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*Preliminary communication*

# DIVERSITY AND ECOLOGY OF MACROMYCETES ON SHARR MOUNTAIN MASSIF, REPUBLIC OF NORTH MACEDONIA

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**Abstract**

New research on the biodiversity of mushrooms in the region of Sharr Mountain massif has been conducted from September to November 2016. The material is collected in a variety of substrates. The types that were found were recorded in some localities such as: near Gajre, Lisec, Popova Sapka, Jellak, Rogachevo, Staro Selo, Leshnica etc. Some living organisms or plant associations are included, such as *Quercetum frainetto-cerris macedonicum, Orno quercetum-Petraea, Calamintha grandiflorae-Fagetum, Fagetum subalpinum-scardopindicum, Piceetum subalpinum scardicum),* etc. out of a total of 76 species described, 59 species are tericolus mushrooms and only 17 are lignicolus. Registered species belong to the Basidiomycota (72) and Ascomycota (4) types and the orders: *Agaricales, Boletales, Polyporales and Russulales*. The most researched gender is Amanita (8). As most common species we can mention: *Amanita rubescens, Amanita pantherina, Agaricus macrosporus, Armillariella mellea, Fomes fomentarius, Laccaria lacata, Oudemansilla radicosum, Russula cyanoxantha, Stereum hirsutum, Trametes hirsuta. The rarest species are: Amanita crocea, Albatrellus cristatus Boletus regius, Panaeolus semiovatus, Stropharia caerulea...*

*Keywords:* Shar Mountain, fungi, macromycetes, edible.

## 1. Introduction

The Republic of North Macedonia is relatively well researched from a mycological point of view, although in some regions it is poorly researched. Systematic mushroom research has so far been developed in these masses such as Pelister, Jakupica, Galichica, Kozhufi, Ujmiri (Dobra Voda), Bistra, Korabi etc. Sharr Mountain is relatively poorly researched although in recent times in different regions find place more intensive researches. Litschauer (1939)[30], makes a significant contribution to the study of corticoid fungi such as Tomentella (in Sharr and Korab) [31], then for parasitic and saprophytic fungus wrote[32,33,34], Tortić (1988)[34], who publishes the first mycoflora in Macedonia where 585 macromycetes are described,[34]. In the latest researches can be named: Karadelev [16-24]; Karadelev & Rusevska (2004)[28]; Karadelev et all (2002; 2009) [26,27]; Karadelev & Murati (2008)[25]; Murati & Karadelev (2012)[29] etc.

## 2. Description of the explored region

The Shar Mountains or Sharr Mountain massif (Albanian: Malet e Sharrit, Masivi malor i Sharrit), form a mountain range in the Balkans that extends from Kosovo and the northwest of the Republic of North Macedonia, to northeastern Albania. The Shar Mountains have a total area of 1600 km. 56,25% of that area is in the Republic of Macedonia, 43.12% in Kosovo, and 0,63% in Albania. There are three plains Sirinich, Vracha and Rudoka.The whole massif is about 80 km long and 10–20 km wide which was formed in the Tertiary Period during alpic wrinkling , where the peaks were covered with ice and snow. During diluvium the massif was loaded with active glaciation, so in its relief today brings together more cirques, valleys and moraine material. It includes several high peaks such as:Titov Vrv or Turku i Madh (2,747 m); Turku i vogel

(2,707 m.); Bakardan (2,704 m.) etc.
The Shar Mountains extend to Mount Korab (2,764 m) in the southwest, and pass into northeastern Albania with very small part (0.63% of the entire length).
Based on previous researches in North Macedonia there are identified and defined around 2350 species of macromyceta of whom 250 species are ascomycota and around 2100 species of fungis to basidiomycota [28a]. Since 2021, Sharr Mountain Massif has been declared a national park in the territory of the Republic of Northern Macedonia.

## 3. Materials and methods

The material is collected in forest associations and substrates such as: on land or branches of rocks, stalks and rotten, semi-rotten trees, lush trees and fallen trees, mainly in beech, oak, willow, Pine, fir etc., as well as in high mountain pastures.
A certain specified number of species are identified and determined in the place where they are found in fresh state immediately after it has been collected ,while in the other part there are made different detailed analysis for identification and determination with the help of the microscope where the fungal spores are identified, cistidies, than its made their measurement chemical reagents (melzer, sulfovanilin, gvajacol, KOH, K2SO4 etc) at the Institute of Ecology and Technology ,,Scardus'' at the SUT and in the Mycological laboratory, at the institute of Biology in Faculty of Natural Science and Mathematics in Skopje. For determination of these fungi there were using the newest keys and monographs: [1-15]. For the determination of some species are used:http://www.Indexfungorum.org/Names/Names.asp; http://www.mycobank.org/MycoTaxo.aspx
From each specie a part is preserved dried and labeled with key data (latin name, association, location, altitude, date of collection, name of person legitimation and determination, etc.

## 4. Results and discussion

In the latest research from August to November 2016, students of Ecology at UT describe 76 species of 59 tericolus and only 17 lignicolus. Research is carried out in some localities such as: Gajre, Lisec, near Shipkovica, Popova Sapka (Kodra e Diellit), Jellak, Staro Selo, Rogachevo etc. The largest numbers of species are: *Agaricales* with 22 species; *Polyporales* with 8 types; *Boletales* with 6, *Russulales* with 8, *Lycoperdales* with 5, *Cantharellales* with 4 types etc. The most represented gender is Amanita (8 species), Boletus (4) and Russula (4).
*Six (6) species of this fungi found in the Sharr Mountains region are listed in the Macedonian Red List*
There are just a few data on the biodiversity of mushrooms in the Sharr Mountains, actually only those mentioned above. With the establishment of the Institute for Ecology and Technology, Skardus, at the Institute for Biology at the Faculty of Mathematics and Natural Sciences in Tetovo and the establishment of the biology department (institute of Mycology) at this institute, started to intensify the mycological research in all forest communities especially those of *Quercus ssp, Fagus, Pinus, Abies, Larix,* mixed forests etc. As the most representative forestry community can be mentioned: *Quercetum frainetto-cerris, Orno-Quercetum-petraea, those of Fagus, Calamintha grandiflorae -Fagetum and Fagetum subalpinum scardo- pindicum* at the altitudes higher than 1650-1750. Researches have also been made on the piscine-fir community at the Jellak locality in the 1750-1800 m altitude, with the engagement of ecologist students at the FNSM of the Institute of Biology on University of Tetova.
List of species macromycetes registered on 2016 in dhe territory on Sharr Mountain massif are:

- *Agaricus augustus Fr.*
- *Agaricus campestris Scop.*
- *Agaricus macrosporus F.H.Møller & Jul.Schff.) Pilát*

- *Amanita caesarea (Scop) Pers.*
- *Amanita rubescens Pers.*
- *Amanita pantherina (DC) Krombh.*
- *Amanita vaginata (Bull) Lam.*
- *Amanita muscaria* (L.) Lam. (1783) - *abies*
- *Amanita muscaria*(L.) Lam. (1783) under Quercus
- *Amanita crocea (*Quél. in Bourd.) Singer ex Singer
- *Amanita fulva (Schaeff.)Fr*
- *Albatrellus cristatus* (Schaeff.) Kotl. & Pouzar -fagus forest
- *Armillariella mellea* (Vahl) P.Kumm.
- *Boletus edulis* Bull.
- *Boletus reticulatus* Schaeff.
- *Butyriboletus regius* (Krombh.) D.Arora & J.L.Frank
- *Boletus satanas Lenz.*
- *Bovista plumbea Pers.*
- *Calvatia utriformis (Bull.)Kreisel* -fagus forest
- *Chalciporus piperatus* (Bull.) Bataille
- *Cantharellus cibarius* Fr.
- *Coprinus comatus* (O.F.Müll.) Pers.
- *Craterellus cornucopiae* (L.) Pers.
- *Cerrena unicolor* (Bull.) Murrill, on stump of fagus
- *Cortinarius cf. duracinus* Fries
- *Exidia glandulosa* (Bull.) Fr., on fallen branch of Quercus
- *Fomes fomentarius* (L.) Fr.
- *Fomitopsis pinicola* (Sw.) P. Karst.
- *Hypholoma fasciculare* (Huds.:Fr.) P.Kumm.
- *Hypoxylon fragiforme* (Pers.: Fr.) J. Kickx.
- *Hydnum repandun* L. fagus forest
- *Hydnum rufescens* Pers., fagus forest
- *Hygrocybe nigrescens* Quél.
- *Hygrocybe conica* (Schaeff.) P.Kumm.
- *Hygrophorus piceae* Kühner
- *Hygrophorus eburneus*(Bull.) Fr.
- *Helvella acetabulum,*. (L.) Quél.. *Lisec*
- *Lactarius deliciosus* (L. ex Fr.) S.F.Gray
- *Lactarius glaucescens* Crossl., fagus forest
- *Lactarius piperatus* (L.) Pers.
- *Laccaria laccata* (Scop.) Cooke., under pinus (abies plantanus)
- *Laccaria laccata* (Scop.) Cooke., under Quercus
- *Lycoperdon perlatum* Pers.
- *Lycoperdon piriforme* Schaeff., fagus forest
- *Macrolepiota procera* (Scop.) Singer
- *Macrolepiota mastoidea* (Fr.) Singer,

- *Marasmius oreades* (Bolton) Fr .
- *Merulius tremellosus* Schrad., fagus forest.
- *Nectria cinnabarina* (Tode)Fr.
- *Hymenopellis radicata* (Relhan) Dörfelt *( Oudemansiella radicata)*
- *Polyporus varius* (Pers.) Fr. *(*lignicolus, polyporales, on fallen branches)
- *Phlebia rufa sp.,* on fallen branches of fagus
- *Russula cyanoxantha* (Schaeff.) Fr.
- *Russula subfoetes W.G.Sm.,on* fagus forest
- *Sarcodon imbricatus* (L.) P.Karst. under fagus
- *Panaeolus semiovatus* Fr. (Lundell)
- *Phellinus igniarius (L)Quel* .
- *Ramaria flava* (Schaeff.) Quél. -fagus forest
- *Ramaria fumigata* (Peck) Corner
- *Sarcodon imbricatus* (L.) P.Karst. -under planted abies
- *Stropharia caerulea* Kreisel
- *Russula queletii* Fr.
- *Stereum hirsutum (Wild.)Pers.*
- *Trametes hirsuta (Wulfen) Pilat*
- *Trametes pubescens* (Schumach.) Pilát, -on stump of fagus *L*
- *Trametes versicolor* (L.) Lloyd
- *Tricholoma portentosum (*Fr.), Quel.,
- *Telephora terrestris* Ehrh.
- *Vascellum pratense* (Pers. : Pers.) Kreisel
- *Xerocomus subtomentosus* (L.) Quél.

We also add to this list the types that were researched in May 2017 registered in the villages of Staro selo and Rogachevo

Staro Selo:

- *Tuber aestivum* Vittad.
- *Russula aurata* Fr.
- *Russula cyanoxantha* (Schaeff.) Fr.
- *Psathyrella sp.* (Fr.) Quél.
- *Gymnopus driophyllus* (Bull.) Murrill under *Quercus* sp (*Collybia driophylla)*
- *Schizopora paradoxa* (Schrad.) Donk
- *Stecherinum ochraceum* (Pers.) Gray
- *Amanita vaginata (Bull) Lam.*

Rogachevo

- *Cantharellus cibarius* Fr.
- *Russulla cyanoxantha* (Schaeff.) Fr.
- *Galerina marginata* (Batsch) Kühner

In the list we have presented a total of 76 species of macromycetes, of which 59 are terricoles and 17 are lignicoles. Of the total number of macromycetes, only 4 belong to the *Ascomycota* type, while the others belong to the *Basidiomycota* type (72). A larger number are identified or registered in the living communities of beech (*Calamintha grandiflorae -Fagetum* and *Fagetum subalpinum scardo-pindicum*), while those of the oak belt (*Quercetum frainetto-cerris* and *Orno-Quercetum-petrae*) are not left out.While at higher altitudes below the *Abies* communities a large numbers of fungi have also been recorded.

**The most frequent terricolous species are:** *Agaricus campestris, Amanita rubescens, Boletus edulis, Bovista plumbea, Cantharellus cibarius, Laccaria lacata, Macrolepiota procera, Marasmius oreades, Russula cyanoxantha, Collybia dryophila etc*

**The most rare terricolous species are:** *Agaricus augustus, Amanita caesarea, Amanita crocea, Russula aurata, Albatrellus cristatus, Butyriboletus regius, Helvella acetabulum, Tuber aestivum etc.*

**The most frequent lignicolous species are**: *Armillariella mellea Hebeloma radicosum, Fomes fomentarius Hypholoma fasciculare, Stereum hirsutum, Trametes hirsuta, Schizopora paradoxa etc.*

**The most rare lignicolus species are:** *Cerrena unicolor, Phlebia rufa, Stecherinum ochraceum* etc.

**Mushrooms of nutritional and commercial importance on the territory of Shar Mountain massif can be mentioned**: *Amanita caesarea, Boletus edulis, Boletus reticulatus, Cantharellus cibarius, Craterellus cornucopioides, Macrolepiota procera, Tuber aestivum, Hydnum repandum etc.* From this list of fungi, a certain number are edible, from which we can single out*: Agaricus macrosporus, Agaricus campestris, Amanita caesarea, Boletus edulis, Boletus reticulatus, Butyriboletus, Cantharellus cibarius, Coprinus comatus, Lactarius deliciosus, Macrolepiota procera etc.* In addition to edible fungi, there are those that are poisonous and dangerous to human life, such as*: Amanita pantherina, Amanita muscaria, Boletus satanas, Hypholoma fasciculare, etc.*

From a previous research we came to the conclusion that a large number of species have been proposed for Macedonia's Red List for their protection, 6 types of mushrooms found in the Sharri Mountains region result to be in this list. [21]

This is due to uncontrolled exploitation and environmental pollution. The species that are declared for the red list and encountered in the Sharr territory are: *Amanita caesarea, Butyriboletus regius, Boletus satanas, Cantharellus cibarius, Craterellus cornucopioides and Lactarius deliciosus*.

## 5. Conclusion

Of the total number of *Ascomycota* types belong to only 4 species whereas others belong to the *Basidiomycota* type (72).

Some types of them are edible and have nutritional values and economic importance, while some of them are poisonous.

From the research so far, as well as from the current research in the Northern Republic of Macedonia, we can conclude that the entire research potential in the Sharr Mountain Massif not that its not just over but it is a call for even greater work that awaits us to reach the number of species that lie in the territory of this massif.

## References


[1]. Ahti et al., (2000): Nordic Macromycetes Volume1. Nordsvamp, Copenhagen. 309 pp.
[2]. Alessio, C, L.(1985): Boletus. Italia. Fungi Europaei, 712 pp.
[3]. Boertman, D. et al., (1992): Nordic Macromycetes Volume 2. Nordsvamp, Copenhagen 474 pp.
[4]. Breitenbach, J.& Kranzlin, F. (1981): Fungi of Switzerland Volume 1, Edition Mycologia, Switzerland, 313 pp.
[5]. Breitenbach, J.& Kranzlin, F.,(1986): Fungi of Switzerland, Volume 2. Edition Mycologia, Switzerland, 412 pp.
[6]. Breitenbach, J.& Kranzlin, F.,(1991): Fungi of Switzerland Volume 3. Edition Mycologia, Switzerland, 361 pp.
[7]. Breitenbach, J.& Kranzlin, F., (1995): Fungi of Switzerland Volume 4. Edition Mycologia , Switzerland, 368 pp.
[8]. Breitenbach, J.& Kranzlin, F.,(2000) Fungi of Switzerland Volume 5. Edition Mycologia, Switzerland. 368 pp.

[9]. Corfixen, P. et al., (1997): Nordic Macromycetes Volume 3. Nordsvamp, Copenhagen.444 pp.
[10]. DÄhncke, R. M,.(2004): 1200 Pilze.Verlag GmbH, Augsburg, 1178 pp.
[11]. Eriksson, J. & Ryvarden, L (1975): The Corticiaceae of North Europe 3 Fungi . Fungiflora, Oslo.
[12]. Eriksson, J. & Hjortstam, K..& Ryvarden, L. (1978): The Corticiaeceae of North Europe 5, Fungiflora, Oslo.1047 pp.
[13]. Eriksson, J. & Hjortstam, K..& Ryvarden, L. (1981): The Corticiaceae of North Europe 6. Fungiflora, Oslo 1276 pp.
[14]. Moser, M. (1983): Die Rorhrnge und Blatterpilze. Gystav Fischer Verlag,, Stuttgard, 533 pp
[15]. Julich, W., (1984). Die Nichtblatterpilze, Gallertpilze und Bauchtpilze. Gustav Fischer Verlag. Stuttgard, 626 pp.
[16]. Karadelev, M, (1989): Lignicolus Aphyllophorales (BASIDIOMYCETES) On Macedonian Oak (Quercus trojana Webb.). Biosistematika, 15 (2):119-125.
[17]. Karadelev, M .,(1993): Contribution to the knowledge of wood- Destroing fungi in the Republic of Macedonia. Young Explorer of Macedonia, Fungi Macedonici I, 78 pp.
[18]. Karadelev, M.,(1994): Qualitative and quantitative analysis of lignicolous macromycetes in different forest associations on Galicica Mountain. Ekol. Zast. Ziv. Sred, 3: 3-12.
[19]. Karadelev M., (1995): Lignicolous Basidiomycetes as producers of antibiotic and citostatics, Fungi Macedonici-MIM, 1-19.
[20]. Karadelev, M., ( 1998): Fungal Biodiversity in Macedonia I with a special regard to substrates with a disjunct range and relict origin. Micologia Montenegrina, I-n, 49-55.
[21]. Karadelev, M., (1999). Preliminarna Crvena Lista na Gabi na Republika Makedonija, Zbornik na Trudovi od I-Kongres na Ekolozite na Makedonija 5: 289-295.
[22]. Karadelev, M., (2000). Preliminary red list of Macrofungi in the Republic of Macedonian European Council of Conservation of Fungi, Newsletter 10, 7-11.
[23]. Karadelev. M., (2001): Fungi Macedonici-Makedonsko Mikoloshko Drushtvo.Skopje.Str.1-299.
[24]. Karadelev, M., (2002a) Fungi Macedonici-Gabite na Makedonija. Makedonsko mikoloshko drushtvo, Skopje:42-48.
[25]. Karadelev,M.&Murati.,E.,(2008).Ecology and distribution of Macromycetes (Basidiomycota and Ascomycota) on Dobra Voda mountain in the Republic of Macedonia. Proceedings of Int. Conf. on Biological and Enviromental Sciences. FNS, 26-28 sept. Tirana, 2008 459-466 pp
[26]. Karadelev,M.,Nastov Z.,& Rusevska K., (2002):Qualitative and quantitative investigation of Macromycetes on Shar Planina Mountain Bull. Biol. Stud. Res. Soc, Skopje, 2, 71-78.
[27]. Караделев, М., Сулејмани, С., и Мурати, Е., (2009). Екологија и дистрибуција на макромицетите во фитоценозата Quercetum frainetto-cerris macedonicum во состав на планината Добра Вода. Зборник на трудови од III Конгрес на еколозите на Македонија со Меѓународно учество. Посебни изданија на МЕД, Скопје, Кн.8, стр. 217-223.
[28]. Karadelev, M., Rusevska K. (2004): Eco-taxonomic research of Fungi on Bistra Mountain. Proceedings of II Congress of Ecologists of the Republic of Macedonia with International Participation. Skopje, Vol. 6, pp. 393-397. [28a]Karadelev. M., Rusevska K., Gerhard Kost., G, Kopanja D.K, (2018). Checklist of macrofungal species from the phylum Basidiomycota of the Republic of Macedonia.. Acta Musei Macedonici Scientiarum Naturalium, 2018, Vol. 21, pp: 23-112
[29]. Murati, E., & Karadelev, M., (2012).,Ecology and distribution of the ascomycota fungi on the Mountain massive Dobra Voda. 4th –Congress of ecologists of the Republic of Macedonia with International participation. Ohrid. Macedonia.Procediings book.
[30]. Litschauer,V., (1939): Beitrag zur Kenntnis der Resupinaten Phylacteriaceen von Südserbien. Glasnik Skopskog naucnog drušstva 20: 13_22.
[31]. Lindtner, V., (1950): Gare Jugoslavije. Glasn. Prir.muz., Beograd, ser.B: 3-4, 110.
[32]. Ranojevich, N. (1909): Prilog flori Stare Srbije I : 3-7.Makedonije. Muzej srpske zemlje
[33]. Sydow, H., (1921): J. Bornműller: Plantae Macedoniae. Pilze. Ann. Myc. 19.
[34]. Tortich, M., (1988): Materials for the mycoflora of Macedonia. Maked. Akad. na Naukite i Umetnostite. Skopje.
[35]. http://www.indexfungorum.org/Names/Names.asp
[36]. http://www.mycobank.org/MycoTaxo.ass