

Contributions to the moss flora of the Caucasian part (Artvin Province) of Turkey

Nevzat BATAN¹, Turan ÖZDEMİR^{2*}

¹Maçka Vocational School, Karadeniz Technical University, 61750, Trabzon, Turkey

²Department of Biology, Faculty of Science, Karadeniz Technical University, 61080, Trabzon, Turkey

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Abstract: The moss flora of Artvin Province (Arduç, Şavşat, Borçka, Murgul, and Arhavi districts) in Turkey was studied between 2009 and 2011. A total of 167 moss taxa (belonging to 80 genera and 33 families) were recorded within the study area. Among these, 3 species [*Dicranella schreberiana* (Hedw.) Dixon, *Dicranodontium asperulum* (Mitt.) Broth., and *Campylopus pyriformis* (Schultz) Brid.] are new records from the investigated area for the moss flora of Turkey. The research area is located in the A4 and A5 squares in the grid system adopted by Henderson in 1961. In the A5 grid-square 127 taxa were recorded as new records, and 1 taxon [*Anomodon longifolius* (Schleich. ex Brid.) Hartm.] was recorded for the second time in Turkey.

Key words: Moss, flora, Artvin Province, A4 and A5 squares, Turkey

1. Introduction

The total Turkish bryoflora comprises 773 taxa (species, subspecies, and varieties), including 187 genera of *Bryophyta* and 175 taxa (species, subspecies, and varieties) of *Marchantiophyta* and *Anthocerotophyta* (Uyar & Çetin, 2004; Kürschner & Erdağ, 2005; Özenoğlu Kiremit & Keçeli, 2009; Lara et al., 2010; Ören et al., 2010; Özenoğlu Kiremit & Hugonnot, 2010; Keceli et al., 2011; Kürschner and Frey, 2011; Özenoğlu Kiremit, 2011; Ören et al., 2012). Nevertheless, in recent years local and foreign bryologists have increased the total numbers with additions to the Turkish moss flora.

Additions to the bryophyte flora of Turkey in the last decade from the Eastern Black Sea region include: *Harpanthus scutatus* (Web. & Mohr.) Spruce, *Nardia scalaris* S.F.Gray, *Scapania subalpina* (Nees ex Lindenb.) Dumort., *Blindia caespiticia* (Web. & Mohr.) Müll. Hal., *Taxiphyllum densifolium* (Lindb. ex Broth.) Reim (Papp, 2004), *Eremonotus myriocarpus* (Carrington) Person (Küschner & Parolly, 2006a), *Warnstorfia sarmentosa* (Wahlenb.) Hedenas (Küschner & Parolly, 2006b), *Bucklandiella microcarpa* (Hedw.) Bednarek-Ochyra & Ochyra (Abay et al., 2007), *Telaranea europea* J.J.Engel & G.L.Merr. (Keçeli & Abay, 2007a), *Pallavicinia lyellii* (Hook.) Carruth. (Keçeli & Abay, 2007b), *Dicranodontium uncinatum* (Harv.) Jaeg. (Batan & Özdemir, 2008), *Rhytidiadelphus loreus* (Hedw.) Warnst. (Özdemir, 2008), *Didymodon asperifolius* (Mitt.) H.A.Crum, Steere & L.E.Anderson (Özdemir et al.,

2008), *Campylopus flexuosus* (Hedw.) Brid. (Özdemir & Uyar, 2008), *Scapania paludosa* (Müll. Frib.) Müll. Frib. (Keçeli et al., 2008), *Dicranum flexicaule* Brid. (Uyar et al., 2008), *Sphagnum centrale* C.E.O.Jensen (Abay et al., 2009), *Orthotrichum callistomum* Fisch. Oost. ex Bruch & Schimp., *O. consobrinum* Cardot, *O. crenulatum* Mitt., *O. hispanicum* F.Lara, Garilleti & Mazimpaka, *O. rogeri* Brid., *O. sordidum* Sull. & Lesq., *O. stellatum* Brid., *O. vladikvkanun* Venturi, *Ulota coarctata* (Palisot de Beauvois) Hammar, *U. rehmannii* Jur. and *Zygodon dentatus* (Breidl. ex Limpr.) Kartt. (Lara et al., 2010), *Seligeria trifaria* (Brid.) Lindb., and *Pseudotaxiphyllum elegans* (Brid.) Z.Iwats. (Ören et al., 2012).

The aim of the present study was to contribute to the moss flora of Artvin Province (Arduç, Şavşat, and Arhavi districts) and the moss flora of Turkey.

2. Description of the study area

In Turkey, 2 areas are included in Conservation International's 25 world biodiversity hotspots; southern Anatolia and a small part of north-eastern Anatolia are included in the Mediterranean basin and Caucasus hotspots, respectively. Turkey is also included in 4 Global 200 Ecoregions, including the Caucasus-Anatolian-Hyrcanian Temperate Forests region (Eminağaoğlu et al., 2010).

The study area is situated in Artvin Province in north-east Turkey between 40 and 42°N and 38 and 42°E. The

* Correspondence: ozdemirturan@gmail.com

region is surrounded to the west by Rize Province, to the east by Ardahan Province, to the north by Georgia, and to the south by Erzurum Province (Figure 1). In addition, the area is situated in the Colchis area of the Euro-Siberian floristic region (Zohary, 1973) and in the A4 and A5 squares adopted by Henderson (1961).

Artvin is an attractive area of steep valleys carved by the Çoruh river system and is surrounded by high mountains and forest. It also hosts national parkland including the Karagöl-Sahara, which contains Şavşat and Borçka lakes. Şavşat has a semi-continental rainfall regime. The first type of the Eastern Black Sea oceanic rainfall regime occurs in Arhavi District. Ardanuç District has a semi-terrestrial upper Mediterranean climate type. Artvin Province has a rainy, cold Mediterranean climate (Akman, 1999).

The vegetation of Ardanuç, Murgul, and Borçka districts changes from the bed of the Çoruh valley to higher elevations. Mainly, *Quercus hartwissiana* Stev. populations are visible along the lower sides of the valley. Up to about 1400 m the upper sides of the valley are covered by mixed forests of *Ulmus glabra* Huds., *U. minor* Miller subsp., *Alnus glutinosa* (L.) Gaertner subsp. *barbata* (C.A.Mey.) Yalt., *Carpinus betulus* L., *Abies nordmanniana* (Stev.) Spach. subsp. *nordmanniana*, *Quercus hartwissiana* Stev., *Populus tremula* L., and *Tilia rubra* DC. subsp. *caucasica* (Rupr.) V.Engler. Between 1400 and 2000 m, *Pinus sylvestris* L. forests appear. The alpine zone above 2000 m consists mainly of steppes covered by meadows (Demirel, 1999). The dominant taxa in the main vegetation from Arhavi District are: *Rhododendron ponticum* L., *R. luteum* Sweet., *Corylus avellana* L., *Alnus glutinosa* L., *Laurus nobilis* L., *Buxus sempervirens* L., *Daphne pontica* L., *Ilex colchica* Pojk., *Castanea sativa* Mill., *Carpinus betulus* L., *Picea orientalis* (L.) Link., *Pinus sylvestris* L., *Acer cappadocicum* Gleditsch., *Frangula alnus* Mill., *Vaccinium arctostaphylos*

L., and *Cornus sanguinea* L. (Anşın, 1981). Some vegetation types in Şavşat District are formed by: *Abies nordmanniana* (Stev.) Spach subsp. *nordmanniana*, *Picea orientalis* (L.) Link., *Pinus sylvestris* L. var. *hamata* Stev., *Taxus baccata* L., *Juniperus communis* L., *J. oxycedrus* L., *Acer tataricum* L., *A. platanoides* L., *Ilex colchica* Pojark, *Cerasus avium* (L.) Moench, *Rubus saxatilis* L., *R. canescens* DC. var. *canescens*, *R. caucasicus* Focke, *Ulmus glabra* Huds., *Juglans regia* L., *Fagus orientalis* Lipsky, *Quercus hartwissiana* Steven, *Q. petraea* (Matt.) Liebl. subsp. *iberica*, *Carpinus betulus* L., *Ostrya carpinifolia* Scop., *Corylus avellana* L., *Betula litwinowii* Doluch., *Alnus glutinosa* (L.) Gaertn. subsp. *barbata*, *Salix alba* L., and *Sorbus caucasica* Zinserl var. *caucasica* (Eminağaoğlu et al., 2007, 2012).

3. Materials and methods

During 2009–2011 extensive moss collection was undertaken in Artvin Province (Ardanuç, Arhavi, Şavşat, Murgul, and Borçka districts) (Table 1). These study areas are situated in the A4 and A5 squares, according to the grid system of Turkey (Henderson, 1961). Field notes were made in detail for each sample collection station (Table 1). The most important areas and different habitats were visited.

The following references were used for identification and nomenclature of moss specimens: Watson (1981), Noguchi and Iwatsuki (1987, 1988, 1989), Noguchi et al. (1991, 1994), Frahm (1997), Cortini-Pedrotti (2001), Smith (2004), Frey et al. (2006), Hill et al. (2006), and Kürschner (2006, 2008).

For each species in the floristic list below we provide detailed information about localities and the voucher number from the collection. The samples are kept in the special collection of ÖZDEMİR and BATAN in the department of biology at Karadeniz Technical University.

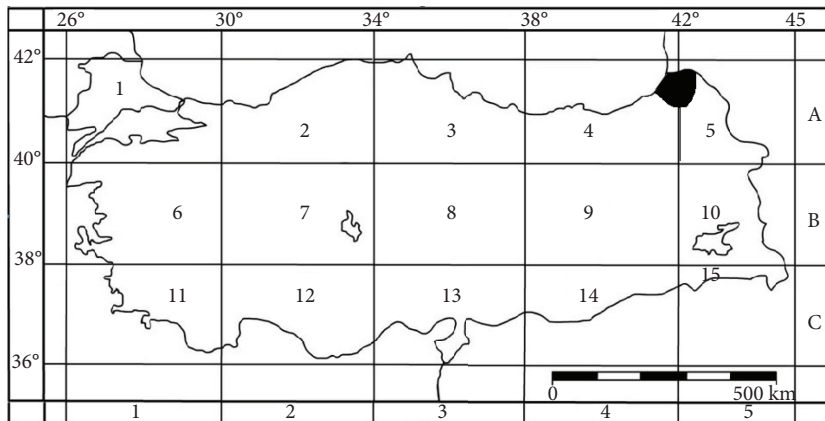


Figure 1. Map of the study area and grid system of Turkey (Henderson, 1961).

Table 1. List of collection stations.

Station no.	Localities	Latitude-longitude	Altitude (m)	Collection date
1	Artvin: Ardanuç District, Ferhatlı village	41°08'18"N, 42°00'29"E	560	18.08.2010
2	Artvin: Ardanuç District, between Ferhatlı village and Avclar village	41°07'36"N, 42°00'10"E	1027	18.08.2010
3	Artvin: Ardanuç District, between Sakarya village and Avclar village	41°08'09"N, 42°59'18"E	958	18.08.2010
4	Artvin: Ardanuç district, Sakarya village	41°06'42"N, 42°00'47"E	1628	18.08.2010
5	Artvin: Ardanuç District, Kapı village	41°10'47"N, 42°13'40"E	1703	19.08.2010
6	Artvin: Ardanuç District, Kutlu village	41°12'03"N, 42°11'55"E	1497	19.08.2010
7	Artvin: Ardanuç District, Yukarı Irmaklar village	41°12'51"N, 42°11'15"E	1386	19.08.2010
8	Artvin: Ardanuç District, Aşağı Irmaklar village	41°11'05"N, 42°12'04"E	1573	19.08.2010
9	Artvin: Ardanuç District, Ustalar village	41°09'40"N, 42°09'40"E	1804	20.08.2010
10	Artvin: Ardanuç District, Cevizli village	41°11'34"N, 42°08'18"E	1200	20.08.2010
11	Artvin: Ardanuç District, Anaçlı village	41°12'41"N, 42°05'05"E	1151	20.08.2010
12	Artvin: Ardanuç District, İncilli village	41°11'30"N, 42°06'25"E	1231	20.08.2010
13	Artvin: Ardanuç District, Yol Üstü village	41°09'40"N, 42°03'48"E	1045	16.09.2010
14	Artvin: Ardanuç District, Naldöken village	41°08'40"N, 42°03'43"E	755	16.09.2010
15	Artvin: Ardanuç District, Gökçe village	41°11'35"N, 42°02'14"E	1244	16.09.2010
16	Artvin: Ardanuç District, Tütünlü village	41°09'06"N, 42°06'09"E	1080	16.09.2010
17	Artvin: Ardanuç District, Beratlı village	41°09'04"N, 42°07'59"E	1140	17.09.2010
18	Artvin: Ardanuç District, Hamurlu village	41°08'04"N, 42°08'22"E	1273	17.09.2010
19	Artvin: Ardanuç District, Soğanlı village	41°10'03"N, 42°00'36"E	731	17.09.2010
20	Artvin: Ardanuç District, Kaşıkçı village	41°07'04"N, 42°09'27"E	1536	17.09.2010
21	Artvin: Ardanuç District, Konaklı village	41°07'37"N, 42°08'46"E	1483	18.09.2010
22	Artvin: Ardanuç District, the canyon of Cehennem Deresi	41°07'59"N, 42°02'54"E	540	18.09.2010
23	Artvin: Şavşat District, Köprülü village	41°15'51"N, 42°26'56"E	1208	19.09.2010

Table 1. (Continued).

24	Artvin: Şavşat District, Kocabey village	41°14'60"N, 42°25'35"E	1504	24.08.2009
25	Artvin: Şavşat District, Atalar village	41°20'24"N, 42°21'52"E	1680	19.09.2010
26	Artvin: Şavşat District, Kayadibi village	41°19'05"N, 42°22'20"E	1650	19.09.2010
27	Artvin: Şavşat District, Yavuz village	41°13'38"N, 42°24'34"E	1711	19.09.2010
28	Artvin: Şavşat District, Kirazlı village	41°15'52"N, 42°29'36"E	1496	20.09.2010
29	Artvin: Şavşat District, near the Şavşat–Ardahan highway (Sahara high plateau)	41°13'26"N, 42°27'13"E	2008	24.08.2009
30	Artvin: Şavşat District, near the Şavşat–Ardahan highway (Sahara high plateau)	41°14'04"N, 42°27'36"E	1900	24.08.2009
31	Artvin: Şavşat District, Sahara high plateau	41°14'44"N, 42°27'09"E	1853	24.08.2009
32	Artvin: Şavşat District, Meşeli Karagöl lake	41°18'25"N, 42°29'24"E	1618	25.08.2010
33	Artvin: Şavşat District, Meşeli village	41°19'02"N, 42°28'10"E	1724	25.08.2009
34	Artvin: Şavşat District, Veliköy village	41°18'57"N, 42°26'26"E	1480	20.09.2010
35	Artvin: Şavşat District, Ciritdüzü village	41°16'49"N, 42°23'44"E	1260	20.09.2010
36	Artvin: Şavşat District, Düzenli village	41°13'08"N, 42°22'21"E	1625	21.09.2010
37	Artvin: Şavşat District, Kireçli village	41°12'41"N, 42°21'33"E	1787	21.09.2010
38	Artvin: Şavşat District, Arpalı village	41°13'51"N, 42°19'06"E	1077	21.09.2010
39	Artvin: Şavşat District, Çamlıca village	41°10'45"N, 42°23'30"E	1077	21.09.2010
40	Artvin: Şavşat District, Çiftlik village	41°14'06"N, 42°16'01"E	1138	21.09.2010
41	Artvin: Şavşat District, Savaş village	41°13'44"N, 42°14'18"E	1421	21.09.2010
42	Artvin: Şavşat District, Ziyaret village	41°15'33"N, 42°20'36"E	972	21.09.2010
43	Artvin: Şavşat District, Şavşat castle	41°14'30"N, 42°20'30"E	1230	25.08.2009
44	Artvin: Arhavi District, Kamilat valley, Meçuna waterfall	41°16'20"N, 41°24'25"E	487	20.04.2011
45	Artvin: Arhavi District, the lower part of Kamilat valley	41°16'23"N, 41°23'35"E	386	20.04.2011
46	Artvin: Murgul District, Kabaca Eğrisu near stream	41°09'14"N, 41°32'28"E	1780	08.09.2009
47	Artvin: Borçka District, Camili Biosphere Reserve area	41°28'44"N, 41°53'48"E	445	11.09.2009

4. Results

After identification of the specimens, a list of the species was created. The newly recorded taxa for the A5 grid square are indicated with an asterisk (*), the taxa recorded from Turkey for a second time are indicated with 2 asterisks (**), and the new record taxa for Turkey are indicated with 3 asterisks (***). The status of taxa for Turkey was evaluated by reviewing the related literature (Uyar & Çetin, 2004; Kürschner & Erdağ, 2005; Kürschner & Frey, 2011).

In the floristic list, the first number (or numbers) is the locality number, the next letter shows the habitat (S: on soil, WS: on wet soil, WSS: on wet soil submerged in water, R: on rock, T: on the bark of tree trunk and branch, DT: on dead tree trunk, WR: on wet rock, WSR: on wet rock submerged in water), and the last number is the collection number in the floristic list.

Floristic list

BRYOPHYTA

Polytrichaceae Schwägr.

1. **Atrichum undulatum* (Hedw.) P.Beauv., loc. 5, 7, 28, 30, S, *Batan* 1001.
2. **Pogonatum aloides* (Hedw.) P.Beauv., loc. 15, 27, 35, S, *Batan* 1002.
3. **P. urnigerum* (Hedw.) P.Beauv., loc. 37, S, *Batan* 1003.
4. **Polytrichum commune* Hedw., loc. 30, S, *Batan* 1004.

Timmiaceae Schimp.

5. **Timmia bavarica* Hessel., loc. 1, S, *Batan* 1005.
6. **T. megapolitana* Hedw., loc. 2, S, *Batan* 1006.

Encalyptaceae Schimp.

7. **Encalypta streptocarpa* Hedw., loc. 12, R, *Batan* 1007.

Grimmiaceae Arn.

8. **Grimmia alpestris* (F.Weber & D.Mohr) Schleich., loc. 5, 6, 22, R, *Batan* 1008.
9. **G. decipiens* (Schultz) Lindb., loc. 19, 23, R, *Batan* 1009.
10. **G. donniana* Sm., loc. 27, R, *Batan* 1010.
11. *G. elatior* Bruch ex Bals.-Criv. & De Not., loc. 10, R, *Batan* 1011.
12. **G. elongata* Kaulf., loc. 12, 13, 14, R, *Batan* 1012.
13. *G. funalis* (Schwägr.) Bruch & Schimp., loc. 9, R, *Batan* 1013.
14. **G. hartmanii* Schimp., loc. 16, 17, S, *Batan* 1014.
15. *G. laevigata* (Brid.) Brid., loc. 20, 21, 32, 33, R, *Batan* 1015.
16. **G. orbicularis* Bruch ex Wilson, loc. 33, R, *Batan* 1016.
17. *G. ovalis* (Hedw.) Lindb., loc. 8, 11, 22, 33, R, *Batan* 1017.

18. *G. pulvinata* (Hedw.) Sm., loc. 8, 10, 13, 18, 19, 27, 37, R, *Batan* 1018.

19. **G. trichophylla* Grev., loc. 11, 13, 16, R, *Batan* 1019.

20. **Racomitrium aciculare* (Hedw.) Brid., loc. 19, WS, *Batan* 1020.

21. **R. affine* (F.Weber & D.Mohr) Lindb., loc. 4, 36, S, *Batan* 1021.

22. **Schistidium papillosum* Culm., loc. 24, 25, R, *Batan* 1022.

Seligeriaceae Schimp.

23. **Blindia acuta* (Hedw.) Bruch & Schimp., loc. 24, T, *Batan* 1023.

Fissidentaceae Schimp.

24. **Fissidens adianthoides* Hedw., loc. 30, 31, WS, *Batan* 1024.

Ditrichaceae Limpr.

25. *Ceratodon purpureus* (Hedw.) Brid., loc. 29, S, *Batan* 1025.

26. *Distichium capillaceum* (Hedw.) Bruch & Schimp., loc. 6, 27, WS, WR, *Batan* 1026.

27. **D. inclinatum* (Hedw.) Bruch & Schimp., loc. 9, 10, S, *Batan* 1027.

28. **Ditrichum heteromallum* (Hedw.) E.Britton, loc. 30, 31, S, *Batan* 1028.

29. *Saelania glaucescens* (Hedw.) Broth., loc. 34, 35, S, *Batan* 1029.

Rhabdoweisiaceae Limpr.

30. **Dichodontium pellucidum* (Hedw.) Schimp., loc. 28, 29, S, *Batan* 1030.

Dicranaceae Schimp.

31. *Dicranella heteromalla* (Hedw.) Schimp., loc. 36, 37, S, *Batan* 1031.

32. ****D. schreberiana* (Hedw.) Dixon, loc. 1, S, *Batan* 1032.

33. **Dicranum fulvum* Hook., loc. 26, 42, 43, S, *Batan* 1033.

34. *D. majus* Sm., loc. 1, 25, 31, S, *Batan* 1034.

35. **D. polysetum* Sw. ex anon., loc. 30, 31, S, *Batan* 1035.

36. *D. scoparium* Hedw. - loc: 1, 2, 27, 30, 32, 35, 38, 40, S, *Batan* 1036.

Leucobryaceae Schimp.

37. ****Campylopus pyriformis* (Schultz) Brid., loc. 46, 47, DT, *Batan* 1181, 1182.

38. ****Dicranodontium asperulum* (Mitt.) Broth., loc. 44, 45, S, T, *Batan* 1037.

39. **Leucobryum juniperoideum* (Brid.) Müll. Hal., loc. 29, DT, *Batan* 1038.

Pottiaceae Schimp.

40. **Eucladium verticillatum* (With.) Brunch & Schimp., loc. 16, 17, WS, *Batan* 1039.

41. **Pleurochaete squarrosa* (Brid.) Lindb., loc. 2, 30, S, *Batan* 1040.

42. **Tortella humilis* (Hedw.) Jenn., loc. 1, 3, R, *Batan* 1041.
43. **T. inclinata* var. *densa* (Lorentz & Molendo) Limpr., loc. 1, 2, 3, 4, R, *Batan* 1042.
44. *T. tortuosa* (Hedw.) Limpr., loc. 2, 4, 8, 25, 28, 30, 34, 35, 42, S, *Batan* 1043.
45. **Trichostomum brachydontium* Bruch, loc. 28, 35, S, *Batan* 1044.
46. **Barbula convoluta* Hedw., loc. 30, S, *Batan* 1045.
47. **B. unguiculata* Hedw., loc. 29, S, *Batan* 1046.
48. **Crossidium squamiferum* (Viv.) Jur., loc. 8, 14, 18, 22, 43, S, *Batan* 1047.
49. **Didymodon ferrugineus* (Schimp. ex Besch.) M.O.Hill, loc. 10, S, *Batan* 1048.
50. **D. insulanus* (De Not.) M.O.Hill, loc. 29, 32, S, *Batan* 1049.
51. **D. luridus* Hornsch. Ex. Spreng, loc. 29, 30, S, *Batan* 1050.
52. **D. sinuosus* (Mitt.) Delogne, loc. 29, 31, R, *Batan* 1051.
53. **Syntrichia montana* Nees, loc. 30, 34, 37, S, *Batan* 1052.
54. **S. norvegica* F.Weber, loc. 22, S, *Batan* 1053.
55. **S. ruralis* var. *ruralis* (Hedw.) F.Weber & D.Mohr, loc. 27, 30, 41, S, *Batan* 1054.
56. *S. ruralis* var. *ruraliformis* (Besch.) Delogne, loc. 18, 20, 22, S, *Batan* 1055.
57. **Tortula caucasica* Lindb. ex Broth., loc. 34, 35, S, *Batan* 1056.
58. **T. lanceola* R.H.Zander, loc. 9, 11, S, *Batan* 1057.
59. **T. muralis* Hedw., loc. 7, 12, 15, 17, 20, 21, 22, S, *Batan* 1058.
60. **T. schimperi* M.J.Cano, O.Werner & J.Guerra, loc. 1, 3, S, *Batan* 1059.
61. **T. subulata* Hedw., loc. 8, 9, 13, 33, 40, 43, S, *Batan* 1060.
- Orthotrichaceae** Arn.
62. **Orthotrichum affine* Schrad. ex Brid., loc. 1, 2, T, *Batan* 1061.
63. **O. anomalum* Hedw., loc. 8, 13, R, *Batan* 1062.
64. **O. cupulatum* Hoffm. Ex Brid., loc. 7, 11, 14, R, *Batan* 1063.
65. *O. rupestre* Schleich. ex Schwägr., loc. 10, 16, R, *Batan* 1064.
66. **O. speciosum* Nees, loc. 1, 2, T, *Batan* 1065.
- Hedwigiaceae** Schimp.
67. *Hedwigia ciliata* var. *ciliata* (Hedw.) P.Beauv., loc. 31, 34, R, *Batan* 1066.
68. **H. ciliata* var. *leucophaea* Bruch & Schimp., loc. 30, 34, R, *Batan* 1067.
69. **H. stellata* Hedenäs, loc. 5, 15, 24, 34, R, *Batan* 1068.

Bartramiaceae Schwägr.

70. **Bartramia pomiformis* Hedw., loc. 9, 31, S, *Batan* 1069.
71. **Philonotis arnellii* Husn., loc. 29, WSS, *Batan* 1070.
72. *P. calcarea* (Bruch & Schimp.) Schimp., loc. 29, 31, WSS, *Batan* 1071.
73. **P. fontana* (Hedw.) Brid., loc. 31, WSS, *Batan* 1072.
74. *P. marchica* (Hedw.) Brid., loc. 35, WSS, *Batan* 1073.
- Bryaceae** Schwägr.
75. *Bryum argenteum* Hedw., loc. 30, S, *Batan* 1074.
76. *B. capillare* Hedw., loc. 5, 6, S, R, *Batan* 1075.
77. **B. creberrimum* Taylor, loc. 1, 11, S, *Batan* 1076.
78. **B. donianum* Grev., loc. 29, S, *Batan* 1077.
79. **B. intermedium* (Brid.) Blandow, loc. 7, 14, WS, *Batan* 1078.
80. **B. moravicum* Podp., loc. 10, 11, DT, *Batan* 1079.
81. *B. pallescens* Schleich. ex Schwägr., loc. 31, S, *Batan* 1080.
82. **B. rubens* Mitt., loc. 30, S, *Batan* 1081.
83. *B. schleicheri* DC., loc. 6, 29, 31, WSS, *Batan* 1082.
84. **B. uliginosum* (Brid.) Bruch & Schimp., loc. 2, 4, WSS, *Batan* 1083.

Mielichhoferiaceae Schimp.

85. **Epipterygium tozeri* (Grev.) Lindb., loc. 35, WS, *Batan* 1084.
86. *Pohlia cruda* (Hedw.) Lindb., loc. 24, WS, *Batan* 1085.

Mniaceae Schwägr.

87. **Mnium hornum* Hedw., loc. 1, 3, 30, WS, *Batan* 1086.
88. **M. lycopodioides* Schwägr., loc. 2, 34, WS, *Batan* 1087.
89. **M. marginatum* (Dicks.) P.Beauv., loc. 2, WS, *Batan* 1088.
90. **M. spinosum* (Voit) Schwägr., loc. 1, WS, *Batan* 1089.
91. **M. spinulosum* Bruch & Schimp., loc. 1, 10, 11, WS, *Batan* 1090.
92. **M. stellare* Hedw., loc. 1, 30, 31, WS, WR, *Batan* 1091.
93. **M. thomsonii* Schimp., loc. 1, 2, 30, WS, *Batan* 1092.

Cinclidiaceae Kindb.

94. **Rhizomnium punctatum* (Hedw.) T.J.Kop., loc. 2, 3, WS, *Batan* 1093.

Plagiomniaceae T.J.Kop.

95. **Plagiomnium cuspidatum* (Hedw.) T.J.Kop., loc. 1, 4, S, *Batan* 1094.
96. **P. elatum* (Bruch & Schimp.) T.J.Kop., loc. 30, 31, WS, *Batan* 1095.
97. **P. ellipticum* (Brid.) T.J.Kop., loc. 29, 2, S, *Batan* 1096.

98. **P. medium* (Bruch & Hedw.) T.J.Kop., loc. 1, 3, 12, S, *Batan* 1097.
99. **P. rostratum* (Schrad.) T.J.Kop., loc. 2, 11, 15, 30, WS, *Batan* 1098.
100. **P. undulatum* (Hedw.) T.J.Kop., loc. 1, 2, 5, 10, 17, 19, 20, 24, 29, 31, WS, *Batan* 1099.
- Climaciaceae** Kindb.
101. **Climacium dendroides* (Hedw.) F.Weber & D.Mohr., loc. 29, 30, 31, S, *Batan* 1100.
- Amblystegiaceae** Kindb.
102. **Amblystegium confervoides* (Brid.) Schimp., loc. 1, WS, *Batan* 1101.
103. **A. serpens* (Hedw.) Schimp., loc. 1, 2, WSS, *Batan* 1102
104. **Campyliadelphus chrysophyllus* (Brid.) R.S.Chopra., loc. 1, 24, 25, 31, WSS, *Batan* 1103.
105. **Campylium protensum* (Brid.) Kindb., loc. 20, 30, WS, WSR, *Batan* 1105.
106. **C. stellatum* (Hedw.) J.Lange & C.E.O.Jensen, loc. 1, 3, 29, WSS, *Batan* 1106.
107. **Cratoneuron filicinum* (Hedw.) Spruce, 1, 2, 30, WSS, *Batan* 1107.
108. **Drepanocladus aduncus* (Hedw.) Warnst., 3, 4, WSS, *Batan* 1108.
109. *Hygroamblystegium humile* (P.Beauv.) Vanderp., Goffinet & Hedenäs, loc. 5, 9, WS, *Batan* 1109.
110. **H. varium* (Hedw.) Mönk., loc. 1, 15, WS, *Batan* 1110.
111. **Hygrohypnum eugyrium* (Schimp.) Broth., loc. 24, 29, 35, WS, WR, *Batan* 1111.
112. **H. luridum* (Hedw.) Jenn., loc. 7, 9, 10, WSS, WR, *Batan* 1112.
113. **Palustriella commutata* (Hedw.) Ochyra, loc. 1, 3, 30, WSS, *Batan* 1113.
114. *Sanionia uncinata* (Hedw.) Loeske, loc. 7, 11, 29, 31, 34, 35, S, *Batan* 1114.
- Calliergonaceae** (Kanda) Vanderp., Hedenäs, C.J.Cox & A.J.Shaw
115. **Scorpidium revolvens* (Sw. ex anon.) Rubers, loc. 1, WSS, *Batan* 1115.
- Leskeaceae** Schimp.
116. **Lescuraea mutabilis* (Brid.) Lindb. ex I.Hagen, loc. 1, 2, 34, T, *Batan* 1116.
117. *L. saxicola* (Schimp.) Molendo, loc. 2, 33, R, *Batan* 1117.
118. **Pseudoleskea incurvata* (Hedw.) Loeske, loc. 1, R, *Batan* 1118.
119. **Pseudoleskeella nervosa* (Brid.) Nyholm, loc. 2, 3, R, *Batan* 1119.
- Thuidiaceae** Schimp.
120. **Abietinella abietina* (Hedw.) M.Fleisch., loc. 8, 9, 10, 29, 30, 31, S, *Batan* 1120.
121. **Thuidium assimile* (Mitt.) A.Jaeger, loc. 29, 31, WS, *Batan* 1121.
122. **T. delicatulum* (Hedw.) Schimp., loc. 29, 33, 34, WS, *Batan* 1122.
123. **T. recognitum* (Hedw.) Lindb., loc. 23, 24, WS, *Batan* 1123.
124. **T. tamariscinum* (Hedw.) Schimp., loc. 29, WS, *Batan* 1124.
- Brachytheciaceae** Schimp.
125. *Palamocladium euchloron* (Müll.Hal.) Wijk & Margad., loc. 31, R, *Batan* 1125.
126. **Plasteurhynchium striatulum* (Spruce) M.Fleisch., loc. 29, R, *Batan* 1126.
127. *Eurhynchium angustirete* (Broth.) T.J.Kop., loc. 29, 31, S, *Batan* 1127.
128. **E. striatum* (Hedw.) Schimp., loc. 29, 30, 31, S, *Batan* 1128.
129. **Rhynchostegium confertum* (Dicks.) Schimp., loc. 3, S, *Batan* 1129.
130. *R. megapolitanum* (Blandow ex F.Weber & D.Mohr), loc. 1, 8, S, *Batan* 1130.
131. **Rhynchostegiella tenella* (Dicks.) Limpr., loc. 2, WS, *Batan* 1131.
132. **Cirriphyllum crassinervium* (Taylor) Loeske & M.Fleisch., loc. 31, 34, R, S, *Batan* 1132.
133. **C. piliferum* (Hedw.) Grout, loc. 31, S, *Batan* 1133.
134. **Kindbergia praelonga* (Hedw.) Ochyra, loc. 29, WS, *Batan* 1134.
135. **Scuiro-hypnum populeum* (Hedw.) Ignatov & Huttunen, loc. 7, 9, 10, 12, 13, WS, *Batan* 1135.
136. **Brachythecium albicans* (Hedw.) Schimp., loc. 1, 29, 38, S, *Batan* 1136.
137. **B. glareosum* (Bruch ex Spruce) Schimp., loc. 6, 7, 10, 11, S, *Batan* 1137.
138. **B. mildeanum* (Schimp.) Schimp., loc. 1, S, *Batan* 1138.
139. *B. rivulare* Schimp., loc. 2, 29, 31, 35, R, S, *Batan* 1139.
140. **B. rutabulum* (Hedw.) Schimp., loc. 2, 31, WS, *Batan* 1140.
141. **B. salebrosum* (Hoffm. ex F.Weber & D.Mohr) Schimp., loc. 2, 4, S, *Batan* 1141.
142. *Eurhynchiastrum pulchellum* var. *diversifolium* (Schimp.) Ochyra & Zarnowiec, 3, S, *Batan* 1142.
143. *Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen, loc. 1, 10, 11, S, *Batan* 1143.
144. **Homalothecium lutescens* (Hedw.) H.Rob., loc. 7, 15, 16, 17, 27, S, *Batan* 1144.
145. *H. philippeanum* (Spruce) Schimp., loc. 7, 33, S, *Batan* 1145.

146. *H. sericeum* (Hedw.) Schimp., loc. 2, 5, 17, S, R, *Batan* 1146.

Hypnaceae Schimp.

147. *Calliergonella cuspidata* (Hedw.) Loeske., loc. 1, 5, 6, 8, 9, 12, 21, 26, 34, 34, 35, 39, 41, 42, WS, *Batan* 1147.

148. **Campylophyllum calcareum* (Crundw. & Nyholm) Hedenäs, loc. 39, S, *Batan* 1148.

149. **Ctenidium molluscum* (Hedw.) Mitt., loc. 1, 8, 23, 30, S, *Batan* 1149.

150. *Hypnum cupressiforme* var. *cupressiforme* Hedw., loc. 24, 29, 30, S, *Batan* 1150.

151. **H. cupressiforme* var. *lacunosum* Brid., loc. 7, 9, 11, 26, 31, 36, S, *Batan* 1151.

152. **H. cupressiforme* var. *resupinatum* (Taylor) Schimp., loc. 11, 12, 34, 38, S, *Batan* 1152.

153. *H. vaucheri* Lesq., loc. 1, 2, S, *Batan* 1153.

154. *Pylaisia polyanta* (Hedw.) Schimp., loc. 14, S, *Batan* 1154.

Hylocomiaceae (Broth.) M.Fleisch.

155. *Hylocomium splendens* (Hedw.) Schimp., loc. 23, 24, 29, 30, 31, WS, *Batan* 1155.

156. *Pleurozium schreberi* (Willd. ex Brid.) Mitt., loc. 1, S, *Batan* 1156.

157. **Rhytidiadelphus squarrosus* (Hedw.) Warnst., loc. 30, S, *Batan* 1157.

158. *R. triquetrus* (Hedw.) Warnst., loc. 1, 25, 26, 27, 29, 30, 31, 35, S, *Batan* 1158.

Rhytidiaceae Broth.

159. **Rhytidium rugosum* (Hedw.) Kindb., loc. 2, 8, 30, 34, S, *Batan* 1159.

Plagiotheciaceae (Broth.) M.Fleisch.

160. **Herzogiella seligeri* (Brid.) Z.Iwats., loc. 29, 31, DT, *Batan* 1160.

Leucodontaceae Schimp.

161. *Leucodon sciuroides* (Hedw.) Schwägr., loc. 7, 35, 36, T, *Batan* 1161.

Neckeraceae Schimp.

162. **Thamnobryum alopecurum* (Hedw.) Gangulee, loc. 24, 25, 29, WS, WR, *Batan* 1162.

Lembophyllaceae Broth.

163. **Isothecium alopecuroides* (Lam. ex Dubois) Isov., loc. 23, 28, 29, 30, 31, S, *Batan* 1163.

164. *I. holtii* Kindb., loc. 1, 3, S, *Batan* 11164.

Anomodontaceae Kindb.

165. **Anomodon attenuatus* (Hedw.) Huebener, loc. 29, 31, S, R, *Batan* 1165.

166. ***A. longifolius* (Schleich. ex Brid.) Hartm., loc. 10, S, *Batan* 1166.

167. **A. viticulosus* (Hedw.) Hook. & Taylor, loc. 9, 34, S, *Batan* 1167.

4.1. New national records

4.1.1. *Dicranella schreberiana* (Hedw.) Dixon

Specimens examined: Turkey, Artvin Province, Ardanuç, Ferhatlı village, 41°08'18"N, 42°00'29"E, on wet soil, 560 m a.s.l., (leg. and det. Batan & Özdemir) 18.08.2010, *Batan* 1032. Specimens collected on wet clay soil near stream bank in woodland, associated with *Mnium spinulosum* Bruch & Schimp. and *M. stellare* Hedw. The species is similar to *Dicranella grevilleana* (Brid.) Schimp. but it differs in denticulate leaf margins, especially near the apex and 9–13-µm wide mid-leaf cells.

The specimens are yellowish-green (Figure 2). Stem up to 3 cm long. Leaves flexuose when moist (Figure 2), crisped when dry (Figure 2). Plants have brown rhizoids and rhizoidal gemmae (Figure 2). In transverse section, cells are circular to indistinctly rounded, consisting of an outer cortex of 2–3 layers of smaller cells (stereid cells) (Figure 2). Upper leaves are larger than lower leaves. Leaf margins are serrate at the apex (Figure 2). When leaves are erect 1–2.7 mm long to a lanceolate, semicanalicate, deflexed, limb from widely ovate sheathing at base (Figure 2). Costa is thin ending in or below apex. Median cells are shorter and irregular, 8–14 µm wide; in basal parts cells are rectangular, narrowly rectangular (Figure 2). The specimens are sterile.

World distribution: *Dicranella schreberiana* is known from many countries in Europe, including England and Iceland; the Far East; and North America (Noguchi & Iwatsuki, 1987; Smith, 2004; Frey et al., 2006); it is recorded for the first time in Turkey with this study.

4.1.2. *Campylopus pyriformis* (Schultz) Brid.

Specimens examined: A4 grid-square, Artvin Province, Murgul District, Kabaca valley in the vicinity of Eğrisu 41°09'14"N, 41°32'28"E, 1780 m a.s.l., on rotten tree stump, 08.09.2009, *Batan* 1181, Borçka District, Camili Biosphere Reserve area, 41°28'44"N, 41°53'48"E, 445 m a.s.l., on rotten tree stump, (leg. and det. Batan & Özdemir) 11.09.2009, *Batan* 1182.

Plants are pale green, tuft, 0.6–2.3 cm high and with reddish brown rhizoids (Figure 3). Leaves are long subulate (2–7 mm) and without hyaline apices. Leaves are broadest at base and gradually narrowed towards apex. Leaf apex is canalicate and serrate. When wet, leaves are straight and when dry they are flexuose. Generally costa reaches apex (Figure 3). Seta is yellow green, 6–8 mm long, twisted 1 or 2 times near the capsule (Figure 3). Transverse section of leaf ventrally contains both hyalocysts and steroids (Figure 3). Costa reddish brown and covers nearly half of leaf width (Figure 3). Basal laminal cells are thin walled and colourless, alar cells hyaline or pale reddish (Figure 3). Capsules are very dense.

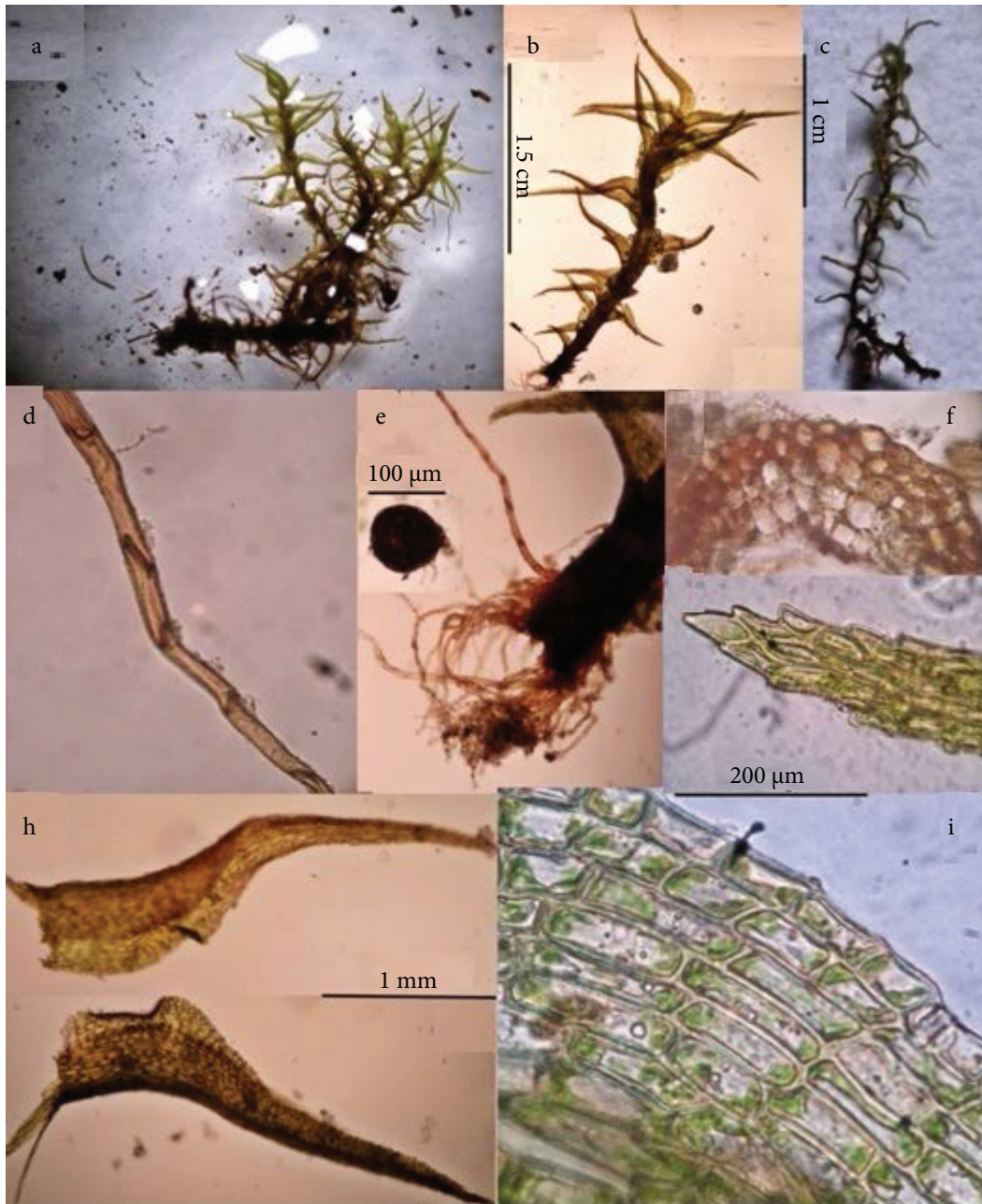


Figure 2. *Dicranella schreberiana*: a- habit, b- shoot (moist), c- shoot (dry), d and e- rhizoids and rhizoidal gemmae, f- transverse section of the stem, g- leaf apex, h- leaves, i- laminal cells near base.

World distribution: This species is known from South America (Argentina, Brazil, Chile), Western Europe, Asia (China), Central and Southern Africa, Atlantic Islands (Azores, Southern Iceland, Madeira), Pacific Islands (New Caledonia, New Zealand), and Australia (Smith, 2004; Frey et al., 2006); here it is recorded for the first time from Turkey.

4.1.3. *Dicranodontium asperulum* (Mitt.) Broth.

Specimens examined: Turkey, Artvin Province, Arhavi District, Kamilet valley, Mençuna waterfall, 41°16'20"N,

41°24'25"E, on soil, 487 m a.s.l., 20.04.2011. Arhavi District, the lower part of Kamilet valley, 41°16'23"N, 41°23'35"E, on the bark of tree trunk and branch, 386 m a.s.l., (leg. and det. Batan & Özdemir) 20.04.2011, *Batan* 1037.

The specimen was collected from its habitat associated with *Dicranodontium uncinatum* (Harv.) A.Jaeger and *Leucobryum juniperoideum* (Brid.) Müll. Hal. The plants are 5–8 cm in length and are yellow green.

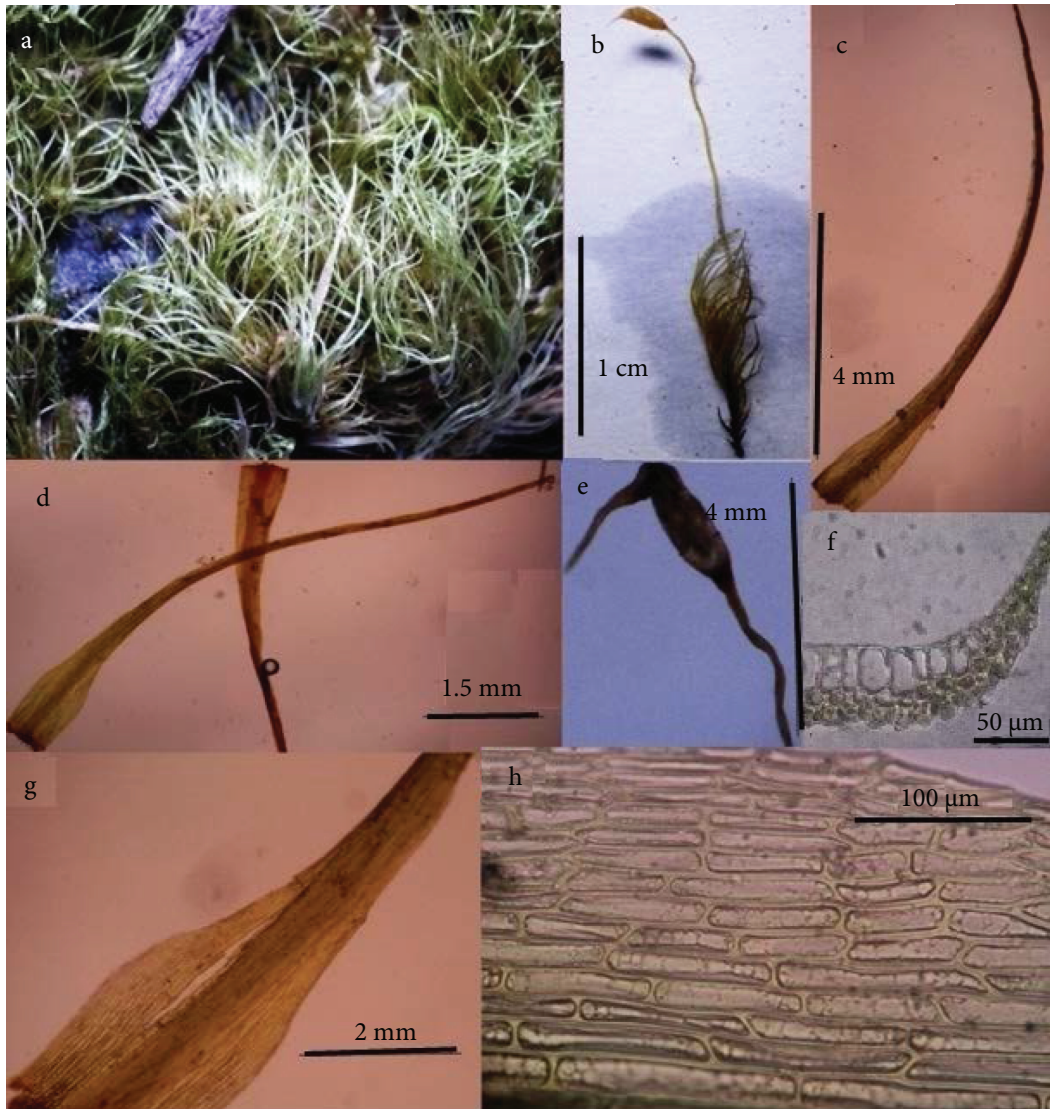


Figure 3. *Dicranodontium asperulum*: a- habit, b- leaf, c- mid-leaf cells, d- leaf margin near the middle of leaf, e- leaf apex, f- leaf base, g- dry shoot.

Stem is flexuose; slender and sparsely branched (Figure 4). Leaves are suddenly narrowed from an ovate base and channelled distally (Figure 4). Mid-leaf cells near the shoulder of sheathing base are linear or rectangular (Figure 4). Leaves sharply toothed from apex to the shoulder of sheathing base (Figure 4). Leaves are usually strongly serrate at the apex but at the leaf base margins are entire and dentate, bases entire (Figure 4). Basal cells are rectangular. Costa is rather wide at base; approximately width reaches 1/3 of base width and shortly excurrent. Basal cells are rectangular and alar cells are sometimes forming indistinct auricles and hyaline. There are many reddish brown rhizoids (Figure 4). Leaves are deciduous, 5–8 mm long, wavy and falcate when dry, and tending to

point in 1 direction when moist, especially they are curved in 1 direction (Figure 4). Sporophytes of this species were not seen in this area.

World distribution: This species is known from many countries in Europe, including England; the Far East; and the United States (Smith, 2004; Frey et al., 2006; Noguchi & Iwatsuki, 1987); here it is recorded for the first time in Turkey.

5. Discussion

At the end of the study, 167 taxa (species, subspecies, and varieties) belonging to 33 families and 80 genera were identified. The moss species were collected in the Ardanuç, Şavşat, and Arhavi districts of Artvin Province,



Figure 4. *Dicranodontium asperulum*: a- habit, b- leaf, c- mid-leaf cells, d- leaf margin near the middle of leaf, e- leaf apex, f- leaf base, g- dry shoot.

which is situated in the Caucasian part of Turkey. Among the specimens, *Dicranella schreberiana*, *Dicranodontium asperulum*, and *Campylopus pyriformis* are new records for the moss flora of Turkey. According to the grid system (Henderson, 1961), 127 taxa are new records for the A5 grid-square. Moreover, a second locality for *Anomodon longifolius* in Turkey was given in this study. *Anomodon longifolius* was recorded for the first time in Bartın Province, Ulus town, Alpi Kayası District in the Küre Mountains National Park by Ören et al. (2010).

The dominant families of the study area are given in Table 2. *Pottiaceae* and *Brachytheciaceae* are the richest families in terms of number of species. *Grimmiaceae*,

Amblystegiaceae, and *Bryaceae* are the other major components of the flora.

The most species-rich genera are presented in Table 3. *Atrichum undulatum*, *Grimmia laevigata*, *G. ovalis*, *G. pulvinata*, *Dicranum scoparium*, *Tortella tortuosa*, *Crossidium squamiferum*, *Tortula muralis*, *T. subulata*, *Hedwigia stellata*, *Plagiomnium rostratum*, *P. undulatum*, *Campyliadelphus chrysophyllus*, *Sanionia uncinata*, *Abietinella abietina*, *Sciuroidium populeum*, *Brachythecium glareosum*, *B. rivulare*, *Homalothecium lutescens*, *Calliergonella cuspidata*, *Hypnum cupressiforme* var. *lacunosum*, *H. cupressiforme* var. *resupinatum*, *Hylocomium splendens*, *Rhytidiadelphus triquetrus*,

Table 2. The distribution of moss taxa according to families.

No.	Families	Taxa number	Percentage (%)
1	<i>Pottiaceae</i>	22	13.17
2	<i>Brachytheciaceae</i>	22	13.17
3	<i>Grimmiaceae</i>	15	8.98
4	<i>Amblystegiaceae</i>	13	7.78
5	<i>Bryaceae</i>	10	5.99
6	<i>Hypnaceae</i>	8	4.79
7	<i>Mniaceae</i>	7	4.19
8	<i>Dicranaceae</i>	6	3.59
9	<i>Plagiomniaceae</i>	6	3.59
10	<i>Orthotrichaceae</i>	5	2.99
11	<i>Bartramiaceae</i>	5	2.99
12	<i>Ditrichaceae</i>	5	2.99
13	<i>Thuidiaceae</i>	5	2.99
14	<i>Polytrichaceae</i>	4	2.40
15	<i>Leskeaceae</i>	4	2.40
16	<i>Hylocomiaceae</i>	4	2.40
17	<i>Anomodontaceae</i>	3	1.80
18	<i>Hedwigiaceae</i>	3	1.80
19	<i>Leucobryaceae</i>	3	1.80
20	<i>Mielichhoferiaceae</i>	2	1.20
21	<i>Timmiaceae</i>	2	1.20
22	<i>Lembophyllaceae</i>	2	1.20
23	<i>Plagiotheciaceae</i>	1	0.60
24	<i>Fissidentaceae</i>	1	0.60
25	<i>Encalyptaceae</i>	1	0.60
26	<i>Neckeraceae</i>	1	0.60
27	<i>Rhabdoweissiaceae</i>	1	0.60
28	<i>Cinclidiaceae</i>	1	0.60
29	<i>Leucodontaceae</i>	1	0.60
30	<i>Seligeriaceae</i>	1	0.60
31	<i>Climaciaceae</i>	1	0.60
32	<i>Calliergonaceae</i>	1	0.60
33	<i>Rhytidiaceae</i>	1	0.60
	TOTAL	167	100.00

Table 3. The distribution of moss taxa according to genera.

No.	Genera	Taxa number	Percentage (%)
1	<i>Grimmia</i>	12	7.19
2	<i>Bryum</i>	10	5.99
3	<i>Mnium</i>	7	4.19
4	<i>Plagiomnium</i>	6	3.90
5	<i>Brachythecium</i>	6	3.59
6	<i>Orthotrichum</i>	5	2.99
7	<i>Tortula</i>	5	2.99
8	<i>Thuidium</i>	4	2.40
9	<i>Hypnum</i>	4	2.40
10	<i>Dicranum</i>	4	2.40
11	<i>Didymodon</i>	4	2.40
12	<i>Philonotis</i>	4	2.40
13	<i>Tortella</i>	3	1.80
14	<i>Syntrichia</i>	3	1.80
15	<i>Hedwigia</i>	3	1.80
16	<i>Homalothecium</i>	3	1.80
17	<i>Anomodon</i>	3	1.80
18	Other genera	81	48.50
	TOTAL	167	100.00

Rhytidium rugosum, and *Isothecium alopecuroides* are the most common species found in 4 or more stations in the study areas.

This paper shows that north-east Anatolia is relatively rich in moss flora compared to other regions of Turkey. This is due to the wet and mild climate, large number of microhabitats, and different ecological conditions present in the region.

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