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# Myxomycetes of Mustafa Kemal University campus and environs (Turkey)

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**Abstract:** In this taxonomic study, myxomycetes of Tayfur Sökmen Campus (Hatay) were collected during 2010-2011. As a result of field and laboratory studies we reported 44 species of protosteliomycetes and myxomycetes. Three of these species (*Diderma deplanatum* Fr., *Didymium megalosporum* Berk & M.A.Curtis, and *Lamproderma atrosporum* Meyl.) are recorded for the first time from Turkey. *Lamproderma atrosporum* was treated with the moist chamber cultures method in the laboratory but *Didymium megalosporum* and *Diderma deplanatum* were determined naturally. The distribution, habitat, and collection numbers of the identified species are given.

**Key words:** Hatay, fungal diversity, new records, myxomycetes, Turkey

## Introduction

Myxomycetes (acellular, non-cellular, plasmodial, or true slime moulds) are characterised by an amorphous, multinucleate, protoplasmic mass called the plasmodium as well as fruiting bodies (1-200 mm) with internally borne spores (5-20 µm). They have been known for more than 350 years based on Pankow's figure and description of *Lycogala epidendrum* (L.) Fr. (Martin & Alexopoulos, 1969).

Myxomycetes have been classified in the kingdom Plantae (class *Myxomycota*) and the kingdom Animalia (class *Mycetozoa*). Because myxomycetes are typically found in the same habitats as fungi, they were treated as taxa within the kingdom Fungi (class *Myxomycetes*). Unlike fungi, myxomycetes do not excrete extracellular, digestive enzymes, and the role of myxomycetes in the environment is not as decomposers or pathogens (Keller & Braun, 1999). Bauldauf and Doolittle (1997) conducted a phylogenetic analysis of highly conserved, elongation factor 1-alpha (EF-1α) gene sequences and showed that myxomycetes are not fungi. Physiology, morphology, life history, and genetic analysis support the classification of myxomycetes in the kingdom Protoctista along with other eukaryotic micro-organisms (Everhart & Keller, 2008).

Myxomycetes are common and relatively cosmopolitan in their distribution. They have been widely studied in worldwide, but those from Turkey are still poorly known. The number of known myxomycetes species in the world is about 1000 (Lado, 2001). The myxomycetes flora of Turkey has not been fully explored. The first extensive studies in Turkey were carried out by Finnish scientists (Härkönen & Uotila, 1983; Härkönen, 1987; Härkönen & Ukkola, 2000). In recent years some macrofungi and myxomycetes have been added to

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the Turkish myxobiota by some researchers (Baba et al., 2008; Doğan & Karadelev, 2009; Alkan et al., 2010; Doğan et al., 2011; Demirel & Kaşık, 2012). So far, 226 species of myxomycetes have been reported from Turkey (Kaşık, 2010). While much research has been done on myxomycetes, the Turkish mycoflora are still incomplete and there have been no previous studies in Hatay. Now 3 taxa have been added to the Turkish myxomycetes flora as new records: *Diderma deplanatum* Fr., *Didymium megalosporum* Berk. & M.A.Curtis, and *Lamproderma atrosporum* Meyl.

**Description of the research area**

The myxomycete specimens in the current study were collected in and around the Tayfur Sökmen Campus of Mustafa Kemal University during 2010 and 2011. The campus is located outside the city of Hatay, in Alahan village district (Figure 1).

The area is situated in the Mediterranean phytogeographical region and square C6 according to Davis's grid system (Davis, 1965-1985). The research area is surrounded to the north by the Amanos Mountains and Alahan village, to the south by Amik plain, to the west by Dikmece village, and to the east by the town of Serinyol. The altitude of the land is 100 m in the region of the highway and the village of Alahan is 350 m a.s.l.

The study area is naturally covered with *Pinus brutia* Ten., scrub vegetation, and furigana formation. In this type of vegetation the woody species *Arbutus andrachne* L., *Quercus coccifera* L., and *Phillyrea latifolia* L. are found; also, in these regions *Olea europea* L. is grown as a culture plant.

According to meteorological data from the directorate of Hatay, the highest average monthly temperature is in August (27.6 °C), while the lowest

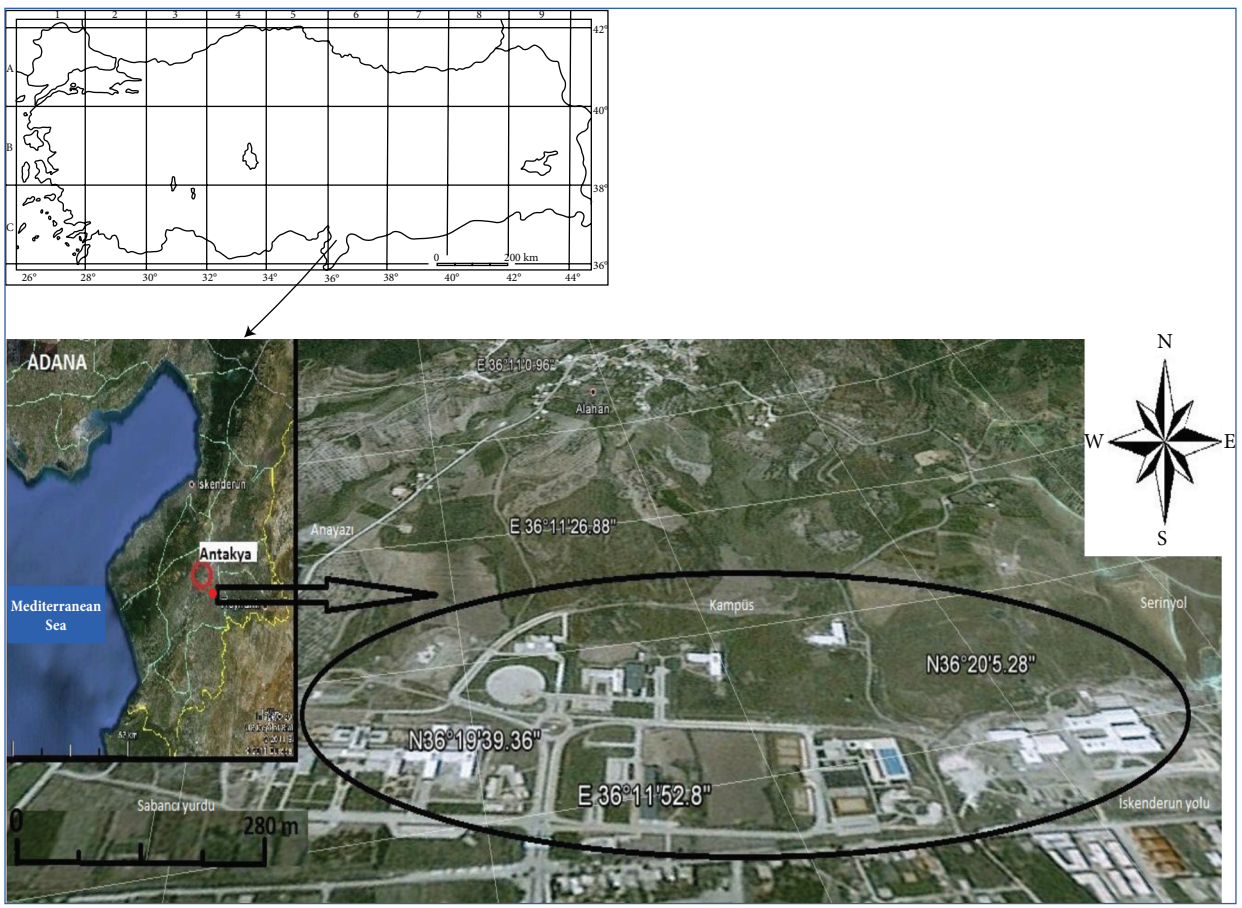


Figure 1. The research area and localities where samples were collected.

average monthly temperature is in December (7.7 °C). The average monthly maximum rainfall of Antakya is in December (192.4 mm), while the lowest average monthly rainfall is in August (3.5 mm) (MGM, 2007).

## Materials and methods

The specimens on natural substrata, bark and debris, the bark of living trees, as well as on decaying bark, wood, leaves, and litter were collected. Natural mature fructifications were gently and directly collected from the substratum and placed in cardboard herbarium boxes. In addition, the fructifications of myxomycetes were as obtained from the moist chamber culture in the laboratory. The cultures were moistened with distilled water. The moist chambers were examined every day under a dissecting microscope. When developing myxomycetes were found, the moist chamber was allowed to dry slowly and the myxomycetes were then dried for 1 week. The same chambers were then rewetted for another 4-week period and examined as before (Martin et al., 1983; Stephenson & Stempen, 2000).

Microscopic and macroscopic features of the samples were determined in the laboratory. The morphological characters examined included fruiting bodies' shape, size and colour, spore size and ornamentation, capillitium colour and branching, lime crystal size and morphology, and stalk colour and proportion. In addition, some photographs from characteristic qualitative objects were taken. All data were evaluated comparatively for taxonomical aims.

The myxomycete specimens were identified with the aid of Martin and Alexopoulos (1969), Neubert et al. (1993, 1995, 2000), and Sesli and Denchev (2008). The samples were prepared as fungarium material and stored in the laboratory of Department of Biology, Faculty of Science and Arts, Mustafa Kemal University in Hatay, and in the author's personal collection.

## Results

Forty-four species belonging to 11 families of myxomycetes from both the field and moist chamber culture were identified.

Protosteliomycetes

Protosteliales

Ceratiomyxaceae

1. *Ceratiomyxa fruticulosa* (O.F.Müll.) T.Macbr.

   Above Alahan village on wood of conifers, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 18.

Myxomycetes

Echinosteliales

Echinosteliaceae

2. *Echinostelium minutum* de Bary

   Above Alahan village on wood of conifers, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 12,17, 25. In front of Faculty of Agriculture on debris of maple, 36°19′30″N, 36°11′45″E, 122 m, 26.01.2010, *Baba* 11. Across from the Faculty of Medicine on the body of *Pinus* sp., 36°20′08″N, 36°11′54″E, 113 m, 16.01.2011, *Baba* 2.

Liceales

Cribrariaceae

3. *Cribraria cancellata* var. *fusca* (G.Lister) Nann.-Bremek.

   Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 9, 30, 41.

4. *Cribraria violacea* Rex

   Over Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 1.

5. *Cribraria vulgaris* Schrad.

   Opposite the Sabancı hostel, on debris, 36°18′27″N, 36°11′58″E, 105 m, 20.10.2010, *Baba* 24.

Dictydiaethaliaceae

6. *Dictydiaethalium plumbeum* (Schumach.) Rostaf.

   Around the library on debris, 36°19′39″N, 36°11′46″E, 140 m, 24.12.2010, *Baba* 4.

Liceaceae

7. *Licea biforis* Morgan

   Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 26.

8. *Licea castanea* G.Lister

   Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 30.

9. *Licea kleistobolus* G.W.Martin

   Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 26.

10. *Licea minima* Fr.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 9, 48.

11. *Licea pusilla* Schrad.

    Across from the Faculty of Medicine on debris of *Pinus* sp., 36°20′08″N, 36°11′54″E, 113 m, 16.01.2011, *Baba* 2.

12. *Licea variabilis* Schrad.

    Anayazı village on debris, 36°19′00″N, 36°11′30″E, 130 m, 24.11.2010, *Baba* 11.

Reticulariaceae

13. *Lycogala epidendrum* (J.C.Buxb. ex L.) Fr.

    Zülüflühan Cemetery on debris of wood, 36°19′00″N, 36°11′30″E, 130 m, 23.12.2010, *Baba* 10.

Physarales

Didymiaceae

14. *Diderma deplanatum* Fr., Syst. Mycol. 3: 110 (1829).

Syn.: *Leocarpus deplanatus* (Fr.) Fr.; *Chondrioderma deplanatum* (Fr.) Rostaf.; *Chondrioderma niveum* var. *deplanatum* (Fr.) Lister; *Diderma niveum* var. *deplanatum* (Fr.) G.Lister; *Diderma niveum* var. *deplanatum* (Fr.) Meyl.; *Diderma deplanatum f. pulverulentum* Meslin.

Sporocarps or curved or ring-shaped plasmodiocarps scattered or in small groups, pulvinate, sessile, 1-1.5 mm diam. white or pale cream-colored or lilaceous. Peridium double, the outer layer smooth, crustose, brittle, thick, the inner layer membranous, iridescent, deep orange below; columella either lacking or represented by a broad convex or thickened orange-brown base; capillitium consisting of dark purple, simple or sparsely branched threads, often bearing spiny or nodular enlargements; plasmodium white; spores rather dark yellow-brown, spinulose, 9-11 µm diam. (Figure 2).

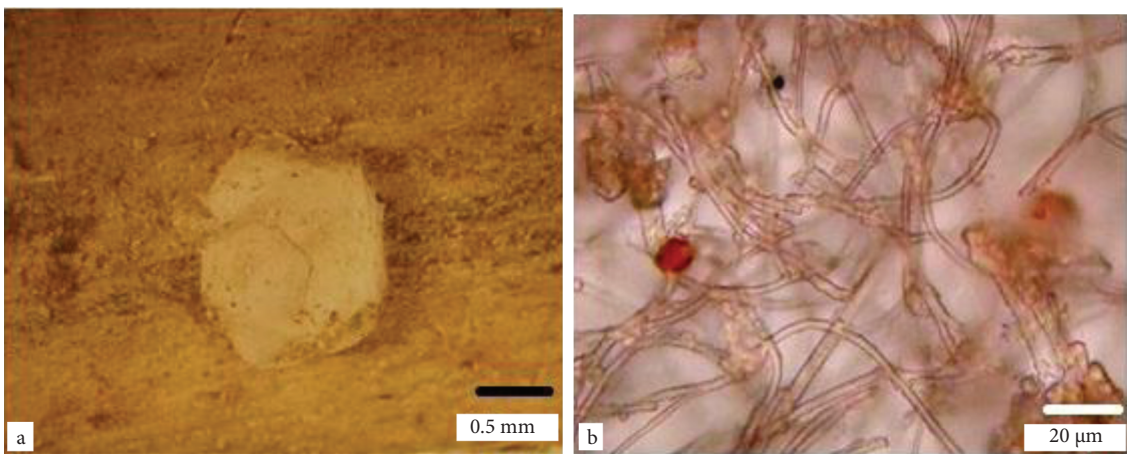


Figure 2. *Diderma deplanatum*: a- stereomicroscopic image of the sporangium, b- light microscopic image of the capillitium and spores.

Locality: Across from the Faculty of Arts and Sciences on debris, 36°19′39″N, 36°11′46″E, 119 m, 23.12.2010, *Baba* 12.

15. *Didymium difforme* (Pers.) S.F.Gray

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 47. In front of Faculty of Agriculture on debris of maple, 36°19′30″N, 36°11′45″E, 122 m, 22.12.2010, *Baba* 34, 78. Across from the Faculty of Medicine on debris of *Pinus* sp., 36°20′08″N, 36°11′54″E, 113 m, 30.12.2010, *Baba* 22, 58.

16. *Didymium megalosporum* Berk. & M.A.Curtis, in Berkeley, Grevillea 2:53 (1873).

Syn.: *Didymium eximium* Peck; *Didymium fulvellum* Massee; *Didymium nigripes* var. *eximium* (Peck) A.Lister; *Didymium discoideum* K.S.Thind & H.S.Sehgal.

Fructifications sporangiate, stalked, sporocarps gregarious, up to 1.8 mm tall. Sporangia scattered, depressed-globose, discoid, usually umbilicate above and below, often sub-annulate or lobate, bluntly conical, white to ochraceous or pale grey, 0.4-0.7 mm in diameter. Peridium membranous, single, thin, often yellowish or ochraceous brown beneath the lime, rather sparsely clothed with yellowish or white lime crystals; stalk slender, cylindrical, striate, pale yellow-brown to orange, translucent except at the base, which is usually darker, somewhat calcareous, yellow, blackish at base with refuse matter; hypothallus prominent, discoidal; columella stalked, prominent, subglobose to discoid, dull yellow to orange-brown, rough or spiny above; capillitium arising from spines when these are present, scanty, threads slender, sparsely branched, flexuous, pallid or smoky, reticulate; spore-mass deep brown-pale purple brown, black in transmitted light, globose, spores violaceous brown, minutely warted to nearly smooth, 8-10 (-12) µm diameter (Figure 3).

Locality: In front of Faculty of Agriculture at bottom of *Populus* sp., 36°19′30″N, 36°11′45″E, 122 m, 18.12.2010, *Baba* 9.

17. *Didymium melanospermum* (Pers.) T.Macbr.

    Zülüflühan Cemetery among debris, 36°19′00″N, 36°11′30″E, 130 m, 23.12.2010, *Baba* 10.

18. *Didymium squamulosum* (Alb. & Schwein.) Fr.

    Opposite the Faculty of Medicine on the body of *Pinus* sp., 36°20′08″N, 36°11′54″E, 113 m, 26.12.2010, *Baba* 15.

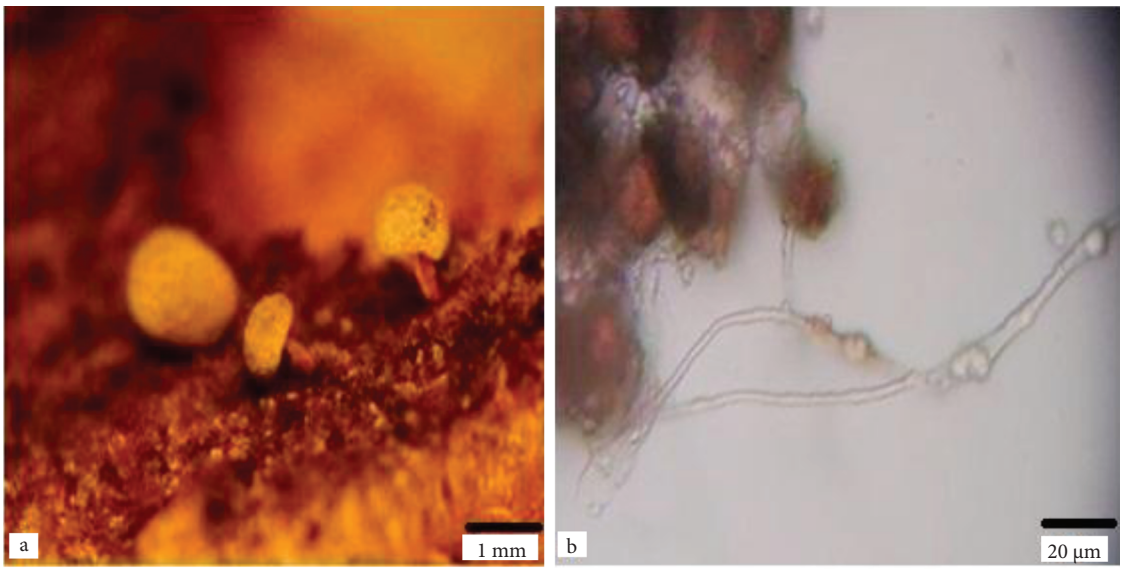


Figure 3. *Didymium megalosporum*: a- stereomicroscopic image of the sporangium, b- light microscopic image of the capillitium and spores.

Physaraceae

19. *Badhamia macrocarpa* (Ces.) Rostaf.

    In front of Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 30.12.2010, *Baba* 78.

20. *Physarum cinereum* (Batsch) Pers.

    In front of Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 22.12.2010, *Baba* 34. Across from the Faculty of Arts and Sciences on debris, 36°19′39″N, 36°11′46″E, 119 m, 30.12.2010, *Baba* 24, 45.

21. *Physarum notabile* T.Macbr.

    Anayazı village on debris, 36°19′00″N, 36°11′30″E, 130 m, 24.11.2010, *Baba* 7.

22. *Physarum leucopheum* Fr.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 42.

Stemonitales

Stemonitidaceae

23. *Collaria elegans* (Racib.) Dhillon & Nann.-Bremek.

    In front of Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 26.01.2010, *Baba* 4.

24. *Collaria lurida* (Lister) Nann.-Bremek.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 8.

25. *Comatrichia ellae* Härk.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 41.

26. *Comatrichia laxa* Rostaf.

    In front of Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 29.12.2010, *Baba* 43. Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 45.

27. *Comatrichia pulchella* var. *pulchella* (C.Bab.) Rostaf.

    Across from the Faculty of Arts and Sciences on debris, 36°19′39″N, 36°11′46″E, 119 m, 01.11.2010, *Baba* 26.

28. *Comatrichia tenerrima* (Berk. & M.A.Curtis) G.Lister

    Anayazı village on debris, 36°19′00″N, 36°11′30″E,130 m, 22.12.2010, *Baba* 35.

29. *Lamproderma atrosporum* Meyl. Bull. Soc. Vaud. Sci. Nat. 46: 51; 1910.

    Syn.: *Lamproderma cribrarioides* sensu Kowalski.

Sporangia dull purplish black, with metallic sheen but not iridescent, sporocarps stipitate, sessile or stalked sporangia are usually ovoid sometimes globose, forming small colonies, plasmodiocarpous. Stalk usually short, black and opaque; peridium is usually evanescent except for a basal cup and small fragments remaining attached to the capillitium, persistent, commonly iridescent and leaving a collar, outermost branchlets of capillitium often attached to peridial fragments by yellowish, funnel-shaped expansions, rest of peridium disappearing except at the base where it forms a cup; columella stout up to about mid-way, usually truncate and with most of the capillitium arising from the top; capillitium often radiating from the centre, frequently branched and sometimes anastomosed, usually with free ends at the periphery. Outermost branchlets of capillitium often attached to peridial fragments by yellowish, funnel-shaped expansions; spore-mass deep brown-pale purple brown, or black in transmitted light, globose, warted or partly to completely spiny-reticulate, 12-18 µm diameter (Figure 4).

Locality: Near the Faculty of Science and Medicine on the twigs and leaves of *Eucalyptus* sp., 36°20′08″N, 36°11′54″E, 113 m, 16.01.2011, *Baba* 4.

30. *Macbrideola cornea* var. *cornea* (G.Lister & Cran) Alexop.

    Above way to Alahan village under *Pinus* sp., 36°19′30″N, 36°11′45″E, 145 m, 14.10.2010, *Baba* 10.

31. *Stemonitis flavogenita* E.Jahn

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 1.

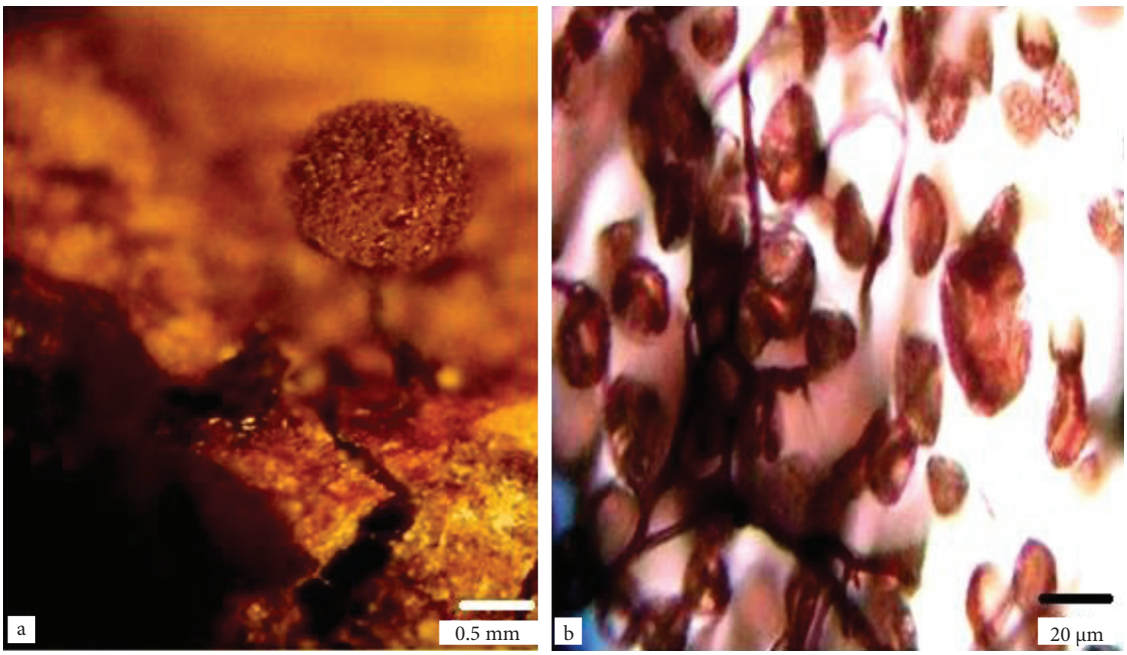


Figure 4. *Lamproderma atrosporum*: a- stereomicroscopic image of the sporangium, b- light microscopic image of the capillitium and spores.

32. *Stemonitis foliicola* Ing

    In front of Faculty of Agriculture at foot of maple, 36°19′30″N, 36°11′45″E, 122 m, 26.01.2010, *Baba* 1.

33. *Stemonitis fusca* Roth

    Alahan village in coniferous forest, 36°19′55″N, 36°11′05″E, 222 m, 25.06.2010, *Baba* 8.

34. *Stemonitis herbatica* Peck.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 22.

35. *Stemonitopsis amoena* (Nann.-Bremek.) Nann.-Bremek.

    Opposite the Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 22.12.2010, *Baba* 14. Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 12.

Trichiales

Arcyriaceae

36. *Arcyria cinerea* (Bull.) Pers.

    Opposite the Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 22.12.2010, *Baba* 17. Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 3, 38.

37. *Arcyria denudata* (L.) Wettst.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 6.

38. *Arcyria incarnata* (Pers.) Pers.

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 13.

39. *Arcyria minuta* Buchet

    Back of Sabancı residence on *Quercus* sp. debris, 36°18′27″N, 36°11′58″E, 105 m, 20.10.2010, *Baba* 5.

40. *Arcyria pomiformis* (Leers) Rostaf.

    Near the Faculty of Arts and Sciences on debris, 36°19′39″N, 36°11′46″E, 119 m, 01.11.2010, *Baba* 26.

Trichiaceae

41. *Perichaena corticalis* (Batsch ) Rostaf.

    Opposite the Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 31.12.2010, *Baba* 63.

42. *Perichaena depressa* Lib.

    Opposite the Faculty of Agriculture under maple, 36°19′30″N, 36°11′45″E, 122 m, 01.11.2010, *Baba* 42.

43. *Perichaena vermicularis* (Schwein.) Rostaf.

    Around the library on debris, 36°19′39″N, 36°11′46″E, 140 m, 24.12.2010, *Baba* 20.

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

    Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, *Baba* 12.

**Discussion**

Forty-four species belonging to 11 families of protosteliomycetes and myxomycetes were identified in this investigation. Three species are new records for Turkey: *Diderma deplanatum*, *Didymium megalosporum*, and *Lamproderma atrosporum*.

In the study area, very rich myxomycete flora was observed. The climatic conditions are suitable for myxomycetes; a very dense flora in both species composition and frequency of myxomycetes was found. Twenty-two myxomycetes were collected in the field. As seen in several reports in the literature, naturally growing myxomycete fructifications are more common in the samples collected in rainy August and September. In fact, as pointed out in many studies, the frequency of myxomycetes from natural habitats is affected by climatic conditions, rainfall, and temperature.

*Echinostelium minutum*, *Arcyria cinerea*, and *Didymium difforme* are the most common species in our investigation but some species are only from certain substrates.

The most important features of *Diderma deplanatum* are stalk absent, columella absent or represented by thickened base, capillitial thread of one type, dark purple and elastic, often bearing nodular enlargement. Spores rather dark brown, finely spinulose, oblong to ring shaped plasmodiocarps.

The typical features of *Didymium megalosporum* are fructifications stalked, sporangia subglobose or umbilicate below, spores minutely warted or nearly smooth. Stalk slender, cylindrical, striate, pale yellow-brown to orange, peridium and capillitium has lime crystals. In our study the habitat and distribution of this species are similar to those of species known elsewhere in the world. Habitat is dead leaves and twigs; spore size range is 8-10 µm. According to Martin and Alexopoulos (1969), fructifications vary greatly in shape and the columella is also shaped like the contours of the fruiting bodies. According to Farr (1981), this rather uncommon species occurs on leaf litter and other plant debris mostly in the east. According to Hagelstein (1944), it seems to favour drier locations. The genus *Didymium* was collected from different substrates, such as *Abies* Mill., *Crataegus* L., *Juglans* L., *Juniperus* L., *Picea* Link, *Pinus* L., *Populus* L., *Quercus* L., *Sorbus* L., and *Ulmus* L. (Baba et al., 2008; Demirel & Kaşık, 2012); we collected this species from the bark of *Populus* sp.

*Lamproderma atrosporum* is stalked, black sporangia are usually ovoid, globose, forming small colonies, peridium is evanescent except for a basal cup and small fragments remaining attached to the capillitium. Capillitium is often attached to peridial fragments by yellowish, funnel-shaped expansions. Spores are warted-reticulate or spiny or partly to completely spiny-reticulate. According to Farr (1981), this is one of the western species, found in melting snowbanks in the mountains. We collected this species on the twigs and leaves of *Eucalyptus* sp.

With this study 3 new *Myxomycetes* were added to the myxobiota of Turkey and all of the species are recorded for the first time in Hatay.

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