

Myxomycete diversity of Uludağ National Park, Turkey

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ABSTRACT — A checklist of the myxomycetes found in Uludağ National Park (Bursa Province, Turkey) revealed a diverse biota. A total of 61 collections of myxomycetes made in the Kirazlı Plateau and upper region was represented by 35 taxa (34 species and 1 variety) in 19 genera. The taxa were distributed among 10 families. These were the *Arcyriaceae* (6 taxa), *Ceratiomyxaceae* (1), *Cribrariaceae* (2), *Dianemataceae* (1), *Echinosteliaceae* (1), *Liceaceae* (1), *Physaraceae* (8), *Reticulariaceae* (4), *Stemonitaceae* (6), and *Trichiaceae* (5). The ecology of the National Park is discussed.

KEY WORDS — Bursa city, myxobiota, slime fungi, distribution, Turkey

Introduction

Uludağ is the highest mountain in the Marmara region of Turkey, where Europe meets Asia around the Marmara sea. The region includes the whole of European Turkey and North Western Anatolia. The mountain, which was previously known as Olympus Misius, Bithyninn Olympus and Keşiş Dağı, was renamed as Uludağ in 1925. The entire mountain range is about 40 km long and 15–20 km wide. It extends from the western parts of Bilecik and Kütahya provinces in a northwesterly direction to the Bursa Province. The elevation varies between 750 m and 2543 m. High plateaus on the northern side of the mountain include Kirazlıyayla, the Sarıalan Plateau and Kadiyayla (Fig. 1). Glacial valleys are found at the summit, and glacial lakes (Aynalı Göl, Kara Göl, Kilimli Göl) are evidence of this glaciation (Çetin 1999). Uludağ was designated as a national park and natural protection area in 1961. Uludağ National Park has a very high incidence of endemic plants and hence it is designated as an “Important Plant Area” of Turkey according to the International Bern Convention. In total, 137 plant species are endemic to Uludağ and thirty of these are unique to the mountain (Özhatay et al. 2003, Kaynak et al. 2008). Three globally endangered plant species are found on Uludağ Mountain and another 54 are endangered in Europe.

Geologically, Uludağ Mountain has experienced oscillating glaciation, with the maximum occurring no later than 20.3 ± 1.5 ka ago, with post glaciation stabilization beginning approximately 15 ± 1 ka years ago (Zahno et al. 2010). The mountain is formed of a nucleus consisting largely of granite, gneiss and marble of Paleozoic age along with Mesozoic ophiolite. Paleozoic granites are found mainly in the higher areas. In general, soil is deposited on the bedrock and ranges from terra rossa at lower elevations to podzol-like brown forest soil at higher elevations (Zech & Çepel 1977). Surface soils at elevations greater than 1000 meters contain rich, dark organic detrital material, especially in densely forested areas. Soils are often acidic (*ca.* pH 5, Atalay 2002). Data for the regional climate were compiled from the nearest weather stations—Yeşilkonak (1025 m) and Zirve (1877 m) (Fig. 2). The average annual rainfall is *ca.* 1180 mm in Yesilkonak and *ca.* 1464 mm in Zirve. Uludağ National Park is part of the mediterranean domain, with a short dry period in summer and rainfall in both spring and autumn, these correlate with elevation and dominant vegetation. In the context of these data and ombrothermic diagrams, the climate of Uludağ Mountain is described as a subsector of the rainy Mediterranean bioclimatic stratum (Atalay 2002, Akman 1990).

The combination of long geographical isolation, an unusual range of climatic conditions, and being located at the junction of Mediterranean and Euro-Siberian floristic regions, has resulted in a unique vegetation in the region (Çetin B. 1999). The composition of the flora is 63% Euro-Siberian, 32% Mediterranean and 6% Irano-Turanian. From this, it is clear that the region has traces of three separate Phytogeographic Zones. Six bioclimatic zones are found on Uludağ Mountain and in the national park. These are *Lauretum* (0–350 m), *Castanetum* (350–700 m), *Fagetum* (750–1100 m), *Pinetum* (1100–1400 m), *Abietum* (1400–2050 m) and *Alpinetum* (2050–2543 m) (Özhatay & Çırpıcı 1987). The *Fagetum*, *Pinetum*, *Abietum* and

Alpinetum zones harbor some of the endemic elements of the vegetation. The national park boundary begins at an elevation of approximately 1200 meters and extends to the summit of the mountain. At lower elevations the vegetation consists of mixed forests, which in some areas are dominated by *Pinus nigra* subsp. *pallasiana* but with scattered trees of *Castanea sativa*, *Carpinus betulus*, *Populus tremula* and *Quercus petraea* subsp. *petraea*. In other areas *Fagus arientalis* is predominant.

In the upper part of Kirazlıyayla (Kirazlı plateau, 1400 m), the vegetation is dominated by forests of *Abies nordmanniana* subsp. *bornmuelleriana*, but *Fagus orientalis*, *Pinus nigra* subsp. *pallasiana* var. *caramanica*, *Carpinus betulus*, *Juniperus communis* var. *saxatilis*, *Vaccinium myrtillus*, *Salix caprea*, *Daphne pontica* and several other species are also found as scattered trees (Çetin 1999, Kaynak et al. 2008). Several temporary small streams with seasonal flow are found on the plateau and in surrounding areas. A dense canopy covers exists on and around the plateau. The overall high humidity, punctuated with a short dry season, heavy canopy with diminished light intensity and rich organic matter provide optimal macro- and microclimatic conditions for the vegetative development and sporulation of myxomycetes (Stephenson 1989). The primary objective of the study reported herein was to document the occurrence of myxomycetes in the forests of Uludağ National Park and to develop a better understanding of their distribution and ecology in this biologically important region of Turkey.

Materials & methods

In the present study specimens of myxomycetes were collected by different researchers in the Bursa-Uludağ National Park between 1983 and 2004. The collections were made during random excursions as allowed by the weather, but most collections were made during August and September. All of the mature sporangia of myxomycetes were collected directly from natural substrata, including forest floor debris, logs, twigs, and decaying wood. Regional records were reviewed and compiled from previously published studies (Härkönen 1988, Ergül 1993, Ergül & Gücin 1994, Lado 1994, Gücin & Ergül 1995, Gün 1995, Ergül & Dülger 2000a,b, 2002). Additional records were added from the unpublished collections of the authors. Routine microscopic observations were made of permanent or semipermanent preparations in Hoyer's or other media. Taxonomic characterizations of collections were accomplished by using morphological data obtained from microscopic investigations of the specimens. Identifications were made using several keys, including Martin & Alexopoulos 1969; Farr 1976; Nannenga-Bremekamp 1991; Ing 1999. Nomenclature used herein follows Lado (2001) and Hernández-Crespo & Lado (2005), with the conserved names of several genera (Lado et al. 2005, Lado 2011), recently approved by the Committee for Fungi (Gams 2005) of the IAPT. Taxon distribution, ecological affinities, locality (to assist in definition of substratum preference), habitat characteristics, dates and all collecting numbers (institutional herbaria and personal herbaria) are indicated. A total of 61 specimens were included, most of which were deposited in the herbarium of the Uludağ University (BULU) and in the personal collection of Cem Ergül (C.E.), Department of Biology, Uludağ University, with a small percentage of the remaining samples deposited in the personal collections of the individual who collected them. A map of the study area and climate diagrams are provided (Fig.1,2).

Discussion

In total, 61 samples were obtained from 21 localities in the study area. These taxa were distributed among 35 taxa (19 genera, 34 species and 1 variety) in six orders and 10 families. The order *Trichiales* was the most diverse group, with 11 species and 1 variety, followed by the *Physarales* (8 species), *Liceales* (7 species), *Stemonitales* (6 species), *Echinosteliales* and *Protosteliales* (each with 1 species). The most genera represented by the most species were *Arcyria* (6 species), *Trichia* (5 species and one variety), *Physarum* (4 species), *Badhamia*, and *Cribraria*, *Lycogala*, *Paradiacheopsis* (each with 2 species). Genera represented by single species were *Ceratiomyxa*, *Dianema*, *Echinostelium*, *Enerthenema*, *Fuligo*, *Lamproderma*, *Leocarpus*, *Licea*, *Macbrideola*, *Reticularia*, *Stemonitopsis* and *Tubifera*. *Arcyria cinerea*, *Echinostelium minutum*, *Lamproderma arcyrioides*, *Licea castanea*, *Macbrideola synspsoros*, *Paradiacheopsis rigida*, *P. solitaria* and *Trichia favoginea* were recovered only from moist chambers. In contrast, *Arcyria incarnata*, *A. versicolor* and *Enerthenema papillatum* were recovered both in field studies and in moist chamber. Two moist chamber specimens (*Paradiacheopsis rigida* and *Enerthenema papillatum*) were recorded from same locality as plasmodia found under snow cover. The remaining specimens were gathered only from the field on natural substrata. *Arcyria versicolor*, *Echinostelium minutum*, *L. arcyrioides*

and *T. favoginea*, among the first myxomycetes recorded for Uludağ National Park (Härkönen 1988), were recovered from moist chamber incubation. Myxomycetes such as species of *Licea* produce very small sporangia that are difficult to see and are thus rarely collected: as such they are considered to be rare. However, these small sporangial myxomycetes are observed more often following incubation in moist chamber, when they are revealed by microscopic observation of substrata.

The most widespread species, *Enerthenema papillatum*, fruited on 5 different substrata; other widespread species *Echinostelium minutum* and *Leocarpus fragilis* were found on 4 substrata; *Arcyria versicolor*, *Ceratiomyxa fruituculosa*, *Lycogala epidendrum*, *L. exiguum*, *Stemonitopsis typhina*, *Perichaena corticalis* were recovered from 3 substrata, and *Arcyria cinerea*, *A. denudata*, *A. incarnata*, *Cribraria argillacea*, *Fuligo septica*, *Physarum album*, *Trichia varia*, *Tubifera ferruginosa* were each found on 2 different substrata. *Arcyria insignis*, *A. obvelata*, *Badhamia foliicola*, *B. cf. utricularis*, *Cribraria cancellata*, *Dianema repens*, *Lamproderma arcyrioides*, *Licea castanea*, *Macbrideola synsporos*, *Paradiacheopsis rigida*, *P. solitaria*, *Physarum flavicomum*, *P. leucophaeum*, *P. viride*, *Reticularia splendens*, *Trichia botrytis*, *T. decipiens*, *T. decipiens* var. *olivacea*, *T. favoginea* were found only once, therefore substratum preference is impossible to determine.

The dominant plant species *Abies nordmanniana* subsp. *bornmuelleriana*, *Fagus orientalis*, and *Pinus nigra* subsp. *pallasiana* var. *caramanica* were the most common substrata for myxomycetes, but most collections were recovered from *Abies*. Thirty-one taxa of myxomycetes were gathered from trunks, stems or stumps of *Abies*. A much smaller number of species were gathered from the other gymnospermous substratum represented by *Pinus*. (1 species) and from the angiospermous *F. orientalis* (2 species), *Castanea sativa* and *Quercus* sp. (1 species each). Corticolous and lignicolous species tend to be substratum-specific, with relative abundance corresponding to the relative numbers of the dominant forest trees. Despite the presence of abundant leaf litter in study areas, the paucity of foliicolous species was unexpected. The main reason why so many more corticolous and lignicolous species were encountered could be the abundance of appropriate substrata such as fallen logs, twigs, soggy timbers and decaying wood in a favorable condition. However, the reasons for this bias also might be related to the non-random and limited selection of the study periods, localities and substrata.

Prevailing macroclimatic features in the region were obtained and determined from the meteorology station in Uludağ (Yeşilkonak, 1025 m), which is situated near the study area (Anonymous, 1995). In this context, the climate of Uludağ National Park is characterized by a short dry period in summer and rainfall in spring and autumn (Fig. 2). The best months for finding myxomycetes in the park are the summer months of July, August and September, when there is less rain (ca. 38.2 mm on average for the three months), relative humidity is apparently optimal (Rh. 68 %, average of three months) and the temperature is mild (an average of combined day and night temperature is 16.6 °C). This is the time of year when most myxomycetes are known to sporulate. Therefore, this is the time when most collecting was conducted. Additional species may sporulate or be present as plasmodia during other times of the year and are potentially missed by surveys. This should be kept in mind when considering the total myxomycete biota of this region.

A similar study was done by Castillo et al. (2009) in a similar region in Spain. National Cabaneros National Park in Spain, located in the center of the Iberian Peninsula, is also in the Mediterranean climate belt. The dominant vegetation of this national park is sclerophilic woodlands of *Quercus* sp. However, as a result of deforestation of the region, *Pinus pinaster* has become common. From Cabaneros National park, 57 different taxa (55 species and 2 varieties) in 21 different genera were determined in a one year period under field and study conditions similar to those of our Turkish study except that material was collected in the field and did not include samples from moist chamber cultures except for two field-collected plasmodia that formed fruiting bodies in the laboratory. Castillo et al. (2009) identified six species in the *Liceales*, one species in the *Protosteliales*, twenty five species (one of variety) in the *Physarales*, eight species in the *Stemonitales* and 17 species (including one variety) in the *Trichiales*. Our collections were distributed among six orders (*Echinosteliales*, *Liceales*, *Physarales*, *Protosteliales*, *Stemonitales* and *Trichiales*), and were represented by 35 taxa (34 species and 1 varieties) in 19 genera. However, we encountered species in several genera (*Dianema*, *Echinostelium*, *Macbrideola*, *Paradiacheopsis*, *Stemonitopsis* and *Tubifera*) that were not reported in the Spanish study. Uludağ National Park is largely undisturbed by human activity and thus the primary causes of change are natural. However, Cabaneros National Park has been deforested,

with consequent disturbance of the entire microbiota and macrobiota, and this may explain the differences in the myxomycete biotas between the two forests.

When all of the environmental factors are considered for the study area, it is clear that Uludağ National Park provides a most productive situation for the proliferation of myxomycetes. The first records of myxomycetes from Uludağ National Park were published in 1988 by the Finnish mycologist Harkönen, who recorded four taxa (*Lamproderma arcyrioides*, *Arcyria versicolor*, *Echinostelium minutum* and *Trichia favoginea*). In this paper we list 35 taxa (34 species and 1 varieties) based on new collecting, scattered publications that have appeared since 1983 and unpublished notes and collections of various authors (Harkönen 1988, Ergül 1993, Ergül & Gücin 1994, Gücin & Ergül 1995, Gün 1995, Ergül & Dülger 2000, 2002, Castillo et al. 2009).

For the first time we correlate myxomycete occurrence with the prevailing ecological conditions of the general study area. The study reported herein was carried out in a narrow range of seasonal periods of different years. Most collecting was carried out in late summer. Therefore, the specimens of myxomycetes reported in this study do not show their seasonal distributions. For the analysis and identification of the seasonal distribution of Uludağ myxomycetes, specimens must be collected throughout the year. This type of study will reflect the realistic temporal and spatial distribution of myxomycetes in the region. Nevertheless, the present study highlights the amazing diversity of myxomycetes of Uludağ National Park. Moreover, it contributes to the documentation of the myxobiota of Turkey and augments the already known plant diversity in the park. It is impossible to ensure overall protection and kind of special environmental protection plan in a scientific manner for any area without having full knowledge of all the biotic elements in the area in question. For this reason we present the first study of myxomycetes for a Turkish national park.

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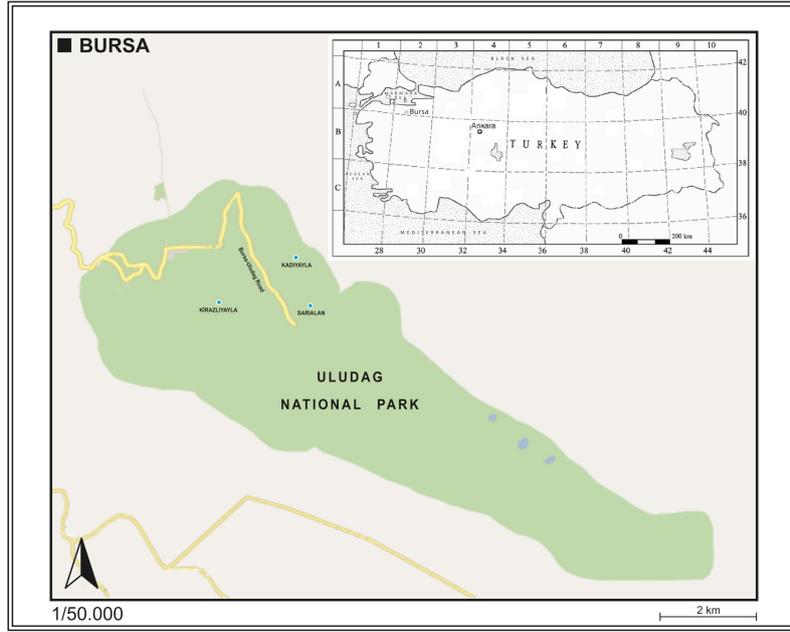


Figure 1. A map of Turkey, with a grid system, and the study area.

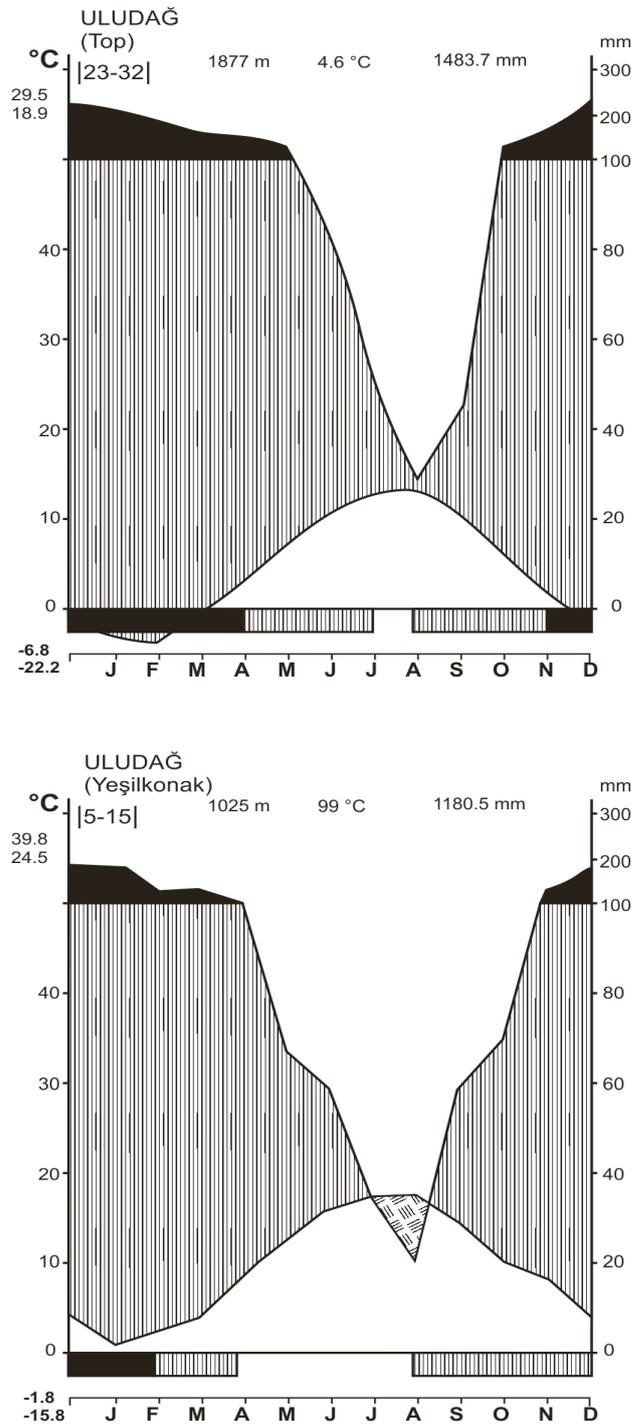


Figure 2. Climate diagrams for Uludağ-Yeşilkonak and Uludağ-Top (redrawn from Güteryüz 1992 for Uludağ-Top and ERGÜL 1987 for Uludağ-Yeşilkonak after Walter & Lieth 1960-67).

▨ : Humide period ▩ : Arid period ■ : Upper 100 mm rain

Taxonomic Catalogue**Order Protosteliales**Genus: *Ceratiomyxa*1 species, *C. fruticulosa*.**Order Echinosteliales**Genus: *Echinostelium*1 species, *Echinostelium minutum*.**Order Liceales**Genera: *Cribraria*, *Licea*, *Lycogala*, *Reticularia*, *Tubifera*.*Cribraria*, 2 species: *C. argillacea*, *C. cancellata*.*Licea*, 1 species: *L. castanea*.*Lycogala*, 2 species: *L. epidendrum*, *L. exigium*.*Reticularia*, 1 species: *R. splendens*.*Tubifera*, 1 species: *T. ferruginosa*.**Order Physarales**Genera: *Badhamia*, *Fuligo*, *Leocarpus*, *Physarum*.*Badhamia*, 2 species: *B. foliicola*, *B. cf. utricularis*.*Fuligo*, 1 species: *F. septica*.*Leocarpus*, 1 species: *L. fragilis*.*Physarum*, 4 species: *P. album*, *P. flavicomum*, *P. leucophaeum*, *P. viride*.**Order Stemonitales**Genera: *Enerthenema*, *Lamproderma*, *Macbrideola*, *Paradiacheopsis*, *Stemonitopsis*.*Enerthenema*, 1 species: *E. papillatum*.*Lamproderma*, 1 species: *L. arcyrioides*.*Macbrideola*, 1 species: *M. synsporos*.*Paradiacheopsis*, 2 species: *P. rigida*, *P. solitaria*.*Stemonitopsis*, 1 species: *S. typhina*.**Order Trichiales**Genera: *Arcyria*, *Dianema*, *Trichia*.*Arcyria*, 6 species: *A. cinerea*, *A. denudata*, *A. incarnata*, *A. insignis*, *A. obvelata*, *A. versicolor*.*Dianema*, 1 species: *D. repens*.*Trichia*, 4 species and 1 variety: *T. botrytis*, *T. decipiens*, *T. decipiens* var. *olivacea*, *T. favoginea*, *T. varia*.

In total, 35 taxa (34 species and 1 varieties) in 19 genera.

List of Species**Ceratiomyxaceae****- *Ceratiomyxa fruticulosa* (O.F. Müll.) T. Macbr.**

Material studied: Bursa-Uludağ Kirazlı Plateau, by the main road, Dolubaba district, on *Pinus nigra* subsp. *nigra* var. *caramanica*, 13.10.1991, C.E. 114. Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Uludağ Kirazlı Plateau, Uludağ Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

Collection notes: All of the samples were collected from the field studies on fallen and rotten log of *Pinus* and *Abies*.

Liceaceae**- *Licea castanea* G. Lister**

Material studied: Bursa-Uludağ Kirazlı Plateau, near Ministry of Finance Rest Hotel, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 02.03.1997, C.E. 168.

Collection notes: The sample material was recovered from snowy twigs that is subsequently sporulated in a moist chamber with *Arcyria cinerea*, *Echinostelium minutum*, *Enerthenema papillatum* and *Paradiacheopsis rigida*.

Surely this taxon will be recovered more frequently in future moist chamber incubations.

Reticulariaceae (=Enteridiaceae)**- *Lycogala epidendrum* (L.) Fr.**

Material studied: Bursa-Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Ibidem, on *Fagus orientalis* 22.06.2000, C.E. 194. Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

Collection notes: The samples were gathered from similar myxobiotic field conditions on fallen twigs and rotten log of *Abies* and decayed wet log of *Fagus* in nearby areas.

- *Lycogala exiguum* Morgan

Material studied: Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper zone, on *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E.191. Ibidem, on *Abies nordmanniana* subsp. *bornmuelleriana*, 24.09.1999, C.E. 192. Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 27.08.2004, C.E. 361.

Collection notes: The samples were obtained from moist and shaded areas on forest floor from fallen and rotten log and decayed twigs which is on the edge of the brook bed.

- *Reticularia (=Enteridium) splendens* (Morgan)

Material studied: Bursa-Uludağ Kirazlı Plateau, from stump of *Abies nordmanniana* subsp. *bornmuelleriana*, 07.05.1994, C.E. 150.

- *Tubifera ferruginosa* (Batsch) J.F. Gmel.

Material studied: Bursa-Uludağ Kirazlı Plateau, Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 24.09.1999, C.E. 192. Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 27.08.2004, C.E. 361.

Collection notes: The samples were obtained from moist and shaded areas of the forest floor from fallen and rotten log and decayed twigs which is on the edge of the brook bed.

Cribrariaceae

- *Cribraria argillacea* (Pers. ex J. F.Gmel.) Pers.

Material studied: Bursa-Uludağ Kirazlı Plateau, vicinity of Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Ibidem, from *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191.

Collection notes: Two samples were collected from fallen twigs and rotten logs that is under similar macroclimatic conditions in close the same days of the year.

- *Cribraria cancellata* (Batsch) Nann.-Bremek.

Material studied: Bursa-Uludağ Kirazlı Plateau, vicinity of Forest Ministry of Uludağ National Park recreational area, on fallen twigs and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186.

Dianemataceae

- *Dianema repens* G. Lister & Cran

Material studied: Bursa-Uludağ Kirazlı Plateau, Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191.

Echinosteliaceae

- *Echinostelium minutum* de Bary

Material studied: Bursa-Uludağ, by the gate of the National Park, mc, 21.05.1983, by M. Harkönen, Specimen No:7. Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel an upper region, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 30.04.1994, GÜN 48-159. Uludağ Kirazlı Plateau, near Ministry of Finance Rest Hotel, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 02.03.1997, C.E. 168. Ibidem, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 17.09.1999, C.E. 191.

Collection notes: It was one of the first recorded myxomycetes (numbered 7) for Uludağ National Park from *Pinus nigra* forest, on bark of *Pinus sp.*, *Castanea sp.* and *Quercus sp.* (Harkönen 1988). The sample material of numbered 168, recovered from snowy twigs that is subsequently sporulated in a moist chamber with *Arcyria cinerea*, *Enerthenema papillatum*, *Lice castanea* and *Paradiacheopsis rigida*.

Arcyriaceae

- *Arcyria cinerea* (Bull.) Pers.

Material studied: Bursa-Uludağ Kirazlı Plateau upper zone, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 17.05.1989, C.E. 23. Uludağ Kirazlı Plateau, near Ministry of Finance Rest Hotel, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 02.03.1997, C.E. 168.

Collection notes: The sample material of numbered 168 recovered from snowy twigs of *Abies* that is subsequently sporulated in a moist chamber with *Echinostelium minutum*, *Enerthenema papillatum*, *Lice castanea* and *Paradiacheopsis rigida* from state on a plasmodium.

- *Arcyria denudata* (L.) Wettst.

Material studied: Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

- *Arcyria incarnata* (Pers. ex J.F. Gmel.) Pers.

Material studied: Bursa- Uludağ Kirazlı Plateau upper zone, from *Abies nordmanniana* subsp. *bornmuelleriana*, mc 17.05.1989, C.E. 22. Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186.

Collection notes: The samples obtained on forest floor litter, fallen twigs and rotten logs of *Abies*.

- *Arcyria insignis* Kalchbr. & Cooke

Material studied: Bursa-Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on brook bed, from wetted and decayed log of *Fagus orientalis*, 22.06.2000, C.E. 193.

- *Arcyria obvelata* (Oeder) Onsberg

Material studied: Bursa- Uludağ Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on fallen twigs and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186.

- *Arcyria versicolor* W. Phillips

Material studied: Bursa-Uludağ National Park, by the main road just below the watering place (Devetaşı Piknik yeri), *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 21.05.1983, M. Harkönen, Specimen No:5. Bursa-Uludağ Kirazlı Plateau lower zones, on *Abies nordmanniana* subsp. *bornmuelleriana*, 20.05.1994, GÜN 52-175. Uludağ Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186.

Collection notes: It was one of the first record on myxomycetes (numbered 5) in the national park from decaying trunk of *Abies* (Harkönen 1988). The other samples obtained from forest floor litter, fallen twigs, rotten log and decaying trunk of *Abies*.

Trichiaceae

- *Trichia botrytis* (J.F. Gmel.) Pers.

Material studied: Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

- *Trichia decipiens* (Pers.) T. Macbr.

Material studied: Bursa-Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on brook bed, from wet and decayed twigs and log of *Abies nordmanniana* subsp. *bornmuelleriana*, 27.08.2004, C.E. 361.

- *Trichia decipiens* var. *olivacea* (Meyl.) Meyl.

Material studied: Uludağ Kirazlı Plateau, near from Kirazlı Hotel facilities, the lower part of water reservoir, wet and decaying undetermined fallen branches of woody species (possibly *Abies* sp.), 17.11.2002, C.E. 327.

- *Trichia favoginea* (Batsch) Pers.

Material studied: Bursa-Uludağ, by the gate of the National Park, mc, 21.05.1983, M. Harkönen, Specimen No:2.

Collection notes: It was one of the first record on myxomycetes from Uludağ National Park from decaying wood and decaying trunk of *Pinus* (Harkönen 1988).

- *Trichia varia* (Pers. ex J.F. Gmel.) Pers.

Material studied: Bursa-Uludağ Kirazlı Plateau, Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191. Ibidem, on *Abies nordmanniana* subsp. *bornmuelleriana*, 24.09.1999, C.E. 192.

Collection notes: Two of samples were collected from fallen and rotten logs that is under similar macroclimatic conditions in close the same days of the year.

Physaraceae

- *Badhamia foliicola* Lister

Material studied: Bursa- Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

- *Badhamia* cf. *utricularis* (Bull.) Berk.

Material studied: Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191.

- *Fuligo septica* (L.) F.H. Wigg.

Material studied: Bursa-Uludağ Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

Collection notes: Two of samples were collected from fallen and rotten logs that is under similar macroclimatic conditions in different years.

- *Leocarpus fragilis* (Dicks.) Rostaf.

Material studied: Bursa-Uludağ National Park, by the main road, lower zone of Kirazlı plateau, Hamuralan district, on *Abies nordmanniana* subsp. *bornmuelleriana*, 29.08.1989, C.E. 38. Kirazlı Plateau, Kirazlı Hotel facilities upper zone, on *Abies nordmanniana* subsp. *bornmuelleriana*, 04.06.1994, C.E. 151. Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Ibidem, on *Fagus orientalis*, 22.06.2000, C.E. 194.

Collection notes: The samples obtained on forest floor litter, on bark of fallen and rotten logs of *Abies* and decayed log of *Fagus*.

- *Physarum album* (Bull.) Chevall.

Material studied: Bursa-Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on fallen twigs and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186.

- *Physarum flavicomum* Berk.

Material studied: Bursa-Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on brook bed, from wet and decayed log of *Fagus orientalis*, 22.06.2000, C.E. 193.

- *Physarum leucophaeum* Fr.

Material studied: Bursa-Uludağ National Park, by the main road, lower zones of Kirazlı plateau, Hamuralan district, on bark of fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 29.08.1989, C.E. 38.

- *Physarum viride* (Bull.) Pers.

Material studied: Bursa-Uludağ Kirazlı Plateau, University of Uludağ Kirazlı Hotel facilities upper region, on fallen and rotten log of *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191.

Stemonitaceae**- *Enerthenema papillatum* (Pers.) Rostaf.**

Material studied: Bursa-Uludağ Kirazlı Plateau, Uludağ Kirazlı Hotel facilities on *Abies nordmanniana* subsp. *bornmuelleriana*, 04.06.1994, C.E. 151. Uludağ Kirazlı Plateau, near Ministry of Finance Rest Hotel, on *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 02.03.1997, C.E. 168. Uludağ, Kirazlı Plateau, around from Forest Ministry of Uludağ National Park recreational area, on *Abies nordmanniana* subsp. *bornmuelleriana*, 01.09.1999, C.E. 186. Ibidem, on *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191. Ibidem, on *Abies nordmanniana* subsp. *bornmuelleriana*, 14.09.2000, C.E. 201.

Collection notes: The sample material of numbered 168, recovered from snowy twigs that is subsequently sporulated in a moist chamber from state on a plasmodium with *Arcyria cinerea*, *Echinostelium minutum*, *Licea castanea* and *Paradiacheopsis rigida*. The other samples gathered from field studies on fallen and rotten logs.

- *Lamproderma arcyrioides* (Sommerf.) Rostaf.

Material studied: Bursa-Uludağ National Park, by the main road just below the watering place (Devetaşı Piknik yeri), from *Abies nordmanniana* subsp. *bornmuelleriana* forest, mc, 21.05.1983, M. Harkönen, Specimen No:1.

Collection notes: It was one of the first record of myxomycetes from Uludağ National Park on litter edge of melting snow (Harkönen 1988).

- *Macbrideola synsporos* (Alexop.) Alexop.

Material studied: Bursa-Uludağ Kirazlı Plateau upper section, Sarıalan district, near brook line, on bark from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 30.04.1994, GÜN 36-125.

- *Paradiacheopsis rigida* (Brändzä) Nann.-Bremek.

Material studied: Bursa-Uludağ Kirazlı Plateau, near Ministry of Finance Rest Hotel, on *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 02.03.1997, C.E. 168.

Collection notes: The sample material recovered from snowy twigs of *Abies* and the latter subsequently sporulated in a moist chamber with *Arcyria cinerea*, *Echinostelium minutum*, *Enerthenema papillatum* and *Licea castanea*.

- *Paradiacheopsis solitaria* (Nann.-Bremek.) Nann.-Bremek.

Material studied: Bursa-Uludağ Kirazlı Plateau upper zones, on bark from *Abies nordmanniana* subsp. *bornmuelleriana*, mc, 07.08.1993, GÜN 11-24.

- *Stemonitopsis typhina* (F.H. Wigg.) Nann.-Bremek.

Material studied: Bursa-Uludağ Kirazlı Plateau, Uludağ Kirazlı Hotel facilities upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 17.09.1999, C.E. 191. Ibidem, on *Abies nordmanniana* subsp. *bornmuelleriana*, 24.09.1999, C.E. 192. Uludağ Kirazlı Plateau, Kirazlı Hotel upper region, on *Abies nordmanniana* subsp. *bornmuelleriana*, 27.08.2004, C.E. 361.

Collection notes: The samples were gathered on fallen and rotten logs and twigs of *Abies* near brook bed under similar myxobiotic field conditions.

Literature cited

- Akman Y. 1990. İklim ve Biyoiklim. Ankara, Palme Yayın Dağıtım, No 103, Ankara, Turkey.
- Anonymous. 1995. Devlet Meteoroloji İşleri Genel Müdürlüğü, Ankara, Turkey.
- Atalay İ. 2002. Ecoregions of Turkey. Meta Basımevi, p.72–80, İzmir.
- Castillo A, Moreno G, Illana C. 2009. Myxomycetes from Cabaneros National Park (Spain). Bol Soc Micol. Madrid 33: 149–170.
- Çetin B. 1999. The Moss Flora of the Uludağ National Park (Bursa / Turkey). Turk J Bot 23: 187–193.
- Ergül CC. 1987. The Anatomical Studies on *Thlaspi jaubertii* Hedge. MSc Thesis. University of Uludağ, Graduate School of Natural and Applied Sciences, Bursa, Turkey.
- Ergül CC. 1993. Marmara Bölgesinin Anadolu Kesiminden Toplanan Myxomycetes Türleri Üzerinde Taksonomik Araştırmalar. PhD Thesis, University of Uludağ, Graduate School of Natural and Applied Sciences, Bursa, Turkey.
- Ergül CC, Gücin F. 1994. Türkiye Myxomycetleri için Yeni Bir Kayıt (*Fuligo septica* (L.) Wiggers). XII. Ulusal Biyoloji Kongresi, Bot. Sect., Cilt II, 157–159, Edirne.
- Ergül CC, Dülger B. 2000a. Myxomycetes of Turkey. Karstenia 40: 39–41.
- Ergül CC, Dülger B. 2000b. Three New Records of *Paradiacheopsis* Hertel for The Turkish Myxomycetes Flora. Proceedings of the 2nd Balkan Botanical Congress, 14–18 May. 2000, Vol.1:201–206, İstanbul.
- Ergül CC, Dülger B. 2002. New record for the myxomycetes flora of Turkey. Turk J Bot 26: 277–280.
- Farr ML. 1976. Flora Neotropica. Monograph No 16, Myxomycetes, The New York Botanical Garden, USA. 305 pp.
- Gams W. 2005. Report of the Committee for Fungi: 13. Taxon 54: 828–830.
- Gücin F, Ergül CC. 1995. A new myxomycetes genus (*Enteridium*) record for the Turkish mycoflora. Turk J Bot 19: 565–566.
- Güleryüz G. 1992. The studies on the nutrient turnover and productivity at some plant communities of Uludağ alpine region. PhD Thesis, University of Uludağ, Graduate School of Natural and Applied Sciences, Bursa, Turkey.
- Gün Z. 1995. Uludağ'ın farklı vejetasyon zonlarındaki ağaç kabuklarından izole edilen myxomycetes türleri üzerinde taksonomik bir araştırma. MSc Thesis, University of Uludağ, Graduate School of Natural and Applied Sciences, Bursa, Turkey.
- Härkönen M. 1987 (1988). Some additions to the knowledge of Turkish Myxomycetes. Karstenia 27: 1–7.
- Hernández-Crespo JC, Lado C. 2005. An on-line nomenclatural information system of Eumycetozoa. <http://www.nomen.eumycetozoa.com> (accessed November 2010).
- Ing B. 1999. The Myxomycetes of Britain and Ireland. The Richmond Publishing Co. Ltd. (England). 374 pp.
- Kaynak G, Daşkın R, Yılmaz Ö. 2008. Bursa Bitkileri. p. 13–26, Bursa.
- Lado C. 1994. A checklist of myxomycetes of Mediterranean countries. Mycotaxon 52: 117–185.
- Lado C. 2001. Caudernos De Trabaja De Flora Micologica Iberica, 16, Nomenmyx. Consejo Superior De Investigaciones Cientificas Real Jardin Botanico: Madrid (Spain). 219 pp.
- Lado C, Eliasson U, Stephenson SL, Estrada-Torres A, Schnittler M. 2005. Proposals to conserve the names *Amaurochaete* against *Lachnobolus*, *Ceratiomyxa* against *Famintzinia*, *Cribraria* Pers. against *Cribraria* Schrad. ex J. F. Gmel. and *Hemitrichia* against *Hyporhamma* (Myxomycetes). Taxon 54: 543–545.
- Lado C. 2011. The nomenclatural status of the genus *Tubifera* (Myxomycetes). Taxon 60 (1): 221–222.
- Martin GW, Alexopoulos CJ. 1969. The Myxomycetes. Iowa City, USA.
- Nannenga-Bremekamp NE. 1991. A Guide to Temperate Myxomycetes. Biopress Ltd. Bristol, England. 409 pp.
- Özhatay N, Çırpıcı A. 1987. Guide to Excursion (Uludağ–Bursa). F.I.P. Pharmaco-Botanical Excursion in Turkey. İstanbul.
- Özhatay N, Byfield A, Atay S. 2003. Türkiyenin Önemli Bitki Alanları. WWF Türkiye, İstanbul. Stephenson S.L. 1989. Distribution and Ecology of Myxomycetes in Temperate Forests. II. Patterns of Occurrence on Bark Surface of Living Trees, Leaf Litter and Dung. Mycologia 8: 608–621.
- Walter H, Lieth H, 1960–1967. Klimadiagramm-Weltatlas. G.Fischer, Jena.
- Zahno C, Akçar N, Yavuz V, Kubik PW, Schlüchter C. 2010. Chronology of Late Pleistocene glacier variations at the Uludağ Mountain, NW Turkey. Quater Sci Reviews 29:1173–1187. doi:10.1016/j.quascirev.2010.01.012
- Zech W, Çepel N. 1977. Anatolien-ein bodengeographischer Streifzug. Mitt.d.Geogr. Gesel. In München, Band 62, p.155–156.