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Macrofungal diversity of Bolu Abant Nature Park (Turkey)

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This study was based on materials of macrofungi collected from Bolu Abant Nature Park between 2008 and 2009. As a result of field and laboratory studies, 103 taxa belonging to 34 families were identified. Five (5) taxa belong to *Ascomycota* and 98 to *Basidiomycota*.

Key words: Biodiversity, macrofungi, taxonomy, Bolu Abant Nature Park.

INTRODUCTION

Fungi are rich and diverse groups of organisms on earth. They have important roles in ecosystems, pharmacology, food industry and biodegradation (Stojchev et al., 1998). More than 70 000 species of fungi have been described; however, some estimates of total numbers suggest that 1.5 million species may exist (Hawksworth, 1991; Hawksworth et al., 1995). Macrofungi are those fungi that form large fructifications visible without the help of a microscope and they are defined here to include *ascomycota* and *basidiomycota* with large, easily observed spore-bearing structures. Most terrestrial macrofungi are saprobes or mycorrhizal symbionts, but some are pathogens of plants or fungi (Mueller et al., 2007).

Many studies were carried out on the macrofungal diversity of Turkey, and they were presented as checklists (Solak et al., 2007; Sesli and Denchev, 2008).

Tracing 416 published studies, Sesli and Denchev (2008) listed 1814 taxa occurring in Turkey. They have updated this number to 1929 by including the newly contributed data (Akata et al., 2009; Aktaş et al., 2009; Baş Sermenli and Işiloğlu, 2009; Doğan, 2009; Doğan and Karadalev, 2009; Ghobad-Nejhad et al., 2009; Işiloğlu et al., 2009a; Kaya, 2009a,b,c,d; Sesli and Castellano, 2009; Sesli et al., 2009; Solak et al., 2009; Uzun, 2010; Uzun et al., 2010a) presented till March 2010. Addition of the findings of recent works (Uzun et al., 2010b, Işiloğlu et al., 2010) and the studies not included in the above checklist (Akata and Çetin 2008, 2009; Akata et al.,

2009a,b,c), the total macrofungi taxa of Turkey stands at 1936 by the end of March 2010. Previous mycological investigations around the region were carried out by Öder (1972), Sümer (1982), Afyon et al. (2000), Afyon and Konuk (2002), Yağız et al. (2005, 2006) and Akata et al. (2009d). But there is no detailed mycological study in Bolu Abant Nature Park.

Bolu Abant Nature Park is situated 33 km south-west of the city Bolu, in the western black sea region of Anatolia. It has a surface area of 1196.5 ha; 646.5 ha of the park is covered by forest and 550 ha by meadows. The Park is surrounded by Abant river to the north, Pelitözü, Örencik and Sariyer plateau to the west, Türkmençalı stream to the south-west, Kızılarçalı hill to the the south and Ballica hill to the east of the lake (Figure 1). The region shows a transitory character between the Mediterranean climate with a very cold, less rainy winter and oceanic climate (Çobanoğlu and Akdemir, 2004; Türker and Güner, 2003).

The forest area is dominated by *Abies* Miller sometimes forming mixed stands with *Pinus* L. and *Fagus* L. Other common trees are *Quercus* L., *Acer* L., *Crataegus* L., *Pyracantha* M.J.Roemer, *Juniperus* L. and *Salix* L. (Türker and Güner, 2003).

The aim of this study is to determinate the macrofungal composition of Bolu Abant Nature Park and make contribution to Turkish mycobiota.

MATERIALS AND METHODS

This study is based on macrofungi materials collected periodically from 20 localities of Bolu Abant Nature Park in autumn and spring between 2008 and 2009 (Table 1). During field studies, macro-

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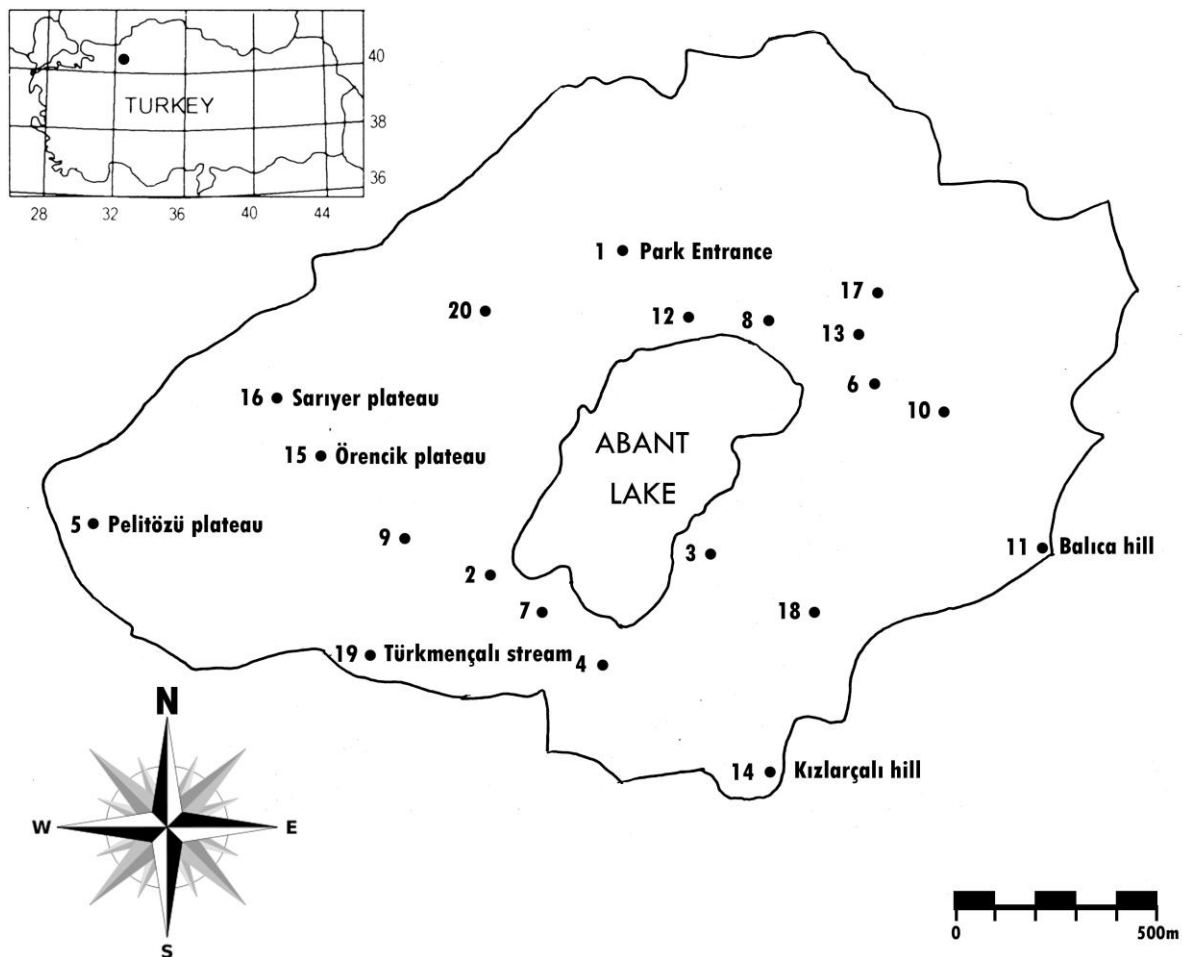


Figure 1. Map of Bolu Abant Nature Park.

Table 1. Macrofungi collecting localities.

| S/N | Localities | Coordinates | Altitudes (m) |
|-----|------------------------|-------------------------------|---------------|
| 1 | Park Entrance | 40° 37' 02" N - 31° 17' 14" E | 1300 |
| 2 | South-west of The Lake | 40° 36' 06" N - 31° 16' 15" E | 1360 |
| 3 | South-east of The Lake | 40° 36' 07" N - 31° 16' 58" E | 1350 |
| 4 | South of The Lake | 40° 35' 48" N - 31° 16' 39" E | 1420 |
| 5 | Peliözü plateau | 40° 36' 09" N - 31° 14' 59" E | 1400 |
| 6 | East of The Lake | 40° 36' 25" N - 31° 17' 46" E | 1380 |
| 7 | South of The Lake | 40° 36' 00" N - 31° 16' 30" E | 1350 |
| 8 | North of The Lake | 40° 36' 45" N - 31° 17' 16" E | 1350 |
| 9 | West of The Lake | 40° 36' 06" N - 31° 15' 50" E | 1430 |
| 10 | East of The Lake | 40° 36' 34" N - 31° 17' 58" E | 1350 |
| 11 | Balıca hill | 40° 36' 07" N - 31° 18' 08" E | 1670 |
| 12 | North of The Lake | 40° 36' 43" N - 31° 16' 55" E | 1350 |
| 13 | North-east of The Lake | 40° 36' 31" N - 31° 17' 38" E | 1340 |
| 14 | Kızlarçalı hill | 40° 35' 27" N - 31° 15' 08" E | 1530 |
| 15 | Örencik plateau | 40° 36' 13" N - 31° 15' 34" E | 1380 |
| 16 | Sarıyer plateau | 40° 36' 28" N - 31° 15' 39" E | 1450 |
| 17 | North-east of The Lake | 40° 36' 41" N - 31° 17' 49" E | 1330 |

Table 1. Continued...

| | | | |
|----|------------------------|-------------------------------|------|
| 18 | South-east of The Lake | 40° 35' 57" N - 31° 17' 31" E | 1630 |
| 19 | Türkmençalı stream | 40° 35' 45" N - 31° 15' 59" E | 1620 |
| 20 | North-east of The Lake | 40° 36' 44" N - 31° 16' 02" E | 1520 |

scopic and ecological characteristics of the samples were recorded and they were photographed in their natural habitats. Then the samples were taken to the laboratory. Macroscopic and microscopic investigations and micro-chemical reactions were carried out. Specimens were identified using the related literature (Bas et al., 1988-1999; Breitenbach and Kranzlin, 1984-2000; Calogne, 1998; Ellis and Ellis, 1990; Hansen and Knudsen, 1992-2000; Heilmann-Clausen et al., 1998; Kranzlin, 2005; Moser, 1983). The specimens were deposited at the herbarium of Ankara University (ANK).

RESULTS

As a result of the present study, 103 taxa belonging to 34 families of the *Ascomycota* and *Basidiomycota* were identified. The systematics of the taxa are in accordance with Cannon and Kirk (2007), Kirk et al. (2008) and Index fungorum (www.speciesfungorum.org: accessed 1 March 2010) and they are listed in alphabetical order.

All taxa were listed together with their distribution, habitat, geographical position, locality, collection date, and accession numbers (S: Servi, A: Akata):

Fungi

Ascomycota Caval.-Sm.

Helotiales Nannf

Helotiaceae Rehm.

Bisporella citrina (Batsch) Korf and S.E. Carp.: On beech branch, locality 4, 03.09.2009, S. 260.

Pezizales J. Schröt.

Caloscyphaceae Harmaja

Caloscypha fulgens (Pers.) Boud.: In fir forest, locality 8, 13.04.2009, S. 151.

Discinaceae Benedix

Discina ancilis (Pers.) Sacc.: On fir stump, locality 8, 13.04.2009, S. 144.

Pyronemataceae Corda

Humaria hemisphaerica (F.H. Wigg.) Fuckel: On fir stump, locality 1, 03.09.2009, S. 211.

Xylariales Nannf.

Xylariaceae Tul. and C. Tul.

Xylaria hypoxylon (L.) Grev.: On fir stump, locality 8, 10.09.2008, S. 050.

Basidiomycota Whittaker ex Moore.

Agaricales Underw.

Agaricaceae Chevall.

Agaricus augustus Fr.: In fir forest, locality 1, 03.09.2009, S. 213.

Agaricus campestris var. *campestris* L.: In pastures, locality 18, 12.11.2009, S. 449.

Bovista nigrescens Pers.: In pastures, locality 20, 12.11.2009, S. 455.

Chlorophyllum rhacodes (Vittad.) Vellinga: In fir forest, locality 6, 12.11.2009, S. 403.

Coprinus comatus (O.F. Müll.) Pers.: In pastures, locality 19, 12.11.2009, S. 451.

Cystoderma amianthinum (Scop.) Fayod: In fir forest, on needle litter, locality 6, 12.11.2009, S. 416.

Cystodermella granulosa (Batsch) Harmaja: In fir forest, locality 3, 05.10.2009, S. 328.

Lepiota cristata (Bolton) P. Kumm.: In beech forest, locality 7, 14.11.2008, S. 138.

Lycoperdon excipuliforme (Scop.) Pers.: In fir forest edge, locality 1, 03.09.2009, S. 215.

Lycoperdon lividum Pers.: In fir forest edge, locality 10, 05.09.2009, A. 2419.

Lycoperdon molle Pers.: In fir forest, locality 6, 12.11.2009, S. 418.

Lycoperdon perlatum Pers.: In fir forest, locality, In fir forest, locality 8, 10.09.2008, S. 068, In fir forest, locality 10, 05.09.2009, A. 2410.

Lycoperdon pyriforme Schaeff.: On fir stump, locality 10, 07.10.2008, S. 079, on rotten fir trunk, locality 8, 05.09.2009, A. 2409.

Lycoperdon utriforme Bull.: In pastures, locality 5, 12.05.2008, S. 043.

Macrolepiota mastoidea (Fr.) Singer: In beech forest, locality 4, 03.09.2008, S. 043.

Macrolepiota procera var. *procera* (Scop.) Singer: In beech forest, locality 7, 14.11.2008, S. 140; On road edge, locality 16, 12.11.2009, S. 442.

Amanitaceae R. Heim ex Pouzar

Amanita citrina var. *citrina* (Pers.) Pers.: In beech forest, locality 9, 12.11.2009, S. 437.

Amanita muscaria var. *muscaria* (L.) Lam.: In fir forest, locality, under pine, locality 17, 12.11.2009, S. 445.

Amanita vaginata (Bull.) Lam.: In fir forest, locality 10, 07.10.2008, S. 084.

Hygrophoraceae Lotsy

Hygrocybe virginea var. *virginea* (Wulfen) P.D. Orton and Watling: In fir forest edge, 11, 05.09.2009, S. 302.

Hygrophorus chrysdon (Batsch) Fr.: In fir forest, locality 1, 03.09.2009, S.224; In fir forest, locality 8, 05.09.2009, A. 2408.

Hygrophorus pudorinus (Fr.) Fr.: In fir forest, locality 1, 03.09.2009, S. 213; In fir forest, locality 8, 05.09.2009, A. 2397; In fir forest, locality 6, 12.11.2009; S. 401.

Inocybaceae Jülich

Inocybe amethystina Kuyper: In fir forest, locality 6, 14.11.2008, S. 129.

Inocybe geophylla var. *geophylla* (Pers.) P. Kumm.: In fir forest, locality 8, 10.09.2008, S. 057.

I. geophylla var. *lilacina* Gillet: In beech forest, locality 4, 03.09.2009, S. 267.

Marasmiaceae Roze ex Kühner

Gymnopus dryophilus (Bull.) Murrill: In beech forest, locality 9, 10.09.2009, S. 063.

Gymnopus hariolorum (Bull.) Antonín, Halling and Noordel.: In beech forest, locality 9, 12.11.2009, S. 426.

Marasmius oreades (Bolton) Fr.: In pastures, locality 15, 12.11.2009, S. 440.

Marasmius rotula (Scop.) Fr.: On beech branch, locality 9, 07.10.2008, S. 113.

Mycenaceae Overeem

Mycena pura (Pers.) P. Kumm.: In fir forest, locality 8, 10.09.2009, S. 053.

Mycena rosea (Schumach.) Gramberg: In beech forest, locality 7, 14.11.2008, S. 141.

Panellus mitis (Pers.) Singer: On fir branch, locality 8, 10.09.2009, S. 059.

Xeromphalina caudicinalis (With.) Kühner and Maire: In fir forest, on needle litter, locality 4, 03.09.2009, S. 241.

Physalacriaceae Corner

Armillaria mellea (Vahl) P. Kumm.: On fir stump, locality 4, 20.10.2009, A. 2936.

Oudemansiella melanotricha (Dörfelt) M.M. Moser: On fir root, locality 1, 03.09.2009, S.210.

Oudemansiella mucida (Schrad.) Höhn.: On beech branch, locality 7, 14.11.2008, S. 137.

Xerula radicata (Relhan) Dörfelt: On fir root, locality 1, 05.09.2009, A. 2427.

Pleurotaceae Kühner

Pleurotus ostreatus (Jacq.) P. Kumm.: On fir stump, locality 8, 10.09.2008, S. 048; On fir stump, locality 1, 20.10.2009, A. 2931.

Pluteaceae Kotl. and Pouzar

Pluteus atromarginatus (Konrad) Kühner: On fir stump, locality 10, 07.10.2008, S. 72.

Psathyrellaceae Vilgalys, Moncalvo and Redhead
Coprinellus disseminatus (Pers.) J.E. Lange: On beech

stump, locality 2, 20.04.2008, S. 19.

Coprinellus micaceus (Bull.) Vilgalys, Hopple and Jacq. Johnson: On rotten beech trunk, locality 4, 07.10.2008, S. 101.

Schizophyllaceae Qué. l.

Schizophyllum commune Fr.: On beech stump, locality 4, 10.09.2008, S. 67.

Strophariaceae Singer and A.H. Sm.

Hypoholoma fasciculare var. *fasciculare* (Huds.) P. Kumm.: On fir stump, locality 8, 10.09.2008, S. 062; On fir stump, locality 10, 07.10.2008, S. 90; On rotten fir root, locality 1, 03.09.2009, S. 219; On fir stump, locality 10, 05.09.2009, A. 2403; On fir stump, locality 6, 12.11.2009, S. 408.

Pholiota limonella (Peck) Sacc.: On fir trunk, locality 3, 05.10.2009, S. 304.

Pholiota lucifera (Lasch) Qué. l.: On fir rot, locality 10, 05.09.2009, A. 2406.

Stropharia caerulea Kreisel: In beech forest, locality 2, 05.10.2009, S. 336.

Tricholomataceae R. Heim ex Pouzar

Clitocybe gibba (Pers.) P. Kumm.: In fir forest, on needle litter, locality 8, 10.09.2008, S. 055.

Clitocybe gracilipes Lamoure: At fir forest edge, In grassy area, locality 3, 05.10.2009, S. 321.

Clitocybe nebularis (Batsch) P. Kumm.: In fir forest, locality 6, 12.11.2009, S. 414.

Clitocybe odora (Bull.) P. Kumm.: In beech forest, among needle litter, locality 2, 05.10.2009, S. 363.

Infundibulicybe geotropa (Bull.) Harmaja: In beech forest, locality 4, 10.09.2008, S. 065.

Lepista flaccida (Sowerby) Pat.: In fir forest, on needle litter, locality 3, 05.10.2009, S. 301.

Lepista nuda (Bull.) Cooke: In fir forest edge, In grassy area, locality 10, 07.10.2008, S. 077.

Melanoleuca graminicola (Velen.) Kühner and Maire: In fir forest edge, In grassy area, locality 6, 12.11.2009, S. 419.

Melanoleuca stridula (Fr.) Singer: In fir forest edge, In grassy area, locality 3, 05.10.2009, S. 307.

Tricholoma batschii Gulden: In fir forest, locality 10, 07.10.2008, S. 89.

Tricholoma myomyces (Pers.) J.E. Lange: In fir forest, locality 3, 05.10.2009, S. 309.

Boletales E.-J. Gilbert

Gomphidiaceae Maire ex Jülich

Chroogomphus rutilus (Schaeff.) O.K. Mill.: Under pine, locality 12, 07.10.2008, S. 119.

Gomphidius glutinosus (Schaeff.) Fr.: Under pine, locality 15, 07.10.2008, S. 121.

Paxillaceae Lotsy

Paxillus involutus (Batsch) Fr.: In fir forest edge, locality 6, 12.11.2009, S. 405.

Rhizopogonaceae Gäum. and C.W. Dodge

Rhizopogon roseolus (Corda) Th. Fr.: Under pine, locality 14, 12.11.2009, S. 438.

Suillaceae Besl and Bresinsky

Suillus collinitus (Fr.) Kuntze: Under pine, locality 11, 07.10.2008, S. 116.

Dacrymycetales Lindau

Dacrymycetaceae J. Schröt

Calocera cornea (Batsch) Fr.: On beech branch, locality 4, 07.10.2008, S. 092.

Calocera viscosa (Pers.) Fr.: On fir branch, locality 2, 05.10.2009, S. 383.

Dacrymyces stillatus Nees: On rotten fir wood, locality 4, 07.10.2008, S. 110.

Geastrales K. Hosaka and Castellano.

Geastraceae Corda.

Geastrum fimbriatum Fr.: In beech forest, locality 3, 05.10.2009, S. 296.

Geastrum triplex Jungh: In fir forest, locality 8, 10.09.2008, S. 056.

Gloeophyllales Thorn

Gloeophyllaceae Jülich

Gloeophyllum sepiarium (Wulfen) P. Karst.: On fallen fir trunk, locality 3, 12.05.2008, S. 025.

Gomphales Jülich

Clavariadelphaceae Corner

Clavariadelphus truncatus (Quél.) Donk: In fir forest, locality 6, 12.11.2009, S. 402.

Gomphaceae Donk

Ramaria flava (Schaeff.) Quél.: In fir forest, locality 1, 03.09.2009, S. 203.

Hymenochaetales Oberw.

Hymenochaetaceae Imazeki and Toki

Inonotus triqueter (Alb. and Schwein.) Teixeira: On fir stump, locality 8, 05.09.2009, A. 2915.

Phellinus hartigii (Allesch. and Schnabl) Pat.: On fallen fir trunk, locality 1, 20.04.2008, S. 004; On fallen fir trunk, locality 10, 07.10.2008, S. 087; On fir, locality 6, 14.11.2008, S. 127; On fir, locality 8, 13.04.2009, S. 157.

Polyporales Gäum.

Fomitopsidaceae Jülich

Fomitopsis pinicola (Sw.) P. Karst.: On fallen fir trunk, locality 1, 20.04.2008, S. 001; On fir stump, locality 10, 07.10.2008, S. 071; On fir stump, locality 6, 14.11.2008, S. 126; On fallen fir trunk, locality 8, 13.04.2009, S. 157; On fallen fir trunk, locality 3, 06.05.2009, S. 170.

Ischnoderma benzoinum (Wahlenb.) P. Karst.: On fir stump, locality 1, 03.09.2009, S. 207.

Phaeolus schweinitzii (Fr.) Pat.: On fir stump, locality 10, 05.09.2009, A. 2411.

Postia caesia (Schrad.) P. Karst.: On fallen fir trunk, locality 1, 03.09.2009, S. 209.

Postia stiptica (Pers.) Jülich: On fir stump, locality 3, 05.10.2009, S. 297.

Ganodermataceae Donk

Ganoderma adspersum (Schulzer) Donk: On fir stump, locality 3, 05.10.2009, S. 299.

Ganoderma applanatum (Pers.) Pat.: On willow, locality 1, 03.09.2009, S. 198.

Ganoderma carnosum Pat.: On fir stump, locality 6, 14.11.2008, S. 128.

Polyporaceae Fr. ex Corda

Cerreana unicolor (Bull.) Murrill: On beech, locality 4, 12.05.2008, S. 038; On beech, locality 2, 06.05.2009, S. 187; On beech, locality 2, 05.09.2009, A. 2398.

Fomes fomentarius (L.) J. Kickx f.: On beech stump, locality 4, 13.04.2009, S. 167.

Hapalopilus rutilans (Pers.) P. Karst.: On fallen beech trunk, locality 2, 05.09.2009, A. 2396.

Polyporus squamosus (Huds.) Fr.: On beech stump, locality 2, 05.10.2009, S. 375.

Polyporus varius (Pers.) Fr.: On beech branch, locality 9, 12.11.2009, S. 421.

Royoporus badius (Pers.) A.B. De: On willow branch, locality 1, 03.09.2009, S. 229.

Trametes versicolor (L.) Lloyd: On beech stump, locality 2, 20.04.2008, S. 011; On fallen beech trunk, locality 4, 10.09.2008, S. 064; On beech stump, locality 4, 05.09.2009, A. 2416.

Trichaptum abietinum (Dicks.) Ryvarden: On fallen fir trunk, locality 1, 20.04.2008, S. 005; On fir stump, locality 3, 12.05.2008, S. 022; On fallen fir trunk, locality 8, 13.04.2009, S. 154; On fallen fir trunk, locality 6, 12.11.2009, S. 407; On fallen fir trunk, locality 10, 05.09.2009, A. 2413.

Russulales Kreisel ex P.M. Kirk, P.F. Cannon and J.C. David

Russulaceae Lotsy

Lactarius deliciosus (L.) Gray: Under pine, locality 11, 07.10.2009, S. 114. Under juniper locality 13, 05.09.2009, A. 2434.

Lactarius salmonicolor R. Heim and Leclair: In fir forest 8, 10.09.2008, S. 061; In fir forest, locality 10, 05.09.2009, A. 2413.

Table 2. Similarity percentages of neighboring investigations with Bolu Abant Nature Park.

| Investigations | Number of common taxa | Total taxa | Similarity percentage (%) |
|------------------------|-----------------------|------------|---------------------------|
| Öder (1972) | 18 | 51 | 35.29 |
| Afyon et al. (2000) | 15 | 62 | 24.19 |
| Afyon and Konuk (2002) | 16 | 77 | 20.78 |
| Yağız et al. (2005) | 32 | 121 | 26.45 |
| Yağız et al. (2006) | 55 | 277 | 19.86 |
| Akata et al. (2009) | 38 | 110 | 34.55 |

Lactarius semisanguifluus R. Heim and Leclair: Under pine, locality 10, 05.09.2009, A. 2423.

Lactarius vellereus (Fr.) Fr.: In beech forest, locality 2, 05.09.2009, A. 2400.

Lactarius volemus (Fr.) Fr.: In fir forest, locality 3, 05.10.2009, S. 313.

Russula chloroides (Krombh.) Bres.: In fir forest, locality 8, 10.09.2008, S. 051.

Russula delica Fr.: In beech forest, locality 10, 07.10.2008, S. 075.

Russula nauseosa (Pers.) Fr.: In fir forest, locality 3, 05.10.2009, S. 327.

Stereaceae Pilát

Stereum hirsutum (Willd.) Pers.: On beech branch, locality 8, 10.09.2008, S. 066; On beech branch, locality 2, 20.04.2008, S. 008.

Tremellales Fr.

Tremellaceae Fr.

Tremella mesenterica Retz: On beech branch, locality 4, 03.09.2009, S. 257.

DISCUSSION

In this study, 103 macrofungi taxa belonging to 67 genera and 34 families were determined. Five of them belong to *Ascomycota* and 98 to *Basidiomycota*. 26.21% of the taxa in the region belong to *Agaricaceae* and *Tricholomataceae*. Fir, pine, beech, mixed forests and meadows provide very suitable conditions for members of these families. The most widespread taxa in the study area are *Fomitopsis pinicola*, *Trichaptum abietinum* and *H. fascicular* var. *fasciculare*. They are very common on dead fir trunks and stumps or living trees.

The results of this work were compared with the findings of the studies carried out in closer regions. Number of macrofungi taxa and similarity percentages are shown in Table 2. These similarities could be because of the similarities in climate, vegetation, habitat and flora.

Eight of the 103 macrofungi taxa in the research area are commonly eaten by local people. These are: *I. geotropa* (Melkadın mantarı), *L. deliciosus* (Çam kanlıcası), *L. salmonicolor* (Küner kanlıcası), *M. oreades*

(Cincile mantarı), *P. ostreatus* (Kavak mantarı), *R. flava* (Tellice Mantarı), *S. collinitus* (Ayı mantarı, Ayıca), *T. myomyces* (Karakulak mantarı). There are also eight (8) poisonous macrofungi taxa in the study area. These are: *A. muscaria* var. *muscaria*, *H. fasciculare* var. *fasciculare*, *I. geophylla* var. *geophylla*, *I. geophylla* var. *lilacina*, *I. amethystina*, *M. pura*, *M. rosea* and *Paxillus involutus*.

Since the locals collect and eat only well known edible mushrooms, no poisoning event were recorded from the area.

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