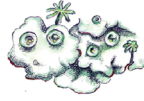




Moss



Liverwort



Hornwort

<http://bryology.karatekin.edu.tr/>

Anatolian Bryol. 2015. 1(1): 18-33

Anatolian Bryology

Anadolu Briyoloji Dergisi

ISSN: 2149-5920 Print

The Moss Flora of Çankırı Alpsarı Pond, with a moss record (*Pterygoneurum crossidioides* W. Frey, Herrnst. & Kürschner) from the Country

Nermin Gündüz KESİM¹ & Serhat URSAVAŞ*²

¹Çankırı Karatekin University, Graduate School of Natural and Applied Sciences
Department of Forest Engineering, 18200 Çankırı, TURKEY

²Çankırı Karatekin University, Faculty of Forestry, Department of Forest Engineering, 18200 Çankırı,
TURKEY

Received (Geliş tarihi): 14.04.2015 - Revised (Düzelme tarihi): 08.06.2015 - Accepted (Kabul tarihi): 15.11.2015

Abstract

The Moss Flora of Çankırı Alpsarı pond (Çankırı, Turkey) was studied. It was found that 332 moss specimen occurred in 73 taxa belonging to 31 genera and 15 families. In The richest 5 families by taxa number were *Pottiaceae* (26), *Brachytheciaceae* (10), *Grimmiaceae* (7), *Orthotrichaceae* (6), *Bryaceae* (5) respectively. The richest species by taxa number were; *Tortula* (8), *Orthotrichum* (7), *Syntrichia* (7), *Grimmia* (6), and *Bryum* (5). While acrocarpous taxa (54) represented 75% of the whole flora, the ratio of pleurocarpous (18) was 25%. *Funaria hygrometrica* (Hedw.), *Grimmia alpestris* (F. Weber & D. Mohr) Schleich., *Bryum pallens* (Sw. ex anon.) were identified first time from Çankırı province; *Ceratodon conicus* (Hampe) Lindb., *Weissia longifolia* (Mitt.), *Bryum intermedium* (Brid.) Blandow, *Grimmia crinita* Brid, and *Tomentypnum nitens* (Hedw.) Loeske. were identified first time from A2 grid square; and *Pterygoneurum subsessile* (Brid.) Jur. record was given for the second time in Turkey. In addition, *P. crossidioides* (W. Frey, Herrnst. & Is Kürschner) was reported for the first time in Turkey. The species which is rarely distributed in arid regions has been reported worldwide in Israel and Hungary

Key words: Bryophyte, Flora, New record, *Pterygoneurum crossidioides*, Çankırı

*Corresponding author / Sorumlu yazar. E-mail: serhatursavas@gmail.com

© 2015 All rights reserved / Tüm hakları saklıdır.

To cite this article (Atıf): Gündüz Kesim N. and Ursavaş, S. 2015. The Moss Flora of Çankırı Alpsarı Pond, with a moss record (*Pterygoneurum crossidioides* W. Frey, Herrnst. & Kürschner) from the Country. *Anatolian Bryology*. 1(1): 18-33.

1. Introduction

Turkey, which is in the transition zone of three biogeographical regions, the Mediterranean, European-Siberian, and Irano-Turanian, is one of richest countries between the Middle East and Europe in terms of biodiversity (Kaya and Raynal, 2001). However, knowledge of the Turkish bryoflora is still far from complete. In recent years there has been a considerable increase in the number of remarkable bryophyte records and bryofloristic papers for Turkey (*Bryoerytrophillum rubrum*, Batan and Özdemir, 2012, *Dicranella schreberiana*, *Dicranodontium asperulum*, and *Campylopus pyriformis*, Batan and Özdemir, 2013; *Didymodon tomaculosus*, Canli and Çetin, 2012; *Pseudocalliergon turgescens*, Ezer and Kara, 2012; *Didymodon icmadophilus*, *Conardia compacta*, *Zygodon gracilis*, *Diphyscium foliosum*, *Pohlia obtusifolia* and *Oligotrichum hercynicum*, Kirmaci et al., 2012; *Crossidium aberrans* Kirmaci and Agcagil, 2012; *Seligeria trifaria* and *Pseudotaxiphyllum elegans*, Ören et al., 2012; *Conardia compacta*, Özdemir et al., 2012; *Seligeria donniana*, Ursavaş and Çetin 2012; *Schistidium sordidum*, Batan et al., 2013; *Syntrichia caninervis* var. *abanchesii*, Can et al., 2013; *Sphagnum contortum*, *S. fallax*, *S. magellanicum*, and *S. rubellum*, Kirmaci and Kürschner, 2013; *Grimmia anomala*, *Pohlia filum*, and *Hookeria acutifolia*, Uyar and Ören, 2013; *Sphagnum molle*, Abay and Keçeli 2014; *Brotherella erythrocaulis*, and *Encalypta pilifera*, Batan et al., 2014; *Rhizomnium striatulum*, *Leucodon coreensis*, and *Leucobryum bowringii*, Özdemir and Batan 2014; *Acaulon fortiquerianum*, Kirmacı and Erdağ, 2014; *Schistidium boreale*, Batan and Özdemir, 2014; *Syntrichia minor*, Ören et al. 2015), and studies continue the bryophyte flora of many regions of

Turkey are still continues. The total number of bryophyte species of Turkey has exceeded 970 according to Uyar and Çetin (2004); Kürschner and Erdağ (2005); Kürschner and Frey (2011) and with new records reported.

Despite all these studies compared to those in European countries, a bryofloristic study in Turkey is still inadequate. Therefore, more research is needed for more comprehensive characterization of bryophyte flora of Turkey. The aim of this study was contribute to the characterization of bryophyte flora of Turkey via studying moss flora at Alpsarı site in Çankırı province of Turkey.

Up to now, many bryophyte studies were done in Çankırı. These are; The Moss Flora of Çankırı-Eldivan Mountain (Keçeli and Çetin, 2000); The moss Flora (Musci) of Ilgaz Mountain National Park (Abay and Çetin, 2003); Contributions to the Moss Flora (Musci) of Çankırı Province (Eldivan-Karadere) (Abay, 2005); Contributions to the moss (Musci) Flora of Çankırı (Yapraklı) (Abay, 2008); The moss (Musci) Flora and Ecology of Çankırı research Forest (Abay and Ursavaş, 2009); Contributions to the Bryoflora of Ilgaz Mountain, Yenice Forests, Turkey (Ursavaş and Abay, 2009); Contributions to the Moss Flora (Musci) of Gürgenli Mountain (Bayramören/Çankırı) (Şahin and Abay, 2009); Contributions to the Liverwort (Marchantiophyta) flora of Ilgaz Mountain (Turkey) (Şimşek, et. al., 2011); *Barbilophozia lycopodioides* (Wallr.) Loeske, new to the liverwort flora of Turkey (Keçeli et. al., 2011); Substratum properties and Mosses in semi-arid environments. A case study from North Turkey (Abay et al., 2014); Spatial variation, mapping, and

classification of moss families in semi-arid landscapes in NW Turkey (Abay, et. al., 2015); The Moss (Musci) Flora In The Urban Area of Çankırı and Surroundings (Yavuz, 2015).

Considering the above bryophyte studies in Çankırı province. Up to now; Çankırı-Alpsarı Pond and around have not been any studies on the flora of mosses. This study; was undertaken to determine the

flora of mosses of Çankırı-Alpsarı Pond and its near environment.

1. Site Description

Çankırı, located in A2 square of the Henderson (1961) grid system. Study area comprised villages in Alpsarı, Gümüşdüven, Kayıçı, Yolkaya, Ortayaka, Akçalı, Yenice and Korgun district (Figure 1).

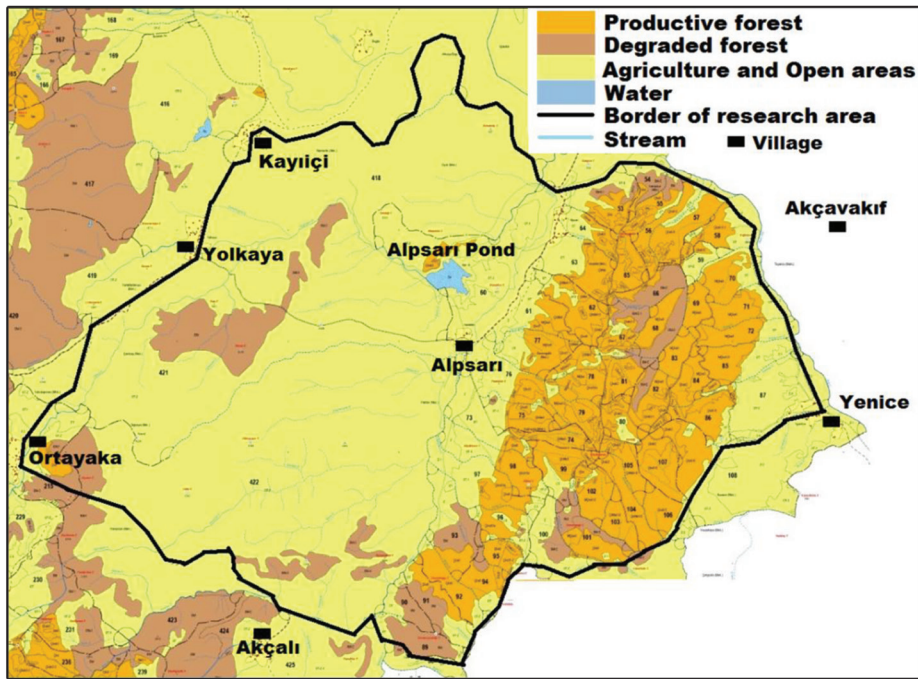


Figure 1. Map of research area

For this study Alpsarı Pond district, of the city of Çankırı, was chosen as the research area. Alpsarı Pond and surroundings in the northwest part of Çankırı are distributed along 44.000 ha and includes open areas, grasslands, agriculture and Anatolian pine plantation

area. The study area, about 21 km NW of Çankırı and 10 km SW of Korgun, is situated between 40° 46' N and 33° 48' E (Anonymus, 2011). Alpsarı Pond and district is located in the A2 grid square according to the system adopted by Henderson (1961) (Fig. 2).

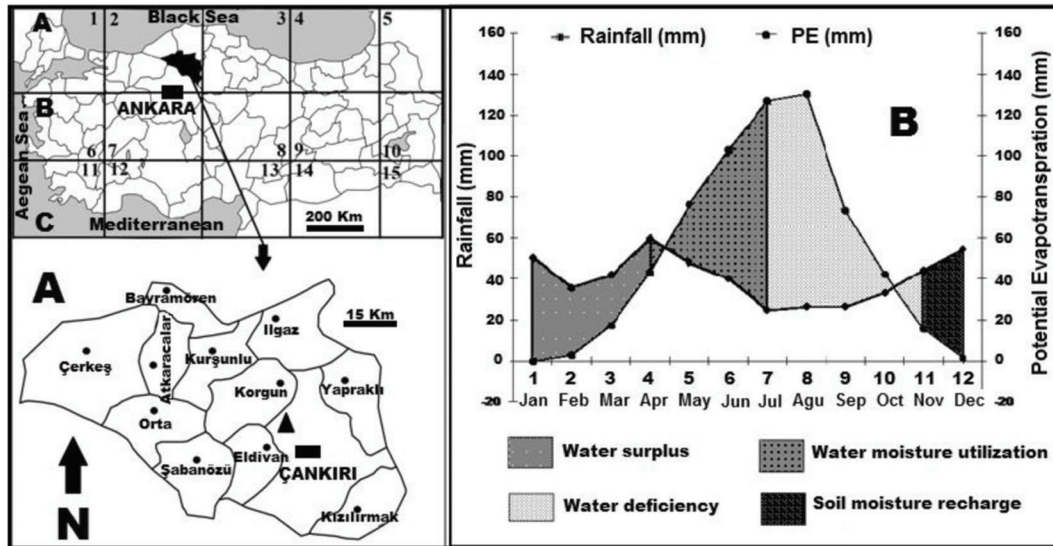


Figure 2. Map of Henderson (1961) grid system. (A): Study area (▲) and (B): Graphic of the water balance according to Thornthwait.

Data from meteorological station of Eldivan district were used. Based on 34 years of climatic data (1977-2010), the mean annual temperature is 10.5 °C, the mean minimum and maximum average temperature range from -0.7 °C (January) to 22.6 °C (August); the average annual precipitation is 486 mm, with the maximum monthly precipitation (54.6 mm) in December and minimum (24.8 mm) in July (Fig. 2). The most abundant vascular plants in the study area are shrubs of *Paliurus spina-christi* Mill., *Berberis vulgaris* L., *Rosa canina* L. and trees are *Pinus nigra* Arnold subsp. *pallasiana* (Lamb.) Holmboe, *Quercus infectoria* Oliver, *Populus nigra* L., *Salix alba* L., and *Crataegus monogyna* Jacq. (Anonymus, 2011).

Main soil great groups are alluvial and colluvial soils, chestnut brown forest soils, lime deficient brown forest and brown soils (Göl and Dengiz, 2007). The predominant rocks of the study area are sandstone, clay stone, precipitated limestone (Anonymus, 2011).

2. Materials and Methods

Moss samples were collected between 2013-2014 in different times of the vegetation. The stations, where the 332 mosses were collected, were discriminated by differences in plant communities, the geographical conditions and the elevation from the sea level (Table 1).

The specimen identification was made based on Savicz-Ljubitzkaja et al., (1970), Lawton (1971), Crum (1973), Smith (1980-2004), Nyholm (1981-1987-1990-1993-1998), Greven (2003), Cortini (2001-2006), Lüth (2006a-2006b-2006c-2007-2008-2009-2010).

For the nomenclatures of the mosses, we followed Hill et al., (2006). The specimens were stored in the private collections of Serhat Ursavaş (Çankırı, Turkey).

Pterygoneurum crossidioides has been approved by Richard H. Zander on 10/01/2014. The species was put into the herbarium at Missouri Botanical Garden in USA by Zander.

Table 1. Site No (SN), Date of moss collection, elevation from the sea level (m), locations and geographic coordinates, Trees, and some shrubs in the study area.

SN	Date	Altitude (m)	Localities and geographic coordinates	Trees and some shrubs
1	18.07.2013	849	Marif stream, 40° 41' 33.111" N – 33° 31' 40.782" E	CM , PN, RC, SA,
2	19.07.2013	896	Alpsarı village, 40° 41' 17.131" N – 33° 31' 31.624" E	A, BV, JO, PNP, SA
3	24.07.2013	992	Yukarı hill, 40° 40' 24.904" N – 33° 31' 55.792" E	A , JO, PNP, QI
4	25.07.2013	902	Yukarı stream, 40° 40' 29.647" N – 33° 32' 1.026" E	PNP, JO, SA, RC, PN, A, BV, E
5	30.07.2013	1144	Alibey, 40° 40' 0.385" N – 33° 32' 16.935" E	QI, PNP, JO, A
6	30.07.2013	1117	Alpsarı hill, 40° 40' 23.641" N – 33° 32' 30.284" E	PNP, QI, JO
7	30.07.2013	1046	Düzmeşelik hill, 40° 41' 9.500" N – 33° 32' 43.820" E	PNP, QI, JO
8	31.07.2013	1088	Alpsarı hill, 40° 40' 42.698" N – 33° 33' 7.201" E	PNP, QI, JO
9	31.07.2013	1173	Sıkçalar, 40° 39' 35.689" N – 33° 32' 27.298" E	PNP, QI, JO, BV
10	12.09.2013	793	Tatlı stream, 40° 40' 54.574" N – 33° 34' 25.599" E	PNP, JO, PN, SA, TP
11	13.09.2013	992	Yenice village, 40° 39' 30.846" N – 33° 33' 44.212" E	PNP, JO, A
12	13.09.2013	1140	Plantation area, 40° 40' 23.641" N – 33° 32' 30.284" E	PNP, JO, A
13	21.03.2014	1270	Sarıdağ hill, 40° 39' 02.898" N – 33° 32' 48.536" E	PNP, QI, JO
14	21.03.2014	1252	Çamolukpınar, 40° 39' 14.246" N – 33° 32' 26.315" E	PNP, JO
15	21.03.2014	1220	Sıkçamlar, 40° 39' 28.303" N – 33° 32' 24.768" E	PNP, JO
16	21.03.2014	1174	Arıgüney hill, 40° 39' 28.303" N – 33° 32' 24.768" E	JO, QI, A
17	22.03.2014	886	Karatekin village 40° 40' 18.620" N – 33° 31' 10.889" E	JO, RC, BV, AC
18	22.03.2014	941	Alpsarı pond, 40° 40' 06.924" N – 33° 29' 54.643" E	RC, A, O
19	22.03.2014	1072	Düzmeşe hill, 40° 40' 15.722" N – 33° 28' 35.696" E	QI, RC, CM, G, O
20	22.03.2014	947	Pamuklar hill, 40° 39' 44.805" N – 33° 31' 15.482" E	PNP, JO, QI, BV, A
21	11.06.2014	882	Alpsarı pond, 40° 40' 44.392" N – 33° 29' 59.523" E	PNP, JO, QI, RC, PN, CB
22	10.07.2014	1027	Yolkaya village, 40° 40' 35.068" N – 33° 27' 43.567" E	A, O, RP
23	10.07.2014	1200	Marif village, 40° 38' 39.343" N – 33° 38' 00.944" E	PNP, QI, RC, QI, BV, PN

A = *Astragalus sp.*, **AC** = *Amygdalus communis L.*, **BV** = *Berberis vulgaris L.*, **CB** = *Carpinus betulus L.*, **CM** = *Crataegus monogyna Jacq.*, **E** = *Elaeagnus sp.*, **G** = Grass, **JO** = *Juniperus oxycedrus L.*, **O** = Opennes, **PN** = *Populus nigra L.*, **PNP** = *Pinus nigra Arnold subsp. pallasiana (Lamb.) Holmboe*, **RC** = *Rosa canina L.*, **RP** = Rocky place, **SA** = *Salix alba L.*, **TP** = *Tamarix parviflora.*, **QI** = *Quercus infectoria Olivier.*

If the first recorded taxa were from Çankırı, they were indicated by one asterisk (*), if the first recorded taxa were from A2 they were indicated by two asterisk (**), if the second recorded taxa were from Turkey, they were indicated by three asterisk (***), and if the first recorded taxa were from Turkey, they were indicated by diamond (◆).

For defitions of habitats in the Study area: **s:** on soil, **r:** on rock, **src:** on soil trunk, **cw:** on concrete wal in rock crevices, **t:** on bark of tree trunk and branch, **dt:** on dead

In the definitions of specimens: The first number represents locality number, the bold abbreviation represents the habitat, U and K abbreviations represent legit and determination (Serhat URSAVAŞ and Nermin Gündüz KESİM), and the last number represents the collections number.

3. Floristic List

Mosses

Encalyptaceae Schimp.

1. *Encalypta streptocarpa* Hedw. – 3:dt, U 1286; 3:dt, K 2; 3:s, U 1287; 15:r, U 1285; 15:r, K 1, 15:s, U 1288; 17:s, U 1286; 17:s, K 3.
2. *E. raptocarpa* Schwägr. – 6:s, U 1290.
3. *E. vulgaris* Hedw. – 20:s, U1291.

Funariaceae Schwägr.

4. **Funaria hygrometrica* Hedw. – 4:s, U 1292; 17:s, U 1293; 17:s, K 91.

Grimmiaceae Arn.

5. **Grimmia alpestris* (F.Weber & D. Mohr) Schleich. – 10:r, U 1294.
6. *G. anodon* Bruch & Schimp. – 2:r, U 1295; 2:r, K 4; 3:r, U 1296; 4:r, K 6; 8:r, U 1298; 8:r, K 7; 11:r, U 1299; 11:r, K 5; 13:r, U 1300; 22:r, U 1301.
7. ***G. crinita* Brid. – 21:r, U 1302.
8. *G. funalis* (Schwägr.) Bruch & Schimp – 3:r, U 1303; 8:r, U 1304; 8:r, K 17.
9. *G. pulvinata* (Hedw.) Sm. – 3:r, U 1305; 4:r, U 1306; 4:r, K 8; 8:r, U 1307; 13:r, U 1308; 13:r, K 9; 15:r, U 1309; 15:r, K 10; 21:r, U 1310; 21:t, U1311.
10. *G. trichophylla* Grev. – 1:r, U 1312; 2:r, U 1313; 2:r, K 11; 3:r, U 1314; 3:r, K12; 7:r, U 1315; 7:r, K16; 10:cw, U 1316; 11:r, U 1317; 14:t, U1318; 17:r, U 1319; 17:r, K 14; 21:r, U 1320; 21:cw, U 1321; 22:r, U 1322; 23:r, U 1323; 23:r, K 15.
11. *Schistidium apocarpum* (Hedw.) Bruch & Schimp. – 21:r, U1324.

Ditrichaceae Limpr.

12. ***Ceratodon conicus* (Hampe) Lindb. – 4:s, U 1332; 18:s, U 1333; 18:s, K 20.
13. *C. purpureus* (Hedw.) Brid. – 2:s, U 1325; 3:s, U 1326; 4:r, U 1327; 4:r, K 18; 7:src, U 1514; 8:s, U 1328; 8:s, K19; 15:r, U 1329; 15:s, U 1342; 17:s, U 1330; 17:s, K 20; 20:s, U 1331.
14. *Ditrichum flexicaule* (Schwägr.) Hampe – 3:r, U 1334; 4:s, U 1335; 4:s, K 22; 10:s, U 1336; 10:s, K23; 11:s, U 1337; 20:s, U1338.
15. *Dicranum scoparium* Hedw. – 14:s, U 1339; 14:t, U1340; 14:t, K 24.
16. *D. tauricum* Sapjegin – 14:t, U 1341.

Pleurochaete Lindb.

17. *Pleurochaete squarrosa* (Brid.) Lindb. – 3:src, U 1343; 10:s, U 1344; 10:s, K 47; 17:s, U 1345.
18. *Tortella inclinata* (R. Hedw.) Limpr. var. *densa* (Lorentz & Molendo) Limpr. – 3:s, U 1346; 3:src, U 1347; 3:src, K36; 8:s, U 1348; 8:s, K 37; 11:s, U 1349; 12:s, U 1350; 12:s, K 54.
19. *T. tortuosa* (Hedw.) Limpr. – 3:s, U 1351; 7:s, U 1352; 7:s, K 38; 8:src, U 1353; 9:s, U 1354; 9:s, K 39; 11:s, U 1355; 12:s, U 1356; 20:s, U 1357; 20:s, K 40.
20. *Weissia brachycarpa* (Nees & Hornsch.) Jur. – 10:s, U 1358; 20:s, U 1359; 20s, K 56.
21. *Weissia controversa* Hedw. – 12:s, U 1360.
22. ***Weissia longifolia* Mitt. – 10:s, U 1361.
23. *Barbula convoluta* Hedw. – 1:cw, U 1362; 2:s, U 1363; 7:s, U 1364; 7:s, K 41; 8:s, U 1365; 10:s, U 1366; 10:s, K 42; 10:src, U 1367; 10:src, K 43.
24. *Barbula unguiculata* Hedw. – 1:dt, U 1368; 2:s, U 1369; 5:s, U 1370; 5:s, K 44; 6:s, U 1371; 6:s, K 45; 7:s, U 1372; 17:cw; U 1373; 23:s, U 1374; 23:s, K 46.

25. *Crossidium squamiferum* (Viv.) Jur.) var. *pottioideum* (De Not.) Mönk. – 11:r, U 1419.
26. *C. squamiferum* (Viv.) Jur.) var. *squamiferum* – 4:s, U 1420.
27. *Didymodon nicholsonii* Culm. – 11:s, U 1375; 21:r, U1376; 21:r, K, 55.
28. *D. tophaceus* (Brid.) Lisa – 17:s, U 1377.
29. *D. vinealis* Brid. – 17:s, U1378.
30. ♦*Pterygoneurum crossidioides* W.Frey, Herrnst. & Kürschner – 18:s, U 1284.
(This sample was confirmed by Dr. Richard H. Zander).
31. *P. ovatum* (Hedw.) Dixon – 16:s, U 1379; 17:s, U 1380; 17:s, K 34; 19:s, U 1381; 19:s, K 35.
32. ****P. subsessile* (Brid.) Jur. – 18:s, U 1382.
33. *Syntrichia caninervis* (Mitt.) var. *gypsophila* (J. J. Amannex G.Roth) Ochyra – 2:s, U 1383; 6:s, U 1384; 8:s, U 1385; 8:s, K 51.
34. *S. montana* Nees (*S. intermedia* Brid.) – 14:s, U 1424.
35. *S. princeps* (De Not.) Mitt. – 12:r, U1386.
36. *S. ruralis* (Hedw.) F.Weber & D.Mohr – 1:t, U1387; 2:s, U1388; 2:s, K29; 3:s, U1402; 3:s, K33; 3:r, U1389; 8:s, U1390; 8:s, K30; 10:s, U1391; 12:s, U1392; 12:s, K31; 15:r, U1394; 18s, U1395; 18:s, K32.
37. *Syntrichia ruralis* var. *ruraliformis* (Besch.) Delogne – 8:s, U1398; 16:t, U1397; 19:t, U1398; 19:t, K25.
38. *Syntrichia virescens* (De Not.) Ochyra – 12:s, U1399; 14:s, U1400; 17:s, U1401; 17:s, K53.
39. *Tortula brevissima* Schiffn. Hedw. – 1:cw, U1403; 13:r, U1404; 21:r, U1405; 21:r, K50.
40. *Tortula inermis* (Brid.) Mont. – 3:r, U1406; 3:s, U1407; 6:s, U1408; 18:s, U1409; 20:s, U1410; 21:s, U1411; 21:s, K27; 21:r, U1412; 21:dt, U1413; 21:dt, K28.
41. *Tortula muralis* Hedw. – 1:cw, U1414; 5:t, U1415; 5:r, U1416; 5:r, K48; 21:cw, U1417; 21:cw, K49; 21:r, U1418.
42. *Tortula subulata* Hedw. – 3:s, U1421; 17:r, U1422; 23:r, U1423; 23:r, K52.

Orthotrichaceae Arn.

43. *Orthotrichum cupulatum* Hoffm. ex Brid. – 23:r, U1425.
44. *O. diaphanum* Schrad. ex Brid. – 1:t, U1426; 3:t, U1427; 3:t, K57; 5:t, U1428; 10:t, U1429; 10:dt, U1430; 10:dt, K58; 14:t, U1431; 15:t, U1432; 15:t, K59; 17:r, U1433; 19:t, U1434; 19:t, K60; 21:t, U1435; 21:t, K61.
45. *O. rupestre* Schleich. ex Schwägr. – 15:r, U1436.
46. *O. affine* Schrad. ex Brid. – 1:r, U1437; 1:t, U1440; 2:t, U 1438; 9:t, U1439; 9:t, K62; 14:t, U1441; 17:t, U1442; 17:t, K63; 21:t, U1443; 21:t, K64.
47. *O. speciosum* Nees – 5:t, U1444.
48. *O. striatum* Hedw. – 9:t, U1445.

Bryaceae Schwägr.

49. *Bryum argenteum* Hedw. – 2:r, U1446; 10:s, U1447; 10:s, K67.
50. *B. caespitium* Hedw. – 2:s, U1448.
51. *B. capillare* Hedw. – 4:s, U1449; 6:s, U1450; 10:s, U1451; 10:t, K65; 18:s, U1452; 21:s, U1453; 21:s, K66.
52. ***B. intermedium* (Brid.) Blandow – 2:s, U1454.
53. **B. pallens* Sw. exanon. – 17:s, U1455.

Mielichhoferiaceae Schimp.

54. *Pohlia elongata* Hedw. – 1:s, U1456.

Amblystegiaceae Kindb.,

55. *Amblystegium serpens* (Hedw.) Schimp. – 1:dt, U1457; 2:dt, U1458; 14:dt, U1459; 14:s, U1460; 14:s, K68; 19:t, U1461; 19:t, K69.

56. *Hygroamblystegium tenax* (Hedw.) Jenn. – 1:r, U1462; 1:t, U1463; 1:t, K71.

57. *Leptodictyum riparium* (Hedw.) Warnst. – 10:s, U1464; 18:s, U1465; 21:t, U1466; 21:t, K70.

58. ***Tomentypnum nitens* (Hedw.) Loeske – 4:s, U1513.

Leskeaceae Schimp.

59. *Pseudoleskeella catenulata* (Brid. ex Schrad.) Kindb. – 2:r, U1467.

Thuidiaceae Schimp.

60. *Abietinella abietina* (Hedw.) M. Fleisch. var. *abietinella* (Hedw.) M.Fleisch – 5:s, U1468; 9:s, U1469; 23:s, U1470; 23:s, K72.

Brachytheciaceae Schimp.

61. *Sciuro-hypnum plumosum* Ignatov & Huttunen – 12:s, U1482.

62. *Brachytecium albicans* (Hedw.) Schimp. – 5:s, U1471; 9:s, U1472; 14:s, U1473; 14:s, K80; 20:s, U1474; 20:s, K81.

63. *B. erythrorrhizon* Schimp. – 5:s, U1475; 7:s, U1476; 8:s, U1477; 8:s, K77; 9:s, U1478; 13:s, U1479; 13:s, K78; 21:t, U1480; 21:t, K79.

64. *B. rivulare* Schimp. – 21:t, U1481.

65. *B. salebrosum* (Hoffm. ex F.Weber & D.Mohr) Schimp. – 21:r, U1483.

66. *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen – 5:s, U1513.

67. *Homalothecium aureum* (Spruce) H. Rob. – 3:s, U1484.

68. *H. lutescens* (Hedw.) H.Rob – 3:s, U1485; 4:s, U1486; 8:s, U1487; 9:s, U1488; 9:s, K82; 23:s, U1489; 23:s, K83.

69. *H. philippeanum* (Spruce) Schimp. – 7:r, U1490.

70. *H. sericeum* (Hedw.) Schimp. – 1:dt, U1491; 2:s, U1492; 2:t, U1493; 2:t, K73; 6:s, U1494; 8:s, U1495; 8:s, K74; 12:s, U1496; 14:s, U1497; 14:s, K75; 23:s, U1498; 23:s, K76.

Hypnaceae Schimp.

71. *Hypnum cupressiforme* (Hedw.) var. *cupressiforme* Hedw. – 9:s, U1499; 12:s, U1500; 12:s, K84; 21:s, U1501; 23:s, U1502; 23:s, K85; 23:r, U1503; 23:r, K86.

72. *H. cupressiforme* var Hedw. *lacunosum* Brid. – 3:r, U1506; 3:s, U1505; 4:r, K87; 4:r, K87; 8:s, U1507; 9:s, U1508; 9:s, K88; 10:s, U1509; 10:s, K89; 14:s, U1510; 16:t, U1511; 16:t, K90.

Pterigynandraceae Schimp.

73. *Pterigynandrum filiforme* Hedw. – 14:t, U1512.

4. Results and Discussion

In this study, 332 moss specimen, the moss species were collected from neighborhood of Alparsı pond in different vegetation periods between 2013 and 2014, were classified in 73 taxa belonging to 31 genera and 15 families. *Funaria hygrometrica*, *Grimmia alpestris*, and *Bryum pallens*

were recorded for the first time from Çankırı. *Grimmia crinita*, *Ceratodon conicus*, *Weissia longifolia*, *Bryum intermedium*, and *Tomentypnum nitens* were recorded also for the first time in A2 grid square.

Pterygoneurum sessile was recorded for the second time in Turkey in the

present study. This first species was known from only one locality in Niğde-Çamardı: Emli Valley, near the village of Çamardı, from 670 m a.s.l., on open, dry soil (Tonguç Yayıntaş, 2009).

Pterygoneurum crossidioides was recorded for the first time for Turkey bryophyte flora. Specimen details:

Turkey, Square A2, between Çankırı to Korgun district, on the western slope of the Alparsarı pond, 941 m above the sea level, 40° 40' 06,9" N; 33° 29' 54,6" E, on gypsum and calcareous soil, associated with *P. ovatum* (Hedw.) Dixon and *P. subsessile* (Brid.) Jur. 22 March 2014, S. URSAVAŞ 1284. *P. crossidioides* is characterized by the well-developed lamellae with filamentous outgrowths (8-12 cells high), strongly branched and smooth, conical terminal cell of the filaments.

A closely related species, *Pterygoneurum ovatum*, was collected from three different localities from Alparsarı pond in Çankırı. The main differences between the two species (*P. crossidioides* and *P. ovatum*) *P. crossidioides* Lamellae: Reaching the leaf base to apex, Filaments: Apical cell smooth, strongly branched and generally conic, 8-12 cells high. Hair-point: of outer leaves reaching until the end of capsules and twice the length of the lamella, up to half slightly denticulate, some inner leaves brown. *Pterygoneurum ovatum* Lamellae: extends up to half the leaf tip, Filaments: Apical cell smooth, weakly branched and generally conic, 5-8 cells high. Hair-point: as long as the

lamella, not reaching until the end of capsules and slightly denticulate from base to up, inner leaves hyaline.

The first record of *P. crossidioides* was from the desert areas near the Dead Sea (Frey et al., 1990). *P. crossidioides* has been found six localities Haifa, Jerusalem, Tel Aviv, Northern, Southern and Central in Israel (URL 1). It is also located on the checklist and the red list of Hungary bryophytes (Papp et al., 2010).

The genus *Pterygoneurum* Jur. is widely distributed both in arid and semi-arid climatic regions of five continents (Cano et al., 1994). *Pterygoneurum* includes ten species, seven of which have been reported in the Mediterranean area (Cano, et al., 1994; Guerra, et al., 1995; Cano, 2006; Hill, et al., 2006; Rose, et al., 2013). Nonetheless, Spanish (Guerra, et al., 1995) records of *P. crossidioides* (Pócs, et al., 2002; Erzberger and Papp, 2004) apparently may have been confused with forms of *P. ovatum* which has short filaments on the distal part of the lamellae (Cano, 2006).

Although there are some morphological differences between the two species (Table 2), it is necessary to investigate whether there is a significant different genetic discrimination or not.

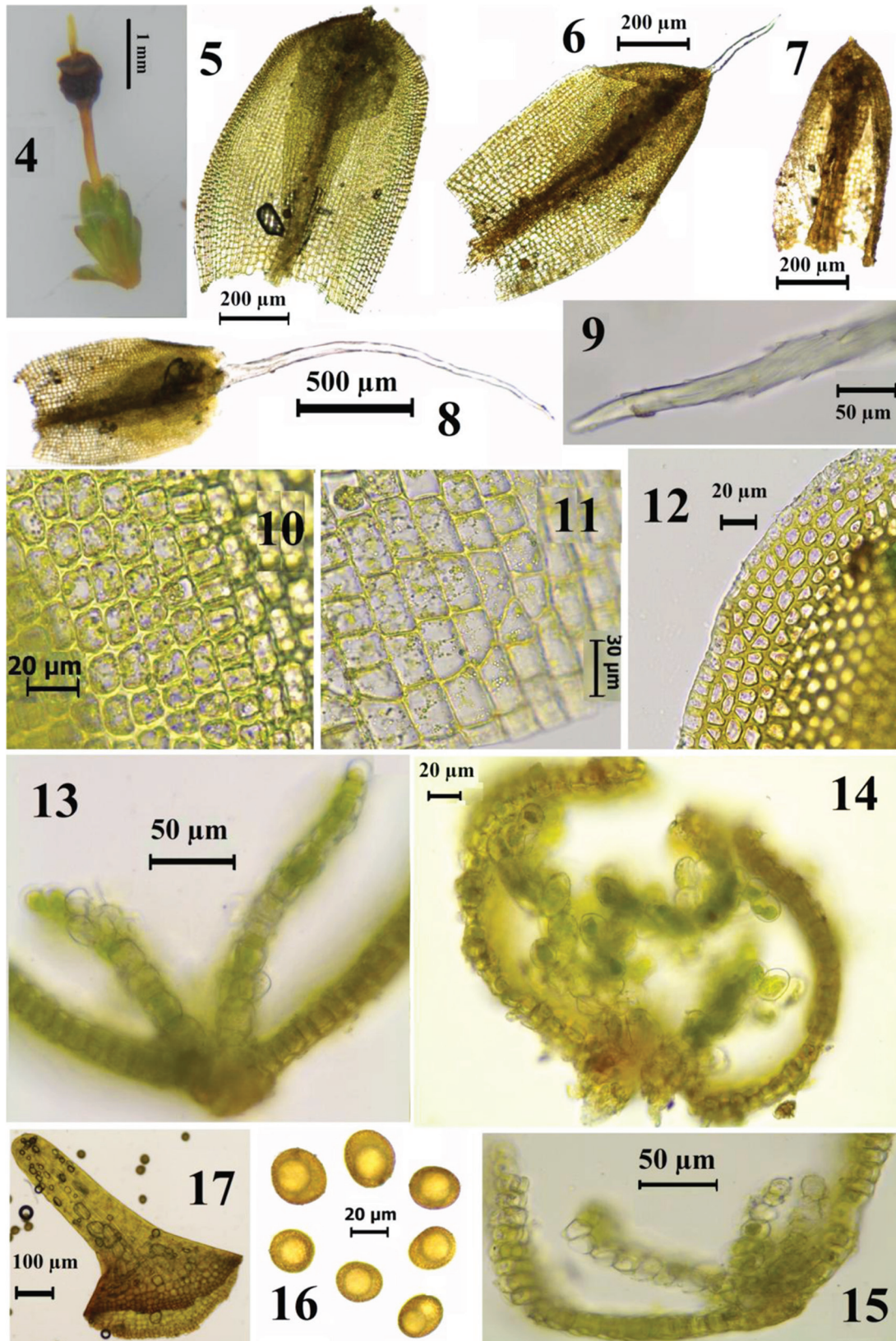
Pterygoneurum are represented by seven taxa in Mediterranean countries and five taxa in Russian. It is represented by four taxa (*P. ovatum*, *P. susessile*, *P. squamosum*, *P. crossidioides*) in Turkey,



Figure 3. Appearance of *Pterygoneurum crossidioides* in the natural environment and Capsule.

Table 2. Characteristic distinctions of *Pterygoneurum crossidioides* and *P. ovatum*

Characters	<i>Pterygoneurum crossidioides</i>	<i>Pterygoneurum ovatum</i>
Lamellae	Lamellae on ventral side of costa starting from the base to up.	Lamellae on ventral side of costa only in upper half, not bearing filaments.
Filaments	Upper cell flat, usually conical and makes strong branching.	Upper cell flat, usually conical and makes weak branching.
Filament cell number	8-12 cell	5-8 cell
Hair-point	Hyaline hair-point longer than twice of lamella to equal, weak serrulation only half to upper.	Hyaline hair-point 2/3 the length of lamina to equal, weak serrulation base to apex.



Figures 4-17. *Pterygoneurum crossidioides* 4. Habit wet plant. 5-6-7. Inner leaves. 8. Upper leaf. 9. Hair-point. 10. Middle cells. 11. Basal cells. 12. Upper cells. 13. Cross section of basal part of leaf. 14. Cross section of upper part of leaf. 15. Cross section of middle part of leaf. 16. Spore. 17. Operculum. All from S. URSAVAŞ 1284

The richest families and the first 15 genera are shown in Table 3. The first 6 families (*Pottiaceae*, *Brachytheciaceae*, *Grimmiaceae*, *Orthotrichaceae*, *Bryaceae*, and *Amblystegiaceae*) make up 79.2 % of the total taxa in the study area and the other 9 families constitute 20.86 %.

(*Grimmia*, *Syntrichia*, *Orthotrichum*, *Bryum*, *Tortula*, *Brachythecium*, *Homalothecium*, *Encalypta*, *Weissia*, *Didymodon*, and *Pterygoneurum*) make up 65 % of the total taxa in the study area and the other 20 genera constitute 35 %.

Table 3. The Distributions of the Taxa by Families and Genera.

Family	NT	(%)	Genera	NT	(%)
Pottiaceae	26	35.6	<i>Grimmia</i>	6	8.2
Brachytheciaceae	10	13.7	<i>Syntrichia</i>	6	8.2
Grimmiaceae	7	9.6	<i>Orthotrichum</i>	6	8.2
Orthotrichaceae	6	8.2	<i>Bryum</i>	5	6.8
Bryaceae	5	6.8	<i>Tortula</i>	4	5.6
Amblystegiaceae	4	5.3	<i>Brachythecium</i>	4	5.6
Encalyptaceae	3	4.1	<i>Homalothecium</i>	4	5.6
Ditrichaceae	3	4.1	<i>Encalypta</i>	3	4.2
Dicranaceae	2	2.8	<i>Weissia</i>	3	4.2
Hypnaceae	2	2.8	<i>Didymodon</i>	3	4.2
Funariaceae	1	1.4	<i>Pterygoneurum</i>	3	4.2
Mielichhoferiaceae	1	1.4	<i>Ceratodon</i>	2	2.7
Leskeaceae	1	1.4	<i>Dicranum</i>	2	2.7
Thuidiaceae	1	1.4	<i>Tortella</i>	2	2.7
Pterigynandraceae	1	1.4	<i>Barbula</i>	2	2.7
TOTAL	73	100	TOTAL	73	100

(NT): Number of taxa, (%): Percentage of taxa according to the total number of taxa

In the study area, taxa distributions are shown by substrata in Figure 18. The openings in the study area, a large agricultural and pasture lands, led to be more growing in terms of the number of moss species on soil. The small number of tree species, composed of young plantation areas, the lack of natural forests has played an influential role in relatively low number of epiphyte species.

Result from Keçeli and Çetin (2000), Abay and Çetin (2003) and Abay (2005) and Ursavaş and Abay (2009) showed that Pottiaceae and Brachytheciaceae families had the largest number of taxa the same as we found our study.

Pottiaceae family members are frequently found in landscapes with semi-arid climate. These landscapes are common in Çankırı. On the contrary, in Ilgaz Mountain National Park, some parts of the south slopes of which are located in the boundaries of Çankırı province, Pottiaceae and Brachytheciaceae families have the same ratios sharing the first row. In conclusion, results obtained in this study had a significant contribution to the database of moss flora in Çankırı Province. In addition, a new taxon (*Pterygoneurum crossidioides*) was introduced to bryophytes Flora of Turkey.

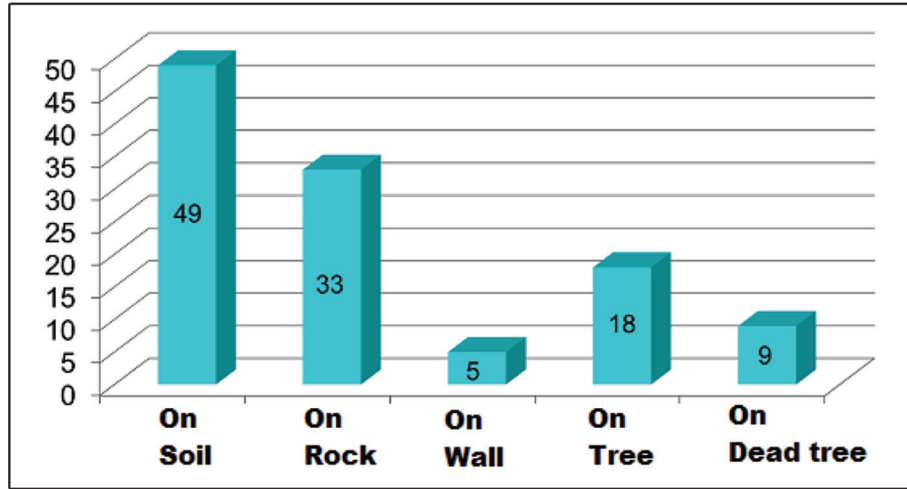


Figure 18. Taxa distribution by the substrate

Table 4. The comparison of the taxa distribution according to the families

Families	1		2		3		4		5	
	NT	%	NT	%	NT	%	NT	%	NT	%
<i>Pottiaceae</i>	26	35.6	18	15.6	14	31.1	15	13.7	14	23.3
<i>Brachytheciaceae</i>	10	13.7	14	12.1	6	13.3	15	13.7	11	18.3
<i>Grimmiaceae</i>	7	9.6	11	10.0	4	8.8	7	6.4	5	8.3
<i>Orthotrichaceae</i>	6	8.2	5	4.3	3	6.6	4	3.6	2	3.3
<i>Bryaceae</i>	5	7.1	4	3.5	7	14.6	8	7.3	5	9.3
<i>Amblystegiaceae</i>	4	6.8	8	7.0	4	8.8	5	4.6	4	6.6
<i>Encalyptacea</i>	3	4.1	2	1.7	2	4.2	3	2.7	1	1.8
<i>Ditrichaceae</i>	3	4.1	5	4.3	1	2.1	2	1.8	1	1.8
<i>Hypnaceae</i>	2	2.7	6	5.2	3	6.6	9	8.2	4	6.6
<i>Dicranaceae</i>	2	2.7	3	2.6	1	2.1	8	7.3	2	3.7

(NT): Number of taxa, (%): Percentage of taxa according to the total number of taxa, (1): Alpsarı Pond and Province (2015); (2): Contributions to the Bryophyte flora of Ilgaz Mountain, Yenice Forests (2009); (3): Contributions to the moss flora of Çankırı province (Eldivan-Karadere) (2005); (4): Ilgaz Mountain National Park (2003); (5): The Moss Flora of Çankırı-Eldivan Mountain (2000)

Acknowledgements: The authors are grateful to the Project Support Unit of Çankırı Karatekin University for financial support (Project No: 2013/17). Special thanks to Richard H. Zander for confirming the identification of *Pterygoneurum crossidioides*. Also thanks to Prof. Dr. Sabit ERŞAHİN for linguistic corrections.

References

- Abay 2008. Contributions to the moss (Musci) flora of Çankırı (Yapraklı). Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi. 1: 24-35.
- Abay G. 2005. Contribution to the moss flora (Musci) of Çankırı province (Eldivan-Karadere). Ot Sistematiği Botanik Dergisi. 12: 175-186.
- Abay G. 2005. Contributions to the moss flora (Musci) of Çankırı province (Eldivan-Karadere). Ot Sistematiği Botanik Dergisi. 12:2, 175-186.
- Abay G. and Çetin B. 2003. The moss flora (Musci) of Ilgaz mountain national park. Turk Journal of Botany. 27: 321-332.

- Abay G. and Çetin B. 2003. The moss flora (Musci) of Ilgaz Mountain National Park. Turkish Journal of Botany. 27: 321-332.
- Abay G. and Keçeli T. 2014. *Sphagnum molle* (Sphagnaceae, Bryophyta) in Turkey and SW Asia. Cryptogamie, Bryologie, 35:1, 105-112.
- Abay G. and Ursavaş S. 2009. Çankırı ili araştırma ormanı Karayosunu (Musci) flora ve ekolojisi. Bartın Orman Fakültesi Dergisi. 11:16, 61-70.
- Abay G. Gül E. Günlü A., Erşahin S. Ursavaş S. 2015. Spatial variation, mapping, and classification of moss families in semi-arid landscapes in NW Turkey. Environmental Monitoring and Assessment. DOI: 10.1007/s10661-014-4240-5.
- Abay G. Gül E. Ursavaş S. and Erşahin S. 2014. Substratum properties and mosses in semi-arid environments. A case study from North Turkey. Cryptogamie, Bryologie. 35:2, 181-196.
- Anonyus 2011. Ankara Orman Bölge Müdürlüğü, Çankırı Orman İşletme Müdürlüğü, Çankırı Orman İşletme Şefliği, Fonksiyonel Orman Amenajman Planı II. Yenileme. p. 418.
- Batan N, Jia, Y., Özdemir, T., and Alataş M. 2014. Brotherella and Encalypta species new to Turkey, Mediterranean and Southwest Asia. Plant Biosystems, Doi:10.1080/11263504.2014.986247.
- Batan, N, and Özdemir, T. 2014. New national and regional bryophyte records, 39, Journal of Bryology. 28. *Schistidium boreale* Poelt. 36: 144.
- Batan, N. and Alataş, M., Özdemir, T. 2013. *Schistidium sordidum* new to Turkey and Southwest Asia. Arch. Biol. Sci. 65:1505-1509.
- Batan, N. and Özdemir, T. 2012. *Bryoerytrophllum rubrum* (Pottiaceae) – a new moss record for Turkey. Phytologia Balcanica. 18: 117-120.
- Batan, N., Özdemir, T. and Alataş, M. 2015. Additional bryophyte records from Gümüşhane province in Turkey. Botanica Serbica. 39:1, 63-70.
- Can, S.M., Kara, R. and Ezer, T. 2013. Bryophyte flora of Melendiz Mountain in Turkey. Turk. J. Bot. 37:575-588.
- Canli, K. and Çetin B. 2012. *Didymodon tomaculosus* (Blockeel) M.F.V. Corley, new to the moss flora of Turkey and Asia. Bangladesh J. Botany 41:177-179.
- Cano M. J. Guerra J. and Ros M. R. 1994. *Pterygoneurum compactum* sp. nov. (Musci: Pottiaceae) from Spain. The Bryologist. 97:4, 412-415.
- Cano M.J. 2006. *Pterygoneurum*. In: Guerra J. Cano M.J. and Ros R.M. (eds), Flora Briofítica Ibérica, Vol. III. Pottiales, Encalyptales. Murcia, Universidad de Murcia. – Sociedad Española de Briología. pp. 98-106.
- Cortini P.C. 2001. Flora dei muschi d'Italia (Sphagnopsida, Andreaeopsida, Bryopsida. I parte). ISBN: 88-7287-250-2: 817 s.
- Cortini P.C. 2006. Flora dei muschi d'Italia (Sphagnopsida, Andreaeopsida, Bryopsida. I parte), ISBN: 88-7287-250-2: 817-1235.
- Crum H. 1973. Mosses of the Great Lakes forest. University of Michigan, 404 s, Michigan, Amerika.
- Erzberger P. and Papp B. 2004. Annotated Checklist of Hungarian Bryophytes. Studia bot. Hung. 35: 91-149.
- Ezer, T. and Kara, R. 2012. New national and regional bryophyte records, 33. 15. *Pseudocalliergon turgescens* (T. Jensen) Loeske, Turkey. J. Bryol. 34: 286.
- Frey W. Herrstadt I. and Kurschner H. 1990. *Pterygoneurum crossidioides* (Pottiaceae, Musci), a new species to the desert flora of the Dead Sea area. Nova Hedwigia 50: 239-244.
- Göl C. Dengiz O. 2007. Çankırı-Eldivan Karataşbağı Deresi Havza Arazi Kullanım-Arazi Örtüsündeki Değişim ve Toprak Özellikleri, OMÜ Ziraat Fakültesi Dergisi, 22:1, 86-97.
- Greven H.C. 2003. Grimmias of The World. Leiden: Backhuys Publishers, 250 s, The Netherlands.
- Guerra J. Ros R.M. Cano M.J. Casares M. 1995. Gypsiferous outcrops in se Spain, refuges of rare, vulnerable and endangered bryophytes and lichens. Cryptogamie, Bryol. Lichenol. 16:2, 125-135.
- Henderson, D.M. 1961. Contributions to the bryophyte flora of Turkey IV. Notes Royal Botanical Garden. 23:263-178.
- Hill MO. Bell N. Buruggeman-Nannenga MA. Brugues M. Cano MJ. Enroth Flatberg KI. Fraham J-P. Gallego MT. Garilleti R. Guerra J. Hedenäs L. et. al., 2006. An annotated checklist of the mosses of Europe and Macronesia. Journal of Bryology. 28: 198-267.
- Kaya, Z. and Roynal, D.J. 2001. Biodiversity and conservation of Turkish forests. Biological conservation, 97: 2, 131-141.

- Keçeli T. Abay G. and Ursavaş S. 2011. *Barbilophozia lycopodioides* (Wallr.) Loeske, new to the liverwort flora of Turkey. *Cryptogamie, Bryologie*. 32:3, 273-277.
- Keçeli T. and Çetin B. 2000. The moss flora of Çankırı-Eldivan mountain. *Turk J Bot.* 24: 249-258.
- Kirmaci, M. and Agcagil, E. 2012. New national and regional bryophyte records, 33. 2. *Crossidium aberrans* Holz. And E.B.Bartram, Turkey. *J. Bryol.* 34:281-282.
- Kirmaci, M. and Erdağ A. 2014. *Acaulon fortiquerianum* (Pottiaceae), a new species to the bryophyte flora of Turkey and SW Asia. *Polish Botanical Journal*. 59:2, 229-233.
- Kirmaci, M. and Kürschner, H. 2013. The genus *Sphagnum* L. in Turkey – with *S. contortum*, *S. fallax*, *S. magellanicum* and *S. rubellum* new to Turkey and Southwest Asia. *Nova Hedwigia*. 96: 383-397.
- Kirmaci, M., Kürschner, H. and Erdağ, A. 2012. New and noteworthy records to the bryophyte flora of Turkey and Southwest Asia. *Cryptogamie Bryol.* 33:267-270.
- Kürschner H. and Erdağ A. 2005. Bryophytes of Turkey: An Annotated Reference List of the Species with Synonyms from the Recent Literature and an Annotated List of Turkish Bryological Literature. *Turkish Journal of Botany*. 29: 95-154.
- Kürschner, H. and Frey, W. 2011. Liverworts, mosses and hornworts of Southwest Asia (Marchantiophyta, Bryophyta, Anthocerotophyta). *Nova Hedwigia*. 139: 1-240.
- Lawton E. 1971. Moss Flora of Pacific Northwest. *Journal of Hattori Botanical Garden. Laboratory, Nichinan*, 760 p.
- Lüth M. 2006a. Bildatlas der Moose Deutschlands, Faszikel 1. Grimmiaceae. Freiburg. Deutschland.
- Lüth M. 2006b. Bildatlas der Moose Deutschlands, Faszikel 2. Dicranaceae – Miniaceae – Politrachaceae. Freiburg. Deutschland.
- Lüth M. 2006c. Bildatlas der Moose Deutschlands, Faszikel 3. Pottiaceae. Freiburg. Deutschland.
- Lüth M. 2007. Bildatlas der Moose Deutschlands, Faszikel 4. Bryaceae – Disceliaceae – Ephemeraceae – Funariaceae – Splachnaceae. Freiburg. Deutschland.
- Lüth M. 2008. Bildatlas der Moose Deutschlands, Faszikel 5. Timmiaceae. Freiburg. Deutschland.
- Lüth M. 2009. Bildatlas der Moose Deutschlands, Faszikel 6. Amblystegiaceae – Thuidiaceae. Freiburg. Deutschland.
- Lüth M. 2010. Bildatlas der Moose Deutschlands, Faszikel 7. Brachytheciaceae – Entodontaceae – Hypnaceae – Plagiotheciaceae – Sematophyllaceae. Freiburg. Deutschland.
- Meteoroloji Genel Müdürlüğü 2007. Çankırı Eldivan Meteoroloji Bülteni. Ankara: T.C. Çevre ve Orman Bakanlığı Devlet Meteoroloji İşleri Genel Müdürlüğü Kayıtları.
- Nyholm E. 1979. Illustrated Moss Flora of Nordic Mosses. Fasc. 5. Lund: Nordic Bryological Society.
- Nyholm E. 1981. Illustrated Moss Flora of Nordic Mosses. Fasc. 6. Lund: Nordic Bryological Society.
- Nyholm E. 1987. Illustrated Moss Flora of Nordic Mosses. Fasc. 1. Fissidentaceae -Seligeriaceae, Stockholm: Nordic Bryological Society.
- Nyholm E. 1993. Illustrated Moss Flora of Nordic Mosses. Fasc. 3. Bryaceae -Rhodobryaceae – Miniaceae – Cinclidiaceae – Plagiomniaceae, Lund: Nordic Bryological Society.
- Nyholm E. 1998. Illustrated Moss Flora of Nordic Mosses. Fasc. 4. Aulacomniaceae –Meesiaceae – Catocopiaceae – Bartramiaceae – Timmiaceae – Encalyptaceae –Grimmiaceae – Ptychomitraceae – Hedwigiaceae – Orthotrichaceae, Lund: Nordic Bryological Society.
- Nyholm, E. 1990. Illustrated Moss Flora of Nordic Mosses. Fasc. 2. Pottiaceae -Sphagnaceae - Schistostegaceae, Lund: Nordic Bryological Society.
- Ören M. Sarı B. Ursavaş S. 2015. *Syntrichia minor* (Pottiaceae) and *Cephaloziella integerrima* (Cephaloziellaceae) new to bryophyte flora of Turkey. *Archives of Biological Science*. DOI:10.2298/ABS1412040040
- Özdemir T., and Batan N. 2014. New and noteworthy moss records for Turkey and Southwest Asia. *Journal of plant systematics*. 17: 35-42.
- Özdemir, T., Batan, N., and Uyar, G. 2012. New national and regional bryophyte records, 31. 8. *Conardia compacta* (Drumm. Ex Müll. Hal.) H.Rob., Turkey. *J. Bryol.* 34: 125-126.
- Papp B. Erzberger P. Ódor P. Hock Z.S. Szövényi P. Szurdoki E. and Tóth Z. 2010. Updated Checklist And Red List of Hungarian Bryophytes. *Studia bot. Hung.* 41: 31–59.
- Pócs T. Goia I. KLS. G. Orbán S. Sass-Gyarmati A. and Van Zanten B.O. 2002. *Hilpertia velenovskyi* (Schiffn.) Zander and other pottoid mosses (Bryophyta) new to Romania. *Studies on the cryptogamic vegetation of loess cliffs, IX. - Contributii Botanicae Grad. Bot. A. Borza Cluj-Napoca*. 37: 13-24.

- Şahin A., Abay G. 2009. Gürgenli Dağı Karayosunu (Musci) Florasına Katkılar (Bayramören/Çankırı). Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi, 10:2, 83-92.
- Savicz L.I. Ljubitzkaja and Smirnova Z.N. 1970. The Handbook Of The Mosses Of The U.S.S.R. The Academy of Sciences of The U.S.R.R. The Komarov Botanical Institute, 824 p.
- Şimşek Ö. Canlı K. and Çetin B. 2011. Contributions to the Liverwort (Marchantiophyta) flora of Ilgaz Mountains (Turkey). 4:1, 7-10.
- Smit A.J.E. 2004. The Moss Flora of Britain and Ireland. Cambridge University Press, 1012 p.
- Smith A.J.E. 1980. The Moss Flora of Britain and Ireland. Cambridge University Press. 706 s.
- URL 1. <http://www.tropicos.org/LocationSubordinate.aspx?locationid=271>, Access date: 24.06.2015.
- Ursavaş, S. and Abay, G. 2009. Contributions to the bryoflora of Ilgaz Mountains, Yenice Forests, Turkey. Biological Diversity and Conservation. 2:3, 112-121.
- Ursavaş, S. and Çetin, B. 2012. *Seligeria donniana* (Sm.) Müll. Hal. (Seligeriaceae) a new record to the bryophyte flora of Turkey. Biodicon 5: 70-72.
- Uyar G. and Çetin B. 2004. A new check-list of the mosses of Turkey. Journal of Bryology. 26: 203-220.
- Uyar, G. and Ören, M. 2013. Three remarkable new moss records for South-West Asia from northern Turkey. Turk. J. Bot. 37: 363-368.
- Yavuz A. 2015. The Moss (Musci) Flora In The Urban Area of Çankırı and Surroundings. Çankırı Karatekin Üniversitesi, Fen Bilimleri Enstitüsü. Yüksek Lisans Tezi.
- Yayıntaş, Ö.T. 2009. *Pterygoneurum subsessile* (Brid.) Jur., New national and regional bryophyte records, 21, Journal of Bryology, 31: 136.