Studies on the Hornworts and Liverworts Flora of Antalya*

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Abstract: This study includes a list of hornwort and liverwort flora of Antalya province. It is composed of 2 species belonging to a family of the class Anthocerotopsida and 35 species belonging to 23 families of the class Marchantiopsida of the division Bryophyta. For the C12 grid square of Turkey, 14 liverworts are new records.

Key Words: Liverworts, hornworts, Anthocerotopsida, Marchantiopsida, Antalya

Introduction

Hornworts and liverworts are the members of classes Anthocerotopsida and Marchantiopsida (Hepaticae), respectively, of the division Bryophyta. According to the most recent references, nearly 10,000 species of liverworts and hornworts exist in the world. To date, only 163 species have been recorded in Turkey (Kürschnner and Erdağ, 2005). However, this number does not reflect the real potential since Turkey possesses different climatic zones, diverse topographic features, and assorted vascular plants. It is known that most of the taxonomic studies in Turkey were related to vascular plants, meaning that cryptogrammic plants have been neglected because of the difficulty of research and insufficient references.

A part of the liverworts flora of Turkey was determined by previous studies (Gökler & Öztürk, 1991, 1996; Kürschnner, 2001; Özenoğlu & Gökler, 2002; Kürschnner & Erdağ, 2005). However, the number of the species recorded by native researchers does not reflect the real potential of this country and the related references in this area are very limited (Crundwell & Nyholm, 1979; Çetin, 1989a, 1989b).

The study area is located between 36° 10.00’ N – 37° 10.00’ N and 30° 00.00’ E – 30° 50.00’ E in south-west Anatolia (Figure 1). The region has a Mediterranean climate with mild and rainy winters and hot and dry summers. The mean annual temperature varies between 18 and 20 °C on the coastal belt of the region. The mean January temperature varies between 10 and 5 °C. The mean July temperature is over 25 °C and the highest value reaches up to 45 °C (Atalay, 2002). The mean annual precipitation ranges from 600 to 1200 mm, half of which falls during the winter. Mediterranean vegetation can be divided into 2 main formations according to the ecological properties of the region.

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Typical Mediterranean vegetation appears on the lower belt of the areas characterized by *Pinus brutia* Ten. and maquis vegetation, and the upper part region contains coniferous forests composed of *Pinus nigra* Arn., *Cedrus libani* A.Rich., and *Abies cilicica* (Ant. & Kotschy) Carr.). Maquis vegetation has developed as the result of the destruction of *Pinus brutia* forests. *Quercus coccifera* L., which is the prominent indicator maquis element of the Mediterranean climate, is found in all parts of the Mediterranean region (Atalay, 2002).

### Materials and Methods

The specimens of the study area were collected during excursions in 2002 and 2005. The liverworts and hornworts localities in the area were visited and different habitat types were investigated. The coordinates for each taxon are determined by a Garmin e-trex Vista GPS. Black dots show the locality coordinates of liverworts and hornworts in the map (Figure). Many plants were collected from every locality in general.

Determinations were carried out using different previously reported lists and flora books (Gökler, 1986; Gökler & Öztürk, 1986, 1991, 1996; Smith, 1991; Frey & Kürschner, 1991; Paton, 1999; Kürschner, 2001) and some other relevant literature (Frey et al., 1991; Gökler, 1992, 1993a, 1993b; Gökler & Özenoğlu, 1999; Özenoğlu & Gökler, 2002; Kürschner & Erdağ, 2005). The plant list is shown in accordance with the system described by Grolle (1983). Distributions of the species in Turkey are given by the grid system of Henderson (1961). All the specimens were deposited in the herbarium of the Department of Biology, Buca Education.
Faculty, Dokuz Eylül University. The new taxa for the grid square C12 are indicated with an asterisk (*) in the floristic catalogue.

Results and Conclusion

BRYOPHYTA

ANTHOCEROTOPSIDA

ANTHOCERATALES

Anthocerotaceae

1. Anthoceros punctatus L., 1753
   - Antalya; Çıralı, Yanartaş (Chimera), on soil bank along the road, with Oxymitra incrassata, Riccia ciliata, Fossombronia pusilla, Petalophyllum ralfsii, Southbya tophaceae, and Cephaloziella hampeana. 28 m, 36° 25'. 779' N 30° 27'. 739' E, North, 16.11.2003. (C12/44-034).

   - Antalya; Antalya, on rocks and soil, with Lunularia cruciata and Reboulia hemisphaerica. 8 m, 36° 23'. 705' N 30° 28'. 322' E, East, 01.05.2004. (C12/73-062).

   - Antalya; Kemer, Olympos Archaic City Ruins, on rocks and soil, with Lunularia cruciata and Reboulia hemisphaerica. 8 m, 36° 23. 705’ N 30° 28. 322’ E, East, 01.05.2004. (C12/73-062).

   - Antalya; Finike, Finike-Elmalı road, on soil bank along the road and on stream banks, with Lunularia cruciata, Fossombronia angulosa, and Fossombronia pusilla. 33 m, 36° 24. 329’ N 30° 08. 901’ E, South-east, 28.11.2004. (C12/81-104).


   - Antalya; Kemer, Olympos Archaic City Ruins, on rocks and soil, with Lunularia cruciata and Reboulia hemisphaerica. 8 m, 36° 23. 705’ N 30° 28. 322’ E, East, 01.05.2004. (C12/73-062).

   Distribution in Turkey: A1, A4, B6, C11, C12

2. Phaeoceros laevis (L.) Proskauer, 1951


   Distribution in Turkey: A1, A4, B6, C11, C12

Targioniaceae

4. Targonia hypophylla L., 1753
   - Antalya; Kemer, Kesme Boğazı, canyon, on soil between rock cavities, 580 m, 36° 36. 875’ N 30° 27. 477’ E, South-east, 15.11.2003. (C12/12-023).

   - Antalya; Altinyaka-Antalya road, 8-10 km from Antalya, under Quercus coccifera shrub, on soil, with Fossombronia pusilla, Lunularia cruciata, and Reboulia hemisphaerica. 541 m, 36° 28. 587’ N 30° 20. 312’ E, North-west, 15.11.2003. (C12/28-026).


   - Antalya; Kemer, Olympos Archaic City Ruins, on rocks and soil, with Lunularia cruciata and Reboulia hemisphaerica. 8 m, 36° 23. 705’ N 30° 28. 322’ E, East, 01.05.2004. (C12/73-062).

   - Antalya; Kemer, Olympos Archaic City Ruins, on rocks and soil, with Lunularia cruciata and Reboulia hemisphaerica. 8 m, 36° 23. 705’ N 30° 28. 322’ E, East, 01.05.2004. (C12/73-062).

   - Antalya; Finike, Finike-Elmalı road, 2-3 km, on soil bank along the road and on stream banks, with Lunularia cruciata, Fossombronia angulosa, and Fossombronia pusilla. 33 m, 36° 24. 329’ N 30° 08. 901’ E, South-east, 28.11.2004. (C12/81-104).


   Distribution in Turkey: A1, A2, B6, B7, C11, C12, C13

Aytoniaceae

5. Plagiochasma rupestre (J.R.Forst. & G.Forst.) Steph., 1898
   - Antalya; Döşemealtı, Yağca Village, Karain Cave, entrance of the cave, on wet rock and soil, with Lunularia cruciata and Riccia sorocarpa. 376 m, 37°04. 666’ N 30° 34. 235’ E, 29.04.2004. (C12/61-050).

   Distribution in Turkey: A2, B6, B7, C11, C12

6. Reboulia hemisphaerica (L.) Raddi, 1818
   - Antalya; Kemer, Kesme Boğazı, on wet soil bank near stream, under Pinus brutia and Mrytus communis L.


- Antalya: Entrance of Düzlerçamı picnic area, on rocks along road, with Southbya tophaceae. 270 m, 36º 58. 572’ N 30º33. 764’ E, East, 29.04.2004. (C12/63-052).

- Antalya: Kemer, Olympos Archaic City Ruins, on rock and soil, with Targionia hypophylla and Lunularia cruciata. 8 m, 36° 23. 705’ N 30º 28. 322’ E, East, 01.05.2004. (C12/73-062).


Distribution in Turkey: A2, A4, B6, B7, B8, C11, C12, C13

* 7. Asterella gracilis (F.Weber) Underwood, 1895

- Antalya: Kemer, Çıralı road, 5-6 km, near stream bed along road, on thin soil covered rocks, with Lunularia cruciata, Riccia sorocarpa, Leicolea turbinata, and Southbya tophaceae. 1200 m, 36º 46. 208’ N 30º 28. 998’ E, North-west, 20.03.2004. (C12/50-039).

Distribution in Turkey: A2, A4, B6, B7, B8, C11, C12

Conocephalaceae

8. Conocephalum conicum (L.) Dumortier, 1822

- Antalya: Altınyaka, Pinargözü fish farm, in stream bed, on wet rocks, epilithic, with Pellia endiviifolia and Porella platyphylla. 1288 m, 36º 34. 150’ N 30º 22. 100’ E, 30.04.2004. (C12/69-058).

Distribution in Turkey: A1, A2, A3, A4, A5, B6, B8, C11, C12

Lunulariaceae

9. Lunularia cruciata (L.) Dumortier ex Lindb., 1868


- Antalya: Between Kemer and Çıralı, Ulupınar Village road, 2-3 km, on soil along road, with Fossombronia pusilla and Petalophyllum ralfsii. 250 m, 36º 27. 640’ N 30º 26. 032’ E, 20.03.2004. (C12/45-035, C12/46-036).


- Antalya: Döşemealtı, Yağca Village, Karain Cave, entrance of cave, on wet rocks and soil, with Plagiochasma rupestre and Riccia sorocarpa. 376 m, 37º 04. 666’ N 30º 34. 235’ E, 29.04.2004. (C12/61-050).


Distribution in Turkey: A1, A2, A3, A4, A5, B6, B9, C11, C12

Marchantiaceae

10. Marchantia polymorpha L., 1753

- Antalya: Finike, Arif Village, Oluklu Plateau road, 2-3 km, in a small stream bed, on soil, with Pellia
endiviifolia and Fossombronia angulosa. 581 m, 36° 29. 867' N 30° 04. 921' E, South, 27.11.2004. (C12/80-103).

Distribution in Turkey: A1, A2, A3, A4, A5, B6, B8, B9, C11, C12, C13, C15

Corsiniaceae
11. Corsinia coriandrina (Spreng.) Lindb., 1877
- Antalya: Finike, Arif Village, Oluköş Plateau road, 5-6 km, in grooved rocks and on soil bank, with Targionia hypophylla and Rebuolia hemisphaerica. 649 m, 36° 29. 762' N 30º 05. 711' E, South-west, 27.11.2004. (C12/79-102).

Distribution in Turkey: B6, C11, C12

Oxymitriaceae
12. Oxymitra incrassata (Brotero) Sergio & Sim-Sim, 1989
- Antalya: Kemer, Olympos Archaic City Ruins, on soil under Pinus brutia, with Oxymitra incrassata, Fossombronia angulosa, and Petalophyllum ralfsii. 45 m, 36° 23. 118' N 30º 27. 548' E, North, 15.11.2003. (C12/30-028).
- Antalya: Çıralı, 50-60 m from beach, on soil. 4 m, 36º 25. 342' N 30º 28. 979' E, 20.03.2004. (C12/51-040).

Distribution in Turkey: C11, C12

Ricciaceae
* 13. Riccia ciliata Hoffm., 1795
- Antalya: Çıralı, Yanartaş (Chimera), on soil banks along road, 1-1.5 km, with Anthoceros punctatus, Oxymitra incrassata, Fossombronia angulosa, Petalophyllum ralfsii, Southbya tophaceae, and Cephaloziella hampeana. 28 m, 36° 25. 779' N 30º 27. 739' E, North, 16.11.2003. (C12/44-034).

Distribution in Turkey: B6, C11, C12

* 14. Riccia glauca L., 1753

Distribution in Turkey: A1, A2, A3, A4, A5, B6, B7, C11, C12, C13

15. Riccia michelii Raddi, 1818
- Antalya: Kemer, Olympos Archaic City Ruins, on soil under Pinus brutia, with Oxymitra incrassata, Fossombronia angulosa, and Petalophyllum ralfsii. 45 m, 36° 23. 118' N 30º 27. 548' E, North, 15.11.2003. (C12/30-028).

Distribution in Turkey: C11, C12

16. Riccia sorocarpa Bisch., 1835
- Antalya: Kemer, Çıralı road, 5-6 km, near stream bed, on soil along road, with Asterella gracilis, Lunularia cruciata, Petalophyllum ralfsii, Leicolea turbinate, and Southbya tophaceae. 42 m, 36º25. 779' N 30º 34. 136' E, North-west, 20.03.2004. (C12/49-039, C12/50-039, C12/56-045).

Distribution in Turkey: B6, C11, C12

METZGERIALES

Metzgeriaceae
17. Metzgeria furcata (L.) Dumortier, 1835
- Antalya: Kuzdere Village, Kesme Boğazı, on rock near the stream, epilithic. 125 m, 36º 36. 125' N 30º 28. 998' E, North-east, 15.11.2003. (C12/4-022).

Distribution in Turkey: B6, C11, C12
Pelliaceae

18. Pellia endiviifolia (Dicks.) Dumortier, 1835
- Antalya: Kumluca-Altinyaka road, 9 km from Altinyaka, on rocks near the road, epilithic. 1213 m, 36° 38'. 286' N 30° 23. 640' E, North-west, 15.11.2003. (C12/25-024, C12/68-057).
- Antalya: Altinyaka-Antalya road, Hisarçandır, on wet rocks in stream bed, epilithic. 782 m, 36º46. 525' N 30º 28. 598' E, South-east, 16.11.2003. (C12/29-027, C12/36-030).
- Antalya: Altinyaka, Pınargözü fish farm, on wet rocks in stream bed, epilithic, with Conocephalum conicum and Porella platyphylla. 1288 m, 36º34. 150' N 30º 22. 100' E, 30.04.2004. (C12/69-058, C12/71-060).
- Antalya: Finike, Arif Village, Oluklu Plateau road, 2-3 km, on soil in stream bed, with Marchantia polymorpha and Pellia endiviifolia. 581 m, 36°29. 867' N 30° 04. 921' E, South, 27.11.2004. (C12/80-103, C12/94-149).

Distribution in Turkey: A1, A2, A3, A4, A5, B6, B7, B9, C11, C12

Codoniaceae

* 19. Fossombronia angulosa (Dicks.) Raddi, 1820
- Antalya: Düzlerçami, entrance of the Düzlerçami picnic area, on small rocks, with Lunularia cruciata, Fossombronia pusilla, and Southbya tophaceae. 270 m, 36° 58. 572' N 30° 33. 764' E, East, 29.04.2004. (C12/64-053).

Distribution in Turkey: A1, A2, A3, A4, A6, B6, C11, C12

20. Fossombronia pusilla (L.) Nees, 1838
- Antalya: Çıralı, Yanartaş (Chimera) road, 1-1.5 km, on soil banks near road, with Anthoceros punctatus, Oxymitra incrassata, Riccia ciliata, Petalophyllum ralfsii, Southbya tophaceae, and Cephaloziella hampeana. 28 m, 36°25. 779' N 30° 27. 739' E, North, 16.11.2003. (C12/44-034, C12/46-036, C12/50-039).

Distribution in Turkey: A1, A2, A3, A4, B6, C11, C12

21. Petalophyllum ralfsii (Wilson) Nees & Gottsche, 1844
- Antalya: Between Kemer and Çıralı, Ulupınar Village, on soil near road, 2-3 km, with Lunularia cruciata and Fossombronia pusilla. 250 m, 36°27. 640' N 30° 26. 032' E, 20.03.2004. (C12/44-034, C12/46-036, C12/49-039).

Distribution in Turkey: B6, C11, C12

JUNGERMANNIALES

Lophoziaceae

22. Leicolea turbinata (Raddi) H.Buch, 1937

- Antalya: Kemer, Çıralı road, 5-6 km, on soil near stream, with Asterella gracilis, Lunularia cruciata, Riccia sorocarpa, and Southbya tophaceae. 42 m, 36° 25. 388’ N 30° 27. 136’ E, North-west, 20.03.2004. (C12/49-039, C12/50-039).

- Antalya: Saklikent TÜBİTAK National Observatory road, Doymran Village, in stream bed, with Fossombronia pusilla. 68 m, 36° 53. 864’ N 30° 31. 711’ E, North, 27.11.2004. (C12/74-095).

Distribution in Turkey: B6, C11, C12

**Jungermanniaceae**

23. *Jungermannia atrovirens* Dumortier, 1831


Distribution in Turkey: A4, C11, C12

24. *Southbya nigrella* (De Not.) Henriq., 1887

- Antalya: Kemer, Kesme Boğazı, on soil covered rocks in stream bed, epilithic, with 580 m, 36°36. 875’ N 30º 27. 477’ E, North-east, 15.11.2003. (C12/18-023).

- Antalya: Between Altınyaka and Antalya, 10 km from Antalya, on soil bank near road, with Targionia hypophylla, Reboulia hemisphaerica, Lunularia cruciata, Pellia endiviifolia, Fossombronia pusilla, and Leicolea turbinata. 544 m, 36° 27. 877’ N 30º 20. 262’ E, North-west, 15.11.2003. (C12/29-027).

- Antalya: Çıralı, Çıralı road, 3-4 km, on rocks near road. 195 m, 36° 29. 600’ N 30° 19. 450’ E, East, 30.04.2004. (C12/65-054).


Distribution in Turkey: B6, C11, C12

25. *Southbya tophacea* (Spruce) Spruce, 1849


- Antalya: Düzlerçami, Düzlerçami picnic area, on rocks near road, with Reboulia hemisphaerica. 270 m, 36° 58. 572’ N 30º 33. 764’ E, East, 29.04.2004. (C12/63-052, C12/64-053).

- Antalya: Kumluca-Altınyaka road, 7 km, on soil near road, with Sphaerocarpos texanus and Lunularia cruciata. 300 m, 36° 28. 001’ N 30º 20. 012’ E, 30.04.2004. (C12/66-055).

Distribution in Turkey: B6, C11, C12

**Plagiochilaceae**

* 26. *Gongylanthus ericetorum* (Raddi) Nees, 1836

- Antalya: Between Kemer and Çıralı, Ulupınar Village, Şelale, on rocks and soil banks near stream bed. 250 m, 36° 27. 440’ N 30º 26. 032’ E, 16.11.2003. (C12/45-035).

Distribution in Turkey: A1, A2, A3, A4, B6, B7, C11

**Geocalycaceae**

* 28. *Lophocolea bidentata* (L.) Dumortier, 1835

- Antalya: Kumluka-Altınyaka road, 10 km, on rock and tree roots in stream bed, with Lunularia cruciata, Metzgeria furcata, and Frullania tamarisci. 500 m, 36°29. 350’ N 30º 19. 470’ E, 30.04.2004. (C12/67-056).

Distribution in Turkey: A1, A2, A3, A4, A5, B6, B7

**Cephalozziellaceae**

* 29. *Cephalozia hampeana* (Nees) Schiffner, 1903

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- **Antalya**: Çıralı, Yanartaş (Chimera), on soil banks near road, 1-1.5 km, with Anthoceros punctatus, Oxymitra incrassata, Riccia ciliata, Fossombronia pusilla, Petalophyllum ralfsii, and Southbya tophaceae. 28 m, 36° 25'. 779' N 30° 27'. 739' E, North, 16.11.2003. (C12/44-034).

  Distribution in Turkey: C11

**Calypogeiaceae**

* 30. *Calypogia fissa* (L.) Raddi, 1818

- **Antalya**: Finike, Finike-Elmalı road, Yalnız Village, on soil bank near stream, with Targionia hypophylla, Lunularia cruciata, Fossombronia angulosa, and Southbya nigrella. 273 m, 36° 28'. 509' N 30° 06'. 269' E, North-west, 28.11.2004. (C12/82-105).

  Distribution in Turkey: A1, A3, A4, A5, B6, B7, C11, C12, C13

**Radulaceae**

* 31. *Radula complanata* (L.) Dumortier, 1831

- **Antalya**: Saklikent TÜB‹TAK National Observatory road, Doyran Village, on roots and bark of *Platanus orientalis* near Boyalı stream. 1193 m, 36° 53'. 585' N 30° 22'. 079' E, 27.11.2004. (C12/77-099).

  Distribution in Turkey: A1, A3, A4, A5, B6, C11

**Porellaceae**

* 32. *Porella cordaeana* (Huebener) Moore, 1876

- **Antalya**: Kemer, Kesme Boğazı, on rocks in stream bed, epilithic. 605 m and 580 m, 36° 36'. 875' N 30° 28'. 598' E, North, 15.11.2003. (C12/6-023, C12/9-023, C12/15-023, C12/16-023, C12/21-023).

  Distribution in Turkey: C12

* 33. *Porella pinnata* L., 1753

- **Antalya**: Kemer, Kesme Boğazı, on rocks in stream bed, epilithic. 605 m and 580 m, 36° 36'. 875' N 30° 28'. 598' E, North, 15.11.2003. (C12/6-023, C12/9-023, C12/15-023, C12/16-023, C12/21-023).

  Distribution in Turkey: A1, A2, A3, A4, A5, B6, B7, C11, C12, C13

**Frullaniaceae**

* 34. *Porella platyphylla* (L.) Pfeiff., 1855

- **Antalya**: Kemer, Kesme Boğazı, on rocks in stream bed, epilithic. 605 m and 580 m, 36° 36'. 875' N 30° 27'. 739' E, North, 15.11.2003. (C12/8-023, C12/15-023, C12/16-023, C12/21-023).

- **Antalya**: Antalya-Altınyaka road, Hisarçandır, on bark of *Platanus orientalis* in stream bed, epiphytic. 782 m, 36° 46'. 525' N 30° 28'. 598' E, North, 16.11.2003. (C12/23-024, C12/34-030, C12/69-058).

- **Antalya**: Termessos National Park, on walls of the archaic city ruins. 853 m, 36° 59'. 248' N 30° 28'. 098' E, 21.03.2004. (C12/60-049).

  Distribution in Turkey: A1, A2, A3, A4, A5, B6, B7, C11, C12, C13

* 35. *Frullania dilatata* (L.) Dumortier, 1835


  Distribution in Turkey: A1, A2, A3, A4, A5, B6, C11

* 36. *Frullania tamarisci* (L.) Dumortier, 1835

- **Antalya**: Kumluca-Altınyaka road, 10 km, on rocks and tree roots in stream bed, with *Lunularia cruciata*, *Metzgeria furcata* and *Lophocolea bidentata*. 500 m, 36° 29'. 350' N 30° 19'. 470' E, 30.04.2004. (C12/67-056).

  Distribution in Turkey: A1, A2, A3, A4, B6, C13

**Lejeuneaceae**

* 37. *Lejeunea lamacerina* (Steph.) Schiffner., 1902

- **Antalya**: Doyran Village, Turgut Ini, on walls near road. 992 m, 36° 53'. 962' N 30° 20'. 768' E, 21.03.2004. (C12/75-096).

  Distribution in Turkey: A1, A2, A3, A4, B6, C11
In the present investigation, 37 species belonging to the division Bryophyta were collected from Antalya, which is included in the C12 grid square of the Henderson system (1961). The results of the study show that 2 species belong to 1 family of Anthocerotopsida and 35 species belong to 23 families of Marchantiopsida. For grid square C12, 14 species (Sphaeorocarpos texanus, Asterella gracilis, Riccia ciliata, Riccia glauca, Fossombronia angulosa, Gongylanthus ericetorum, Plagiochila porelloides, Lophocolea bidentata, Cephaloziella hampeana, Calypogeia fissa, Radula complanata, Porella cordaeana, Frullania tamarisci, and Lejeunea lamacerina) are new records. As a result of our study, the number of species increased from 27 to 41 for square C12.

References