

Distribution Maps of Critical Endangered Species from Macedonian Red List of Fungi

MITKO KARADELEV*¹ & KATERINA RUSEVSKA¹

¹*Institute of Biology, Faculty of Natural Sciences and Mathematics, University “Ss. Cyril and Methodius”, Arhimedova 5, 1000 Skopje, Republic of Macedonia*

**Corresponding author: Mitko Karadelev; Email: mitkok@pmf.ukim.mk*

Abstract

Macedonian Red list of fungi includes 213 species of Ascomycota and Basidiomycota following the strict IUCN Red List criteria to set categories. From 213 listed fungal species 21 are Critically Endangered species (CR), 30 Endangered (EN) species and 71 Vulnerable (VU) species. Critically endangered species require special attention to ensure their survival, thus we provide in the paper the most important information on localities with distribution maps, habitats and hosts of the CE species recorded up to date in Macedonia.

Key words: Macedonia, Fungi Red List, critical endangered species, mapping.

INTRODUCTION

Fungi are a large and an ecologically diverse group of organisms. Fungi are present worldwide, yet there are species that are mainly threatened with disappearance due to degradation or changes of habitat, however there are also other important threats such as pollution, climate change and excessive gathering of fruiting bodies of edible species. The preparation of a Red List of Macedonian Fungi is an essential step in their conservation. The Preliminary Red List of macromycetes in the Republic of Macedonia (KARADELEV 2000) included 67 species, all belonging to the class Basidiomycetes. Since then, the Macedonian mycobiota started to be widely investigated and many collections were mapped and deposited in the Macedonian collection of Fungi (MCF). This data enabled preparation of a contemporary Red List of Macedonian Fungi, where the IUCN Red List categories were used (IUCN 2001, 2003a, b). The Macedonian Red List of Fungi has a total of 213 species, both ascomycetes and basidiomycetes, as follows: 21 Critically Endangered (CR), 30 Endangered (EN), 71 Vulnerable (VU), 40 Near Threatened (NT), 9 Least

Concern (LC) and 42 Data Deficient (DD) (KARADELEV & RUSEVSKA 2013).

MATERIALS AND METHODS

Data sources used are as follows: exsiccates and notes from own studies, Macedonian collection of Fungi (MCF), data base (MAK FUNGI), as well as specimens from other collectors. This paper includes the data published or collected up till May 2016. The identification of the species has been carried out using JÜLICH (1984), BREITENBACH & KRANZLIN (1986, 1991), RYVARDEN (1991), RYVARDEN & GILBERTSON (1993, 1994), CALONGE (1998), HORAK (2005) and KNUDSEN & VESTERHOLT (2012). The species names follow Index Fungorum (KIRK, 2016) and MycoBank (STALPERS & COCK, 2016). The species are reported in alphabetical order. Data pertaining to previous publications, geographical distribution, altitude, forest association, and data source are provided under each fungal species. The species distribution map was generated in ArcGIS 10.1 based on Digital Elevation Model (ASTERGDEM) (<http://asterweb.jpl.nasa.gov/gdem.asp>, 09. 2012).

RESULTS

A list of critical endangered species with important data (localities, associations and/or substrates) and distribution maps are presented.

1. *Antrodia gossypium* (Speg.) Ryvarden (Fig. 1)
Krushevo, pine plantation, on log of *Pinus nigra*.
2. *Antrodia juniperina* (Murrill) Niemelä & Ryvarden
Galichica Mountain, Mariovo, Golem Grad Island (Prespa Lake), and vicinities of Demir Kapija, Valandovo and Kozhle village, *Juniperus excelsa* forest, on dry branches of living trees of *J. excelsa*.
3. *Antrodia variiformis* (Peck) Donk
Korab, beech-fir forest, log of *Abies*.
4. *Antrodiella citrinella* Niemelä & Ryvarden [syn. *Flaviporus citrinellus* (Niemelä & Ryvarden) Ginns]
Mavrovo, beech-fir forest, on *Abies*; Skopje, pine plantations, log of *Pinus nigra*.
5. *Battarrea phalloides* (Dicks.) Pers.
Golem Grad Island (Prespa Lake), *Juniperus excelsa* forest, on soil; monastery St. Jovan Bigorski monastery (vicinity), *Carpinus betulus* forest, on soil (extinct); shore of Dojran Lake, on soil under *Salix alba* (extinct).
6. *Cotylidia diaphana* (Schwein.) Lentz
Monospitovsko Blato, *Osmunda regalis* stands, on soil.
7. *Dendrocollybia racemosa* (Pers.) R.H. Petersen & Redhead
Pelister, *Gentiano luteae*-Pinetum peuces abietetosum.
8. *Discina parma* J. Breitenb. & Maas Geest.

Kitka, beech forest, rotten wood of *Fagus*; Shar Planina, pasture, on soil, wet place; Dobra Voda, azonal vegetation with *Populus tremula*, soil, under poplar.

9. *Disciseda bovista* (Klotzsch) P. Henn
Krupishte village, *Populus tremula* forest, on soil; Kozhle village, *Juniperus excelsa* forest, on soil.
10. *Disciseda candida* (Schwein.) Lloyd
Vicinity of Gevgelija (Gjavato vill. and Gorni Bolovan), kermes oak forest, on soil.
11. *Erastia salmonicolor* (Berk. & M.A. Curtis) Niemelä & Kinnunen
Pelister, molika pine forest, on fallen trunk of *Pinus peuce*.
12. *Galerina jaapii* A.H. Sm. & Singer
Shar Planina, peat bog, on wet place, among Sphagnum.
13. *Galerina sphagnum* (Pers.) Kühner
Shar Planina, peat bog, on wet place, among Sphagnum.
14. *Galerina tibiucystis* (G.F. Atk.) Kühne
Shar Planina, peat bog, on wet place, among Sphagnum.
15. *Inocutis tamaricis* (Pat.) Fiasson & Niemelä
Vicinity of Demir Kapija and Gevgelija, tamarisk shrubland, on stumps and living tree of *Tamarix* sp.
16. *Lactarius omphaliiformis* Romagn.
Koleshino village, *Osmunda regalis* stand, soil.
17. *Lenzitopsis oxycedri* Malençon & Bertault
Galichica, at the base of branches of living *Juniperus foetidissima*.
18. *Mycena juniperina* Aronsen

Chalakli village in Greek juniper forest; Jasen reserve in pine-oak forest, on *Juniperus excelsa* (bark of living tree)

19. *Poronia punctata* (L.) Fr.

Skopska Crna Gora Mountain, Vodno, Jakupica, Bistra, and vicinities of Kumanovo, Demir Kapija and Stojakovo village; on dung.

20. *Pyrofomes demidoffii* (Lév.) Kotl. & Pouzar

Vicinities of Demir Kapija, Katlanovo, villages Kozhle, Udovo, Chalakli and mountains Galichica and Kozhuf, Greek juniper forest; on living tree of *Juniperus excelsa*.

21. *Xeromphalina junipericola* G. Moreno & Heykoop

Chalakli village, Greek juniper forest, *Juniperus excelsa*, stump.

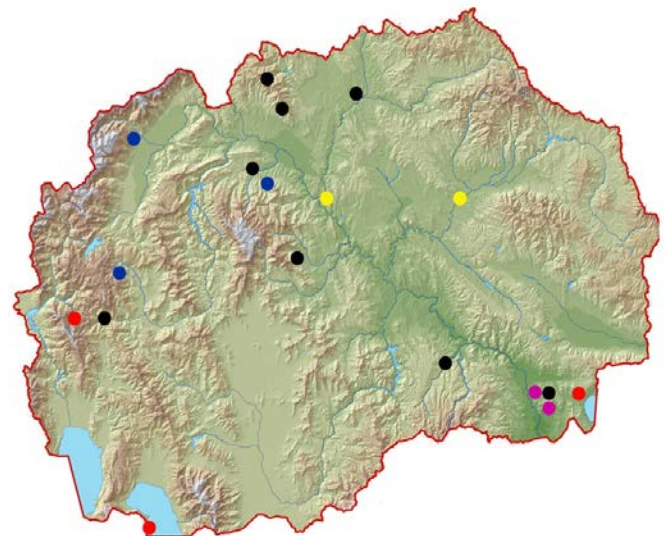


Fig. 2. Distribution map of the CR species *Battarrea phalloides* (●), *Discina parma* (●), *Disciseda bovista* (●), *D. candida* (●) and *Poronia punctata* (●) in Macedonia.

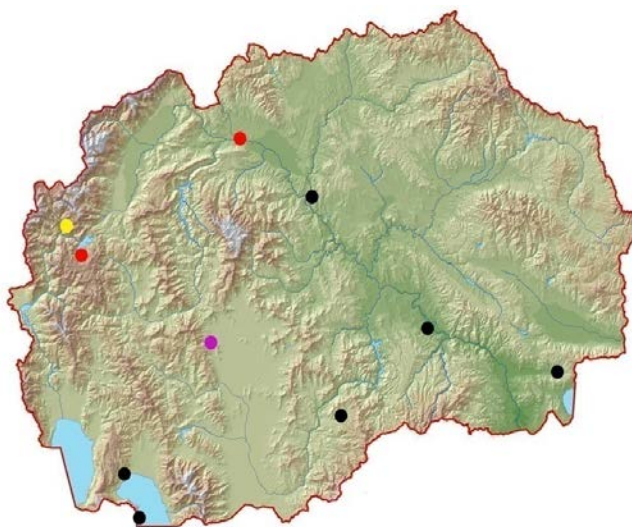


Fig. 1. Distribution map of the CR species *Antrodiagossypium* (●), *A. variiformis* (●), *A. juniperina* (●) and *Antrodiellacitrinella* (●) in Macedonia.

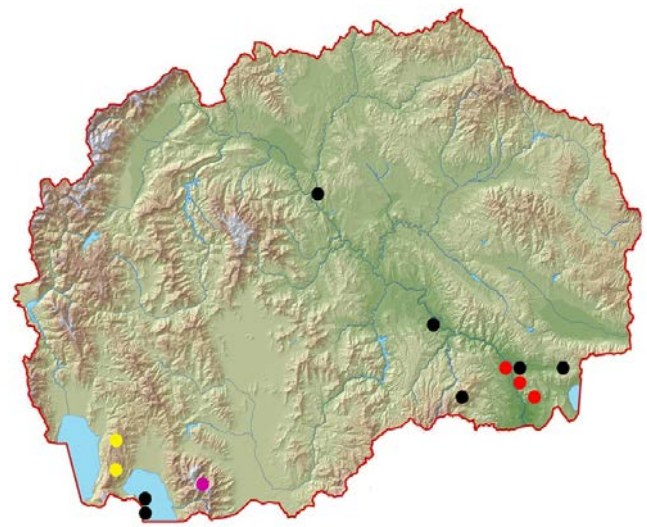


Fig. 3. Distribution map of the CR species: *Erastia salmonicolor* (●), *Inonotus tamaricis* (●), *Lenzitopsis oxycedri* (●) and *Pyrofomes demidoffii* (●) in Macedonia.

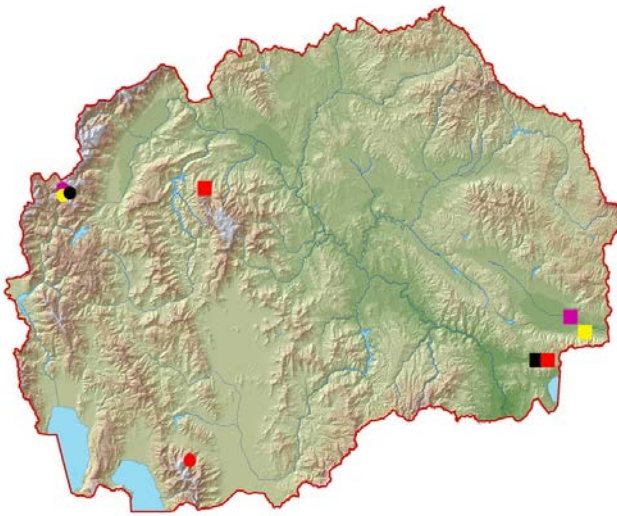


Fig. 4. Distribution map of the CR species: *Cotylidia diaphana* (■), *Dendrocollybia racemosa* (●), *Galerina jaapi* (●), *G. sphagnorum* (●), *G. tibiicystis* (●), *Lactarius omphaliformis* (■), *Mycena juniperina* (■) and *Xeromphalina junipericola* (■) in Macedonia.

DISCUSSION

Currently a total of 21 fungal species were determined as critically endangered (CR) species and are part of the Macedonian Red List of Fungi. Only two species (*Discina parva* and *Poronia punctata*) belong to the phylum Ascomycota, while the majority (19) belong to the phylum Basidiomycota, where three of them are gasteroid fungi (*Battarrea phalloides*, *Disciseda Bovista* and *D. candida*). Almost half of the species (10) are lignicolous, while the rest are terricolous, bryocolous (*Galerina* spp.) or coprophilous (*Poronia punctata*).

The following ten species: *Antrodia gossypium*, *A. variiformis*, *Erastia salmonicolor*, *Cotylidia diaphana*, *Dendrocollybia racemosa*, *Galerina jaapi*, *G. sphagnorum*, *G. tibiicystis*, *Lactarius omphaliformis* and *Xeromphalina junipericola* are known only from single localities. Concerning the hosts and habitats it is important to underline that the species (1) *Pyrofomes demidoffii*, *Antrodia juniperina*, *Mycena juniperina* and *Xeromphalina junipericola* are found in juniper forests, as saprobes or parasites on *Juniperus excelsa*; (2)

Lenzitopsis oxycedri is collected only on *Juniperus foetidissima*; (3) *Inocutis tamaricis* as a parasite on living *Tamarix* spp.; (4) *Erastia salmonicolor* a saprobe of *Pinus peuce*; (5) *Antrodia gossypium* is collected on black pine; (6) *A. variiformis* on fir; (7) *Antrodiella citrinella* is found on black pine and fir; (8) *Dendrocollybia racemosa* is collected only in molika pine forest (*Pinus peuce*); (9) bryocolous species (*Galerina jaapi*, *G. sphagnorum* and *G. tibiicystis*) are found in peat bog, among *Sphagnum* spp.; (10) while the species *Cotylidia diaphana* and *Lactarius omphaliiformis* are recorded also from wet places but in other localities with *Osmunda regalis* stands. In the past the gasteroid fungus *Battarrea phalloides*, was known from three localities in Macedonia. The data from the area of St. Jovan Bigorski monastery, in river Radika valley, a hornbeam forest, at 700 meters altitude, from 1924 (Lindtner 1931-1932); and the vicinity of Dojran Lake have not been confirmed. The only existing locality is the island Golem Grad on Prespa Lake, where it is found in *Juniperus excelsa* forest. This small island (20 ha) has maybe the biggest population in Europe with more than 60 fruiting bodies.

Some of the species, such as: *Battarrea phalloides*, *Lenzitopsis oxycedri* and *Pyrofomes demidoffii* as very rare species in Europe are suggested to be assessed for inclusion on a global red list, they are under process of evaluation to be IUCN categorized. The site of Golem Grad, also known as Snake Island, as a single locality of *B. phalloides*, should be protected. The associations of *Junierus excellsa* and *J. foetidissima*, as one of the southernmost distributed juniper forests in Europe with high level of richness of host specific species. This forest represents habitats which should have strict protection in the near future.

REFERENCES

- BREITENBACH, J., KRÄNZLIN, F. (1986): Fungi of Switzerland Vol. 2. Non gilled fungi. Heterobasidiomycetes (jelly fungi), Aphyllophorales

- (non-gilled fungi), Gasteromycetes (puffballs). Lucerne: Verlag Mycologia.
- BREITENBACH, J., KRANZLIN, F. (1991): Fungi of Switzerland. Volume 3. Edition Mycologia, Switzerland.
- CALONGE, F. D. (1998): Gasteromycetes, I. Lycoperdales, Nidulariales, Phallales, Sclerodermatales, Tulostomatales. Flora Mycologica Iberica. Vol. 3. Madrid, Spain, and Berlin, German: Real Jardin Botanico & J. Cramer.
- HORAK, E. (2005): Röhrlinge und Blätterpilze in Europa. Kleine Kryptogamenflora, Band 2. Teil b2. Ed. 2. Spektrum Akad. Verlag, München.
- IUCN (2001): IUCN Red List categories and criteria: Version 3.1. IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN (2003a): Guidelines for application of IUCN Red List categories at regional levels: Version 3.0. IUCN species survival Commission, IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN (2003b): Guidelines for using the IUCN Red List categories and criteria. Standards and Petitions Subcommittee of the IUCN SSC Red List Programme Committee, IUCN, Gland, Switzerland and Cambridge, UK.
- JÜLICH, W. (1984): Die Nichtblaterpilze, Gallertpilze und Bauchpilze. Kleine Kryptogamenflora Bd.II, b/1. Stuttgart.
- KARADELEV, M. (2000): A preliminary red list of macromycetes in the Republic of Macedonia. European Council of Conservation of Fungi. Newsletter 10: 7-11.
- KARADELEV, M., RUSEVSKA K. (2013): Contribution to Macedonian Red List of fungi. Proceedings of the 4th Congress of Ecologists of Macedonia with International Participation, Ohrid, 12-15 October 2012. Macedonian Ecological Society, Special issue 28: 68-73. Skopje.
- KIRK, P. (2013): Onward (Continuously updated). Index Fungorum. Website: <http://www.indexfungorum.org> [accessed 25.05.2016].
- KNUDSEN, H., VESTERHOLT, J. (2012): Funga Nordica (agaricoid, boletoid, clavarioid, cyphelloid and gastroid genera). Nordsvamp, Copenhagen.
- LINDTNER, V. (1931–1932): *Battarrea phalloides* (Dicks.) Pers. aus Südserbien. Extrait du Bulletin de l'Institut et du Jardin Botaniques de l'Université de Beograd, 2 (1/2): 104-105.
- RYVARDEN, L. (1991): Genera of Polypores. Nomenclature and Taxonomy (Synopsis Fungorum Series, No. 5). Fungiflora, Oslo.
- RYVARDEN, L., GILBERTSON, R. L. (1993): European polypores, Part 1. Synopsis fungorum 6. Fungiflora – Oslo – Norway.
- RYVARDEN, L., GILBERTSON, R. L. (1994): European polypores, Part 2. Synopsis fungorum 7. Fungiflora – Oslo – Norway.
- STALPERS J, COCK, A. (2013): Onward (Continuously updated). MycoBank. Website <http://www.mycobank.org> [accessed 25.05.2016].