OVERVIEW OF FUNGI SPECIES IN PRESPA NATIONAL PARK (ALBANIA)

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ABSTRACT

This paper includes a list – a preliminary inventory of macromycete species in NP Prespa. The source of these data is exclusively based on our own field studies performed in October 2012. Fungi play a critical role in National Park. They are key in recycling dead vegetation and making the nutrients available for the next generation of plant life. They act also as plant pathogens and they form symbioses with the vast majority of herbaceous and woody plants, allowing them to colonize poor soils and pull otherwise unavailable nutrients from the soil.

There are very few published data on fungi in Albania. Area of National Park Prespa was never studied from the mycological standpoint and there are no previously published data on fungi from this area. Our field studies have included sites with representative vegetation, represented by meadows and pastures, forests of oak belt, forests of beech belt and specific forest stands with three species of junipers.

Valuable results were obtained within a short period of time, a large number of specimens were collected and it was possible to assess habitat quality with high level of precision. The 174 listed species-level taxa of fungi were recorded. Although it is still not possible to determine with precision the final number of species recorded for the first time at territory of Albania, it seems that it is the case with most species recorded at the territory of National Park during our research.

Key words: Fungi inventory, Prespa NP, Albania

INTRODUCTION

During the studies of fungi in the National Park Prespa (Albania) most of the studied species belonged to macromycetes or macro-fungi. It is an artificially formed but practical group that includes species not strictly by their phylogenetical position but by size of their sporocarp, which in this group is visible with naked eye, 2 mm or larger. Species with smaller sporocarps or completely lacking them are grouped into “micro-fungi” and only a few species were included in our preliminary inventory list. The macromycetes are generally the species most commonly considered under the term fungi, including mushrooms and toadstools, bracket fungi and other fungi with the greatest importance in context of conservation of biodiversity, natural habitats and nature in general.

There are very few published data on fungi in Albania, and for the area of National Park Prespa in Albania there are no published data on fungi. The only data that could be obtained pertain to commercial collecting of mushrooms, as trade in mushrooms has been organized for the last three years. By this way the following species were identified: *Amanita caesarea*, *Boletus aereus*, *Boletus reticulatus* and *Cantharellus cibarius*. The area of vicinity of Prespa Lake and part of Mt. Galičica that is situated in Macedonia were much better studied over the course of several years by a number of researchers, and there are published data (Ivančević & Karadelev 2009). The list in 2009 for that area consists of 364 species of macromycetes, including 41 species known for Macedonia only from this area. Until today some 35 new species are recorded there. These two localities are in vicinity of each other, both are protected and bearing a status of national parks. However the forest vegetation at the Macedonian side is much better preserved so comparison cannot be completely straightforward and any unconditional approximations are impossible.

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MATERIAL AND METHODS

Material collected during these studies was mostly preserved and stored in the mycological collection of Natural History Museum in Belgrade (BEO) and in the Macedonian Collection of Fungi (MCF) within the Mycological

Laboratory of Institute of Biology, Faculty of Natural Sciences, Skopje. Part of collected material was photographed with digital camera, macro and micro images.

Determination of species was performed both immediately in the field and in the Mycological Laboratory at the Institute of Biology, Faculty of Natural Science, Skopje and laboratory of Natural History Museum in Belgrade, using light microscopes, differential and other types of reagents (Melzer's reagent, KOH, sulphovaniline etc.). Certain species were identified in fresh state (*Agaricales*, *Boletales*, *Cortinariales*, *Russulales*, etc.), while others were preserved and later processed and studied (*Polyporales*). Identification of collected macromycetes was performed with help of following key guides and monographs: Ahti *et al*. (2000), Allesio (1985), Basso (1999), Breitenbach & Kränzlin (1981, 1986, 1991, 1995, 2000), Boertmann *et al*. (1992), Corfixen *et al*. (1997), Hansen & Knudsen (1992), Horak (2005), Krieglsteiner (2000), Moser (1983), Pegler, Spooner & Young (1993) etc. The nomenclature of species' names and synonyms follows Index Fungorum 2012.

The field studies have included sites with representative vegetation, represented by meadows and pastures, forests of oak belt, forests of beech belt and specific forest stands with three species of junipers. Due to dynamics and available time for field work, which was greatly influenced by extremely dry weather throughout the year, the individual sites estimated to be representative were sampled, while extensive studies of large areas and a large number of localities were not performed, as conditions were not suitable. The geological substrate in most of the investigated area is composed of limestone rocks, but there are also "islands", areas with substrate of silicate rocks. As silicate substrate is better in preventing water from sinking underground and therefore such places retain higher humidity, that caused appearance of a greater number of fungi. Therefore sites with fragments of silicate rocky substrate were purposefully chosen for research on fungi.

The first investigated area is situated toward southeast from Gorna Gorica, locality Rezervat, where vegetation is represented by oak forests composed of Hungarian Oak and Turkey Oak (*Quercetum frainetto-cerris*). Within this phytocenosis the locality also includes smaller areas with planted trees of pine (*Pinus nigra*), fir (*Abies alba*) and chestnut (*Castanea sativa*). These artificial stands have contributed to diversity of fungia in the area. The forest at the locality is mostly degraded as in the past it was intensively exploited. The stands are below 20 years of age, growing at the soil with silicate substrate. There is a noticeable impact of human activity and livestock. There is a lot of discarded plastic packaging, cut trees and even trees dug from the ground for their roots, as well as a large amount of livestock excrement, primarily from cattle, representing an additional habitat for fungi species developing in that specific substrate. This area also includes spacious meadows used for grazing flocks of sheep. These habitats have a completely different character from the forest habitats, leading to discovery of several specific meadow species and species preferring natural pastures.

The second investigated area is situated toward west and southwest from Gorna Gorica, around the locality Volča Jama. This site is also situated on silicate geological substrate, causing an increased humidity of soil, especially in places where this effect is accentuated by characteristics of microrelief such as various ravines. This area has three types of forest vegetation. In the easternmost area there are fully degraded stands with *Quercus pubescens* (*Querco-Carpinetum orientalis*). This type of vegetation was subjected to intensive forestry exploitation and cutting, as well as grazing by domestic goats, so presently it is in a radically degraded shrub stage. Further west there are stands of vegetation with Sessile Oak (*Orno-Quercetum petraea*), including not only oaks but also various other deciduous tree species such as *Corylus avelana*, *Carpinus betulus*, maple (*Acer platanoiodes*) etc. Further southwest, with increase of altitude, this vegetation is replaced by beech forests and vegetation *Festuco heterophyllae-Fagetum*.

The third investigated area is situated toward northwest from village Tuminec, at locality Stano Nivje, with three types of vegetation. The part at lowest altitude is occupied by meadows of eryngo (*Eryngium* sp.) and specific mycorrhizal fungi following this species. Forest vegetation with *Quercus pubescens* (*Querco-Carpinetum orientalis*) appears with increase in altitude and further away from the settlements. On the plateau above this belt, there is some interesting vegetation with *Juniperus excelsa*, *Juniperus foetidissima*, *Juniperus oxicedrus*, *Quercus trojana* and *Acer monspensulanum* (*Querco trojanae-Juniperetum excelsae*). This whole area has limestone geological substrate typical of the region, causing presence of drier soil and more xerothermic conditions in the habitat, followed by changes in composition of mycopopulations when compared to previously cited areas.

A small number of specimens (only four) were acquired from employees of the National Park from the area close to Macedonian border (border-cross Stenje) where vegetation was represented by association *Quercetum frainetto-cerris.*

In all these localities, chosen for representative vegetation types, forests were greatly degraded and damaged by forestry exploitation. Age of trees in these forests is relatively low, mostly 15-20 years, and there are no old, well-preserved stands or stands without a pronounced anthropogenous impact. Therefore there is a lack of habitats for those species of fungi that demand conditions present only in well-preserved forest associations. Such species are indicators of good stable conditions and fine state of preservation of a forest.

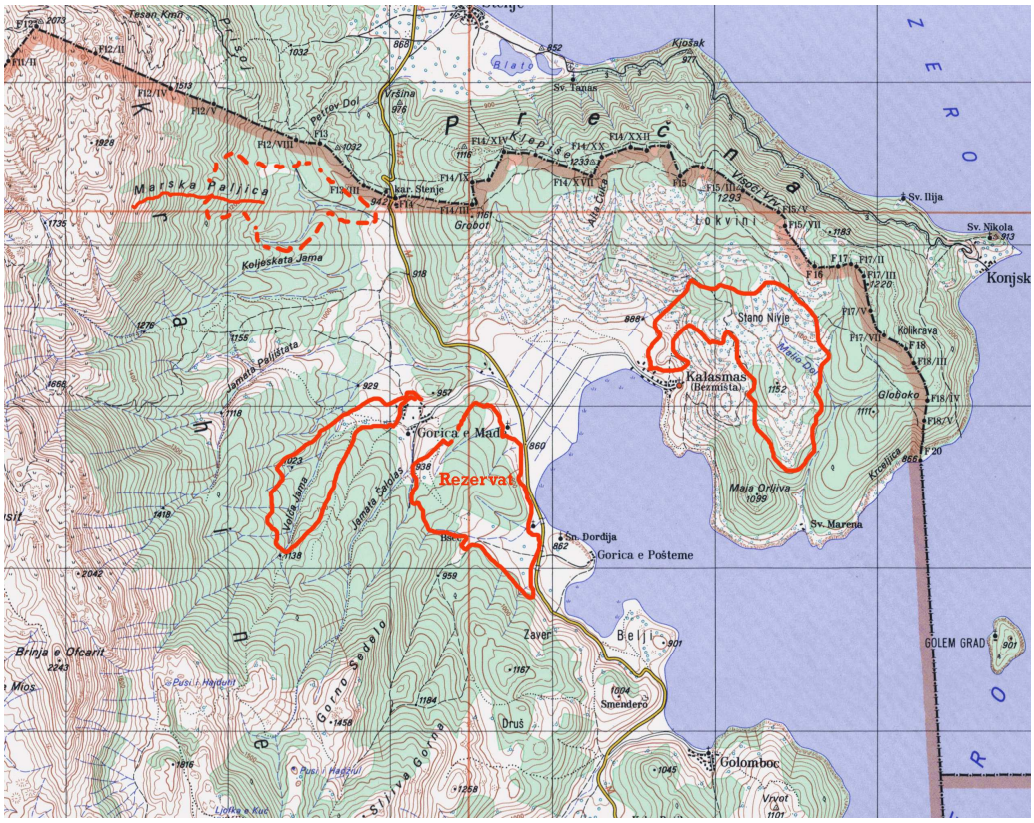

Figure 1. Map of investigated localities

RESULTS

The 174 listed species-level taxa of fungi were recorded during the research.

1. **Agaricus campestris var. squamulosus (Rea) Pilát**
2. ***Albatrellus cristatus (Schaeff.) Kotl. & Pouzar**
3. **Amanita caesarea (Scop.) Pers.**
4. **Amanita citrina (Schaeff.) Pers.**
5. **Amanita pantherina (DC.) Krombh.**
6. **Amanita phalloides (Vaill. ex Fr.) Link**
7. **Antrodia juniperina (Murrill) Niemelä & Ryvarden**
8. **Armillaria mellea (Vahl) P. Kumm.**
9. ***Armillaria tabescens (Scop.) Emel**
10. ***Arrhenia lobata (Pers.) Kühner & Lamoure ex Redhead**
11. ***Artomyces pyxidatus (Pers.) Jülich**
12. ***Aureoboletus gentilis (Quél.) Pouzar**
13. **Bisporella citrina (Batsch) Korf & S.E. Carp.**
14. ***Bolbitius titubans (Bull.) Fr.**
15. **Boletus aereus Bull.**
16. **Boletus chrysenteron Bull.**
17. ***Boletus erythropus Pers.**
18. ***Boletus ferrugineus Schaeff.**
19. **Boletus impolitus Fr.**
20. **Boletus luridus Schaeff.**
21. **Boletus queletii Schulzer**
22. ***Boletus regius Krombh.**
23. **Boletus reticulatus Schaeff.**
24. **Boletus rhodoxanthus (Krombh.) Kallenb.**
25. **Boletus subtomentosus L.**
26. **Bovista plumbea Pers.**
27. **Byssomerulius corium (Pers.) Parmasto**
28. ***Calvatia cyathiformis (Bosc) Morgan**
29. **Calvatia gigantea (Batsch) Lloyd**
30. **Cantharellus cibarius Fr.**
31. **Cerrena unicolor (Bull.) Murrill**
32. ***Cheilymenia stercorea (Pers.) Boud.**
33. ***Chroogomphus helveticus (Singer) M.M. Moser**
34. ***Clavulina rugosa (Bull.) J. Schröt.**
35. ***Clavulinopsis corniculata (Schaeff.) Corner**
36. ***Clitocybe dealbata (Sowerby) P. Kumm.**

37. ***Clitocybe nebularis (Batsch) P. Kumm.**
38. **Clitocybe odora (Bull.) P. Kumm.**
39. ***Clitocybe subspadicea (J.E. Lange) Bon & Chevassut**
40. **Coniophora arida (Fr.) P. Karst.**
41. ***Coprinopsis marcescibilis (Britzelm.) Örstadius & E. Larss.**
42. ***Coprinopsis picacea (Bull.) Redhead, Vilgalys & Moncalvo**
43. ***Coprinus silvaticus Peck**
44. **Corticium roseum Pers.**
45. ***Cortinarius infractus (Pers.) Fr.**
46. ***Cortinarius rigens (Pers.) Fr.**
47. **Cortinarius trivialis J.E. Lange**
48. **Cortinarius venetus (Fr.) Fr.**
49. **Crinipellis scabella (Alb. & Schwein.) Murrill**
50. **Diatrype disciformis (Hoffm.) Fr.**
51. **Diatrype stigma (Hoffm.) Fr.**
52. ***Entoloma sinuatum (Bull.) P. Kumm.**
53. **Entoloma subradiatum (Kühner & Romagn.) M.M. Moser**
54. ***Erysiphe alphitoides (Griffon & Maubl.) U. Braun & S. Takam.**
55. **Exidia truncata Fr.**
56. **Fistulina hepatica (Schaeff.) With.**
57. ***Fomitiporia robusta (P. Karst.) Fiasson & Niemelä**
58. **Galerina marginata (Batsch) Kühner**
59. **Gloeocystidiellum porosum (Berk. & M.A. Curtis) Donk**
60. **Gymnopus dryophilus (Bull.) Murrill**
61. ***Gymnopus erythropus (Pers.) Antonín, Halling & Noordel.**
62. ***Hebeloma sacchariolens Quél.**
63. **Hebeloma sinapizans (Paulet) Gillet**
64. ***Helvella elastica Bull.**
65. **Humaria hemisphaerica (F.H. Wigg.) Fuckel**
66. ***Hygrocybe psittacina (Schaeff.) P. Kumm.**
67. ***Hygrophorus chrysodon (Batsch) Fr.**
68. **Hygrophorus cossus (Sowerby) Fr.**
69. ***Hygrophorus eburneus (Bull.) Fr.**
70. ***Hygrophorus latitabundus Britzelm.**
71. **Hygrophorus lindtneri M.M. Moser**
72. **Hymenochaete rubiginosa (Dicks.) Lév.**
73. **Hymenoscyphus calyculus (Sowerby) W. Phillips**
74. **Hyphodontia juniperi (Bourdot & Galzin) J. Erikss. & Hjortstam**
75. **Hypholoma lateritium (Schaeff.) P. Kumm.**
76. ***Hypocrea citrina (Pers.) Fr.**
77. ***Inocybe geophylla var. lilacina Gillet**
78. ***Inocybe griseolilacina J.E. Lange**
79. **Inocybe rimosa (Bull.) P. Kumm.**
80. ***Inocybe splendens R. Heim**
81. ***Inocybe tricolor Kühner**
82. ***Kuehneromyces mutabilis (Schaeff.) Singer & A.H. Sm.**
83. **Laccaria laccata (Scop.) Cooke**
84. ***Lactarius azonites (Bull.) Fr.**
85. ***Lactarius deliciosus (L.) Gray**
86. ***Lactarius piperatus (L.) Pers.**
87. ***Lactarius pyrogalus (Bull.) Fr.**
88. ***Lactarius vellereus (Fr.) Fr.**
89. **Lactarius zonarius (Bull.) Fr.**
90. **Lenzites betulina (L.) Fr.**
91. **Lepiota clypeolaria (Bull.) P. Kumm.**
92. ***Lepista flaccida (Sowerby) Pat.**
93. ***Leratiomyces squamosus (Pers.) Bridge & Spooner**
94. ***Leucoagaricus leucothites (Vittad.) Wasser**
95. ***Lycoperdon atropurpureum Vittad.**
96. ***Lycoperdon marginatum Vittad.**
97. ***Lycoperdon molle Pers.**
98. **Lycoperdon perlatum Pers.**
99. **Lycoperdon pyriforme Schaeff.**
100. **Lycoperdon utriforme Bull.**
101. ***Macrolepiota excoriata (Schaeff.) Wasser**
102. ***Macrolepiota mastoidea (Fr.) Singer**
103. ***Marasmius cohaerens (Alb. & Schwein.) Cooke & Quél.**
104. **Marasmius oreades (Bolton) Fr.**
105. **Megacollybia platyphylla (Pers.) Kotl. & Pouzar**
106. ***Melanoleuca cognata (Fr.) Konrad & Maubl.**
107. **Merulius tremellosus Schrad.**
108. ***Mutinus caninus (Huds.) Fr.**
109. ***Mycena capillaris (Schumach.) P. Kumm.**
110. ***Mycena crocata (Schrad.) P. Kumm.**
111. **Mycena galericulata (Scop.) Gray**
112. **Mycena inclinata (Fr.) Quél.**
113. **Mycena pelianthina (Fr.) Quél.**
114. **Mycena pura (Pers.) P. Kumm.**
115. **Mycena renati Quél.**
116. **Mycena rosea Gramberg**
117. ***Mycenastrum corium (Guers.) Desv.**
118. **Omphalotus olearius (DC.) Singer**
119. **Panaeolus papilionaceus (Bull.) Quél.**
120. ***Panaeolus semiovatus (Sowerby) S. Lundell & Nannf.**
121. **Panellus stipticus (Bull.) P. Karst.**
122. ***Parasola plicatilis (Curtis) Redhead, Vilgalys & Hopple**
123. ***Paxillus rubicundulus P.D. Orton**
124. **Peniophora incarnata (Pers.) P. Karst.**
125. ***Peniophora quercina (Pers.) Cooke**
126. **Peziza arvernensis Roze & Boud.**
127. **Phanerochaete velutina (DC.) Parmasto**
128. **Pleurotus eryngii (DC.) Quél.**
129. **Pluteus cervinus (Schaeff.) P. Kumm.**
130. **Polyporus arcularius (Batsch) Fr.**
131. **Polyporus brumalis (Pers.) Fr.**
132. **Polyporus varius (Pers.) Fr.**
133. **Postia subcaesia (A. David) Jülich**
134. ***Postia tephroleuca (Fr.) Jülich**
135. ***Psathyrella bipellis (Quél.) A.H. Sm.**
136. ***Psathyrella murcida (Fr.) Kits van Wav.**
137. ***Pseudoclitocybe cyathiformis (Bull.) Singer**
138. **Pycnoporus cinnabarinus (Jacq.) P. Karst.**
139. **Pyrofomes demidoffii (Lév.) Kotl. & Pouzar**
140. **Ramaria flava (Schaeff.) Quél.**
141. ***Rhizopogon luteolus Fr.**
142. **Rhodocollybia butyracea (Bull.) Lennox**
143. ***Rhytisma acerinum (Pers.) Fr.**
144. ***Rugosomyces ionides (Bull.) Bon**
145. ***Russula chloroides (Krombh.) Bres.**
146. **Russula cyanoxantha (Schaeff.) Fr.**

147. ***Russula heterophylla (Fr.) Fr.**
148. ***Russula maculata Quél.**
149. ***Russula ochroleuca Fr.**
150. ***Russula pectinata Fr.**
151. ***Russula rosea Pers.**
152. ***Russula rubra (Fr.) Fr.**
153. ***Russula solaris Ferd. & Winge**
154. ***Russula subfoetens W.G. Sm.**
155. ***Russula torulosa Bres.**
156. **Schizopora paradoxa (Schrad.) Donk**
157. **Stereum hirsutum (Willd.) Pers.**
158. **Stereum rugosum Pers.**
159. ***Strobilurus tenacellus (Pers.) Singer**
160. ***Stropharia cyanea Tuom.**
161. **Stropharia semiglobata (Batsch) Quél.**
162. **Suillus luteus (L.) Roussel**
163. **Trametes hirsuta (Wulfen) Lloyd**
164. **Trametes versicolor (L.) Lloyd**
165. **Tricholoma acerbum (Bull.) Vent.**
166. ***Tricholoma columbetta (Fr.) P. Kumm.**
167. **Tricholoma saponaceum (Fr.) P. Kumm.**
168. **Tricholoma scalpturatum (Fr.) Quél.**
169. ***Tricholoma sejunctum (Sowerby) Quél.**
170. **Tricholoma ustaloides Romagn.**
171. **Vuilleminia comedens (Nees) Maire**
172. **Vuilleminia coryli Boidin, Lanq. & Gilles**
173. **Xerula radicata (Relhan) Dörfelt**
174. **Xylaria hypoxylon (L.) Grev.**

Area of National Park Prespa Albania was never studied from the mycological standpoint and there are no previously published data on fungi from this area. The only available information pertains to four edible species that have been collected at the territory of Park for trade purposes during the last three years. These species are: *Amanita caesarea* (Scop.) Pers., *Boletus aereus* Bull., *Boletus reticulatus* Schaeff. and *Cantharellus cibarius* Fr. Therefore, practically all species recorded during the field studies are new and presently the only data for inventory of fungi in this area. Although it is still not possible to determine with precision the final number of species recorded for the first time at territory of Albania, it seems that it is the case with most species recorded at the territory of National Park during our research.

Area of vicinity of Prespa Lake is situated within the territory of three countries: Albania, Macedonia and Greece. Massif of Mt. Galičica is divided by the Macedonian-Albanian border, and the mycological studies in Albania were performed at its foothills. The Macedonian side of Galičica was far better studied for many years, and as these are neighboring areas with similar geographic and climatic conditions it is possible to compare fungias of these two areas. As mycological data are also lacking for the Greek part of vicinity of Prespa Lake, the data from Macedonia (Ivančević 2009, Ivančević & Karadelev 2009) are presently the sole known mycological inventory of Prespa area. Comparison with field data has shown that of the total number of fungi recorded at Prespa Albania, for 82 species this is the first record for the whole Prespa area. These species were not previously recorded at the neighboring National Park Galičica in Macedonia, where about 400 species were recorded so far. All such species are marked with an asterisk (*). Such a high number of newly recorded species may be explained by differences in vegetation and primary conditions in forests at the Albanian and Macedonian side of Prespa. These are mostly terricolous species that may be found in various types of forests, while there was a much smaller number of species that are indicators of older, well-preserved forest complexes and lignicolous species connected with a certain type of substrate.

Table 1. Fungi species from Prespa National Park included in European Fungi Red List (Ing 1993)

№	Species	Category
1.	*Amanita caesarea*	D
2.	*Boletus aereus*	C
3.	*Boletus impolitus*	B
4.	*Boletus queletii*	B
5.	*Boletus regius*	A
6.	*Boletus rhodoxanthus*	A
7.	*Lycoperdon marginatum*	C
8.	*Mutinus caninus*	C
9.	*Mycenastrum corium*	C
10.	*Tricholoma acerbum*	B

Categories:
A – widespread losses, rapidly declining populations, many national extinctions, high-level concern
B - widespread losses, evidence of steady decline, some national extinctions, medium-level concern
C – widespread, but scattered populations, fewer extinctions, lower-level concern.
D – local losses, some extinctions but mainly at edge of geographical range

Threatened fungi species from Prespa National Park included in ECCF Atlas of 50 threatened European species (ECCF European Red List of the Fungi preliminary proposal)

1. *Amanita caesarea*
2. *Panaeolus semiovatus*

Species with globally significant status – These are internationally significant species**,** which have found satisfactory conditions for growth in region of Prespa, and their optimal areal of distribution i.e. most of its population is located in this region or country. Species where one state (or National Park) is responsible for a significant proportion of total range or population, or species rare throughout the global range and with part of the range within the territory of that particular state (or NP). These species are included in conservation programmes worldwide (European Red List of Threatened Macromycetes, European Council for Conservation of Fungi etc).

1. *Amanita caesarea*
2. *Antrodia juniperina*
3. *Boletus aereus*
4. *Boletus impolitus*
5. *Boletus regius*
6. *Hygrophorus lindtneri*
7. *Pyrofomes demidoffii*

In the Albanian part of Prespa area there were no records of fungi species included in the list of species proposed for conservation through directives of Bern Convention.

CONCLUSIONS

Fungi play a critical role in National Park Prespa. They are key in recycling dead vegetation and making the nutrients available for the next generation of plant life. They act also as plant pathogens and they form symbioses with the vast majority of herbaceous and woody plants, allowing them to colonize poor soils and pull otherwise unavailable nutrients from the soil.

There are no written data but only oral reports suggest that in the area of National Park Prespa there is no tradition of collecting fungi for food in any larger amounts, nor are they traditionally collected for trade. The local community has started to collect fungi only since 2010. There is currently no hard evidence that careful harvesting of macrofungi, as a single cause has a negative impact on sporocarp production or fungal species diversity. Exploitation may even promote awareness of the cultural and economic value of fungi, which in turn should encourage protection of a valuable resource. However, secondary impacts of harvesting, on both fungi and other species groups, should be considered and guidelines for harvesting developed.

Since the forest areas in the National Park Prespa are quite degraded, the main task is rehabilitation and conservation of the forests and conservation of pastures. Therefore, it is necessary to take the following general actions:

- Stop the mass tree-felling and left much of the forest to spontaneous or carefully controlled development
- Promote retention trees in managed forests
- Increase amount of coarse deadwood left to decay in forests
- Enable the emergence of old growth forests in the future (protect and left trees to grow without exploitation of some sections of the forest)
- Promote continued grazing and absence of fertilization and tillage in old grasslands
- Protecting fungi from over-exploitation
- Provide optimal ways to collect mushrooms and control mushroom picking on the territory of the Park
- Develop harvest guidelines to protect macrofungi and associated organisms

In the future it is necessary to provide the following programs:

- Identify Important Fungal Areas (IFA)
- Identify a Key fungal species
- Develop management plans to ensure protection of IFAs
- Ensure funding for mapping and monitoring of IFAs and other important fungal habitats and species for their quality, conservation status and trends.
- Consider appropriate mechanisms to alleviate the threats, this is likely to include a mix of policy measures, protected areas, habitat action and some species-specific actions.
- Develop monitoring programs

Species monitoring is important to enable trends in population sizes to be ascertained. In the National park there is a need to conduct monitoring of two groups of fungi. The first group are commercially harvested mushrooms. There is a need to monitor the impact of harvesting on macrofungi communities. It is necessary to know the exact daily and total amount of mushrooms that are commercially collected on the territory of the Park, and at the same time to follow the most basic climate parameters, temperature and monthly precipitation amount. Then, monitoring needs to include length of fruiting season, as well as information on harvesting techniques and land use that may have an impact on fruit body production. Details about this will be valuable in making decisions related to licensing, temporary limiting the gathering of mushrooms and management of fungal resources generally. Another group of fungi provided for monitoring are individual species, which can be in danger of extinction in all or part of its range, an indicator species that indicates the ecosystem condition, endangered or otherwise significant populations of individual fungal species or due to the economic importance of a species.

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