

MACROFUNGI AND LICHEN-FORMING FUNGI ON THE TERRITORY OF IBUR RESERVE, RILA NATIONAL PARK (BULGARIA)

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Abstract. Data on the species diversity of macrofungi and lichen-forming fungi recorded in Ibur Reserve (Rila Mts) are presented in the paper. All taxa belong to Ascomycota and Basidiomycota. One species (*Russula sphagnophila*) is new for Bulgaria. Four macrofungi (*Galerina paludosa*, *Lactarius sphagneti*, *Limacellopsis guttata* and *Mitrula paludosa*) are of high conservation value, included in the Red List of fungi of Bulgaria. The lichen *Nephromopsis chlorophylla* is a rare species, known as an old-growth forest indicator.

Key words: *Agaricomycotina*, ascomycetes, basidiomycetes, fungal conservation, *Pezizomycotina*, Rila Mts

INTRODUCTION

This work reports the preliminary data on the species diversity of macrofungi and lichen-forming fungi in the Reserve Ibur (known also as Ibar) on Rila Mts. A list of 384 macrofungi from the eastern part of Rila Mts was published by HINKOVA

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(1958). However, there is no information about the fungal diversity of the reserve. Later, data about conservationally important fungi of the region were presented by GYOSHEVA ET AL. (2017). The Catalogue of the lichenized and lichenicolous fungi in Bulgaria (MAYRHOEFER ET AL. 2005) includes a total number of 388 taxa, known from Rila Mts. To our knowledge, there is no information available in the previous lichenological studies about the lichen-forming fungi from Ibur Reserve. The only exception is the report of tree lungwort found on maple along the Kraina River (СТОЙКОВ 2018). Therefore, the information concerning macrofungi and lichens presented in this paper is the first report for the Reserve Ibur.

MATERIAL AND METHODS

The reserve Ibur is situated on the northern slopes of Rila Mts (Western Bulgaria) on the territory of Rila National Park. It was declared as such in 1985, with a total area of 2263.2 ha dominated by forests. Among them the coniferous forests prevail (75% of the whole area). Typical for the reserve are *Picea abies* (L.) Karst. forests, code 34G3 and *Pinus sylvestris* L. forests, code 35G3 (Natura 2000 habitats). The communities of *Fagus sylvatica* L. dominated in the broadleaf forests. Scrublands of *Pinus mugo* Turra cover large areas in the subalpine belt.

Most of the materials have been collected in the framework of the project for updating the Management Plan of the Rila National Park, conducted in 2015. During the field studies the transect methods were applied with main attention to the forest communities in the valley of the Kraina River and the coniferous bog woodlands in the locality *Shavaritoto Dere*. Most of the color photographs were taken in the field using Canon PS digital cameras. The threat status was determined following the Red List of fungi in Bulgaria (GYOSHEVA ET AL. 2006). Microscopic examinations of the lichen-forming fungi were done on the light microscope Boeco BM-180/T/SP LM. Cross-sections of thalli were prepared in tap-water, and lactophenol was added for better visualization of the asci and spores. Spot tests with C, K and Lugol's solution (after DOBSON 2011) were applied *ex situ*. The studied specimens of fungi (new for Bulgaria and those of conservation significance) are preserved in the Mycological Collection of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia (SOMF).

RESULTS AND DISCUSSION

Species diversity of macrofungi

Seventy-nine macrofungal species were recorded in the reserve with the greatest fungal diversity in the spruce and beech forests, and in peat habitats. The species found are enlisted alphabetically in phyla, subphyla, classes, orders and families.

In the list provided below, nine species belong to the division Ascomycota,

subdivision Pezizomycotyna (3 classes, 4 orders, 7 families, 8 genera), and 71 species belong to the division Basidiomycota, subdivision Agaricomycotina (2 classes, 11 orders, 32 families, 49 genera). Order Agaricales dominated by the number of taxa (37 species and 1 variety). The most abundant were the families Agaricaceae (9 species), Russulaceae (7 species), Amanitaceae (6 species), Cortinariaceae, Mycenaceae and Tricholomataceae (each with 5 species). The richest genera were *Amanita* Pers. and *Cortinarius* (Pers.) Gray (each with 5 species), followed by *Mycena* (Pers.) Roussel and *Russula* Pers. (each with 4 species). One species – *Russula sphagnophila* Kauffmann (**Plate I, Figs 1-2**) is a new macrofungus for Bulgarian mycota, and its brief description is provided below. Three rarely found species in Bulgaria: *Cortinarius coniferarum* (M. M. Moser) Moëgne-Locc. & Reumaux, *Gymnopus aquosus* (Bull.) Antonín & Noordel. and *Xylaria longipes* Nitschke were collected in the valley of the Kraina River in 2015.

PHYLUM ASCOMYCOTA

SUBPHYLLUM PEZIZOMYCOTINA

CLASS LEOTIOMYCETES

Order Helotiales

Family Chlorociboriaceae: *Chlorociboria aeruginascens* (Nyl.) Kanouse ex C. S. Ramamurthy, Korf & L. R. Batra

Family Cudoniaceae: *Cudonia circinans* (Pers. : Fr.) Fr.

Family Helotiaceae: *Bisporella citrina* (Batch : Fr.) Korf. & S. E. Carp., *Mitrula paludosa* Fr. : Fr.

CLASS PEZIZOMYCETES

Order Pezizales

Family Discinaceae: *Gyromitra esculenta* (Pers. : Fr.) Fr.

Family Helvellaceae: *Helvella lacunosa* Afzel. : Fr.

CLASS SORDARIOMYCETES

Order Xylariales

Family Hypoxylaceae: *Hypoxylon fuscum* (Pers. : Fr.) Fr.

Family Xylariaceae: *Xylaria hypoxylon* (L. : Fr.) Grev., *X. longipes* Nitschke (**Plate I, Fig. 3**)

PHYLUM BASIDIOMYCOTA

SUBPHYLLUM AGARICOMYCOTINA

CLASS AGARICOMYCETES

Order Agaricales

Family Agaricaceae: *Agaricus augustus* Fr., *A. silvaticus* Schaeff., *A. xanthodermus* Genev., *Chlorophyllum rhacodes* (Vittad.) Vellinga, *Cystoderma carcharias* (Pers.) Fayod, *Lycoperdon perlatum* Pers. : Pers., *L. excipuliforme* (Scop. : Pers.) Perdeck, *Apioperdon pyriforme* (Schaeff. : Pers.) Vizzini, *Macrolepiota procera* (Scop. : Fr.) Singer

Family Amanitaceae: *Amanita excelsa* (Fr.) Bertill., *A. muscaria* (L. : Fr.) Lam.,



Plate I, Figs. 1-4: **1** - *Russula sphagnophila* – basidioma (pileus); **2** - *Russula sphagnophila* – basidioma (stipe and gills); **3** - *Xylaria longipes*– ascomata; **4** - *Galerina paludosa* – basidiomata.

A. rubescens Pers. : Fr., *A. submembranacea* (Bon) Gröger, *A. vaginata* (Bull. : Fr.) Lam., *Limacellopsis guttata* (Pers. : Fr.) Zhu L. Yang, Q. Cai & Y. Y. Cui

Family Cortinariaceae: *Cortinarius bivelus* (Fr. : Fr.) Fr., *C. brunneus* (Pers. : Fr.) Fr., *C. coniferarum* (M. M. Moser) Moënne-Loec. & Reumaux, *C. multiformis* (Fr.) Fr., *C. sanguineus* (Wulfen. : Fr.) Gray

Family Entolomataceae: *Entoloma vernalis* S. Lundell

Family Hydnangiaceae: *Laccaria amethystina* Cooke

Family Hygrophoraceae: *Hygrophorus piceae* Kühner

Family Marasmiaceae: *Mycetinis alliaceus* (Jacq. : Fr.) Earle ex A. W. Wilson & Desjardin

Family Mycenaceae: *Hemimycena lactea* (Pers. : Fr.) Singer, *Mycena epipterygia* (Scop. : Fr.) Gray, *M. pura* (Pers. : Fr.) P. Kumm., *Xeromphalina campanella* (Batsch : Fr.) Künner & Maire

Family Omphalotaceae: *Gymnopus androsaceus* (L.) Della Magg. & Trassin, *G. aquosus* (Bull. : Fr.) Antonín & Noordel., *Rhodocollybia butyracea* (Bull.

: Fr.) Lennox

Family Physalacriaceae: *Armillaria mellea* (Vahl. : Fr.) P. Kumm.

Family Hymenogastraceae: *Galerina paludosa* (Fr.) Kühner (**Plate I, Fig. 4**),
Hypholoma capnoides (Fr. : Fr.) P. Kumm.

Family Tricholomataceae: *Clitocybe ditopa* (Fr.) Gillet, *C. gibba* (Pers. : Fr.) P. Kumm., *C. odora* (Bull. : Fr.) P. Kumm., *Tricholoma saponaceum* (Fr. : Fr.) P. Kumm., *T. vaccinum* (Schaeff. : Fr.) P. Kumm.

Order Auriculariales

Family Auriculariaceae: *Exidia glandulosa* (Bull. : Fr.) Fr.

Order Boletales

Family Boletaceae: *Boletus edulis* Bull. : Fr., *Chalciporus piperatus* (Bull. : Fr.) Bataille, *Xerocomus subtomentosus* (L. : Fr.) Quél.

Family Gomphidiaceae: *Chroogomphus helveticus* (Singer) M. M. Moser, *C. rutilus* (Schaeff. : Fr.) O. K. Mill., *Gomphidius glutinosus* (Schaeff. : Fr.) Fr.

Family Suillaceae: *Suillus luteus* (L. : Fr.) Roussel

Order Cantharellales

Family Cantharellaceae: *Cantharellus cibarius* Fr. : Fr.

Family Hydniaceae: *Hydnum repandum* L. : Fr.

Order Gloeophyllales

Family Gloeophyllaceae: *Gloeophyllum abietinum* (Bull. : Fr.) P. Karst.

Order Gomphales

Family Gomphaceae: *Ramaria aurea* (Schaeff. : Fr.) Quél., *R. formosa* (Pers. : Fr.) Quél.

Order Hymenochaetales

Family Hymenochaetaceae: *Coltricia perennis* (L. : Fr.) Murrill

Family Repetobasidiaceae: *Rickenella fibula* (Bull. : Fr.) Raithelh.

Order Polyporales

Family Fomitopsisaceae: *Fomitopsis pinicola* (Sw. : Fr.) P. Karst.

Family Ganodermataceae: *Ganoderma applanatum* (Pers.) Pat.

Family Polyporaceae: *Polyporus leptcephalus* (Jacq. : Fr.) Fr., *Trametes hirsuta* (Wulfen : Fr.) Lloyd, *Trichaptum abietinum* (Pers. ex J. F. Gmel.) Ryvarden

Order Russulales

Family Albatrellaceae: *Albatrellus ovinus* (Schaeff. : Fr.) Kotl. & Pouzar

Family Bondarzewiaceae: *Heterobasidion annosum* (Fr. : Fr.) Bref.

Family Peniophoraceae: *Peniophora pini* (Schleich. ex DC.) Boidin

Family Russulaceae: *Lactarius badiosanguineus* Kühner & Romagn., *L. scrobiculatus* (Scop.) Fr., *L. sphagnetii* (Fr.) Neuhoff, *Russula delica* Fr., *R. densifolia* Secr. ex Gillet, *R. queletii* Fr., **R. sphagnophila* Kauffmann (**Plate I, Figs. 1-2**)

Order Thelephorales

Family Bankeraceae: *Sarcodon imbricatus* (L. : Fr.) P. Karst.

Family Thelephoraceae: *Thelephora palmata* (Scop.) Fr.

Class Dacrymycetes

Order Dacrymycetales

Family Dacrymycetaceae: *Calocera viscosa* (Pers. : Fr.) Fr

Description of the species, new for the Bulgarian mycota

Russula sphagnophila Kauffmann, Report Mich. Acad. Sci 11: 86 (1909) (**Plate I, Figs 1-2**).

Pileus was up to 4 cm in diameter, initially convex to plane, depressed in the center, pale-pinkish, pink-violaceous to ochraceous-pink, darker in the center, viscid, margin furrowed striate. Gills were distant, loosely attached to almost free, white to cream in colour. Stipe was to 4 cm long and 1 cm thick, cylindrical to slightly clavate, smooth, white, fragile. Context was whitish, very fragile. Smell was slightly fruity. Basidia were clavate, 4-spored. Basidiospores were 7.5-10×6-8.5 µm, broadly-ellipsoidal, ornamented, consisting of warts, which formed in places a partial reticulum. Cheilocystidia were fusiform. Pileipellis was with cylindrical to clavate, septate (one or two septa) pileocystidia.

Habitat: In peaty habitats and in moist spruce forests in mountains, among *Sphagnum* spp., solitary or in groups, summer to autumn. Mycorrhizal fungus, associated with birch and spruce (COURTECUISE & DUHEM 1995; KRIEGLSTEINER 2000; KRÄNZLIN 2005).

The examined specimen was found in the locality *Shavaritoto Dere*, in a bog coniferous forest (*P. abies* and *P. sylvestris*), solitary among peat mosses, at ca. 1652 m a.s.l., on 08.06.2015, leg. & det. M. GYOSHEVA (SOMF 30028).

Species of conservation importance

Four macrofungi with high conservation value, included in the Red List of fungi in Bulgaria have been recorded in Ibur Reserve so far: *Mitrula paludosa* Fr. – Critically Endangered (CR), *Galerina paludosa* (Fr.) Kühner – Endangered (EN), *Limacellopsis guttata* (Pers.) Zhu L. Yang, Q. Cai & Y. Y. Cui – Vulnerable (VU), and *Lactarius sphagneti* (Fr.) Neuhoff – Data Deficient (DD). *M. paludosa* and *G. paludosa* are included also in the Red Data Book of the Republic of Bulgaria (PEEV ET AL. 2015). All species were recorded in peat habitats on the territory of the reserve. Macrofungi with conservation value were found in other localities on the territory of Rila National Park as well, by the authors (GYOSHEVA ET AL. 2017).

Species diversity of lichen-forming fungi

Forty-three species of lichen-forming fungi were collected from the reserve area during field trips in the vicinity of the stream *Shavaritoto Dere* and close to the *Kraina River*, performed in June 2015. They belong to the division Ascomycota, subdivision Pezizomycotina, 3 classes (Arthoniomycetes, Coniocybomycetes and Lecanoromycetes), 4 subclasses, 10 orders, 20 families and 29 genera and are enlisted below in alphabetical order.

PHYLUM ASCOMYCOTA

SUBPHYLUM PEZIZOMYCOTINA

CLASS ARTHONIOMYCETES

SUBCLASS ARTHONIOMYCETIDAE

Order Arthoniales

Family Arthoniaceae: *Arthonia radiata* (Pers.) Ach. (**Plate II, Fig. 1**)

Family Chrysotrichaceae: *Chrysothrix chlorina* (L.) J. R. Laundon

Family Roccellaceae: *Alyxoria varia* (Pers.) Ertz & Tehler, s.l. (after ERTZ & TEHLER 2011). Note: Thallus growing on bark of old spruce, not surrounded by black prothallus. Species with positive reaction of the hymenium in Melcer's reagent. Asci are about $37\text{--}40 \times 16\text{--}18.5\ \mu\text{m}$, with 4-celled hyaline spores: $(17.5\text{--})\ 20\text{--}22.5 \times 5\text{--}7\text{--}(7.5)\ \mu\text{m}$, with second cell widened. (**Plate II, Fig. 2**)

CLASS CONIACYBOMYCETES

Order Coniocybales

Family Coniocybaceae: *Chaenotheca chrysocephala* (Turner ex Ach.) Th. Fr.

CLASS LECANOROMYCETES

Subclass Lecanoromycetidae

Order Candelariales

Family: Candelariaceae: *Candelariella aurella* (Hoffm.) Zahlbr., *C. vitellina* (Hoffm.) Müll. Arg.

Order Lecanorales

Family Cladoniaceae: *Cladonia coccifera* (L.) Willd., *C. coniocraea* (Flörke) Spreng., *C. fimbriata* (L.) Fr., *C. macilenta* Hoffm., s.l.

Family Lecanoraceae: *Lecanora albella* (Pers.) Ach., *Lecidella elaeochroma* (Ach.) M. Choisy

Family Parmeliaceae: *Bryoria capillaris* (Ach.) Brodo & D. Hawksw., s.l., *B. fuscescens* (Gyeln.) Brodo & D. Hawksw., *Evernia divaricata* (L.) Ach., *E. prunastri* (L.) Ach., *Hypogymnia physodes* (L.) Nyl., *H. tubulosa* (L.) Hue, *Parmelia saxatilis* (L.) Ach., *P. sulcata* Taylor, *Pseudevernia furfuracea* (L.) Zopf, *Melanohalea elegantula* (Zahlbr.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch, *Nephromopsis chlorophylla* (Willd.) Divakar, A. Crespo & Lumbsch (after DIVAKAR ET AL. 2017; **Plate II, Fig. 3**), *Usnea florida* (L.) F.H. Wigg. emend. Clerc, s.l., *Vulpicida pinastri* (Scop.) J.-Mattson & M.J. Lai, *Xanthoparmelia pulla* (Ach.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch

Family Ramalinaceae: *Ramalina farinacea* (L.) Ach.

Family Stereocaulaceae: *Lepraria incana* (L.) Ach., s.l.

Order Lecideales

Family Lecideaceae: *Porpidia macrocarpa* (DC.) Hertel & A. J. Schwab

Order Peltigerales

Family Lobariaceae: *Lobaria pulmonaria* (L.) Hoffm.

Family Peltigeraceae: *Peltigera aphthosa* (L.) Willd., *P. canina* (L.) Willd.

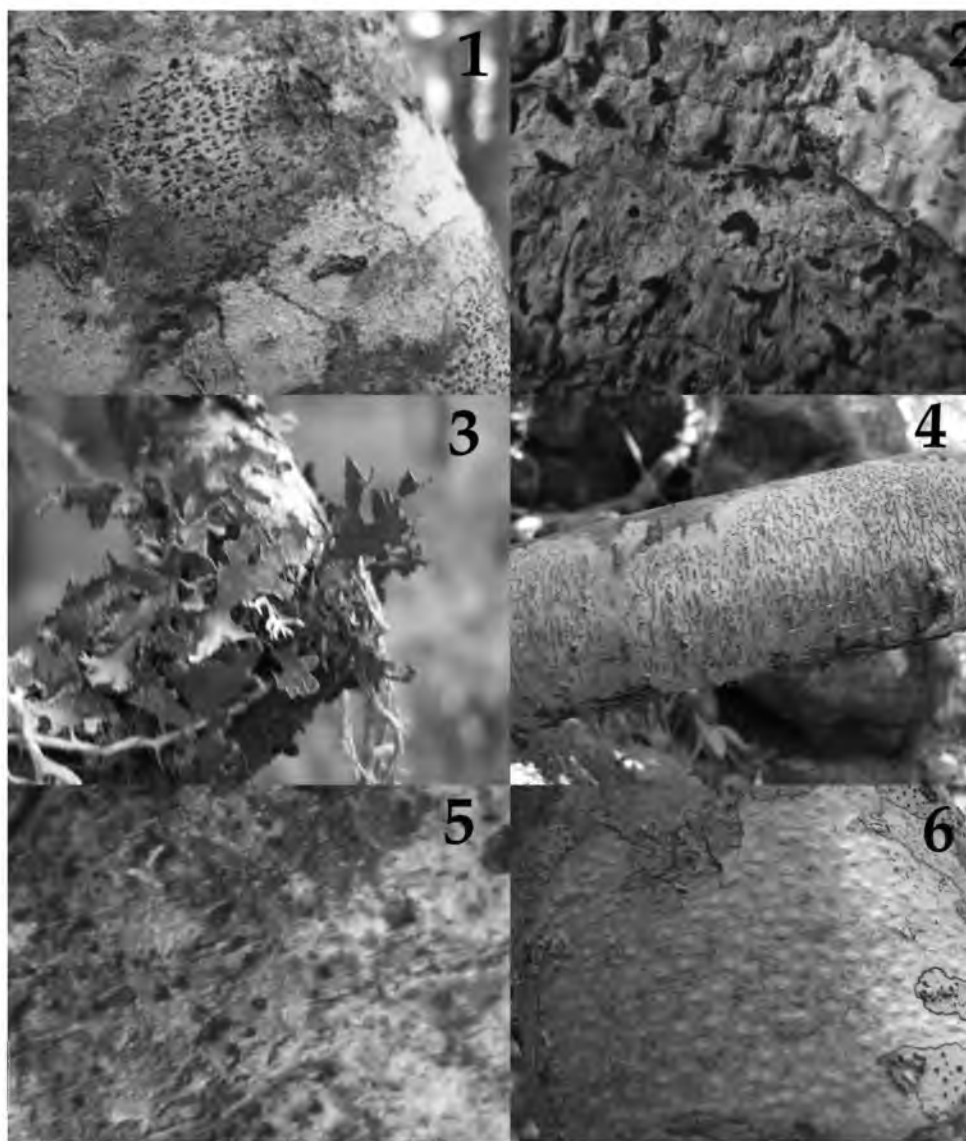


Plate II, Figs. 1-6: 1 - *Arthonia radiata* – thalli; 2 - *Alyxoria varia*, s.l. – thallus, *ex situ*; 3 - *Nephromopsis chlorophylla* – thallus, along with *Parmelia sulcata* and *Evernia divaricata*; 4 - *Graphis scripta* – thallus; 5 - *Pseudosagedia aenea* – thalli, *ex situ*; 6 - *Pertusaria leioplaca* – thallus.

Order Rhizocarpales

Family Rhizocarpaceae: *Rhizocarpon geographicum* (L.) DC., *R. hochstetteri* (Körb.) Vain.

SUBCLASS OSTROPOMYCETIDAE

Order Ostropales

Family Graphidaceae: *Graphis scripta* (L.) Ach. (Plate II, Fig. 4)

Family Phlyctidaceae: *Phlyctis argena* (Spreng.) Flot. s.l.

Family Porinaceae: *Pseudosagedia aenea* (Wallr.) Hafellner & Kalb. Note: Thallus thin, smooth, green-brown, without prothallus, on bark of beech. Perithecia black, up to 200 µm diam. Ascospores hyaline, 3-septate, mostly 11-13.5(-15) × 3.5-4 µm. (Plate II, Fig. 5)

Order Pertusariales

Family Ochrolechiaceae: *Ochrolechia alboflavescens* (Wulfen) Zahlbr., *O. parella* (L.) A. Massal.

Family Pertusariaceae: *Pertusaria lactea* (L.) Arnold, *P. leioplaca* DC. (Plate II, Fig. 6)

SUBCLASS UMBILICARIOMYCETIDAE

Order Umbilicariales

Family Umbilicariaceae: *Umbilicaria cylindrica* (L.) Delise ex Duby, *U. deusta* (L.) Baumg.

The richest order was Lecanorales (5 families, 15 genera, 22 species), with most species belonging to the families Parmeliaceae (10 genera, 14 species) and Cladoniaceae (1 genus, 4 species). *Pseudosagedia aenea* (Wallr.) Hafellner & Kalb. (Porinaceae), *Alyxoria varia* (Pers.) Ertz & Tehler, s.l. (Rocellaceae) and *Phlyctis argena* (Spreng.) Flot., s.l. (Phlyctidaceae) are new records for Rila Mts.

The lung lichen, *Lobaria pulmonaria* (L.) Hoffm. was found by STOYKOV (2018) on a bark of maple along the Kraina River. *Arthonia radiata* (Pers.) Ach., *Graphis scripta* (L.) Ach., *Pertusaria leioplaca* DC., *Phlyctis argena* (Spreng.) Flot., s.l. and *Pseudosagedia aenea* were recorded on twigs or trunks of smooth-bark trees in the region of the Kraina River. *P. aenea*, along with *Lecidella elaeochroma* (Ach.) M. Choisy, grows on bark of old *Fagus sylvatica*.

Graphis scripta, recorded during this study on the twigs of *Corylus avellana* L. near the Kraina River, is known as an important component of epiphytic climax lichen communities and as a typical inhabitant of old beech forests (RAVERA ET AL. 2010). From Bulgaria it was known in Belasitsa Mts (STOYKOV 2014), while in the Eastern Forebalkan (Northern Bulgaria), *G. scripta* occurred on the bark of beeches, with *Acrocordia gemmata* (Ach.) A. Massal (STOYKOV, unpubl.). *Phlyctis argena* found during this study, was recorded earlier (2013) on the bark of an old maple tree in Central Stara Planina Mts (Nature Park *Balgarka*, above the hut *Bulgarka*, STOYKOV, unpubl.).

The powdered ruffle lichen *Nephromopsis chlorophylla* (Willd.) Divakar, A. Crespo & Lumbsch is an epiphyte, known as an old-growth forest indicator (ELLIS ET AL. 2015). It was reported as a lichen of conservation value in the North European countries - Scotland (GRAHAM 2012), Poland (CZARNOTA 2012). In Central Europe (Czech Republic, Hungary and Slovakia) it is considered as infrequent and

rare species from old oak forests, with occurrence in the studied areas below 20% (SVOBODA ET AL. 2011). During this study, *N. chlorophylla* was recorded only once on a twig of old spruce only in the locality *Shavaritoto Dere*.

CONCLUSION

The data presented in the paper, show that the Reserve Ibur contains rich species diversity of ascomycetous and basidiomycetous macrofungi, and lichen-forming fungi, some of which are of conservational importance or are good ecological indicators. Therefore, it is necessary to ensure regular systematic studies, including monitoring and mapping, especially of the conservationally significant fungi.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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