

THE DIVERSITY OF MACROMYCETES IN THE TERRITORY OF BATOČINA (SERBIA)

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ABSTRACT. The purpose of this paper was discovering the diversity of macromycetes in the territory of Batočina (Serbia). Field studies, which lasted more than a year, revealed the presence of 200 species of macromycetes. The identified species belong to phyla Basidiomycota (191 species) and Ascomycota (9 species). The biggest number of registered species (100 species) was from the order *Agaricales*. Among the identified species was one strictly protected – *Phallus hadriani* and seven protected species: *Amanita caesarea*, *Marasmius oreades*, *Cantharellus cibarius*, *Craterellus cornucopiodes*, *Tuber aestivum*, *Russula cyanoxantha* and *R. virescens*; also, several rare and endangered species of Serbia. This paper is a contribution to the knowledge of the diversity of macromycetes not only in the territory of Batočina, but in Serbia, in general.

Keywords: Ascomycota, Basidiomycota, Batočina, the diversity of macromycetes.

INTRODUCTION

Fungi represent one of the most diverse and widespread group of organisms in terrestrial ecosystems, but, despite that fact, their diversity remains highly unexplored. Until recently it was considered that there are 1.6 million species of fungi, from which only something around 100 000 were described (KIRK *et al.*, 2001), while data from 2017 lists 120000 identified species, which is still a slight number (HAWKSWORTH and LÜCKING, 2017). Modern estimations, based on new molecular methods (such as HTS method – high-throughput screening) suggest the existence of 5.1 million species of fungi (BLACKWELL, 2011). The number of species of macromycetes was estimated to be 140000, while the rest of those 1.6 million species belonged to micromycetes which is just 10% (STAJIĆ, 2015).

Studies of biota in the territory of Batočina remain scarce (GLAVENDEKIC and KOLAROV, 1994; RANKOVIĆ, 2002; MARKOVIĆ *et al.*, 2015) and macromycetes are unexplored. In the territory of Serbia 1 300 species and subspecies of macromycetes were noted, but it is estimated that that number is much bigger, somewhere between 3 000 and 6 000 species of macromycetes (SADIKOVIĆ and KUŠTERA, 2013). Lack of the national database of fungi and the small number of scientific publications led to poor knowledge about the distribution of macromycetes in Serbia (LAČKOVIĆ, 2015). Even though studying macromycetes in Serbia has been intensified over the past few years (VUKOJEVIĆ and HADŽIĆ, 2013; LUKIĆ, 2013; IVANČEVIĆ, 2016; SAVIĆ, 2016; VUKOJEVIĆ *et al.*, 2016), the diversity of

macromycetes of Batočina hasn't been studied yet, so the primary aim of this study was the contribution to the knowledge of the diversity of macromycetes in the territory of Batočina.

MATERIALS AND METHODS

The description of the studied area

Batočina is a municipality in the central part of Serbia, located in the lower part of the basin of Lepenica river. The municipality is located at a longitude of 21° 04' E and latitude of 44° 09' N and contains ten villages (Brzan, Dobrovodica, Badnjevac, Gradac, Žirovnica, Kijevo, Crni Kao, Milatovac, Nikšić and Prnjavor) and the town of Batočina. It covers the area of 136 km², from which 10 474 ha is agricultural land and 2 735 ha is forest area (ILIĆ, 2014). The area is plain and hilly, with average altitude of 110 m. The climate is humid continental, characterized by hot summers, cold winters, with autumn being the warmer period than spring. Precipitation is the greatest during late autumn and late spring. Cambisol, vertisol and alluvial soils are the most common types of soil. Besides river Lepenica, there is a lot of springs, but they are low water springs (ILIĆ, 2014).

The vegetation of the area is represented with plant communities, where different species of oak (*Quercus* spp.) are dominant and other species can be found, too, such as: common ash (*Fraxinus excelsior* L.), silver linden (*Tilia tomentosa* Moench.), common hornbeam (*Carpinus betulus* L.), hop-hornbeam (*Ostrya carpinifolia* Scop.) etc. At some localities black pine (*Pinus nigra* L.) and Scots pine (*P. sylvestris* L.) can be found. Willow (*Salix* spp.) and poplar (*Populus* spp.) forests are present by the river and in moist areas. Black locust forests (*Robinia pseudoacacia* L.) occur as secondary vegetation in places, where the primary forests had been cut down. Deforestation, degradation and fragmentation of natural habitats are a big problem in the territory of Batočina.

Collecting samples and identification

Monitoring of fungi in the area of Batočina (Fig. 1) was performed from June 2017 to August 2018. Field studies were conducted in the town of Batočina and several villages: Brzan, Kijevo, Gradac, Prnjavor, Crni Kao and Dobrovodica. Most of the field studies was performed in the town of Batočina (town of Batočina will be referred to as Batočina further in the text). Several localities were investigated in the territory of Batočina, such as: Gornja Batočina, Rogot, Straževica hill, Donja Mala and Gornja Mala. Among the investigated localities, Straževica hill was the locality with the highest altitude (358 m), while Rogot forest was the only protected locality, representing a natural monument (http://www.zzps.rs/novo/kontent/stranic/zastita_priode_spomenici_priode/PrirodniSpomenik.pdf).

The localities were visited by a certain dynamic, but more frequently in optimal periods for the growth of macromycetes. Thus, greater number of field trips was in 2018 due to higher rainfall which was favorable for the development of mushrooms' fruiting bodies.

All collected fruiting bodies were photographed using the camera (Canon ixus 185), from all angles, so that the most important taxonomic characteristics could be noted. Photographs were taken in the locality where the basidiocarps were found, unless the circumstances were not proper, in that case photographs of them were taken on a neutral background in the laboratory. For each identified species the locality, date of collection, type of habitat and general conditions of the environment were noted. Fruiting bodies samples were collected manually (usually one mature fruiting body was taken) with a piece of the substrate.



Figure 1. The map of Batočina municipality and its position in the map of Serbia.

The investigated localities are marked with red dots.

(The map of Batočina: <https://www.google.com/maps/place/Баточина/>; The map of Serbia: [https://upload.wikimedia.org/wikipedia/commons/thumb/b/b3/Serbia_Bato% C4% 8Dina.png/250px-Serbia_Bato% C4% 8Dina.png](https://upload.wikimedia.org/wikipedia/commons/thumb/b/b3/Serbia_Bato%C4%8Dina.png/250px-Serbia_Bato%C4%8Dina.png))

Morphological characteristics of the fruiting bodies were firstly analyzed: the type, shape, color, consistency, type of hymenophore, as well as the cross section of the fruiting body, scent and taste (not with every species). In cases where that wasn't sufficient to identify the species, spore print was taken, and the characteristics of spores were observed by Optika B-180 microscope. Some of the identified specimens are preserved in the Department of Biology and Ecology, Faculty of Science, University of Kragujevac.

Specimen identification was done using relevant literature and identification keys (MOSER, 1983; BOŽAC, 1984; FOCHT, 1990; <https://nature.berkeley.edu/brunslab/ev/CHLOROPHYLLUM.pdf>; UZELAC, 2009; HADŽIĆ, 2012; FLIK, 2017; <http://www.vielepilze.de/coprinus/copkey/ecopkey.pdf>). The species names were given based on Index Fungorum (<http://www.indexfungorum.org/names/names.asp>). The identified species were ranked taxonomically, in compliance with the mentioned site. Within taxa, the list of species was presented in alphabetic order.

RESULTS AND DISCUSSION

The presence of 200 species of macromycetes was recorded in the territory of Batočina municipality. The identified species belong to phyla Basidiomycota (191 species) and Ascomycota (9 species). Species of Basidiomycota phylum were classified into 10 orders and 40 families, while species of Ascomycota phylum were classified into three orders and seven families. The highest number of species belongs to the order Agaricales. The list of the identified species is shown in Table 1.

Table 1. The list of the identified species of macromycetes in the territory of Batočina municipality.

SH = Straževica hill; R = Rogot; DM = Donja Mala; GM = Gornja Mala; GB = Gornja Batočina; BA = Batočina (the town, urban areas where macromycetes were found – lawns, gardens, by the road, etc.); K = Kijevo; D = Dobrovodica; P = Prnjavor; G = Gradac; CK = Crni Kao. * = strictly protected species, ** = protected species.

Species	Family	Order	Date and place of collection
BASIDIOMYCOTA			
<i>Agaricus bisporus</i> (J.E. Lange) Imbach	Agaricaceae	Agaricales	11. 11. 2017 GB
<i>Agaricus bohusii</i> Bon.	Agaricaceae	Agaricales	21. 07. 2018 R
<i>Agaricus bresadolanus</i> Bohus	Agaricaceae	Agaricales	11. 10. 2017 G
<i>Agaricus silvicola</i> (Vittad.) Peck.	Agaricaceae	Agaricales	05. 07. 2018 CK
<i>Agaricus xanthodermus</i> Genev.	Agaricaceae	Agaricales	26. 05. 2018 GB
<i>Calvatia gigantea</i> (Batsch) Lloyd	Agaricaceae	Agaricales	02. 08. 2018 DM
<i>Chlorophyllum rhacodes</i> (Vittad.) Vellinga	Agaricaceae	Agaricales	05. 07. 2018 CK
<i>Chlorophyllum venenatum</i> (Bon)	Agaricaceae	Agaricales	11. 11. 2017 GB
<i>Cyathus striatus</i> (Huds.) Willd.	Agaricaceae	Agaricales	21. 07. 2018 R
<i>Lepiota clypeolaria</i> (Bull.) P. Kumm.	Agaricaceae	Agaricales	10. 07. 2018 SH
<i>Lepiota cristata</i> (Bolton) P. Kumm.	Agaricaceae	Agaricales	25. 09. 2017 R
<i>Leucoagaricus americanus</i> (Peck) Vellinga	Agaricaceae	Agaricales	28. 07. 2018 BA
<i>Leucoagaricus barssii</i> Zeller (Vellinga)	Agaricaceae	Agaricales	25. 10. 2017 DM
<i>Leucoagaricus leucothites</i> (Vittad.) Wasser	Agaricaceae	Agaricales	20. 09. 2017 BA
<i>Lycoperdon molle</i> Pers.	Agaricaceae	Agaricales	05. 07. 2018 CK
<i>Lycoperdon perlatum</i> Pers.	Agaricaceae	Agaricales	05. 07. 2018 CK, SH
<i>Lycoperdon pratense</i> Pers.	Agaricaceae	Agaricales	10. 07. 2018 SH
<i>Macrolepiota fuliginosa</i> (Barla) Bon	Agaricaceae	Agaricales	05. 07. 2018 CK
<i>Macrolepiota mastoidea</i> (Fr.) Singer	Agaricaceae	Agaricales	25. 09. 2017 DM
<i>Amanita caesarea</i> (Scop.) Pers. **	Amanitaceae	Agaricales	10. 07. 2018 SH
<i>Amanita citrina</i> Pers.	Amanitaceae	Agaricales	22. 07. 2018 SH

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Amanita dryophila</i> Consiglio & Contu	Amanitaceae	Agaricales	25. 05. 2018 R
<i>Amanita pantherina</i> (DC.) Krombh	Amanitaceae	Agaricales	10. 07. 2018 SH
<i>Amanita phalloides</i> (Vaill. ex Fr.) Link	Amanitaceae	Agaricales	10. 07. 2018 SH
<i>Amanita rubescens</i> Pers.	Amanitaceae	Agaricales	10. 07. 2018 SH
<i>Amanita subnudipes</i> (Romagn.) Tullos	Amanitaceae	Agaricales	25. 05. 2018 R, SH
<i>Amanita vaginata</i> (Bull.) Lam.	Amanitaceae	Agaricales	25. 05. 2018 R
<i>Amanita vaginata</i> var. <i>alba</i> (De Seynes) Gillet	Amanitaceae	Agaricales	25. 05. 2018 R
<i>Conocybe tenera</i> (Schaeff.) Fayod.	Bolbitiaceae	Agaricales	24. 04. 2018 GB
<i>Coprinellus disseminatus</i> (Pers.) J. E. Lange	Coprinaceae	Agaricales	11. 11. 2017 GB
<i>Coprinus comatus</i> (D. F. Müll.) Pers.	Coprinaceae	Agaricales	20. 10. 2017 BA, G
<i>Entoloma clypeatum</i> (L.) P. Kumm.	Entolomataceae	Agaricales	10. 05. 2017 R
<i>Entoloma sepium</i> (Noulet & Dass.) Richon & Roze	Entolomataceae	Agaricales	29. 04. 2018 BA
<i>Entoloma sinuatum</i> (Bull.) P. Kumm.	Entolomataceae	Agaricales	10. 07. 2018 SH
<i>Hygrophorus cossus</i> (Sowerby) Fr.	Hygrophoraceae	Agaricales	29. 09. 2017 DM
<i>Hygrophorus eburneus</i> (Bull.) Fr.	Hygrophoraceae	Agaricales	11. 11. 2017 GB
<i>Crepidotus mollis</i> (Schaeff.) Stande	Inocybaceae	Agaricales	25. 09. 2017 R
<i>Crepidotus variabilis</i> (Pers.) P. Kumm.	Inocybaceae	Agaricales	10. 10. 2017 R, DM
<i>Inocybe rimosa</i> (Bull.) P. Kumm.	Inocybaceae	Agaricales	25. 05. 2018 R
<i>Marasmius candidus</i> (Fr.) Singer	Marasmiaceae	Agaricales	25. 07. 2018 GB, BR
<i>Marasmius capillaris</i> Morgan	Marasmiaceae	Agaricales	26. 09. 2017 R
<i>Marasmius oreades</i> (Bolton) Fr. **	Marasmiaceae	Agaricales	20. 09. 2017 BA
<i>Marasmius rotula</i> (Scop.) Fr.	Marasmiaceae	Agaricales	17. 06. 2018 R, SH, P, BR
<i>Megacollybia platyphyla</i> (Pers.) Kotl. & Pouzar	Marasmiaceae	Agaricales	25.09. 2017 DM
<i>Hemimycena pseudocrispula</i> (Kühner) Singer	Mycenaceae	Agaricales	11. 10. 2017. P
<i>Hemimycena tortuosa</i> (P. D. Orton) Redhead	Mycenaceae	Agaricales	01. 12. 2017 DM
<i>Mycena filopes</i> (Bull.) P. Kumm.	Mycenaceae	Agaricales	30. 12. 2017 BR

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Mycena galericulata</i> (Scop.) Gray	Mycenaceae	Agaricales	16. 10. 2017 DM
<i>Mycena inclinata</i> Fr. (Quél)	Mycenaceae	Agaricales	25. 05. 2018 R
<i>Mycena niveipes</i> (Murrill) Murrill	Mycenaceae	Agaricales	05. 07. 2018 CK
<i>Mycena polygramma</i> (Bull.) Gray	Mycenaceae	Agaricales	25. 10. 2017 DM
<i>Mycena pura</i> (Pers.) P. Kumm.	Mycenaceae	Agaricales	05. 07. 2018 CK
<i>Mycena pura f. alba</i> (Gillet) Kühner	Mycenaceae	Agaricales	05. 05. 2018 GB
<i>Panellus stipticus</i> (Bull.) P. Karst.	Mycenaceae	Agaricales	20. 09. 2017 R, SH
<i>Gymnopus dryophilus</i> (Bull.) Murrill	Omphalotaceae	Agaricales	30. 12. 2017 R, BR
<i>Gymnopus foetidus</i> (Sowerby) J. L. Mata & R. H. Petersen	Omphalotaceae	Agaricales	25. 09. 2017 R
<i>Gymnopus peronatus</i> (Bolton) Gray	Omphalotaceae	Agaricales	02. 08. 2018 DM, CK
<i>Omphalotus illudens</i> (Schwein.) Bresinsky & Besl.	Omphalotaceae	Agaricales	05. 01. 2018 GB
<i>Omphalotus olearius</i> (DC.) Singer	Omphalotaceae	Agaricales	10. 07. 2018 SH, R, BR, K, CK, P, DM
<i>Rhodocollybia butyracea</i> (Bull.) Lennox	Omphalotaceae	Agaricales	25. 07. 2018 GB
<i>Armillaria cepistipes</i> Velen.	Physalacriaceae	Agaricales	25. 10. 2017 DM
<i>Armillaria gallica</i> Marxm. & Romagn.	Physalacriaceae	Agaricales	25. 10. 2017 DM
<i>Armillaria mellea</i> (Vahl) P. Kumm.	Physalacriaceae	Agaricales	13. 11. 2017 BA
<i>Armillaria tabescens</i> (Scop.) Emel	Physalacriaceae	Agaricales	25. 10. 2017 DM, R
<i>Flammulina velutipes</i> (Curtis) Singer	Physalacriaceae	Agaricales	05. 01. 2018 GB, R
<i>Hymenopellis radicata</i> (Relhan) R. H. Petersen	Physalacriaceae	Agaricales	11. 07. 2018 SH
<i>Hohenbuehelia angustata</i> (Berk.) Singer	Pleurotaceae	Agaricales	02. 08. 2018 DM
<i>Hohenbuehelia petaloides</i> (Bull.) Schulzer	Pleurotaceae	Agaricales	22. 07. 2018 SH
<i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.	Pleurotaceae	Agaricales	11. 10. 2017 P
<i>Pluteus aurantiorugosus</i> (Trog.) Sacc.	Pluteaceae	Agaricales	10. 12. 2017 DM
<i>Pluteus cervinus</i> (Schaeff.) P. Kumm.	Pluteaceae	Agaricales	10. 10. 2017 P, SH, R
<i>Pluteus cervinus var. albus</i> Peck.	Pluteaceae	Agaricales	11. 07. 2018 SH

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Pluteus nanus</i> (Pers.) P. Kumm.	Pluteaceae	Agaricales	16. 10. 2017 DM
<i>Pluteus petasatus</i> (Fr.) Gillet	Pluteaceae	Agaricales	18. 07. 2018 SH
<i>Volvariella bombycina</i> (Schaeff.) Singer	Pluteaceae	Agaricales	20. 09. 2018 BA, SH
<i>Volvopluteus gloiocephalus</i> (DC.) Vizzini, Contu & Justo	Pluteaceae	Agaricales	30. 10. 2017 BA, SH, GB
<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	Psathyrellaceae	Agaricales	22. 07. 2018 SH
<i>Coprinellus micaceus</i> (Bull.) Fr.	Psathyrellaceae	Agaricales	25. 05. 2018 R
<i>Coprinopsis lagopus</i> (Fr.) Redhead, Vilgalys & Moncalvo	Psathyrellaceae	Agaricales	11. 10. 2017 P
<i>Lacrymaria lacrymabunda</i> (Bull.) Pat.	Psathyrellaceae	Agaricales	10. 10. 2017 BA, SH
<i>Panaeolus papilionaceus</i> (Bull.) Quél.	Psathyrellaceae	Agaricales	11. 11. 2017 GB
<i>Parasola auricoma</i> (Pat.) Redhead, Vilgalys & Hopple	Psathyrellaceae	Agaricales	21. 05. 2018 BA
<i>Parasola conopilus</i> (Fr.) Örstadius & E. Larss.	Psathyrellaceae	Agaricales	17. 06. 2018 R
<i>Psathyrella candolleana</i> (Fr.) Maire	Psathyrellaceae	Agaricales	25. 05. 2018 R, CK, P
<i>Psathyrella pseudogracilis</i> (Romagn.) M. M. Mosser	Psathyrellaceae	Agaricales	10. 11. 2017 BA
<i>Radulomyces confluens</i> (Fr.) M. P. Christ.	Pterulaceae	Agaricales	22. 07. 2018 SH
<i>Schizophyllum commune</i> Fr.	Schizophyllaceae	Agaricales	30.12.2017 BR, BA, R, P, K, DM
<i>Agrocybe molesta</i> (Lasch) Singer	Strophariaceae	Agaricales	09. 09. 2017 BA
<i>Hebeloma crustuliniforme</i> (Bull.) Quél.	Strophariaceae	Agaricales	10. 10. 2017 BA
<i>Hypholoma fasciculare</i> (Huds.) P. Kumm.	Strophariaceae	Agaricales	16. 10. 2017 G, P, R, SH
<i>Hypholoma lateritium</i> (Schaeff.) P. Kumm.	Strophariaceae	Agaricales	25. 09. 2017 R
<i>Clitocybe gibba</i> (Pers.) P. Kumm.	Tricholomataceae	Agaricales	10. 07. 2018 SH, CK
<i>Clitocybe maxima</i> (P. Gaertn., G. Mey. & Scherb.) P. Kumm.	Tricholomataceae	Agaricales	03. 08. 2018 DM
<i>Clitocybe odora</i> (Bull.) P. Kumm.	Tricholomataceae	Agaricales	03. 08. 2018 SH, DM
<i>Melanoleuca brevipes</i> (Bull.) Pat.	Tricholomataceae	Agaricales	14. 11. 2017 GB
<i>Melanoleuca melaleuca</i> (Pers.) Murrill	Tricholomataceae	Agaricales	10. 12. 2018 DM
<i>Phyllotopsis nidulans</i> (Pers.) Singer	Tricholomataceae	Agaricales	30. 12. 2017 BR

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Pseudoclitocybe cyathiformis</i> (Bull.) Singer	Tricholomataceae	Agaricales	14. 11. 2017 GB
<i>Tubaria conspersa</i> (Pers.) Fayod.	Tubariaceae	Agaricales	05. 01. 2018 GB
<i>Tubaria furfuracea</i> (Pers.) Gillet	Tubariaceae	Agaricales	10. 03. 2018 BA
<i>Athelia arachnoidea</i> (Berk.) Jülich	Atheliaceae	Atheliales	30. 12. 2017 BR
<i>Athelia pyriformis</i> (M. P. Christ.) Jülich	Atheliaceae	Atheliales	20. 10. 2017 R, DM, SH
<i>Auricularia auricula-judae</i> (Bull.) Quél.	Auriculariaceae	Auriculariales	25. 10. 2017 DM
<i>Auricularia mesenterica</i> (Dicks.) Pers.	Auriculariaceae	Auriculariales	05. 01. 2018 DM, GB
<i>Exidia glandulosa</i> (Bull.) Fr.	Exidiaceae	Auriculariales	17. 06. 2018 BR, GB, R
<i>Exidia nigricans</i> (With.) P. Roberts	Exidiaceae	Auriculariales	30. 12. 2017 BR, P
<i>Exidia recisa</i> (Ditmar) Fr.	Exidiaceae	Auriculariales	30. 12. 2017 BR
<i>Exidia thuretiana</i> (Lév.)	Exidiaceae	Auriculariales	30. 12. 2017 BR
<i>Boletus subtomentosus</i> J. A. Palmer	Boletaceae	Boletales	11. 07. 2018 SH
<i>Hortiboletus rubellus</i> (Krombh.) Simonini, Vizzini & Gelardi	Boletaceae	Boletales	25. 05. 2018 R
<i>Imperator rhodopurpureus</i> Assyov, Bellanger, Bertéa, Courtec., Koller, Loizides, G. Marques, J. A Muñoz, N. Oppicelli, D. Puddu, F. Rich. & P. - A. Moreau	Boletaceae	Boletales	03. 08. 2018 DM
<i>Leccinum duriusculum</i> (Schulzer ex Kalchbr.) Singer	Boletaceae	Boletales	20. 06. 2018 BA
<i>Neoboletus erythropus</i> (Pers.) C. Hahn	Boletaceae	Boletales	10. 07. 2018 SH
<i>Xerocomellus chrysenteron</i> (Bull.) Šutara	Boletaceae	Boletales	10. 07. 2018 R, SH
<i>Xerocomellus porosporus</i> (Imler ex Watling) Šutara	Boletaceae	Boletales	10. 07. 2018 SH
<i>Xerocomellus pruinaus</i> (Fr. & Höh) Šutara	Boletaceae	Boletales	25. 05. 2018 R
<i>Gyroporus castaneus</i> (Bull.) Quél.	Gyroporaceae	Boletales	11. 07. 2018 SH
<i>Scleroderma citrinum</i> Pers.	Sclerodermataceae	Boletales	20. 05. 2018 BA
<i>Scleroderma verrucosum</i> (Bull.) Pers.	Sclerodermataceae	Boletales	21. 07. 2018 R, SH
<i>Cantharellus cibarius</i> Fr. **	Cantharellaceae	Cantharellales	10. 07. 2018 SH, R
<i>Craterellus cornucopiodes</i> (L.) Pers. **	Cantharellaceae	Cantharellales	11. 07. 2018 SH
<i>Dacrymyces capitatus</i> Schwein.	Dacrymycetaceae	Dacrymycetales	30. 12. 2017 BR

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Geastrum fimbriatum</i> Fr.	Geastraceae	Geastrales	22. 07. 2018 GB
<i>Fomitiporia punctata</i> (P. Karst.) Murrill	Hymenochaetaceae	Hymenochaetales	16. 10. 2018 DM
<i>Fuscoporia torulosa</i> (Pers.) T. Wagner & M. Fisch	Hymenochaetaceae	Hymenochaetales	03. 04. 2018 DM
<i>Hymenochaete rubiginosa</i> (Dicks.) Lév.	Hymenochaetaceae	Hymenochaetales	30. 12. 2017 BR
<i>Inonotus dryadeus</i> (Pers.) Murrill	Hymenochaetaceae	Hymenochaetales	11. 10. 2017 P
<i>Inonotus hispidus</i> (Bull.) P. Karst.	Hymenochaetaceae	Hymenochaetales	03. 05. 2018 BA
<i>Phellinus igniarius</i> (L.) Quéf.	Hymenochaetaceae	Hymenochaetales	30. 10. 2017 SH
<i>Phellinus pomaceus</i> (Pers.) Maire	Hymenochaetaceae	Hymenochaetales	16. 10. 2017 DM, BA
<i>Phellinus robiniae</i> (Murrill) A. Ames	Hymenochaetaceae	Hymenochaetales	16. 10. 2017 G
<i>Trichaptum bifforme</i> (Fr.) Ryvarden	incertae sedis	Hymenochaetales	20. 10. 2017 P, DM
<i>Phallus hadriani</i> Vent. *	Phallaceae	Phallales	05. 07. 2018 GM, CK, BA
<i>Antrodia albida</i> (Fr.) Donk.	Fomitopsidaceae	Polyporales	20. 07. 2018 BA, SH
<i>Daedalea quercina</i> (L.) Pers.	Fomitopsidaceae	Polyporales	25. 09. 2017 R
<i>Laetiporus sulphureus</i> (Bull.) Murrill	Fomitopsidaceae	Polyporales	08. 09. 2017 BA
<i>Ganoderma applanatum</i> (Pers.) Pat.	Ganodermataceae	Polyporales	17. 10. 2017 DM
<i>Ganoderma lucidum</i> (Curtis) P. Karst.	Ganodermataceae	Polyporales	20. 05. 2016 DM, R, K, SH
<i>Ganoderma resinaceum</i> Boud.	Ganodermataceae	Polyporales	01. 10. 2017 K
<i>Meripilus giganteus</i> (Pers.) P. Karst.	Meripilaceae	Polyporales	25. 10. 2017 DM
<i>Rigidoporus ulmarius</i> (Sowerby) Imazeki	Meripilaceae	Polyporales	20. 09. 2017 BR
<i>Abortiporus biennis</i> (Bull.) Singer	Meruliaceae	Polyporales	25. 09. 2017 R, CK
<i>Bjerkandera adusta</i> (Willd.) P. Karst.	Meruliaceae	Polyporales	25. 09. 2017 GB
<i>Ceriporia spissa</i> (Schwein. ex Fr.) Rajchenb.	Meruliaceae	Polyporales	25. 10. 2017 DM
<i>Cerocorticium molare</i> (Chaillet ex Fr.) Jülich & Stalpers	Meruliaceae	Polyporales	17. 06. 2018 BR
<i>Gelatoporia dichroa</i> (Fr.) Ginns.	Meruliaceae	Polyporales	16. 10. 2017 BR, P
<i>Irpex lacteus</i> (Fr.) Fr.	Meruliaceae	Polyporales	25. 09. 2017 R
<i>Phlebia radiata</i> Fr.	Meruliaceae	Polyporales	30. 12. 2017 BR

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Phlebia tremellosa</i> (Schrad.) Nakasone & Burds.	Meruliaceae	Polyporales	30. 12. 2017 BR
<i>Steccherinum ochraceum</i> (Pers.) Gray	Meruliaceae	Polyporales	30. 12. 2017 BR
<i>Byssomerulius corium</i> (Pers.) Parmesto	Phanerochaetaceae	Polyporales	30. 12. 2017 BR
<i>Hapalopilus rutilans</i> (Pers.) Murrill	Phanerochaetaceae	Polyporales	28. 10. 2017 SH, K, P
<i>Cerioporus squamosus</i> (Huds.) Quél.	Polyporaceae	Polyporales	25. 05. 2018 GB
<i>Cerrena unicolor</i> (Bull.) Murrill	Polyporaceae	Polyporales	25. 10. 2017 DM
<i>Coriolopsis gallica</i> (Fr.) Ryvarden	Polyporaceae	Polyporales	25. 09. 2017 R
<i>Daedaleopsis tricolor</i> (Bull.) Bondartsev & Singer	Polyporaceae	Polyporales	22. 07. 2018 SH
<i>Daedaleopsis confragosa</i> (Bolton) J. Schröt.	Polyporaceae	Polyporales	25. 09. 2017 R
<i>Fomes fomentarius</i> (L.) Fr.	Polyporaceae	Polyporales	25. 10. 2017 DM, GB
<i>Lentinus arcularius</i> (Batsch.) Zmitr.	Polyporaceae	Polyporales	13. 07. 2017 R
<i>Lentinus brumalis</i> (Pers.) Zmitr.	Polyporaceae	Polyporales	05. 01. 2018 GB
<i>Lentinus tigrinus</i> (Bull.) Fr.	Polyporaceae	Polyporales	25. 05. 2018 R
<i>Pycnoporus cinnabarinus</i> (Jacq.) P. Karst.	Polyporaceae	Polyporales	11. 07. 2018 R, SH
<i>Trametes gibbosa</i> (Pers.) Fr.	Polyporaceae	Polyporales	05. 01. 2018 GB
<i>Trametes hirsuta</i> (Wulfen) Lloyd	Polyporaceae	Polyporales	13. 09. 2017 R
<i>Trametes versicolor</i> (L.) Lloyd.	Polyporaceae	Polyporales	25. 09. 2017 R, SH, DM
<i>Artomyces pyxidatus</i> (Pers.) Jülich	Auriscalpiaceae	Russulales	03. 01. 2018 GB
<i>Peniophora cinerea</i> (Pers.) Cooke	Peniophoraceae	Russulales	30. 12. 2017 BR
<i>Peniophora quercina</i> (Pers.) Cooke	Peniophoraceae	Russulales	25. 10. 2017 R
<i>Peniophora rufa</i> (Fr.) Boidin	Peniophoraceae	Russulales	01. 10. 2017 R
<i>Lactarius fuliginosus</i> var. <i>albipes</i> (J. E. Lange)	Russulaceae	Russulales	25. 05. 2018 R
<i>Lactarius fulvissimus</i> Romagn.	Russulaceae	Russulales	10. 07. 2018 SH
<i>Lactarius quietus</i> (Fr.) Fr.	Russulaceae	Russulales	10. 07. 2018 SH
<i>Russula amoenolens</i> Romagn.	Russulaceae	Russulales	10. 07. 2018 SH
<i>Russula atropurpurea</i> Peck.	Russulaceae	Russulales	11. 07. 2018 SH

Table 1. continued

Species	Family	Order	Date and place of collection
<i>Russula cyanoxantha</i> f. <i>peltereaui</i> Singer	Russulaceae	Russulales	11. 07. 2018 SH
<i>Russula cyanoxantha</i> (Schaeff.) Fr. **	Russulaceae	Russulales	25. 05. 2018 R
<i>Russula foetens</i> Pers.	Russulaceae	Russulales	25. 05. 2018 R
<i>Russula fragrans</i> Romagn.	Russulaceae	Russulales	10. 07. 2018 R, CK, SH
<i>Russula grata</i> Britzelm	Russulaceae	Russulales	05. 07. 2018 CK
<i>Russula grisea</i> Fr.	Russulaceae	Russulales	10. 07. 2018 SH, CK
<i>Russula heterophyla</i> (Fr.) Fr.	Russulaceae	Russulales	25. 05. 2018 R
<i>Russula nigricans</i> Fr.	Russulaceae	Russulales	22. 07. 2018 SH
<i>Russula odorata</i> Romagn.	Russulaceae	Russulales	10. 07. 2018 SH
<i>Russula rosea</i> Pers.	Russulaceae	Russulales	11. 07. 2018 SH
<i>Russula rubroalba</i> (Singer) Romagn.	Russulaceae	Russulales	25. 05. 2018 SH, R
<i>Russula virescens</i> (Schaeff.) Fr. **	Russulaceae	Russulales	11. 07. 2018 SH, CK
<i>Stereum hirsutum</i> (Willd.) Pers.	Stereaceae	Russulales	16. 10. 2017 P, R
<i>Stereum ochraceoflavum</i> (Schwein.) Sacc.	Stereaceae	Russulales	25. 10. 2017 R
<i>Stereum ostrea</i> (Blume & T. Nees) Fr.	Stereaceae	Russulales	01. 09. 2017 R
<i>Stereum rugosum</i> Pers.	Stereaceae	Russulales	06. 10. 2017 R
<i>Stereum subtomentosum</i> Pouzar	Stereaceae	Russulales	01. 10. 2017 R, K, P
ASCOMYCOTA			
<i>Hymenoscyphus albidus</i> (Gillet) W. Phillips	Helotiaceae	Helotiales	25. 10. 2017 DM
<i>Hymenoscyphus epiphyllus</i> (Pers.) Rehm ex Kauffman	Helotiaceae	Helotiales	16. 10. 2017 P
<i>Lachnum virgineum</i> (Batsch.) P. Karst.	Hyaloscyphaceae	Helotiales	05. 01. 2018 GB
<i>Helvella spadicea</i> Schaeff.	Helvellaceae	Pezizales	01. 05. 2018 BA
<i>Peziza domiciliana</i> Cooke	Pezizaceae	Pezizales	06. 04. 2018 BA
<i>Sarcoscypha coccinea</i> (Jacq.) Sacc.	Sarcoscyphaceae	Pezizales	15. 03. 2018 GB, R
<i>Tuber aestivum</i> (Wulfen) Spreng. **	Tuberaceae	Pezizales	13. 07. 2018 SH, R
<i>Xylaria hypoxylon</i> (L.) Grev.	Xylariaceae	Xylariales	11. 11. 2017 GB
<i>Xylaria polymorpha</i> (Pers.) Grev.	Xylariaceae	Xylariales	17. 06. 2018 GB, BR, R

The vast number of identified species of macromycetes in the territory of Batočina implicates that this area is suitable for their growth, despite the extensive destruction of habitats. This area was covered with dense forests in the past. Nowadays, many forests are destroyed and turned into building and agricultural land, while the remaining fragments of forests are surrounded by agricultural land and are under a huge impact of pesticides, used in agriculture. Macromycetes rarely grow in areas which are immensely under human impact and tend to withdraw to higher altitude areas, with limited human impact (RANKOVIĆ, 2014). In accordance with that, the biggest number of species of macromycetes was recorded on Straževica hill (the highest locality) and in Rogot (the only protected locality by the government).

According to the regulations of the Government of the Republic of Serbia (Sl. Glasnik RS”, br. 5/2010 i 47/2011) there are several rare, protected and strictly protected species among the identified species. One of them (*Phallus hadriani*) is strictly protected (Fig. 2) and 7 are protected (*Amanita caesarea*, *Marasmius oreades*, *Cantharellus cibarius*, *Craterellus cornucopioides*, *Tuber aestivum*, *Russula cyanoxantha* and *R. virescens*).



Figure 2. Strictly protected species *Phallus hadriani* Vent. (Photo: N. Petrović 05.07.2018)

Phallus hadriani, the dune stinkhorn, often grows in sandy soils, which aren't common in the territory of Serbia, thus this species is strictly protected. In Batočina municipality, this species was found in Gornja Mala, by the road in Batočina and in Crni Kao.

Amanita caesarea, Caesar's mushroom, is a mycorrhizal species, which often grows in thermophilic oak forests, or in forest edges. It is a highly regarded edible species, which has become endangered as a consequence to overharvesting and habitat destruction. It was found on Straževica hill only.

Marasmius oreades, the fairy ring mushroom, is an edible species, which grows in lawns and meadows. It was abundant in a meadow, by the road, in the town of Batočina.

Cantharellus cibarius, golden chanterelle, grows in broad-leaved and coniferous forests. It is edible and high-quality. It has become endangered due to overharvesting and habitat destruction. The presence of the golden chanterelle was noted in Straževica hill and Rogot.

Craterellus cornucopioides, the horn of plenty, is a species of edible mushroom, widely used because of its rich aroma. It often occurs in broad-leaved forests. It was noted in Straževica hill. *Cantharellus cibarius* and *Craterellus cornucopioides* are famous for

accumulating cesium intensively, so mushroom gatherers should not collect these species on places rich with cesium (KOSTIAINEN, 2005).

Russula cyanoxantha, the charcoal burner, and *R. virescens*, the greencracked brittlegill, are edible and high-quality species, which is the reason why they are the most famous species of genus *Russula* among mushroom gatherers. They inhabit broad-leaved forests (FLIK, 2017). *R. cyanoxantha* was recorded in Donja Mala and Rogot and *R. virescens* was recorded in Straževica hill and Crni Kao.

According to literature (UZELAC, 2009) and sites (<https://www.mushroomexpert.com/>, <http://www.gobe.si/>, <https://www.iucnredlist.org/>) 11 species of the identified species are rare and endangered: *Leucoagaricus americanus* (Fig. 3), *Coriolopsis gallica*, *Volvariella bombycina*, *Macrolepiota fuliginosa*, *Pluteus aurantiorugosus*, *Marasmius candidus*, *Phyllostopsis nidulans*, *Russula fragrans*, *R. grata*, *R. amoenolens* and *Helvella spadicea*. *V. bombycina*, *R. fragrans* and *M. candidus* were frequent in the territory of Batočina.



Figure 3. Rare species *Leucoagaricus americanus* (Peck.) Vellinga. (Photo: N. Petrović 28.07.2018)

While there aren't any published data on the diversity of macromycetes of Batočina, they exist for other areas of Serbia. Similar research on Kopaonik, in central Serbia, has shown the presence of 180 species of macromycetes in that area (IVANČEVIĆ, 1996). On Tara mountain, in western Serbia, 251 species of macromycetes were noted (COLIĆ, 1967). On Bukulja mountain, in central Serbia, 225 species of macromycetes were recorded (LAČKOVIĆ, 2015). A total of 117 species of macromycetes was recorded on the Serbian side of Stara planina mountain, located in the eastern part of Serbia (IVANČEVIĆ and BERONJA, 2004). Apart from roughly comparing the number of recorded species of macromycetes in different areas, it is impossible to make any conclusions, since the vegetation and habitat conditions differ among investigated areas. Also, important factors are volume and duration of the research. The total number of species of macromycetes is certainly higher, but it is necessary to engage in research, far more extensive, covering the whole vegetation period over several years.

Researches of macromycetes diversity in various areas are crucial and mandatory for obtaining data of the number of species and their habitats, which is essential for preservation.

CONCLUSION

Field studies on the diversity of macromycetes during 2017 and 2018 have shown that the area of Batočina is suitable for growth of many species of macromycetes. The presence of 200 species, which belong to phyla Basidiomycota and Ascomycota, was noted. Some of the identified species were strictly protected, protected and rare in the territory of Serbia.

Many localities remained unexplored or were explored in the wrong time, thus the total number of species might be even bigger, which is an opportunity for forthcoming researches.

This paper is a contribution to the knowledge of the diversity of macromycetes in the territory of Batočina and also a contribution to the knowledge of the diversity of macromycetes in Serbia.

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