

Contributions to the bryophyte flora of Turkey

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Abstract: In this study, the 227 bryophyte specimens, collected from different localities in various provinces of Turkey, were identified and a total of 98 taxa (10 liverworts and 88 mosses) belonging to 34 families and 54 genera were determined. Among them, according to the Turkey bryophytes grid-square system of Henderson, 17 taxa are new for B9, 6 taxa are new for C14 and, 2 taxa are new for A5 grid-square.

Keywords: Flora, Liverwort, Moss, Turkey.

Introduction

Bryophytes which have wide geographical distribution on the Earth from the poles to the equator (Shaw, 2001), have been ignored by many botanists because of their primitive structures and small sizes. Turkey is one of the most important countries in terms of bryo-diversity. Until now 966 bryophyte taxa have been recorded from Turkey, including 780 mosses, 182 liverworts and 4 hornworts (Özdemir and Batan, 2014; Batan et al., 2014; Kırmacı and Erdağ, 2014; Ören et al., 2015; Alataş and Batan, 2016; Ezer, 2016; Karakaş and Ezer, 2016; Kırmacı and Ağcagil, 2016; Özdemir and Batan, 2016; Batan et al., 2016; Özenoğlu Kiremit et al., 2016; Kırmacı and Erdağ, 2016; Kırmacı and Kürschner, 2017). Although the

studies on bryophytes have increased rapidly in recent years, there is not yet a bryophyte flora belonging to Turkey. In this study, new square records for the Turkish bryophyte flora were presented.

Materials and Methods

The bryophyte specimens were collected from Sakarya, Erzincan, Ankara, Kars, Mardin, Erzurum, Sivas, Kahramanmaraş and Adana provinces between the years 2010 and 2014. Locality details are given in Table 1 and the locations of the localities according to the Henderson (1961) grid-square system are shown in Figure 1.

The collected bryophyte specimens were identified using various flora and revisional studies (Zander, 1993;

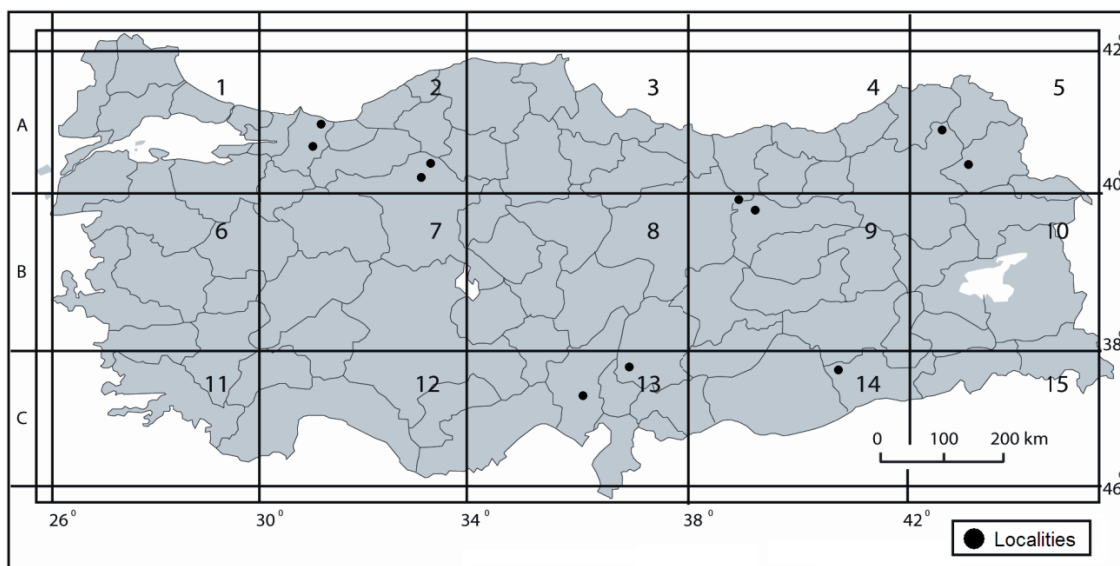
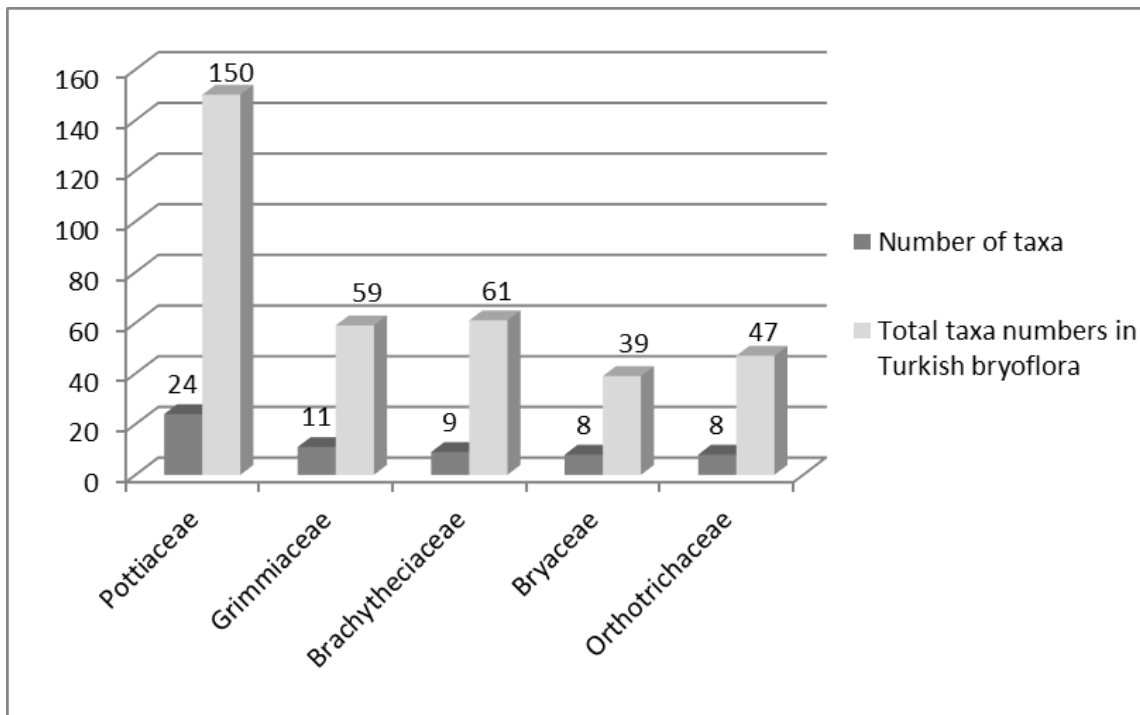


Figure 1. Grid system of Turkey (Henderson 1961) and distribution of the localities.

Table 1. Locality details (L.N.: locality number).

L.N.	Square	Altitude (m)	GPS Coordinates	Locality	Date
1	A2	226	40°38'480"N/30°38'047"E	Sakarya-Akyazı	08.11.2011
2	A2	10-65	41°00'510"N/30°39'560"E	Sakarya-Karasu	16.09.2011
3	B9	1778	39°50'570"N/38°46'248"E	Erzincan-Refahiye	07.11.2011
4	A2	1894	40°39'336"N/32°45'490"E	Ankara-Kızılcahamam-Işık Mountain	24.05.2012
5	A2	1346	40°26'450"N/32°37'140"E	Ankara-Kızılcahamam Waterfall	31.07.2011
6	A5	2000	40°33'300"N/42°40'070"E	Kars-Selim-Akçakale Village	31.07.2011
7	C14	680	37°24'129"N/40°08'507"E	Mardin-Derik	03.08.2010
8	A5	1410	40°49'190"N/42°08'200"E	Erzurum-Olur	21.09.2012
9	B9	1510	40°03'280"N/38°39'240"E	Sivas-Gölova	03.06.2011
10	C13	897-2085	37°37'419"N/36°25'043"E	Kahramanmaraş-Andırın	18.04.2013
11	C13	78	37°15'266"N/35°39'357"E	Adana-İmamoğlu	14.11.2013
					09.02.2014
					22.02.2014

**Figure 2.** Number of taxa belonging to the first five families and the comparison of total taxa numbers in Turkish bryoflora (Ros et al., 2013).

Greven, 1995; Muñoz, 1999; Paton, 1999; Cortini Pedrotti, 2001; 2006; Greven, 2003; Heyn and Herrnstadt, 2004; Smith, 2004; Guerra et al., 2006; 2007). Voucher specimens are deposited in the Herbarium of Niğde Ömer Halisdemir University. The latest distributional and taxonomic status of the bryophyte taxa in Turkey were determined according to the recent literatures (Uyar and Çetin, 2004; Kürschner and Erdağ, 2005; Özenoğlu Kiremit and Keçeli, 2009; Kürschner and Frey, 2011; Ros et al., 2013). Arrangement Nomenclature of the floristic list follows Ros et al. (2013) for mosses and Söderström et al. (2016) for liverworts. For each taxon, only one

collector number was given to avoid repetition in the floristic list.

Results and Discussion

As a result of identifying collected bryophyte specimens, in a total 98 taxa (88 mosses and 10 liverworts), belonging to 34 families and 54 genera were determined (Table 2). While, Pottiaceae is the most species-rich family with 24 taxa, Grimmiaceae (11 taxa) and Brachytheciaceae (9 taxa) are other common families of mosses (Fig. 2). Pottiaceae which contains many species tolerant of long droughts is the richest and the most spread moss family

Table 1. Floristic list. (L.N.: locality number, r: rock, s: soil, t: tree, sr: the soil covering the rock, C.N.: collector number).

Families	Taxa	L.N.	Substrat				C.N.	New square records		
			r	s	t	sr		A5	B9	C14
Hepaticopsida										
Calypogeiaceae	<i>Calypogeia fissa</i> (L.) Raddi	1		+			T.E.1732f			
Cephaloziaceae	<i>Cephalozia bicuspidata</i> (L.) Dumort.	1		+			T.E.1732g			
Cephaloziellaceae	<i>Cephaloziella baumgartneri</i> Schiffn.	11		+			T.E.1807e			
Anastrophyllaceae	<i>Barbilophozia hatcheri</i> (A.Evans) Loeske	1,4,5				+	T.E.1756b			
Fossombroniaceae	<i>Fossombronia pusilla</i> (L.) Nees	10,11		+			T.E.1792b			
Arnelliaceae	<i>Gongylanthus ericetorum</i> (Raddi) Nees	11		+			T.E.1807c			
Lunulariaceae	<i>Lunularia cruciata</i> (L.) Dumort. ex Lindb.	10		+			T.E.1783a			
Pelliaceae	<i>Pellia epiphylla</i> (L.) Corda	7				+	T.E.1760a			+
Aytoniaceae	<i>Reboulia hemisphaerica</i> (L.) Raddi	10		+			T.E.1774c			
Targioniaceae	<i>Targionia hypophylla</i> L.			+			T.E.1793c			
Bryopsida										
Thuidiaceae	<i>Abietinella abietina</i> Hedw. M.Fleisch.	4	+				T.E.1758b			
Pottiaceae	<i>Aloina aloides</i> (Schultz) Kindb.	11		+			T.E.1808b			
Amblystegiaceae	<i>Amblystegium serpens</i> (Hedw.) Schimp.	5,7	+				T.E.1760b			+
	<i>Atrichum angustatum</i> (Brid.) Bruch & Schimp.	1		+			T.E.1732e			
Polytrichaceae	<i>A. undulatum</i> (Hedw.) P.Beauv.	2		+			T.E.1731			
Pottiaceae	<i>Barbula unguiculata</i> Hedw.	2,10,11		+			T.E.1740d			
Brachytheciaceae	<i>Brachythecium albicans</i> (Hedw.) Schimp.	10		+			T.E.1783d			
	<i>Bryum argenteum</i> Hedw.	2,5,7,9,11				+	T.E.1759a			
Bryaceae	<i>B. dichotomum</i> Hedw.	2,3,11		+			T.E.1740c			+
	<i>B. gemmiparum</i> De Not.	10				+	T.E.1789			
Ditrichaceae	<i>Ceratodon purpureus</i> (Hedw.) Brid.	10		+			T.E.1778			
Amblystegiaceae	<i>Cratoneuron filicinum</i> Hedw. Spruce	2,3		+			T.E.1746b			
Cryphaeaceae	<i>Cryphaea heteromalla</i> (Hedw.) D.Mohr	3				+	T.E.1757			+
Dicranaceae	<i>Dicranella heteromalla</i> (Hedw.) Shimp.	1		+			T.E.1732a			
	<i>D. varia</i> (Hedw.) Schimp.	3		+			T.E.1740a			+
Rhabdoweisiaceae	<i>Dicranoweisia cirrata</i> (Hedw.) Lindb.	3				+	T.E.1738			+
Dicranaceae	<i>Dicranum scoparium</i> Hedw.	5				+	T.E.1756a			
	<i>Didymodon cordatus</i> Jur.	11		+			T.E.1806b			
	<i>D. fallax</i> (Hedw.) R.H.Zander	10,11		+			T.E.1782a			
	<i>D. insulanus</i> (De Not.) M.O.Hill	3,10				+	T.E.1700b			
Pottiaceae	<i>D. rigidulus</i> Hedw.	2,6,7,10				+	T.E.1759a			+
	<i>D. vinealis</i> (Brid.) R.H.Zander	1,10		+			T.E.1745			
Encalyptaceae	<i>Encalypta vulgaris</i> Hedw.	10		+			T.E.1782c			
Brachytheciaceae	<i>Eurhynchium striatum</i> (Hedw.) Shimp.	2		+			T.E.1727b			
Fabroniaceae	<i>Fabronia pusilla</i> Raddi	10				+	T.E.1769a			
Fissidentaceae	<i>Fissidens viridulus</i> (Sw. ex anon.) Wahlenb.	10,11		+			T.E.1792a			
Funariaceae	<i>Funaria hygrometrica</i> Hedw.	5,9,10,11				+	T.E.1756a			
	<i>Grimmia decipens</i> (Schultz) Lindb.	9	+				T.E.1704			+
	<i>G. laevigata</i> Brid.	6,8,10	+				T.E.1765			
	<i>G. montana</i> Bruch & Schimp.	8	+				T.E.1752			
	<i>G. ovalis</i> (Hedw.) Lindb.	4,8,10	+				T.E.1756			
	<i>G. pulvinata</i> (Hedw.) Sm.	7,9,10,11	+				T.E.1761			
Pottiaceae	<i>Gymnostomum viridulum</i> Brid.	11		+			T.E.1807a			
	<i>Habrodon perpusillus</i> (De Not.) Lindb.	10				+	T.E.1769b			
Pterigynandraceae	<i>Heterocladium heteropterum</i> (Brid.) Schimp.	2		+			T.E.1742			
	<i>Homalothecium aureum</i> (Supruce) H.Rob.	4	+				T.E.1758a			
Brachytheciaceae	<i>H. sericeum</i> (Hedw.) Schimp.	2,10				+	T.E.1733a			
Amblystegiaceae	<i>Hygroamblystegium varium</i> (Hedw.) Mönk.	3,9	+				T.E.1717			
	<i>Hypnum cupressiforme</i> Hedw. var. <i>cupressiforme</i>	1,2,4,9				+	T.E.1733b			+
	<i>H. cupressiforme</i> Hedw. var. <i>lacunosum</i> Brid.	9	+				T.E.1719			+
Hypnaceae	<i>H. vaucheri</i> Lesq.	4	+				T.E.1756b			
Lembophyllaceae	<i>Isoetecium alopecuroides</i> (Lam. ex Dubois) Isov.	2		+			T.E.1746a			

Table 1. Continued.

Families	Taxa	L.N.	Substrat				C.N.	New square records		
			r	s	t	sr		A5	B9	C14
Brachytheciaceae	<i>Kindbergia praelonga</i> (Hedw.) Ochyra	2			+		T.E.1722a			
Leucobryaceae	<i>Leucobryum juniperoideum</i> (Brid.) Müll.Hal.	1		+			T.E.1732b			
Leucodontaceae	<i>Leucodon sciuroides</i> (Hedw.) Schwägr.	10	+				T.E.1788a			
Pottiaceae	<i>Microbryum starckeianum</i> (Hedw.) R.H. Zander	11		+			T.E.1805b			
Orthotrichaceae	<i>Orthotrichum affine</i> Schrad. ex Brid.	2			+		T.E.1741			
	<i>O. diaphanum</i> Brid.	11			+		T.E.1797			
	<i>O. lyellii</i> Hook. & Taylor	2			+		T.E.1737			
	<i>O. patens</i> Bruch ex Brid.	9	+				T.E.1715a		+	
	<i>O. rupestre</i> Schleich. ex Schwägr.	10		+			T.E.1771b			
	<i>O. speciosum</i> Nees	5,9			+		T.E.1757		+	
	<i>O. sprucei</i> Mont.	9	+				T.E.1702a		+	
Brachytheciaceae	<i>Oxyrrhynchium hians</i> (Hedw.) Loeske	1		+			T.E.1725			
	<i>O. schleicheri</i> (R.Hedw.) Röhl.	1		+			T.E.1743b			
	<i>Palamocladium euchloron</i> (Müll.Hal.) Wijk & Margad.	1			+		T.E.1743a			
Bartramiaceae	<i>Philonotis rigida</i> Brid.	10		+			T.E.1768			
Mniaceae	<i>Pohlia drummondii</i> (Müll.Hal.) A.L.Andrews	7				+	T.E.1760c			+
Leskeaceae	<i>Pseudoleskeella tectorum</i> (Funck ex Brid.) Kindb. ex Broth.	8	+				T.E.1755	+		
Pterigynandraceae	<i>Pterigynandrum filiforme</i> Hedw.	4	+				T.E.1756a			
Bryaceae	<i>Ptychostomum archangelicum</i> (Bruch & Schimp.) J.R. Spence	10				+	T.E.1770			
	<i>P. capillare</i> (Hedw.) Holyoak & N.Pedersen	2,3,10,11				+	T.E.1735a			
	<i>P. compactum</i> Hornsch.	6				+	T.E.1762a	+		
	<i>P. imbricatulum</i> (Müll.Hal.) Holyoak & N.Pedersen	3				+	T.E.1711			
	<i>P. pseudotriquetrum</i> (Hedw.) J.R.Spence & H.P.Ramsay	2		+			T.E.1724			
Brachytheciaceae	<i>Rhynchostegiella litorea</i> (De Not.) Limpr.	5,11				+	T.E.1756b			
Grimmiaceae	<i>Schistidium apocarpum</i> (Hedw.) Bruch & Schimp.	6	+				T.E.1763			
	<i>S. atrofusum</i> (Schimp.) Limpr.	9	+				T.E.1716c		+	
	<i>S. confertum</i> (Funk.) Bruch & Schimp.	4	+				T.E.1756b			
	<i>S. crassipilum</i> H.H.Blom	1	+				T.E.1721a			
	<i>S. elegantulum</i> H.H.Blom	1	+				T.E.1721b			
	<i>S. flaccidium</i> (De Not.) Ochyra	9	+				T.E.1716a		+	
Pottiaceae	<i>Syntrichia caninervis</i> Mitt. var. <i>caninervis</i>	9				+	T.E.1716b			
	<i>S. caninervis</i> Mitt. var. <i>gypsophila</i> (J.J.Amann ex G.Roth) Ochyra	9				+	T.E.1710		+	
	<i>S. echinata</i> (Schiffn.) Herrnst. & Ben-Sasson	9	+				T.E.1707		+	
	<i>S. princeps</i> (De Not.) Mitt.	2,6,10	+				T.E.1764			
	<i>S. ruralis</i> (Hedw.) F.Weber & D. Mohr. var. <i>ruralis</i>	9,10		+			T.E.1703			
	<i>S. ruralis</i> (Hedw.) F.Weber & D. Mohr. var. <i>ruraliformis</i> (Besch.) Delogne	4	+				T.E.1758c			
	<i>S. virescens</i> (De Not.) Ochyra	8,10				+	T.E.1753b			
	<i>Tortula atrovirens</i> (Sm.) Lindb.	7				+	T.E.1759d			+
	<i>T. brevissima</i> Schiffn.	7,9,10				+	T.E.1759c		+	+
	<i>T. canescens</i> Mont.	9				+	T.E.1702b		+	
	<i>T. inermis</i> (Brid.) Mont.	10				+	T.E.1772c			
	<i>T. muralis</i> Hedw.	2,11	+				T.E.1739			
	<i>T. subulata</i> Hedw.	3,10				+	T.E.1718a			
	<i>Weissia controversa</i> Hedw.	11				+	T.E.1809			
<i>W. condensa</i> (Voit) Lindb.	11		+			T.E.1810a				

within the Turkish bryoflora (Kırmacı and Erdağ, 2014; Ros et al., 2013). Therefore, not surprising that Pottiaceae is the most dominant family in the present study. Mesophytic Bryaceae and xerophytic Orthotrichaceae are relatively rich families with 8 taxa (Fig. 2). While, the acrocarpous moss genus *Orthotrichum* is the most species-rich with 8 members, *Syntrichia* is represented by 7 taxa and *Schistidium* is represented by 6 species in this study.

Although, contributions of the Turkish bryoflora has increased over last decades in the several regions of Turkey, especially southeast and eastern parts of Turkey are still unexplored, significant contributions to the bryoflora from this region are possible in future studies. In the present study, Sakarya and Ankara localities are located in the grid-square A2, Kars and Erzurum are located in the grid-square A5, Erzincan and Sivas are located in the grid-square B9, Kahramanmaraş and Adana are located in the grid-square C13, and Mardin is located in the grid-square C14, according to the system adopted by Henderson (1961) (Fig. 1).

As a result of the study, while, 17 taxa are new for B9 square, 6 taxa are new to C14, and 2 taxa are new for A5 square (Table 2). Especially, in the Erzurum, Sivas, Kahramanmaraş, and Mardin localities almost no bryological investigation has been done. Therefore, the results of the present study will contribute to the “Bryophyte Flora of Turkey” book to be written.

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