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The Moss Flora of Maltepe University Central Campus (İstanbul-Türkiye)

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Abstract

This study focused on the bryophyte flora of Maltepe University Central Campus, with samples collected between March 2023 and March 2024. Approximately 150 moss samples were collected from the study area, and through taxonomic identification, a total of 42 moss taxa belonging to 10 families and 26 genera were identified. Among these taxa, 19 represent new records for the province of Istanbul.

Keywords: Bryophytes, mosses, flora, urban area, biological diversity.

Maltepe Üniversitesi Merkez Kampüsü Karayosunu Florası (İstanbul-Türkiye)

Öz

Bu çalışmada, 2023 yılının Mart ve 2024 yılının Mart ayları arasında Maltepe Üniversitesi Merkez Kampüsünün karayosunu florası çalışılmıştır. Çalışma alanından toplanan yaklaşık 150 karayosunu örneğinin teşhis edilmesi sonucunda 10 familya, 26 cinse ait toplam 42 karayosunu taksonu tanımlanmıştır. Bu taksonlardan 19 tanesi İstanbul ili için yeni kayıttır.

Anahtar kelimeler: Briyofitler, karayosunu, flora, kentsel alan, biyolojik çeşitlilik.

1. Introduction

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Bryophytes exhibit a broad geographic distribution worldwide, ranging from the poles to the equator, thriving in environments abundant with water and moisture (Glime, 2017). However, due to their primitive structures and small sizes, they have often been overlooked by many botanists. Turkey stands out as one of the richest countries in terms of bryo-floristic diversity among European and Asian nations. The inception of bryological investigation in Turkey can be traced back to 1829 when foreign scholars embarked on research endeavors in this field, a process that has been continued with the participation of local bryologists since the 1980s. The most recently updated lists of bryophytes (Erdağ and Kürschner, 2017; Kürschner and Frey, 2020) and recent studies on bryophytes (Alataş et al., 2019; Batan et al., 2019; Ellis et al., 2019, 2020; Ursavaş and Keçeli, 2019; Ursavaş and Işın, 2019; Ünan et al., 2020; Erata and Batan, 2020; Ünan and Ören, 2021; Erata et al., 2021; Ellis et al., 2021; Ursavaş et al., 2021; Ünan and Ören, 2021; Abay et al., 2022; Erata, 2022; Batan et al., 2022), including studies conducted from 1829 to the end of 2023, have contributed to the current flora, which comprises ±1057 taxa (±849 mosses, ±204 liverworts, and ±4 hornworts).

The contemporary expansion of urban areas leads to the diminishment and fragmentation of natural spaces, consequently diminishing their ecological values (Bairoch, 1988). Urbanization's fragmentation of natural areas results in a decline in ecological values, contributing to the rapid extinction of species within these areas (Soule, 1991). To mitigate this extinction, it is imperative to establish ecological networks between urban and natural areas. One significant urban habitat where such ecological networks can be established is university campuses. University campuses possess characteristics akin to natural laboratories, particularly conducive to applied sciences and significant biological diversity. Despite being under human pressure, campus areas of well-established universities with a long history can be considered as areas where biological diversity is preserved (Ezer et al., 2021). One exemplary instance of this preservation is the Central Campus of Maltepe University, which hosts numerous seed plants and moss species.

University campus areas are integral components of urban living spaces. The focus of this study is the Central Campus of Maltepe University, located within the city of Istanbul, Turkey. As academic and administrative structures continue to proliferate within university campuses over time, coupled with the implementation of new landscaping projects featuring both native and exotic plant species, the natural floristic composition of the campus is inevitably influenced. Consequently, the investigation of plant species within such areas, particularly bryophytes, facilitates the comparison of future research findings and the monitoring of species turnover (Abay, 2018).

University campus areas serve as natural laboratories, particularly for applied-sciences and significant bio-diversity research. Campus areas of universities, especially those with a rich and longstanding history, can be regarded as areas where biological diversity is preserved. In this context, a few floristic studies have been conducted to unveil the plant biological diversity of campus areas in Turkey (Alataş et al., 2011; Erata et al., 2017; Abay, 2018; Ezer, 2021; Alataş and Çambay, 2024).

The aim of this study is to investigate the bryophyte flora in the urban area of the Maltepe University Central Campus.

1. Materials and Methods

1.1 Study area

The Marmara Education Village was established in 2002 amidst pine forests, covering an area of 1000 hectares of open space and 300 hectares of enclosed space, with the primary objective of bringing together various educational institutions under the umbrella of the Marmara Education Foundation (MEF). The campus, which is also home to Maltepe University, encompasses various faculties, including the Faculty of Education, Faculty of Fine Arts, Faculty of Law, Faculty of Communication, Faculty of Humanities and Social Sciences, Faculty of Business and Management Sciences, Faculty of Architecture and Design, Faculty of Engineering and Natural Sciences, Faculty of Medicine, Conservatory, Nursing School, Vocational School, School of Foreign Languages, and the Graduate School of Education (URL, 1).

The study area is situated within grid square A1 according to the Henderson (1961) grid system (Figure 1). The selected study area, Maltepe University Central Campus, has not been the subject of a detailed investigation regarding its bryophyte flora until now.

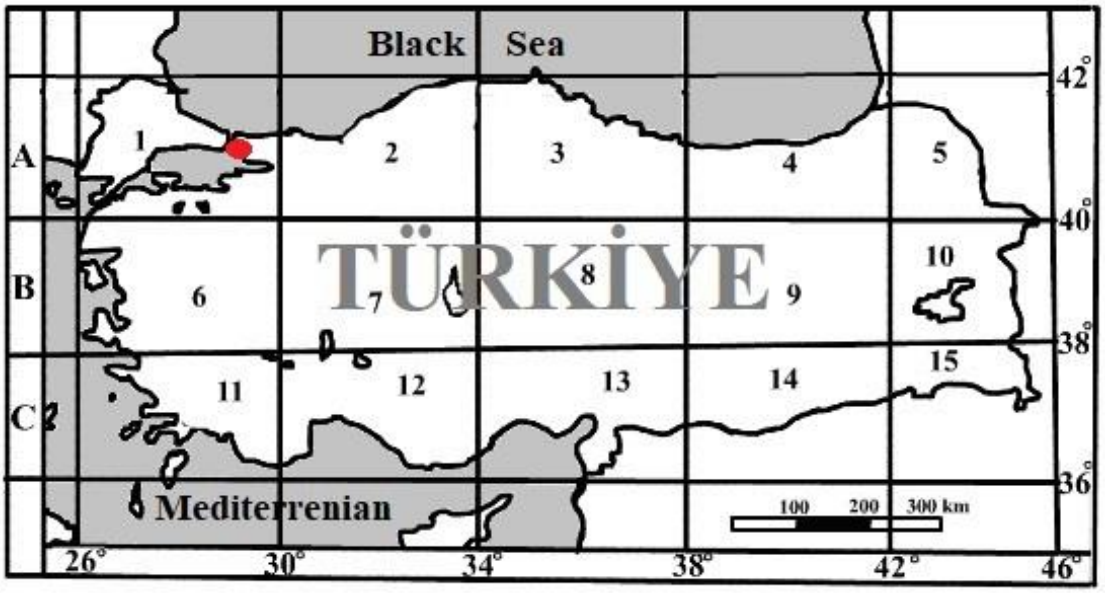

Figure 1. The geographical location of the study area (●) are determined within the grid system of Turkey as delineated by Henderson (1961).

2.2. Material

The material under study comprises moss samples collected from various localities and habitats within the Central Campus of Maltepe University during distinct vegetation periods of the years 2023 and 2024 (Figure 2).

Detailed informations of localities for moss samples collected from various localities and habitats of Maltepe University Central Campus are presented in Table 1.

Figure 2. Maltepe University Central Campus and Sampling Localities (Modified from Google Maps).

Table 1. Localities

Locality Number	Altitude (m)	Date	GPS Record	Localities
1	213	10.03.2024	N 40º 57' 35", E 029º 11' 10"	Rectorate
2	189	27.05.2023	N 40º 57' 39", E 029º 11' 10"	Vocational School
3	186	01.06.2023	N 40º 57' 34", E 029º 11' 25"	Cultural Center
4	188	05.06.2023	N 40º 57' 31", E 029º 11' 25"	Faculty of Law
5	200	11.07.2023	N 40º 57' 29", E 029º 11' 18"	Faculty of Education
6	210	23.07.2023	N 40º 57' 28", E 029º 11' 14"	Marmara College
7	218	05.08.2023	N 40º 57' 22", E 029º 11' 25"	Maltepe University Mosque
8	216	12.08.2023	N 40º 57' 25", E 029º 11' 00"	Marmara Educational Institutions
9	221	22.08.2023	N 40º 57' 26", E 029º 10' 54"	Marma Hotel Istanbul Asia
10	215	03.09.2023	N 40º 57' 27", E 029º 11' 00"	Student house
11	205	11.09.2023	N 40º 57' 32", E 029º 11' 70"	Library
12	198	15.09.2023	N 40º 57' 30", E 029º 11' 16"	Medical Center
13	203	23.09.2023	N 40º 57' 27", E 029º 11' 22"	Faculty of Education
14	207	02.10.2023	N 40º 57' 25", E 029º 11' 26"	Cemetery
15	209	06.10.2023	N 40º 57' 24", E 029º 11' 22"	School of Foreign Languages
16	213	13.10.2023	N 40º 57' 25", E 029º 11' 20"	School of Nursing
17	224	28.10.2023	N 40º 57' 28", E 029º 11' 28"	Faculty of Engineering and Natural Sciences
18	188	30.10.2023	N 40º 57' 31", E 029º 11' 33"	Faculty of Architecture and Design
19	181	02.11.2023	N 40º 57' 34", E 029º 11' 36"	Faculty of Architecture and Design (Wall)
20	176	15.01.2024	N 40º 57' 38", E 029º 11' 40"	Faculty of Architecture and Design (Car park)
21	167	10.02.2024	N 40º 57' 43", E 029º 11' 39"	Sports Complex
22	171	12.02.2024	N 40º 57' 41", E 029º 11' 37"	Sports Complex
23	165	05.03.2024	N 40º 57' 41", E 029º 11' 29"	Faculty of Communication
24	165	08.03.2024	N 40º 57' 43", E 029º 11' 20"	Faculty of Medicine
25	175	16.03.2024	N 40º 57' 41", E 029º 11' 24"	Faculty of Medicine
26	183	05.03.2024	N 40º 57' 35", E 029º 11' 30"	Faculty of Architecture and Design
27	190	12.03.2024	N 40º 57' 32", E 029º 10' 39"	Marmara Education Village Entrance area

2.3. Method

The collected specimens were placed in plastic bags and brought to the laboratory for further processing, adhering to herbarium techniques. Identified specimens are preserved at the Herbarium of the Department of Forest Botany, Faculty of Forestry, Çankırı Karatekin University (Ursavaş and Tuttu, 2020).

The examination of moss specimens for diagnosis was conducted using the Leica EZ4 HD Stereo microscope and the Olympus BX50 Light microscope (Ursavaş and Keçeli, 2021). Various flora and revision works were consulted for the diagnosis of moss specimens (Hedenäs, 1992; Lewinsky, 1993; Zander, 1993; Plášek, et al., 2015; Smith, 2004; Lara et al., 2016; Kürschner and Frey, 2020). During the compilation of plant lists, taxonomic arrangement considering valid names and synonymy status was based on Hodgetts et al. (2020). Taxa in the floristic list are presented in alphabetical order.

3. Findings

Following the diagnosis of collected samples, 42 taxa belonging to 10 families and 21 genera were identified. The identified taxa are listed alphabetically in the floristic list. There have been few bryophyte flora studies conducted in Istanbul province to date (Henderson, 1958; Robinson and Godfrey, 1960; Yayıntaş and Tonguç, 1994; Nacheava et al., 2008; Papp and Sabovljevic, 2003). These studies are generally attributed to foreign researchers and are of considerable age. Taxa recorded for the first time in Istanbul province are marked with an asterisk (*) based on the examination of these studies. The floristic list encompasses the species nomenclature, familial classification, locality number, habitat description, and sequential collector identification.

3.1. Floristic list

1. **Amblystegium serpens* (Hedw.) Schimp., (Amblystegiaceae), 17, 18, on wall, GÜRSU 1-2.
2. *Barbula unguiculata* Hedw. (Pottiaceae),15, 16, on wall, GÜRSU 5-6.
3. **Brachythecium mildeanum* (Schimp.) Schimp., (Brachytheciaceae), 3, 5, on wall, GÜRSU 7.
4. *Brachythecium rutabulum* (Hedw.) Schimp., (Brachytheciaceae), 1, 2, on trunk linden tree, GÜRSU 8-9.
5. **Brachythecium starkei* (Brid.) Schimp., (Brachytheciaceae), 6, on trunk plane tree, GÜRSU 10.
6. **Bryum argenteum* Hedw., (Bryaceae), 6, 16, on the wall, GÜRSU 11-12.
7. **Calliergonella cuspidata* (Hedw.) Loeske, (Hypnaceae), 6, on soil, GÜRSU, 14.
8. *Ceratodon purpureus* (Hedw.) Brid., (Ditrichaceae), 23, 27, on soil, GÜRSU 15-16.
9. *Fissidens taxifolius* Hedw., (Fissidentaceae), 3, 4, on soil, GÜRSU 28-29.
10. *Funaria hygrometrica* Hedw. (Funariaceae), 21, 22, 24, on soil, on stony soil, GÜRSU 30-31-32.
11. *Geheebia tophacea* (Brid.) R.H. Zander (Syn: *Didymodon tophaceus* (Brid.) Lisa), (Pottiaceae), 1, 10, on soil, GÜRSU 17-18.
12. **Gemmabryum caespiticium* (Hedw.) J.R. Spence (Syn*: Ptychostomum imbricatulum* (Müll. Hal.) Holyoak & N. Pedersen), (Bryaceae), 10, on rock, GÜRSU 66.
13. **Gemmabryum dichotomum* (Hedw.) J.R. Spence & H.P. Ramsay (Syn: *Bryum dunense* A.J.E. Sm. & H. Whitehouse), (Bryaceae), 4, on wall, GÜRSU 13.
14. *Grimmia pulvinata* (Hedw.) Sm., (Grimmiaceae), 13, 15, 16, on rock, GÜRSU 33-34-35.
15. **Grimmia trichophylla* Grev., (Grimmiaceae), 10, 13, on rock, on wal, GÜRSU 36-37.
16. *Homalothecium lutescens* (Hedw.) H. Rob., (Brachytheciaceae), 1, 27, on wall, on soil, GÜRSU 38-39.
17. **Homalothecium philippeanum* (Spruce) Schimp., 5, 12, on rock, on soil, GÜRSU 40-41.
18. *Homalothecium sericeum* (Hedw.) Schimp., (Brachytheciaceae), 7, 14, 19, on rock, on soil, GÜRSU 42-43-44.
19. **Homomallium incurvatum* (Schrad. ex Brid.) Loeske, (Hypnaceae), 25, on wall, GÜRSU 45.
20. *Hypnum cupressiforme* Hedw., (Hypnaceae), 25, 26, 27, on rock, on soil, GÜRSU 46-47-48.
21. *Hypnum cupressiforme* var. *lacunosum* Brid., (Hypnaceae), 23, 25, on rock, on soil, GÜRSU 49-50.
22. **Hypnum jutlandicum* Holmen & E. Warncke, (Hypnaceae), 3, on wall, GÜRSU 51.
23. **Hypnum resupinatum* Taylor, (Hypnaceae), 5, 11, on rock, on soil, GÜRSU 52-53.
24. *Kindbergia praelonga* (Hedw.) Ochyra, (Syn: *Eurhynchium praelongum* (Hedw.) Schimp., (Brachytheciaceae), 10, on soil, GÜRSU 25.
25. *Lewinskya affinis* (Brid.) F. Lara, Garilleti & Goffinet (Syn: *Orthotrichum affine* Brid.), (Orthotrichaceae), 1, 6, 8, 10, on plane tree, GÜRSU 54-55.
26. **Orthotrichum cupulatum* Hoffm. ex Brid., (Orthotrichaceae), 6, 12, on trunk ash tree, GÜRSU 56-57.
27. *Orthotrichum diaphanum* Schrad. ex Brid., (Orthotrichaceae), 6, 12, 17, on trunk ash tree, GÜRSU 58-59-60.
28. *Oxyrrhynchium hians* (Hedw.) Loeske (Syn: *Eurhynchium hians* (Hedw.) Sande Lac.), (Brachytheciaceae), 8, 9, 10, 27, on soil, GÜRSU 21-22-23-24.
29. *Oxyrrhynchium schleicheri* (R. Hedw.) Röll (Syn: *Eurhynchium schleicheri* (R. Hedw.) Milde, (Brachytheciaceae), 20, on soil, on branch, GÜRSU 26-27.
30. *Pseudoscleropodium purum* (Hedw.) M. Fleisch., (Brachytheciaceae), 1, 24, 27, on soil, GÜRSU 61-62-63.
31. **Ptychostomum creberrimum* (Taylor) J.R. Spence & H. P. Ramsay, (Bryaceae), 10, on rock, GÜRSU 65.
32. **Rhynchostegium confertum* (Dicks.) Schimp., (Brachytheciaceae), on rock, 13, GÜRSU 67.
33. *Rhynchostegium murale* (Hedw.) Schimp., (Brachytheciaceae), 8, on soil, GÜRSU 68.
34. *Rosulabryum capillare* (Hedw.) J.R. Spence (Syn: *Ptychostomum capillare* (Hedw.) Holyoak & N. Pedersen), (Bryaceae), 16, on rock, GÜRSU 64.
35. **Schistidium apocarpum* (Hedw.) Bruch & Schimp., (Grimmiaceae), 9, on rock, GÜRSU 69.
36. **Schistidium confertum* (Funck) Bruch & Schimp., (Grimmiaceae), 13, on rock, GÜRSU 70.
37. *Scleropodium touretii* (Brid.) L. F. Koch, (Brachytheciaceae), 1, 10, on soil, GÜRSU 71-72.
38. **Streblotrichum commutatum* (Jur.) Hilp., (Syn: *Barbula convoluta* subsp. *commutata* (Jur.) Boulay), (Pottiaceae), 26, on wall, GÜRSU 4.
39. *Streblotrichum convolutum* (Hedw.) P. Beauv., (Syn: *Barbula convoluta* Hedw.) (Pottiaceae), 13, on rock, GÜRSU 3.
40. **Tortula brevissima* Schiffn., (Pottiaceae), 10, 27, on rock, on trunk ash tree, GÜRSU 73.74.
41. *Tortula muralis* Hedw., (Pottiaceae), 10, 19, 23, on wall, GÜRSU 75-76-77.
42. *Vinealobryum vineale* (Brid.) R.H. Zander (Syn: *Didymodon vinealis* (Brid.) R.H. Zander),

(Pottiaceae), 11, 12, on wall, on rock, GÜRSU 19-20.

4. Results and Discussion

A total of 120 samples were collected from the designated study area, resulting in the identification of 42 taxa belonging to 26 genera and 10 families. The predominant families within the campus bryoflora are Brachytheciaceae with 13 taxa and Pottiaceae with 7 taxa. The most abundant genera of mosses are *Hypnum* with 4 taxa, followed by *Brachythecium*, and *Homalothecium* each with 3 taxa. Furthermore, 19 of these taxa are recorded for the first time in İstanbul province.

Approximately 47.7% of mosses identified in the study area are pleurocarpous, while 52.3% are acrocarpous. The equal representation of acrocarpous and pleurocarpous species in the campus area can be attributed to the presence of human-made habitats and the abundance of materials such as stone, rock, concrete, mortar and coexistence of arid, semi-arid and humid habitats along with taxa that have adapted to these human-made environments. The presence of 42 different species in the area indicates that despite anthropogenic pressures, campus areas serve as significant ecological networks, well-conserved and situated between urban and natural landscapes.

This study compares with Table 2 some campus flora studies that have been previously conducted, demonstrating similar characteristics in terms of human density and campus size.

Table 2. Comparison of moss flora studies conducted on Maltepe Campus and other campuses.

Article	**Maltepe University Campus (Gürsu and Ursavaş, 2024)**		**Ankara University Beşevler 10th Year Campus (Ezer et al. 2021)**		**Recep Tayyip Erdoğan University, Zihni Derin Campus (Abay, 2018)**		**Karadeniz Technical University Kanuni Campus (Erata et al., 2017)**		**Zonguldak Karaelmas University Central Campus (Alataş et al., 2011)**	
Total Number of Taxa	42		28		53		94		51	
Families	N.T	%	N.T	%	N.T	%	N.T	%	N.T	%
Brachytheciaceae	13	31	5	18	13	25	21	23	15	29,5
Pottiaceae	7	17	9	32	12	23	16	17	12	23,6
Hypnaceae	6	14,2	-	-	4	7,4	6	6,3	2	4
Bryaceae	5	12	3	11	5	9,4	10	11	5	10
Grimmiaceae	4	9,5	2	7,1	-	-	12	13	2	4
Orthotrichaceae	3	7,1	6	21,3	2	3,7	3	3,2	4	7,8
Fissidentaceae	1	2,3	-	-	1	1,8	2	2,2	3	5,8
Amblystegiaceae	1	2,3	2	7,1	1	1,8	4	4,2	1	1,9
Funariaceae	1	2,3	1	3,5	1	1,8	1	1	1	1,9
Ditrichaceae	1	2,3	-	-	2	3,7	2	2,2	-	-
Mniaceae	-	-	-	-	-		6	6,3	3	5,8
Entodontaceae	-	-	-	-	-		2	2,2	-	-
Thuidiaceae	-	-	-	-	-		2	2,2	-	-
Dicranaceae	-	-	-	-	3	5,6	2	2,2	1	1,9
Cinclidiaceae	-	-	-	-	-		1	1	-	-
Rhabdoweisiaceae	-	-	-	-	1	1,8	1	1	-	-
Polytrichaceae	-	-	-	-	5	9,4	1	1	1	1,9
Leucodontaceae	-	-	-	-	-		1	1	-	-
Bartramiaceae	-	-	-	-	3	5,6	-	-	-	-
Hylocomiaceae	-	-	-	-	-	-	-	-	1	1,9
		100		100		100		100		100

N.T: Number of Taxa

Examining Table 2 reveals that the families Brachytheciaceae and Pottiaceae are the most common taxa in all studies. This prevalence likely stems from the abundance of taxa within these families that have adapted well to urban environments. Taxa belonging to the families Hypnaceae, Fissidentaceae, and Ditrichaceae were not encountered solely at Ankara University

Beşevler 10th Year Campus. This occurrence could be attributed to the high level of air pollution and lower humidity levels prevalent in the Inner Anatolian region and the central area of the city where Ankara University is situated compared to other campuses. Furthermore, individuals of the Grimmiaceae family were exclusively absent at Recep Tayyip Erdoğan University Zihni Derin Campus. This observation suggests that although members of this family typically thrive on man-made structures such as stone or concrete walls, they may not have had sufficient time to colonize the area due to the university's recent establishment.

Deklarasyon

Yazar katkıları: Fikir/Kavram, GG, SU; Tasarım ve dizayn, GG, SU, NT; Denetleme danışmanlık, GG, SU, NT; Kaynaklar, GG, SU; Malzemeler, GG, NT, SU; Ver toplama ve/veya işleme, GG, SU; Analiz ve/veya yorum, SU, NT; Literatür taraması, GG, SU; Yazım aşaması, GG, SU, NT; Eleştirel inceleme, SU, NT.

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