

CONTRIBUTION TO THE BRYOPHYTE FLORA OF THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

BEÁTA PAPP & PETER ERZBERGER

Abstract. During a field trip carried out in 2010 in the Former Yugoslav Republic of Macedonia (FYROM), 229 bryophyte taxa (43 liverworts and 186 mosses) were documented. Of the material, 10 liverwort and 33 moss taxa are recorded for the first time in the country and four species are included in the Red data book of European bryophytes.

Key words: Pelister National Park, Prilep castle hill, liverworts, mosses, new national records, redlisted species in Europe

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INTRODUCTION

In the field bryology, the Former Yugoslav Republic of Macedonia (FYROM) is the most poorly investigated country of former Yugoslavia (Martinčič 2009) and also of Southeastern Europe (Sabovljević *et al.* 2008). Data on the bryophyte flora of the FYROM are included in Düll *et al.* (1999) and in the checklists of the Southeastern European and Mediterranean countries (Ros *et al.* 2007; Sabovljević & Natcheva 2006; Sabovljević *et al.* 2008), and in Martinčič (2009) and Papp *et al.* (2011). On the basis of these papers the bryophyte flora of the Former Yugoslav Republic of Macedonia comprises 501 species including 96 liverworts and 405 mosses. Further investigations are needed to achieve a more complete picture of the bryophyte flora of the region, and the present report aims to provide additions towards to that end.

STUDY AREA

Pelister National Park is located in the southwestern part of the Former Yugoslav Republic of Macedonia (FYROM), comprising an area of 17.150 ha on the northern side of the Baba massif between 900 and 2600 m a.s.l. Pelister National

Park was proclaimed on November 30, 1948 (<http://park-pelister.com>).

Geologically, the mountain mainly consists of volcanic rocks. The most interesting periglacial formations are the so-called ravines ('stone rivers'). These are slopes in the alpine zone covered by crushed material, composed of granite blocks, dolerite, gabbro and schists, piled up onto each other without any orientation. The longest stone river in the park reaches 3 km.

Pelister Mt. is rich in springs and streams, and there are two glacial lakes, Big Lake (Golemo ezero) and Small Lake (Malo ezero), the so-called Pelister Eyes. Big Lake lies at an altitude of 2218 m. It is one of the glacial lakes with the highest elevation in the FYROM.

The Macedonian pine (Molika) – *Pinus peuce* Griseb. – is the most notable tree species of the Pelister National Park, which was described from here by Grisebach in 1843. It is an endemic tree species of the Balkans and considered a Tertiary relict. Although the Macedonian pine is also found in other mountains of the Balkan Peninsula, some of the oldest and most untouched forests can be found here, in Pelister National Park. The flora of Pelister Mt. consists of more than 1050 higher

plant taxa, among them many Tertiary relicts (<http://park-pelister.com>).

The Prilep castle hill is situated in the south-central part of the FYROM. With an elevation of almost 1000 m, the hill arises at Prilep town and consists of sandstone, with many huge boulders on the surface.

MATERIAL AND METHODS

Our collecting trip to the area investigated in the Former Yugoslav Republic of Macedonia (FYROM), shown in Figure 1, was made in July 2010. All main habitat types, such as stream valleys, gorges, forests, rock formations and grasslands were investigated, and bryophytes were collected from different substrates (soil, exposed and shaded rocks, tree bark, decaying wood). The research was focused on following 16 collecting sites:

1. PELISTER MT., at hotel Molika, *Pinus peuce* forest, 41°02'23.7"N, 21°13'21.5"E, 1385 m, 17 July 2010.

2. PELISTER MT., near trail from hotel Molika through Kopanki tourist house to the spring of Magarevska stream, 41°02'00.0"N, 21°13'10.3"E, 1625–1745 m, 18 July 2010.

3. PELISTER MT., at the spring of Magarevska stream, 41°01'22.7"N, 21°12'39.9"E, 1745 m, 18 July 2010.

4. PELISTER MT., near trail from the spring of Magarevska stream to Jorgov kamen, 41°01'22.7"N, 21°12'39.9"E – 41°01'16.6"N, 21°13'21.7"E, 1745–1760 m, 18 July 2010.

5. PELISTER MT., at Jorgov kamen, 41°01'16.6"N, 21°13'21.7"E, 1760 m, 18 July 2010.

6. PELISTER MT., around a spring above Magarevo village, 41°02'39.1"N, 21°13'48.4"E, 1130 m, 19 July 2010.

7. PELISTER MT., above Niže pole village, spring at the ski lift, 41°58'42.2"N, 21°15'07.8"E, 1360 m, 19 July 2010.

8. PELISTER MT., Magarevska stream above Magarevo village, 41°02'02.7"N, 21°14'05.1"E, 1170 m, 19 July 2010.

9. PELISTER MT., above Magarevo village, *Juni-peretum*, 41°02'44.1"N, 21°13'33.0"E, 1140 m, 19 July 2010.

10. PELISTER MT., above Magarevo village, at Golema livada, 41°02'44.7"N, 21°12'43.4"E, 1195 m, 19 July 2010.

11. PELISTER MT., above Izvidnica towards Stiv peak from hotel Molika, 41°01'22.7"N, 21°12'16.2"E

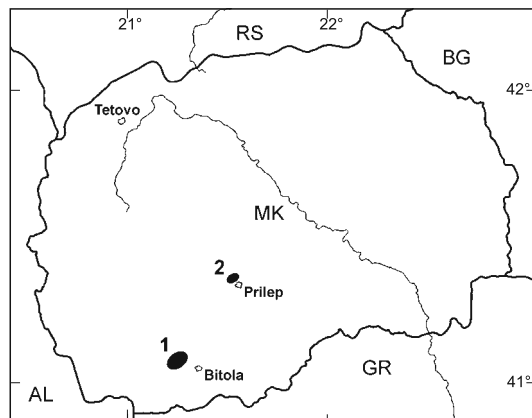


Fig. 1. Location of the investigated areas. 1 – Pelister National park, 2 – Prilep castle hill, AL – Albania, BG – Bulgaria, GR – Greece, MK – Former Yugoslav Republic of Macedonia, RS – Republic of Serbia.

– 41°01'09.1"N, 21°12'02.1"E, 2045–2275 m, 20 July 2010.

12. PELISTER MT., above Niže pole towards Golemo ezero, 40°59'09.1"N, 20°14'10.9"E – 40°58'25.7"N, 21°13'09.8"E, 1450 – 2005 m, 21 July 2010.

13. PELISTER MT., at Golemo ezero 40°58'09.9"N, 21°12'18.5"E, 2230 m, 21 July 2010.

14. PELISTER MT., at Sv. Gorgi before Malovište village, 41°02'38.4"N, 21°07'57.2"E, 1075 m, 22 July 2010.

15. PELISTER MT., eastern slope of the mountain at Prespa lake, at Arvati above Krani village, 41°56'46.3"N, 21°07'21.0"E, 1070 m, 22 July 2010.

16. PRILEP, castle hill, 41°21'32.0"N, 21°32'27.0"E – 41°21'43.4"N, 21°32'21.8"E, 750–955 m, 23 July 2010.

The specimens are preserved in the Herbarium of the Hungarian Natural History Museum, Budapest (BP) and in the Herbarium of the Botanical Museum Berlin-Dahlem (B). 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. New floristic results for the country are given according to the checklists of Southeast Europe and Mediterranean (Sabovljević & Natcheva 2006; Sabovljević *et al.* 2008; Ros *et al.* 2007) and Düll *et al.* (1999) updated with all new records reported for the Former Yugoslav Republic of Macedonia by Martinčič (2009) and Papp *et al.* (2011).

Taxa recorded for the first time in the country are marked by an asterisk (*).

RESULTS AND DISCUSSION

During our field trip 229 bryophyte taxa (43 liverworts and 186 mosses) were collected. Ten liverwort and 33 moss taxa are recorded for the first time in the Former Yugoslav Republic of Macedonia. Here we report the second data from the country of the liverworts *Lophozia incisa*, *L. longidens*, *L. wenzelii*, *Marsupella sphacelata* and of the mosses *Grimmia anomala*, *G. muehlenbeckii*, *Pseudoleskea patens*; their first records were recently published by Papp *et al.* (2011) from Nidže (Voras) Mts. Four moss species recorded (*Buxbaumia viridis*, *Grimmia caespiticia*, *G. plagiopodia*, *Pseudoleskea saviana*) are included in the *Red Data Book of European Bryophytes* (Anonymous 1995).

HEPATICAEE

Aneura pinguis (L.) Dumort.

COLLECTING SITE: 7 – at the spring.

Barbilophozia hatcheri (A. Evans) Loeske

COLLECTING SITES: 2, 3, 4, 5, 11 – siliceous rock; 12 – soil.

Barbilophozia lycopodioides (Wallr.) Loeske

COLLECTING SITES: 3, 11 – siliceous rock.

**Calypogeia fissa* (L.) Raddi

COLLECTING SITE: 12 – soil.

NOTES. Known from almost all Southeast European countries except Montenegro and FYROM according to Sabovljević and Natcheva (2006), but in Ros *et al.* (2007) also reported from Montenegro.

**Calypogeia muelleriana* (Schiffn.) Müll. Frib.

COLLECTING SITE: 12 – soil.

NOTES. In Southeast Europe reported from Bulgaria, Romania, Serbia, and Slovenia (Sabovljević & Natcheva 2006).

**Cephalozia pleniceps* (Austin) Lindb.

COLLECTING SITE: 13 – bog.

NOTES. In Southeast Europe known from Bulgaria, Romania, and Slovenia according to Sabovljević and Natcheva (2006), in Ros *et al.* (2007) reported also from Montenegro and the European part of Turkey.

Cephalozia divaricata (Sm.) Schiffn.

COLLECTING SITES: 9, 12 – soil; 10 – soil (det. L. Meinunger); 2, 14, 15 – siliceous rock.

Cephalozia hampeana (Nees) Schiffn.

COLLECTING SITE: 7 – at the spring.

**Cephalozia rubella* (Nees) Warnst.

COLLECTING SITE: 12 – soil.

NOTES. In Southeast Europe recorded in Bulgaria, Croatia, Romania, Serbia, Slovenia and the European part of Turkey (Sabovljević & Natcheva 2006), recently reported from Greece by Papp *et al.* (2011).

Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort.

COLLECTING SITES: 8, 14 – at the stream.

Chiloscyphus polyanthus (L.) Corda

COLLECTING SITE: 8 – at the stream.

Fossombronia pusilla (L.) Nees

COLLECTING SITES: 9, 12 – soil.

Frullania dilatata (L.) Dumort.

COLLECTING SITE: 2 – siliceous rock.

**Jungermannia hyalina* Lyell

COLLECTING SITE: 12 – soil among siliceous rocks and bog.

NOTES. Known from almost all Southeast European countries except Montenegro, the

European part of Turkey and FYROM according to Sabovljević and Natcheva (2006), but in Ros *et al.* (2007) also reported from the European part of Turkey.

****Lejeunea cavifolia*** (Ehrh.) Lindb.

COLLECTING SITE: 3 – siliceous rock.

NOTES. Recorded in all Southeast European countries except FYROM according to Sabovljević and Natcheva (2006).

Lophocolea minor Nees

COLLECTING SITES: 3, 4 – siliceous rock; 8, 14 – siliceous rock at the stream; 12 – soil.

****Lophozia bicrenata*** (Schmidel *ex* Hoffm.) Dumort.

COLLECTING SITE: 12 – soil.

NOTES. In Southeast Europe known from several countries, e.g. Greece, Croatia, Romania, Serbia, and Slovenia (Sabovljević & Natcheva 2006), in Ros *et al.* (2007) also reported from the European part of Turkey, and in Papp and Erzberger (2010) from Montenegro.

Lophozia excisa (Dicks.) Dumort.

COLLECTING SITE: 15 – siliceous rock.

Lophozia incisa (Schrad.) Dumort.

COLLECTING SITE: 12 – soil.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

Lophozia longidens (Lindb.) Macoun

COLLECTING SITES: 3, 4, 11 – siliceous rock.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

****Lophozia obtusa*** (Lindb.) A. Evans

COLLECTING SITES: 4, 11 – siliceous rock; 12 – soil.

NOTES. In Southeast Europe reported from Bulgaria, Greece, Montenegro, Romania, and Serbia (Sabovljević & Natcheva 2006).

Lophozia sudetica (Nees *ex* Huebener) Grolle

COLLECTING SITE: 12 – soil.

Lophozia ventricosa (Dicks.) Dumort.

COLLECTING SITE: 12 – soil.

Lophozia wenzelii (Nees) Steph.

COLLECTING SITE: 12 – soil.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

Marsupella emarginata (Ehrh.) Dumort.

COLLECTING SITE: 11 – siliceous rock (det. L. Meinunger).

Marsupella funckii (F. Weber & D. Mohr) Dumort.

COLLECTING SITES: 2 – siliceous rock; 12 – soil.

Marsupella sphacelata (Gieseke *ex* Lindenb.) Dumort.

COLLECTING SITE: 2 – siliceous rock.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

Metzgeria furcata (L.) Dumort.

COLLECTING SITES: 2, 4 – siliceous rock; 8 – siliceous rock at the stream.

Nardia scalaris Gray

COLLECTING SITE: 12 – soil.

Pellia endiviifolia (Dicks.) Dumort.

COLLECTING SITE: 1 – at a spring.

Pellia epiphylla (L.) Corda

COLLECTING SITE: 12 – bog.

Pellia neesiana (Gottsche) Limpr.

COLLECTING SITE: 13 – bog.

Plagiochila porelloides (Torrey ex Nees) Lindenb.

COLLECTING SITES: 3, 4, 15 – siliceous rock; 8, 14 – siliceous rock at the stream.

Porella cordaeana (Huebener) Mohr

COLLECTING SITES: 2, 3, 4, 12 – siliceous rock; 8, 14 – siliceous rock at the stream.

Radula complanata (L.) Dumort.

COLLECTING SITES: 2, 3 – siliceous rock.

Reboulia hemisphaerica (L.) Raddi

COLLECTING SITES: 9 – soil; 14 – at the stream; 15 – siliceous rock.

****Riccardia chamedryfolia*** (With.) Grolle

COLLECTING SITE: 7 – at the spring.

NOTES. Known from almost all Southeast European countries except Albania, Montenegro, FYROM, Serbia and the European part of Turkey according to Sabovljević and Natcheva (2006), but in Ros *et al.* (2007) also reported from Montenegro and the European part of Turkey.

****Riccardia incurvata*** Lindb.

COLLECTING SITE: 7 – at the spring.

NOTES. In Southeast Europe recorded only in Bulgaria, Romania and Serbia (Sabovljević & Natcheva 2006).

Riccia ciliata Hoffm.

COLLECTING SITE: 9 – soil.

Riccia ciliifera Link ex Lindenb.

COLLECTING SITES: 2 – siliceous rock; 12 – soil.

Riccia sorocarpa Bisch.

COLLECTING SITE: 12 – soil.

Scapania irrigua (Nees) Nees

COLLECTING SITES: 7 – at the spring; 13 – bog.

Scapania undulata (L.) Dumort.

COLLECTING SITES: 3, 8 – siliceous rock in the stream; 7 – at the spring; 12 – bog.

MUSCI

Abietinella abietina (Hedw.) M. Fleisch.

COLLECTING SITE: 12 – soil.

Amblystegium serpens (Hedw.) Schimp.

COLLECTING SITES: 1, 12 – at a spring; 8, 14 – at the stream.

Amphidium mougeotii (Schimp.) Schimp.

COLLECTING SITES: 2, 12 – siliceous rock.

Andreaea rupestris Hedw.

COLLECTING SITES: 3, 11 – siliceous rock.

Antitrichia californica Sull.

COLLECTING SITE: 16 – sandstone rock.

Atrichum undulatum (Hedw.) P. Beauv.

COLLECTING SITES: 1, 10, 15 – soil; 7 – at the spring; 8 – at the stream.

Aulacomnium palustre (Hedw.) Schwägr.

COLLECTING SITES: 12, 13 – bog.

Barbula unguiculata Hedw.

COLLECTING SITES: 1 – at a spring and soil;
7 – at the spring.

Bartramia ithyphylla Brid.

COLLECTING SITES: 4, 12 – siliceous rock.

Bartramia pomiformis Hedw.

COLLECTING SITES: 4, 15 – siliceous rock; 8 –
at the stream.

Blindia acuta (Hedw.) Bruch & Schimp.

COLLECTING SITES: 8 – at the stream; 12 –
siliceous rock; 13 – bog.

Brachytheciastrum olympicum (Jur.) Vanderp.
et al.

COLLECTING SITES: 1 – decaying wood; 4 –
siliceous rock.

Brachytheciastrum velutinum (Hedw.) Ignatov
& Huttunen

COLLECTING SITES: 1 – bark of *Alnus* and soil;
2, 4, 12, 14 – siliceous rock; 8 – at the stream.

Brachythecium albicans (Hedw.) Schimp.

COLLECTING SITES: 1, 9 – soil; 2, 14 – siliceous
rock; 7 – at the spring.

Brachythecium glareosum (Bruch *ex* Spruce)
Schimp.

COLLECTING SITES: 1, 10 – soil; 4, 11 – sili-
ceous rock.

Brachythecium rivulare Schimp.

COLLECTING SITES: 1 – at a spring; 3, 8, 14,
15 – siliceous rock in the stream; 13 – bog.

Brachythecium rutabulum (Hedw.) Schimp.

COLLECTING SITES: 8 – at the stream; 12 – at
a spring.

Brachythecium salebrosum (Hoffm. *ex* F. Weber
& D. Mohr) Schimp.

COLLECTING SITES: 2, 4 – siliceous rock.

Bryoerythrophyllum recurvirostrum (Hedw.) P. C.
Chen

COLLECTING SITE: 5 – siliceous rock.

Bryum alpinum Huds. *ex* With.

COLLECTING SITES: 2 – siliceous rock; 7 – at
the spring (conf. W. Schröder); 12 – soil; 16 –
sandstone rock.

Bryum argenteum Hedw.

COLLECTING SITES: 2 – siliceous rock; 16 –
sandstone rock.

Bryum caespiticium Hedw.

COLLECTING SITES: 1 – at a spring, siliceous
rock; 2, 15 – siliceous rock.

Bryum capillare Hedw.

COLLECTING SITES: 2 – siliceous rock (det.
W. Schröder); 14 – siliceous rock; 16 – sandstone
rock.

Bryum elegans Nees

COLLECTING SITE: 3 – siliceous rock.

Bryum moravicum Podp.

COLLECTING SITES: 1 – decaying wood; 2, 14 –
siliceous rock.

****Bryum muehlenbeckii*** Bruch & Schimp.

COLLECTING SITES: 12 – siliceous rock (det. W.
Schröder); 13 – bog (det. W. Schröder).

NOTES. Recorded in numerous Southeast
European countries including Bulgaria, Bosnia-
Herzegovina, Greece, Montenegro, Romania, and
Slovenia (Sabovljević *et al.* 2008).

Bryum pallens Sw. *ex anon.*

COLLECTING SITE: 7 – at the spring (det. W. Schröder).

Bryum pallescens Schleich. *ex Schwägr.*

COLLECTING SITE: 12 – siliceous rock.

Bryum pseudotriquetrum (Hedw.) P. Gaertn. *et al.*

COLLECTING SITES: 3, 8 – siliceous rock in the stream; 7 – at the spring; 12 – soil; 13 – bog.

****Bryum rubens*** Mitt.

COLLECTING SITES: 1, 9 – soil.

NOTES. Reported from almost all Southeast European countries except Albania and FYROM (Sabovljević *et al.* 2008).

Bryum turbinatum (Hedw.) Turner

COLLECTING SITE: 7 – at the spring.

Buxbaumia viridis (Moug. *ex* Lam. & DC.) Brid. *ex* Moug. & Nestl.

COLLECTING SITES: 1, 4 – decaying wood.

NOTES. This boreal, montane species (Düll 1984) lives on well-decayed wood in constantly humid forests, sheltered or shaded places, rarely on humous-rich acidic soil. The Red data book of European bryophytes rates it as vulnerable, and it is listed in the Bern Convention and the European Union Habitats and Species Directive (Anonymous 1995). *Buxbaumia viridis* is known from all South-east European countries except the European part of Turkey (Sabovljević *et al.* 2008). It was found on decaying wood in Pelister Mt in the *Pinus peuce* forest at hotel Molika and between the spring of Magarevska stream and Jorgov kamen. It has been known from the Pelister National Park (<http://park-pelister.com>).

Calliergonella cuspidata (Hedw.) Loeske

COLLECTING SITE: 8 – at the stream.

Campylium stellatum (Hedw.) Lange & C. E. O. Jensen

COLLECTING SITE: 12 – bog.

Campylophyllum calcareum (Crundw. & Nyholm) Hedenäs

COLLECTING SITE: 10 – soil.

****Campylopus pyriformis*** (Schultz) Brid.

COLLECTING SITE: 3 – siliceous rock.

NOTES. In Southeast Europe recorded only in Croatia, Romania and Slovenia (Sabovljević *et al.* 2008).

Ceratodon purpureus (Hedw.) Brid.

COLLECTING SITES: 1, 9 – soil; 2, 14, 15 – siliceous rock; 12 – bog; 16 – sandstone rock.

Cirriphyllum crassinervium (Taylor) Loeske & M. Fleisch.

COLLECTING SITE: 14 – at the stream.

Climacium dendroides (Hedw.) F. Weber & D. Mohr

COLLECTING SITE: 1 – at a spring.

Cynodontium bruntonii (Sm.) Bruch & Schimp.

COLLECTING SITE: 2 – trunk base of *Pinus peuce*.

Dicranella rufescens (Dicks.) Schimp.

COLLECTING SITE: 7 – at the spring.

****Dicranella varia*** (Hedw.) Schimp.

COLLECTING SITE: 1 – soil.

NOTES. Known from all Southeast European countries except FYROM (Sabovljević *et al.* 2008).

****Dicranoweisia cirrata*** (Hedw.) Lindb.

COLLECTING SITE: 1 – bark of *Pinus peuce*.

NOTES. Recorded in almost all Southeast European countries except Montenegro and FYROM (Sabovljević *et al.* 2008).

Dicranoweisia crispula (Hedw.) Milde

COLLECTING SITES: 2, 3, 11 – siliceous rock.

Dicranum bonjeanii De Not.

COLLECTING SITES: 12, 13 – bog.

Dicranum scoparium Hedw.

COLLECTING SITES: 2, 4, 11, 15 – siliceous rock; 8 – at the stream; 12 – soil.

Dicranum tauricum Sapiegin

COLLECTING SITE: 1 – bark of *Pinus peuce* and decaying wood.

Didymodon acutus (Brid.) K.Saito

COLLECTING SITE: 16 – sandstone rock.

****Didymodon insulanus*** (De Not.) M. O. Hill

COLLECTING SITES: 1, 9, 10 – soil; 14, 15 – siliceous rock; 16 – sandstone rock.

NOTES. Known from almost all Southeast European countries except Albania, Bosnia-Herzegovina, Croatia and FYROM according to Sabovljević *et al.* (2008), but later reported from Albania by Papp *et al.* (2010).

Didymodon vinealis (Brid.) R. H. Zander

COLLECTING SITES: 14 – at the stream; 16 – sandstone rock.

****Ditrichum pusillum*** (Hedw.) Hampe

COLLECTING SITE: 1 – soil.

NOTES. Reported from almost all Southeast European countries except Albania and FYROM (Sabovljević *et al.* 2008).

Encalypta ciliata Hedw.

COLLECTING SITE: 2 – siliceous rock.

Encalypta microstoma Bals.-Criv. & De Not.

COLLECTING SITE: 2 – siliceous rock.

Encalypta streptocarpa Hedw.

COLLECTING SITE: 5 – siliceous rock.

Entosthodon fascicularis (Hedw.) Müll. Hal.

COLLECTING SITE: 9 – soil.

Entosthodon muhlenbergii (Turner) Fife

COLLECTING SITE: 15 – siliceous rock.

Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. ***pulchellum***

COLLECTING SITES: 12, 14 – siliceous rock.

Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. ***diversifolium*** (Schimp.) Ochyra & Żarnowiec

COLLECTING SITES: 2, 4, 11, 15 – siliceous rock.

Fissidens bryoides Hedw.

COLLECTING SITES: 4, 15 – siliceous rock; 14 – at the stream.

****Fissidens pusillus*** (Wilson) Milde

COLLECTING SITE: 15 – in the stream.

NOTES. Known from almost all Southeast European countries except Albania, Montenegro and FYROM according to Sabovljević *et al.* (2008), later reported in Papp *et al.* (2010) from Albania, and in Papp and Erzberger (2010) from Montenegro.

****Fissidens viridulus*** (Sw. *ex anon.*) Wahlenb.

COLLECTING SITE: 15 – siliceous rock.

NOTES. According to Sabovljević *et al.* (2008) recorded in almost all Southeast European countries except Albania, Bulgaria and FYROM, recently reported in Papp *et al.* (2010) from Albania.

Fontinalis antipyretica Hedw.

COLLECTING SITES: 8, 14, 15 – at the stream.

Funaria hygrometrica Hedw.

COLLECTING SITES: 1 – soil; 15 – siliceous rock.

Grimmia alpestris (F. Weber & D. Mohr) Schleich.

COLLECTING SITES: 2, 11, 12 – siliceous rock (specimens from 12 rev. E. Maier).

Grimmia anomala Hampe *ex* Schimp.

COLLECTING SITES: 2, 12 – siliceous rock.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

Grimmia caespiticia (Brid.) Jur.

COLLECTING SITE: 12 – siliceous rock.

NOTES. This subarctic-subalpine element (Düll 1984) is in the rare (R) category according to the Red data book of European Bryophytes (Anonymous 1995). It can be found on acidic rocks in alpine mountains of Europe, Asia and Greenland (Nyholm 1998). In Pelister Mt. it was found on exposed siliceous rocks above 2000 m a.s.l. near Golemo ezero. In Southeast Europe it is known from Bulgaria, Montenegro, Romania, Serbia (Sabovljević *et al.* 2008) and Greece (Blockeel 2010).

****Grimmia elatior*** Bruch *ex* Bals.-Criv. & De Not.

COLLECTING SITE: 2 – siliceous rock (rev. E. Maier).

NOTES. Known from numerous Southeast European countries including Bulgaria, Bosnia-Herzegovina, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008).

Grimmia funalis (Schwägr.) Bruch & Schimp.

COLLECTING SITE: 3 – siliceous rock.

Grimmia fuscolutea Hook.

COLLECTING SITE: 14 – siliceous rock (det. E. Maier).

Grimmia hartmannii Schimp.

COLLECTING SITES: 2, 3 – siliceous rock (conf. E. Maier).

Grimmia incurva Schwägr.

COLLECTING SITES: 3, 11 – siliceous rock (conf. E. Maier).

Grimmia laevigata (Brid.) Brid.

COLLECTING SITES: 2, 14 – siliceous rock (conf. E. Maier); 5, 12 – siliceous rock; 16 – sandstone rock.

****Grimmia lisae*** De Not.

COLLECTING SITE: 4 – siliceous rock (rev. R. Ochyra).

NOTES. In Southeast Europe reported only from Bulgaria, Greece and Slovenia (Sabovljević *et al.* 2008).

Grimmia montana Bruch & Schimp.

COLLECTING SITES: 2, 12 – siliceous rock (conf. E. Maier); 5, 12 – siliceous rock (conf. R. Ochyra).

Grimmia muehlenbeckii Schimp.

COLLECTING SITES: 2, 12 – siliceous rock; 3 – siliceous rock (conf. E. Maier), 4 – siliceous rock (conf. R. Ochyra); 16 – sandstone rock (rev. E. Maier).

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voras) Mts by Papp *et al.* (2011).

Grimmia ovalis (Hedw.) Lindb.

COLLECTING SITES: 2, 14, 15 – siliceous rock (conf. E. Maier); 5, 12 – siliceous rock; 8 – siliceous rock at the stream; 16 – sandstone rock.

****Grimmia plagiopodia*** Hedw.

COLLECTING SITE: 16 – sandstone rock.

NOTES. This subcontinental species occurs on exposed siliceous rocks. It is included in the Red data book of European bryophytes (Anonymous 1995) in the rare category. In Southeast Europe it was reported only from Romania according to Sabovljević *et al.* (2008). Here we collected it on sandstone rocks in Prilep castle hill. This is its first record from the Former Yugoslav Republic of Macedonia.

Grimmia pulvinata (Hedw.) Sm.

COLLECTING SITES: 1, 15 – siliceous rock; 2, 14 – siliceous rock (conf. E. Maier); 8 – siliceous rock at the stream; 16 – sandstone rock.

Grimmia ramondii (Lam. & DC.) Margad.

COLLECTING SITES: 4 – siliceous rock (conf. E. Maier); 11 – siliceous rock.

Grimmia trichophylla Grev.

COLLECTING SITES: 14 – siliceous rock (conf. R. Ochyra); 15 – siliceous rock (rev. R. Ochyra); 16 – sandstone rock.

Hedwigia ciliata (Hedw.) P. Beauv. var. *ciliata*

COLLECTING SITES: 2, 5, 15 – siliceous rock.

Hedwigia ciliata (Hedw.) P. Beauv. var. *leucophaea* Bruch & Schimp.

COLLECTING SITE: 16 – sandstone rock.

Hedwigia stellata Hedenäs

COLLECTING SITES: 2, 14 – siliceous rock; 16 – sandstone rock.

Herzogiella seligeri (Brid.) Z. Iwats.

COLLECTING SITE: 1 – decaying wood.

Heterocladium dimorphum (Brid.) Schimp.

COLLECTING SITES: 4, 11 – siliceous rock.

Homalothecium lutescens (Hedw.) H. Rob.

COLLECTING SITES: 1, 9, 10, 15 – soil; 16 – sandstone rock.

Homalothecium sericeum (Hedw.) Schimp.

COLLECTING SITES: 2 – bark of *Prunus*; 14, 15 – siliceous rock; 14 – bark of *Fagus*; 16 – sandstone rock.

Hygroamblystegium tenax (Hedw.) Jenn.

COLLECTING SITE: 14 – at the stream.

Hygrohypnum duriusculum (De Not.) D. W. Jamieson

COLLECTING SITES: 3, 8, 15 – siliceous rock in the stream.

Hylocomium splendens (Hedw.) Schimp.

COLLECTING SITES: 4, 11 – siliceous rock.

Hypnum cupressiforme Hedw. var. *cupressiforme*

COLLECTING SITES: 1 – bark of *Alnus* and *Pinus peuce*; 2, 5, 12, 14, 15 – siliceous rock; 8 – siliceous rock at the stream; 16 – sandstone rock.

Hypnum cupressiforme Hedw. var. *lacunosum* Brid.

COLLECTING SITES: 1, 9 – soil; 4, 8, 12, 14 – siliceous rock.

Isothecium alopecuroides (Lam. ex Dubois) Isov.

COLLECTING SITES: 2, 4 – siliceous rock.

Lescuraea saxicola (Schimp.) Molendo

COLLECTING SITE: 11 – siliceous rock.

Leucodon sciuroides (Hedw.) Schwägr.

COLLECTING SITES: 6 – on the bark of *Tilia*; 8 – siliceous rock at the stream; 16 – sandstone rock.

Mnium marginatum (Dicks.) P. Beauv.

COLLECTING SITE: 14 – at the stream.

Mnium stellare Hedw.

COLLECTING SITE: 8 – at the stream.

Orthotrichum affine Schrad. ex Brid.

COLLECTING SITES: 1 – bark of *Alnus*; 2 – bark of *Prunus*; 6 – bark of *Quercus* and *Tilia*; 8 – siliceous rock at the stream; 10 – bark of tree; 15 – bark of *Quercus pubescens*.

Orthotrichum anomalum Hedw.

COLLECTING SITE: 16 – sandstone rock.

Orthotrichum cupulatum Hoffm. ex Brid.

COLLECTING SITES: 11 – siliceous rock; 16 – sandstone rock.

Orthotrichum lyellii Hook. & Taylor

COLLECTING SITE: 6 – bark of *Tilia*.

Orthotrichum obtusifolium Brid.

COLLECTING SITE: 6 – on the bark of *Tilia*.

Orthotrichum pallens Bruch ex Brid.

COLLECTING SITES: 1 – bark of *Alnus*; 6 – bark of *Tilia*; 10 – bark of tree; 14 – bark of *Fagus*.

Orthotrichum pumilum Sw. ex anon.

COLLECTING SITES: 6 – bark of *Tilia*; 10 – bark of tree.

Orthotrichum lypestre Schleich. ex Schwägr.

COLLECTING SITES: 2, 12, 14, 15 – siliceous rock; 6 – bark of *Tilia*; 8, 14 – siliceous rock at the stream; 16 – sandstone rock.

Orthotrichum speciosum Nees

COLLECTING SITES: 1 – bark of *Alnus*; 6 – bark of *Tilia*; 10 – bark of tree.

Orthotrichum stramineum Hornsch. ex Brid.

COLLECTING SITE: 1 – bark of *Alnus*.

Orthotrichum striatum Hedw.

COLLECTING SITES: 1 – bark of *Alnus*; 6 – bark of *Quercus*; 10 – bark of tree.

Paraleucobryum longifolium (Hedw.) Loeske

COLLECTING SITE: 3 – siliceous rock.

Philonotis arnellii Husn.

COLLECTING SITES: 1 – soil; 2, 15 – siliceous rock.

Philonotis caespitosa Jur.

COLLECTING SITE: 15 – siliceous rock.

Philonotis fontana (Hedw.) Brid.

COLLECTING SITES: 1, 7 – at a spring; 9 – soil; 12, 14 – siliceous rock.

Philonotis seriata Mitt.

COLLECTING SITES: 12, 13 – bog.

Plagiomnium affine (Blandow ex Funck)

T. J. Kop.

COLLECTING SITES: 8, 14 – at the stream.

Plagiomnium elatum (Bruch & Schimp.)

T. J. Kop.

COLLECTING SITES: 1 – at a spring; 8 – siliceous rock at the stream.

Plagiomnium medium (Bruch & Schimp.)

T. J. Kop.

COLLECTING SITE: 3 – siliceous rock in the stream.

Plagiomnium undulatum (Hedw.) T. J. Kop.

COLLECTING SITES: 8, 14 – at the stream.

Plagiothecium denticulatum (Hedw.) Schimp.

COLLECTING SITES: 4 – siliceous rock; 14 – at the stream.

Plagiothecium platyphyllum Mönk.

COLLECTING SITES: 2, 3 – siliceous rock.

Platyhypnidium riparioides (Hedw.) Dixon

COLLECTING SITES: 8, 14, 15 – in the stream.

Pleurodium acuminatum Lindb.

COLLECTING SITES: 1, 9 – soil.

Pogonatum aloides (Hedw.) P. Beauv.

COLLECTING SITES: 1 – soil; 2 – siliceous rock; 7 – at the spring; 8 – siliceous rock at the stream.

Pogonatum urnigerum (Hedw.) P. Beauv.

COLLECTING SITES: 14 – siliceous rock; 7 – at the spring.

****Pohlia andalusica*** (Höhn.) Broth.

COLLECTING SITE: 12 – soil.

NOTES. In Southeast Europe known only from Montenegro, Romania and Serbia (Sabovljević *et al.* 2008).

****Pohlia annotina*** (Hedw.) Lindb.

COLLECTING SITES: 11 – soil among siliceous rocks; 12 – soil.

NOTES. Known from almost all Southeast European countries except Albania, Croatia and FYROM (Sabovljević *et al.* 2008).

Pohlia cruda (Hedw.) Lindb.

COLLECTING SITES: 2, 3, 11, 12, 15 – siliceous rock.

****Pohlia lutescens*** (Limpr.) H. Lindb.

COLLECTING SITES: 1 – soil; 2 – soil among siliceous rocks (det. W. Schröder).

NOTES. In Southeast Europe reported only from Bulgaria, Serbia and Slovenia (Sabovljević *et al.* 2008).

Pohlia nutans (Hedw.) Lindb.

COLLECTING SITES: 3, 11 – siliceous rock.

Pohlia wahlenbergii (F. Weber & D. Mohr) A. L. Andrews

COLLECTING SITES: 7 – at the spring; 14 – at the stream.

Polytrichastrum alpinum (Hedw.) G. L. Sm.

COLLECTING SITES: 1, 12 – soil; 2, 14 – siliceous rock; 7 – at the spring.

Polytrichum commune Hedw. var. ***perigoniale*** (Michx.) Hampe

COLLECTING SITE: 12 – soil.

Polytrichum juniperinum Hedw.

COLLECTING SITES: 2 – siliceous rock; 9, 12 – soil.

Polytrichum piliferum Hedw.

COLLECTING SITES: 2, 3, 14, 15 – siliceous rock; 9, 12 – soil; 16 – sandstone rock.

****Pseudocrossidium hornschurchianum*** (Schultz) R. H. Zander

COLLECTING SITE: 16 – sandstone rock.

NOTES. Known from almost all Southeast European countries except Albania, and FYROM (Sabovljević *et al.* 2008), later reported also from Albania (Papp *et al.* 2010).

Pseudoleskea incurvata (Hedw.) Loeske

COLLECTING SITES: 2, 12 – siliceous rock.

Pseudoleskea patens (Lindb.) Kindb.

COLLECTING SITES: 8 – at the stream; 12 – siliceous rock.

NOTES. Second record of the species in FYROM; for the first time it was reported from Nidže (Voraz) Mts by Papp *et al.* (2011).

Pseudoleskea saviana (De Not.) Latzel

COLLECTING SITES: 2, 3, 4, 5, 11 – siliceous rock; 8 – siliceous rock at the stream.

NOTES. This is a species of shaded volcanic rocks, but sometimes found on tree bark mainly at the trunk bases. It is in the regionally threatened (RT) category according to the Red data book of European bryophytes (Anonymous 1995) and regarded as a rare, continental-subalpine species found in the Alps and other areas towards east (Düll 1985). It is known from all Southeast European countries except the European part of Turkey (Sabovljević *et al.* 2008). It does not appear to be rare in Southeast Europe, evidenced by several collections in Albania, Bulgaria, Greece, Montenegro, and Serbia (Papp *et al.* 2009, 2010, 2011, Papp & Erzberger 2009, 2010). It was collected from siliceous rocks in several localities in the Pelister National Park.

Pseudoscleropodium purum (Hedw.) M. Fleisch.

COLLECTING SITES: 7 – at the spring; 10 – soil.

Pterigynandrum filiforme Hedw.

COLLECTING SITES: 1, 2 – siliceous rock.

Racomitrium aciculare (Hedw.) Brid.

COLLECTING SITES: 3 – siliceous rock in the stream; 12 – bog.

Racomitrium canescens (Hedw.) Brid.

COLLECTING SITE: 12 – soil (conf. S. Caspari).

****Racomitrium elongatum*** Ehrh. *ex* Frisvoll

COLLECTING SITES: 2 – siliceous rock; 3 – siliceous rock (conf. S. Caspari); 7 – at the spring; 8 – siliceous rock at the stream; 9, 12 – soil.

NOTES. In Southeast Europe known from Greece, Montenegro, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008).

****Racomitrium microcarpon*** (Hedw.) Brid.

COLLECTING SITE: 3 – siliceous rock (conf. S. Caspari).

NOTES. In Southeast Europe reported only from Bulgaria, Montenegro, Romania and Slovenia (Sabovljević *et al.* 2008).

Racomitrium sudeticum (Funck) Bruch & Schimp.

COLLECTING SITES: 3, 5, 11 – siliceous rock (conf. R. Ochyra); 4 – siliceous rock (rev. R. Ochyra).

****Rhabdoweisia fugax*** (Hedw.) Bruch & Schimp.

COLLECTING SITE: 12 – siliceous rock.

NOTES. In Southeast Europe known from Bulgaria, Montenegro, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008).

Rhizomnium magnifolium (Horik.) T. J. Kop.

COLLECTING SITE: 12 – bog.

Rhizomnium punctatum (Hedw.) T. J. Kop.

COLLECTING SITES: 1 – at a spring; 2 – siliceous rock; 3, 8 – siliceous rock in the stream.

Rhytidiadelphus triquetrus (Hedw.) Warnst.

COLLECTING SITES: 3, 11, 12 – siliceous rock.

Saelania glaucescens (Hedw.) Broth.

COLLECTING SITES: 4, 11 – siliceous rock; 12 – soil.

Sanionia uncinata (Hedw.) Loeske

COLLECTING SITE: 12 – siliceous rock (det. W. Schröder).

Schistidium apocarpum (Hedw.) Bruch & Schimp.

COLLECTING SITES: 1 – siliceous rock; 14 – siliceous rock at the stream.

Schistidium confertum (Funck) Bruch & Schimp.

COLLECTING SITES: 2 – siliceous rock (conf. R. Ochyra); 12, 14 – siliceous rock.

****Schistidium crassipilum*** H. H. Blom

COLLECTING SITE: 5 – siliceous rock.

NOTES. Known from almost all Southeast European countries except Albania, FYROM, Slovenia and the European part of Turkey (Sabovljević *et al.* 2008), later reported also from Albania (Papp *et al.* 2010).

Schistidium dupretii (Thér.) W. A. Weber

COLLECTING SITE: 14 – siliceous rock (conf. R. Ochyra).

****Schistidium flaccidum*** (De Not.) Ochyra

COLLECTING SITE: 14 – siliceous rock.

NOTES. Recorded in almost all Southeast European countries except Albania, Croatia, Montenegro, FYROM and the European part of Turkey (Sabovljević *et al.* 2008), later reported also from Albania (Papp *et al.* 2010).

****Schistidium helveticum*** (Schkuhr) Deguchi

COLLECTING SITE: 7 – on the macadam road (conf. W. Schröder).

NOTES. Known from almost all Southeast European countries except Albania, FYROM and Slovenia (Sabovljević *et al.* 2008), later reported also from Albania (Papp *et al.* 2010).

****Schistidium lancifolium*** (Kindb.) H. H. Blom

COLLECTING SITE: 8 – at the stream (conf. R. Ochyra).

NOTES. It is reported for the first time from Southeast Europe.

****Schistidium papillosum*** Culm.

COLLECTING SITE: 14 – siliceous rock (conf. R. Ochyra).

NOTES. In Southeast Europe known only from Bulgaria, Greece, Romania, Serbia and Slovenia (Sabovljević *et al.* 2008).

****Schistidium pruinosum*** (Wilson *ex* Schimp.) G. Roth

COLLECTING SITE: 14 – siliceous rock.

NOTES. In Southeast Europe recorded only in Bulgaria and Serbia (Sabovljević *et al.* 2008) and from Albania by Papp *et al.* (2010).

****Schistidium rivulare*** (Brid.) Podp.

COLLECTING SITE: 3 – siliceous rock in the stream.

NOTES. Known from almost all Southeast European countries except Albania, FYROM and the European part of Turkey (Sabovljević *et al.* 2008).

Sciuro-hypnum populeum (Hedw.) Ignatov & Huttunen

COLLECTING SITE: 8 – at the stream.

****Sciuro-hypnum reflexum*** (Starke) Ignatov & Huttunen

COLLECTING SITE: 11 – siliceous rock.

Reported from almost all Southeast European countries except Albania, Greece, FYROM and the European part of Turkey (Sabovljević *et al.* 2008).

Sphagnum capillifolium (Ehrh.) Hedw.

COLLECTING SITE: 13 – bog.

Sphagnum contortum Schultz

COLLECTING SITE: 7 – at the spring.

Sphagnum subsecundum Nees

COLLECTING SITES: 12, 13 – bog.

Sphagnum teres (Schimp.) Ångstr.

COLLECTING SITES: 12, 13 – bog.

Straminergon stramineum (Dicks. ex Brid.)
Hedenäs

COLLECTING SITE: 13 – bog.

Syntrichia montana Nees var. *montana*

COLLECTING SITE: 16 – sandstone rock.

**Syntrichia montana* Nees var. *calva* (Durieu
& Sagot ex Bruch & Schimp.) J. J. Amann

COLLECTING SITE: 16 – sandstone rock.

NOTES. This taxon was recorded only in Serbia
among the countries of former Yugoslavia (Düll
et al. 1999).

Syntrichia norvegica F. Weber

COLLECTING SITE: 11 – siliceous rock.

**Syntrichia papillosa* (Wilson) Jur.

COLLECTING SITE: 16 – sandstone rock.

NOTES. Known from almost all Southeast
European countries except Albania, FYROM and
the European part of Turkey (Sabovljević *et al.*
2008).

Syntrichia ruralis (Hedw.) F. Weber & D. Mohr

COLLECTING SITES: 2, 5, 11, 12, 14, 15 – sili-
ceous rock; 6 – on the bark of *Tilia*; 9 – soil;
16 – sandstone rock.

Syntrichia ruralis (Hedw.) F. Weber & D. Mohr
var. *ruraliformis* (Besch.) Delogne

COLLECTING SITE: 15 – siliceous rock.

**Syntrichia virescens* (De Not.) Ochyra

COLLECTING SITE: 16 – sandstone rock.

NOTES. Recorded in almost all Southeast Euro-
pean countries except Albania, FYROM and Mon-
tenegro (Sabovljević *et al.* 2008), later reported
also from Albania (Papp *et al.* 2010).

Thamnobryum alopecurum (Hedw.) Gangulee

COLLECTING SITE: 8 – at the stream.

Timmia austriaca Hedw.

COLLECTING SITES: 4, 11 – siliceous rock.

Tortella tortuosa (Hedw.) Limpr.

COLLECTING SITE: 11 – siliceous rock.

Tortula muralis Hedw.

COLLECTING SITE: 16 – sandstone rock.

**Tortula schimperi* M. J. Cano, O. Werner
& J. Guerra

COLLECTING SITES: 1 – soil; 4 – siliceous
rock.

NOTES. In Southeast Europe known only from
Greece, Montenegro and Serbia (Sabovljević *et al.*
2008).

Tortula subulata Hedw.

COLLECTING SITES: 4, 12, 15 – siliceous rock;
9, 10 – soil; 14 – at the stream.

**Trichodon cylindricus* (Hedw.) Schimp.

COLLECTING SITE: 1 – soil.

NOTES. Known from almost all Southeast Eu-
ropean countries except Albania, Croatia, FYROM
and the European part of Turkey (Sabovljević *et al.*
2008).

Trichostomum crispulum Bruch

COLLECTING SITE: 14 – siliceous rock.

Warnstorfia exannulata (Schimp.) Loeske

COLLECTING SITES: 12, 13 – bog.

Weissia brachycarpa (Nees & Hornsch.) Jur.

COLLECTING SITES: 10 – soil; 15 – siliceous
rock.

Weissia controversa Hedw.

COLLECTING SITE: 2 – siliceous rock.

**Zygodon rupestris* Schimp. ex Lorentz

COLLECTING SITE: 14 – bark of *Fagus*.

NOTES. In Southeast Europe reported from several countries, viz. Greece, Montenegro, Romania, Serbia, Slovenia and the European part of Turkey (Sabovljević *et al.* 2008).

CONCLUSIONS

The high number of species recorded for the first time in the Former Yugoslav Republic of Macedonia (FYROM) during this short (seven-day) field trip is just an evidence to the great need of explorations for the country's bryophyte flora. Our findings reflect a wide variation of species found here. For example, among the newly reported species several are common taxa, frequently found all over Europe, including *Lejeunea cavifolia*, *Bryum rubens*, *Dicranella varia*, *Didymodon insulanus*, *Fissidens pusillus*, *Pseudocrossidium hornschuchianum* or *Syntrichia virescens*. In other cases, several species-rich genera were represented only by a few taxa in previous reports from the FYROM, such as *Fissidens*, *Grimmia* and *Schistidium*. Our work has added many species records to these groups. Apart from these, numerous taxa that are rarer on the Balkan Peninsula or even in the scale of Europe, are hereby reported for the first time in the country. The occurrence of four European red-listed species (*Buxbaumia viridis*, *Grimmia caespiticia*, *Grimmia plagiopodia*, *Pseudoleskea saviana*) are notable records from the aspect of nature conservation, at local but also at European level.

ACKNOWLEDGEMENTS. We are indebted to Wiebke Schröder and Ludwig Meinunger (Ludwigsstadt-Ebersdorf), Eva Maier (Geneva), Steffen Caspari (St. Wendel), Halina Bednarek-Ochyra and Ryszard Ochyra (Kraków) for their help in the confirmation, identification, or revision of certain problematic specimens. The study was supported by the EDIT Integrating Research Grants project 'Ten species in one: the hidden biodiversity of European mosses'.

We are pleased to publish this report in a memorial volume honouring Dr. Marian Kuc, who has done a great deal of work on the Balkan and contributed to the knowledge on the Balkan bryoflora.

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Received 23 January 2012