Contribution to the bryophyte flora and mycota of Bulgaria II. Bryophytes and larger fungi from the Bogdan Managed Reserve, Mt Sredna Gora Proper, Bulgaria

Rayna Natcheva & Melania Gyosheva

Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. Georgi Bonchev Str., bl. 23, 1113 Sofia; e-mail: renimoss@bio.bas.bg (corresponding author)

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Abstract. The bryophyte flora and mycota of the Bogdan Managed Reserve, Mt Sredna Gora, were studied. It comprises 26 species of mosses, seven species of liverworts and 40 of larger fungi (ascomycetes and basidiomycetes). Two bryophytes and one fungal species of conservation importance were recorded from this protected area. Comments on the influence of ecological conditions on diversity of the studied groups are provided.

Key words: Bogdan Managed Reserve, bryophytes, Bulgaria, larger fungi, liverworts, Mt Sredna Gora Proper

Introduction

This is the second paper in a series of contributions presenting chorological data about the bryophyte and fungal diversity of particular areas that have not been studied so far in detail (Natcheva & Gyosheva 2016). Often, they are not geographically but functionally delimited, e.g. nature reserves, protected sites, etc. The aim of this study was to investigate the bryophyte flora and larger fungi of the Bogdan Managed Reserve. There is no earlier data on the bryophytes and fungi in this Reserve. It lies in the Sredna Gora floristic region. In general, there are very few records of the bryophytes in this region. There are bryological reports only from the wetland area of Sredna Gora (Hájková & al. 2007; Hájek & al. 2008; Natcheva 2008). Over 450 taxa of larger fungi (ascomycetes and basidiomycetes) have been found so far in Mt Sredna Gora (Hinkova & Fakirova 1970; Hinkova & Aleksandrov 1971; Stoichev & Dimcheva 1982; Dimcheva & al. 1992; Mihov 1994; Gyosheva 2000; Vulchev & al. 2000; Assyov & Denchev 2004; Stoichev & Gyosheva 2005; Lacheva 2008, 2012a, 2012b, 2014; Dimitrova & Gyosheva 2009, 2010; Denchev & Assyov 2010; Lacheva & Radoukova 2014; Assyov & al. 2012). Many taxa (species and varieties) have been reported from Mt Western Sredna Gora. Contemporary information on the diversity of larger fungi in the beech forests of Mt Sredna Gora Proper (Koprivshtitsa Divide, up to Oborishte locality and Chivira Protecred Area) has been published by Vulchev & al. (2000) and Lacheva & Radoukova (2014).

Material and methods

The Bogdan Managed Reserve was created in 1972 for conservation of the old beech forests. The Reserve lies within the boundaries of Natura2000 site BG0001389 Sredna Gora. It is situated in the eastern part of Mt Sredna Gora Proper and occupies its highest part (Figs. 1, 2). The area is 113.4 ha. The highest peak is Bogdan – 1603.4 m a.s.l., the lowest elevation is 1360 m a.s.l.

The climate is temperate continental. A cold winter with negative mean temperatures from December

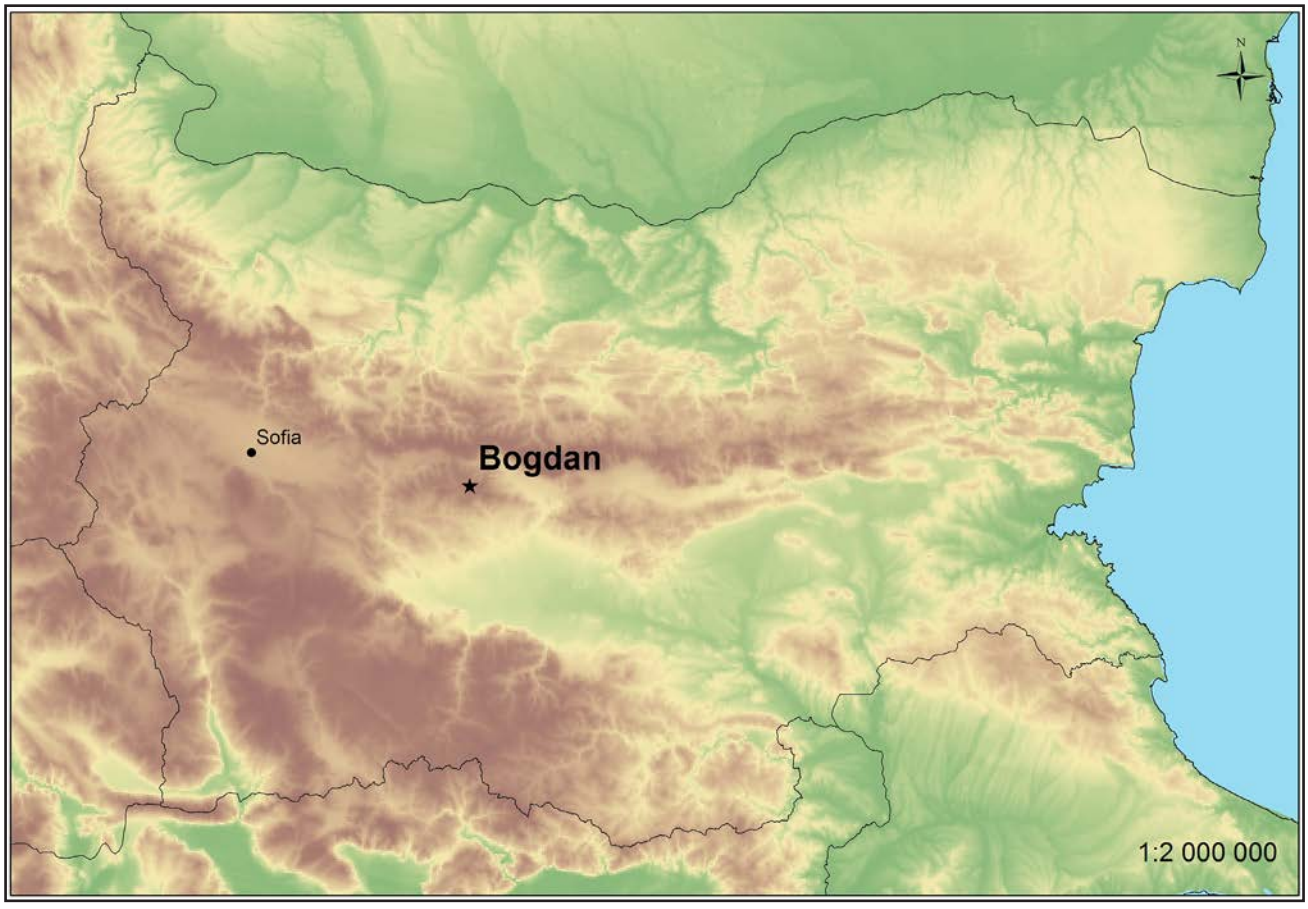

Fig. 1. Map of Bulgaria with location of the Bogdan Managed Resereve.

to February. A relatively cool spring. Mean summer temperatures amounting to 16.5–16.8 °C. A warm autumn with mean October temperatures ca. 12.2 °C. Average precipitation is 740 mm, with its maximum in June and its minimum in February (Mateeva 2002, Velev 2002).

The soils are distric and eutric cambisols (Panagos & al. 2012) developed over granitized biotites, migmatites, gneisses, amphibolites, and granites (Iliev & Katsakov 1989).

There are two major habitat types: Moesian *Fagus* forests dominated by Common Beech (*Fagus sylvatica* L.). The forests age is ca. 140–170 years. They propagate exclusively by seed. The projection cover is 60–80 %. A small proportion of the Reserve area is covered by forest glades of the Balkan mountain hay meadows type.

Field studies were carried out in 2015. The transect method was used. Transects were selected in order to cover the entire range of microhabitats for bryophytes and larger fungi. Since many bryophytes and fungi inhabit similar substrates, parallel investigations of the two groups were possible and successful (Lisiewska 1992; Natcheva & Gyosheva 2016).

Data about substrates and plant-hosts of fungal species were collected in the course of investigations. Voucher specimens of all species were deposited in the bryophyte and mycological collections of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (SOM and SOMF). The nomenclature follows Söderström & al. (2002) for liverworts, Hill & al. (2006) for mosses, and Kirk & Ansell (2004) for fungi.

Results and discussion

Bryophytes

A total of 33 bryophyte species were found on the territory of the Bogdan Managed Reserve (Table 1). Of these, seven species were liverworts (*Marchantiophyta*) and 26 species were mosses (*Bryophyta*). *Orthotrichum patens* Bruch ex Brid. and *O. pumilum* Sw. ex anon. were included in the *Red List of Bryophytes in*

Fig. 2. Bogdan Managed Reserve in Mt Sredna Gora (view).

Bulgaria (Natcheva & al. 2006), in the category Near Threatened.

The major substrates for bryophytes were tree bark, soil and rocks. Due to the very low level of soil disturbance and scarcity of open soil patches, few species were recorded on soil. The largest proportion of species was found on tree bark and rocks.

Larger fungi

In the course of the present study, the authors have found 40 species of larger fungi (Table 2). Of these, 12 were Ascomycota and 28 Basidiomycota. They belong to six classes, nine orders, 19 families, and 32 genera. The highest species diversity was demonstrated by the families *Polyporaceae* (10 species), *Xylariaceae* (7 species) and *Auriculariaceae* (4 species). One species was included in the *Red List of Fungi in Bulgaria* (Gyosheva & al. 2006), *Hericium coralloides* (Scop. : Fr.) Pers., as Near Threatened. All registered fungi were collected in the wooded area. The major substrates for larger fungi were living and dead wood, and soil. Lignicolous fungi (saprotrophs and parasites) prevailed among the studied taxa: 37 species. Five species of these were parasites and very important in terms of the sanitary status of forest ecosystems (*Armillaria mellea*, *Fomes fomentarius*, *Ganoderma applanatum*, *Laetiporus sulphureus*, and *Polyporus squamosus*). Lignicolous fungi prevailed in the old forests with larger amount of dead wood (Parmasto & Parmasto 1997).

Generally, diversity of bryophytes and larger fungi in the Bogdan Managed Reserve is low. This is due to the uniformity of biotopes and low diversity of habitats and micro habitats in the area. The reasons for this are: 1) the climax state of the forest and its relative homogeneity with respect to dominant species and structure, 2) the small size of the protected area and its relative isolation, and 3) the uniform sloping relief, without well-developed ravines and very few rock outcrops. Such forest ecosystems have low species diversity, in spite of their high general conservation value. The habitats are well preserved.

The short period of investigation of only one season also reflected on the low number of detected larger fungi. The presented data on the species diversity and

ecological-trophic structure of fungi are preliminary. Mycological studies in this protected area are still in their initial stage.

In spite of the strict regime in the Reserve, several major threats for the diversity of bryophytes and larger fungi were identified: 1) the forest communities in the buffer zone of the Reserve were affected by windfalls and heavy snow. These sites were subject to sanitary felling. The removal of dead wood reflects negatively on the diversity of the studied groups; 2) the arable fields situated in the vicinity of the Reserve were burned before ploughing. This is a threat to the Reserve in dry and windy weather.

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Table 1. List of bryophyte taxa in the Bogdan Managed Reserve, location (geographic coordinates, elevation), and substrate. * – species of conservation importance (Near Threatened).

№	Taxon	Location/elevation	Substrate
	Marchantiophyta		
1.	*Frullania dilatata* (L.) Dumort.	24.44972°E 42.6062°N (1456 m) 24.451002°E 42.6059°N (1488 m)	bark
2.	*Lophocolea buidentata* (L.) Dumort.	24.450161°E 42.6085°N (1445 m)	soil, rock
3.	*L. heterophylla* (Schrad.) Dumort.	24.44972°E 42.6062°N (1456 m) 24.450161°E 42.6085°N (1445 m)	decaying wood
4.	*Plagiochilla porelloides* (Torr. ex Nees) Lindenb.	24.450161°E 42.6085°N (1445 m)	soil, rock
5.	*Porella cordeana* (Huebener) Moore	24.450161°E 42.6085°N (1445 m)	rock, bark
6.	*P. platyphylla* (L.) Pfeiff.	24.448145°E 42.6060°N (1406 m)	bark, rock
7.	*Radula complanata* (L.) Dumort.	24.460692°E 42.6075°N (1610 m)	bark
	Bryophyta		
1.	*Amblystegium serpens* (Hedw.) Schimp.	24.448145°E 42.6060°N (1406 m)	bark
2.	*Atrichum undulatum* (Hedw.) P.Beauv.	24.450161°E 42.6085°N (1445 m)	soil
3.	*Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen	24.448145°E 42.6060°N (1406 m) 24.460692°E 42.6075°N (1610 m) 24.450161°E 42.6085°N (1445 m)	soil, rock, bark, decaying wood
4.	*Brachythecium glareosum* (Bruch ex Spruce) Schimp.	24.456628°E 42.6071°N (1541 m)	soil
5.	*B. rivulare* Schimp.	24.450161°E 42.6085°N (1445 m)	rock
6.	*Bryum capillare* Hedw.	24.448145°E 42.6060°N (1406 m)	bark, soil
7.	*Ceratodon purpureus* (Hedw.) Brid.	24.456628°E 42.6071°N (1541 m)	soil, rock
8.	*Dicranum scoparium* Hedw.	24.460692°E 42.6075°N (1610 m)	soil, rock, bark
9.	*Grimmia hartmanii* Schimp.	24.448145°E 42.6060°N (1406 m) 24.450161°E 42.6085°N (1445 m)	rock
10.	*Hypnum cupressiforme* Hedw.	24.448145°E 42.6060°N (1406 m) 24.456628°E 42.6071°N (1541 m) 24.460692°E 42.6075°N (1610 m)	soil, rock, bark, decaying wood
11.	*H. jutlandicum* Holmen & E. Warncke	24.448145°E 42.6060°N (1406 m)	soil, rock
12.	*Isothecium alopecuroides* (Lam. ex Dubois) Isov.	24.448145°E 42.6060°N (1406 m) 24.460692°E 42.6075°N (1610 m)	soil, rock, bark
13.	*Leskea polycarpa* Hedw.	24.451002°E 42.6059°N (1488 m)	bark
14.	*Leucodon sciuroides* (Hedw.) Schwägr.	24.448145°E 42.6060 (1406 m) 24.44972°E 42.6062°N (1456 m) 24.451002°E 42.6059°N (1488 m)	bark

Table 1. Continuation.

№	Taxon	Location/elevation	Substrate
15.	*Orthotrichum obtusifolium* Schrad. ex Brid.	24.448145°E 42.6060 (1406 m) 24.451002°E 42.6059°N (1488 m)	bark
16.	* *O. patens* Bruch ex Brid.	24.448145°E 42.6060 (1406 m) 24.451002°E 42.6059°N (1488 m) 24.454836°E 42.6070°N (1551 m)	
17.	* *O. pumilum* Sw. ex anon.	24.44972°E 42.6062°N (1456 m)	bark
18.	*O. striatum* Hedw.	24.448145°E 42.6060°N (1406 m) 24.44972°E 42.6062°N (1456 m) 24.451002°E 42.6059°N (1488 m) 24.454836°E 42.6070°N (1551 m)	bark
19.	*Paraleucobryum longifolium* (Hedw.) Loeske	24.448145°E 42.6060 (1406 m) 24.460692°E 42.6075°N (1610 m)	rock, bark
20.	*Plagiothecium denticulatum* var. *undulatum* R.Ruthe ex Geh.	24.450161°E 42.6085°N (1445 m)	soil, rock
21.	*Polytrichum commune* Hedw.	24.450161°E 42.6085°N (1445 m)	soil
22.	*P. piliferum* Hedw.	24.456628°E 42.6071°N (1541 m)	soil
23.	*Pseudoleskeella nervosa* (Brid.) Nyholm	24.448145°E 42.6060°N (1406 m) 24.451002°E 42.6059°N (1488 m) 24.454836°E 42.6070°N (1551 m)	bark
24.	*Pterigynandrum filiforme* Hedw.	24.448145°E 42.6060°N (1406 m) 24.451002°E 42.6059°N (1488 m) 24.460692°E 42.6075°N (1610 m)	bark
25.	*Rhizomnium punctatum* (Hedw.) T.J.Kop	24.450161°E 42.6085°N (1445 m)	soil, decaying wood
26.	*Syntrichia ruralis* (Hedw.) F.Weber & D.Mohr	24.44972°E 42.6062°N (1456 m) 24.456628°E 42.6071°N (1541 m)	soil, bark, rock

Table 2. List of fungal taxa in the Bogdan Managed Reserve, their conservation status, location of more interesting species (geographic coordinates, elevation), and substrate. * – species of conservation importance (Near Threatened).

№	Taxon	Location	Substrate
	Ascomycota		
	Leotiomycetes		
	Helotiales		
	Helotiaceae		
1.	*Ascocoryne sarcoides* (Jacq.) J.W. Groves & D.E. Wilson		dead wood
2.	*Bisporella citrina* (Batsch) Korf & S.E. Carp.		dead wood
3.	*Chlorociboria aeruginascens* (Nyl.) Kanouse ex C.S. Ramamurthi, Korf & L.R. Batra		dead wood
	Pezizomycetes		
	Pezizales		
	Pyronemataceae		
4.	*Scutellinia scutellata* (L.) Lambotte		moist soil
	Sarcoscyphaceae		
5.	*Sarcoscypha coccinea* (Jacq.) Sacc.	24.27371°E 42.36425°N (1546 m)	dead beech wood

Table 2. Continuation.

№	Taxon	Location	Substrate
	Sordariomycetes		
	Xylariales		
	Diatrypaceae		
6.	*Diatrype disciformis* (Hoffm. : Fr.) Fr.		dead wood
	Xylariaceae		
7.	*Biscogniauxia nummularia* (Bull. : Fr.) Kuntze		dead wood
8.	*Hypoxylon fragiforme* (Pers. : Fr.) J. Kickx		dead wood
9.	*H. multiforme* (Fr. : Fr) Fr.		dead wood
10.	*Kretzschmaria deusta* (Hoffm. : Fr.) P.M.D. Martin		dead beech wood
11.	*Nomania serpens* (Pers. : Fr.) Gray		dead beech wood
12.	*Xylaria hypoxilon* (L. : Fr.) Grev.		dead wood
	Basidiomycota		
	Agaricomycetes		
	Agaricales		
	Agaricaceae		
13.	*Lycoperdon pyriforme* Schaeff. : Pers.		dead wood
	Entolomaraceae		
14.	*Entoloma vernum* S. Lundell		soil
	Hydnangiaceae		
15.	*Laccaria laccata* (Scop. : Fr.) Cooke		soil
	Marasmiaceae		
16.	*Marasmius rotula* (Scop. : Fr.) Fr.		dead beech wood
	Physalacriaceae		
17.	*Armillaria mellea* (Vahl : Fr.) P. Kumm		living and dead wood
	Schyzophyllaceae		
18.	*Schyzophyllum commune* Fr. : Fr.		dead wood
	Auriculariales		
	Auriculariaceae		
19.	*Auricularia auricula-judae* (Bull. : Fr.) Quél.		wood of *Sambucus nigra* L.
20.	*A. mesenterica* (Dicks. : Fr.) Pers.		dead wood
21.	*Exidia glandulosa* (Bull. : Fr.) Fr.		dead wood
22.	*E. plana* (F.H. Wigg.) Donk		dead wood

Table 2. Continuation.

№	Taxon	Location	Substrate
	Polyporales		
	Ganodermataceae		
23.	*Ganoderma applanatum* (Pers.) Pat.		dead beech wood
	Fomitopsidaceae		
24.	*Laetiporus sulphureus* (Bull. : Fr.) Murrill		living beech wood
	Polyporaceae		
25.	*Cerrena unicolor* (Bull. : Fr.) Murill		beech wood
26.	*Datronia mollis* (Sommerf. : Fr.) Donk		dead beech wood
27.	*Fomes fomentarius* (L. : Fr.) J.J. Kickx		living and dead beech wood
28.	*Lenzites betulina* (L. : Fr.) Fr.		dead wood
29.	*Polyporus badius* (Pers.) Schwein.		beech wood
30.	*P. leptocephalus* (Jacq. : Fr.) Fr.		dead wood
31.	*P. squamosus* (Huds. : Fr.) Fr.		living beech wood
32.	*Trametes hirsuta* (Wulfen : Fr.) Pilát		dead wood
33.	*T. versicolor* (L. : Fr.) Lloyd		dead wood
34.	*Trichaptum biforme* (Fr.) Ryvarden		dead beech wood
	Russulales		
	Hericiaceae		
35.	* *Hericium coralloides* (Scop. : Fr.) Persl.	24.27371°E 42.36425°N (1546 m)	dead beech wood
	Stereaceae		
36.	*Stereum hirsutum* (Willd. : Fr.) Gray		dead wood
37.	*S. rugosum* (Pers. : Fr.) Fr.		dead wood
38.	*S. subtomentosum* Pouzar		dead beech wood
	Dacrymycetes		
	Dacrymycetales		
	Dacrymycetaceae		
39.	*Calocera cornea* (Batsch : Fr.) Fr.		dead beech wood
	Tremellomycetes		
	Tremellales		
	Tremellaceae		
40.	*Tremella mesenterica* Retz. : Fr.		dead wood

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