

## *A Study of Larger Fungi of the Boraka Managed Reserve, Central Rhodopes Mts.*

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**Abstract.** Data on the species composition, distribution and the ecological-trophic structure of larger fungi in Boraka Managed Reserve, Central Rhodopes Mts. are published for the first time. Six species includes in the Red List of fungi in Bulgaria: *Auriscalpium vulgare* Gray, *Hymenogaster luteus* Vittad., *Phallus hadriani* Vent:Pers., *Rozites caperatus* (Pers.:Fr.) P. Karst., *Russula solaris* Ferd. & Winge. and *Sarcosphaera coronaria* (Jacq.) Boud. The aim of the paper is to enrich the information about fungal diversity in the reserves of Rhodopes, as well as in a natural forest of *Pinus nigra* L. in Bulgaria.

**Key words:** Boraka Managed Reserve, conservation value, ecological-trophic structure, fungal diversity, larger fungi, rare taxa, Bulgaria.

### **Introduction**

Boraka Managed Reserve is situated in the foot of Central-Rhodopes hill Mechkovets, in the land of village of Sarnitsa, Mineralni Bani Municipality, Haskovo distr., close to the Haskovo town. Its altitude ranges up to 850 m a.s.l. The Reserve covers 11.10 ha of the State forest fund. It was founded with the sole purpose of protecting the natural habitat for old, natural, self-reproducing black pine forest and to maintain representative ecosystem for *Pinus nigra* Arn. (Decree 163/22.04.1966 of the Ministry of Agriculture and Forestry). Subsequently, its category was changed to a Managed Reserve (Regulation RD 384/15.10.1999 of the Ministry of Environment and Waters) under the Protected Areas Act (Darzhaven Vestnik 135/1998). The reserve is managed and guarded by RIOSV-Haskovo.

The present work reports on the larger fungi diversity in the Boraka Managed

Reserve. This is the first mycological study conducted on the territory of this interesting reserve.

Data on larger fungi in the Boraka Managed Reserve provide information on the species diversity of fungi in the *Pinus nigra* communities in Bulgaria. These communities have a rather limited distribution in the country (MESHINEV *et al.*, 1998), while mycologically they are absolutely unstudied. Any fungus species have been so far published exclusively in relation to cultures, and not in relation to the natural black pine communities in Bulgaria (HINKOVA & DROUMEVA, 1978; HINKOVA *et al.*, 1979; STOICHEV & DIMCHEVA, 1987; GYOSHEVA, 1991, 2000; DIMCHEVA *et al.*, 1992; LACHEVA & GYOSHEVA, 2013, etc.). Information of fungi in the *Pinus nigra* communities, available in the work by GYOSHEVA & ANDREEVA (2000) about fungi of Momchilovski Dol Reserve (Central Rhodopes).

The purpose of the present study was to provide an upgraded inventory of the species composition, distribution and the conservation status of the larger fungi in the reserve. The collected scientific information will be used for analysis and planning activities on the conservation and management of the biodiversity in a secure territory in the future.

### Material and Methods

The mycological studies were carried out within the 2010-2012 period on the territory of the Boraka Managed Reserve.

The soil is humus-carbonate, sandy-clay, on a base of calcareous rock. The forest litter is composed of needles, cones, bark, dead fragments of grassy plants, etc. The composition of the tree stand is 10 Pn - *Pinus nigra* Arn. Single specimens of *Picea abies* Karst., *Fagus sylvatica* L., and *Quercus* sp. also involved in some places.

Field studies were carried out by the transect method. The specimens were collected from April to November, during each vegetation season. Were collected fungal samples and making observations on the ecology of taxa. The fungal species were determined according to (MOSER, 1963, 1967, 1978, 1983; PHILLIPS, 1981; HANSEN & KNUDSEN, 1992; RYVARDEN & GILBERTSON, 1993, 1994) and the ecological-trophic structure were carried out after direct observations and based on literature data (KALAMEES, 1979; ARNOLDS, 1981; GYOSHEVA & VASILEV, 1994).

Classification of fungal taxa followed KIRK *et al.* (2008).

The author's names of the fungal taxa are given by KIRK & ANSELL (2004) and the plants taxa by BRUMMIT & POWELL (1992).

The ecological-trophic groups are identified by the abbreviated latin names of substrates (ARNOLDS, 1981).

The conservation status is indicated according to the *Red List* of fungi in Bulgaria (GYOSHEVA *et al.*, 2006). The fungus species with conservation value are designed in the list with CV. Designations of ecological-trophic groups: Ad - needle-debris saprotrophs, St - litter saprotrophs, Hu - humus saprotrophs, Br - moss

saprotrophs, Mr - mycorrhizal fungi, LeS - wood saprotrophs, LeP - wood parasites.

The characteristics of the reserve were provided by the Haskovo State Forestry.

### Results and Discussion

In the result of mycological investigations 103 taxa were identified, related to 2 classes (Pezizomycetes and Agaricomycetes), 7 orders, 26 families and 47 genera. The prevailing number of taxa related to the class Agaricomycetes: 6 orders, 25 families and 46 genera and 97 species. Order Agaricales dominated by the number of species (67). Most species abundant were the families: Pezizaceae (6), Agaricaceae and Russulaceae (16 each), Tricholomataceae (21). The greatest number of larger fungi was identified from the genera *Amanita* (3), *Clitocybe* (6), *Cystoderma* (4), *Lactarius* (7), *Russula* (9), *Tricholoma* (4).

All registered fungal species are reported for the first time for the Boraka Managed Reserve. One species are new for the Rhodopes - *Hymenogaster hessei*. Six larger fungi are rare and threatened in Bulgaria and Europe: *Auriscalpium vulgare*, *Hymenogaster luteus*, *Phallus hadriani*, *Rozites caperatus*, *Russula solaris*, and *Sarcosphaera coronaria* (DAHLBERG & CRONEBORG, 2003; GYOSHEVA *et al.*, 2006; DENCHEV & PETROVA, 2011).

Of all species registered in the Boraka Managed Reserve, the following species are characteristic of the pine forests: *Auriscalpium vulgare*, *Mycena epipterigia*, *Lactarius deliciosus*, *L. rufus*, *L. vellereus*, *Tricholoma equestre*, *T. imbricatum*, *Russula rosea*, *R. roseipes*.

In the two years of study, the greatest diversity of species and high production of fruiting bodies of fungi were recorded in late summer - in August and September. Dominant in the number of fruiting bodies were identified following: *Boletus edulis*, *Cantharellus cibarius*, *Gomphidius glutinosus*, *Marasmiellus ramealis* and species of the genera *Lactarius* and *Russula* during August and *Agaricus sylvaticus*, *Amanita phalloides*, *A. rubescens*, *Lepista nuda*, *Marasmiellus ramealis*, and species of the genera *Lactarius* and *Russula* during September.

The reserve was established fungi from 7 ecological-trophic groups: needle-debris saprotrophs (4), litter saprotrophs (12), humus saprotrophs (53), moss saprotrophs (2), mycorrhizal fungi (18), wood saprotrophs (8) and wood parasites (1). Of fungi belonging to trophic groups and food substrates which are developed are given in Table 1. Despite a short period of study in the pine forests of the reserve was reported right fungal diversity of species of fungi of the most important in forestry terms ecological-trophic groups, namely: mycorrhizal fungi, wood saprotrophs and litter, wood saprotrophs and humus saprotrophs.

Within the reserve were established nine species valuable edible mushrooms - *Agaricus sylvaticus*, *Boletus edulis*, *Cantharellus cibarius*, *Gomphidius glutinosus*, *Lactarius piperatus*, *Lepista nuda*, *Lycoperdon perlatum*, *Russula xerampelina* and *R. virescens*. Among the edible mushrooms, most abundant fructification - *Agaricus sylvaticus*, *Boletus edulis*, *Cantharellus cibarius*, *Lactarius piperatus*, *Lycoperdon perlatum*, and *Russula xerampelina*.

List of all taxa in a systematic order is presented on Table 1.

**Table 1.** Species composition and ecological-trophic structure of larger fungi in Boraka Managed Reserve

Taxa	Substrate	Ecological-trophic groups
<b>Pezizomycetes</b>		
<b>Pezizales</b>		
<b>Pezizaceae</b>		
<i>Otidea umbrina</i> (Pers.) Bres.	on soil	Hu
<i>Discina perlata</i> (Fr.) Fr.	on soil	Hu
<i>Helvella lacunose</i> Fr. ex Afzelius	on soil	Hu
<i>Peziza repanda</i> Pers.	on soil	Hu
CV <i>Sarcosphaera coronaria</i> (Jacq.) Boud.	on soil	Hu
<i>Verpa digitaliformis</i> Pers.	on soil	Hu
<b>Agaricomycetes</b>		
<b>Agaricales</b>		
<b>Agaricaceae</b>		
<i>Agaricus xanthodermus</i> Genev.	on soil	Hu
<i>Agaricus sylvaticus</i> Schaeff.	on soil	Hu
<i>Chlorophyllum rachodes</i> (Vittad.) Velinga	on soil	Hu
<i>Cystoderma amianthinum</i> (Scop. : Fr.) Fayod	on soil among mosses	Br
<i>Cystoderma carcharias</i> (Pers.) Fayod	on the forest litter	St
<i>Cystoderma cinnabarinum</i> (Alb. & Schwein) Fayod	on soil among mosses	Br
<i>Cystoderma granulorum</i> (Batsch : Fr.) Fayod	on the forest litter	St
<i>Coprinellus micaceus</i> (Bull. : Fr.) Vilgalys	on soil	Hu
<i>Lepiota erminea</i> (Fr. : Fr.) P. Kumm.	on soil	Hu
<i>Lepiota clypeolaria</i> (Bull. : Fr.) P. Kumm.	on soil	Hu
<i>Lepiota magnispora</i> Murrill	on soil	Hu
<i>Leucoagaricus leucothites</i> (Vittad.) Wasser	on soil	Hu
<i>Lycoperdon perlatum</i> (Pers.) Pers.	on the forest litter	St
<i>Lycoperdon echinatum</i> (Pers.) Pers.	on the forest litter	St
<i>Macrolepiota excoriata</i> (Schaeff.:Fr.) Wasser	on soil	Hu
<i>Macrolepiota procera</i> (Scop. : Fr.) Singer	on soil	Hu
<b>Amanitaceae</b>		

<i>Amanita pantherina</i> (DC. : Fr.) Krombh	on soil	Hu
<i>Amanita phalloides</i> (Vaill. : Fr.) Link	on soil	Hu
<i>Amanita rubescens</i> Pers. : Fr.	on soil	Hu
<b>Cortinariaceae</b>		
<i>Cortinarius torous</i> (Fr. : Fr.) Fr.	on soil	Hu
CV <i>Rozites caperatus</i> (Pers. : Fr.) P. Karst.	on soil	Hu
<b>Bolbitiaceae</b>		
<i>Hebeloma crustuliniforme</i> (Bull. : Fr.) Quél.	on soil	Mr
<i>H. sinapizans</i> (Paulet : Fr.) Gilett.	on soil	Mr
<b>Hydnangiaceae</b>		
<i>Laccaria amethystine</i> Cooke	of dead wood	LeS
<i>L. laccata</i> (Scop. : Fr.) Cooke	on soil	Hu
<b>Inocybaceae</b>		
<i>Inocybe asterospora</i> Quél.	on soil	Hu
<i>Inocybe dulcamara</i> (Alb. & Schwein. ex Pers.) P. Kumm.	on soil	Hu
<b>Marasmiaceae</b>		
<i>Marasmiellus ramealis</i> (Bull. : Fr.) Singer	on fallen needles	Ad
<i>Marasmius oreades</i> (Bolton : Fr.) Fr.	on soil	Hu
<i>Marasmius rotula</i> (Scop. : Fr.) Fr.	on fallen needles	Ad
<i>Mycetinis scorodonius</i> (Fr. : Fr.) A.W. Wilson	on fallen needles	Ad
<i>Setulipes androsaceus</i> (L. : Fr.) Antonín	on fallen needles	Ad
<b>Mycenaceae</b>		
<i>Mycena epipterygia</i> (Scop.: Fr.) Gray	on dead wood	LeS
<i>Mycena galericulata</i> (Scop.: Fr.) Gray	on dead wood	LeS
<b>Physalacriaceae</b>		
<i>Xerulla radicata</i> (Relhan : Fr.) Dörfelt	on soil	Hu
<b>Pleurotaceae</b>		
<i>Pleurotus ostreatus</i> (Jacq. : Fr.) P. Kumm.	on dead wood	LeS
<b>Polyporales</b>		
<i>Polyporus squamosus</i> (Huds. : Fr.) Fr.	on dead wood	LeP
<b>Psathyrellaceae</b>		
<i>Psathyrella candolleana</i> (Fr. : Fr.) Maire	on buried wood	LeS
<b>Strophariaceae</b>		
<i>Agrocybe molesta</i> (Lasch) Singer	on soil	Hu
<i>Agrocybe praecox</i> (Pers. : Fr.) Fayod	on soil	Hu
* <i>Hymenogaster hessei</i> Soehner	in soil	Mr
CV <i>Hymenogaster luteus</i> Vittad.	in soil	Mr
<i>Hypholoma fasciculare</i> (Huds. : Fr.) P. Kumm.	on dead wood	LeS
<i>Pholiota highlandensis</i> (Peck) Quadr. & Lunghini	on dead wood	LeS
<i>Stropharia aeruginosa</i> (Curtis : Fr.) Quél.	on buried wood and in the litter	St
<i>Stropharia coronilla</i> (Bull. : Fr.) Fr.	on buried wood and in the litter	St
<b>Tricholomaceae</b>		
<i>Calocybe gambosa</i> (Fr. : Fr.) Donk	on soil	Hu
<i>Clitocybe phyllophila</i> (Pers. : Fr.) P. Kumm.	on soil	Hu
<i>Clitocybe geotropa</i> (Bull. ex DC.) Quél.	on soil	Hu
<i>Clitocybe gibba</i> (Pers. : Fr.) P. Kumm.	on soil	Hu
<i>Clitocybe metachroa</i> (Fr. : Fr.) P. Kumm.	on soil	Hu
<i>Clitocybe nebularis</i> (Batsch : Fr.) P. Kumm.	on soil	Hu
<i>Clitocybe odora</i> (Bull. : Fr.) P. Kumm.	on soil	Hu
<i>Gymnopus acervata</i> (Fr. : Fr.) Murrill	on the forest litter	St

<i>Gymnopus dryophilus</i> (Bull. : Fr) Murrill	on the forest litter	St
<i>Hygrocybe conica</i> (Schaeff. : Fr.) P. Kumm.	on soil	Hu
<i>Hygrophorus agathosmus</i> (Fr.) Fr.	on soil	Hu
<i>Hygrophorus camarophyllus</i> (Alb. & Schwein. : Fr.) Dumée, Grandjean & Maire	on soil	Hu
<i>Lepista flaccida</i> (Sowerby : Fr.) Pat.	on the forest litter	St
<i>Lepista nuda</i> (Bull. : Fr.) Cooke	on soil	Hu
<i>Melanoleuca melaleuca</i> (Pers. : Fr.) Murrill	on soil	Hu
<i>Melanoleuca grammopodia</i> (Bull. : Fr.) Pat.	on soil	Hu
<i>Rhodocollybia butiracea</i> (Bull. : Fr.) Lennox	on the forest litter	St
<i>Tricholoma equestre</i> (L. : Fr.) P. Kumm.	on soil	Hu
<i>Tricholoma imbricatum</i> (Fr. : Fr.) P. Kumm.	on soil	Hu
<i>Tricholoma portentosum</i> (Fr. : Fr.) Quél.	on soil	Hu
<i>Tricholoma terreum</i> (Schaeff. : Fr.) P. Kumm.	on soil	Hu
<b>Boletales</b>		
<b>Boletaceae</b>		
<i>Boletus edulis</i> Bull. : Fr.	on soil	Hu
<i>Boletus luridus</i> Schaeff. : Fr.	on soil	Hu
<b>Diplocystidiaceae</b>		
<i>Astraeus hygrometricus</i> (Pers. : Pers.) Morgan	on the forest litter	St
<b>Gomphidiaceae</b>		
<i>Gomphidius glutinosus</i> (Schaeff. : Fr.) Fr.	on soil	Hu
<b>Gyroporaceae</b>		
<i>Leccinum scabrum</i> (Bull. : Fr.) Gray	on soil	Hu
<b>Paxillaceae</b>		
<i>Paxillus involutus</i> (Batsch : Fr.) Fr.	on dead wood	LeS
<b>Suillaceae</b>		
<i>Suillus bovinus</i> (L. : Fr.) Roussel	on soil	Hu
<i>Suillus granulatus</i> (L. : Fr.) Roussel	on soil	Hu
<b>Cantharellales</b>		
<b>Clavulinaceae</b>		
<i>Clavulina cinerea</i> (Bull. : Fr.) J. Schröt.	on soil among mosses	Br
<i>Clavulina coralloides</i> (Bull. : Fr.) J. Schröt.	on soil among mosses	Br
<i>Cantharellus cibarius</i> Fr. : Fr.	on soil	Mr
<b>Phallales</b>		
<b>Phallaceae</b>		
CV <i>Phallus hadriani</i> Vent. : Pers.	on soil	Hu
<b>Russulales</b>		
<b>Auriscalpiaceae</b>		
CV <i>Auriscalpium vulgare</i> Gray	on pine cones in the forest litter	St
<b>Russulaceae</b>		
<i>Lactarius controversus</i> (Pers. : Fr.) Fr.	on soil	Mr
<i>Lactarius deliciosus</i> (L. : Fr.) Gray	on soil	Mr
<i>Lactarius piperatus</i> (L. : Fr.) Pers.	on soil	Mr
<i>Lactarius rufus</i> (Scop. : Fr) Fr.	on soil	Mr
<i>Lactarius semisanguifluus</i> R. Heim & Leclair	on soil	Mr
<i>Lactarius torminosus</i> (Schaeff. : Fr.) Pers.	on soil	Mr
<i>Lactarius vellereus</i> (Fr. : Fr.) Fr.	on soil	Mr
<i>Russula foetens</i> (Pers. : Fr) Fr.	on soil	Mr
<i>Russula integra</i> L. : Fr.	on soil	Mr
<i>Russula lilacea</i> Quél.	on soil	Mr
<i>Russula olivacea</i> (Schaeff.) Fr.	on soil	Mr

CV <i>Russula solaris</i> Ferd. & Winge.	on soil	Mr
<i>Russula rosea</i> Pers.		
<i>Russula roseipes</i> Secr ex Bres.		
<i>Russula virescens</i> (Schaeff.) Fr.	on soil	Mr
<i>Russula xerampelina</i> (Schaeff.) Fr.	on soil	Mr
<b><u>Thelephorales</u></b>		
<b><u>Thelephoraceae</u></b>		
<i>Thelephora terrestris</i> Ehrh. : Fr.	on soil	Hu

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