Contributions to the bryoflora of the Kaçkar Mts (NE Anatolia, Turkey)

Gökhan Abay[1], Güray Uyar[2], Tamer Keçeli[3] & Barbaros Çetin[4]

[1] Department of Forest Engineering, Faculty of Forestry, Çankırı Karatekin University, 18200 Çankırı, Turkey, e-mail: gokhanabay@gmail.com; gokhanabay@karatekin.edu.tr (author for correspondence)

[2] Department of Biology, Faculty of Arts and Sciences, Zonguldak Karaelmas University, 67100 Zonguldak, Turkey, e-mail: gurayuyar@karaelmas.edu.tr

[3] Department of Biology, Faculty of Arts and Sciences, Çankırı Karatekin University, 18200 Çankırı, Turkey, e-mail: tkeceli@gmail.com

[4] Department of Biology, Faculty of Science, Ankara University, 06100 Ankara, Turkey, e-mail: bcetin@science.ankara.edu.tr

Received: September 10, 2009 ▷ Accepted: October 10, 2009

Abstract. Field studies have been carried out to determine the bryoflora of the Kaçkar Mts in the Eastern Black Sea Region of Turkey. Nearly 1500 bryophyte specimens were collected from diverse localities in this mountain range. After identification of these specimens, 255 taxa (203 mosses and 52 liverworts) with specific and subspecific rank, belonging to 125 genera and 58 families, are presented here. Among them, eight mosses were new records for A4 grid square, which was adopted by Henderson. Furthermore, the list of taxa was compared with the Red Data Lists of European Bryophytes. Apparently, three taxa – *Jubula hutchinsiae* subsp. *javanica*, *Scapania verrucosa* and *Schistidium trichodon* – are threatened in Europe.

Key words: *Bryophyta*, Eastern Black Sea Region, Kaçkar Mts, Turkey

Introduction

The available bryofloristic studies covering a number of localities in the Eastern Black Sea Region of Turkey carried out by local and foreign botanists focus only on a small localized area. The present study, however, is the first detailed account of the bryoflora in the eastern part of the region.

As Abay & al. (2009a) has pointed out, the Kaçkar Mountain Range is the third most important glacial region in Turkey, after the Ağrı (Ararat) and Cilo-Sat Mts (Fındık 2001) (Fig. 1). A collecting trip was made to the vast granitoid unit of this mountain chain, with a focus on the best preserved natural biotopes. The wooded slopes showed a high diversity of many natural types of Oriental Spruce, Beech, Common Alder, Hornbeam, Chestnut, Boxwood and *Rhododendron* species. The northern slopes of the Kaçkar Mountains are subject to oceanic climate and are the rainiest parts of Turkey. On the contrary, the climate on the eastern and southern slopes, including Yusufeli and its surroundings, is Submediterranean (Fındık & Melikoğlu 2001).

The exclusiveness of the area is due to its climate and geographical diversity, and is reflected in the presence of rare or biogeographically interesting bryophytes (Abay & al. 2009a).

The recent additions to the Turkish bryophyte flora from the eastern part of North Anatolia in the last decade include *Entodon schleicheri* (Schimp.) Demet., *Plagiothecium cavifolium* (Brid.) Iwatsuki (Townsend 1997), *Harpanthus scutatus* (Web. & Mohr) Spruce, *Nardia scalaris* S.F. Gray, *Scapania subalpina* (Nees ex

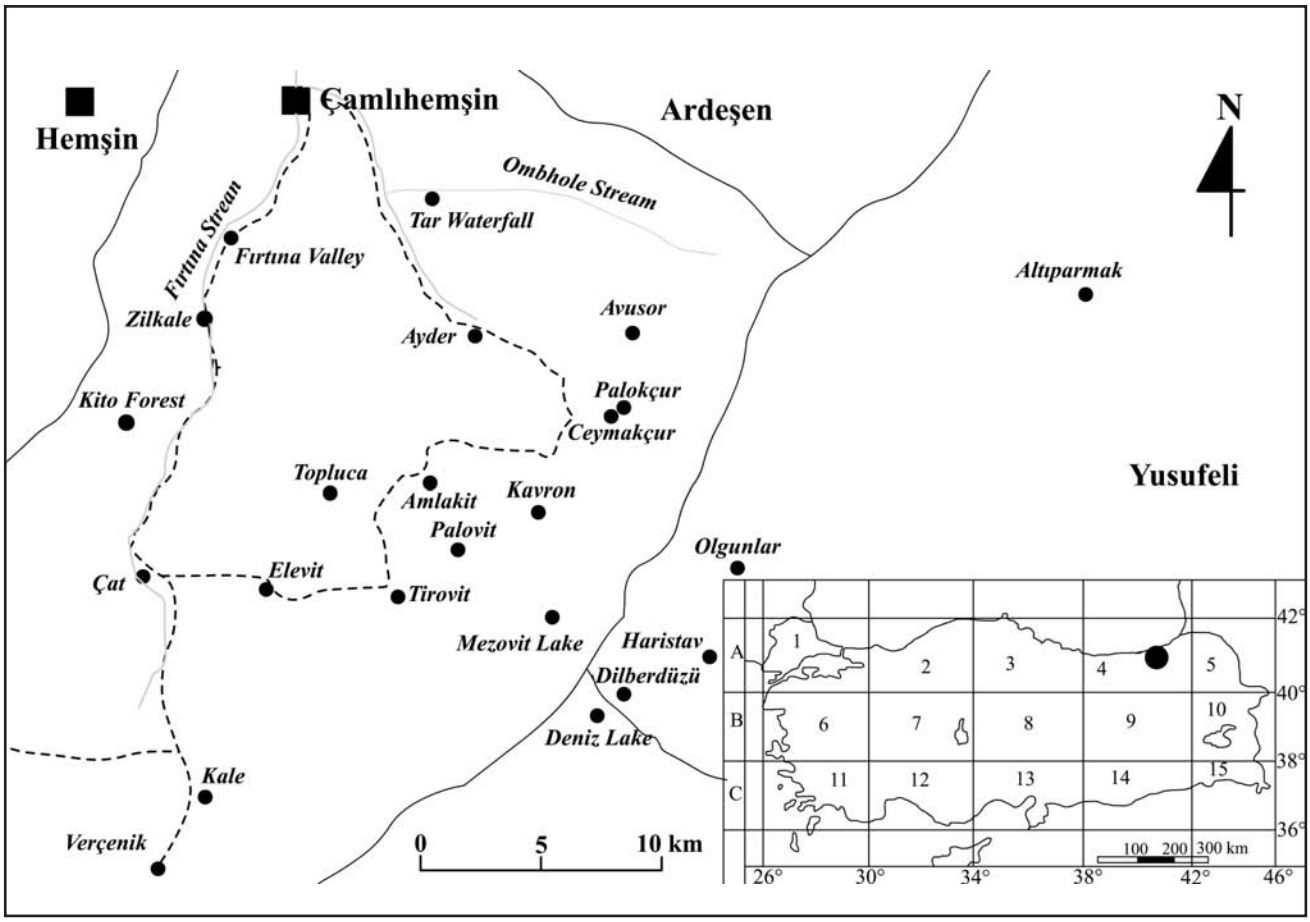

Fig. 1. Map of the area studied.

Lindenb.) Dumort., *Blindia caespiticia* (Web. & Mohr) Müll.Hal., *Taxiphyllum densifolium* (Lindb. ex Broth.) Reim. (Papp 2004), *Eremonotus myriocarpus* (Carrington) Pearson (Kürschner & Parolly 2006a), *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs (Kürschner & Parolly 2006b), *Bucklandiella microcarpa* (Hedw.) Bednarek-Ochyra & Ochyra (Abay & al. 2007), *Telaranea europaea* J.J. Engel & G.L. Merr. (Keçeli & Abay 2007a), *Pallavicinia lyellii* (Hook.) Carruth. (Keçeli & Abay 2007b), *Rhytidiadelphus loreus* (Hedw.) Warnst. (Özdemir 2008), *Didymodon asperifolius* (Mitt.) H.A. Crum, Steere & L.E. Anderson (Özdemir & al. 2008), *Campylopus flexuosus* (Hedw.) Brid. (Özdemir & Uyar 2008), *Scapania paludosa* (Müll. Frib.) Müll. Frib. (Keçeli & al. 2008), *Dicranum flexicaule* Brid. (Uyar & al. 2008), and *Sphagnum centrale* C.E.O. Jensen (Abay & al. 2009a). They reveal that our knowledge about the bryophyte flora of Turkey is still imperfect.

The aim of our study was to determine the bryophyte flora of the Kaçkar Mts and to provide more data about the bryodiversity of Turkey. We hope that this research will contribute to the bryophyte flora of Turkey and will be useful as a guide for future studies.

Materials and methods

The bryophyte specimens were collected by the authors between the years 2004–2006. Several different habitats were investigated for bryophytes (*e.g.* shaded rock crevices and exposed rocks, tree barks, decayed logs and stream banks, etc.).

The following references were used for identification and nomenclature of the bryophyte specimens: Schuster (1966, 1969, 1974), Lawton (1971), Arnell (1981), Nyholm (1981), Watson (1981), Frey & al. (1995, 2006), Greven (1995, 2003), Smith (1980, 1996, 2004), Paton (1999), Cortini Pedrotti (2001a, b, 2006), Kürschner (2001, 2006, 2007, 2008), Heyn & Hernstadt (2004), Ros & al. (2008). The new taxa for A4 grid square are indicated with an asterisk (*) (Abay & al. 2006, 2009b; Özdemir 2009; Özenoğlu Kiremit &

Keçeli 2009). The status of the taxa for Turkey was determined by reviewing the related literature (Uyar & Çetin 2004; Kürschner & Erdağ 2005).

The locations of the collection sites are listed with their coordinates and altitudes. The localities belong to A4 grid square, according to Henderson's (1961) system. Of these, the ones between 39th–42th and 49th–58th localities fall within the boundaries of Artvin city. The others belong to the Rize province.

The materials collected from the study area are kept in the bryophyte collections of Abay (Çankırı), Uyar (Zonguldak) and Keçeli (Çankırı). Nomenclature of the species follows Grolle & Long (2000) for liverworts and Hill & al. (2006) for mosses.

Abbreviations used:

For specimens: the first digit shows the locality number; abbreviation in bold shows the habitat; collectors and determinatives: *GA* (Gökhan Abay), *GU* (Güray Uyar) and *TK* (Tamer Keçeli), and the last digit shows the collection number.

For habitats in the study area: s – on soil; **ws –** on wet soil; **r –** on rock; **wr –** on wet rock; **t –** on the bark of tree trunk and branch; **dtt –** on dead tree trunk; **rsw –** on rock submerged in water.

List of collection sites

1. Ayder high plateau, 1245 m, 40°57'18.0"N, 41°05'56.0"E.
2. Ayder high plateau, Ayder stream, 1231 m, 40°57'20.4"N, 41°05'57.4"E.
3. Zilkale (Zir kale), 743 m, 40°57'33.8"N, 40°57'46.4"E.
4. Palovit stream, 813 m, 40°56'23.8"N, 40°58'57.3"E.
5. Palovit stream, the rocky part on the right slope of the upper reaches of the stream after the concrete bridge, 835 m, 40°56'29.7"N, 40°59'05.3"E.
6. The upper parts of Palovit waterfall, 925 m, 40°56'38.5"N, 41°59'17.1"E.
7. The upper parts of Elevit plateau, 1886 m, 40°51'14.7"N, 41°00'51.4"E.
8. The end of the Elevit plateau road, Çat road 2nd km, the steep slopes on the right, 1780 m, 40°51'39.9"N. 40°59'56.0"E.
9. The end of the Çat road, Elevit plateau 2nd km, right side of the stream, 1485 m, 40°51'47.8"N, 40°53'09.4"E.
10. End of the Çat road, Castle-Hemşin direction, the steep rocky slopes on the right 50 m after the bridge, 1310 m, 40°51'43.4"N, 40°56'40.1"E.
11. Yukarı Kavron plateau, 300 m up the stream, 2265 m, 40°53'00.1"N, 41°07'52.6' E.
12. Around Mezovit (Öküz yatağı, Gelgelen) lake, 2830 m, 40°51'0.89"N, 41°08'67.7"E.
13. Ayder plateau, the hills on the left of the main road covered with trees, 1350 m, 40°57'25.5"N, 41°06'10.9"E.
14. Ayder plateau, upper parts of the hills on the left of the main road, 1450 m, 40°57'38.2"N, 41°06'23.3"E.
15. Ayder plateau, lower part of the hotsprings, Fırtına stream, wooden bridge, 1180 m, 40° 57' 16.3" N 41° 05' 83.9" E.
16. Ayder plateau, lower part of hotsprings, upper parts of Fırtına stream, 1190 m, 40°57'11.4"N, 41°05'88.4"E.
17. Between Çamlıhemşin and Topluca village, 309 m, 41°02'55.7"N, 41°00'18.1"E.
18. Between Çamlıhemşin and Topluca village, 318 m, 41°02'58.7"N, 41°00'20.1"E.
19. Between Çamlıhemşin and Ayder plateau, Kavak bridge, 306 m, 41°02'44.1"N, 41°00'40.1"E.
20. Between Ayder plateau and Çamlıhemşin, on the road to Kalerindüzü, 1100 m, 40°57'35.2"N, 41°05'10.3"E.
21. Between Ayder plateau and Çamlıhemşin, 1034 m, 40°57'53.7"N, 41°04'26.4"E.
22. Between Çamlıhemşin and Çat, Meydan village, 1260 m, 40°54'37.0"N, 40°56'46.1"E.
23. Between Çiçekli and Kale plateaus, 1815 m, 40°48'41.6"N, 40°56'15.0"E.
24. Between Çamlıhemşin and Şenyuva, Ortan village, 395 m, 41°00'43.0"N, 40°59'39.5"E.
25. Verçenik plateau, 2016 m, 40°47'56.9"N, 40°54'25.5"E.
26. Upon climbing the Verçenik Mt, 2300 m, 40°47'00.4"N, 40°54'08.2"E.
27. Verçenik Mt, 2540 m, 40°46'53.6"N, 40°53'38.9"E.
28. Avusor plateau, 2360 m, 40°58'08.8"N, 41°11'34.7"E.
29. The lower slopes of Kemerli Kaçkar Mt, glacier lake, 2680 m, 40°56'17.2"N, 41°12'01.1"E.
30. Aşağı Kavrun plateau, 1985 m, 40°54'27.9"N, 41°08'17.5"E.
31. Between Aşağı Kavrun and Galerdüzü, 1948 m, 40°55'02.7"N, 41°08'46.1"E.
32. The upper parts of Meydan village, Kolona, 990 m, 40°54'21.9"N, 40°56'52.4"E.
33. Tirovit, 2451 m, 40°51'37.3"N, 41°04'01.8"E.

34. Yukarı Ceymakçur plateau, 2350 m, 40°53'34.7"N, 41°10'27.5"E.
35. Yukarı Ceymakçur Mountains, 2590 m, 40°53'08.3"N, 41°10'22.6"E.
36. Palokçur plateau, 2231 m, 40°55'34.5"N, 41°10'37.4"E.
37. The upper parts of Avusor plateau, 2545 m, 40°57'24.3"N, 41°12'12.9"E.
38. The upper parts of Avusor plateau, Mezare Yatak location, 2691 m, 40°57'27.5"N, 41°12'69.9"E.
39. The lower slopes of Altıparmak mountains, 2810 m, 40°57'21.7"N, 41°13'20.1"E.
40. Altıparmak mountains, 3065 m, 40°57'53.0"N, 41°13'85.2"E.
41. The upper parts of Ombhole stream, the northern lower slopes of Altıparmak Mt, 2721 m, 40° 57'45.2"N, 41°13'25.0"E.
42. The lower slopes of Ombhole, 2725 m, 40°57'49.9"N, 41°13'10.2"E.
43. Between Meydan and Çat, 1km to Çat, 1290 m, 40°51'79.8"N, 41°55'93.2"E.
44. The upper parts of Kale plateau, 2273 m, 40°47'11.4"N, 40°58'29.1"E.
45. Amlakit plateau, 1980 m, 40°54'06.7"N, 41°04'41.5"E.
46. The mountain pass between Amlakit and Palovit plateaus, 2860 m, 40°52'02.8"N, 41°04'16.6"E.
47. Kito forests, 1555 m, 40°55'20.6"N, 40°55'24.2"E.
48. The lower parts of Kito forests, 1360 m, 40°55'15.6"N, 40°55'70.5"E.
49. Yusufeli-Olgunlar (Heveg) plateau, Dibe stream, 2210 m, 40°51'80.6' N, 41°14'11.7"E.
50. To the northwest of Olgunlar (Heveg) plateau, along Dibe stream, 2320 m, 40°52'10.7"N, 41°13'82.7"E.
51. The northern parts of Olgunlar (Heveg), around the waterfall, Koginbarak, 2360 m, 40°52'17.8"N, 41°13'78.9"E.
52. The upper parts of Heveg, 2490 m, 40°52'00.2"N, 41°14'01.2"E.
53. Climbing to the Deniz lake, 3255 m, 40°48'90.8"N, 41°14'08.6"E.
54. Deniz lake, 3400 m, 40°49'08.5"N, 41°09'75.6"E.
55. Upper parts of Dilberdüzü, 3029 m, 40°49'06.1"N, 41°10'35.3"E.
56. Dilberdüzü, 2882 m, 40°49'23.2"N, 41°10'58.8"E.
57. Haristav plateau, 2422 m, 40°50'26.0"N, 41°12'80.5"E.
58. Between Yaylalar and Barhal villages, around the bridge, 1700 m, 40°51'97.8"N, 41°20'06.6"E.
59. Tar stream, 737 m, 40°59'83.7"N, 41°04'11.2"E.
60. Tar stream, around the bridge, 806 m, 40°59'92.9"N, 41°04'56.0"E.
61. Tar waterfall, 844 m, 40°59'81.2"N, 41°04'70.7"E.
62. Between Çat and Hisarcık (Kale village), 2510 m, 40°50'02.9"N, 40°56'70.6"E.

Results

At the end of the study, 1500 collected bryophytes were evaluated and 255 taxa (species, subspecies and varieties) belonging to 125 genera and 58 families were determined. According to the system of Henderson (1961), the number of the new records for A4 was eight.

List of the species

Marchantiopsida (*Hepaticae*)

Aytoniaceae

Reboulia hemisphaerica (L.) Raddi – 62:s, *TK*3301.

Conocephalaceae

Conocephalum conicum (L.) Dumort. – 1:ws, *TK*2809, 2:wr, *TK*2828, 3:r, *TK*2844, 4:wr, *TK*2881, 7:r, *TK*2898, 10:wr, *TK*2934, 15:r, *TK*3031, 16:r, *TK*3045.

Marchantiaceae

Marchantia polymorpha L. – 4:r, *TK*2852, 7:wr, *TK*2905, 11:ws, *TK*2942, 12:wr, *TK*2958, 36:wr, *TK*3078, 44:ws, *TK*3128.

Metzgeriaceae

Metzgeria furcata (L.) Dumort. – 4:t, *TK*2854, 7:r, *TK*2892, 32:r, *TK*3092, 45:r, *TK*3148.

M. conjugata Lindb. – 3:r, *TK*2843, 5:wr, *TK*2870, 7:s, *TK*2904, 9:r, *TK*2916, 10:s, *TK*2920, 15:r, *TK*3020, 32:r, *TK*3086, 45:s, *TK*3135.

Apometzgeria pubescens (Schrank) Kuwah. – 10:r, *TK*2919.

Aneuraceae

Aneura pinguis (L.) Dumort. – 11:wr, *TK*2950.

Riccardia chamaedryfolia (With.) Grolle – 12:ws, *TK*2963.

R. palmata (Hedw.) Carruth. – 1:dtt, *TK*2812, 2:dtt, *TK*2826, 13:s, *TK*2992, 45:dtt, *TK*3151.

Pelliaceae

Pellia epiphylla (L.) Corda – 5:wr, *TK*2883.

P. endiviifolia (Dicks.) Dumort. – 1:ws, *TK*2816,

2:ws, *TK*2833, 5:wr, *TK*2875, 7:wr, TK2895, 11:wr, *TK*2949, 12:wr, *TK*2962, 32:ws, *TK*3068, 37:ws, *TK*3105, 43:wr, *TK*3119.

Lophoziaceae

Barbilophozia hatcheri (A.Evans) Loeske – 1:dtt, *TK*2811, 11:r, *TK*2945, 12:wr, *TK*2964, 13:s, *TK*2981, 16:r, *TK*3052.

B. barbata (Schmidel ex Schreb.) Loeske – 7:r, *TK*2891, 10:r, *TK*2927, 13:s, *TK*2983, 15:r, *TK*3015, 16:r, *TK*3041.

Lophozia ventricosa (Dicks.) Dumort. – 15:r, *TK*3014, 16:r, *TK*3047, 31:dtt, *TK*3065, 45:dtt, *TK*3133.

L. sudetica (Huebener) Grolle – 15:r, *TK*3013.

Leiocolea bantriensis (Hook.) Jörg. – 44:ws, *TK*3129.

Tritomaria quinquedentata (Huds.) H. Buch – 3:r, *TK*2846, 7:r, *TK*2897, 7:s, *TK*2901, 8:r, *TK*2912, 15:r, *TK*3011.

Jungermanniaceae

Jungermannia atrovirens Dumort. – 5:wr, *TK*2868, 15:r, *TK*3021, 37:ws, *TK*3098.

J. sphaerocarpa Hook. – 11:s, *TK*2952, 30:wr, *TK*3063, 37:s, *TK*3099.

J. hyalina Lyell – 1:ws, *TK*2808, 14:s, *TK*3008, 16:r, *TK*3053, 34:wr, *TK*3070, 37:s, *TK*3104.

Nardia scalaris S.F. Gray – 13:s, *TK*2975, 38:ws, *TK*3107.

Gymnomitriaceae

Marsupella emarginata (Ehrh.) Dumort. – 39:s, *TK*3109.

M. funckii (F. Weber & D. Mohr) Dumort. – 5:r, *TK*2869, 8:s, *TK*2908, 13:s, *TK*2974, 14:s, *TK*3009, 15:r, *TK*3017, 39:ws, *TK*3108, 40:s, *TK*3113, 43:dtt, *TK*3123.

Plagiochilaceae

Plagiochila asplenioides (L. emed. Taylor) Dumort. – 8:r, *TK*2911, 9:r, *TK*2917, 11:wr, *TK*2954, 15:r, *TK*3036.

P. porelloides (Torrey ex Nees) Lindenb. – 1:r, *TK*2814, 2:dtt, *TK*2824, 3:r, *TK*2847, 5:r, *TK*2858, 7:r, *TK*2894, 10:r, *TK*2931, 11:r, *TK*2957, 13:s, *TK*2979, 13:t, *TK*2987, 15:r, *TK*3033, 15:t, *TK*3040, 16:r, *TK*3054, 32:r, *TK*3096, 37:ws, *TK*3102, 43:s, *TK*3118, 44:wr, *TK*3130, 45:r, *TK*3143.

Geocalycaceae

Lophocolea bidentata (L.) Dumort. – 1:dtt, *TK*2803.

L. heterophylla (Schrad.) Dumort. – 1:dtt, *TK*2804, 2:dtt, *TK*2825, 13:t, *TK*2989, 43:dtt, *TK*3122.

Chiloscyphus polyanthos (L.) Corda – 15:r, *TK*3039, 44:rsw, *TK*3156.

C. pallescens (Ehrh. ex Hoffm.) Dumort. – 2:wr, *TK*2821, 2:dtt, *TK*2832, 7:r, *TK*2899, 11:ws, *TK*2939, 28:rsw, *TK*3061, 32:s, *TK*3066, 36:s, *TK*3081.

Scapaniaceae

Diplophyllum albicans (L.) Dumort. – 5:wr, *TK*2860, 8:s, *TK*2914, 13:s, *TK*2976, 14:s, *TK*3007, 35:wr, *TK*3074.

Scapania irrigua (Nees) Nees – 13:s, *TK*3004, 15:r, *TK*3016, 36:r, *TK*3076, 36:s, *TK*3077, 44:s, *TK*3126.

S. undulata (L.) Dumort. – 2:wr, *TK*2820, 5:wr, *TK*2880, 11:ws, *TK*2940, 12:ws, *TK*2972, 37:wr, *TK*3101, 38:wr, *TK*3103.

S. subalpina (Nees ex Lindenb.) Dumort. – 29:rsw, *TK*3062, 35:rsw, *TK*3073.

S. nemorea (L.) Grolle – 3:r, *TK*2845, 4:r, *TK*2856, 5:wr, *TK*2864, 13:r, *TK*2978, 13:t, *TK*2985, 15:r, *TK*3012, 16:r, *TK*3044, 16:dtt, *TK*3048.

S. aspera Bernet et M. Bernet – 7:r, *TK*2896.

S. verrucosa Heeg – 3:r, *TK*2842, 5:wr, *TK*2872, 10:r, *TK*2921, 16:r, *TK*3056.

Cephaloziellaceae

Cephaloziella divaricata (Sm.) Schiffn. – 45:s, *TK*3136.

C. hampeana (Nees) Schiffn. – 2:dtt, *TK*2823.

Cephaloziaceae

Cephalozia bicuspidata (L.) Dumort. – 2:dtt, *TK*2830, 12:wr, *TK*2959, 37:s, *TK*3100.

Nowellia curvifolia (Dicks.) Mitt. – 2:dtt, *TK*2831, 6:dtt, *TK*2888, 13:dtt, *TK*2988.

Lepidoziaceae

Bazzania trilobata (L.) Gray – 5:wr, *TK*2862, 45:r, *TK*3140.

B. tricrenata (Wahlenb.) Lindb. – 6:r, *TK*2889.

Calypogeiaceae

Calypogeia fissa (L.) Raddi – 5:wr, *TK*2861, 32:r, *TK*3085.

Pseudolepicoleaceae

Blepharostoma trichophyllum (L.) Dumort. – 8:s, *TK*2909, 13:dtt, *TK*2990, 22:r, *TK*3089, 43:dtt, *TK*3124, 45:dtt, *TK*3132, 45:r, *TK*3134.

Radulaceae

Radula complanata (L.) Dumort. – 1:dtt, *TK*2810, 4:t, *TK*2853, 6:t, *TK*2887, 13:t, *TK*2986, 22:t, *TK*3084, 32:t, *TK*3091, 45:r, *TK*3142.

R. lindenbergiana Gottsche ex C. Hartm. – 1:r, *TK*2801, 7:r, *TK*2890, 10:r, *TK*2925, 13:s, *TK*2973, 15.r, *TK*3027, 28:r, *TK*3060, 36:r, *TK*3075, 45:r, *TK*3139.

Porellaceae

Porella arboris-vitae (With.) Grolle – 33:r, *TK*3097.

P. platyphylla (L.) Pfeiff. – 16:t, *TK*3042.

Frullaniaceae

Frullania tamarisci (L.) Dumort. – 3:r, *TK*2848, 5:r, *TK*2876, 10:r, *TK*2930, 15:r, *TK*3018, 15:t, *TK*3029, 16:t, *TK*3046, 32:t, *TK*3067, 32:r, *TK*3082, 32:t, *TK*3095.

F. dilatata (L.) Dumort. – 1:t, *TK*2802, 6:t, *TK*2886, 10:r, *TK*2928, 13:t, *TK*2982.

Jubulaceae

Jubula hutchinsiae (Hook.) Dumort. ssp. *javanica* (Steph.) Verd. – 5:wr, *TK*2857, 10:r, *TK*2933, 32:r, *TK*3094.

Lejeuneaceae

Lejeunea cavifolia (Ehrh.) Lindb. – 5:r, *TK*2858, 9:r, *TK*2918, 10:r, *TK*2923.

Bryopsida (*Musci*)

Polytrichaceae

Atrichum angustatum (Brid.) Bruch & Schimp. – 18:r, *GA*874, 19:s, *GU*852.

A. undulatum (Hedw.) P.Beauv. – 3:s, *GA*682, 15:s, *GU*810, *GA*707, 24:s, *GU*810A, 43:s, *GA*1326, 47:s, *GA*1327.

Pogonatum aloides (Hedw.) P. Beauv. – 4:r, *GA*579, 47:s, *GA*1328.

P. urnigerum (Hedw.) P. Beauv. – 2:dtt, *GA*573, 15:r, *GU*765, *GU*765E, 15:s, *GU*765A, 19:r, *GU*765C, 20:r, *GU*765B, 23:r, *GU*765A, *GU*765F, 27:r, *GU*765D.

Polytrichastrum alpinum (Hedw.) G. L. Sm. – 11:ws, *GA*626.

P. formosum (Hedw.) G. L. Sm. – 13:s, *GU*786B, 14:s, *GU*786, 15:s, *GU*786A, 59:s, *GA*1338.

Polytrichum commune Hedw. –3:r, *GA*587, 5:r, *GA*588, 13:s, *GU*797, 44:s, *GA*1329, 48:r, *GA*1330, 59:s, *GA*1331.

P. juniperinum Hedw. – 1:s, *GA*570, 5:r, *GA*612, 12:r, *GA*619, 20:t, *GU*825, 21:s, *GU*825A, *GU*899, 42:r, *GA*1332, 48:r, *GA*1333, 53:s, *GU*825B, 58:r, *GA*1334.

P. piliferum Hedw. – 11:s, *GA*623, 13:s, *GU*877, 27:r, *GU*877A.

Encalyptaceae

Encalypta streptocarpa Hedw. – 17:rsw, *GA*833, 24:r, *GU*886.

E. vulgaris Hedw. – 27:r, *GU*915.

Funariaceae

Funaria hygrometrica Hedw. – 21:s, *GU*891.

Grimmiaceae

Grimmia alpestris (F.Weber & D.Mohr) Schleich. – 11:r, *GA*614, 25:r, *GU*835D, 26:r, *GU*835A, 27:r, *GU*835, *GU*851, 44:r, *GA*1268, 54:s, *GU*835B, *GU*851B, 57:r, *GU*835C, *GU*851A.

G. decipiens (Schultz) Lindb. – 29:wr, *GA*824.

G. elatior Bruch ex Bals.-Criv. & De Not. – 23:r, *GU*898, 29:r, *GA*825.

G. elongata Kaulf. – 15:r, *GU*832.

G. laevigata (Brid.) Brid. – 12:r, *GU*905, 52:r, *GA*1269.

G. longirostris Hook. – 26:r, *GU*882.

G. montana Bruch & Schimp. – 23:r, *GU*814, *GU*814B, 25:r, *GU*814A, 49:r, *GA*1270.

G. ovalis (Hedw.) Lindb. – 17:r, *GA*826, 35:r, *GA*827, 54:r, *GU*926.

G. pulvinata (Hedw.) Sm. – 26:r, *GA*818, 28:r, *GA*817, 29:r, *GA*816, 36:r, *GA*819.

G. trichophylla Grev. – 6:r, *GA*822, 18:r, *GA*823, 23:r, *GU*824, 29:r, *GA*820, 36:r, *GA*821.

Racomitrium canescens (Hedw.) Brid. – 13:s, *GU*806C, 14:s, *GU*806, 14:r, *GU*806A, 15:r, *GU*806E, 20:r, *GU*806D, 21:r, *GU*806B, 36:r, *GA*1272, 39:s, *GA*1273, 41:r, *GA*1274, 45:r, *GA*1275.

R. heterostichum (Hedw.) Brid. – 29:r, *GA*815.

Schistidium apocarpum (Hedw.) Bruch & Schimp. – 5:r, *GA*605.

S. atrofuscum (Schimp.) Limpr. – 19:s, *GU*820B, 25:r, *GU*820A, 26:r, *GU*820.

S. confertum (Funck) Bruch & Schimp. – 21:r, *GU*889A, 23:r, *GU*889B, 26:r, *GU*889.

S. trichodon (Brid.) Poelt – 1:r, *GA*567.

Seligeriaceae

Blindia acuta (Hedw.) Bruch & Schimp. – 21:r, *GU*836, *GU*836B, 21:wr, *GU*836A, 24:r, *GU*836C.

Archidiaceae

Archidium alternifolium (Hedw.) Mitt. – 17:r, *GA*858.

Fissidentaceae

Fissidens adianthoides Hedw. – 3:r, *GA*603, 5:r, *GA*602, 59:r, *GA*1266.

F. dubius P.Beauv. – 14:s, *GU*780, 15:s, *GU*780A, 19:t, *GU*780B, 48:r, *GA*1265.

F. taxifolius Hedw. – 24:s, *GU*907.

F. exilis Hedw. – 18:ws, *GA*779.

Ditrichaceae

Ceratodon purpureus (Hedw.) Brid. – 4:r, *GA*678, 13:r, *GU*813, 20:dtt, *GU*875, 20:t, *GU*813F, 21:r, *GU*813A, 21:t, *GU*813B, 29:t, *GU*813C, 29:r, *GU*813D, 47:t, *GA*1261, 47:s, *GA*1262, 54:r, *GU*813E.

Distichium capillaceum (Hedw.) Bruch & Schimp. – 40:s, *GA*1263, 53:r, *GU*859A, 54:r, *GU*859.

Ditrichium flexicaule (Schwägr.) Hampe – 40:s, *GA*1264, 55:ws, *GU*884.

D. heteromallum (Hedw.) E.Britton – 11:r, *GA*631, 14:s, *GU*804.
D. pallidum (Hedw.) Hampe – 2:dtt, *GA*650.
D. pusillum (Hedw.) Hampe – 29:r, *GA*797.
D. subulatum Hampe – 36:r, *GA*1110.
Trichodon cylindricus (Hedw.) Schimp. – 20:r, *GA*796.

Rhabdoweisiaceae

Amphidium mougeotii (Schimp.) Schimp. – 59:r, *GA*1320.
Dichodontium palustre (Dicks.) M.Stech – 29:rsw, *GA*803.
D. pellucidum (Hedw.) Schimp. – 1:ws, *GA*569, 15:r, *GA*639, 43:r, *GA*1242, *GA*1256.
Dicranoweisia cirrata (Hedw.) Lindb. – 29:*r, GA*801, 54:*s, GU856.*
D. crispula (Hedw.) Milde – 27:r, *GU*831, *GU*831A, 28:r, *GA*799, 36:r, *GA*800, 38:r, *GA*1257, 39:r, *GA*1258.
Oncophorus virens (Hedw.) Brid. – 54:rsw, *GU*861D, 56:ws, *GU*861, 56:ws, *GU*861A, 56:ws, *GU*861B, *GU*861C, *GU*901.

Dicranaceae

Dicranella heteromalla (Hedw.) Schimp. – 14:s, *GU*801, 61:r, *GA*1243.
Dicranum bonjeanii De Not. – 12:s, *GU*795.
D. majus Sm. – 31:s, *GA*1245.
D. polysetum Sw. ex anon. – 28:s, *GA*809.
D. scoparium Hedw. – 3:r, *GA*583, 9:r, *GA*584, 13:s, *GU*781, 14:t, *GU*781A, 15:s, *GU*781B, 23:r, *GU*781C, 35:r, *GA*1246, 45:dtt, *GA*1247, 47:dtt, *GA*1248, *GA*1249, 58:s, *GA*1250, 58:r, *GA*1251, 58:t, *GA*1252.
D. fuscescens Sm. – 11:r, *GU*785.
Paraleucobryum enerve (Thed.) Loeske – 11:r, *GU*768A, 12:r, *GU*768, 19:t, *GU*768B.
P. longifolium (Hedw.) Loeske – 15:r, *GU*809.

Leucobryaceae

Dicranodontium denudatum (Brid.) E.Britton – 12:ws, *GA*621, 13:t, *GU*764, 13:r, *GU*764A, 13:s, *GU*764B, 45:dtt, *GA*1254, 47:t, *GA*1255.
Leucobryum glaucum (Hedw.) Angstr. – 13:s, *GU*762.
L. juniperoideum (Brid.) Müll. Hal. – 13:s, *GU*799, 19:t, *GU*799A, 47:r, *GA*1259, 48:t, *GA*1260.

Pottiaceae

Eucladium verticillatum (With.) Bruch & Schimp. – 23:r, *GU*881.
Gymnostomum aeruginosum Sm. – 5:r, *GA*592.
G. calcareum Nees & Hornsch. – 4:r, *GA*674, 60:r, *GA*1340.
Tortella inclinata (R.Hedw.) Limpr. var. *densa* (Lorentz & Molendo) Limpr. – 12:s, *GA*628.
T. inflexa (Bruch) Broth. – 56:s, *GU*871.
T. nitida (Lindb.) Broth. – 5:r, *GA*590.
T. tortuosa (Hedw.) Limpr. – 5:r, *GA*597, *GU*811B, 11:r, *GA*627, 12:ws, *GA*625, 13:r, *GU*811, 15:r, *GU*811A, 23:r, *GU*811C, 23:t, *GU*811G, 23:r, *GU*854, *GU*854A, 24:r, *GU*811D, 25:r, *GU*811F, 26:s, *GU*811E, 44:r, *GA*1346, 50:r, *GA*1347, 52:r, *GA*1348, 53:r, *GU*811H, 59:r, *GA*1349.
Trichostomum brachydontium Bruch – 19:ws, *GU*890.
T. crispulum Bruch – 17:r, *GA*795.
**Weissia condensa* (Voit) Lindb. – 54:r, *GU*927.
W. controversa Hedw. – 2:r, *GA*651, 23:r, *GU*827, 27:r, *GU*827B, 54:s, *GU*827A.
Barbula unguiculata Hedw. – 19:r, *GU*902, 30:s, *GA*1113.
Bryoerythrophyllum recurvirostrum (Hedw.) P.C.Chen – 53:s, *GU*863A, 54:r, *GU*863.
Didymodon fallax (Hedw.) R.H.Zander – 15:r, *GU*823, 23:r, *GU*823B, 54:s, *GU*823A, 59:r, *GA*1339.
D. vinealis (Brid.) R.H.Zander – 12:ws, *GU*774, 15:r, *GU*774B, 23:r, *GU*774C, 56:wr, *GU*774A.
Syntrichia norvegica F.Weber – 25:r, *GA*789.
S. ruralis (Hedw.) F.Weber & D.Mohr – 3:r, *GA*596, 10:r, *GA*595, 23:r, *GU*918, 52:r, *GA*1341, 58:r, *GA*1342.
Tortula hoppeana (Schultz) Ochyra – 54:ws, *GU*857, 37:r, *GU*933, 54:ws, *GU*857A.
* *T. lindbergii* Broth. – 54:r, *GU*867, 54:s, *GU*867A.
* *T. marginata* (Bruch & Schimp.) Spruce – 36:s, *GA*1111.
* *T. caucasica* Lindb. – 57:r, *GU*869.
T. muralis Hedw. – 54:s, *GU*930, 57:s, *GU*923.
T. subulata Hedw. – 14:s, *GU*805, 23:r, *GU*805A, *GU*892, 26:r, *GU*805C, 52:r, *GA*1343, 54:r, *GU*805B, 58:s, *GA*1344.
T. schimperi M.J.Cano, O.Werner & J.Guerra – 13:s, *GU*812.

Orthotrichaceae

Orthotrichum anomalum Hedw. – 23:r, *GU*878A, 24:r, *GU*878B, 58:r, *GU*878.
O. cupulatum Hoffm. Ex Brid. – 23:r, *GU*893.
O. urnigerum Myrin – 23:r, *GU*822.
O. diaphanum Schrad. ex Brid. – 51:r, *GA*1322.
O. pumilum Sw. ex anon. – 23:t, *GU*850.
O. rupestre Schleich. ex Schwägr. – 12:r, *GU*778, 26:r, *GU*778A.
O. affine Schrad. ex Brid. – 23:t, *GU*910, 58:r, *GA*1321.
O. speciosum Nees – 4:r, *GA*607.
Ulota crispa (Hedw.) Brid. – 1:t, *GA*572, 3:t, *GU*817A, 15:t, *GA*636, 21:t, *GU*817, 60:t, *GA*1323.

Hedwigiaceae

Hedwigia ciliata (Hedw.) P.Beauv. var. *ciliata* – 8:r, *GA*611, 10:r, *GA*610, 11:r, *GA*618, 12:s, *GA*616, 15:r, *GU*821, 46:s, *GA*1277.

H. ciliata (Hedw.) P.Beauv. var. *leucophaea* Bruch & Schimp. – 23:r, *GU*853, *GU*853A.

Bartramiaceae

Bartramia halleriana Hedw. – 3:r, *GA*589, 23:r, *GU*895.

B. pomiformis Hedw. – 21:r, *GU*818.

B. ithyphylla Brid. – 10:r, *GA*670, 40:s, *GA*1202, 54:r, *GU*868, *GU*868A.

Philonotis arnellii Husn. – 17:r, *GA*784.

P. marchica (Hedw.) Brid. – 15:ws, *GU*787.

* *P. caespitosa* Jur. – 34:wr, *GA*1201, 56:rsw, *GU*858.

P. calcarea (Bruch & Schimp.) Schimp. – 12:ws, *GU*830.

P. fontana (Hedw.) Brid. – 17:wr, *GA*785, 29:ws, *GA*787, 44:s, *GA*1203, 50:ws, *GA*1204, 51:r, *GA*1205, 51:wr, *GA*1206.

P. tomentella Molendo – 36:r, *GA*786.

Bryaceae

Bryum argenteum Hedw. – 5:r, *GA*580.

B. caespiticium Hedw. – 27:r, *GU*834, 54:ws, *GU*834C, 56:ws, *GU*834A, 57:ws, *GU*834B.

B. capillare Hedw. – 4:r, *GU*793C, 10:r, *GA*581, 14:s, *GU*793, 19:wr, *GU*793D, 23:r, *GU*793B, 24:r, *GU*793A, 34:r, *GA*1238, 44:s, *GA*1345, 46:s, *GA*1239, 58:s, *GA*1240.

B. elegans Nees – 15:r, *GU*833, 53:s, *GU*833A.

B. moravicum Podp. – 23:t, *GU*908.

B. pallescens Schleich. ex Schwägr. – 14:s, *GU*788.

B. pseudotriquetrum (Hedw.) P. Gaertn. – 20:dtt, *GU*903.

B. schleicheri DC. – 11:s, *GA*620, 25:ws, *GU*879A, 57:ws, *GU*879.

B. torquescens Bruch & Schimp. – 18:r, *GA*766.

Rhodobryum roseum (Hedw.) Limpr. – 13:s, *GU*755A, 15:s, *GU*755, 19:s, *GU*755B.

Mielichhoferiaceae

Pohlia cruda (Hedw.) Lindb. – 58:s, *GA*1241.

P. nutans (Hedw.) Lindb. – 12:s, *GU*864A, 53:s, *GU*864B, 54:r, *GU*864.

P. ludwigii (Spreng. Ex Schwaegr.) Broth. – 56:ws, *GU*929.

P. wahlenbergii (F.Weber & D.Mohr) A.L.Andrews – 21:s, *GU*885.

Mniaceae

Mnium hornum Hedw. – 15:s, *GU*761, 47:s, *GA*1301.

M. lycopodioides Schwägr. – 44:s, *GA*1300.

M. marginatum (Dicks.) P.Beauv. – 24:s, *GU*872A, 28:ws, *GA*834, 54:s, *GU*872.

M. stellare Hedw. – 23:s, *GU*894, 48:r, *GA*1302, 58:s, *GA*1303.

Cinclidiaceae

Rhizomnium punctatum (Hedw.) T.J.Kop. – 2:dtt, *GA*574, 5:r, *GA*585, 12:ws, *GA*622, 19:wr, *GU*855A, 24:t, *GU*855, 44:s, *GA*1313, 44:wr, *GA*1314, 47:dtt, *GA*1315, 48:r, *GA*1316.

Plagiomniaceae

Plagiomnium cuspidatum (Hedw.) T.J.Kop. – 8:s, *GA*591, 15:s, *GU*759, 58:s, *GA*1307.

P. affine (Blandow ex Funck) T.J.Kop. – 3:r, *GA*586, 13:s, *GU*758A, 15:s, *GU*758, 43:r, *GA*1305, 48:r, *GA*1306.

P. elatum (Bruch & Schimp.) T.J.Kop. – 13:s, *GU*757A, 15:s, *GU*757, 16:t, *GA*641, 19:r, *GU*757B, 58:r, *GA*1308.

P. medium (Bruch & Schimp.) T.J.Kop. – 45:s, *GA*1309.

P. undulatum (Hedw.) T.J.Kop. – 15:s, *GU*756, 31:s, *GA*1311, 43:r, *GA*1312.

P. rostratum (Schrad.) T.J.Kop. – 24:r, *GU*874, 43:r, *GA*1310.

Aulacomniaceae

Aulacomnium palustre (Hedw.) Schwägr. – 11:r, *GA*632, 53:s, *GU*873A, 54:ws, *GU*873.

Fontinalaceae

Fontinalis antipyretica Hedw. – 33:rsw, *GA*859, 44:rsw, *GA*1267.

Amblystegiaceae

Amblystegium serpens (Hedw.) Schimp. – 47:dtt, *GA*1198.

Campylium protensum (Brid.) Kindb. – 13:r, *GU*803.

Cratoneuron filicinum (Hedw.) Spruce – 12:s, *GA*693, 43:ws, *GA*1200.

**Drepanocladus aduncus* (Hedw.) Warnst. – 54:ws, *GU*932.

Hygrohypnum luridum (Hedw.) Jenn. – 24:r, *GU*866A, 57:r, *GU*866.

Palustriella commutata (Hedw.) Ochyra – 11:s, *GA*615, 12:ws, *GA*645, 44:ws, *GA*1192, 50:s, *GA*1193, 51:r, *GA*1194.

P. decipiens (De Not.) Ochyra – 11:r, *GA*617.

P. falcata (Brid.) Hedenäs – 11:s, *GA*613.

Sanionia uncinata (Hedw.) Loeske – 7:r, *GA*606, 11:r, *GU*794A, 14:s, *GU*794, 47:t, *GA*1197, 54:ws, *GU*794C, 56:ws, *GU*794B.

Calliergonaceae

Straminergon stramineum (Dicks. ex Brid.) Hedenäs – 12:s, *GU*783, 12:ws, *GU*783A.

Leskeaceae

Leskea polycarpa Hedw. – 11:r, *GA*692, 37:r, *GA*1290, 46:r, *GA*1291.

Pseudoleskea incurvata (Hedw.) Loeske – 7:r, *GA*684, 39:r, *GA*1292, 12:r, *GU*934.

P. patens (Lindb.) Kindb. – 26:r, *GU*917, 39:r, *GA*1293.

Pseudoleskeella catenulata (Brid. ex Schrad.) Kindb. – 7:r, *GA*582.

P. nervosa (Brid.) Nyholm – 23:r, *GU*887, 36:r, *GA*857.

**Ptychodium plicatum* (Schleich ex F. Weber & D. Mohr) Schimp. – 12:r, *GU*769.

Thuidiaceae

Abietinella abietina (Hedw.) M.Fleisch. – 3:r, *GA*593, 7:r, *GA*594, 13:s, *GU*777B, 14:s, *GU*777, 23:r, *GU*777A, 58:r, *GA*1355.

Helodium blandowii (F.Weber & D.Mohr) Warnst. – 11:r, *GA*630.

Thuidium delicatulum (Hedw.) Schimp. – 2:r, *GA*577, 15:s, *GU*802, 15:r, *GU*802A, 19:s, *GU*802B, 59:r, *GA*1356, 58:r, *GA*1357.

Brachytheciaceae

Pseudoscleropodium purum (Hedw.) M.Fleisch. – 2:dtt, *GA*568.

Eurhynchium striatum (Hedw.) Schimp. – 17:r, *GA*885, *GA*886, 19:r, *GU*826, 59:r, *GA*1225.

Platyhypnidium riparioides (Hedw.) Dixon – 24:rsw, *GU*913, 35:rsw, *GA*1139, 48:r, *GA*1235.

Rhynchostegium murale (Hedw.) Schimp. – 43:r, *GA*1237.

Rhynchostegiella tenella (Dicks.) Limpr. – 45:dtt, *GA*1236.

Oxyrrhynchium hians (Hedw.) Loeske – 15:r, *GA*633.

O. schleicheri (R.Hedw.) Röll – 43:t, *GA*1220, 43:s, *GA*1221, 59:t, *GA*1222.

O. speciosum (Brid.) Warnst. – 43:s, *GA*1223, 59:r, *GA*1224.

Kindbergia praelonga (Hedw.) Ochyra – 1:r, *GA*656, 58:r, *GA*1217.

Sciuro-hypnum populeum (Hedw.) Ignatov & Huttunen – 15:r, *GU*816, 16:r, *GU*816A, 19:r, *GU*816B, 47:s, *GA*1210.

S. reflexum (Starke) Ignatov & Huttunen – 54:ws, *GU*921.

Brachythecium albicans (Hedw.) Schimp. – 13:s, *GU*782, 14:s, *GU*782B, 20:r, *GU*782A.

B. erythrorrhizon Schimp. – 10:r, *GA*658, 54:ws, *GU*931, 58:r, *GA*1207.

B. glareosum (Bruch ex Spruce) Schimp. – 3:r, *GA*659, 34:ws, *GA*1208, 43:r, *GA*1209.

B. mildeanum (Schimp.)Schimp. – 17:r, *GA*881, 28:s, *GA*888, 54:ws, *GU*925.

B. rivulare Schimp. – 8:r, *GU*784C, 11:r, *GU*784, 15:s, *GU*784A, 25:r, *GU*784B, 33:wr, *GA*1211, 34:r, *GA*1212, 36:r, *GA*1213, 48:r, *GA*1214.

B. rutabulum (Hedw.) Schimp. – 24:t, *GU*896, 56:ws, *GU*896A.

B. salebrosum (Hoffm. ex F. Weber & D. Mohr) Schimp. – 2:dt, *GA*564, 21:r, *GU*916, 54:ws, *GU*916A.

Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen – 9:r, *GA*600, 58:s, *GA*1219.

Brachytheciastrum collinum (Schleich. ex Müll.Hal.) Ignatov & Huttunen – 54:r, *GU*928.

B. velutinum (Hedw.) Ignatov & Huttunen – 35:s, *GA*1138, 47:s, *GA*1215, 48:r, *GA*1216.

Homalothecium lutescens (Hedw.) H.Rob. var. *fallax* H.Philib. ex Schimp. – 24:t, *GU*883, 24:r, *GU*883A.

H. lutescens (Hedw.) H.Rob. var. *lutescens* – 10:r, *GA*601, 23:r, *GU*909, 58:r, *GA*1226.

H. sericeum (Hedw.) Schimp. – 2:dtt, *GA*566, 7:r, *GU*920, 58:r, *GA*1227.

Hypnaceae

Calliergonella lindbergii (Mitt.) Hedenäs – 15:s, *GU*888, 19:s, *GU*888A, 59:s, *GA*1283.

Ctenidium molluscum (Hedw.) Mitt. – 5:r, *GA*599, 13:s, *GU*779, 14:s, *GU*779B, 15:r, *GA*640, *GU*779A, 45:r, *GA*1278, 47:r, *GA*1279, *GA*1280, 48:r, *GA*1281, 20:s, *GU*819, 21:r, *GU*819A.

Hypnum andoi A.J.E.Sm. – 20:t, *GU*862A, 28:r, *GA*842, 53:r, *GU*862.

H. cupressiforme Hedw. var. *cupressiforme* – 1:t, *GA*575, 13:t, *GU*776, 13:s, *GU*776A, 13:r, *GU*776C, 15:r, *GA*640, *GU*776B.

H. cupressiforme Hedw. var. *lacunosum* Brid. – 1:r, *GA*756, 23:r, *GU*914, 58:r, *GA*1282.

H. cupressiforme Hedw var. *resupinatum* (Taylor) Schimp. – 15:t, *GA*643, 58:r, *GA*1284.

H. imponens Hedw. – 14:s, *GU*766A, 15:r, *GU*766, 16:t, *GA*644.

Ptilium crista-castrensis (Hedw.) De Not. – 8:s, *GA*664, 8:r, *GA*666.

Pterigynandraceae

Heterocladium dimorphum (Brid.) Schimp. – 11:r, *GA*629, 38:r, *GA*1352.

Pterigynandrum filiforme Hedw. – 13:t, *GU*775, 15:t, *GA*638, 21:t, *GU*775A, 23:r, *GU*775B, 45:r, *GA*1294, 47:t, *GA*1295.

Hylocomiaceae

Hylocomium splendens (Hedw.) Schimp. – 8:r, *GA*663, 8:t, *GA*667, 13:s, *GU*798, 13:s, *GU*798A, 58:r, *GA*1285.

Loeskeobryum brevirostre (Brid.) M.Fleisch. – 19:s, *GU*828.

Pleurozium schreberi (Willd. ex Brid.) Mitt. – 15:s, *GU*815, *GU*815A.

Rhytidiadelphus squarrosus (Hedw.) Warnst. – 7:wr, *GA*598, 12:r, *GA*624, 44:ws, *GA*1286, 50:ws, *GA*1287.

R. triquetrus (Hedw.) Warnst. – 27:r, *GU*848, 45:s, *GA*1288, 58:r, *GA*1289.

Rhytidiaceae

Rhytidium rugosum (Hedw.) Kindb. – 23:r, *GU*897.

Plagiotheciaceae

Isopterygiopsis pulchella (Hedw.) Z.Iwats. – 13:s, *GU*789, 47:t, *GA*1324.

**Plagiothecium curvifolium* Schlieph. ex Limpr. – 19:s, *GU*849.

P. denticulatum (Hedw.) Schimp. – 47:t, *GA*1325, 54:rsw, *GU*865.

P. laetum Schimp. – 19:s, *GU*911.

P. succulentum (Wilson) Lindb. – 31:s, *GA*853.

Leucodontaceae

Leucodon immersus Lindb. – 1:t, *GA*571, 15:t, *GA*635, 16:t, *GA*634.

L. sciuroides (Hedw.) Schwägr. – 4:r, *GA*679, 10:r, *GA*680, 47:t, *GA*1296, *GA*1297, 58:r, *GA*1298.

Pterogonium gracile (Hedw.) Sm. – 47:t, *GA*1299.

Neckeraceae

Neckera complanata (Hedw.) Huebener – 3:r, *GA*608, 4:r, *GA*609, 15:t, *GA*637, *GU*763, 24:t, *GU*763A, 48:t, *GA*1317.

N. crispa Hedw. – 3:r, *GA*669, 59:t, *GA*1318, 59:r, *GA*1319.

Thamnobryum alopecurum (Hedw.) Gangulee – 24:r, *GU*876.

Lembophyllaceae

Isothecium alopecuroides (Lam. ex Dubois) Isov. – 2 :dtt, *GA*565, 11:r, *GU*791B, 13:s, *GU*791, 13:r, *GU*791A, 13:t, *GU*791C, 34:r, *GA*1228, 36:r, *GA*1229, 47:r, *GA*1230, 47:t, *GA*1232, 48:t, *GA*1233.

I. myosuroides Brid. – 19:r, *GU*900, 28:r, *GA*879, 13:t, *GU*800, *GU*800A.

Anomodontaceae

Anomodon viticulosus (Hedw.) Hook. & Taylor – 3:r, *GA*689, 23:r, *GU*912, 44:r, *GA*1351.

Discussion

Although the studies of the bryophyte flora of Turkey by some foreign and local botanists have increased in the last ten years (Uyar & Çetin 2001, 2006; Çetin & al. 2002; Erdağ 2002; Uyar 2003; Everest & Ellis 2003; Papp & Sabovljevic 2003; Keçeli & Çetin 2006; Ören & al. 2007; Natcheva & al. 2008; Abay & al. 2009a, b; Tonguç Yayıntaş 2009), Turkey is still one of the least studied countries in Europe, as far as its bryophyte flora is concerned. The knowledge of the bryophyte flora of the Kaçkar Mts was greatly expanded with this work, mainly because of the scarcity of earlier information. In the present study, above all, the authors have compared all bryophyte species in the floristic list with the red listing of European bryophytes by the European Committee for Conservation of Bryophytes (ECCB 1995). Consequently, we indicated that three taxa in the *European Red List*, namely *Jubula hutchinsiae* (Hook.) Dumort. subsp. *javanica* (Steph.) Verd. Vulnerable (V) and *Scapania verrucosa* Heeg Rare (R), *Schistidium trichodon* (Brid.) Poelt, are insufficiently known (K). Furthermore, eight new records for A4 grid square were considered below, according to contributions to the bryofloristic distribution in Turkey.

Weissia condensa (Voit) Lindb.

This temperate Submediterranean species was previously known in Turkey from Central Anatolia, the Aegean, Thrace and Mediterranean regions, at lower altitudes (Schiffner 1913; Robinson & Godfrey 1960; Walther 1967; Papp & Sabovljevic 2003). The new findings extend its distribution range to the Eastern Black Sea Region in Turkey.

Tortula marginata (Bruch & Schimp.) Spruce

The first report of this temperate Mediterranean species in Turkey was from the Izmir province (Walther 1967). The second record was provided by Papp & Sabovljevic (2003) in Turkish Thrace. The closest localities of *T. marginata* are located in Southeast Bulgaria, Iraq, Israel, Lebanon, and Central Asia (Ignatov & Afonina 1992; Natcheva & Ganeva 2005; Kürschner 2007). Apparently, this new record bridges a remarkable distribution gap of this species towards the Caucasus.

Tortula caucasica Lindb.

The earlier reports of this circumpolar temperate species in Turkey have been from the Kocaeli province; Gebze town and Izmir province; Pınarbaşı town

(Walther 1967; 1970) and also from Turkish Thrace (Papp & Sabovljevic 2003) and the Aydın area (Kırmacı & Ağcagil 2009). It is new to the northeastern part of Turkey. Besides, except in Turkey, it is known only in Israel and Southwest Asia (Heyn & Herrnstadt 2004).

Tortula lindbergii Broth.

This circumpolar temperate southern species had been so far reported from only two localities in A1 and C14 grid squares in Turkey (Schiffner 1913; Yayıntaş & Tonguç 1994). Here, after aproximately one century, it is newly reported in A4 grid square. Furthermore, this new record contributes to its known range in the Caucasus region (Ignatov & Afonina 1992).

Drepanocladus aduncus (Hedw.) Warnst.

This circumpolar boreal temperate species was known in Turkey from the Bolu province, around Abant lake and Gerede town and also from the Manisa and Denizli provinces (Walther 1967); Bitlis province, Süphan Mt. This record contributes to its known range towards the Caucasus region (Ignatov & Afonina 1992).

Ptychodium plicatum (Schleich ex F. Weber & D. Mohr) Schimp.

The first report of this Mediterranean arctic mountain species in Turkey was from the Sinop province (Çetin & Uyar 1997). It has not been recorded again in Turkey ever since. This new record in A4 grid square contributes to its known range in the Caucasus region (Ignatov & Afonina 1992).

Plagiothecium curvifolium Schlieph. ex Limpr.

This Mediterranean arctic mountain species has been so far recorded in Turkey only from A1 and A2 grid squares (Yayıntaş 1993; Ören & al. 2007). The new record from A4 grid square contributes to its known range in the Caucasus region (Ignatov & Afonina 1992). Moreover, it is known only from the Southwest Asia part of Turkey (Kürschner 2006).

Philonotis caespitosa Jur.

This boreal temperate mountain species has been so far known in Turkey only from the Marmara and Aegean regions (Walther 1967; Erdağ 2002). The new record extends its distribution range to the northeastern part of Turkey.

Acknowledgements. The authors are grateful to the Turkish Scientific and Technical Research Council for its financial support [TBAG – 2404(104T014)]. Special thanks go to Arzu Sari Abay for the linguistic corrections of the manuscript and to the anonymous reviewer for the sugesstions and critical notes on the manuscript.

References

Abay G., Uyar, G., Çetin, B. & Keçeli, T. 2006. The moss (musci) flora of the spreading areas of *Buxus sempervirens* L. communities in Fırtına valley (Çamlıhemşin, Rize). – Süleyman Demirel Üniv. Orman Fak. Derg., **2**:37-49 (in Turkish).

Abay G., Uyar, G., Çetin, B. & Keçeli, T. 2007. *Bucklandiella microcarpa* (Hedw.) Bednareck-Ochyra & Ochyra, (*Grimmiaceae*, *Bryopsida*): new to the moss flora of Turkey and Southwest Asia. – Cryptog. Bryol., **28**(2): 145-148.

Abay, G., Uyar, G., Keçeli, T. & Çetin, B. 2009a. *Sphagnum centrale* and other remarkable bryophyte records from the Kaçkar Mountains (Northern Turkey). – Cryptog. Bryol., **30**(3): 399-407.

Abay, G., Uyar, G., Çetin, B. & Keçeli, T. 2009b. New bryofloristic records for the square A4 (Rize, Turkey). – In: **Ivanova, D.** (ed.), Proc. Fourth Balkan Bot. Congr., Sofia 2006. Pp. 134-139. Bulg. Acad. Publishing House, Sofia.

Arnell, S. 1981. Illustrated Moss Flora of Fennoscandia, Vol. **1**. *Hepaticae*. Swedish Natural Science Research Council, Stocholm.

Cortini Pedrotti, C. 2001a. New checklist of the mosses of Italy. – Fl. Medit., **11**: 23-107.

Cortini Pedrotti, C. 2001b. Flora dei muschi d'Italia, *Sphagnopsida*, *Andreaeopsida*, *Bryopsida* (**I** parte). Antonio Delpfino Editore, Roma.

Cortini Pedrotti, C. 2006. Flora dei muschi d'Italia, *Bryopsida* (**II** parte). Antonio Delpfino Editore, Roma.

Çetin, B. & Uyar, G. 1997. The moss flora of Sinop and its environs (Ayancık, Boyabat and Gerze). – Turk. J. Bot., **21**: 231–244.

Çetin, B., Unç, E. & Uyar, G. 2002. The moss flora of Ankara – Kızılcahamam –Çamkoru and Çamlıdere districts. – Turk. J. Bot., **26**: 91-101.

ECCB. 1995. Red Data Book of European Bryophytes. European Committee for Conservation of Bryophytes (ECCB), Trondheim.

Erdağ, A. 2002. A contribution to the bryophyte flora of Western Turkey: the bryophyte flora of Madran Mountain and the Çine Valley (Aydın, Turkey). – Turk. J. Bot., **26**: 31-42.

Everest, A. & Ellis, L. 2003. A contribution to the moss flora of the Taurus Mountains, Southern Turkey. – Cryptog. Bryol., **24**: 33-42.

Fındık, T. 2001. Kaçkar Mountains. Homer Kitabevi, İstanbul (in Turkish).

Fındık, T. & Melikoğlu, Z. 2001. Turkish Mountains. Homer Kitabevi ve Yayıncılık, İstanbul (in Turkish).

Frey, W., Frahm, J.P., Fischer, E. & Lobin, W. 1995. Kleine Kryptogamenflora, Die Moos- und Farnpflanzen Europas. Gustav Fischer Verlag, Stuttgart.

Frey, W., Frahm, J.P., Fischer, E. & Lobin, W. 2006. The Liverworts, Mosses and Ferns of Europe. English edition revised and edited by T.L. Blockeel. Harley Books, Colchester.

Greven, H.C. 1995. Grimmia Hedw. (*Grimmiaceae*, *Musci*) in Europe. Backhuys Publishers, Leiden.

Greven, H.C. 2003. Grimmias of The World. Backhuys Publishers, Leiden.

Grolle, R. & Long, D.G. 2000. An annotated checklist of the *Hepaticae* and *Anthocerotae* of Europe and Macaronesia. – J. Bryol., **22**: 103-104.

Henderson, D. M. 1961. Contributions to the bryophyte flora of Turkey V: Summary of Present Knowledge. – Notes Roy. Bot. Gard., **23**: 279-301.

Heyn, C.C. & Herrnstadt, I. (eds.) 2004. The Bryophyte Flora of Israel and Adjacent Regions. The Israel Acad. Sci. & Humanities, Israel.

Hill, M.O., Bell, N., Bruggeman-Nannenga, M.A., Brugues, M., Cano, M.J., Enroth, Flatberg, KI., Frahm, J-P., Gallego, M.T., Garilleti, R., Guerra, J., Hedenäs, L., Holyoak, D.T., Hyvönen, J., Ignatov, M.S., Lara, F., Mazimpaka, V., Munoz, J. & Söderström, L. 2006. An annotated checklist of the mosses of Europe and Macronesia. – J. Bryol., **28**: 198-267.

Ignatov, M.S. & Afonia, O.M. 1992. Checklist of mosses of the former USSR. – Arctoa, **1**: 1-85.

Keçeli, T. & Abay, G. 2007a. *Telaranea europaea* (*Lepidoziaceae*, *Hepaticae*), new for Turkey. – Cryptog. Bryol., **28**(1): 79-81.

Keçeli, T. & Abay, G. 2007b. *Pallavicinia lyellii* (Hook.) Carruth. in Turkey, new to Southwestern Asia. – Cryptog. Bryol., **28**(3): 249-252.

Keçeli, T. & Çetin, B. 2006. A contribution to the liverwort flora of the Western Black Sea Region, Northern Turkey, and a new record (*Cephaloziella dentata*, *Cephaloziellaceae*) to Southwest Asia. – Cryptog. Bryol., **27**: 459-470.

Keçeli, T., Abay, G., Uyar, G. & Çetin, B. 2008. New national and regional bryophyte records-19:15. *Scapania paludosa* (Müll.Frib.) Müll. Frib. – J. Bryol., **19**: 231-237.

Kırmacı, M. & Ağcagil, E. 2009. The Bryophyte flora in the urban area of Aydın (Turkey). – Int. J. Bot., **5**(3): 216-225.

Kürschner, H. 2001. Towards a bryophyte flora of the Near and Middle East 3. An artificial key to the *Anthocerotophytina* and *Hepaticophytina* of the Near and Middle East. – Nova Hedwigia, **72**(1-2): 161-200.

Kürschner, H. 2006. A key to the pleurocarpous mosses (*Bryophytina* p. p.) of the Near and Middle East. Towards a bryophyte flora of the Near and Middle East 5. –Nova Hedwigia, **83**(3-4): 353-386.

Kürschner, H. 2007. A key to the *Pottiaceae* (*Bryopsida–Bryophytina*) of the Near and Middle East. Towards a bryophyte flora of the Near and Middle East 6. – Nova Hedwigia, **84**(1-2): 21-50.

Kürschner, H. 2008. A key to the acrocarpous mosses (*Bryophytina* p.p. excl. *Pottiaceae*) of the Near and Middle East. Towards a bryophyte flora of the Near and Middle East 7. – Nova Hedwigia, **86**(1-2): 43-103.

Kürschner, H. & Erdağ, A. 2005. Bryophytes of Turkey: An annotated reference list of the species with synonyms from recent literature and an annotated list of Turkish bryological literature. – Turk. J. Bot., **29**: 95-154.

Kürschner, H. & Parolly, G. 2006a. New national and regional bryophyte records-12: 9: *Eremonotus myriocarpus* (Carrington) Lindb. & Kaal. ex Pearson. – J. Bryol., **28**: 69.

Kürschner, H. & Parolly, G. 2006b. New national and eegional bryophyte records-13:11: *Warnstorfia sarmentosa* (Wahlenb.) Hedenäs. – J. Bryol., **28**: 154.

Lawton, E. 1971. Moss Flora of the Pacific Northwest. Suppl. No: 1. The Hattori Bot. Laboratory, Nichinan.

Natcheva, R. & Ganeva, A. 2005. Checklist of the bryophytes of Bulgaria. II. *Musci*. – Cryptog. Bryol., **26**: 209-232.

Natcheva, R., Coşkun, M. & Çayır, A. 2008. Contribution to the bryophyte flora of European Turkey. – Phytol. Balcan., **14**: 335-341.

Nyholm, E. 1981. Illustrated Moss Flora of Fennoscandia. Fasc.1-6. Swedish Natural Science Research Council, Lund.

Ören, M., Uyar, G. & Keçeli, T. 2007. The bryophyte flora of Erdek, Bandırma, Manyas Districts (Balıkesir, Turkey). – Int. J. Bot., **3**: 1-14.

Özdemir, T. 2008. *Rhytidiadelphus loreus* (Hedw.) Warnst. (*Hylocomiaceae*, *Bryopsida*) new to the moss flora of Turkey and Southwest Asia. – Cryptog. Bryol., **29**(2): 207-208.

Özdemir, T. 2009. A revised checklist of the bryophytes of A4 square of Turkey. – Int. J. Bot., **5**(1): 1-35.

Özdemir, T. & Uyar, G. 2008. *Campylopus flexuosus* (Hedw.) Brid. (*Dicranaceae*, *Bryopsida*), a new record in Turkey. – Cryptog. Bryol., **29**(4): 401-404.

Özdemir, T., Koz, B. & Batan, N. 2008. *Didymodon asperifolius* (*Pottiaceae*, *Bryopsida*), new to the moss flora of Turkey and Southwest Asia. – Cryptog. Bryol., **29**(3): 311-312.

Özenoğlu Kiremit, H. & Keçeli, T. 2009. An annotated checklist of the *Hepaticae* and *Anthocerotae* of Turkey. – Cryptog. Bryol., **30**(3): 343-356.

Papp, B. 2004. Contributions to the bryoflora of the Pontic Mts, North Anatolia, Turkey. – Stud. Bot. Hung., **35**: 81-89.

Papp, B. & Sabovljevic, M. 2003. Contribution to the bryophyte flora of Turkish Thrace. – Stud. Bot. Hung., **34**: 43-54.

Paton, J.A. 1999. The Liverwort Flora of the British Isles. Harley Books, Colchester.

Robinson, H. & Godfrey, R.K. 1960. Contributions to the bryophyte flora of Turkey. – Rev. Bryol. Lichénol., **29**: 244-253.

Ros, R.M., Muñoz, J., Werner, O. & Rams, S. 2008. New typifications and synonyms in *Tortula* sect. *Pottia* (*Pottiaceae*, *Musci*). – Taxon, **57**(1): 279-288.

Schiffner, V. 1913. *Bryophyta* aus Mesopotamien und Kurdistan. – Ann. Nathurhist. Hofmus., Wien, **27**: 1-34.

Schuster, R.M. 1966. The *Hepaticae* and *Anthocerotae* of North America, East of the Hundredth Meridian. Vol. **2**. Columbia Univ. Press, New York.

Schuster, R.M. 1969. The *Hepaticae* and *Anthocerotae* of North America. Vol. **2**. Columbia Univ. Press, New York.

Schuster, R.M. 1974. The *Hepaticae* and *Anthocerotae* of North America. Vol. **3**. Columbia Univ. Press, New York.

Smith, A.J.E. 1980. The Moss Flora of Britain and Ireland. Cambridge Univ. Press, Cambridge.

Smith, A.J.E. 1996. The Liverworts of Britain and Ireland. Cambridge Univ. Press, Cambridge.

Smith, A.J E. 2004. The Moss Flora of Britain and Ireland. Cambridge Univ. Press, Cambridge.

Tonguç Yayıntaş, Ö. 2009. A contribution to the bryophyte flora of Southwest Turkey: Bryophyte flora of Yılanlı Mountain (Muğla-Turkey). – Euroasian J. BioSci., **3**: 29-39.

Townsend, C.C. 1997. Two mosses new to Turkey. Bryological notes. – J. Bryol., **19**: 641.

Uyar, G. 2003. The moss flora of Düzce – Akçakoca Mountains. – Ot, **10**: 77-95.

Uyar, G., Abay, G., Çetin, B. & Keçeli, T. 2008. *Dicranum flexicaule* Brid. (*Dicranaceae*, *Bryopsida*), new to the moss flora of Southwest Asia. – Cryptog. Bryol., **29**(1): 103-106.

Uyar, G. & Çetin, B. 2001. The moss flora of Ankara. – Kızılcahamam Soğuksu National Park. – Turk. J. Bot., **25**: 261-273.

Uyar, G. & Çetin, B. 2004. A new checklist of the mosses of Turkey. – J. Bryol., 26. 203-220.

Uyar, G. & Çetin, B. 2006. Contribution to the moss flora of Turkey: Western Black Sea Region (Bolu, Katamonu, Karabük, Bartın and Zonguldak). – Int. J. Bot., **2**: 229-241.

Walther, K. 1967. Beiträge zur Moosflora Westanatoliens I. – Mitt. Staatinst. Allg. Bot. Hamburg, **12**: 129-186.

Walther, K. 1970. Beiträge zur Moosflora Westanatoliens II. – Mitt. Staatsinst. Allg. Bot. Hamburg, **13**: 167-180.

Watson, E.V.P. 1981. British Mosses and Liverworts. Cambridge Univ. Press, Cambridge.

Yayıntaş, A. 1993. New moss record for Turkey. *Plagiothecium curvifolium* Schlieph. ex Limpr. (*Plagiotheciaceae*). – Ege Üniv. Fen Fak. Derg., **15**: 21-23.

Yayıntaş, A. & Tonguç, Ö. 1994. New moss records from Thrace for A1. – Ege Üniv. Fen Fak. Derg., **16**: 51-61.