

BRYOPHYTE FLORA ON THE NORTHERN SLOPES OF ZLATAR MOUNTAIN (SOUTHWEST SERBIA)

M. VELJIĆ, BILJANA LJUBIĆ, P. D. MARIN, and MARIJA MARIN

Institute of Botany, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia

Abstract — This work presents a contribution to knowledge of the bryophyte flora of Zlatar Mountain. A total of 127 taxa from 35 families were identified. The hepatics are represented by 18 and mosses by 109 taxa. Representatives of the Holarctic distribution type and the temperate floristic category are highly present in the investigated area.

Key words: Bryophytes, ecology, Zlatar Mountain, Serbia

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INTRODUCTION

Floristic and phyto-cenological examinations in Southwest Serbia have been conducted since the beginning of the 20th century. In previous studies on the regional flora (Košanin, 1908, 1909; Černjavski, 1929; Pavlović, 1951), there are very few data on bryophytes. More intensive bryological investigations in this area were initiated in the 1990's (Veljić and Marin, 1997; Veljić et al., 2001a, 2001b; Veljić et al., 2004; Papp and Erzberger, 2005; Veljić et al., 2006).

Zlatar Mountain is located in the southwestern part of Serbia, in the region of Stari Vlah and Raška. It extends 23 km from southeast to northwest and is 3 km wide. The altitude varies from 450 m in Bistrica to 1,650 m in the Veliki Krš area. The geological base is made up of massive calcareous rocks, marly calcareous rocks with quartz, sands, and clay. The pedological substratum consists of brownized soil on calcareous rocks, rendzina and brownish rendzina on quartz, and brownized skeleton soil on sands. The climate is of the humid temperate continental type with average annual precipitation of 850 mm and average temperature of 7.4°C. The major part of Zlatar Mountain is covered by the following forest associations: *Fagetum montanum serbicum* Rudski; *Abieti-Fagetum calcicolum* B. Jov.; *Abietipicetum serbiacum typicum* Mišić et al.; *Picetum*

excelsae serbiacum Greb.; and *Piceto-Pinetum moesiacum* Obratov (Obratov, 1992).

MATERIAL AND METHODS

The material was collected from April 1998 until April 2001. Sampling was performed at twelve selected points on the northern slopes of Zlatar Mountain (Map 1). Material was collected from the following points: 1. Gačevo Spring, 2. Zložnica Brook (500 m downstream from Gačevo Spring), 3. Zložnica Brook (mouth of the Vukovac), 4. Zložnica Brook (Mišići), 5. Zložnica Brook (Kocelj), 6. Zložnica Brook (entrance into Zlatarsko Lake), 7. fountainhead of the Zlatarska River, 8. Zlatarska River (1 km downstream from the fountainhead), 9. Zlatarska River (500 m upstream from mouth of the Batrovac), 10. Zlatarska River (mouth of the Batrovac), 11. Rehabilitation Center, and 12. Panorama Hotel. Identification was done using relevant bryological literature. The nomenclature follows Grolle and Long (2000) and Hill et al. (2006). Floristic elements and distribution are according to Düll et al. (1999) and ecological parameters according to Boros (1964). The collection is preserved in the herbarium of the Department of Plant Morphology and Systematics, Institute of Botany and Jevremovac Botanical Garden, Faculty of Biology, Belgrade.

Table 1. List of taxa with locality number(s) where taxa were recorded.

TAXON	LOCALITY
Mosses	
<i>Abietinella abietina</i> (Hedw.) M. Fleisch.	1, 2, 4, 6, 8, 9, 11, 12
<i>Amblystegium serpens</i> (Hedw.) Schimp.	4
<i>Anomodon attenuatus</i> (Hedw.) Huebener	3, 6, 10
<i>Anomodon viticulosus</i> (Hedw.) Hook. & Taylor	8, 10, 11
<i>Atrichum undulatum</i> (Hedw.) P. Beauv.	10
<i>Aulacomnium palustre</i> (Hedw.) Schwägr. var. <i>inbricatum</i> Br.Eur.	7
<i>Aulacomnium palustre</i> (Hedw.) Schwägr. var. <i>palustre</i>	7
<i>Bartramia pomiformis</i> Hedw.	8
<i>Brachythecium albicans</i> (Hedw.) Schimp.	3, 4.
<i>Brachythecium glareosum</i> (Bruch ex Spruce) Schimp.	4, 5, 8
<i>Brachythecium mildeanum</i> (Schimp.) Schimp.	1, 8
<i>Brachythecium rivulare</i> Schimp.	5, 6, 10, 11, 12
<i>Brachythecium rutabulum</i> (Hedw.) Schimp.	1, 3, 4, 5, 6, 7, 10
<i>Brachythecium salebrosum</i> (Hofm. Ex F. Weber & D. Mohr.) Schimp.	3
<i>Brachytheciastrium velutinum</i> (Hedw.) Ignatov & Huttunen	3, 4, 5, 8, 10
<i>Breidleria pratensis</i> (W.D.J. Koch ex Spruce) Loeske	7
<i>Bryoerythrophyllum recurvirostrum</i> (Hedw.) P. C. Chen	6
<i>Bryum argenteum</i> Hedw.	5
<i>Bryum caespiticium</i> Hedw.	3
<i>Bryum capillare</i> Hedw.	1, 3, 5, 6, 12
<i>Bryum pallens</i> Sw.	4
<i>Bryum pseudotriquetrum</i> (Hedw.) P.Gaertn.	1, 6, 7
<i>Calliergon cordifolium</i> (Hedw.) Kindb.	5
<i>Calliergonella cuspidata</i> (Hedw.) Loeske	5, 7, 9, 10, 12
<i>Campyliadelphus chrysophyllus</i> (Brid.) R. C. Chopra	4
<i>Campylium stellatum</i> (Hedw.) Lange & C. E. O. Jensen	10
<i>Ceratodon purpureus</i> (Hedw.) Brid.	12
<i>Cirriphyllum piliferum</i> (Hedw.) Grout	9
<i>Climacium dendroides</i> (Hedw.) F. Weber & D. Mohr	4, 6, 8
<i>Cratoneuron filicinum</i> (Hedw.) Spruce var. <i>filicinum</i>	6, 10, 11, 12
<i>Ctenidium molluscum</i> (Hedw.) Mitt.	6, 8, 9, 10
<i>Dicranella heteromalla</i> (Hedw.) Schimp.	5
<i>Dicranum scoparium</i> Hedw.	4, 6, 8
<i>Didymodon insulanus</i> (De Not.) M. O. Hill	10, 11, 12
<i>Didymodon rigidulus</i> Hedw.	6
<i>Didymodon vinealis</i> (Brid.) R. H. Zander	3, 4, 6
<i>Distichium inclinatum</i> (Hedw.) Bruch & Schimp.	12
<i>Ditrichum flexicaule</i> (Schwägr.) Hampe	9
<i>Encalypta streptocarpa</i> Hedw.	6, 8, 9, 10, 12
<i>Eucladium verticillatum</i> (With.) Bruch & Schimp.	6
<i>Eurhynchium angustirete</i> (Broth.) T. J. Kop.	5, 6, 8, 10
<i>Fissidens dubius</i> P. Beauv.	10
<i>Fissidens taxifolius</i> Hedw. subsp. <i>taxifolius</i>	6, 11
<i>Fontinalis antipyretica</i> Hedw. var. <i>antipyretica</i>	2
<i>Funaria hygrometrica</i> Hedw.	11
<i>Grimmia pulvinata</i> (Hedw.) Sm.	2, 4, 12
<i>Homalia webbiana</i> (Mont.) Schimp.	10
<i>Homalothecium lutescens</i> (Hedw.) H. Rob.	6, 8
<i>Homalothecium philippeanum</i> (Spruce) Schimp.	3, 10, 12
<i>Homalothecium sericeum</i> (Hedw.) Schimp.	5, 9, 10, 11
<i>Homomallium incurvatum</i> (Schrad. Ex Brid.) Loeske	3
<i>Hygroamblystegium varium</i> (Hedw.) Mönk..	3
<i>Hygrohypnum luridum</i> (Hedw.) Jenn.	6, 12
<i>Hylocomium splendens</i> (Hedw.) Schimp.	4, 5, 6, 7, 8, 9
<i>Hypnum cupressiforme</i> Hedw. var. <i>resupinatum</i> (Taylor) Schimp.	5, 6
<i>Hypnum cupressiforme</i> Hedw. var. <i>cupressiforme</i>	2, 3, 4, 5, 6, 8, 10, 12
<i>Isothecium alopecuroides</i> (Lam. Ex Dubois) Isov.	10
<i>Isothecium myosuroides</i> Brid.	10
<i>Leucodon sciuroides</i> (Hedw.) Schwägr.	11
<i>Mnium marginatum</i> (Dicks.) P. Beauv.	6
<i>Mnium stellare</i> Hedw.	10
<i>Mnium thomsonii</i> Schimp.	10
<i>Neckera complanata</i> (Hedw.) Huebener	6, 9, 10

Table 1. Ctd.

TAXON	LOCALITY
<i>Neckera crispa</i> Hedw.	9, 10
<i>Neckera pumila</i> Hedw.	5
<i>Orthotrichum affine</i> Schrad. ex Brid.	5, 10
<i>Orthotrichum anomalum</i> Hedw.	1, 2, 4, 10, 11
<i>Orthotrichum cupulatum</i> Hoffm. ex Brid.	5
<i>Orthotrichum stramineum</i> Hornsch. ex Brid.	4
<i>Oxyrrhynchium hians</i> (Hedw.) Loeske	5, 6, 10, 12
<i>Oxyrrhynchium speciosum</i> (Brid.) Warnst.	3
<i>Palustriella commutata</i> (Hedw.) Ochyra var. <i>commutata</i>	6
<i>Philonotis fontana</i> (Hedw.) Bird .	7
<i>Plagiomnium affine</i> (Blandow ex Funck) T. J. Kop.	2, 3, 4
<i>Plagiomnium cuspidatum</i> (Hedw.) T. J. Kop.	5, 12
<i>Plagiomnium elatum</i> (Bruch & Schimp.) T. J. Kop.	1, 3, 6
<i>Plagiomnium rostratum</i> (Schrad.) T. J. Kop.	1, 3, 5, 6, 8, 9, 10
<i>Plagiomnium undulatum</i> (Hedw.) T. J. Kop.	1, 3, 5, 6, 8, 9, 10, 12
<i>Plagiopus oederianus</i> (Sw.) H. A. Crum & L. E. Anderson	10
<i>Plagiothecium cavifolium</i> (Brid.) Z. Iwats.	10
<i>Platygyrium repens</i> (Brid.) Schimp.	6
<i>Pleurozium schreberi</i> (Willd. ex Brid.) Mitt.	7
<i>Polytrichum formosum</i> (Hedw.) G. L. Sm.	10
<i>Pseudocrossidium revolutum</i> (Brid.) R. H. Zander	11
<i>Pseudoleskeella catenulata</i> (Brid. ex Schrad.) Kindb.	3
<i>Pseudoleskeella nervosa</i> (Brid.) Nyholm	3, 10
<i>Pseudoscleropodium purum</i> (Hedw.) M. Fleisch.	6, 8, 10, 12
<i>Pterigynandrum filiforme</i> Hedw.	4, 5
<i>Pylaisia polyantha</i> (Hedw.) Schimp.	5
<i>Racomitrium canescens</i> (Hedw.) Brid. var. <i>canescens</i>	4, 9
<i>Rhizomnium punctatum</i> (Hedw.) T. J. Kop.	8
<i>Rhodobryum roseum</i> (Hedw.) Limpr.	10
<i>Rhytidiadelphus squarrosus</i> (Hedw.) Warnst.	4, 7
<i>Rhytidiadelphus triquetrus</i> (Hedw.) Warnst.	5, 6, 8, 12
<i>Rhytidium rugosum</i> (Hedw.) Kindb.	3, 6
<i>Schistidium apocarpum</i> (Hedw.) Bruch. & Schimp. var. <i>apocarpum</i>	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12
<i>Scleropodium cespitans</i> (Wilson ex Müll.) L. F. Koch	8
<i>Scleropodium touretii</i> (Brid.) L. F. Koch	10, 12
<i>Syntrichia ruralis</i> (Hedw.) F. Weber & D. Mohr subsp. <i>ruralis</i>	1, 2, 3, 4, 5, 9, 11
<i>Thamnobryum alopecurum</i> (Hedw.) Gangulee	10
<i>Thuidium assimile</i> (Mitt.) A. Jaeger	3, 4, 5, 6, 7, 10, 12
<i>Thuidium delicatulum</i> (Hedw.) Schimp.	6
<i>Thuidium recognitum</i> (Hedw.) Lindb.	1, 5, 6, 9, 10
<i>Tortella tortuosa</i> (Hedw.) Limpr.	3, 4, 6, 8, 9, 10, 12
<i>Tortula lanceolata</i> R. H. Zander	8
<i>Tortula muralis</i> Hedw. var. <i>muralis</i>	6, 11, 12
<i>Tortula subulata</i> Hedw.	3, 4, 5, 8, 12
<i>Ulota crispa</i> (Hedw.) Brid.	8
<i>Warnstorfia exanulata</i> (Schimp.) Loeske	1
Hepatics	
<i>Barbilophozia barbata</i> (Schmid. ex Schreb.) Loeske	4
<i>Conocephalum conicum</i> (L.) Dumort.	6
<i>Frullania dilatata</i> (L.) Dumort.	5, 10
<i>Lophocolea bidentata</i> (L.) Dumort. var. <i>bidentata</i>	4, 9, 10, 12
<i>Lophocolea bidentata</i> (L.) Dumort. var. <i>rivularis</i> (Raddi) Warnst.	5
<i>Marchantia polymorpha</i> L.	6
<i>Metzgeria conjugata</i> Lindb.	8, 10
<i>Metzgeria furcata</i> (L.) Dumort.	5, 6, 10
<i>Pedinophyllum interruptum</i> (Ness) Kaal.	10
<i>Pellia endiviifolia</i> (Dicks.) Dumort.	10
<i>Pellia epiphylla</i> (L.) Corda	6
<i>Plagiochila asplenioides</i> (L. emend. Taylor) Dumort.	4, 5, 6, 8, 9, 10
<i>Porella arboris – vitae</i> (With.) Grolle	10
<i>Porella cordaeana</i> (Huebener) Moore	10
<i>Porella platyphylla</i> (L.) Pfeiff.	8
<i>Ptilidium pulcherrimum</i> (Weber) Vain.	8
<i>Radula complanata</i> (L.) Dumort.	3, 5, 6, 8, 10
<i>Scapania calcicola</i> (Arnell et J. Perss.) Ingham	9



Map. 1. Zlatar Mt. - Investigated area.

RESULTS AND DISCUSSION

At the researched localities, 127 bryophyte taxa were recorded (Table 1). The liverworts are represented by 18 and mosses by 109 taxa. Representatives of 35 families are recorded, the most numerous being *Brachytheciaceae*, with six genera and 19 species; *Hypnaceae*, with nine genera and 12 species; and *Pottiaceae*, with seven genera and 11 species; *Amblystegiaceae*, with eight genera and 10 species; and *Mniaceae*, with three genera and 9 species. The genera *Brachythecium*, *Bryum*, and *Plagiomnium* are present with the highest number of species (six and five, respectively). *Schistidium apocarpum* var. *apocarpum* was recorded at 11 localities. Other very frequent species are: *Hypnum cupressiforme* var. *cupressiforme*, *Plagiomnium undulatum*, and *Abietinella abietina* (eight localities); and *Brachythecium rutabulum*, *Plagiomnium rostratum*, *Syntrichia ruralis* subsp. *ruralis*, and *Tortella tortuosa* (seven localities). Sixty-seven taxa were recorded at just one locality.

Diversity of the bryophyte flora is very great in the investigated area; the bryologically poorest was locality 2 (eight taxa), and the most diverse bryophyte flora was recorded at locality 10 (52 taxa).

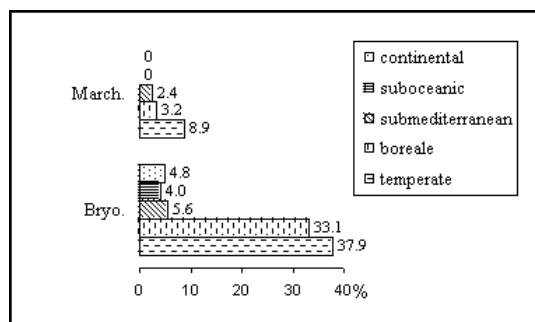


Fig. 1. Floral elements, presence by number/percentage.

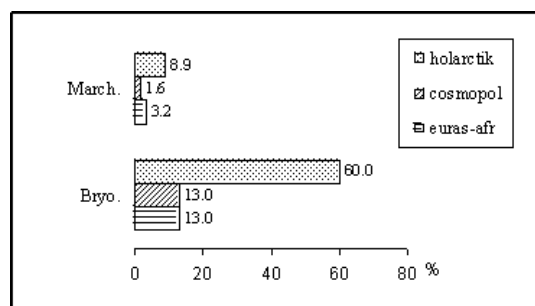


Fig. 2. Distribution, presence by number/percentage.

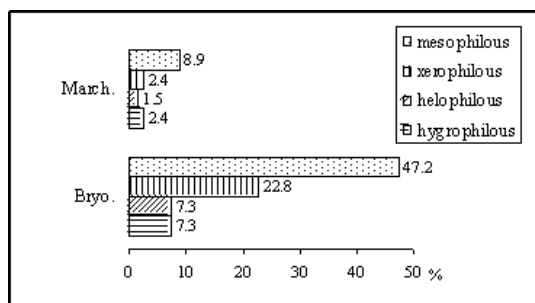


Fig. 3. Category by humidity, presence by number/percentage..

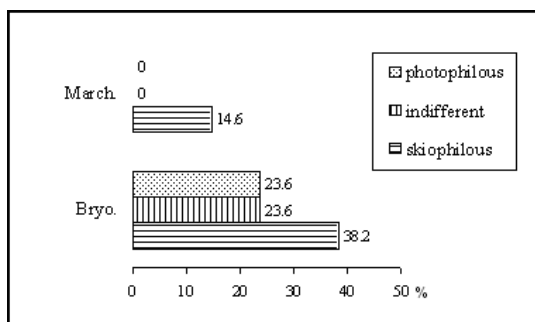


Fig. 4. Light, presence by number/percentage

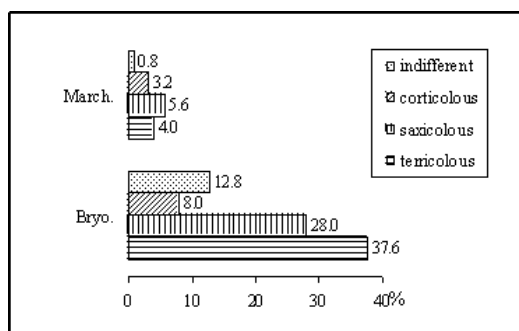


Fig. 5. Substratum type, presence by percentage.

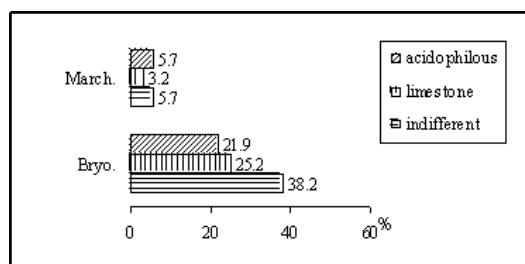


Fig. 6. Substratum pH, presence by percentage.

Analysis of floristic elements (Dülli et al., 1999) indicated dominance of moss temperate elements (37.9%); boreal elements were numerous as well (33.1%). The remaining representatives were sub-continental, sub-Mediterranean, and sub-oceanic elements. The same types of elements were also dominant among representatives of the Hepaticae (Fig. 1).

Analysis of bryophyte distribution types (Dülli et al., 1999) showed taxa with the Holarctic distribution type to be the most numerous (60%), while the rest were species with cosmopolitan (sub-cosmopolitan included) and European-Asiatic distribution (Fig. 2).

Ecological analysis included the following parameters: humidity, light, substratum type, and substratum pH. With respect to humidity as an ecological parameter, mesophilous species were present with the highest percentages (mosses with 47.2% and liverworts with 8.9%). The rest were mostly xerophilous, hygrophilous, and heliophilous species (Fig. 3). It is known that mosses are most diverse and most numerous in shade. In our examinations, most of the species found were skiophilous (52.8%).

All of the 18 liverwort taxa were skiophilous (Fig. 4). Most of the taxa (41.6%) were ones that prefer soil as substratum, followed by rocks and bark. However, the liverworts were forms that prefer rocks (5.6%) over other substrata (Fig. 5). The observed diversity was determined by substratum acidity; the greatest number of taxa were indifferent (Fig. 6), while almost the same number preferred limestone (28.4%) acidophilous (27.6%) substrates.

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ФЛОРА МАХОВИНА СЕВЕРНИХ ПАДИНА ПЛАНИНЕ ЗЛАТАР (ЈУГОЗАПАДНА СРБИЈА)

М. ВЕЉИЋ, БИЉАНА ЉУБИЋ, П. Д. МАРИН и МИРЈАНА МАРИН

Институт за ботанику, Биолошки факултет, Универзитет у Београду, 11000 Београд, Србија

Рад представља прилог познавању бриофлоре планине Златар у југозападној Србији. Узорковање је обављено на 12 локалитета. На истраживаном подручју идентификовано је 127 таксона из 35 фамилија. Класу јетрењача представља 18, а класу правих маховина

109 таксона. Фитогеографском анализом установљено је да су најзаступљенији представници холарктичког распрострањења и умереног флорног елемента. Еколошком анализом констатовано је да највећи број врста преферира мезофилна и скиофилна станишта.