

## CONTRIBUTION TO THE BRYOPHYTE FLORA OF THE DJERDAP NATIONAL PARK (E SERBIA)

B. PAPP<sup>1</sup>, P. ERZBERGER<sup>2</sup> and M. SABOVLJEVIĆ<sup>3</sup>

<sup>1</sup>*Department of Botany, Hungarian Natural History Museum  
H-1476 Budapest, Pf. 222, Hungary; pappbea@bot.nhmus.hu*  
<sup>2</sup>*Belziger Str. 37, D-10823 Berlin, Germany*

<sup>3</sup>*Institute of Botany and Bot. Garden, Faculty of Biology, Univ. Belgrade  
Takovska 43, 11000 Belgrade, Serbia-Montenegro; marko@bfbot.bg.ac.yu*

During the bryological investigations carried out in July 2004 in the Djerdap National Park (E Serbia) altogether 192 bryophyte taxa (25 liverworts and 167 mosses) were recorded. Among them 6 are new to Serbia (*Bryum microerythrocarpum*, *Encalypta spathulata*, *Grimmia decipiens*, *Grimmia elatior*, *Taxiphyllum densifolium*, and *Tortula vahliana*). Three species of European conservation interest were recorded: *Anomodon rostratus*, *Rhynchostegiella teneriffae* and *Taxiphyllum densifolium*, all in the category rare (R) in the Red Data Book of European Bryophytes (ECCB 1995). Further, 4 liverwort and 11 moss species were recorded that are of national conservation and protection interest.

Key words: bryophyte flora, Djerdap National Park, red-listed species, Serbia

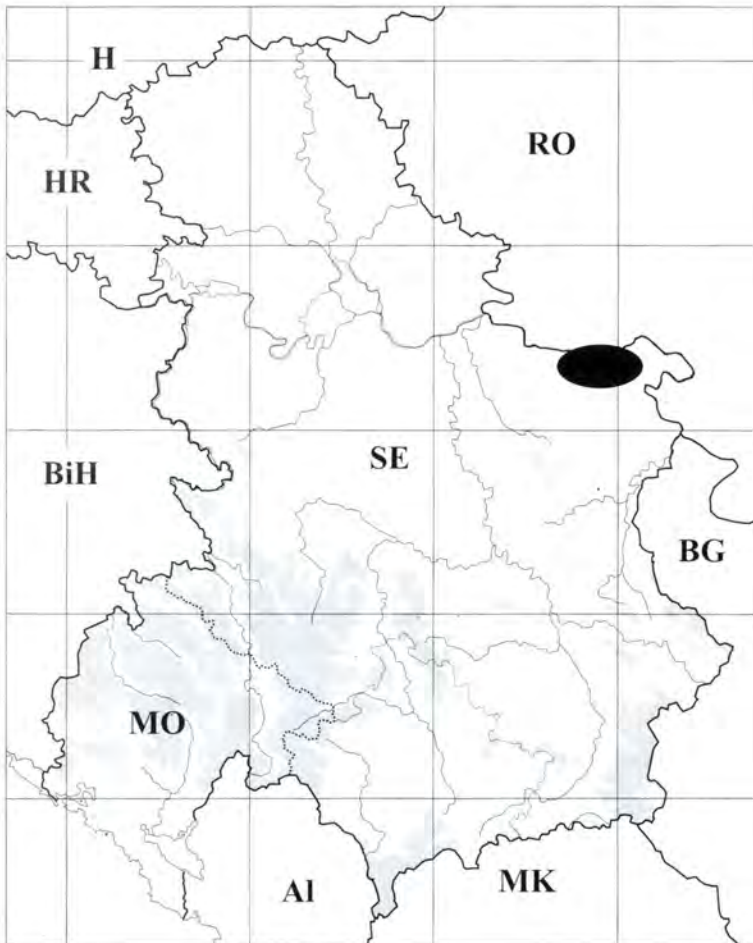
### INTRODUCTION

The region of South-Eastern Europe in general, and Serbia in particular, are bryologically poorly known compared to other parts of Europe (SABOVLJEVIĆ *et al.* 2001). However, recently efforts have been made to improve the knowledge on the distribution of bryophytes in this region, and in Serbia many new species have been recorded within the last years (*e.g.* SABOVLJEVIĆ 1999, 2000*b*, 2002, 2003*a, b*, SABOVLJEVIĆ *et al.* 1999, SABOVLJEVIĆ and STEVANOVIĆ 2000, PAPP and SABOVLJEVIĆ 2001, SABOVLJEVIĆ and CVETIĆ 2001, 2003, VELJIĆ *et al.* 2001, PÓCS *et al.* 2004). The series of bryophyte studies concerning protected regions and national parks (SABOVLJEVIĆ 1998, PAPP and SABOVLJEVIĆ 2002, PAPP *et al.* 2004, CVETIĆ and SABOVLJEVIĆ 2005, PAPP and ERZBERGER 2005, SABOVLJEVIĆ *in press*) is continued by this comprehensive contribution to the bryophyte flora of the Djerdap National Park (E Serbia).

## MATERIALS AND METHODS

### The investigated area

The Djerdap National Park (Iron Gate Gorge of the Danube) is situated in Eastern Serbia on the right side of the Danube canyon (Fig. 1). The park is an international protected region that continues in the Romanian Iron Gate Nature Reserve (Porta Ferul) along the left side of the Danube. The area of the park in Serbia covers 63,608 ha, with a surrounding protective area of 93,968 ha. The Djerdap National Park covers a narrow, 100 km long and about 2–8 km wide strip of forested hills along the Danube from Golubac town to Karataš, and ranges in altitude from 50 to 800 metres ([www.npdjerdap.co.yu](http://www.npdjerdap.co.yu)).



**Fig. 1.** The location of Djerdap National Park. (H = Hungary, RO = Romania, HR = Croatia, BiH = Bosnia-Herzegovina, SE = Serbia, MO = Montenegro, BG = Bulgaria, MK = FYR Macedonia, Al = Albania).

Djerdap gorge was established as a National Park in 1974. The area is mostly covered by forest (ca 64%). The park covers terrestrial and riverside parts, and consists of three canyon-gorge valleys (Golubačka, Gospodjin Vir and Mali i Veliki Kazan) and three basins (Ljupkovska, Donjomilanovačka and Oršavska). The canyons cut through the limestone rocks of the South-Carpathians.

Due to specific conditions of climate, relief and soils, and the hydrology of the Danube canyon in particular, the ecosystems of the park show refugial characteristics with a high percentage of relict species and communities, one of the most precious peculiarities of this region (STEVANOVIĆ and VASIĆ 1995).

The vascular flora comprises over 1100 species within the park borders, with an unusually rich relict tree flora. Of ca 50 forest communities within the park, some 35 have relict characteristics, some of which represent relict and endemic polydominant forest types (e.g. *Fago-Colurnetum mixtum*, *Quercu-Colurnetum mixtum*, *Fraxino-Colurnetum mixtum*, *Syringo-Colurnetum mixtum*, *Celto-Juglandetum*) (STEVANOVIĆ and VASIĆ 1995). Endemics are mostly present among non-tree species; one of the famous endemics of Djerdap gorge is *Tulipa hungarica*.

Up to date no bryophyte survey has been made for the region of the Djerdap National Park, although some older bryophyte records can be found (PAVLETIĆ 1955); a recent contribution of the third author will be published separately (SABOVLJEVIĆ in press).

## Methods

The collecting trip was made in July 2004 by the first two authors. Main habitat types such as stream valleys, forests, and grasslands developed on various bedrocks were visited, and bryophytes were collected from different substrates (soil, calcareous and non-calcareous, exposed and shady rocks, tree bark and decaying wood).

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 of the species follows ERZBERGER and PAPP (2004) and KOPERSKI *et al.* (2000). New floristical results for the country are analysed according to the checklists of Serbia-Montenegro (SABOVLJEVIĆ 2000a, SABOVLJEVIĆ and STEVANOVIĆ 1999) updated by the new records (see quotations in the introduction).

## Site details

1. Serbia, Djerdap National Park, Boljetin, Boljetinska reka stream, 120 m a. s. l., N 44°32' 24.2", E 22°01'47.1", 10.07.2004.

2. Serbia, Djerdap National Park, Pesaća stream at Sokolovac hill, 360 m a. s. l., N 44°35' 04.5", E 21°59'21.7", 10.07.2004.

3. Serbia, Djerdap National Park, Danube bank at Pesaća stream, 110 m a. s. l., N 44°36'02.8", E 21°00'29.5", 10.07.2004.

4. Serbia, Djerdap National Park, from Ploče to Veliki Štrbac hill, 745 m a. s. l., N 44°35'42.0", E 22°16'57.5", 11.07.2004.

5. Serbia, Djerdap National Park, north of Ploče towards Mali Štrbac hill, dolinas, 390 m a. s. l., N 44°37'01.2", E 22°17'26.5", 12.07.2004.

6. Serbia, Djerdap National Park, Mali Štrbac hill, 630 m a. s. l., N 44°37'54.5", E 22°18'35.6", 12.07.2004.

7. Serbia, Djerdap National Park, Golubac castle at the Danube bank, 90 m a. s. l., N 44°39' 37.1", E 21°40'36.6", 13.07.2004.

8. Serbia, Djerdap National Park, Brnjička reka at Brnjica village, 104 m a. s. l., N 44°38'12.6", E 21°44'42.5", 13.07.2004.
9. Serbia, Djerdap National Park, andesite outcrops along the road from the Danube bank to Ploče, 352 m a. s. l., N 44°36'27.0", E 22°16'53.2", 14.07.2004.
10. Serbia, Djerdap National Park, east of Mali Štrbac towards Golo brdo hill, dolina, 447 m a. s. l., N 44°37'51.6", E 22°19'13.8", 14.07.2004.
11. Serbia, Djerdap National Park, Tatarski vis hill, 664 m a. s. l., N 44°32'35.5", E 21°56'22.0", 15.07.2004.
12. Serbia, Djerdap National Park, Šomrski kamen hill, sandstone rocks, Fagetum, 755–800 m a. s. l., N 44°32'42.3", E 21°57'50.2", 15.07.2004.
13. Serbia, Djerdap National Park, Fagetum along the road between Šomrski kamen hill and "Ilex aquifolium reservat", 747 m a. s. l., N 44°32'31.5", E 21°58'17.7", 15.07.2004.

## RESULTS AND DISCUSSION

Altogether 192 bryophyte taxa (25 liverworts and 167 mosses) were collected during our field trip. The following 6 species are recorded for the first time in Serbia: *Bryum microerythrocarpum*, *Encalypta spathulata*, *Grimmia decipiens*, *Grimmia elatior*, *Taxiphyllum densifolium*, and *Tortula vahliana*.

*Bryum microerythrocarpum* is a European temperate species according to SMITH (2004). It was reported earlier in SE Europe from Greece only (BLOCQUEL *et al.* 2002, PAPP 2002).

*Encalypta spathulata* is a boreal-subalpine element. It was recorded in SE Europe in Greece and Romania, but its presence in former Yugoslavia was doubtful (DÜLL 1984).

*Grimmia decipiens* is sub-Mediterranean-subatlantic species according to SMITH (2004). It is known from Macedonia and Croatia in former Yugoslavia. It occurs in all other SE European countries, except Montenegro, Slovenia and Bosnia-Herzegovina (DÜLL 1984, NATCHEVA and GANEVA 2005).

*Grimmia elatior* is a circumpolar boreal-montane species according to SMITH (2004). It was reported in SE Europe from, Bulgaria, Romania and former Yugoslavia (DÜLL 1984), where it was known from Slovenia and Bosnia-Herzegovina (DÜLL *et al.* 1999).

*Taxiphyllum densifolium* was described from the forests of the Caucasus Mts by Brotherus in 1892. It is a Pontic-montane element according to DÜLL (1985). It is sporadically found in the Czech Republic, Poland, Hungary and Russia. In SE Europe it was reported only from Romania. It was discovered recently in Turkey in the Asian part of Black Sea coast (PAPP 2004).

*Tortula vahliana* is a Mediterranean-atlantic species according to SMITH (2004). It is known in SE Europe from Greece only (DÜLL 1984).

## List of the species

Following the species name, the numbers of the localities and the substrates are given.

## Hepaticae

- Barbilophozia barbata* (Schreb.) Loeske – 9: on shaded andesite rock  
*Cephaloziella divaricata* (Sm.) Schiffn. – 9: on exposed andesite rock  
*Cephaloziella rubella* (Nees) Warnst. – 12: on sandstone rock; 13: on soil  
*Cololejeunea calcarea* (Lib.) Schiffn. – 1, 8: on limestone rock  
*Cololejeunea rosettiana* (C. Massal.) Schiffn. – 1, 5, 8, 10: on limestone rock  
*Conocephalum conicum* (L.) Dumort. – 8: on limestone rock  
*Frullania dilatata* (L.) Dumort. – 1: on the bark of *Fraxinus* and *Syringa*; 2: on the bark of *Acer platanoides*; 4: on the bark of *Carpinus* and *Fraxinus*; 5: on the bark of *Quercus*; 6: on the bark of *Quercus*; 9: on exposed and shaded andesite rocks and on the bark of *Quercus*; 12: on sandstone rock  
*Leiocolea badensis* (Gottsche) Jörg. – 9: on shaded andesite rock  
*Leiocolea bantriensis* (Hook.) Jörg. – 1: on limestone rock  
*Leiocolea collaris* (Nees) Schljakov – 1: on limestone rock  
*Leijeunea cavifolia* (Ehrh.) Lindb. – 8: on limestone rock; 9: on shaded andesite rock  
*Lophocolea bidentata* (L.) Dumort. – 8: on limestone rock  
*Lophocolea heterophylla* (Schrad.) Dumort. – 1: on the base of *Crataegus*; 4: on the base of *Fraxinus*; 5: on limestone rock, on the bark of *Carpinus orientalis*; 9: on decaying wood; 11: on the base of *Fagus* tree and on the base of *Carpinus*; 13: on decaying wood  
*Lophocolea minor* Nees – 4: on limestone rock  
*Marchantia polymorpha* L. – 8: on limestone rock  
*Metzgeria conjugata* Lindb. – 1, 5, 8, 10: on limestone rock  
*Metzgeria furcata* (L.) Dumort. – 1: on the base of *Carpinus*; 2: on the bark of *Acer platanoides*; 4: on the bark of *Tilia* and *Fraxinus*; 5, 8, 11: on limestone rock; 5: on decaying wood, on the bark of *Fagus* and *Quercus*; 8: on limestone rock; 9: on shaded andesite rock and on the bark of *Quercus*; 11: on conglomerate rock; 12: on sandstone rock  
*Pedinophyllum interruptum* (Nees) Kaal. – 8: on limestone rock  
*Pellia endiviifolia* (Dicks.) Dumort. – 8: on limestone rock  
*Plagiochila porelloides* (Nees) Lindenb. – 5, 8, 10: on limestone rock; 9: on andesite rock  
*Porella arboris-vitae* (With.) Grolle – 8: on limestone rock  
*Porella cordaeana* (Huebener) Moore – 4: on limestone rock; 12: on sandstone rock  
*Porella platyphylla* (L.) Pfeiff. – 1, 2, 4, 5, 7, 8, 10: on limestone rock; 4: on the bark of *Fraxinus* and *Corylus colurna*; 5: on the bark of *Fagus* and on decaying wood; 9: on exposed andesite rock; 11: on the bark of *Acer*; 12: on sandstone rock  
*Ptilidium pulcherrimum* (Weber) Vain. – 4: on decaying wood  
*Radula complanata* (L.) Dumort. – 1, 4, 5, 8, 10: on limestone rock; 2: on the bark of *Acer platanoides*; 4: on the bark of *Fraxinus*; 8: on the bark of *Juglans regia*; 9: on shaded andesite rock and on the bark of *Quercus*

## Musci

- Amblystegium confervoides* (Brid.) Schimp. – 1, 5, 8; on limestone rock; 10: on the bark of *Acer platanoides*
- Amblystegium serpens* (Hedw.) Schimp. – 1, 2, 11: on limestone rock; 4: on the bark of *Fraxinus*; 9: on decaying wood; 11: on conglomerate rock
- Amblystegium serpens* (Hedw.) Schimp. var. *juratzkanum* (Schimp.) Rau et Herv. – 5: on the bark of *Quercus*
- Amblystegium subtile* (Hedw.) Schimp. – 5: on limestone rock, on decaying wood, on the bark of *Quercus* and *Fagus*
- Amblystegium tenax* (Hedw.) C. E. O. Jensen – 1, 8: on limestone rock; 7: on stones in the Danube river; 9: on andesite rock
- Amblystegium varium* (Hedw.) Lindb. – 8: on limestone rock
- Amphidium mougeotii* (Bruch et Schimp.) Schimp. – 9: on shaded andesite rock
- Anomodon attenuatus* (Hedw.) Huebener – 1, 2, 5, 8, 10: on limestone rock; 5: on decaying wood and on the bark of *Fagus*; 9: on shaded andesite rock; 11: on conglomerate rock
- Anomodon longifolius* (Brid.) Hartm. – 5: on limestone rock, on decaying wood
- Anomodon rostratus* (Hedw.) Schimp. – 5, 10: on limestone rock
- Anomodon viticulosus* (Hedw.) Hook. et Taylor – 1, 2, 5, 8, 10: on limestone rock; 4: on the bark of *Fraxinus*; 5: on the bark of *Fagus*; 11: on the bark of *Acer*
- Atrichum undulatum* (Hedw.) P. Beauv. – 4, 11, 13: on soil
- Barbula convoluta* Hedw. – 4: on soil
- Barbula unguiculata* Hedw. – 1, 3, 7, 11: on soil overlying limestone rock; 9: on exposed andesite rock
- Bartrania pomiformis* Hedw. – 9: on shaded andesite rock
- Brachythecium glareosum* (Spruce) Schimp. – 11: on soil
- Brachythecium mildeanum* (Schimp.) Schimp. ex Milde – 5: on the bark of *Fagus*
- Brachythecium populeum* (Hedw.) Schimp. – 5: on limestone rock, on soil; 9: on shaded andesite rock
- Brachythecium rivulare* Schimp. – 1, 8: on limestone rock; 9: on shaded andesite rock
- Brachythecium rutabulum* (Hedw.) Schimp. – 1, 5, 8, 9, 11: on limestone rock
- Brachythecium salebrosum* (F. Weber et D. Mohr) Schimp. – 5: on soil; 8: on limestone rock
- Brachythecium velutinum* (Hedw.) Schimp. – 2, 8, 11: on limestone rock; 4: on loamy soil; 9: on exposed andesite rock and on decaying wood; 11: on soil
- Bryoerythrophyllum recurvirostrum* (Hedw.) P. C. Chen – 1, 11: on limestone rock
- Bryum argenteum* Hedw. – 1, 4: on limestone rock; 9: on exposed andesite rock; 11: on soil
- Bryum bicolor* Dicks. – 11: on limestone rock
- Bryum caespiticium* Hedw. – 4: on limestone rock, on soil; 5: on decaying wood
- Bryum capillare* Hedw. – 1, 4, 7: on limestone rock; 9: on shaded andesite rock; 11: on soil
- Bryum laevifilum* Syed – 1: on limestone rock and on the bark of tree; 4: on the bark of *Tilia* and *Corylus colurna*; 9: on exposed andesite rock; 11: on conglomerate rock; 12: on sandstone rock
- Bryum microerythrocarpum* Müll. Hal. et Kindb. – 11: on soil
- Bryum pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. et Scherb. – 9: on shaded andesite rock
- Bryum rubens* Mitt. – 4, 5, 8: on soil
- Calliergonella cuspidata* (Hedw.) Loeske – 8: on soil
- Campylium calcareum* Crundw. et Nyholm – 1, 4, 5: on limestone rock; 9: on exposed andesite rock
- Ceratodon purpureus* (Hedw.) Brid. – 3: on limestone rock; 4, 11: on soil; 5: on decaying wood; 9: on exposed andesite rock

- Cinclidotus riparius* (Brid.) Arnell – 7: on stones in the Danube river  
*Cirriphyllum tommasinii* (Boulay) Grout – 5, 10: on limestone rock  
*Cratoneuron filicinum* (Hedw.) Spruce – 7, 8: on limestone rock  
*Ctenidium molluscum* (Hedw.) Mitt. – 1, 5, 8, 11: on limestone rock  
*Dicranella heteromalla* (Hedw.) Schimp. – 4, 11, 12: on soil; 12: on sandstone rock  
*Dicranella schreberiana* (Hedw.) Hilf. ex H. A. Crum et L. E. Anderson – 4: on soil  
*Dicranella varia* (Hedw.) Schimp. – 1, 8: on limestone rock; 5, 7: on soil  
*Dicranum scoparium* Hedw. – 9: on shaded andesite rock; 12: on soil  
*Dicranum tauricum* Sapjegin – 12: on the bark of *Fagus*  
*Didymodon fallax* (Hedw.) R. H. Zander – 1: on limestone rock  
*Didymodon ferrugineus* (Besch.) M. O. Hill – 1: on limestone rock  
*Didymodon luridus* Hornsch. ex Spreng. – 1, 3, 7: on limestone rock  
*Didymodon rigidulus* Hedw. – 1, 3, 4, 7: on limestone rock; 1: on the bark of tree  
*Didymodon sinuosus* (Mitt.) Delogne – 11: on limestone and conglomerate rocks  
*Ditrichum flexicaule* (Schwägr.) Hampe – 4: on limestone rock  
*Ditrichum pusillum* (Hedw.) Hampe – 13: on soil  
*Encalypta spathulata* Müll. Hal. – 4: on limestone rock (conf. L. Meinunger)  
*Encalypta streptocarpa* Hedw. – 1, 4, 8: on limestone rock  
*Encalypta vulgaris* Hedw. – 7: on limestone rock  
*Eucladium verticillatum* (Brid.) Bruch et Schimp. – 1, 8: on limestone rock  
*Eurhynchium crassinervium* (Wilson) Schimp. – 1, 2, 5, 8, 10: on limestone rock; 9: on shaded andesite rock; 12: on sandstone rock  
*Eurhynchium flotowianum* (Sendtn.) Kartt. – 11: on conglomerate rock  
*Eurhynchium hians* (Hedw.) Sande Lac. – 1, 2, 4, 5, 7, 8: on limestone rock; 11: on soil  
*Eurhynchium pumilum* (Wilson) Schimp. – 8: on limestone rock  
*Eurhynchium striatulum* (Spruce) Schimp. – 1, 2, 5, 7, 8, 10, 11: on limestone rock  
*Fissidens crassipes* Wilson ex Bruch et Schimp. – 8: on limestone rock  
*Fissidens dubius* P. Beauv. – 1, 8: on limestone rock  
*Fissidens exilis* Hedw. – 4: on soil  
*Fissidens gracilifolius* Brugg.-Nann. et Nyholm – 1, 5, 8, 10: on limestone rock  
*Fissidens pusillus* (Wilson) Milde – 1, 8, 11: on limestone rock; 12: on sandstone rock  
*Fissidens taxifolius* Hedw. – 4, 5, 9: on soil; 8, 11: on limestone rock  
*Fissidens viridulus* (Sw.) Wahlenb. – 4: on soil (det. J. Klawitter); 9: on exposed andesite rock (rev. T. Homm); 11: on conglomerate rock (rev. T. Homm)  
*Fontinalis antipyretica* Hedw. – 8: on limestone rock  
*Funaria hygrometrica* Hedw. – 4, 12: on soil; 5: on decaying wood  
*Grimmia anodon* Bruch et Schimp. – 4: on limestone rock  
*Grimmia decipiens* (Schultz) Lindb. – 9: on exposed andesite rock (conf. E. Maier)  
*Grimmia elatior* Bruch ex Bals.-Criv. et De Not. – 12: on sandstone rock (conf. E. Maier)  
*Grimmia hartmanii* Schimp. – 9: on exposed andesite rock; 12: on sandstone rock  
*Grimmia laevigata* (Brid.) Brid. – 9, 13: on exposed andesite rock  
*Grimmia muehlenbeckii* Schimp. – 9: on exposed andesite rock (conf. E. Maier)  
*Grimmia ovalis* (Hedw.) Lindb. – 9: on exposed andesite rock; 12: on exposed sandstone rock  
*Grimmia pulvinata* (Hedw.) Sm. – 3, 4, 11: on limestone rock; 9: on exposed andesite rock  
*Grimmia tergestina* Tomm. ex Bruch et Schimp. – 6: on exposed limestone rock  
*Gymnostomum calcareum* Nees et Hornsch. – 1, 8: on limestone rock  
*Hedwigia ciliata* (Hedw.) Ehrh. ex P. Beauv. var. *ciliata* – 9: on exposed andesite rock; 12: on exposed sandstone rock

- Hedwigia ciliata* var. *leucophaea* Bruch et Schimp. – 9: on exposed andesite rock; 12: on sandstone rock
- Herzogiella seligeri* (Brid.) Z. Iwats. – 12: on sandstone rock; 13: on decaying wood
- Homalia besseri* Lobarz. – 1, 2, 5, 8, 10: on limestone rock; 4: on the bark of *Corylus colurna*; 5: on the bark of *Fagus*; 9: on siliceous rock; 11: on the bark of *Acer*
- Homalia trichomanoides* (Hedw.) Schimp. – 5: on the bark of *Fagus*
- Homalothecium lutescens* (Hedw.) H. Rob. – 1, 7: on limestone rock; 9: on the bark of tree
- Homalothecium philippeanum* (Spruce) Schimp. – 5, 10, 11: on limestone rock
- Homalothecium sericeum* (Hedw.) Schimp. – 1, 4, 7: on limestone rock; 4: on the bark of *Corylus colurna*; 11: on conglomerate rock and on the bark of *Acer*; 12: on sandstone rock
- Homomallium incurvatum* (Brid.) Loeske – 1, 2, 4, 5, 8, 11: on limestone rock; 5: on decaying wood; 9: on exposed andesite rock
- Hygrohypnum luridum* (Hedw.) Jenn. – 8: on limestone rock
- Hypnum cupressiforme* Hedw. – 1, 2, 5, 8: on limestone rock; 4: on decaying wood; 9: on exposed and shaded andesite rocks; 11: on the base of *Fagus* tree; 12: on sandstone rock
- Hypnum cupressiforme* var. *lacunosum* Brid. – 7: on limestone rock
- Isothecium alopecuroides* (Dubois) Isov. – 4, 5: on the bark of *Tilia*; 9: on siliceous rock; 12: on sandstone rock
- Leptodictyum riparium* (Hedw.) Warnst. – 7: on stones in the Danube river
- Leskea polycarpa* Ehrh. ex Hedw. – 1, 8: on limestone rock, on the bark of tree; 7: on stones in the Danube river; 8: on the bark of *Juglans regia*
- Leucodon sciuroides* (Hedw.) Schwägr. – 1: on the bark of *Crataegus* and other trees; 4: on the bark of *Fraxinus* and *Corylus colurna*; 5, 6: on the bark of *Quercus*; 7: on limestone rock; 8: on the bark of *Juglans regia*; 9: on exposed andesite rock; 12: on sandstone rock
- Mnium marginatum* (Dicks.) P. Beauv. – 5, 8, 10: on limestone rock
- Mnium stellare* Hedw. – 5, 8: on limestone rock
- Neckera complanata* (Hedw.) Huebener – 1, 7, 8: on limestone rock
- Neckera crispa* Hedw. – 1, 8: on limestone rock
- Orthotrichum anomalum* Hedw. – 1, 4, 6, 7, 11: on limestone rock; 9: on exposed andesite rock
- Orthotrichum cupulatum* Brid. var. *cupulatum* – 1, 4, 7: on limestone rock; 11: on conglomerate rock
- Orthotrichum cupulatum* var. *riparium* Huebener – 8: on limestone rock
- Orthotrichum diaphanum* Schrad. ex Brid. – 1: on the bark of *Salix*; 7: on the bark of *Populus*
- Orthotrichum lyellii* Hook. et Taylor – 5, 6, 9: on the bark of *Quercus*
- Orthotrichum obtusifolium* Brid. – 1: on the bark of tree; 4: on the bark of *Fraxinus*; 7: on the bark of *Populus*
- Orthotrichum pallens* Bruch ex Brid. – 1: on the bark of tree; 5: on decaying wood
- Orthotrichum punilum* Sw. – 4: on the bark of *Fraxinus*; 5: on the bark of *Carpinus orientalis*; 7: on the bark of *Populus*
- Orthotrichum speciosum* Nees – 1: on the bark of tree
- Orthotrichum stramineum* Hornsch. ex Brid. – 5: on the bark of *Acer campestre*; 6: on the bark of *Quercus*
- Orthotrichum striatum* Hedw. – 1: on the bark of tree; 4: on the bark of *Quercus*; 5: on the bark of *Carpinus orientalis*
- Phascum cuspidatum* Hedw. – 6: on limestone rock
- Plagiomnium affine* (Blandow) T. J. Kop. – 1: on limestone rock; 9: on soil
- Plagiomnium cuspidatum* (Hedw.) T. J. Kop. – 2, 5: on limestone rock
- Plagiomnium elatum* (Bruch et Schimp.) T. J. Kop. – 1: on limestone rock
- Plagiomnium rostratum* (anon.) T. J. Kop. – 1, 2, 5, 8: on limestone rock



- Plagiomnium undulatum* (Hedw.) T. J. Kop. – 1, 8: on limestone rock
- Plagiothecium cavifolium* (Brid.) Z. Iwats. – 4: on limestone rock; 12: on sandstone rock
- Plagiothecium denticulatum* (Hedw.) Schimp. – 13: on soil
- Plagiothecium laetum* Schimp. var. *curvifolium* (Limpr.) Mastracci et M. Sauer – 12: on sandstone rock
- Plagiothecium succulentum* (Wilson) Lindb. – 8: on limestone rock; 9: on shaded andesite rock; 12: on conglomerate rock
- Platygyrium repens* (Brid.) Schimp. – 4, 6: on the bark of *Quercus*
- Platyhypnidium riparioides* (Hedw.) Dixon – 1, 8: on limestone rock; 7: on stones in the Danube river, 9: on shaded andesite rock
- Pogonatum aloides* (Hedw.) P. Beauv. – 11, 13: on soil
- Pohlia lescuriana* (Sull.) Ochi – 8: on limestone rock
- Pohlia lutescens* (Limpr.) H. Lindb. – 4, 13: on soil
- Pohlia melanodon* (Brid.) A. J. Shaw – 1, 7, 8: on soil over limestone rock
- Pohlia nutans* (Hedw.) Lindb. – 9: on shaded andesite rock; 11: on the base of *Fagus* tree; 12: on soil
- Polytrichum formosum* Hedw. – 9: on exposed and shaded andesite rocks; 11, 12: on soil; 13: on decaying wood
- Polytrichum juniperinum* Hedw. – 13: on soil
- Polytrichum piliferum* Schreb. ex Hedw. – 9: on exposed andesite rock; 12: on sandstone rock
- Pottia intermedia* (Turner) Fűrnr. – 4: on limestone rock; 9: on exposed andesite rock
- Pottia lanceolata* (Hedw.) Müll. Hal. var. *gasilienii* (Vent.) Corb. – 7: on limestone rock
- Pseudoleskeella catenulata* (Schrad.) Kindb. – 4: on limestone rock; 12: on sandstone rock
- Pseudoleskeella nervosa* (Brid.) Nyholm – 1, 11: on limestone rock; 1: on the bark of *Crataegus*; 2: on the bark of *Acer platanooides*; 4: on the bark of *Fraxinus*; 5, 6: on the bark of *Quercus*; 9: on shaded andesite rock and on the bark of *Corylus colurna*; 11: on conglomerate rock and on the bark of *Acer*; 12: on sandstone rock
- Pterigynandrum filiforme* Hedw. – 4: on the bark of *Tilia* and *Carpinus*; 6: on the bark of *Quercus*; 11: on the base of *Fagus* tree; 12: on sandstone rock and on the bark of *Fagus*
- Pylaisia polyantha* (Hedw.) Schimp. – 1: on the bark of tree; 8: on limestone rock
- Rhizomnium punctatum* (Hedw.) T. J. Kop. – 4: on soil; 8: on limestone rock; 12: on sandstone rock
- Rhynchostegiella tenella* (Dicks.) Limpr. – 1, 7, 8: on limestone rock
- Rhynchostegiella teneriffae* (Mont.) Dirkse et Bouman – 8: on limestone rock
- Rhynchostegium megapolitanum* (F. Weber et D. Mohr) Schimp. – 5: on soil
- Rhynchostegium murale* (Hedw.) Schimp. – 8: on limestone rock
- Rhytidiadelphus triquetrus* (Hedw.) Warnst. – 1: on limestone rock
- Schistidium apocarpum* (Hedw.) Bruch et Schimp. – 1, 8: on limestone rock
- Schistidium crassipilum* H. H. Blom – 1, 5, 11: on limestone rock; 9: on exposed andesite rock
- Schistidium elegantulum* Blom – 1, 5, 11: on limestone rock
- Schistidium pruinosum* (Wils. ex Schimp.) Roth – 9: on exposed andesite rock
- Scleropodium purum* (Hedw.) Limpr. – 1: on limestone rock
- Taxiphyllum densifolium* (Broth.) Reimers – 5, 10: on limestone rock
- Taxiphyllum wissgrillii* (Garov.) Wijk et Margad. – 2, 5, 8, 10: on limestone rock; 12: on sandstone rock
- Thamnobryum alopecurum* (Hedw.) Gangulee – 5, 8, 10: on limestone rock; 9: on siliceous rock
- Thuidium abietinum* (Hedw.) Schimp. – 7: on limestone rock
- Thuidium delicatulum* (Hedw.) Schimp. – 1: on limestone rock
- Tortella tortuosa* (Hedw.) Limpr. – 1, 4, 8, 11: on limestone rock; 11: on conglomerate rock
- Tortula crinita* (De Not.) De Not. – 1, 4, 7: on limestone rock

- Tortula inermis* (Brid.) Mont. – 7: on dry, soil-covered limestone rock  
*Tortula muralis* var. *aestiva* Brid. ex Hedw. – 12: on sandstone rock  
*Tortula muralis* L. ex Hedw. var. *muralis* – 1, 7, 11: on limestone rock; 9: on exposed andesite rock; 12: on sandstone rock  
*Tortula papillosa* Wilson – 1: on the bark of tree  
*Tortula ruralis* (Hedw.) P. Gaertn., B. Mey. et Scherb. – 4, 7: on limestone rock; 9: on exposed andesite rock; 12: on sandstone rock  
*Tortula subulata* Hedw. var. *angustata* (Schimp.) Limpr. – 5: on limestone rock; 9: on exposed andesite rock; 11: on soil  
*Tortula subulata* Hedw. var. *subulata* – 4: on limestone rock; 9: on exposed andesite rock  
*Tortula vahliana* (Schultz) Mont. – 12: on sandstone rock  
*Tortula virescens* (De Not.) De Not. – 4: on limestone rock; 11: on conglomerate rock  
*Trichostomum brachydontium* Bruch – 1, 8: on limestone rock  
*Trichostomum crispulum* Bruch – 1: on limestone rock  
*Weissia condensa* (Voit) Lindb. – 1, 7: on limestone rock  
*Weissia controversa* Hedw. – 9: on exposed andesite rock

### Conservation value of the bryoflora

Three species are included in the Red Data Book of European Bryophytes (ECCB 1995), viz. *Anomodon rostratus*, *Rhynchostegiella teneriffae* and *Taxiphyllum densifolium*. All of them are placed in the rare (R) category. *Anomodon rostratus* and *Taxiphyllum densifolium* were found on the limestone rocks in the dolinas between Ploče and Mali Štrbac. The latter species has quite large populations here, numerous patches can be found in several dolinas. *Anomodon rostratus* was found in only one large dolina and in a few patches on a rock wall. *Rhynchostegiella teneriffae* was collected on the stones of Brnjička reka stream. Two patches were found.

According to the preliminary national red list of bryophytes (SABOVLJEVIĆ *et al.* 2004) the region of Djerdap National Park is rich in species of conservation interest. Among the liverworts, these are: *Cephaloziella rubella* (VU = vulnerable), *Cololejeunea rossettiana* (LR = lower risk), *Leiocolea badensis* (VU) and *L. bantriensis* (VU). Among the mosses, red-listed species are: *Amphidium mougeotii* (VU), *Amblystegium confervoides* (DD = data deficient), *Anomodon longifolius* (DD), *A. rostratus* (VU), *Dicranella schreberiana* (DD), *Didymodon ferrugineus* (DD), *Fissidens exilis* (DD), *Orthotrichum obtusifolium* (VU), *Rhynchostegiella teneriffae* (LR), *Tortula papillosa* (LR) and *Tortula virescens* (LR).

*Cephaloziella rubella* seems to be rare in Serbia or under-recorded (only one unprecise previous record; GAJIĆ *et al.* 1991, SABOVLJEVIĆ 2000a). The presence of the species in Serbia was confirmed by PAPP *et al.* (2004) in Kopaonik Mts. This species occurs mainly in temperate to boreal ecosystems, and so this population at the border of its European area is of high conservation value. In SE Europe it possi-

bly has a scattered distribution, and it is known from few localities in Bulgaria, Croatia, Romania, Slovenia and Turkey (SABOVLJEVIĆ and NATCHEVA, in press).

*Cololejeunea rossettiana*, *Leiocolea badensis* and *L. bantriensis* are tiny leafy liverworts and are probably under-recorded. However, the first one is widespread in the region, with records in all countries except Bosnia-Herzegovina, Macedonia and Turkey (SABOVLJEVIĆ and NATCHEVA, in press). The last two are sporadically present in a few countries of the region. *Cololejeunea rossettiana* was found in Serbia in Petnica region (PAPP and SABOVLJEVIĆ 2001) and in Tara National Park (PAPP and SABOVLJEVIĆ 2002), while *Leiocolea badensis* was collected in Tara National Park and Kopaonik Mts (PAPP *et al.* 2004). *Leiocolea bantriensis* was collected in Tara National Park, Kopaonik Mts (several localities) and the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). According to these data, *L. bantriensis* seems to be less threatened, at least in the protected areas investigated.

*Amphidium mougeotii* is a circumpolar montane species becoming rare in Europe towards the Southeast. It was not expected at such low altitude in Southern Europe. Due to its isolation, the population deserves special conservation attention. However, in higher mountains of Serbia it might be more frequent, as *e.g.* in Stara Planina (PAPP and ERZBERGER, numerous unpublished records).

*Amblystegium confervoides* occurs in some neighbouring countries (*e.g.* Bosnia-Herzegovina, Bulgaria, Croatia, Romania and Slovenia), but former records in Serbia are very few. It was published without precise locality by GAJIĆ *et al.* (1991) and MARTINČIĆ (1968). In the Djerdap National Park many suitable growth sites are present (shaded calcareous rock) and numerous populations were registered, some even with sporophytes.

*Anomodon longifolius*, an Eurasian boreo-temperate species (SMITH 2004), is a tiny, easily overlooked, pleurocarpous moss. It has recently been recorded from W Serbia (PAPP and SABOVLJEVIĆ 2001) and this is its second record. At both locations the species grows under similar conditions on shadowed calcareous rock.

The first record of the European red-listed *Anomodon rostratus* in Serbia was from Petnica, W Serbia (PAPP and SABOVLJEVIĆ 2001), the second in Tara National Park (PAPP and SABOVLJEVIĆ 2002) and the third in Mt Avala (C. Serbia; SABOVLJEVIĆ and CVETIĆ 2003). The fourth record in Serbia is reported here.

*Dicranella schreberiana*, a circumpolar boreo-temperate species according to SMITH (2004), was previously only mentioned by MARTINČIĆ (1968) without precise locality.

*Didymodon ferrugineus* is known to be present in Serbia sporadically. It was recorded recently from Tara National Park (PAPP and SABOVLJEVIĆ 2002) and Kopaonik Mts (PAPP *et al.* 2004). This is its third recent record in Serbia.

*Fissidens exilis* is a species newly recorded for Serbia recently in Mt Avala (SABOVLJEVIĆ and CVETIĆ 2003). It has also been published from the surroundings of Belgrade by GRDOVIC (2005). This is its third record in Serbia. In a similar way, our record of *Fissidens viridulus* is the second record in Serbia, since it was also found in Mt Avala (SABOVLJEVIĆ and CVETIĆ 2003). It has not been assigned a threat status in SABOVLJEVIĆ *et al.* (2004), but obviously it qualifies as data deficient (DD).

*Orthotrichum obtusifolium* appears to be extremely rare in Serbia (PAVLETIĆ 1955, SABOVLJEVIĆ *et al.* 2004). Recently it was reported from Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). In Djerdap National Park it was recorded on several trees. According to the observations in Central Europe, this species is generally more frequent in calcareous areas.

The European red-listed *Rhynchostegiella teneriffae* was first recorded in Serbia by PAPP and SABOVLJEVIĆ (2001). It was known from Bosnia-Herzegovina and Slovenia. This is the second record of this rare European species in Serbia.

*Tortula papillosa*, first recorded in Serbia recently (SABOVLJEVIĆ 2000b), seems to be in range expansion within the region since many new records appear recently.

*Tortula virescens* has rarely been recorded in Serbia.

There are also several other species, which were reported only from a few localities in Serbia. *Cephaloziella divaricata*, *Cinclidotus riparius*, *Hedwigia ciliata* var. *leucophaea*, *Pohlia lescuriana*, *Pohlia lutescens* were reported for the first time in Serbia from the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). Their 2nd locality is in Djerdap National Park. *Bryum rubens* was found around Petnica, W Serbia (PAPP and SABOVLJEVIĆ 2001). Its 2nd locality is reported here from Djerdap National Park. *Ditrichum pusillum* was reported from the surrounding of Belgrade by GRDOVIC (2005). Its 2nd locality is in Djerdap National Park. *Schistidium pruinosum* was found for the first time in Serbia in Tara National Park (PAPP and SABOVLJEVIĆ 2002). Its 2nd locality is reported here. *Fissidens pusillus* was recorded in Petnica, W Serbia (PAPP and SABOVLJEVIĆ 2001) and the Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). Its 3rd locality is in the Djerdap National Park. *Grimmia tergestina* reported from Kopaonik Mts (PAPP *et al.* 2004) and Golija-Studenica Biosphere Reserve (PAPP and ERZBERGER 2005). This is its 3rd locality in Serbia.

\* \* \*

*Acknowledgements* – The authors are grateful to the Institute for the Protection of Nature of Serbia and the leadership and staff of the Djerdap National Park for their support of our field surveys. Many thanks are due to Duska Dimović (Belgrade), for her essential help in the organisation of the field trip. We are also indebted to E. Maier (Geneva), J. Klawitter (Berlin), Thomas Homm

(Oldenburg), W. Schröder and L. Meinunger (Ludwigsstadt) for confirmation, determination or revision of some specimens.

## REFERENCES

- BLOCKEEL, T. L., ROS, R. M., SABOVLJEVIĆ, M., CANO, M. J., GALLEGU, M. T. and MUNOZ, (2002): New and interesting bryophyte records for Greece. – *Cryptogamie, Bryologie* **23**(2): 149–155.
- CVETIĆ, T. and SABOVLJEVIĆ, M. (2005): A contribution to the bryophyte flora of Fruška Gora (Vojvodina, Serbia). – *Phytologia Balcanica* **11**(1): 35–43.
- DÜLL, R. (1984): Distribution of the European and Macaronesian mosses (Bryophytina) I. – *Bryol. Beitr.* **4**: 1–109.
- DÜLL, R. (1985): Distribution of the European and Macaronesian mosses (Bryophytina) II. – *Bryol. Beitr.* **5**: 110–232.
- DÜLL, R., GANEVA, A., MARTINČIČ, A. and PAVLETIĆ, Z. (1999): *Contributions to the bryoflora of former Yugoslavia and Bulgaria*. – IDH-Verlag, Bad Münstereifel, 199 pp.
- ECCB (1995): *Red Data Book of European Bryophytes*. – European Committee for Conservation of Bryophytes, Trondheim, 291 pp.
- ERZBERGER, P. and PAPP, B. (2004): Annotated checklist of Hungarian bryophytes. – *Studia bot. hung.* **35**: 91–150.
- GAJIĆ, M., KORAČ, M. and OBRATOV, D. (1991): *Pregled mahovina u Srbiji*. – In: Zbornik radova sa simpozijuma “Nedeljko Košanin i Bonaničke Nauke”, SANU-Institut za Botaniku i Botanička Bašta PMF. JP za gazdovanje šumama Golija-Ivanjica. pp. 400–407.
- GRDOVIC, S. (2005): *Moss flora in the greater area of Belgrade*. – Abstracts, XVII International Botanical Congress, Vienna, 17–23 July 2005, p. 453.
- KOPERSKI, M., SAUER, M., BRAUN, W. and GRADSTEIN, S. R. (2000): Referenzliste der Moose Deutschlands. – *Schriftenr. f. Vegetationsk.* **34**: 1–519.
- MARTINČIČ, A. (1968): *Catalogus florae Jugoslaviae II/1. Bryophyta – Musci*. – SAZU, 102 pp.
- NATCHEVA, R. and GANEVA, A. (2005): Check-list of the bryophytes of Bulgaria. II. Musci. – *Cryptogamie, Bryologie* **24**(3): 229–239.
- PAPP, B. (2002): New records of bryophytes from a saline area of Greece. – *Studia bot. hung.* **33**: 21–24.
- PAPP, B. (2004): Contributions to the bryoflora of the Pontic Mts, North Anatolia, Turkey. – *Studia bot. hung.* **35**: 81–90.
- PAPP, B. and ERZBERGER, P. (2005): The bryophyte flora of Golija-Studenica Biosphere Reserve and some adjacent sites (SW Serbia, Serbia-Montenegro). – *Studia bot. hung.* **36**: 101–116.
- PAPP, B. and SABOVLJEVIĆ, M. (2001): Contribution to the knowledge of the bryoflora of the region of Petnica (W. Serbia, Yugoslavia). – *Studia bot. hung.* **32**: 107–120.
- PAPP, B. and SABOVLJEVIĆ, M. (2002): The bryophyte flora of Tara National Park (W Serbia, Yugoslavia). – *Studia bot. hung.* **33**: 25–39.
- PAPP, B., ERZBERGER, P. and SABOVLJEVIĆ, M. (2004): Contribution to the bryophyte flora of Kopaonik Mts (Serbia, Serbia-Montenegro). – *Studia bot. hung.* **35**: 67–79.
- PAVLETIĆ, Z. (1955): *Prodromus Flore Briofita Jugoslavije*. – Jugoslovenska Akademija Znanosti i Umjetnosti. Zagreb, 758 pp.
- PÓCS, T., SABOVLJEVIĆ, M., PUCHE, F., SEGARRA MORAGUES, J. G., GIMENO, C. and KÜRSCHNER, H. (2004): *Crossidium laxifilamentosum* Frey and Kürschner (Pottiaceae), new to Europe and

- to North Africa. Studies on the cryptogamic vegetation on loess cliffs, VII. – *Journal of Bryology* **26**: 113–124.
- SABOVLJEVIĆ, M. (1998): The rare bryophytes of Šara Mountain, Yugoslavia. – *Planta Europa* **2**: 159–161.
- SABOVLJEVIĆ, M. (1999): *Anastrophyllum minutum* (Schreb.) Schuster, new to Serbia (FR Yugoslavia) and its distribution in the Balkans. – *Phytologia Balcanica* **5**(2–3): 93–96.
- SABOVLJEVIĆ, M. (2000a): Checklist of hepatics of the Federal Republic of Yugoslavia. – *Lindbergia* **25**: 37–42.
- SABOVLJEVIĆ, M. (2000b): *Tortula papillosa*. The Federal Republic of Yugoslavia: Serbia. – In: New national and regional bryophyte records, 3. *Journal of Bryology* **22**(4): 303–306.
- SABOVLJEVIĆ, M. (2002): *Dryotodon patens* (Hedw.) Brid. The Federal Republic of Yugoslavia: Serbia: Kosovo. – In: New national and regional bryophyte records, 6. *Journal of Bryology* **24**(4): 329–332.
- SABOVLJEVIĆ, M. (2003a): Bryophyte flora of South Banat (Vojvodina, Yugoslavia). – *Cryptogamie, Bryologie* **24**(3): 241–252.
- SABOVLJEVIĆ, M. (2003b): Données sur la présence et la chorologie des taxons du genre *Schistidium* Bruch et Schimper (Grimmiaceae) dans la République Fédérale de Yougoslavie (Serbie et Monténégro). – *Bocconea* **16**(2): 991–999.
- SABOVLJEVIĆ, M. (in press): Contribution to the bryophyte flora of Djerdap National Park (E. Serbia). – *Phytologia Balcanica*
- SABOVLJEVIĆ, M. and CVETIĆ, T. (2001): *Rhodobryum ontariense* (Kindb.) Kindb. new to Yugoslavia and some notes on the genus *Rhodobryum* (Schimp.) Limpr. in Yugoslavia. – *Ekologija* **36**(2): 145–153.
- SABOVLJEVIĆ, M. and CVETIĆ, T. (2003): Bryophyte flora of Avala Mt. (C. Serbia, Yugoslavia). – *Lindbergia* **28**: 90–96.
- SABOVLJEVIĆ, M. and NATCHEVA, R. (in press): Checklist of the liverworts and hornworts of South-Eastern Europe. – *Phytologia Balcanica*
- SABOVLJEVIĆ, M. and STEVANOVIĆ, V. (1999): Moss conspectus of Federal Republic of Yugoslavia. – *Flora Mediterranea* **9**: 65–95.
- SABOVLJEVIĆ, M. and STEVANOVIĆ, V. (2000): *Sphagnum denticulatum*, una novedad para la flora briofítica de Serbia (Yugoslavia). – *Botanica Complutensis* **24**: 61–63.
- SABOVLJEVIĆ, M., CVETIĆ, T. AND STEVANOVIĆ, V. (2004): Bryophyte Red List of Serbia and Montenegro. – *Biodiversity and Conservation* **13**: 1781–1790.
- SABOVLJEVIĆ, M., GANEVA, A., TSAKIRI, E. and STEFANUT, S. (2001): Bryology and bryophyte protection in the south-eastern Europe. – *Biological Conservation* **101**: 73–84.
- SABOVLJEVIĆ, M., STEVANOVIĆ, V. and LAKUŠIĆ, D. (1999): *Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl., rediscovered in Yugoslavia. – *Phytologia Balcanica* **5**(1): 51–52.
- SMITH, A. J. E. (2004): *The moss flora of Britain and Ireland*. 2nd ed. – University Press, Cambridge, 1012 pp.
- STEVANOVIĆ, V. and VASIĆ, V. (eds) (1995): *Biodiversity of Yugoslavia with survey of internationally significant species*. – Biološki fakultet Univerziteta u Beogradu, Ecolibri, Beograd, pp. 1–298.
- VELJIĆ, M., MARIN, P. D., PETKOVIĆ, B. and LJUBIĆ, B. (2001): New species for the bryophyte flora of Yugoslavia. – *Cryptogamie, Bryologie* **22**(4): 275–277.

(Received 15 March, 2006)