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Contribution to the Moss Flora of Kizildağ (Isparta) National Park in Turkey

Serhat Ursavaş and Barbaros Çetin

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/52937>

1. Introduction

The Kızıl Mountain National Park chosen as the study area is in Dedegül Mountain range which is in the 122 important plant areas in Turkey [59]. As a reliable indication of its highly diversified flora. Although the National Park of Kızıl Mountain range was important plant area, was not studied for moss flora, up to now. So, we believed the necessity of studying the mosses of the Kızıl Mountain National Park in Turkey. It is located in a transitional zone of Mediterranean and continental climate. In accordance with its transitional location, Irano-Turanian and Mediterranean flora elements are dominant in the area (Figure 1).

Studies on the bryophyte flora of Turkey were carried out firstly in the 18th century by Müller [1829], Tchihatcheff [1860], Juratzka and Milde [1870], Wettstein [1889], Barbey [1890] and Schiffner [1896, 1897]. The available bryofloristic studies covering a number of localities in Turkey carried out by local and foreign botanists focus only on a small localized area. Especially from late 20th century up to date, many studies were published.

Mosses are important components of forest ecosystems. They have important contributions on biological diversity providing wet habitats for much type living organisms. The study on mosses in Turkey are not extensive as in many other countries, thus the moss flora of Turkey is still largely unknown.

According to the grid system adopted by Henderson [30], the research area is between B7 and C12 squares. While the total number of new records for these square grids is 63, new taxa records for B7 is 7, for C12 is 47, as well as both grid squares are 9, respectively.

To date, nearly studies have been deal with the bryophyte flora of southwest of Turkey. The new records belonging to the B7 mosses taxa were found out from the following literatures: Henderson and Muirhead [28], Henderson [27], Robinson and Godfrey [63], Walther [75],

Henderson and Prentice [29], Yücel and Tokur [80], Yücel and Magil [79], Erdağ et al. [23], Uyar and Ünal [76], Savaroğlu and Tokur [64], Kürschner and Erdağ [37]. On the other hand, the literatures followed up to obtain the new records belonging to the C12 mosses taxa were: Henderson and Prentice [29], Çetin [12-15, 17], Tonguç and Yayıntaş [67], Kürschner and Nestle [38], Erdağ et al. [21], Abay et al. [2], and Kırmacı and Özçelik [35].

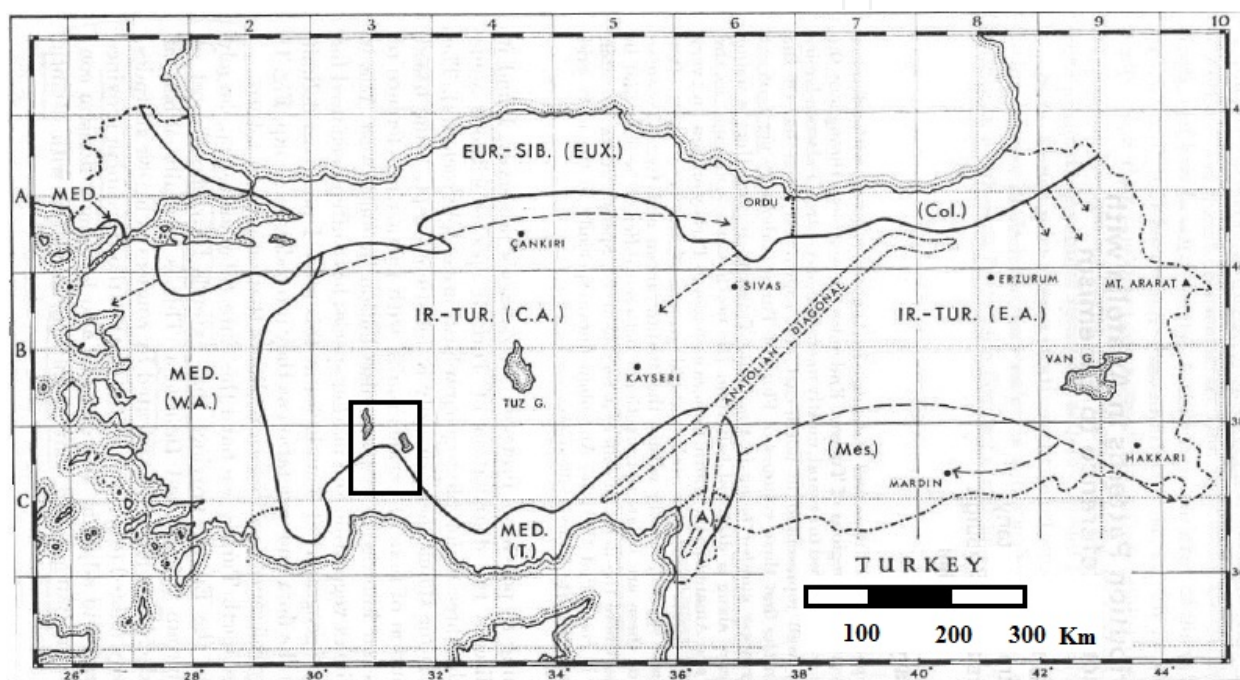


Figure 1. The flora areas of Turkey

This study was carried out between 2009 and 2011 in Kızıldağ National Park. The results obtained from a research on the bryophyte flora of Kızıldağ National Park (Isparta), Turkey) were reported in this paper. 156 taxa of bryophytes belonging to 66 genera and 29 families from the study area are recorded by the authors. Out of these, one species, *Seligeria donniana* (Sm.) Müll Hal. was a new record for Turkey. Also *Crossidium crassinerve* (De Not.) Jur. and one endemic species, *Cinclidotus vardaranus* Erdağ & Kürschner are reported for the second time from Turkey. Moreover, species such as *Plagiomnium cuspidatum* (Hedw.) T.J.Kop., *Pseudoleskea patens* (Lindb.) Kindb. *Isothecium holtii* Kindb. and *Racomitrium canescens* (Hedw.) Brid. reported many times for the northern part of Turkey, are reported for the first time for the southern part of Turkey.

The aim of this study was to explore the moss flora of Kızıldağ National Park. We hope that this study will serve as a valuable contribution to the knowledge of the bryophyte of Turkey and gives a base for future biodiversity and nature conservation surveys.

1.1. Description of the study area

Turkey contains a great variety of natural habitats, ranging from Mediterranean (e.g., Muğla, Antalya and Mersin cities), Aegean (e.g., Aydın and İzmir cities), and Black Sea beaches to towering coastal and interior mountains, (e.g., Zonguldak, Kastamonu, Sinop, Samsun, Ordu, Giresun, Trabzon, and Rize cities) from deeply incised valleys to expansive steppes (e.g., Altındere, Hatilla, Ihlara, Kelebek, Munzur valleys), and from fertile alluvial plains to arid, rocky hill slopes (e.g., Cihanbeyli, Haymana, Yazılıkaya and Bozok plains). Different community types (e.g., *Cedrus libani* with *Pinus nigra* subsp. *pallasiana*; *Abies cilicica* with *Quercus coccifera*) and habitat mosaics occur (e.g., Beyşehir Lake and Dedegül Mountain), containing a rich mixture of plant and animal species, many of which are endemic [33, 54]. Endemic plants for Kızıl Mountain National Park is 201 some of them *Quercus vulcanica* (Boiss. Heldr. ex) Kotschy, *Abies cilicica* (Ant. & Kotschy) Carr. ssp. *isaurica* Coode & Cullen, *Consolida raveyi* (Boiss.) Raveyi, *Nigella lancifolia* Hub.-Mor. *Papaver apokrinomenon* Fedde, *Alyssum filiforme* Nyar, etc. Endemic animals for Kızıl Mountain National Park is 5, this is *Gobio gobio microlepidotus* Battalgiç, *Pseudophoxinus battalgiçli* Bogutskaya, *Chondrostoma beysehirensis* Bogutskaya, *Alburnus akili* Battalgiç, and *Cobitis bilseli* Battalgiç [5]

The study areas' climate data were taken from the Yenişarbademli meteorological station (1150 m). According to the Anonymus [5], the annual average temperature is 20.9 °C. The highest temperature is 25.4 °C in July and the lowest is -7.2 °C in February. The annual rain precipitation is 631.7 mm [5]. The annual temperature and rain rates recorded during the last 25 years (1980-2005) by the above mentioned meteorological observation station were considered also for a water balance graph according to Thornthwaite method was obtained (Figure 2). The climate type of the area is "moist and semi-humid" [5]. Thus, the components and the resource values such as biological diversity, wetlands, endemic species, medicinal and aromatic plants, natural ecosystems of the park are very diverse [5].

The Kızıldağ National Park was declared first time as a national park in 1969 occupying 2316 hectares. Later, the area of the national park was expanded to 59400 hectares in 1993. The national park is situated in the Mediterranean region of Turkey. The geographical position of the park, encircling the north and east of Beyşehir Lake, lies between 37° 38' 32" – 38° 03' 21" Northern Latitudes and 31° 14' 59" – 31° 29' 58" East longitudes [5].

National Park district is surrounded by Şarkikaraağaç town and Beyköy province in the north, Beyşehir Lake in the east, Beyşehir town, Kurucuova village, Gavur hill, Tozan hill, Kuzgun hill, Yeropkunu hill, Karakaya hill, Dedegül hill, in the south, Üzümkarı hill, Melikler plateau, Dörtkardeşler hill, Mehmetkırı hill, Hacibey plateau, Altınoluk hill, Höyük hill, Kızıldağ hill, Bozyamaç hill, Tuzlabeli hill, Çiçekli hill, Yoncalı hill, Büyükkaç hill in the west [5].

There are some high plateaus and hills such as; Büyükçeşan hill (2390 m), Alataş hill (2208 m), Küçükdağ hill (2302 m), Yumrutaş hill (2437 m), Karakaya hill (2384 m), Karagöl hill (2215 m), Üzüm karı hill (1978 m), Mehmetkir hill (1838 m), Zenit plateau (1755 m), Melikler plateau (1730 m), Saraycık plateau (1700 m), Küçükseki plateau (1320 m), Küre plateau (1165 m) [5].

The chosen study area, Kızıldağ National Park, encloses very important plant areas (Endemic and Endangered) including the Dedegül Mountain (2996 m) range that is also among the 122 important plant areas in Turkey [59]. The study area is located in the Kızıldağ National Park that is in Isparta province. Its lies in the Beyşehir Lake range, which is running from north to south in the southern part of Turkey. The localities belong to B7 and C12 grid-square according to Henderson's [30] system (Figure 3).

The geological structure of the field is composed of formations consisting of limestone rocks. Vegetation from the National Park, tree species are: *Cedrus libani* A. Rich, *Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe, *Abies cilicica* Car., and *Juniperus* species comprising the forest makes up. *C. libani* A. Rich, Şarkikaraağaç within the boundaries of the Kızıldağ National Park to the south of the town is 5 km north-facing slopes of the rising Kızıldağ shows the natural distributions of 1200-1700 meters. Shrub layer of the *Cedrus libani* A. Rich is *Quercus coccifera* L. [5].

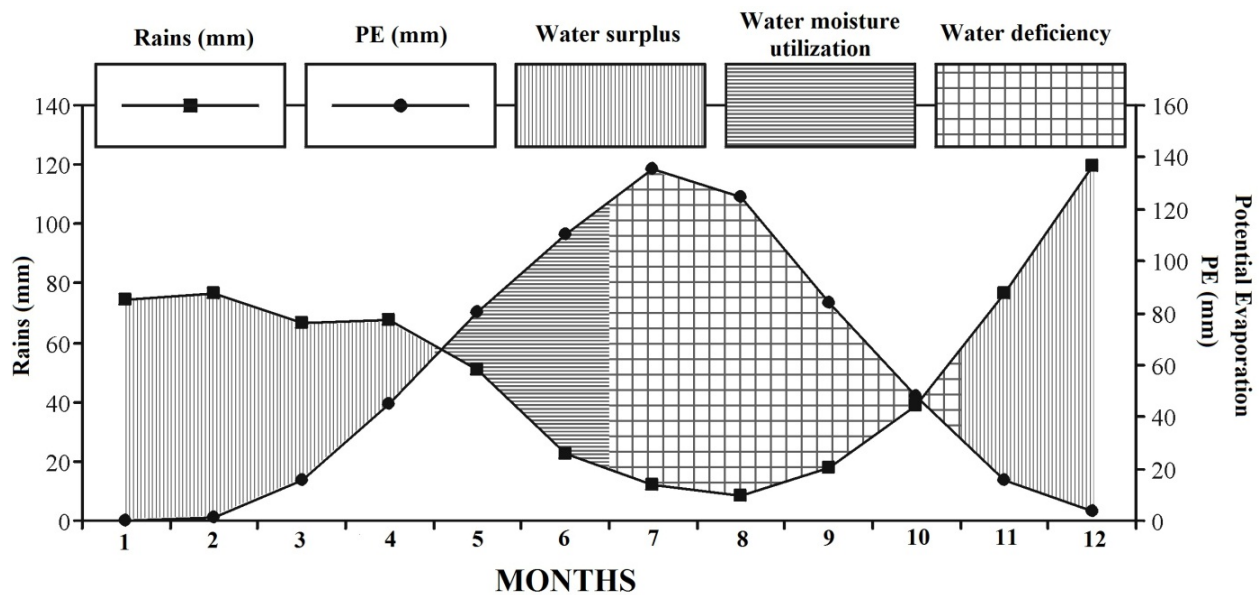


Figure 2. Graphic of the water balance according to Thornthwaite method [5]

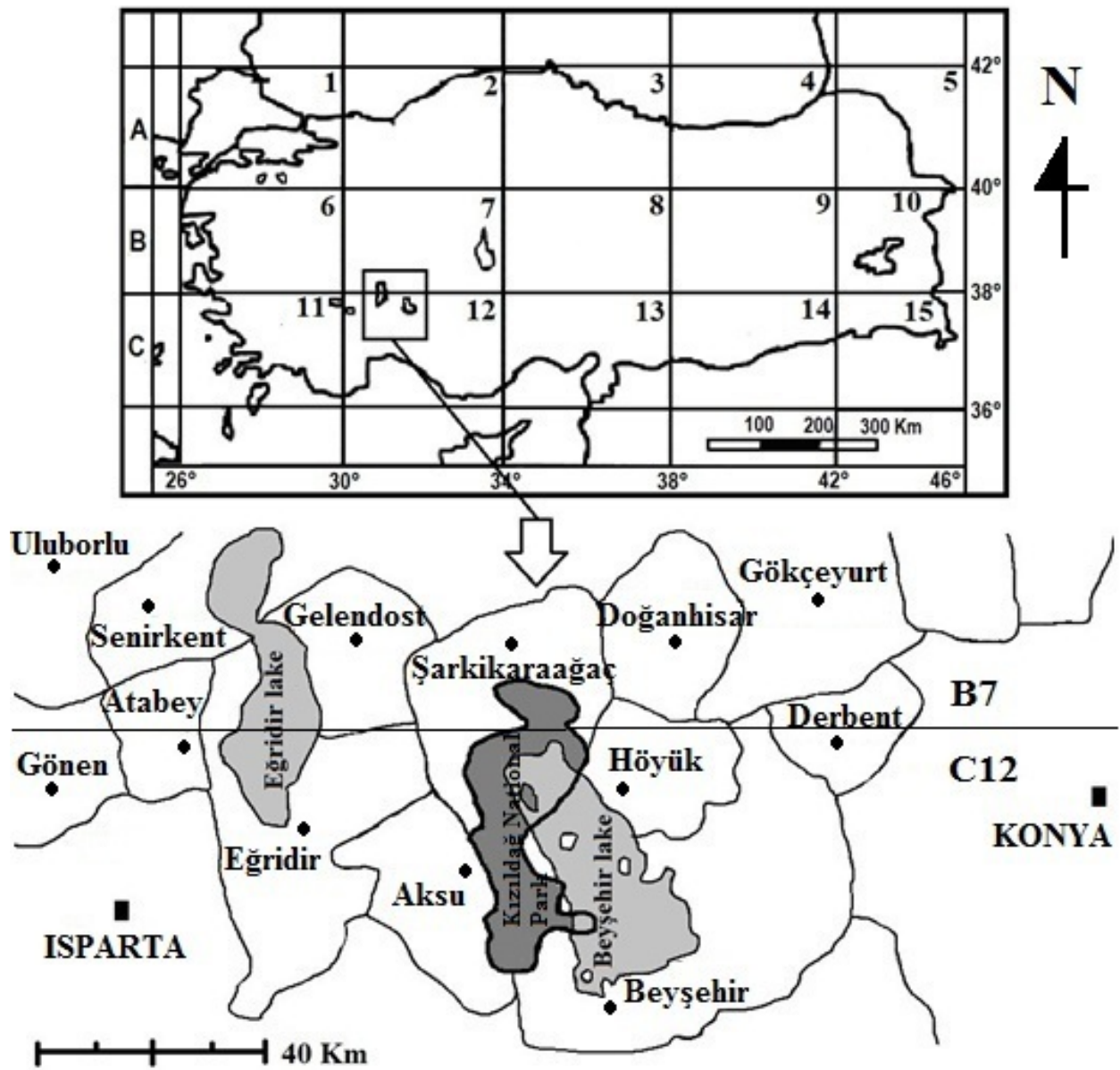


Figure 3. Location of Kızıldağ National Park in Turkey [5]

2. Materials and methods

The moss samples were collected from the study area during different vegetation periods between 2009 and 2011. The stations were selected according to different plant communities, and the geographical condition (Table 1).

The moss sample samples were incised by spatula from their habitats. After the samples were cleaned, they were preserved in plastic bags. Each plastic bag has a label providing the

information about the habitat of the area. For example: Samples collecting number, moisture, exposure, substratum, the date of collecting, geographic coordinate, etc.

Identification of the specimens was based on Lawton [39], Crum [11], Smith [65-66], Nyholm [50-53], Gao Chien et al. [7], Cortini [9-10], Lu Xingjiang [41], Wu Peng-cheng et al. [62], Gao Chien [8], Greven [25], Herrnstadt and Heyn [31], Lüth [42-48]. Li Xing-Jiang et al. [40], Wang You-fang et al. [78] and Atherton et al. [6]. After the classification was completed, specimens were placed in the private collections of Serhat URSAVAŞ (Çankırı, Turkey).

Plants in the division Bryophyta have features that are considered to be rather primitive. These are plants with little specialization of tissue, which are not well-adapted to life in a relatively dry land environment. They also have comparatively simple reproductive processes, and are the only plants which have a dominant gametophyte generation. A study of the features of mosses will illustrate the major characteristics of this plant division [81].

In mosses, the gametophyte is small and at least partially erect, with very little specialization of cells and tissues, specifically, no true leaves, stems, or roots. The moss gametophyte has a shoot portion that appears leafy, and has rhizoids which emerge from its base to attach it to the substratum upon which it grows. The gametophyte is generally green and photosynthetic, and obtains water and other nutrients from the soil by direct absorption into its cells. It contains no cells specializing in the transport of water and/or nutrients (vascular tissue) and therefore cannot grow so large as to prevent contact between the soil and the majority of its cells [81].

At maturity, the moss gametophyte is capable of developing gametangia on its surface. Sperm-producing antheridia can arise amongst the leaf-like structures along the length of the thallus; egg-producing archegonia most often develop at the tip of the erect gametophyte. When fully developed, flagellated sperm are released from an antheridium and swim through a film of water to reach an egg-containing archegonium (Figure 4) [81].

Syngamy of the egg and sperm produce a zygote within the archegonium. This zygote undergoes mitosis to produce an embryo, again retained within the archegonium. Finally, the embryo matures into a sporophyte, consisting of a sporangium (capsule), a seta (stalk), and a foot which remains embedded in the gametophyte tissue. The continued attachment of the sporophyte to the gametophyte allows the sporophyte to absorb most of its needed nutrients from the gametophyte [81].

Meiosis occurring within the sporangium produces spores. Following spore production, the capsule opens up to release the spores, which germinate to produce new moss gametophytes [81].

The firstly recorded taxa from B7 were indicated by asteriks (*), from C12 by two asterisks (**), and from both of them (B7 and C12) by three asterisks (***). The status of the taxa for Turkey was determined by reviewing the related literature [36, 70]. The first record for the Turkish bryophyte flora was indicated by diamond (◆).

In the statements of specimens: The first number shows the Site no., the bold abbreviation shows the habitat, U abbreviations shows collector and identified (Serhat Ursavaş), and the last number shows the collection no.

Habitats in the study area: **s:** on soil, **r:** on rock, **src:** on soil in rock crevices, **rc:** rock crevices, **t:** on bark of tree trunk and branch, **dt:** on dead trunk, **ws:** wet soil, **wr:** wet rock.

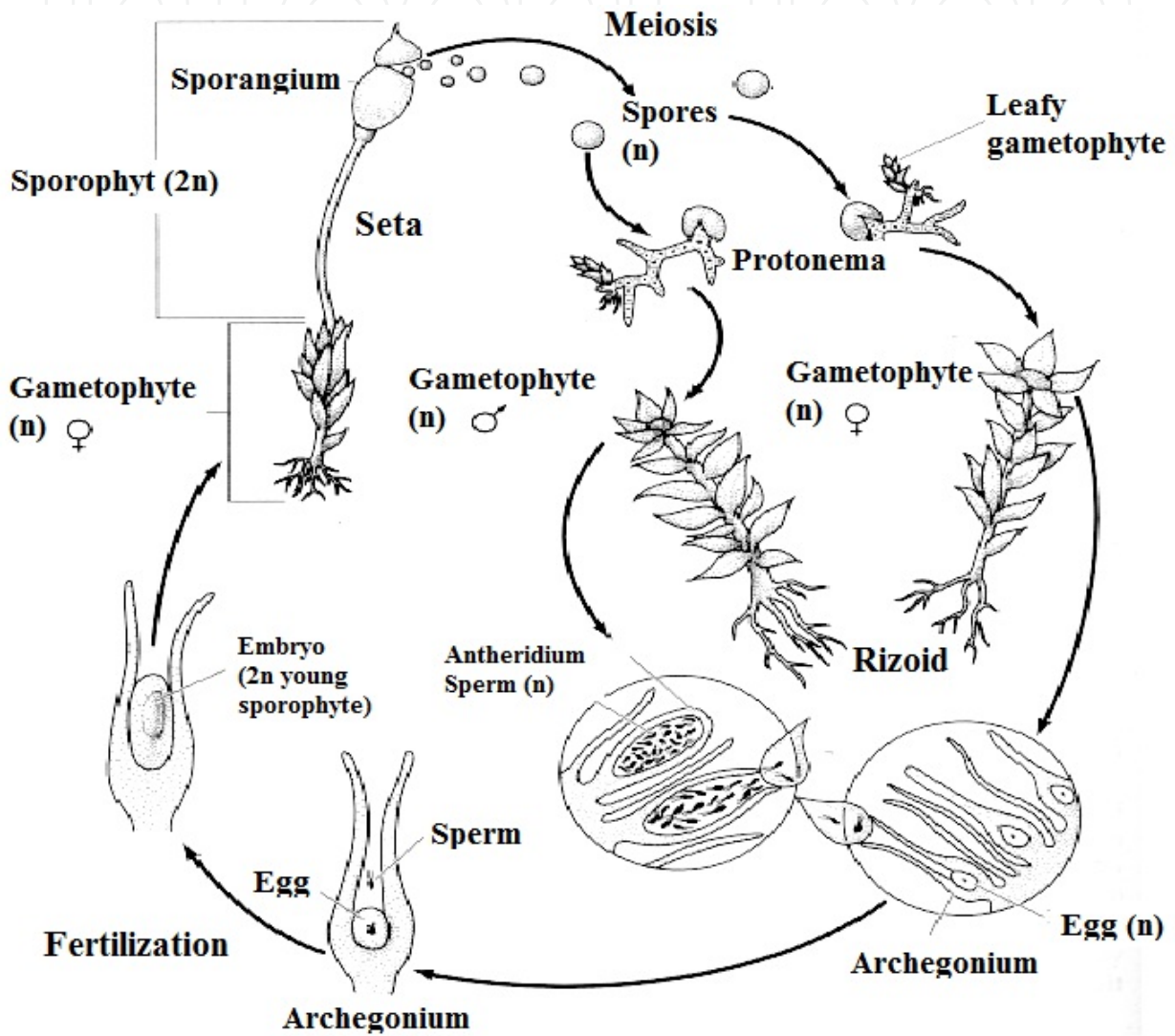


Figure 4. Life cycle of moss [81]

Table 1 provides a list of stations from the research area. Subsequently, the lists of taxa determined from the research area species are given.

| Site No. | Date-Altitude(m) | Localites and geographic coordinate | Trees and some shrubs |
|----------|------------------|---|--------------------------------|
| 1 | 29.08.2009-1410 | Beş kardeşler, N 38° 22' 55.0" - E 31° 22' 48.7" | CL, JO, JE, JC, QC, MC |
| 2 | 29.08.2009-1310 | Ulusazlık pınarı, N 38° 17' 10.0" - E 31° 23' 04.7" | CL, JO, JE, JC, QC, MC |
| 3 | 29.08.2009-1180 | Kale, N 37° 59' 83.1" - E 31° 24' 32.4" | RP, AA, MC |
| 4 | 29.08.2009-1140 | Karayaka village, N 37° 58' 52.0" - E 31° 25' 20.5" | RB, G |
| 5 | 30.08.2009-1308 | Forest cottage, N 38° 02' 33.7" - E 31° 21' 40.1" | CL, QC, JE, JC |
| 6 | 30.08.2009-1960 | Büyük sivri hill., N 38° 13' 93.0" - E 31° 21' 84.7" | RP, O, JC |
| 7 | 30.08.2009-1684 | Küçük sivri hill., N 38° 02' 00.4" - E 31° 21' 69.4" | RP, O |
| 8 | 31.08.2009-1540 | Pınargözü cave, N 37° 41' 78.3" - E 31° 18' 46.1" | PN, PT, SA, JC, JE, CB |
| 9 | 31.08.2009-1120 | Pınarbaşı district, N 37° 45' 01.6" - E 31° 24' 95.3" | JO, JE, JC, RP |
| 10 | 01.09.2009-1550 | Ince oluk pınarı, N 37° 42' 90.1" - E 31° 19' 80.1" | PN, JE, JC, SA, RP |
| 11 | 01.09.2009-1810 | Vali Çeşmesi, N 37° 42' 93.4" - E 31° 17' 57.0" | PN, JC |
| 12 | 15.06.2010-980 | Kızıl hill, N 37° 53' 90.3" - E 31° 20' 39.2" | RP, O, LM |
| 13 | 15.06.2010-1330 | Gedikli village, N 37° 53' 38.0" - E 31° 19' 19.5" | JE, JC, JF, AN |
| 14 | 15.06.2010-1490 | Güzel sırt, N 37° 53' 38.0" - E 31° 19' 19.5" | CL, JF, JO |
| 15 | 15.06.2010-1620 | Akbel hill, N 37° 53' 17.0" - E 31° 17' 31.5" | CL, JF, JO, JC, QV |
| 16 | 15.06.2010-1720 | Katranbaşı hill, N 37° 51' 06.2" - E 31° 18' 52.7" | CL, JF, JO, QV, AP |
| 17 | 15.06.2010-1700 | Kaşıklı, N 35° 17' 84.0" - E 41° 90' 09.5" | CL, JF, JO, JE, QV, AP |
| 18 | 15.06.2010-1610 | Katran sivri hill, N 37° 50' 46.0" - E 31° 18' 55.4" | QV, CL, AP |
| 19 | 15.06.2010-1440 | İncebel hill, N 37° 50' 30.0" - E 31° 20' 39.9" | JO, JE |
| 20 | 16.06.2010-1308 | Bungalow, N 38° 02' 33.0" - E 31° 21' 40.3" | CL, PN, QC, PT, DO, JO, BI, QP |
| 21 | 17.06.2010-1251 | Pancar hill, N 37° 45' 06.0" - E 31° 22' 52.6" | QC, QI, JO, JF, AC |
| 22 | 17.06.2010-1320 | Küçükseki plateau, N 37° 44' 53.0" - E 31° 22' 19.4" | AC, JO, JF, JE |
| 23 | 17.06.2010-1400 | Körlük, N 37° 44' 53.0" - E 31° 21' 37.2" | AC, QC, QI, PN, JE |
| 24 | 17.06.2010-1540 | Pancar hill., N 37° 45' 09.9" - E 31° 20' 43.1" | AC, PN, JE, JF |
| 25 | 17.06.2010-1555 | Pınargözü cave, N 37° 41' 51.0" - E 31° 18' 30.7" | PN, PT, SA, JC, JE, CB |
| 26 | 14.08.2010-1550 | Pınargözü cave, N 37° 41' 42.6" - E 31° 18' 24.4" | PN, PT, JC, JE, CB |
| 27 | 14.08.2010-1400 | Hızar stream, N 37° 42' 34.0" - E 31° 19' 16.1" | PN, PT, SA, QC, QI |
| 28 | 31.03.2011-1213 | Konya road, N 38° 02' 40.89" - E 31° 26' 38.51" | PN, BV, CL, QC, JF, JO, PS |
| 29 | 01.04.2011-1172 | Fakılar village, N 38° 02' 19.03" - E 31° 18' 38.04" | AN, PS, O, AA |
| 30 | 01.04.2011-1228 | Çeltek village, N 38° 0' 35.52" - E 31° 21' 0.37" | CL, RP, O |
| 31 | 01.04.2011-1148 | Karayaka village, N 37° 58' 34.32" - E 31° 25' 27.94" | JE, JO, RP |
| 32 | 01.04.2011-1221 | Yassibel village, N 37° 58' 55.00" - E 31° 26' 31.87" | JE, JO, QC, RP |
| 33 | 02.04.2011-1132 | Sarıkaya village, N 37° 55' 23.19" - E 31° 18' 47.90" | JE, JO, AN, LM |
| 34 | 02.04.2011-1137 | Gedikli village, N 37° 55' 23.19" - E 31° 18' 47.90" | JE, JO, JF, RP, G |
| 35 | 02.04.2011-1241 | Mada valley, N 37° 51' 51.53" - E 31° 20' 28.53" | JE, JO, BV, AS, RP |
| 36 | 31.05.2011-1736 | Vali çeşmesi rooad, N 37° 42' 27.46" - E 31° 17' 47.24" | PN, PT |
| 37 | 31.05.2011-1730 | Melikler plateau, N 37° 42' 11.08" - E 31° 17' 41.08" | JE, JO, BV |

| Site No. | Date-Altitude(m) | Localities and geographic coordinate | Trees and some shrubs |
|----------|------------------|---|------------------------|
| 38 | 31.05.2011-1555 | Pınargözü cave, N 37° 41' 50.47" - E 31° 18' 34.27" | PN, PT, JC, JE, CB |
| 39 | 31.05.2011-1571 | Gedikli village, N 37° 50' 06.28" - E 31° 20' 16.98" | CL, JE, JO, JF, QC, QI |
| 40 | 01.06.2011-1250 | Mada island, N 37° 53' 24.40" - E 31° 22' 34.91" | JE, JO, JF, QC |
| 41 | 01.06.2011-1165 | Küre plateau, N 37° 51' 3.88" - E 31° 21' 31.63" | JE, JO, JF |
| 42 | 02.06.2011-1387 | Hızar stream, N 37° 42' 39.73" - E 31° 20' 13.20" | PN, JF |
| 43 | 02.06.2011-1368 | Hızar stream, N 37° 42' 26.35" - E 31° 20' 28.70" | PN, PT, SA, QI |
| 44 | 02.06.2011-1754 | Zenit plateau, N 37° 44' 2.58" - E 31° 19' 33.44" | G, RP, O |
| 45 | 02.06.2011-1575 | Kirazlı stream, N 37° 45' 01.77" - E 31° 20' 17.87" | AC, PN, JE, JO, JF |
| 46 | 23.07.2011-1234 | Küçükçal hill, N 37° 41' 34.88" - E 31° 21' 38.97" | PN, PT, SA |
| 47 | 23.07.2011-1631 | Malanda hill, N 37° 41' 12.41" - E 31° 20' 28.22" | PN, PT, SA |
| 48 | 24.07.2011-1518 | Fire tower, N 37° 41' 12.41" - E 31° 20' 28.22" | PN, JO, BV, AS |
| 49 | 24.07.2011-1968 | Üzüm karı hill, N 37° 41' 15.77" - E 31° 17' 6.22" | AS, V, E, O, RP |
| 50 | 25.07.2011-1812 | Mehmetkir hill, N 37° 43' 40.02" - E 31° 18' 46.81" | JE, JO, JF, BV, E, V |
| 51 | 25.07.2011-1755 | Zenit plateau, N 37° 43' 54.86" - E 31° 20' 12.46" | PN, JE, JF |
| 52 | 25.07.2011-1775 | Karıncık area, N 37° 45' 42.56" - E 31° 18' 26.49" | JE, JO, JF, BV, E |
| 53 | 25.07.2011-1802 | Keşaphane hill, N 37° 46' 1.76" - E 31° 18' 53.60" | AC, PN, JE, BV |
| 54 | 25.07.2011-1571 | Dergül stream, N 37° 45' 33.94" - E 31° 20' 37.18" | AC, JE, BV |
| 55 | 25.07.2011-1417 | Canavar area, N 37° 46' 9.70" - E 31° 21' 7.48" | AC, JE, BV |
| 56 | 25.07.2011-1154 | Yenice district, N 37° 44' 16.14" - E 31° 24' 20.42" | RP, JO, BV |
| 57 | 26.07.2011-1378 | Karanlık stream, N 37° 39' 38.92" - E 31° 21' 18.01" | PN, JE, QI |
| 58 | 26.07.2011-1565 | Isilyurt hill, N 37° 39' 13.46" - E 31° 20' 23.03" | AC, PN, PT, V |
| 59 | 26.07.2011-2000 | Kara lake hill, N 37° 38' 47.80" - E 31° 19' 56.22" | RP, O, AS, V |
| 60 | 26.07.2011-2215 | Kara lake, N 37° 38' 18.23" - E 31° 18' 53.85" | RP, AS, V |
| 61 | 27.07.2011-1150 | Hamal hill, N 37° 58' 12.96" - E 31° 17' 46.72" | CL, AN, AS, V |
| 62 | 27.07.2011-1138 | Trout plant, N 37° 59' 59.14" - E 31° 18' 13.78" | SA, RP |
| 63 | 27.07.2011-1242 | Süzmedağ hill, N 37° 58' 39.35" - E 31° 21' 24.32" | QC, AS, V, RP |
| 64 | 27.07.2011-1555 | Pınargözü cave, N 38° 17' 10.00" - E 31° 23' 04.70" | PN, PT, SA, JC, JE, CB |
| 65 | 28.07.2011-1850 | Dedegül foothill, N 37° 41' 38.69" - E 31° 13' 41.05" | JO, BV, AS, E, RP |
| 66 | 28.07.2011-2410 | Dedegül foothill, N 37° 41' 16.76" - E 31° 18' 2.29" | AS, E, RP |
| 67 | 28.07.2011-2885 | Dedegül mountain, N 37° 40' 10.43" - E 31° 18' 8.62" | RP, O |

AA: Agricultural area, **AC:** *Abies cilicica* (Antoine & Kotschy) Carrière, **AN:** *Amygdalus nana* L., **AP:** *Acer platanoides* L., **AS:** *Astragalus* sp., **BI:** *Berberis iberica* Steve. & Fisch. ex DC., **BV:** *Berberis vulgaris* L., **CB:** *Carpinus betulus* L., **CL:** *Cedrus libani* A. Rich., **DO:** *Daphne oleoides* Schreb., **E:** *Euphorbia* sp., **G:** Grass, **JO:** *Juniperus oxycedrus* L., **JF:** *Juniperus foetidissima* Willd., **JE:** *Juniperus excelsa* M. Bieb., **JC:** *Juniperus communis* L., **LM:** Lake margin, **MC:** *Myrtus communis* L., **O:** Opennes, **PN:** *Pinus nigra* Arnold subsp. *pallasiana* (Lamb.) Holmboe, **PS:** *Paliurus spina-christi* Mill., **PT:** *Populus tremula* L., **RB:** Rush bed, **RP:** Rock place, **QC:** *Quercus coccifera* L., **QI:** *Quercus infectoria* G. Olivier, **QP:** *Quercus pubescens* O. Schwarz, **QV:** *Quercus vulanica* Boiss. & Heldr. ex Kotschy, **SA:** *Salix alba* L., **V:** *Verbascum* sp.,

Table 1. Site no: Altitude in meters above sea level (m), Localities and geographic coordinates, Trees and some shrubs

3. Taxa list

Polytrichaceae Schwägr.

1. ***Polytrichum juniperinum* Hedw. - 59:r, U545; 59:s, U546; 60:s, U547.

Timmiaceae Schimp.

2. ***Timmia austriaca* Hedw. - 52:src, U540; 52:s, U541.

3. ****Timmia norvegica* J.E.Zetterst. - 15:rc, U542; 20:s, U543; 23:s, U544.

Encalyptaceae Schimp.

4. *Encalypta streptocarpa* Hedw. - 5:r, U854; 8:r, U856; 8:rc, U857; 10:r, U855; 13:r, U858; 16:r, U859; 20:s, U860; 25:wr, U861; 38:r, U862; 40:rc, U863; 41:r, U864; 45:r, U865; 46:s, U866; 49:r, U867; 51:r, U868; 52:r, U869; 53:r, U870; 65:r, U871; 66:r, U872.

5. *Encalypta raptocarpa* Schwägr. - 8:rc, U889; 20:s, U890.

6. *Encalypta vulgaris* Hedw. - 5:rc, U873; 13:r, U874; 16:r, U875; 30:s, U876; 32:r, U877; 34:r, U878; 39:rc, U879; 40:s, U880; 41:rc, U881; 48:t, U882; 49:r, U883; 52:r, U884; 60:r, 885; 63:r, U886; 65:r, U887; 67:s, U888.

7. *Encalypta ciliata* Hedw. - 58:r, U891.

Funariaceae Schwägr.

8. ***Entosthodon muhlenbergii* (Turner) Fife - 41:s, U577; 61:r, U558; 62:src, U559.

9. ***Entosthodon pulchellus* (H.Philib.) Brugue 's - 29:s, U560; 34:s, U561; 35:s, U562; 40:s, U563; 41:s, U564; 63:s, U565.

10. *Funaria hygrometrica* Hedw. - 5:s, U550; 33:r, U551; 35:s, U552; 38:r, U553; 44:dt, U554; 57:s, U555; 62:r, U556.

Grimmiaceae Arn.

11. *Grimmia anodon* Bruch & Schimp. - 1:r, U927; 3:r, U928; 4:r, U929; 15:r, U930; 28:r, U931; 29:r, U932; 49:r, U933; 63:r, U934; 66:r, U935.

12. ***Grimmia caespiticia* (Brid.) Jur. - 59:r, U949.

13. ****Grimmia funalis* (Schwägr.) Bruch & Schimp. - 3:r, U941; 5:r, U942; 8:r, U943.

14. *Grimmia hartmanii* Schimp. - 41:r, U950.

15. *Grimmia laevigata* (Brid.) Brid. - 12:r, U946; 30:r, U947; 61:r, U948.

16. ****Grimmia montana* Bruch & Schimp. - 6:r, U944; 7:r, U946.

17. *Grimmia orbicularis* Bruch ex Wilson - 13:r, U951.

18. *Grimmia ovalis* (Hedw.) Lindb. - 6:r, U936; 7:r, U937; 12:r, U938; 37:r, U939; 58:r, U940.

19. *Grimmia pulvinata* (Hedw.) Sm. - 1:r, U910; 2:r, U911; 3:r, U912; 4:r, U913; 5:r, U914; 6:r, U915; 7:r, U916; 8:r, U917; 10:r, U918; 15:r, U919; 18:r, U920; 19:r, U921; 21:r, U922; 40:r, U923; 50:r, U924; 56:r, U925; 61:r, U926.

20. *Grimmia trichophylla* Grev. - 1:r, U892; 2:r, U893; 3:r, U894; 4:r, U895; 5:r, U896; 8:r, U897; 10:r, U898; 13:r, U899; 15:r, U900; 18:r, U901; 19:t, U902; 19:r, U903; 20:r, U904; 22:r, 905; 40:r, U906; 41:r, U907; 46:r, U908; 63:r, U909.

21. ***Racomitrium canescens* (Hedw.) Brid. - 37:r, U952.

22. *Schistidium apocarpum* (Hedw.) Bruch & Schimp. - 5:r, U953; 8:r, U954; 16:r, U955; 23:r, U956; 34:r, U957; 42:r, U958; 43:r, U959; 45:r, U960.

23. **Schistidium atrofusum* (Schimp.) Limpr. - 6:r, U970; 40:r, U971.

24. *Schistidium confertum* (Funck) Bruch & Schimp. - 1:r, U961; 5:r, U962; 6:r, U963; 8:r, U964; 47:r, U965; 49:r, U966; 59:r, U967; 65:r, U968.

25. *Schistidium flaccidum* (De Not.) Ochyra - 6:r, U1269.

26. *Schistidium helveticum* (Schkuhr) Deguchi - 49:r, U969.

27. ***Schistidium trichodon* (Brid.) Poelt - 8:r, U1270.

Seligeriaceae Schimp.

28. ◆ *Seligeria donniana* (Sm.) Müll.Hal. - 45:r, U1282.

Fissidentaceae Schimp.

29. ***Fissidens taxifolius* Hedw. - 47:ws, U549.

30. *Fissidens pusillus* (Wilson) Milde - 40:r, U1275; 40:s, U1276; 43:s, U1277; 45:r, U1278.

31. *Fissidens viridulus* (Sw. ex anon.) Wahlenb. - 43:ws, U548.

Ditrichaceae Limpr.

32. ****Ceratodon conicus* (Hampe) Lindb. - 6:r, U622; 8:src, U623, 47:s, U624; 60:s, 625.

33. *Ceratodon purpureus* (Hedw.) Brid. - 4:r, U609; 13:r, U610; 13:s, U611, 19:r, U612; 28:s, U613; 33:s, U614; 37:s, U615; 40:r, U616; 41:r, U617; 59:r, U618; 61:r, U619; 62:r, U620; 65:s, U621.

34. **Distichium capillaceum* (Hedw.) Bruch&Schimp - 8:rc, U601; 25:wr, U602; 40:r, U603; 47:r, U604; 49:r, U605; 52:r, U606; 67:s, U607.

35. ***Distichium inclinatum* (Hedw.) Bruch & Schimp. - 67:s, U599; 67:r, U600.

36. *Ditrichum flexicaule* (Schwägr.) Hampe - 1:r, U626; 5:r, U632; 8:r, U627; 8:rc, U628; 15:s, U629; 15:r, U630; 40:r, U631.

Rhabdoweisiaceae Limpr.

37. *Dicranoweisia cirrata* (Hedw.) Lindb. - 8:t, U633; 10:t, U634.

Dicranaceae Schimp.

38. ***Dicranum tauricum* Sapjegin - 8:dt, U635; 8:t, U636; 11:t, U637; 15:r, U638; 45:dt, U608; 59:t, U639.

Pottiaceae Schimp.

39. *Eucladium verticillatum* (With.) Bruch & Schimp. - 27:ws, U1092; 51:wr, U1093; 55:wr, U1094; 57:wr, U1095.

40. ***Gymnostomum aeruginosum* Sm. - 8:s, 1088.

41. *Gymnostomum calcareum* Nees & Hornsch. - 49:r, U1089.

42. ***Gyroweisia reflexa* (Brid.) Schimp. - 41:s, U1090; 44:s, U1091.

43. *Pleurochaete squarrosa* (Brid.) Lindb. - 13:s, U1059; 28:s, U1060; 30:rc, U1061; 34:r, U1062; 47:s, U1063; 63:src, U1064.

44. *Tortella fragilis* (Hook. & Wilson) Limpr. - 8:t, U1123.

45. ****Tortella inclinata* var. *densa* (Lorentz & Molendo) Limpr. - 1:r, U1126; 6:r, U1127; 7:r, U1128; 15:r, U1129; 17:r, U1130; 18:r, U1131; 66:r, U1132.

46. **Tortella nitida* (Lindb.) Broth. - 6:r, U1124; 8:r, 1125.

47. *Tortella tortuosa* (Hedw.) Limpr. - 1:r, U1133; 5:r, U1134; 7:r, U1135; 8:r, U1136; 15:r, U1137; 15:s, U1138; 16:r, U1157; 17:r, U1139; 19:r, U1140; 21:r, U1141; 23:r, U1142; 24:r, U1143; 39:r, U1144; 40:r, U1145; 43:s, U1146; 46:r, U1147; 48:r, U1148; 48:s, U1149; 49:r, U1150; 51:r, U1152; 60:r, U1153; 65:s, U1154; 66:r, U1155; 67:s, U1156.

48. ***Weissia brachycarpa* (Nees & Hornsch.) Jur. - 47:s, U1100.

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49. *Weissia condensa* (Voit) Lindb. - 8:t, U1109; 49:r, U1110, 50:r, U1111; 65:r, U1112; 66:r, U1113; 67:r, U1114.
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50. *Weissia controversa* Hedw. - 13:t, U1101; 41:t, U1102; 45:s, U1103; 45:t, U1104; 47:s, U1105; 53:t, U1106; 58:r, U1107; 60:r, U1108.
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51. *Barbula convoluta* Hedw. - 51:src, U1065; 65:r, U1066.
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52. *******Bryoerythrophyllum recurvirostrum* (Hedw.) P.C.Chen - 50:rc, U1280, 53:r, U1281.
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53. *Cinclidotus fontinaloides* (Hedw.) P.Beauv. - 8:wr, 1118; 25:wr, U1119; 26:wr, U1120; 38:wr, U1121; 43:wr, U1122.
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54. *Cinclidotus riparius* (Host ex Brid.) Arn. - 8:wr, U1115; 25:wr, U1116; 26:wr, U1117.
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55. *******Cinclidotus vardaranus* Erdağ & Kürschner - 8:wr, U1274. (Not: The accuracy of this species were made by Michael Lüth.)
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56. *******Crossidium crassinerve* (De Not.) Jur. - 28:r, U1098.
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57. *Crossidium squamiferum* (Viv.) Jur. - 13:r, U1097, 31:r, U1097; 48:r, U1099.
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58. *Didymodon fallax* (Hedw.) R.H.Zander - 45:r, U1069.
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59. *Didymodon spadiceus* (Mitt.) Limpr. - 51:r, U1071; 57:wr, U1072.
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60. *Didymodon tophaceus* (Brid.) Lisa - 48:r, U1070.
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61. *Didymodon vinealis* (Brid.) R.H.Zander - 8:r, U1067; 45:r, U1068.
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62. *Phascum cuspidatum* var. *cuspidatum* Hedw. - 29:s, U1078; 34:s, U1079; 63:s, U1080.
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63. *******Phascum cuspidatum* var. *piliferum* (Hedw.) Hook. & Taylor - 29:t, U1081; 35:s, 1082.
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64. ********Pseudocrossidium hornschuchianum* (Schultz) R.H.Zander - 1:r, U1073; 4:r, U1074.
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65. *Pseudocrossidium revolutum* (Brid.) R.H.Zander - 13:r, U1075; 30:rc, U1076; 40:rc, U1077.
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66. *******Pterygoneurum ovatum* (Hedw.) Dixon - 4:r, U1083; 13:r, U1084; 28:r, U1085; 29:s, U1086; 30:s, U1087.
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67. *Syntrichia laevipila* Brid. - 1:s, U1235; 34:t, U1236.
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68. *Syntrichia montana* Nees - 13:t, U1201; 15:r, U1002; 16:r, U1203; 17:r, U1204; 22:r, U1205; 24:r, U1206.
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69. *Syntrichia norvegica* F.Weber - 1:r, U1207; 6:r, U1208; 28:s, U1209; 37:r, U1210; 49:r, U1211; 60:r, U1212; 65:r, U1213; 67:r, U1214.
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70. *Syntrichia papillosissima* (Copp.) Loeske - 1:r, U1245.
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71. *Syntrichia princeps* (De Not.) Mitt. - 40:t, U1215.
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72. *Syntrichia ruralis* var. *ruraliformis* (Besch.) Delogne - 2:s, U1237; 2:r, U1244; 8:r, U1238; 10:r, U1239; 17:t, U1240; 18:r, U1241; 20:s, U1242; 22:r, U1243.
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73. *Syntrichia ruralis* var. *ruralis* (Hedw.) F.Weber & D.Mohr - 1:r, U1246; 2:r, U1247; 3:r, U1248; 4:r, U1249; 5:r, U1250; 6:r, U1251; 7:r, U1252; 8:r, U1253; 8:t, U1254; 10:r, U1255; 10:s, U1256; 10:t, U1257; 18:r, U1258; 41:r, U1259; 47:rc, U1260; 48:r, U1261; 49:r, U1262; 50:r, U1263; 52:r, U1264; 60:s, U1265; 61:r, U1266; 63:s, U1267; 67:r, U1268.
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74. ********Syntrichia virescens* (De Not.) Ochyra - 1:r, U1226; 5:r, U1227; 7:s, U1231; 8:r, U1232; 10:r, U1233; 21:t, U1228; 24:r, U1229; 25:r, U1234; 40:t, U1230.
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75. *******Tortula atrovirens* (Sm.) Lindb. - 49:r, U1159; 62:r, U1160.
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76. *******Tortula brevissima* Schiffn. - 4:r, U1161; 31:r, U1162; 33:r, U1163; 40:r, U1164; 41:r, U1165; 52:r, U1166; 60:r, U1167; 62:r, U1168.
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77. *Tortula inermis* (Brid.) Mont. - 1:r, U1216; 4:r, U1217; 5:r, U1218; 8:r, U1219; 10:t, U1220; 10:r, U1221; 13:r, U1222; 15:r, U1223; 50:r, U1224; 60:r, U1225.
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78. ********Tortula marginata* (Bruch & Schimp.) Spruce - 7:s, U1169; 43:rc, U1170; 65:r, U1171.
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79. *Tortula muralis* Hedw. - 6:r, U1295; 10:r, U1191; 16:r, U1196; 28:r, U1197; 35:r, U1198; 53:r, U1199; 57:r, U1193; 62:r, U1194.

80. ***Tortula schimperi* M.J.Cano, O.Werner & J.Guerra - 47:s, U1200.

81. *Tortula subulata* Hedw. - 1:s, U1172; 6:s, U1173; 7:s, U1174; 8:s, U1175; 11:s, U1176; 18:s, U1177; 20:s, U1178; 28:s, U1179; 32:s, U1180; 40:r, U1181; 41:s, U1182; 44:s, U1183; 46:s, U1184; 57:s, U1185; 58:s, U1186; 59:s, U1187; 59:r, U1188; 60:r, U1189; 65:s, U1190.

Orthotrichaceae Arn.

82. **Orthotrichum anomalum* Hedw. - 1:r, U734; 5:r, U735; 8:r, U736; 10:r, U737; 17:r, U738; 20:r, U739; 21:r, U740; 56:r, U741; 61:r, U742.

83. *Orthotrichum cupulatum* Hoffm.exBrid. - 1:r, U682; 2:r, U683; 3:r, U684; 4:r, U685; 5:rc, U686; 5:r, U687; 6:r, U688; 8:r, U689; 10:r, U690; 13:r, U691; 16:r, U692; 18:r, U693; 19:r, U694; 20:r, U696; 22:r, U695; 24:r, U697; 25:r, U698; 26:r, U696; 33:r, U700; 38:r, U701; 40:r, U702; 41:r, U703; 43:r, U704; 44:r, U705; 52:r, U706.

84. *Orthotrichum urnigerum* Myrin - 6:r, U753; 8:rc, U754.

85. *Orthotrichum diaphanum* Schrad. ex Brid. - 40:t, U759.

86. *Orthotrichum rupestre* Schleich. ex Schwägr. - 6:r, U723; 7:r, U724; 8:r, U725; 10:t, U726; 19:r, U727; 25:r, U728; 27:r, U729; 46:r, U730; 47:r, U731; 49:r, U732; 58:r, U733.

87. *Orthotrichum affine* Schrad. ex Brid. - 1:t, U707; 5:t, U708; 6:t, U709; 10:t, U710; 15:t, U711; 16:t, U712; 17:t, U713; 20:t, U714; 21:t, U715; 22:t, U716; 23:t, U717; 24:t, U718; 27:t, U719; 50:t, U720; 54:t, U721; 55:t, U722.

88. *Orthotrichum lyellii* Hook. & Taylor - 16:t, U755; 20:t, U756; 21:t, U757; 22:t, U758.

89. *Orthotrichum speciosum* Nees - 5:t, U745; 10:t, U746; 16:t, U747; 17:t, U748; 20:t, U749; 27:rc, U750; 37:t, U751; 58:t, U752.

90. **Orthotrichum striatum* Hedw. - 5:t, U743; 7:r, U744.

91. ***Ulotia crispa* (Hedw.) Brid. - 8:t, U760; 45:t, U761; 46:t, U762.

Bartramiaceae Schwägr.

92. *Bartramia pomiformis* Hedw. - 8:rc, U570; 38:s, U566; 38:s, U567.

93. ***Bartramia ithyphylla* Brid. - 8:rc, U568; 58:r, U569.

94. ***Philonotis marchica* (Hedw.) Brid. - 46:wr, U571.

95. ***Philonotis fontana* (Hedw.) Brid. - 10:rc, U572; 10:ws, U573; 27:ws, U574; 44:s, U575; 46:ws, U576; 57:ws, U577; 60:s, U577.

96. ***Philonotis tomentella* Molendo - 8:rc, U578.

Bryaceae Schwägr.

97. *Bryum alpinum* Huds. ex With. - 29:ws, U663; 42:s, U664; 44:ws, U665.

98. *Bryum argenteum* Hedw. - 6:r, U650; 28:r, U651; 60:r, U652; 62:r, U653.

99. *Bryum caespiticium* Hedw. - 5:rc, U666; 11:s, U667; 39:t, U669; 39:rc, U668; 40:s, U670; 63:s, U671.

100. *Bryum capillare* Hedw. - 1:r, U654; 5:r, U655; 8:r, U656; 10:s, U657; 20:s, U658; 40:r, U659; 41:rc, U660; 58:r, U661; 60:r, U662.

101. ***Bryum creberrimum* Taylor - 25:t, U677.

102. *Bryum moravicum* Podp. - 40:s, U672.

103. ***Bryum pallens* Sw. ex anon. - 8:src, U673; 28:wr, U674; 45:s, U675.

104. *Bryum pallescens* Schleich. ex Schwägr. - 44:s, U676.

105. *Bryum pseudotriquetrum* (Hedw.) P.Gaertn. et al. - 8:s, U678; 25:r, U679; 27:ws, U681; 58:ws, U680.

106. ****Bryum schleicheri** DC. - 27:wr, U648; 60:ws, U649.

107. ****Bryum torquescens** Bruch & Schimp. - 1:s, U1279.

Mielichhoferiaceae Schimp.

108. *Pohlia cruda* (Hedw.) Lindb. - 25:wr, U640; 49:s, U641; 58:r, U642; 67:s, U643.

109. *Pohlia melanodon* (Brid.) A.J.Shaw - 47:ws, U647.

110. *Pohlia wahlenbergii* var. *wahlenbergii* (F.Weber&D.Mohr) A.L.Andrews - 10:s, U644; 42:s, U645; 47:ws, U646.

Mniaceae Schwägr.

111. ****Mnium marginatum** (Dicks.) P.Beauv. - 8:s, U763; 8:rc, U764.

Plagiomniaceae T.J.Kop.

112. ****Plagiomnium cuspidatum** (Hedw.) T.J.Kop. - 63:r, U767.

113. *Plagiomnium ellipticum* (Brid.) T.J.Kop. - 38:ws, U765.

114. ****Plagiomnium undulatum** (Hedw.) T.J.Kop. - 47:s, U768; 47:ws, U769; 58:ws, U770; 63:wr, U771.

115. *Plagiomnium rostratum* (Schrad.) T.J.Kop. - 25:wr, U766.

Aulacomniaceae Schimp.

116. ****Aulacomnium androgynum** (Hedw.) Schwägr. - 8:t, U533; 36:dt, U534; 38:t, U535; 42:dt, U536; 45:dt, U537; 47:t, U538; 53:t, U539.

Amblystegiaceae Kindb.

117. *Cratoneuron filicinum* (Hedw.) Spruce - 8:s, U841; 8:wr, U842; 25:wr, U843; 27:s, U844; 30:wr, U845; 38:wr, U846; 42:ws, U847; 42:r, U848; 44:s, U49; 47:wr, U850; 48:wr, U851.

118. ****Drepanocladus aduncus** (Hedw.) Warnst - 44:ws, 852.

119. *Hygroamblystegium tenax* (Hedw.) Jenn. - 10:s, U1272.

120. *Palustriella commutata* (Hedw.) Ochyra - 8:wr, U834; 10:rc, U835; 27:wr, U836; 27:s, U837; 46:ws, U839; 47:ws, U840; 48:wr, U838.

Leskeaceae Schimp.

121. *Pseudoleskea incurvata* (Hedw.) Loeske - 8:rc, U771; 49:r, U772; 67:r, U773.

122. ****Pseudoleskea patens** (Lindb.) Kindb. - 59:r, U774; 60:r, U775; 65:r, U776.

123. ****Pseudoleskeella catenulata** (Brid. ex Schrad.) Kindb. - 13:t, U777; 23:r, U778; 45:r, U779; 52:r, U780.

124. ****Pseudoleskeella tectorum** (Funck ex Brid.) Kindb. ex Broth. - 8:r, U781; 19:t, U782; 23:r, U783; 39:r, U784; 54:r, U785; 55:t, U786.

Brachytheciaceae Schimp.

125. *Eurhynchium striatum* (Hedw.) Schimp. - 1:r, U1028.

126. *Platyhypnidium riparioides* (Hedw.) Dixon - 8:t, U1049; 8:wr, U1050; 47:wr, U1051; 57:wr, U1052; 58:ws, U1053; 58:wr, U1054; 63:wr, U1055.

127. ****Rhynchostegium confertum** (Dicks.) Schimp. - 42:ws, U1056.

128. *Oxyrrhynchium hians* (Hedw.) Loeske - 47:wr, U1024; 47:ws, U1025.

129. *****Oxyrrhynchium schleicheri** (R.Hedw.) Röhl - 8:r, U1026; 25:r, U1027.

130. ****Brachythecium albicans** (Hedw.) Schimp. - 8:rc, U1040; 10:s, U1041; 27:s, U1042;

131. ****Brachythecium erythrorrhizon** Schimp. - 7:s, U1043; 11:s, U1044; 45:s, U1045; 45:r, U1046; 46:r, U1047; 47:s, U1048.

132. *Brachythecium rivulare* Schimp. - 27:s, U1035; 38:wr, U1036; 47:wr, U1037; 59:ws, U1038; 63:r, U1039.

133. *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen - 7:s, U1029.

134. *Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen - 10:s, U1030; 28:s, U1031; 45:t, U1032; 47:t, U1033; 53:t, U1034.

135. *Homalothecium aureum* (Spruce) H.Rob. - 2:s, U999; 34:s, U1000; 40:r, U1001; 40:s, U1002; 46:s, U1003; 47:t, U1004; 56:r, U1005.

136. *Homalothecium lutescens* (Hedw.) H.Rob. - 1:r, U977; 2:s, U972; 5:r, U973; 6:r, U974; 7:r, U975; 8:rc, U976; 10:r, U978; 10:t, U979; 15:r, U980; 16:r, U981; 19:s, U982; 20:t, U983; 22:r, U984; 45:s, U985; 54:r, U986.

137. *Homalothecium philippeanum* (Spruce) Schimp. - 13:r, U1006; 13:t, U1007; 15:r, U1008; 16:r, U1009; 17:r, U1010; 17:s, U1011; 20:r, U1012; 21:r, U1014; 21:t, U1014; 2:r, U1015; 23:r, U1016; 24:r, U1017; 34:r, U1018; 40:r, U1019; 45:r, U1020; 49:r, U1021; 51:r, U1022; 63:r, U1023.

138. *Homalothecium sericeum* (Hedw.) Schimp. - 1:r, U987; 7:r, U988; 8:r, U989; 11:t, U990; 13:s, U991; 15:r, U992; 17:r, U993; 18:r, U994; 19:r, U995; 20:s, U996; 21:t, U997; 49:r, U998.

Hypnaceae Schimp.

139. ***Calliergonella cuspidata* (Hedw.) Loeske - 8:s, U813.

140. *Ctenidium molluscum* (Hedw.) Mitt. - 8:rc, U814.

141. *Hypnum cupressiforme* var. *cupressiforme* Hedw. - 7:s, U802; 23:r, U803; 23:s, U804; 43:r, U805; 47:t, U806; 55:r, U807.

142. *Hypnum cupressiforme* var. *lacunosum* Brid. - 7:s, U808; 7:r, U809; 21:t, U810; 40:t, U811; 46:s, U812; 47:s, U813.

143. ***Hypnum cupressiforme* var. *resupinatum* (Taylor) Schimp. - 21:t, U800; 47:r, U801.

Pterigynandraceae Schimp.

144. *Habrodon perpusillus* (De Not.) Lindb. - 45:t, U799.

145. *Pterigynandrum filiforme* Hedw. - 8:t, U787; 13:t, U788; 16:t, U789; 17:s, U790; 18:t, U791; 19:t, U792; 21:t, U799; 37:r, U794; 40:t, U795; 53:t, U796; 57:t, U797; 58:r, U798.

Plagiotheciaceae (Broth.) M.Fleisch.

146. ***Plagiothecium laetum* Schimp. - 8:rc, U1271.

Pylaisiadelphaceae Goffinet & W.R.Buck

147. ***Platygyrium repens* (Brid.) Schimp. - 69:r, U815.

Leucodontaceae Schimp.

148. ***Leucodon immersus* Lindb. - 7:r, U1273.

149. *Leucodon sciuroides* var. *morensis* (Schwägr.) De Not. - 12:s, U590; 13:t, U591; 15:r, U592; 16:r, U593; 21:r, U594; 35:r, U595; 47:r, U596; 55:r, U597; 56:r, U598.

150. *Leucodon sciuroides* var. *sciuroides* (Hedw.) Schwägr. - 13:r, U579; 17:r, U580; 19:t, U581; 21:t, U582; 22:t, U583; 24:r, U584; 35:r, U585; 38:r, U586; 40:r, U587; 41:r, U588; 41:t, U589.

Neckeraceae Schimp.

151. **Homalia trichomanoides* (Hedw.) Brid. - 17:r, U830; 54:r, U831.

152. *Neckera besserii* (Lobarz.) Jur. - 52:r, U832.

153. *Neckera menziesii* Drumm. - 8:t, U816; 8:rc, U817; 8:r, U818; 17:r, U819; 18:r, U820; 23:r, U821; 23:rc, U822; 24:r, U823; 24:t, U824; 39:r, U825; 43:r, U828; 45:r, U826; 45:s, U827; 54:r, U829.

Leptodontaceae Schimp.

154. *Leptodon smithii* (Hedw.) F.Weber & D.Mohr - 23:r, U833.

Lembophyllaceae Broth.

155. *Isothecium alopecuroides* (Lam. ex Dubois) Isov. - 58:r, U1057.

156. *Isothecium holtii* Kindb. - 63:r, U1058.

4. Synonyms

Subspecies and varieties are included; hybrids are omitted. The taxonomic hierarchy is based on one published by Goffinet & Buck in [24]. While it has been strongly influenced by results of modern molecular methods, there are still many remaining uncertainties, even at family level. Because of these uncertainties, taxonomic innovation has generally been avoided which was also interiorized in the Bryological Monograph related with the Mosses of Europe and Macaronesia prepared by Hill et al. in [32].

In this list, prepared according to the most recent nomenclatural changes in the mentioned monograph above, some species have been mentioned in different genus and some of them have been referred in different families. In accordance with that, taxonomic synonyms are given below.

Brachythecium velutinum (Hedw.) Bruch & Schimp. → *Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen

Bryum subelegans Kindb. → *Bryum moravicum* Podp.

Eurhynchium hians (Hedw.) Sande Lac. → *Oxyrrhynchium hians* (Hedw.) Loeske.

Eurhynchium pulchellum (Hedw.) Jenn. → *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen

Eurhynchium schleicheri (R.Hedw.) Jur. → *Oxyrrhynchium schleicheri* (R.Hedw.) Röll

Funaria muehlenbergii Turner → *Entosthodon muhlenbergii* (Turner) Fife

Funaria pulchella H.H.Philib. → *Entosthodon pulchellus* (H.Philib.) Brugué's

Homalia besserii Lobarz. → *Neckera besserii* (Lobarz.) Jur.

Hypnum lacunosum (Brid.) Hoffm.ex Brid. → *Hypnum cupressiforme* var. *lacunosum* Brid.

Hypnum resupinatum Taylor → *Hypnum cupressiforme* var. *resupinatum* (Taylor) Schimp.

Metaneckeramenziesii (Drumm.) Steere → *Neckera menziesii* Drumm.

Syntrichia intermedia Brid. → *Syntrichia montana* Nees

Tortula subulata var. *angustata* (Schimp.) Limpr. → *Tortula schimperi* M.J.Cano, O.Werner & J.Guerra

5. Conclusions

A total number of 156 taxa belonging to 66 genera and 29 families were determined by evaluating 1.148 bryophytes collected from Kızıldağ National Park between 2009-2011 at different seasons and habitats. The number of taxa recorded from Pınargözü cave location was the highest (58 taxa) within all study area (Figure 5). The cracks on the rock which placed at the entrance and the surrounding area of a cave are suitable environments for the development of the mosses. In addition, Pınargözü cave streams and more rainfall has increased moss species diversity of this area. Among the 156 species determined in the research area, identified 63 species are new to the area for the mentioned grid squares. This means that approximately 40% of the records were determined as new records for the grid squares.

Seligeria donniana was recorded for the first time for Turkish bryophyte flora (Figure 6). This genus contains nineteen species in the European countries [32] and hitherto, six species; *Seligeria acutifolia* Lindb., *S. pusilla* (Hedw.) Bruch & Schimp., *S. recurvata* (Hedw.) Bruch & Schimp., *S. tristichoides* Kindb., *S. calycina* (*S. paucifolia* auct. non (With.) Carruth.), Mitt. ex Lindb. and *S. trifaria* (Brid.) Lindb. [54, 61, 70] have been recorded in Turkey.

In this study, an endemic taxon *Cinclidorus vardaranus* Erdağ and Kürschner was recorded for the second time for Turkish moss flora (Figure 7). This species was identified and reported by Adnan Erdağ and Harald Kürschner in [22] from B9 grid square (Kemaliye, Erzincan) for the first time. In addition, *Crossidium crassinerve* (De Not.) Jur. is an other species reported for the second time from Turkey in this study (Figure 8). The first report of this species from Turkey was from Denizli Babadağ by Kırmacı et al. in [34].

Despite of being given several times in the northern part of Turkey's registration, species given for the first time for the southern Turkey's (C12) registration are:

Plagiomniumcuspidatum (Hedw.) T.J.Kop (Figure 9): The species was firstly identified from Turkey by Henderson [26], from a specimen collected from Artvin at 1500 a.s.l. In the following years, the records of this moss species were given by Henderson and Prentice [29]; Çetin [13]; Yayıntaş and Tonguç [77]; Yayıntaş et al. [76]; Özdemir [58]; Abay and Çetin [1]; Uyar [73]; Abay et al. [2]; Uyar and Çetin [71]; Özdemir and Koz [57]; Ursavaş and Abay [68]; Abay et al. [4]; and Abay et al. [3].

Pseudoleskeapatens (Lindb.) Kindb (Figure 10): According to Uyar and Çetin [70] "A new check-list of the moss flora of Turkey" was present. Subsequently, Özdemir and Batan [56], Ursavaş and Abay [68], and Abay et al. [4] records were given.

Isothecium holtii Kindb is not abundant in Turkey (Figure 11): first record was from Turkey of Balıkesir Kapıdağ peninsula (545 a.s.l.) by Uyar and Ören [72]. Afterwards, an other report from Kaçkar Mountains from Amlakit plateau (2000 a.s.l.) was given by Abay et al. [3].

Racomitrium canescens (Hedw.) Brid (Figure 12): The species was recorded for the first time from Artvin Çoruh Valley from Tiryal Mountain (2150 a.s.l.) on rock by Henderson [71] in Turkey. The later records of the species were given by Henderson [26]; Henderson and Prentice [29]; Çetin and Yurdakulol [19]; Çetin and Yurdakulol [20]; Çetin [16]; Özdemir and Çe-

tin [55]; Çetin et al. [18]; Abay and Çetin [1]; Papp [60]; Uyar and Çetin [71]; Abay et al. [2]; Uyar et al. [69]; Natcheva et al. [49]; and Abay et al. [4].

New moss record for B7 square is *Schistidium atrofusum* (Schimp.) Limpr., *Distichium capillaceum* (Hedw.) Bruch&Schimp., *Tortella nitida* (Lindb.) Broth., *Syntrichia norvegica* F.Weber, *Orthotrichum anomalum* Hedw., *Orthotrichum striatum* Hedw., *Homalia trichomanoides* (Hedw.) Brid.

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Figure 5. A view from the entrance of the Pınargözü cave (Image by Serhat URSAVAŞ)

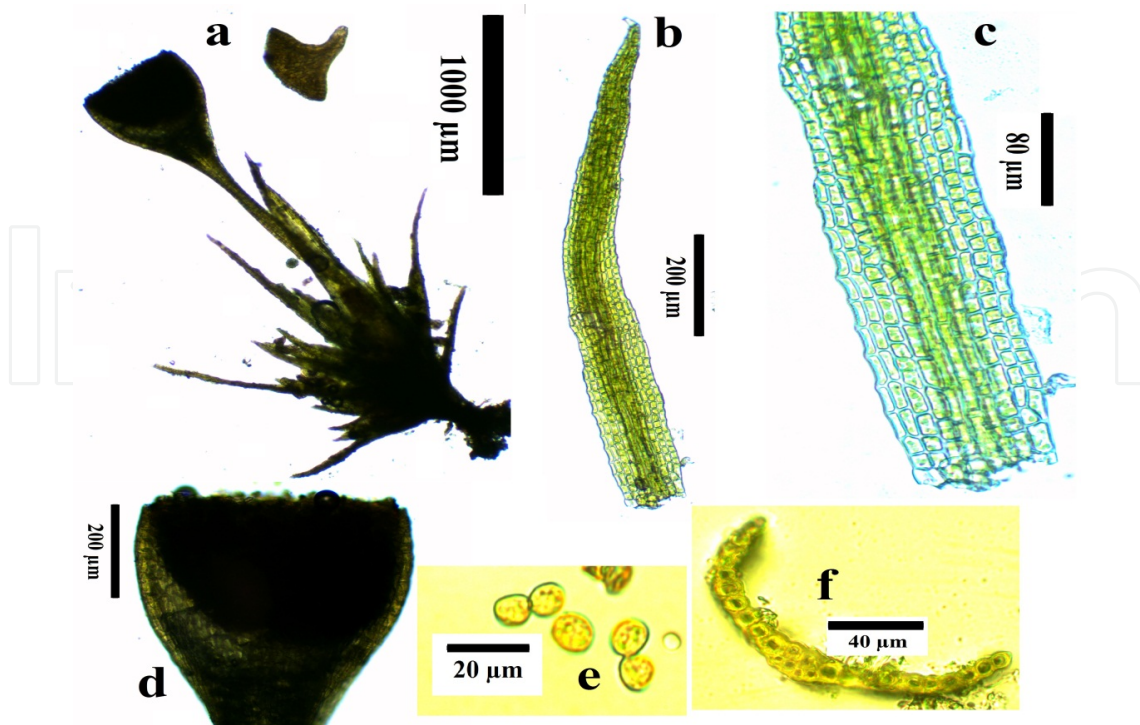


Figure 6. Characteristic features of *Seligeria donniana* (Image by Serhat URSAVAŞ) a. Plant, b. Leaf, c. Leaf base, d. Capsule, e. Spor, f. Transverse section

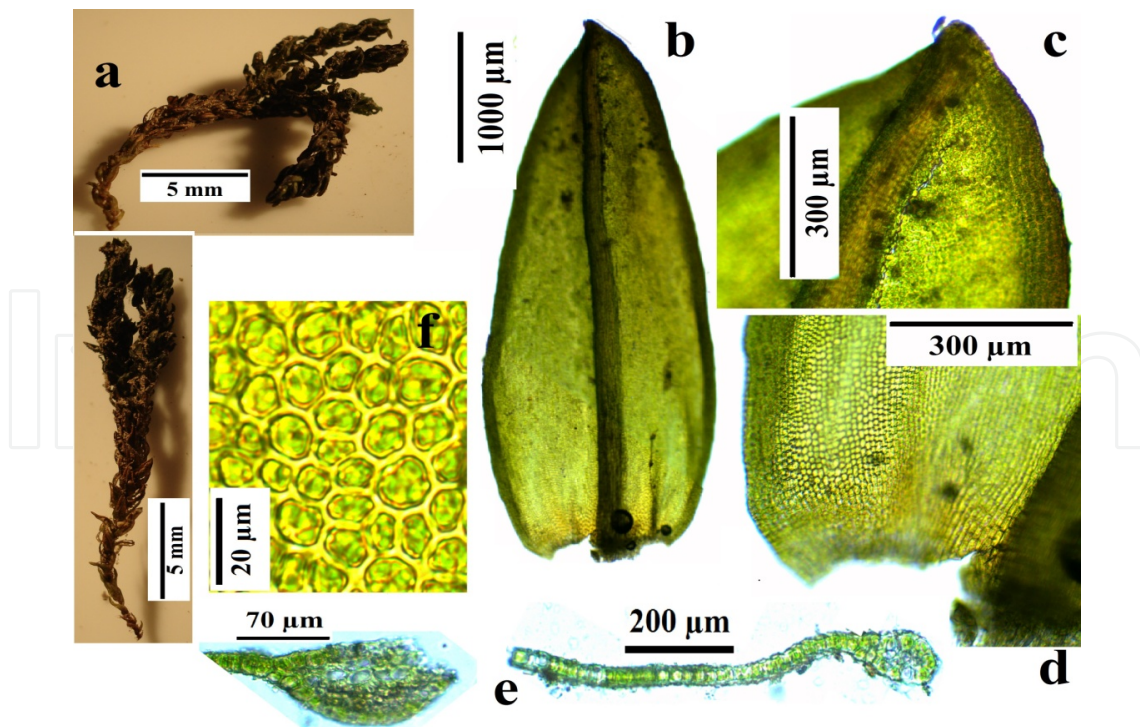


Figure 7. Characteristic features of *Cinclidotus vardaranus* (Image by Serhat URSAVAŞ) a. Plant, b. Leaf, c. Leaf apex, d. Leaf base, e. Transverse section, f. Middle cells

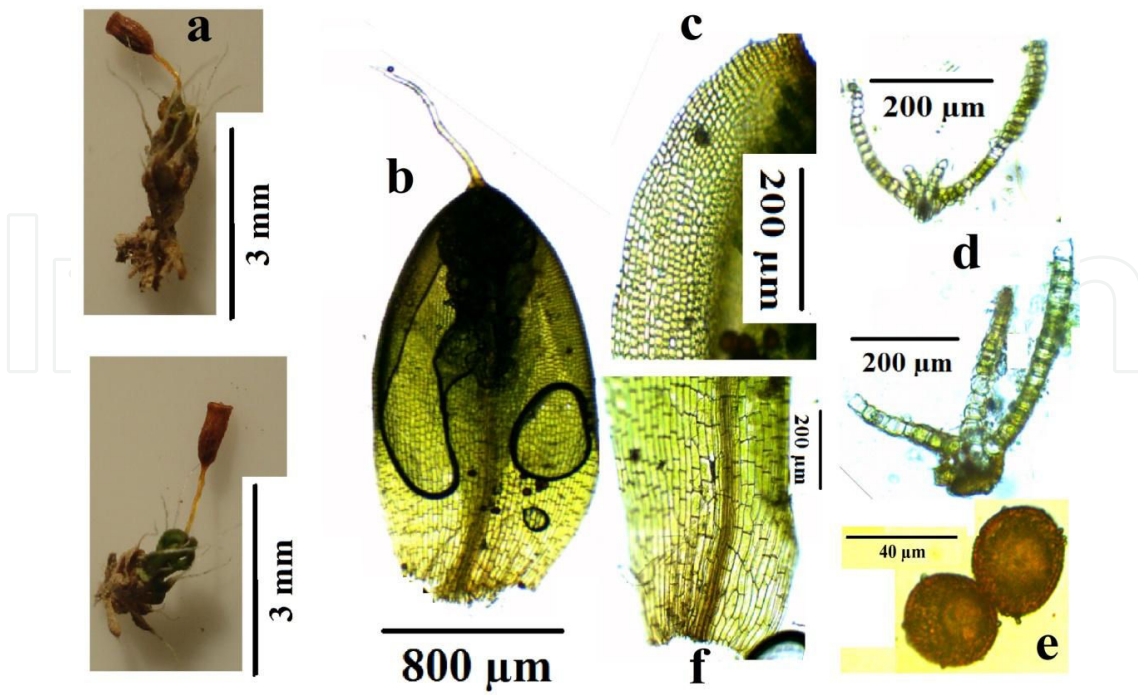


Figure 8. Characteristic features of *Crossidium crassinerve* (Image by Serhat URSAVAŞ) **a.** Plant, **b.** Leaf, **c.** Upper cells of leaf, **d.** Transverse section, **f.** Leaf base, **e.** Spore

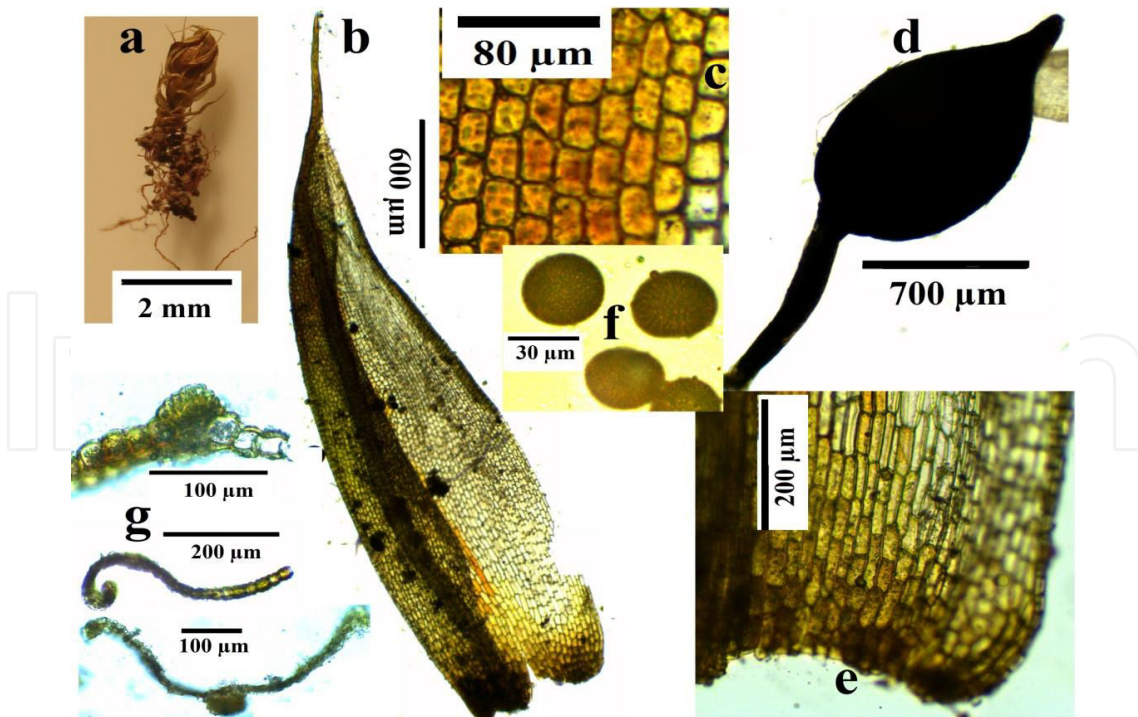


Figure 9. Characteristic features of *Phascum cuspidatum* (Image by Serhat URSAVAŞ) **a.** Plant, **b.** Leaf, **c.** Middle cells, **d.** Capsule, **e.** Leaf base, **f.** Spore, **g.** Transverse section

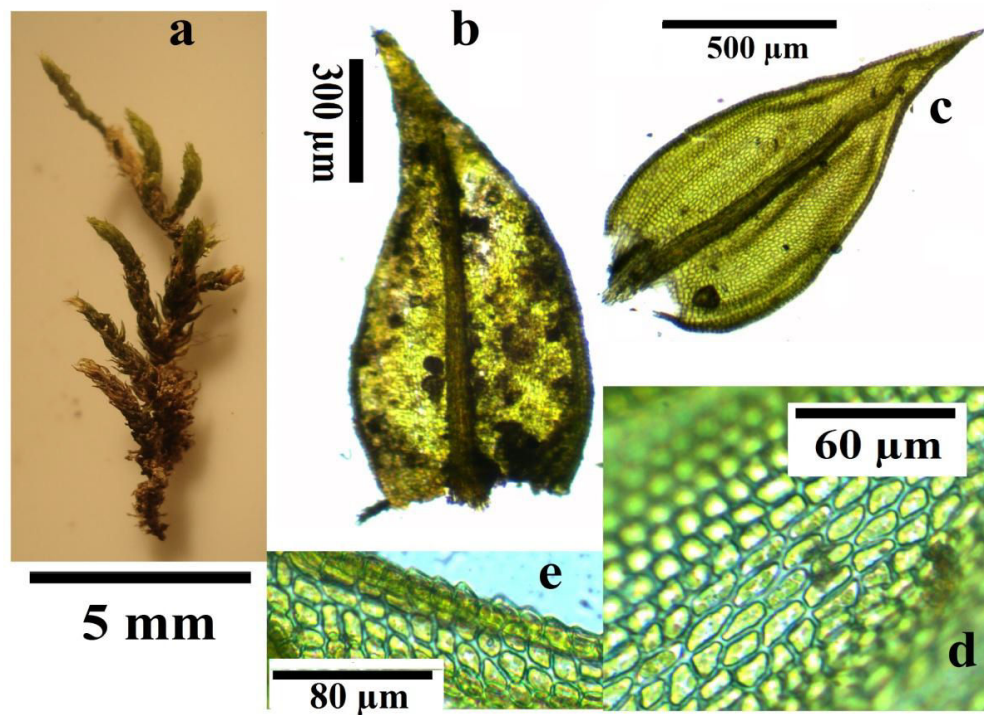


Figure 10. Characteristic features of *Pseudoleskea patens* (Image by Serhat URSAVAŞ) a. Plant, b. Stem leaf, c. Branch leaf, d. Middle cells, e. Leaf margin

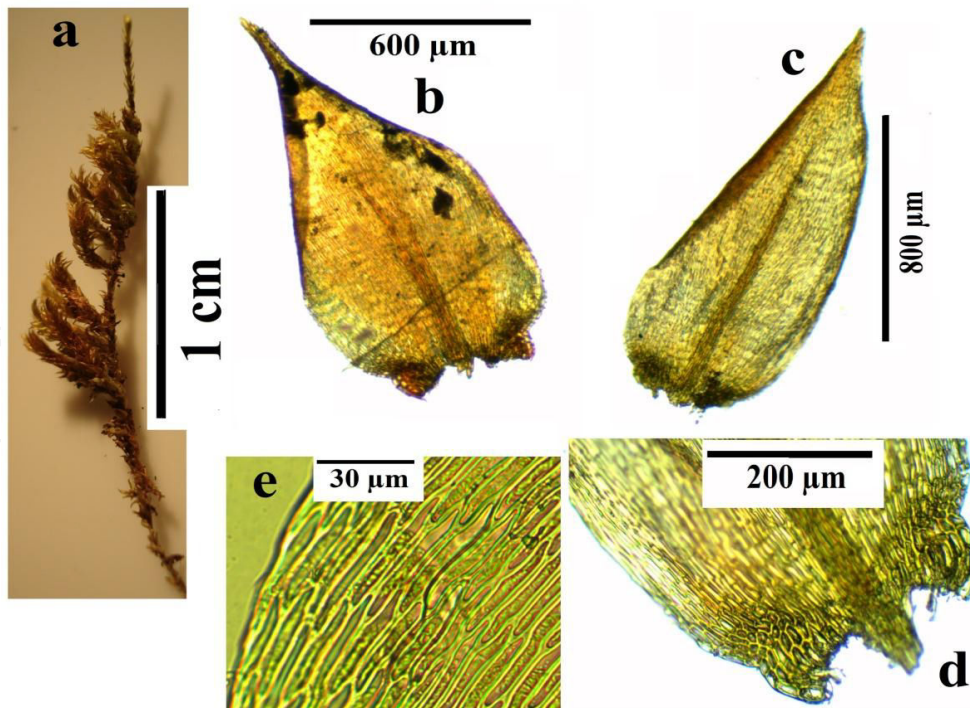


Figure 11. Characteristic features of *Isotheicum holtii* (Image by Serhat URSAVAŞ) a. Plant, b. Stem leaf, c. Branch leaf, d. Leaf base, e. Middle cells

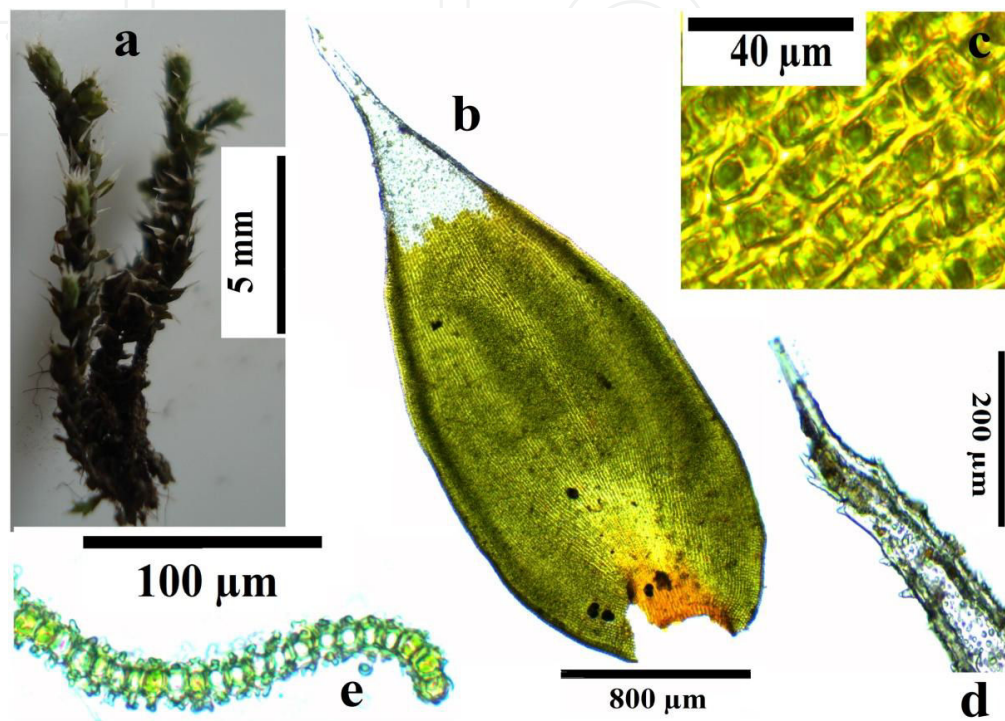


Figure 12. Characteristic features of *Racomitrium canescens* (Image by Serhat URSAVAŞ) **a.** Plant, **b.** Leaf, **c.** Middle cells, **d.** Leaf apex, **e.** Transverse section

New moss record for C12 square is *Polytrichum juniperinum* Hedw., *Timmia austriaca* Hedw., *Entosthodon muhlenbergii* (Turner) Fife, *Entosthodon pulchellus* (H.Philib.) Brugué's, *Grimmia caespiticia* (Brid.) Jur., *Racomitrium canescens* (Hedw.) Brid., *Schistidium trichodon* (Brid.) Poelt, *Fissidens taxifolius* Hedw., *Distichium inclinatum* (Hedw.) Bruch & Schimp., *Dicranum tauricum* Sapjegin, *Gymnostomum aeruginosum* Sm., *Gyroweisia reflexa* (Brid.) Schimp., *Weissia brachycarpa* (Nees & Hornsch.) Jur., *Cinclidotus vardaranus* Erdağ & Kürschner, *Crossidium crassinerve* (De Not.) Jur., *Phascum cuspidatum* var. *piliferum* (Hedw.) Hook. & Taylor, *Pterygoneurum ovatum* (Hedw.) Dixon, *Tortula atrovirens* (Sm.) Lindb., *Tortula brevissima* Schiffn., *Tortula schimperi* M.J.Cano, O.Werner & J.Guerra, *Ulota crispa* (Hedw.) Brid., *Bartra-*

mia ithyphylla Brid., *Philonotis marchica* (Hedw.) Brid., *Philonotis fontana* (Hedw.) Brid., *Philonotis tomentella* Molendo, *Bryum creberrimum* Taylor, *Bryum pallens* Sw. ex anon., *Bryum torquescens* Bruch & Schimp., *Bryum schleicheri* DC., *Mnium marginatum* (Dicks.) P.Beauv., *Plagiomnium cuspidatum* (Hedw.) T.J.Kop., *Plagiomnium undulatum* (Hedw.) T.J.Kop., *Aulacomnium androgynum* (Hedw.) Schwägr., *Drepanocladus aduncus* (Hedw.) Warnst, *Pseudoleskea patens* (Lindb.) Kindb., *Pseudoleskeella catenulata* (Brid. ex Schrad.) Kindb., *Pseudoleskeella tectorum* (Funck ex Brid.) Kindb. ex Broth., *Rhynchostegium confertum* (Dicks.) Schimp., *Brachythecium albicans* (Hedw.) Schimp., *Brachythecium erythrorrhizon* Schimp., *Calliergonella cuspidata* (Hedw.) Loeske, *Hypnum cupressiforme* var. *resupinatum* Hedw., *Plagiothecium laetum* Schimp., *Platygyrium repens* (Brid.) Schimp., *Leucodon immersus* Lindb. *Neckera crispa* Hedw., *Isothecium holtii* Kindb.

New moss records for both of them (B7 and C12) are *Timmia norvegica* J.E.Zetterst., *Grimmia funalis* (Schwägr.) Bruch & Schimp., *Grimmia montana* Bruch & Schimp., *Ceratodon conicus* (Hampe) Lindb., *Tortella inclinata* var. *densa* (Lorentz & Molendo) Limpr., *Pseudocrossidium hornschuchianum* (Schultz) R.H.Zander, *Syntrichia virescens* (De Not.) Ochyra, *Tortula marginata* (Bruch & Schimp.) Spruce, *Oxyrrhynchium schleicheri* (R.Hedw.) Röll.

The revelation of the importance of Pınargözü Cave for the biodiversity of mosses comes out as another important finding of the study. Namely, the taxa detected from this locality constitutes alone approximately the one third (37%) of the overall taxa determined from the whole research area. This result indicates the value of the Pınargözü Cave in terms of its contribution to the bryophyte diversity. Unfortunately, human activities in and around the Pınargözü Cave either by using the site as a picnic area or as a hiking site on the Mount Dedeğöl are certainly putting an enormous pressure on the local flora, which in turn, conceive a negative effect on the rich biodiversity of Pınargözü Cave.

According to the our findings, 4 families out of 29 in the study area detected from the research area constitute 55 % of the total taxa. These families are: Pottiaceae, Grimmiaceae, Brachytheciaceae and Bryaceae, which are also known to be the families containing the highest number of taxon of the Turkish Bryophyte Flora (Table 2).

While evaluating the table 2, the total number of taxon of each family was handled. According to this, it was inferred that the family containing the utmost number of taxa within the study area was Pottiaceae family with 43 taxa, constituting the 28 % of the total taxa.

This situation can be explained by the summer droughts (25.4 °C and 8.2 mm) within the study area which takes place in the C12 square grid. Because, species shows acrocarp growth as the ones within the Pottiaceae family are relatively more resistant to the long term high temperatures and drought since they usually have hair like appendages that are called "hair-point" on the tip of their leaves and show a dense, cushion like growth. Also, the existence of a great number of taxa belonging to the drought resistant families such as Grimmiaceae, Brachytheciaceae and Bryaceae in the study area can be seen as a result arising from the long lasting drought period at C12 square.

| Families | Number of Taxa | Percentage of taxa according to total number of taxa (%) |
|--------------------|----------------|--|
| Pottiaceae | 43 | 28.0 |
| Grimmiaceae | 17 | 11.0 |
| Brachytheciaceae | 14 | 9.0 |
| Bryaceae | 11 | 7.0 |
| Orthotrichaceae | 10 | 6.5 |
| Bartramiaceae | 5 | 3.2 |
| Ditrichaceae | 5 | 3.2 |
| Hypnaceae | 5 | 3.2 |
| Encalyptaceae | 4 | 2.6 |
| Plagiomniaceae | 4 | 2.6 |
| Amblystegiaceae | 4 | 2.6 |
| Leskeaceae | 4 | 2.6 |
| Neckeraceae | 3 | 1.9 |
| Funariaceae | 3 | 1.9 |
| Fissidentaceae | 3 | 1.9 |
| Mielichhoferiaceae | 3 | 1.9 |
| Leucodontaceae | 3 | 1.9 |
| Timmiaceae | 2 | 1.2 |
| Pterigynandraceae | 2 | 1.2 |
| Lembophyllaceae | 2 | 1.2 |
| Polytrichaceae | 1 | 0.6 |
| Rhabdoweisiaceae | 1 | 0.6 |
| Dicranaceae | 1 | 0.6 |
| Mniaceae | 1 | 0.6 |
| Aulacomniaceae | 1 | 0.6 |
| Plagiotheciaceae | 1 | 0.6 |
| Pylaisiadelphaceae | 1 | 0.6 |
| Leptodontaceae | 1 | 0.6 |
| Seligeriaceae | 1 | 0.6 |
| Total | 156 | 100 |

Table 2. The distributions of the taxa according to the families

Acknowledgements

Many thanks to Funda OSKAY and Üstüner BİRBEN for the linguistic corrections of the manuscript and also thanks a lot to Türk Eğitim Vakfı (TEV) which I was provided scholarships by. Special thanks to Richard H. Zander for confirming the determination of *Seligeria donniana* (Sm.) Müll. Hal. and Michael Lütke for confirming the determination of *Cinclidotus vardaranus* Erdağ and Kürschner.

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