

New data on the bryophyte flora of the Bulgarka Nature Park

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Abstract. The paper presents new data on the composition of bryophyte species in the Bulgarka Nature Park. A total of 103 bryophyte species have been identified (17 liverworts and 86 mosses). Comments are offered on the distribution of *Dicranum viride*, *Leucobryum glaucum* and on the debatable report of *Dichelyma falcatum* and *Trichocolea tomentella*, two species rare for Bulgaria.

Key words: Bulgarka Nature Park, bryophytes, *Dicranum viride*

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Introduction

Studies of diversity, distribution and ecological preferences of the bryophyte species in Bulgaria are important both for strictly scientific and for conservation purposes. Several bryophyte species in the Bulgarian bryoflora are of European conservation importance and occur in the NATURA 2000 sites. According to Directive 92/43/EEC (Habitats Directive), the Member States are obligated to study the distribution and conservation status of these species and also to apply measures for maintenance or improvement of their conservation status.

Bulgarka Nature Park is situated in the central part of Bulgaria, on the northern slopes and ridges of Shipchenska and Trevnenska divides of the Balkan Range.

It was designated as protected area in 2002 and overlaps entirely with the NATURA 2000 site BG0000399 Bulgarka. The Park offers a wide range of habitats for bryophytes, both in the predominantly broadleaf deciduous forest and shrubland types of vegetation, as well as in some rocky habitats, and in riparian and marsh vegetation.

Data on the bryophyte species of the Bulgarka Nature Park could be found in the phytocoenological studies, where bryophytes are listed in the phytocoenological relevés (Tzonev & al. 2006), and also in some taxonomic studies (Orgaz & al. 2012). In the publication of Stoyanov & al. (2016) on the bryophyte flora of the Bulgarka Nature Park, the authors reported 55 species on its territory. In 2021, a Management Plant of the Bulgarka Nature Park was drawn (Anonymous

2021), in which 41 bryophyte species were reported.

The present study aims to present more data on the distribution of bryophytes on the territory of the Park and the NATURA 2000 Bulgarka site, with an emphasis on the distribution of some rare species and especially on the locations of *Dicranum viride* (Sull. & Lesq.) Lindb. included in the Annex II of Directive 92/43/EEC.

Material and methods

Study site

Bulgarka Nature Park covers an area of ca. 21 772.16 ha. The climate is temperate continental, with significant mountain influence. Most of the Park territory falls into the lower (500-700 m) and middle (700-900 m) mountain belts. The average elevation is 870 m, the highest point is 1505 m a.s.l. The bedrock varies, ranging from calcareous rocks with karst phenomena and sandstones to metamorphic siliceous rocks. The Park's hydrology is characterized by a relatively long dry period – ca. six to seven months, starting from July (Anonymous 2021) - which affects the species composition of bryophytes.

Bryophyte sampling

Bryophyte samples were collected from transects in various territories intended to feature as much as possible the bryophyte habitats diversity. Epiphytes, bryophytes growing on rocks, soil and along streams were collected. Herbarium specimen were deposited in SOM.

Nomenclature follows Hodgetts & Lockhart (2020).

Results

During the present study, 103 bryophyte species have been identified. Of them, 17 were liverworts and 86 mosses (Table 1). Some of them were already published for the Bulgarka Nature Park (Tzonev & al. 2006; Stoyanov & al. 2016; Anonymous 2021). Twenty-nine species were new to the Central Balkan floristic region. One species, *Thamnobryum neckeroides* (Hook.) E. Lawton, was new to the bryophyte flora of Bulgaria.

Discussion

The present study has revealed a relatively rich and varied bryophyte flora of the Bulgarka Nature Park. This is due to varied bedrock and diversity of well-preserved habitats and micro-habitats.

Special attention merited the distribution of *Dicranum viride*, as well as the ecological status of its population and habitat. The information was intended to support the arguments for its inclusion in the Standard Data Form of NATURA 2000 site BG0000399 Bulgarka. The authors have not confirmed the presence of this species in the locality reported by Stoyanov & al. (2016). As an epiphyte, its habitats are usually old-growth beech forests, and along permanent mountain rivers or streams, where air humidity is higher. In such habitats, the species has grown in the central and western parts of the Balkan Range. The locality reported by Stoyanov & al. (2016) has been quite different: steep slopes and no permanent river or stream nearby. No epiphyte species have been found on the beech trunks, except at the base of the trees, where such common species as *Hypnum cupressiforme* Hedw. occurred.

During the present study, *Dicranum viride* was found on two trees along river Suhata, SE from the Vikanata Skala locality. The species formed small cushions on the beech trunks (95 cm in diameter), from 69 cm up to 134 cm above the tree base, and covered about 25 cm². Some cushions occurred as high as up to 5 m. The forest canopy was 0.8 and the herb layer projection cover was 75%.

Leucobryum glaucum (Hedw.) Ångstr. is another species listed in Directive 92/43/EEC, Annex V. Along with *Leucobryum juniperoideum* (Brid.) Müll. Hal., it forms a broad layer on a slope in a beech forest facing NW.

Occurrence of *Trichocolea tomentella* (Ehrh.) Dumort. (Anonymous 2021), a conservation important species assessed as Endangered in Bulgaria (Natcheva & al. 2006), and of *Dichelyma falcatum* (Hedw.) Myrin. has not been confirmed in the Bulgarka Nature Park (Stoyanov & al. 2016). *Trichocolea tomentella* is known from the Western Balkan Range, Berkovska Divide, above the town of Varshets, in the valley

of river Stara, where it grows on acidic rocks in wet places along the permanent streams (Arnaudoff 1911; Ganeva & al. 2008). *Dichelyma falcatum* was reported from the Rila Mts (Natcheva 2007) and Mt Vitosha (Dimitrov & al. 2015). It is an arctic-alpine aquatic bryophyte growing on siliceous rocks and distributed

in subalpine regions (Dierßen 2001). Presence of these species in the Bulgarka Nature Park is doubtful.

As compared to earlier studies, the large number of species new to the Park (more than double) testifies to the need in further investigations so as to uncover fully its bryophyte species diversity.

Table 1. List of bryophytes species collected in the Bulgarka Nature Park. Abbreviations: * - species new to the Central Balkan, ** - species new to Bulgarian bryoflora, CR – Critically Endangered, EN - Endangered, VU – Vulnerable, NT - Near Threatened, DD – Data Deficient (Natcheva & al. 2006)

Taxon	GPS coordinates (N latitude; E longitude)	Elevation (m a.s.l.)	Substrate	Red List
Division Marchantiophyta				
<i>Aneura pinguis</i> (L.) Dumort.	42.748212; 25.236293 42.78920; 25.362959	1266.16 650.844	rock	
<i>Apopellia endiviifolia</i> (Dicks.) Nebel & D.Quandt	42.749798; 25.432582	1511.409	soil	
<i>Cephaloziella divaricata</i> (Sm.) Schiffn.	42.777839; 25.423656	1025.012	soil	
<i>Cephaloziella rubella</i> (Nees) Warnst. *	42.764135; 25.454623	1282.284	rock	EN
<i>Conocephalum salebrosum</i> Szweyk., Buczk. & Odrzyk.	42.797513; 25.338772	710.848	rock	
<i>Frullania dilatata</i> (L.) Dumort.	42.76490; 25.455828	1296.633	bark	
<i>Jungermannia pumila</i> With. *	42.797513; 25.338772	710.848	rock	VU
<i>Marchantia quadrata</i> Scop.	42.789204; 25.362959	650.844	soil	
<i>Marsupella sparsifolia</i> (Lindb.) Dumort. *	42.777839; 25.423656	1025.012	soil	DD
<i>Mesoptychia badensis</i> (Gottsche ex Rabenh.) L.Söderstr. & Váňa*	42.778609; 25.251454	1005.892	rock	
<i>Metzgeria pubescens</i> (Schrank) Raddi	42.751345; 25.327723	1254.54	rock	
<i>Plagiochila porelloides</i> (Torrey ex Nees) Lindenb.	42.751345; 25.327723	1254.54	rock	
	42.764974; 25.458739	1303.278		
	42.76423; 25.496484	1120		
	42.762244; 25.512339	1100.516		
<i>Porella arboris-vitae</i> (With.) Grolle	42.76490; 25.45582834	1296.633	rock	
<i>Porella cordaeana</i> (Huebener) Moore	42.778609; 25.251454	1005.892	rock	
<i>Porella platyphylla</i> (L.) Pfeiff.	42.764135; 25.454623	1282.284	rock, bark	
<i>Radula complanata</i> (L.) Dumort.	42.777117; 25.244286	1024.642	bark	
<i>Scapania calcicola</i> (Arnell & J.Perss.) Ingham	42.751345; 25.327723	1254.54	rock	
Division Bryophyta				
<i>Abietinella abietina</i> (Hedw.) M.Fleisch.	42.777117; 25.2442866	1024.642	soil	
	42.766336; 25.455851	1246.722		
<i>Alleniella besseri</i> (Lobarz.) S.Olsson, Enroth & D.Quandt	42.778609; 25.251454	1005.892	rock	
<i>Alleniella complanata</i> (Hedw.) S.Olsson, Enroth & D.Quandt	42.777117; 25.244286	1024.642	rock	
	42.751345; 25.327723	1254.54		
<i>Anomodon viticulosus</i> (Hedw.) Hook. & Taylor	42.751345; 25.327723	1254.54	rock	
	42.766287; 25.456649	1285.962		
<i>Atrichum undulatum</i> (Hedw.) P.Beauv.	42.749798; 25.432582	1511.409	soil	
<i>Bartramia halleriana</i> Hedw.	42.764135; 25.454623	1282.284	rock	
<i>Brachythecium rivulare</i> Schimp.	42.749798; 25.432582	1511.409	soil	
<i>Brachythecium tommasinii</i> (Sendtn. ex Boulay) Ignatov & Huttunen	42.766592; 25.455185	1223.165	rock	
<i>Calliergonella cuspidata</i> (Hedw.) Loeske	42.748212; 25.236293	1266.16	soil	
<i>Campyladelphus chrysophyllus</i> (Brid.) R.S.Chopra	42.748212; 25.236293	1266.16	soil	
<i>Campylium protensum</i> (Brid.) Kindb. *	42.748212; 25.236293	1266.16	rock	

Taxon	GPS coordinates (N latitude; E longitude)	Elevation (m a.s.l.)	Substrate	Red List
<i>Cinclidotus fontinaloides</i> (Hedw.) P.Beauv. *	42.748212; 25.236293	1266.16	rock	
<i>Cirriphyllum crassinervium</i> (Taylor) Loeske & M.Fleisch.	42.778609; 25.251454	1005.892	rock	
<i>Claopodium rostratum</i> (Hedw.) Ignatov	42.751345; 25.327723	1254.54	rock	CR
<i>Cratoneuron filicinum</i> (Hedw.) Spruce	42.74813; 25.23644	1225	soil,	
	42.749798; 25.432582	1511.409	rock	
<i>Ctenidium molluscum</i> (Hedw.) Mitt.	42.751345; 25.327723	1254.54	rock	
	42.766287; 25.456649	1285.962		
<i>Cynodontium bruntonii</i> (Sm.) Bruch & Schimp.	42.764135; 25.454623	1282.284	rock	
<i>Cynodontium strumiferum</i> (Hedw.) Lindb. *	42.764135; 25.454623	1282.284	rock	
	42.76423; 25.496484	1120		
	42.764135; 25.454623	1282.284		
	42.777839; 25.423656	1025.012		
	42.750559; 25.432492	1499.239	soil, rock	
	42.764006; 25.45578	1327.235	bark	
	42.76490; 25.455828	1296.633		
<i>Dicranum scoparium</i> Hedw.	42.764974; 25.458739	1303.278		
<i>Dicranum spadiceum</i> J.E.Zetterst. *	42.764135; 25.454623	1282.284	rock	
<i>Dicranum viride</i> (Sull. & Lesq.) Lindb.	42.762244; 25.512339	1100.516	bark	EN
<i>Distichium capillaceum</i> (Hedw.) Bruch & Schimp.	42.766592; 25.45518	1223.165	rock	
<i>Encalypta streptocarpa</i> Hedw.	42.766287; 25.456649	1285.962	rock	
	42.778609; 25.251454	1005.892		
	42.751345; 25.327723	1254.54	rock, bark	
<i>Exsertotheca crispa</i> (Hedw.) S.Olsson, Enroth & D.Quandt	42.766287; 25.456649	1285.962		
	42.766287; 25.456649	1285.962		
<i>Fissidens gracilifolius</i> Brugg.-Nann. & Nyholm *	42.778609; 25.251454	1005.892	rock	VU
	42.797513; 25.338772	710.848		
<i>Fissidens taxifolius</i> Hedw. *	42.776081; 25.243254	1023.956	soil	
<i>Flexitrichum flexicaule</i> (Schwägr.) Ignatov & Fedosov	42.764135; 25.454623	1282.284	rock	
<i>Flexitrichum gracile</i> (Mitt.) Ignatov & Fedosov *	42.751345; 25.327723	1254.54	rock	
	42.766287; 25.456649	1285.962		
<i>Grimmia hartmanii</i> Schimp.	42.76490; 25.455828	1296.633	rock	
	42.764974; 25.458739	1303.278		
	42.76423; 25.496484	1120		
<i>Hedwigia ciliata</i> (Hedw.) P.Beauv.	42.7640; 25.4557845	1327.235	rock	
	42.764135; 25.454623	1282.284		
<i>Homalothecium lutescens</i> (Hedw.) H.Rob.	42.764938; 25.238005	1245	soil	
	42.777117; 25.244286	1024.642		
<i>Homalothecium philippeanum</i> (Spruce) Schimp.	42.751345; 25.327723	1254.54	rock	
	42.76490; 25.455828	1296.633		
	42.766287; 25.456649	1285.962		
<i>Hylocomiadelphus triquetrus</i> (Hedw.) Ochyra & Stebel	42.766592; 25.45518	1223.165	soil	
	42.76423; 25.496484	1120		
<i>Hylocomium splendens</i> (Hedw.) Schimp.	42.751241; 25.432755	1496.575	soil, rock	
	42.764135; 25.454623	1282.284		
	42.766287; 25.456649	1285.962		
<i>Hymenostylium recurvirostrum</i> (Hedw.) Dixon	42.789204; 25.362959	650.844	rock	
	42.76423; 25.496484	1120		
	42.762431; 25.512097	1058.427		
	42.764135; 25.454623	1282.284		
	42.777839; 25.423656	1025.012		
	42.764006; 25.45578	1327.235		
<i>Hypnum cupressiforme</i> Hedw.	42.76490; 25.455828	1296.633	rock, soil bark	
	42.774941; 25.243908	1035.338		
	42.777839; 25.423656	1025.012		
	42.781490; 25.425755	980.772		
	42.781490; 25.425755	980.772		

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<i>Hypnum jutlandicum</i> Holmen & E.Warncke *	42.764135; 25.454623	1282.284	soil	
<i>Isothecium alopecuroides</i> (Lam. ex Dubois) Isov.	42.764135; 25.454623	1282.284	bark	
	42.762431; 25.512097	1058.427		
<i>Leucobryum glaucum</i> (Hedw.) Ångstr.	42.748450; 25.533663	1068.941	soil	
<i>Leucobryum juniperoideum</i> (Brid.) Müll.Hal. *	42.781490; 25.425755	980.772	soil	
<i>Leucodon sciuroides</i> (Hedw.) Schwägr.	42.764135; 25.454623	1282.284	bark	
	42.762244; 25.512339	1100.516		
<i>Lewinskya affinis</i> (Schrad. ex Brid.) F.Lara, Garilleti & Goffinet	42.763468; 25.472287	1310	bark	
<i>Lewinskya striata</i> (Hedw.) F.Lara, Garilleti & Goffinet	42.763468; 25.472287	1310	bark	
	42.778609; 25.251454	1005.892		
<i>Mnium stellare</i> Hedw.	42.797513; 25.338772	710.848	rock	
<i>Nyholmiella gymnostoma</i> (Bruch ex Brid.) Holmen & Warncke *	42.796739; 25.338594	715.487	bark	VU
<i>Nyholmiella obtusifolia</i> (Brid.) Holmen & Warncke *	42.796739; 25.338594	715.487	bark	
<i>Orthotrichum cupulatum</i> Hoffm. ex Brid. *	42.74813; 25.23644	1215	bark	
	42.751426; 25.237578	1279.357	rock	
<i>Orthotrichum diaphanum</i> Schrad. ex Brid. *	42.796739; 25.338594	715.487	bark	
	42.76423; 25.496484	1120	rock, bark	
	42.76490; 25.455828	1296.633		
	42.764974; 25.458739	1303.278		
	42.764135; 25.454623	1282.284		
42.762431; 25.512097	1058.427			
<i>Philonotis fontana</i> (Hedw.) Brid.	42.76458; 25.23988	1240	soil	
<i>Philonotis tomentella</i> Molendo *	42.749798; 25.432582	1511.409	soil	
	42.76423; 25.496484	1120	soil	
	42.749798; 25.432582	1511.409		
<i>Plagiomnium affine</i> (Blandow ex Funck) T.J.Kop.	42.764135; 25.454623	1282.284		soil
	42.778609; 25.251454	1005.892		
<i>Plagiomnium cuspidatum</i> (Hedw.) T.J.Kop. *	42.776081; 25.243254	1023.956	soil	
	42.751345; 25.327723	1254.54		
<i>Plagiothecium denticulatum</i> (Hedw.) Schimp.	42.764135; 25.454623	1282.284	rock	
<i>Plagiothecium laetum</i> Schimp. *	42.764135; 25.454623	1282.284	rock	
<i>Plagiothecium nemorale</i> (Mitt.) A.Jaeger	42.774941; 25.243908	1035.338	rock	
<i>Pleurozium schreberi</i> (Willd. ex Brid.) Mitt.	42.764135; 25.454623	1282.284	soil	
<i>Polytrichum commune</i> Hedw.	42.764135; 25.454623	1282.284	soil	
	42.777839; 25.423656	1025.012		
<i>Polytrichum juniperinum</i> Hedw.	42.777839; 25.423656	1025.012	soil	
	42.750559; 25.432492	1499.239		
<i>Polytrichum piliferum</i> Hedw.	42.777839; 25.423656	1025.012	soil	
	42.778609; 25.251454	1005.892		
<i>Pseudanomodon attenuates</i> (Hedw.) Ignatov & Fedosov	42.762244; 25.512339	1100.516	rock	
			bark	
<i>Pseudoleskeella catenulata</i> (Brid. ex Schrad.) Kindb.	42.74813; 25.23644	1215	rock	
	42.751345; 25.327723	1254.54		
<i>Pseudoleskeella nervosa</i> (Brid.) Nyholm	42.76490; 25.455828	1296.633	rock	
<i>Pseudotaxiphyllum elegans</i> (Brid.) Z.Iwats.	42.76423; 25.496484	1120	rock	
	42.777117; 25.244286	1024.642		
	42.76490; 25.455828	1296.633		
<i>Pterigynandrum filiforme</i> Hedw.	42.774941; 25.243908	1035.338	rock, bark	
	42.766287; 25.456649	1285.962		
<i>Ptychostomum capillare</i> (Hedw.) Holyoak & N.Pedersen	42.777839; 25.423656	1025.012	rock, soil	
<i>Ptychostomum imbricatum</i> (Müll.Hal.) Holyoak & N.Pedersen	42.74813; 25.23644	1225	soil	
<i>Ptychostomum moravicum</i> (Podp.) Ros & Mazimpaka	42.762431; 25.512097	1058.427	bark	
<i>Ptychostomum pseudotriquetrum</i> (Hedw.) J.R.Spence & H.P.Ramsay	42.748212; 25.236293	1266.16	soil	
	42.749798; 25.432582	1511.409		

Taxon	GPS coordinates (N latitude; E longitude)	Elevation (m a.s.l.)	Substrate	Red List
<i>Pulviger a lyellii</i> (Hook. & Taylor) Plášek, Sawicki & Ochyra *	42.778941; 25.252726	968.256	bark	
<i>Rhizomnium punctatum</i> (Hedw.) T.J.Kop.	42.749798; 25.432582 42.789204; 25.362959	1511.409 650.844	rock, soil	
<i>Rhynchostegiella tenella</i> (Dicks.) Limpr. *	42.797513; 25.338772	710.848	rock	VU
<i>Rhynchostegium confertum</i> (Dicks.) Schimp. *	42.778609; 25.251454	1005.892	rock	NT
<i>Rhynchostegium riparioides</i> (Hedw.) Cardot	42.751426; 25.237578	1279.357	rock	
<i>Schistidium apocarpum</i> (Hedw.) Bruch & Schimp.	42.778941; 25.252726	968.256	rock	
<i>Seligeria donniana</i> (Sm.) Müll.Hal. *	42.797513; 25.338772	710.848	rock	VU
<i>Syntrichia papillosa</i> (Wilson) Jur. *	42.796739; 25.338594	715.487	bark	EN
<i>Syntrichia ruraliformis</i> (Besch.) Mans	42.751345; 25.327723	1254.54		
<i>Taxiphyllum wissgrillii</i> (Garov.) Wijk & Margad. *	42.778609; 25.251454	1005.892	rock	VU
<i>Thamnobryum alopecurum</i> (Hedw.) Gangulee	42.778609; 25.251454	1005.892	rock	
<i>Thamnobryum neckeroides</i> (Hook.) E.Lawton **	42.776081; 25.243254	1023.956	rock	
<i>Tortella inclinata</i> (R.Hedw.) Limpr.	42.748212; 25.236293	1266.16	soil	
<i>Tortella pseudofragilis</i> (Thér.) Köckinger & Hedenäs *	42.775270; 25.244849 42.778941; 25.252726	1043.604 968.256	rock	
<i>Tortella tortuosa</i> (Hedw.) Limpr.	42.76423; 25.496485 42.766336; 25.455851 42.766592; 25.455185	1120 1246.722 1223.165	rock, soil	
<i>Ulota crispa</i> (Hedw.) Brid.	42.762431; 25.512097	1058.427	bark	EN

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