of *Salix*

Hygroamblystegium fluviatile (Hedw.) Loeske – 8: at the stream; 19: sandstone rocks at the stream

Hygroamblystegium tenax (Hedw.) Jenn. – 3, 14, 17: wet sandstone rocks

Hygroamblystegium varium (Hedw.) Mönk. – 16: limestone rocks at the stream

Hygrohypnum luridum (Hedw.) Jenn. – 17: sandstone rocks at the stream

Hylocomiastrum pyrenaicum (Spruce) M. Fleisch. – 2: sandstone rocks, rock crevices

Hylocomium splendens (Hedw.) Schimp. – 1: sandstone rocks, rock crevices; 9: on wet soil; 10, 11, 17, 18: on soil

Hypnum cupressiforme Hedw. var. ***cupressiforme*** – 1, 2, 10, 11, 12, 14: sandstone rocks, rock crevices; 7: on the bark of *Juglans*; 16, 17: on soil; 18: wet sandstone rocks; 19: on the bark of *Salix*

Hypnum cupressiforme Hedw. var. ***lacunosum*** Brid. – 1, 2, 6, 10: sandstone rocks, rock crevices

Hypnum cupressiforme Hedw. var. ***subjulaceum*** Molendo – 1, 11: sandstone rocks, rock crevices

Hypnum hamulosum Schimp. – 11: sandstone rocks, rock crevices

Hypnum revolutum (Mitt.) Lindb. – 11: sandstone rocks, rock crevices

Isopterygiopsis pulchella (Hedw.) Z. Iwats. – 3, 12: sandstone rocks, rock crevices

Isothecium alopecuroides (Lam. ex Dubois) Isov. – 1, 2, 3, 11, 14: sandstone rocks, rock crevices; 5: on the bark of *Fagus*

Isothecium myosuroides Brid. subsp. ***myosuroides*** – 11: sandstone rocks, rock crevices

Leptobryum pyriforme (Hedw.) Wilson – 17: on soil

Leptodictyum riparium (Hedw.) Warnst. – 7: at the stream

Lescuraea saxicola (Schimp.) Molendo – 1: sandstone rocks, rock crevices; 5: on the bark of *Fagus*

Leskea polycarpa Hedw. – 16: on the bark of *Populus* and *Juglans*
Leucodon sciuroides (Hedw.) Schwägr. – 3, 4, 5: on the bark of *Fagus*; 7: on the bark of *Juglans*; 10, 14: sandstone rocks, rock crevices; 16: on the bark of *Populus* and *Prunus cerasus*
Mnium lycopodioides Schwägr. – 1, 3: sandstone rocks, rock crevices
Mnium marginatum (Dicks.) P. Beauv. – 1: sandstone rocks, rock crevices
Mnium spinosum (Voit) Schwägr. – 1, 11: sandstone rocks, rock crevices
Mnium spinulosum Bruch et Schimp. – 12: sandstone rocks, rock crevices
Mnium stellare Hedw. – 1, 3, 11, 12, 18: sandstone rocks, rock crevices; 17: sandstone rocks at the stream
Mnium thomsonii Schimp. – 1, 11, 12: sandstone rocks, rock crevices
Myurella julacea (Schwägr.) Schimp. – 12: sandstone rocks, rock crevices
Neckera besseri (Lobarz.) Jur. – 1, 14: sandstone rocks, rock crevices; 16: limestone rocks at the stream
Neckera complanata (Hedw.) Huebener – 1: sandstone rocks, rock crevices; 16: limestone rocks
Neckera crispa Hedw. – 1: sandstone rocks, rock crevices; 16: limestone rocks
Neckera menziesii Drumm. – 1: sandstone rocks, rock crevices
Orthothecium intricatum (Hartm.) Schimp. – 1, 3: sandstone rocks, rock crevices
Orthotrichum affine Schrad. ex Brid. – 7: on the bark of *Juglans*; 16: on the bark of *Juglans*, *Populus* and *Prunus cerasus*; 8, 19: on the bark of *Salix*
Orthotrichum anomalum Hedw. – 6, 10: sandstone rocks, rock crevices; 16: limestone rocks
Orthotrichum cupulatum Hoffm. ex Brid. var. ***cupulatum*** – 6: black schistose rocks; 10, 13, 14: sandstone rocks, rock crevices; 16: limestone rocks
Orthotrichum obtusifolium Brid. – 5: on the bark of *Fagus*; 13: on the bark of *Sambucus*
Orthotrichum pallens Bruch ex Brid. – 3, 4, 5: on the bark of *Fagus*; 13: on the bark of *Sambucus*
Orthotrichum rupestre Schleich. ex Schwägr. – 10, 11: sandstone rocks, rock crevices
Orthotrichum stramineum Hornsch. ex Brid. – 3, 5, 13: on the bark of *Fagus*
Orthotrichum striatum Hedw. – 5, 13: on the bark of *Fagus*; 16: on the bark of *Prunus cerasus*; 19: on the bark of *Salix*
Orthotrichum urnigerum Myrin – 10: sandstone rocks, rock crevices; 14: sandstone rocks at the stream
Oxyrrhynchium hians (Hedw.) Loeske – 16: limestone rocks at the stream
Oxystegus tenuirostris (Hook. et Taylor) A. J. E. Sm. – 3: sandstone rocks at the stream (det. Klawitter)
Palustriella commutata (Hedw.) Ochyra – 16, 17: limestone rocks at waterfalls
Palustriella decipiens (De Not.) Ochyra – 4: on wet soil
Paraleucobryum longifolium (Hedw.) Loeske – 1: sandstone rocks, rock crevices and at base of *Fagus*; 3: at base of *Fagus*
Paraleucobryum sauteri (Bruch et Schimp.) Loeske – 1: sandstone rocks

Philonotis arnellii Husn. – 17: on soil
Philonotis calcarea (Bruch et Schimp.) Schimp. – 4, 9, 10: on wet soil
Philonotis fontana (Hedw.) Brid. – 1, 10, 12: sandstone rocks, rock crevices; 4, 9: on wet soil; 7: at the stream
Philonotis marchica (Hedw.) Brid. – 6: sandstone rocks, rock crevices; 16: near waterfall
Philonotis seriata Mitt. – 4: on wet soil
Plagiobryum zierii (Hedw.) Lindb. – 1, 2, 10, 11: sandstone rocks, rock crevices
Plagiomnium affine (Blandow ex Funck) T. J. Kop. – 4, 13: on soil
Plagiomnium elatum (Bruch et Schimp.) T. J. Kop. – 4, 9: on wet soil
Plagiomnium ellipticum (Brid.) T. J. Kop. – 16: limestone rocks at a waterfall
Plagiomnium rostratum (Schrad.) T. J. Kop. – 3: wet sandstone rocks; 8: at the stream; 16: limestone rocks at the stream
Plagiomnium undulatum (Hedw.) T. J. Kop. – 1, 3, 6: wet sandstone rocks; 8: at the stream; 17, 18, 19: sandstone rocks at the stream
Plagiopus oederianus (Sw.) H. A. Crum et L. E. Anderson – 3, 12: sandstone rocks, rock crevices
Plagiothecium cavifolium (Brid.) Z. Iwats. – 1, 10, 12: sandstone rocks, rock crevices
Plagiothecium denticulatum (Hedw.) Schimp. var. ***denticulatum*** – 1, 3, 10: sandstone rocks, rock crevices
Plagiothecium denticulatum (Hedw.) Schimp. var. ***obtusifolium*** (Turner) Moore – 1, 3: sandstone rocks, rock crevices
Plagiothecium laetum Schimp. – 3: at the stream
Plagiothecium nemorale (Mitt.) A. Jaeger – 1: sandstone rocks, rock crevices
Plagiothecium succulentum (Wilson) Lindb. – 1, 3: sandstone rocks, rock crevices
Plasteurhynchium striatulum (Spruce) M. Fleisch. – 1: sandstone rocks, rock crevices; 16: limestone rocks at the stream
Platyhypnidium riparioides (Hedw.) Dixon – 3, 6, 8: at the stream, 14, 17, 19: wet sandstone rocks; 16: limestone rocks at a waterfall
Pleuridium acuminatum Lindb. – 5: on soil
Pleurochaete squarrosa (Brid.) Lindb. – 6: sandstone rocks, rock crevices
Pleurozium schreberi (Willd. ex Brid.) Mitt. – 1, 10: sandstone rocks, rock crevices, 16: on soil; 18: wet sandstone rocks
Pogonatum aloides (Hedw.) P. Beauv. – 1: on soil; 18: wet sandstone rocks
Pogonatum nanum (Hedw.) P. Beauv. – 5: on soil
Pogonatum urnigerum (Hedw.) P. Beauv. – 1: on soil over sandstone rocks, in rock crevices
Pohlia andalusica (Höhn.) Broth. – 10, 12: on soil over sandstone rocks, rock crevices
Pohlia bulbifera (Warnst.) Warnst. – 10: on soil
Pohlia cruda (Hedw.) Lindb. – 1, 2, 5, 10, 11: sandstone rocks, rock crevices
Pohlia elongata Hedw. – 5: on soil
Pohlia longicolla (Hedw.) Lindb. – 1, 11, 12, 15: sandstone rocks, rock crevices
Pohlia lutescens (Limpr.) H. Lindb. – 1: sandstone rocks, rock crevices; 5, 13, 17: on soil
Pohlia melanodon (Brid.) A. J. Shaw – 16: on soil

Pohlia nutans (Hedw.) Lindb. subsp. ***nutans*** – 1, 2, 10, 11: sandstone rocks, rock crevices

Pohlia nutans (Hedw.) Lindb. subsp. ***schimperi*** (Müll. Hal.) Nyholm – 1, 10, 11: sandstone rocks, rock crevices; 15: on soil

Pohlia wahlenbergii (F. Weber et D. Mohr) A. L. Andrews – 16, 17: limestone rocks at a waterfall

Polytrichastrum alpinum (Hedw.) G. L. Sm. – 1, 2, 5, 11, 12, 18: sandstone rocks, rock crevices

Polytrichastrum formosum (Hedw.) G. L. Sm. – 1, 2: sandstone rocks, rock crevices; 15, 17: on soil

Polytrichum commune Hedw. – 18: wet sandstone rocks

Polytrichum juniperinum Hedw. – 2, 4, 10: sandstone rocks, rock crevices

Polytrichum piliferum Hedw. – 1, 2, 6, 10, 12, 18: sandstone rocks, rock crevices

Pseudoleskea incurvata (Hedw.) Loeske – 1, 11, 15: sandstone rocks, rock crevices

Pseudoleskea patens (Lindb.) Kindb. – 1, 3: sandstone rocks, rock crevices

Pseudoleskea radicosa (Mitt.) Macoun et Kindb. – 1, 3, 5, 15: sandstone rocks, rock crevices

Pseudoleskea saviana (De Not.) Latzel – 3: on the bark of *Fagus* (conf. H. Köckinger)

Pseudoleskeella catenulata (Brid. ex Schrad.) Kindb. – 10, 12: sandstone rocks, rock crevices

Pseudoleskeella nervosa (Brid.) Nyholm – 1, 2, 10, 14: sandstone rocks, rock crevices; 1: on decaying wood; 3, 4, 5: on the bark of *Fagus*

Pseudoscleropodium purum (Hedw.) M. Fleisch. – 16: on soil

Pseudotaxiphyllum elegans (Brid.) Z. Iwats. – 18: wet sandstone rocks

Pterigynandrum filiforme Hedw. – 1, 2, 3, 10, 12, 14: sandstone rocks, rock crevices; 1, 4, 5: on the bark of *Fagus*, 1: on decaying wood

Racomitrium aciculare (Hedw.) Brid. – 3, 18: wet sandstone rocks

Racomitrium affine (F. Weber et D. Mohr) Lindb. – 1: exposed sandstone rocks; 2: sandstone rocks, rock crevices; 17, 18: wet sandstone rocks (det./conf. F. Müller)

Racomitrium aquaticum (Brid. ex Schrad.) Brid. – 1: sandstone rocks, rock crevices

Racomitrium canescens (Hedw.) Brid. – 2, 10: sandstone rocks, rock crevices; 8: at the stream

Racomitrium ericoides (Brid.) Brid. – 12: sandstone rocks, rock crevices

Racomitrium heterostichum (Hedw.) Brid. – 1, 2: sandstone rocks, rock crevices; 17, 18: wet sandstone rocks (rev./conf. F. Müller)

Racomitrium lanuginosum (Hedw.) Brid. – 1, 2, 11: sandstone rocks, rock crevices

Racomitrium sudeticum (Funck) Bruch et Schimp. – 2: sandstone rocks, rock crevices; 18: wet sandstone rocks (rev./conf. F. Müller)

Rhabdoweisia fugax (Hedw.) Bruch et Schimp. – 18: wet sandstone rocks

Rhizomnium punctatum (Hedw.) T. J. Kop. – 1, 3, 5: sandstone rocks, rock crevices; 1: on decaying wood; 18: wet sandstone rocks

Rhytidiadelphus squarrosus (Hedw.) Warnst. – 9: on wet soil

Rhytidiadelphus triquetrus (Hedw.) Warnst. – 1, 11: sandstone rocks, rock crevices; 18: wet sandstone rocks

Rhytidium rugosum (Hedw.) Kindb. – 10: sandstone rocks, rock crevices
Saelania glaucescens (Hedw.) Broth. – 11: sandstone rocks, rock crevices
Sanionia uncinata (Hedw.) Loeske – 1, 2, 3, 11, 15: sandstone rocks, rock crevices; 3: on the bark of *Fagus*; 18: wet sandstone rocks
Schistidium apocarpum (Hedw.) Bruch et Schimp. – 3, 7, 10, 14: sandstone rocks; 16: on soil over calcareous rock (conf./det. W. Schröder)
Schistidium confertum (Funck) Bruch et Schimp. – 2, 10: sandstone rocks, rock crevices (conf. W. Schröder)
Schistidium crassipilum H. H. Blom – 6: on schistose rocks; 16: limestone rocks; 17: sandstone rocks; 18: wet sandstone rocks (conf. W. Schröder)
Schistidium flaccidum (De Not.) Ochyra – 10: sandstone rocks, rock crevices (conf. W. Schröder)
Schistidium papillosum Culm. – 1, 5, 10, 11, 12: sandstone rocks, rock crevices (conf. W. Schröder)
Schistidium pruinosum (Wilson ex Schimp.) G. Roth – 10, 12: sandstone rocks, rock crevices (conf./det. W. Schröder)
Sciuro-hypnum populeum (Hedw.) Ignatov et Huttunen – 1, 10: sandstone rocks, rock crevices; 3, 19: sandstone rocks at the stream
Sciuro-hypnum reflexum (Starke) Ignatov et Huttunen – 1, 3, 11, 15: sandstone rocks, rock crevices
Sciuro-hypnum starkei (Brid.) Ignatov et Huttunen – 1: sandstone rocks, rock crevices
Syntrichia laevipila Brid. – 16: calcareous soil near waterfall
Syntrichia montana Nees – 10: sandstone rocks, rock crevices
Syntrichia ruralis (Hedw.) F. Weber et D. Mohr – 1, 3, 6, 10, 14, 18: sandstone rocks, rock crevices; 3: on the bark of *Fagus*; 16: on calcareous soil
Syntrichia virescens (De Not.) Ochyra – 10: sandstone rocks, rock crevices
Taxiphyllum wissgrillii (Garov.) Wijk et Margad. – 1, 3: sandstone rocks, rock crevices
Thuidium assimile (Mitt.) A. Jaeger – 16, 17: on soil
Thuidium recognitum (Hedw.) Lindb. – 9, 17: on soil
Thuidium tamariscinum (Hedw.) Schimp. – 18: wet sandstone rocks
Timmia austriaca Hedw. – 1, 11: sandstone rocks, rock crevices
Timmia bavarica Hessl. – 1, 3: sandstone rocks, rock crevices
Tortella fragilis (Hook. et Wilson) Limpr. – 12: sandstone rocks, rock crevices
Tortella tortuosa (Hedw.) Limpr. – 1, 10, 12: sandstone rocks, rock crevices; 16: on soil
Tortula atrovirens (Sm.) Lindb. – 6: soil in crevices of schistose rocks
Tortula inermis (Brid.) Mont. – 6: sandstone rocks, rock crevices
Tortula lanceola R. H. Zander – 6: sandstone rocks, rock crevices
Tortula hoppeana (Schultz) Ochyra – 10, 12: sandstone rocks, rock crevices
Tortula muralis Hedw. – 6: sandstone rocks, rock crevices; 16: limestone rocks; 17: sandstone rocks at the stream
Tortula schimperi M. J. Cano, O. Werner et J. Guerra – 10, 14: sandstone rocks, rock crevices
Tortula subulata Hedw. – 10, 14, 18: sandstone rocks, rock crevices

Trichodon cylindricus (Hedw.) Schimp. – 2: sandstone rocks, rock crevices
Trichostomum brachydontium Bruch – 1, 6: sandstone rocks, rock crevices
Warnstorfia exannulata (Schimp.) Loeske – 15: on soil
Weissia condensa (Voit) Lindb. – 6, 10, 12: sandstone rocks, rock crevices
Weissia controversa Hedw. var. ***controversa*** – 10: sandstone rocks, rock crevices
Weissia controversa Hedw. var. ***crispata*** (Nees et Hornsch.) Nyholm – 10: sandstone rocks, rock crevices

List of the species collected in the Bulgarian side of the Stara Planina Mts

Locality: Midžor peak, Permian red sandstone rocks and rock cervices, 2,169 m, 43° 23' 42.7" N, 22° 40' 39.4" E, 30.06.2005.

Hepaticae

Anastrophyllum minutum (Schreb.) R. M. Schust.
Apometzgeria pubescens (Schrank) Kuwah.
Barbilophozia floerkei (F. Weber et D. Mohr) Loeske
Bazzania tricrenata (Wahlenb.) Lindb.
Fossombronia husnotii Corb. (conf. Váňa)
Frullania jackii Gottsche
Jamesoniella autumnalis (DC.) Steph.
Jungermannia sphaerocarpa Hook. (det. Váňa)
Lejeunea cavifolia (Ehrh.) Lindb.
Lophozia excisa (Dicks.) Dumort.
Lophozia incisa (Schrad.) Dumort.
Plagiochila porelloides (Torrey ex Nees) Lindenb.
Tritomaria exsecta (Schmidel) Loeske
Tritomaria quinquedentata (Huds.) H. Buch

Musci

Amphidium lapponicum (Hedw.) Schimp.
Amphidium mougeotii (Schimp.) Schimp.
Bartramia ithyphylla Brid.
Cynodontium tenellum (Schimp.) Limpr.
Dicranoweisia crispula (Hedw.) Milde

Dicranum spadiceum J. E. Zetterst.
Distichium capillaceum (Hedw.) Bruch et Schimp.
Ditrichum gracile (Mitt.) Kuntze
Encalypta alpina Sm.
Encalypta ciliata Hedw.
Encalypta microstoma Bals.-Criv. et De Not.
Eurhynchiastrum pulchellum (Hedw.) Ignatov et Huttunen
Grimmia alpestris (F. Weber et D. Mohr) Schleich. (conf. E. Maier)
Grimmia elatior Bruch ex Bals.-Criv. et De Not. (conf. E. Maier)
Grimmia funalis (Schwägr.) Bruch et Schimp. (conf. E. Maier)
Grimmia ovalis (Hedw.) Lindb.
Hedwigia ciliata (Hedw.) P. Beauv. var. ***leucophaea*** Bruch et Schimp.
Heterocladium dimorphum (Brid.) Schimp.
Hylocomium splendens (Hedw.) Schimp.
Lescuraea saxicola (Schimp.) Molendo
Mnium thomsonii Schimp.
Plagiothecium laetum Schimp.
Pohlia cruda (Hedw.) Lindb.
Pohlia elongata Hedw.
Pohlia longicolla (Hedw.) Lindb.
Polytrichastrum alpinum (Hedw.) G. L. Sm.
Polytrichastrum formosum (Hedw.) G. L. Sm.
Racomitrium canescens (Hedw.) Brid.
Saelania glaucescens (Hedw.) Broth.
Schistidium confertum (Funck) Bruch et Schimp. (conf. W. Schröder)
Syntrichia ruralis (Hedw.) F. Weber et D. Mohr
Tortella tortuosa (Hedw.) Limpr.

Conservation value of the bryophyte flora of the Stara Planina Mts

According to present knowledge, 36 species redlisted in Europe occur in Serbia (Red data book of European bryophytes, ECCB 1995, PAPP *et al.* in press). Of these, the following 7 species were found in the Western Stara Planina Mts: *Brachythecium geheebii*, *Bryum neodamense*, *Encalypta microstoma*, *Grimmia caespiticia*, *Lophozia ascendens*, *Paraleucobryum sauteri*, *Pseudoleskea saviana*. Except the last one, which is in the regionally threatened (RT) category, all of them are placed in the rare (R) category.

Part of the data concerning the populations of European redlisted species in Serbian Stara Planina were published also in PAPP *et al.* (in press).

Brachythecium geheebii Milde

A moss species listed in the rare (R) category of the Red data book of European bryophytes (ECCB 1995), it is a subcontinental-montane element (DÜLL 1985) and a European endemism (ECCB 1995). It occurs on shaded, slightly basic rocks in the high mountains of Central Europe and Norway (FREY *et al.* 1995, DÜLL 1985). We found it under Babin Zub, on a boulder scree and the basis of great, Permian red sandstone rocks and under Midžor peak on sandstone rock outcrops in subalpine grassland.

The species was first recorded in Serbia from the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005) thus this is the second locality in Serbia. It was reported earlier from Montenegro (SABOVLJEVIĆ and STEVANOVIĆ 1999). In SE Europe it has records from Bulgaria, Romania (DÜLL 1985), Montenegro and Slovenia (PAVLETIĆ and PULEVIĆ 1975, ECCB, 1995).

Bryum neodamense Itzigs.

It is in the rare (R) category according to the Red data book of European bryophytes (ECCB 1995) and is regarded as a subarctic element (DÜLL 1985). It is reported for the first time from Serbia; in SE Europe it is known from Croatia, Slovenia (DÜLL *et al.* 1999) and Bulgaria (NATCHEVA and GANEVA 2005), in the latter only from the Vitosha Mts.

Encalypta microstoma Bals.-Criv. et De Not.

In the rare (R) category according to the Red data book of European bryophytes (ECCB 1995), this is a subarctic, subalpine species (DÜLL 1984). According to NYHOLM (1998) it is very rare, confined to the higher mountains of Europe. In the western Stara Planina Mts we found it under Midžor peak, at the peak of Tupanar on sandstone rocks in subalpine

grassland; also found it on the Bulgarian side of Mižor peak. This is the first record in Serbia and also a new locality of this redlisted species for Bulgaria. Formerly, in SE Europe it was only known from Bulgaria, only from the Rila Mts (NATCHEVA and GANEVA 2005).

Grimmia caespiticia (Brid.) Jur.

It is in the rare (R) category according to the Red data book of European bryophytes (ECCB 1995). Regarded as a subarctic-subalpine element (DÜLL 1984) it occurs on acidic rocks in the alpine belts of mountains of Europe, Asia and Greenland (NYHOLM 1998). In the western Stara Planina Mts it was found at Crnovrska reka (stream) near Baltaberilovac village, on exposed, black schistose sandstone rocks and under Midžor peak, at the peak of Tupanar, on sandstone rocks at a temporary small pool in subalpine grassland. This is its second occurrence in Serbia, after the first record in Serbia is from the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). Previous records are from Montenegro (SABOVLJEVIĆ and STEVANOVIĆ 1999), from Bulgaria and Romania (DÜLL 1984). It is also is recorded in Turkey (DÜLL 1984).

Lophozia ascendens (Warnst.) R. M. Schust.

It is in the rare (R) category according to the Red data book of European bryophytes (ECCB 1995). As a boreal, montane leafy hepatic (DÜLL 1983, 1984) it lives on large, well-decayed logs in constantly humid forests; therefore, it is considered an indicator of old-growth forests. We collected it on decaying wood at Zubska reka (stream) below the hotel of Babin Zub.

Lophozia ascendens was found in Serbia for the first time in the Tara Mts (PAPP and SABOVLJEVIĆ 2002); later we collected it also in Kopaonik National Park (PAPP *et al.* 2004), and Golija-Studenica Biosphere Reserve is its third locality in Serbia (PAPP and ERZBERGER 2005). In SE Europe it was also reported from Bulgaria, Romania (DÜLL 1983).

Paraleucobryum sauteri (Bruch et Schimp.) Loeske

It is in the rare (R) category according to the Red data book of European bryophytes (ECCB 1995) known as a subcontinental, montane element (DÜLL 1984). We found it, as a first record in Serbia, under Babin Zub on a sandstone boulder in block scree under *Fagus*. In SE Europe it is reported from Bulgaria, but it has only a pre-1956 literature record from the Vitosha Mts (NATCHEVA and GANEVA 2005) and it is known from almost all former Yugoslavian countries as Bosnia-Herzegovina, Montenegro, Croatia, Slovenia (DÜLL *et al.* 1999, MARTINČIČ 2003).

Pseudoleskea saviana (De Not.) Latzel

It is in the regionally threatened (RT) category according to the Red data book of European bryophytes (ECCB 1995). A species of shaded volcanic rocks, it is sometimes found on tree bark mainly at the base of trunks. Regarded as a rare, continental-subalpine species, it can be found in the Alps and towards the east in Romania, Bulgaria, Greece and Turkey (DÜLL 1985). From Slovenia it is reported by MARTINČIČ (2003). In the western Stara Planina Mts we collected it on the bark of *Fagus* at Zubska reka (stream) below the hotel of Babin Zub. Previously, it was also collected by us in the Kopaonik Mts (PAPP *et al.* 2004) and in the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005).

Two species of *Schistidium* (*S. papillosum*, *S. pruinosum*) are in the insufficiently known (K) category in the Red data book of European bryophytes (ECCB 1995). We found them on exposed sandstone rocks in subalpine grassland area. Their records from the western Stara Planina Mts are an important contribution to establish their range of distribution and conservation status.

According to the preliminary national red list of bryophytes of Serbia and Montenegro (SABOVLJEVIĆ *et al.* 2004) this mountainous area is very rich in species of national conservation interest. Two hepatics (*Bazzania tricrenata*, *Scapania aequiloba*) and two mosses (*Anomodon rugelii*, *Pohlia longicolla)* are in the endangered (EN) category. 4 hepatics (*Lophozia*

ascendens, *Lophozia badensis*, *L. heterocolpos*, *L. collaris*) and 8 mosses (*Amphidium mougeotii*, *Cynodontium bruntonii*, *Encalypta ciliata*, *Grimmia caespiticia*, *Orthotrichum obtusifolium*, *Paraleucobryum sauteri*, *Pseudoleskea saviana*, *Timmia bavarica*) are vulnerable (VU). Three hepatics (*Anastrophyllum minutum*, *Barbilophozia floerkei*, *Barbilophozia hatcheri*) and 13 mosses (*Andraea rupestris*, *Brachytecium geheebii*, *Hygroamblystegium tenax*, *Ditrichum pusillum*, *Isopterygiopsis pulchella*, *Leptobryum pyriforme*, *Myurella julacea*, *Plagiobryum zierii*, *Pseudoleskea radicosa*, *Racomitrium sudeticum*, *Syntrichia virescens*, *Timmia austriaca*) were placed in the category of lower risk (LR) in the national red list of bryophytes. Four mosses (*Brachythecium reflexum*, *B. starkei*, *Dicranella schreberiana*, *Philonotis arnellii*) are data deficient (DD). It is hoped that the new data presented here are going to improve the knowledge about their distribution.

Although our exploration on the Bulgarian side of Midžor peak was very short, 10 species were collected, which are included in the national red list of bryophytes of Bulgaria (NATCHEVA *et al.* 2006). Of the liverworts, *Fossombronia husnotii* is critically endangered (CR), and *Frullania jackii* is endangered (EN). Another liverwort species, *Tritomaria exsecta* and 5 mosses (*Amphidium lapponicum*, *Encalypta microstoma*, *Grimmia elatior*, *Grimmia funalis*, *Lescuraea saxicola*) are vulnerable (VU). *Schistidium confertum* is in the near threatened or lower risk (LR) and *Pohlia longicolla* in the data deficient (DD) category.

CONCLUSION

Though our investigation on the Western Stara Planina Mts covered a relatively small area (surroundings of Midžor peak), we found several redlisted species. The impressive species diversity can be attributed to the special circumstances provided by the bedrock (Permian red sandstone) and climate. Several species, characterized by boreal or arctic-alpine distribution, occur here extrazonally, supported by the special micro- and meso-climate with high precipitation coupled with the high elevations and the fact that the Stara Planina Mts is connected to the Carpathians, and hence it forms a natural pathway for northern species to reach areas

further south. The species newly reported for Serbia are also mainly montane species known as subarctic, alpine elements, or boreal, montane taxa. The base of Babin Zub with vertical faces of shaded, moist, sandstone rocks and fissures, the sandstone outcrops in the alpine meadows and wind-swept ridges of sandstone rock maintain a very special bryoflora. Mainly these are the substrates for the mosses discussed here as new records and redlisted species. Conservationally, it is very important to preserve the forests and montane habitats by leaving them intact around Babin Zub and down to the eastern slope towards Topli Do village. Because the shaded, moist microhabitats, essential for the bryophyte flora living there, can be sustained only this way. Unfortunately, we observed active forestry operations in the area, in spite that it is a nature reserve well marked with signs.

The survival of this truly valuable bryoflora requires more effective and very strict protection. The Midžor region should be considered as a hot-spot of bryophyte diversity on the Balkans and it would deserve declaration of a trans-border Important Bryophyte Area.

* * *

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