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A Research On Sera Lake Nature Park (Akçaabat-Trabzon) Bryophytes

Sera Gölü Tabiat Parkı (Akçaabat-Trabzon) Briyofitleri Üzerine Bir Araştırma

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Abstract

Bryophyte samples were collected from 5 different localities in March and April 2024 at Sera Lake Nature Park (Akçaabat/Trabzon) in Türkiye. As a result of the identification of the samples, a total of 1 hornwort taxa belonging to 1 genera and 1 family; 14 liverwort taxa belonging to 12 genera and 11 families; 60 mosses taxa belonging to 41 genera and 16 families were determined. Among the identified species, *Cryphaea heteromalla* is new to the A4 grid-square. *Aneura pinguis* is a new record for Trabzon and all species are new records for Sera Lake Nature Park.

Keywords: Biodiversity, Bryophyte, Flora, Sera Lake, Türkiye

Özet

2024 Mart ve Nisan aylarında, Sera Gölü (Akçaabat/Trabzon) Tabiat Parkı'da 5 farklı lokaliteden briyofit örnekleri toplanmıştır. Örneklerin teşhis edilmesi sonucunda 1 familya ve 1 cinse ait 1 boynuzotu taksonu; 11 familya ve 12 cinse ait 14 ciğerotu taksonu ile 16 familya ve 41 cinse ait 60 yapraklı karayosunu olmak üzere toplamda 75 briyofit taksonu (tür, alttür ve varyete) saptanmıştır.Teşhis edilen türler arasında *Cryphaea heteromalla* A4 karesi için yenidir. *Aneura pinguis* Trabzon için ve diğer tüm türler de Sera Gölü Tabiat Parkı için yeni kayıttır.

Anahtar Kelimeler: Biyoçeşitlilik, Briyofit, Flora, Sera Gölü, Türkiye

1. INTRODUCTION

This study investigates the bryophyte flora of Sera Lake Nature Park, which had not previously been studied from a bryofloristic perspective, with the aim of contributing to the bryophyte flora of Turkey. Thus, it is hoped that this will enhance the understanding of the biodiversity of the study area.

The study area, Sera Lake Nature Park (41.0197°N, 39.56293°E), is located between the Yıldızlı (Sera) and Derecik neighborhoods of Trabzon. It is 12 km from the center of Trabzon and 8 km from the Akçaabat district (Çavuş, 2014). The lake was formed as a result of a landslide in 1950 and is fed by the waters of the Sera Stream (Çavuş, 2014; Güneroğlu & Pektaş, 2022).

The nature park covers an area of 219 decares. Its width is approximately 150 m, and its length is 1200 m. The width of Sera Lake decreases from 250 m in the north to 110 m in the south. The deepest part of the lake is measured at 20 m. The lake contains two small (5-10 m²) and one large (60 m²) islets. Due to its wetland features and rich biodiversity, Sera Lake Nature Park was declared a Nature Park on April 24, 2010, and placed under protection (Çavuş, 2014; Güneroğlu & Pektaş, 2022).

The boundaries of Sera Lake Nature Park are not extensive, and its surroundings are privately owned. For these reasons, a vegetation study was conducted based on the Akçaabat district. The forested area of the district constitutes 37% of the total district area, covering 14.3 hectares (Çavuş, 2014).

Figure 1. Google Earth view of the study area.

Figure 2. A picture of the study area.

The Sera Lake catchment area is located in the Colchic section of the Euro-Siberian Phytogeographic Region. The woody taxa found in the 0-600 m sections of the area include hazel, blackthorn, fir, oak, hornbeam, and chestnut taxa.

The vegetation within and around the area generally includes the following species: *Platanus orientalis* L., *Corylus colurna* L., *C. avellana* L., *Ilex aquifolium* L., *Castanea sativa* Mill., *Populus* ssp. L., *Pinus sylvestris* L., *Quercus* ssp. L., *Laurocerasus officinalis* L., *Laurus nobilis* L., *Arbutus unedo* L., *A. andrachne* L., *Pistacia* sp. L., *Sorbus aucuparia* L., *Hedera* ssp. L., *Fragaria* sp. L., *Urtica* ssp. L., *Pteridium* sp. Gled. ex Scop. (Karahasanoğlu, 2019).

2. MATERIALS AND METHODS

Bryophyte samples were collected by the authors from five different localities within the boundaries of Sera Lake Nature Park during field surveys conducted in March and April 2024 (Table 1).

Table 1. Locality information of bryophyte specimens collected from the study area (URL-1, 2024).

No.	Locality	GPS (Latitude, Longitude)	Altitude (m)	Date
1	Trabzon (Akçaabat): Sera Lake Nature Park	40°59'15"N 39°37'12"E	113	14.03.2024
2	Trabzon (Akçaabat): Sera Lake Nature Park	40°58'56"N 39°36'45"E	110	14.03.2024
3	Trabzon (Akçaabat): Sera Lake Nature Park	40°58'51"N 39°36'29"E	97	06.04.2024
4	Trabzon (Akçaabat): Sera Lake Nature Park	40°58'57"N 39°36'35"E	92	06.04.2024
5	Trabzon (Akçaabat): Sera Lake Nature Park	40°59'04"N 39°36'46"E	101	06.04.2024

Bryophyte samples collected from Sera Lake Nature Park (Akçaabat, Trabzon) and air-dried samples were examined with Carl Zeiss Stemi 2000-C stereomicroscope and Carl Zeiss Axio İmager A2 light microscope.

The bryophyte samples were identified using relevant literatures (Nyholm, 1986, 1989, 1993, 1998; Crum & Anderson, 1981; Paton, 1999; Smith, 1996, 2004; Hedenäs, 1992; Cortini-Pedrotti, 2001, 2006; Guerra et al., 2006, 2010, 2014, 2018; Frey et al., 2006; Brugués et al., 2007; Casas et al., 2009; Brugués & Guerra, 2015; Lüth, 2019; Kürschner & Frey, 2020). For creating the list of taxa and nomenclatural changes and synonyms for the identified taxa, Hodgetts et al. (2020) followed. The status of bryophyte taxa for the A4 square was evaluated by scanning the relevant literature (Batan & Özdemir, 2013a; Abay et al., 2016; Özdemir and Batan, 2017a, 2017b, Erata et al., 2018, 2020a, 2020b, 2021, 2022). Also, the situation of bryophyte taxa was appraised by reviewing related literature for the Trabzon (Batan & Özdemir,

2011, 2013b; Özdemir & Batan, 2017a; Erata et al., 2017, 2018, 2020a, 2020b, 2021, 2022; Batan et al., 2018; Özen et al., 2019).

The bryophyte samples are stored at the bryophyte collection at the Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University, and preserved as herbarium specimens.

3. RESULTS AND DISCUSSION

Bryophyte samples were collected from Sera Lake Nature Park, located in Akçaabat district of Trabzon province in the Eastern Black Sea region of Türkiye, during May and April of 2024. A total of 75 bryophyte taxa determined.

In this study, as a result of examination of ± 500 bryophyte specimens have been determined a total of 75 taxa belonging to 28 families and 54 genera in Bryophyte. Among them, 1 taxon from 1 family and 1 genus in the Anthocerotophyta (hornworts), 14 taxa from 11 families and 12 genera in the Marchantiophyta (liverworts), and 60 taxa from 16 families and 41 genera in the Bryophyta (mosses) were found to be present in the study area.

According to literature reviews on the study area, *Cryphaea heteromalla* is a new record for new to the A4 grid-square, while *Aneura pinguis* is a new record for Trabzon province.

3.1. Bryofloristic List

The systematic list is prepared using nomenclature of the species and synonym status were evaluated by reviewing Hodgetts et al. (2020). For each taxa, their localities, substrate, and some ecological characteristics were given in the floristic list (Dierßen, 2001). Taxa new for A4 square is indicated with (+) in the bryofloristic list. Also, new for Trabzon province is indicated with (#) bryofloristic list.

ANTHOCEROTOPHYTA

Anthocerotaceae Dumort.
Anthoceros L.
1. *Anthoceros punctatus* L.
Loc.: 1, 3, 5**;** on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.

MARCHANTIOPHYTA
Cephaloziaceae Mig.
Cephalozia (Dumort.) Dumort.

2. *Cephalozia bicuspidata* (L.) Dumort.
Loc.: 1, 2, 4, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Jungermanniaceae Rchb.
Mesoptychia (Lindb.) A.Evans
3. *Mesoptychia bantriensis* (Hook.) L.Söderstr. & Váňa.
Loc.: 1, 2, 4, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
4. *M. collaris* (Nees) L.Söderstr. & Váňa
Loc.: 1, 2, 4, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
5. *M. heterocolpos* (Thed. ex Hartm.) L.Söderstr. & Váňa
Loc.: 1, 2, 4, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, basiphyte.
Frullaniaceae Lorch
Frullania Raddi
6. *Frullania dilatata* (L.) Dumort.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Porellaceae Cavers
Porella L.
7. *Porella platyphylla* (L.) Pfeiff.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Mesophyte, sciophyte, acidophyte.
Radulaceae Müll.Frib.
Radula Dumort.
8. *Radula complanata* (L.) Dumort.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Aneuraceae H.Klinggr.
Aneura Dumort
9. (#) *Aneura pinguis* (L.) Dumort.
Loc.: 1, 2; on wet rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Metzgeriaceae H.Klinggr.
Metzgeria Raddi
10. *Metzgeria conjugata* Lindb.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Pelliaceae H.Klinggr.
Apopellia (Grolle) Nebel & D.Quandt
11. *Apopellia endiviifolia* (Dicks.) Nebel & D.Quandt
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Pellia Raddi
12. *Pellia epiphylla* (L.) Corda.
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Lunulariaceae H.Klinggr
Lunularia Adans.

13. *Lunularia cruciata* (L.) Dumort. ex Lindb.
Loc.: 1, 2, 4; on rock, on soil.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
Conocephalaceae Müll.Frib. ex Grolle
Conocephalum Hill
14. *Conocephalum conicum* (L.) Dumort.
Loc.: 1, 4, 5; on wet soil.
Ecological Characteristics: Hygrophyte, sciophyte, basiphyte.
Marchantiaceae Lindl.
Marchantia L.
15. *Marchantia polymorpha* L.
Loc.: 1, 2, 4; on soil.
Ecological Characteristics: Hygrophyte, sciophyte, basiphyte.

BRYOPHYTA
Polytrichaceae Schwägr.
Atrichum P.Beauv
16. *Atrichum undulatum* (Hedw.) P.Beauv.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Polytrichum Hedw.
17. *Polytrichum formosum* Hedw.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, acidophyte.
Encalyptaceae Schimp.
Encalypta Hedw.
18. *Encalypta streptocarpa* Hedw.
Loc.: 1, 2, 4; on soil.
Ecological Characteristics: Xerophyte, sciophyte, subneutrophyte.
Dicranellaceae M.Stech
Dicranella (Müll.Hal.) Schimp.
19. *Dicranella heteromalla* (Hedw.) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
20. *D. howei* Renauld & Cardot
Loc.: 1, 2, 4; on rock, on wet soil.
Ecological Characteristics: Xerophyte, photophyte, basiphyte.
Fissidentaceae Schimp.
Fissidens Hedw.
21. *Fissidens taxifolius* Hedw.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
Pottiaceae Schimp.
Barbula Hedw.
22. *Barbula unguiculata* Hedw.
Loc.: 2, 3; on tree bark, on rock.
Ecological Characteristics: Hygrophyte, photophyte, acidophyte.
Dialytrichia (Schimp.) Limpr.
23. *Dialytrichia mucronata* (Brid.) Broth.
Loc.: 1, 3, 4, 5; on soil, on rock.

Ecological Characteristics: Rheophyte, photophyte, subneutrophyte.
Didymodon Hedw.
24. *Didymodon insulanus* (De Not.) M.O.Hill
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Tortella (Müll.Hal.) Limpr.
25. *Tortella fasciculata* (Culm.) Culm.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, basiphyte.
26. *T. humilis* (Hedw.) Jenn.
Loc.: 1, 2, 5; on rock
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
27. *T. inflexa* (Bruch) Broth.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, photophyte, basiphyte.
28. *T. tortousa* (Hedw.) Limpr.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, basiphyte.
Tortula Hedw.
29. *Tortula canescens* Mont.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
30. *T. subulata* Hedw.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
Weissia Hedw.
31. *Weissia brachycarpa* (Nees & Hornsch.) Jur.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
Bryaceae Schwägr
Bryum Hedw.
32. *Bryum dichotomum* Hedw.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
Imbribryum Pedersen
33. *Imbribryum mildeanum* (Jur.) J.R.Spence.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Ptychostomum Hornsch.
34. *Ptychostomum capillare* (Hedw.) Holyoak & N.Pedersen.
Loc.: 1, 3, 4, 5; on rock, on soil
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
35. *P. rubens* (Mitt.) Holyoak & N.Pedersen.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, photophyte, basiphyte.
36. *P. torquescens* (Bruch & Schimp.) Ros & Mazimpaka
Loc.: 2, 3; on tree bark, on rock.
Ecological Characteristics: Hygrophyte, photophyte, basiphyte.
Mniaceae Schwägr.
Pohlia Hedw.

37. *Pohlia annotina* (Hedw.) Lindb.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, acidophyte.
38. *P. filum* (Schimp.) Mårtensson
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, photophyte, subneutrophyte.
Epipterygium Lindb.
39. *Epipterygium tozeri* (Grev.) Lindb.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Plagiomnium T.J.Kop.
40. *Plagiomnium drummondii* (Bruch & Schimp.) T. Kop.
Loc.: 1, 4; on wet soil.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
41. *P. ellipticum* (Brid.) T.J.Kop.
Loc.: 1, 2, 3; on tree bark, on soil, on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
42. *P. medium* (Bruch & Schimp.) T.J.Kop.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
43. *P. undulatum* (Hedw.) T.J.Kop.
Loc.: 1, 2, 3; on tree bark, on rock, on soil.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Orthotrichaceae Arn.
Orthotrichum Hedw.
44. *Orthotrichum diaphanum* Brid.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
45. *O. pallens* Bruch ex Brid.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Ulota D.Mohr
46. *Ulota crispa* (Hedw.) Brid.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, photophyte, subneutrophyte.
Amblystegiaceae G.Roth
Cratoneuron (Sull.) Spruce
47. *Cratoneuron filicinum* (Hedw.) Spruce.
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Hygrophyte, photophyte, basiphyte.
Amblystegium Schimp.
48. *Amblystegium serpens* (Hedw.) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Campyliadelphus (Kindb.) R.S.Chopra
49. *Campyliadelphus chrysophyllus* (Brid.) R.S.Chopra.
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Mesophyte, photophyte, subneutrophyte.
Hygroamblystegium Loeske
50. *Hygroamblystegium tenax* (Hedw.) Jenn.

Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
51. *H. varium* (Hedw.) Mönk.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Pseudoamblystegium Vanderp. & Hedenäs
52. *Pseudoamblystegium subtile* (Hedw.) Vanderp. & Hedenäs.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, photophyte, subneutrophyte.
Brachytheciaceae Schimp.
Eurhynchium Bruch & Schimp.
53. *Eurhynchium striatum* (Hedw.) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Palamocladium M.Fleisch.
54. *Palamocladium euchloron* (Bruch ex Müll.Hal.) Wijk & Margad.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Xerophyte, sciophyte, basiphyte.
Pseudoscleropodium (Limpr.) M.Fleisch.
55. *Pseudoscleropodium purum* (Hedw.) M.Fleisch.
Loc.: 1, 2, 4, 5; on rock, on soil.
Ecological Characteristics: Mesophyte, sciophyte, acidophyte.
Rhynchostegium Bruch & Schimp.
56. *Rhynchostegium confertum* (Dicks.) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
57. *R. rotundifolium* (Scop. ex Brid.) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Microeurhynchium Ignatov & Vanderp.
58. *Microeurhynchium pumilum* (Wilson) Ignatov & Vanderp.
Loc.: 1, 2, 4, 5; on rock, on soil.
Ecological Characteristics: Xerophyte, sciophyte, subneutrophyte.
Oxyrrhynchium (Schimp.) Warnst.
59. *Oxyrrhynchium hians* (Hedw.) Loeske.
Loc.: 1, 2, 3; on tree bark, on rock, on soil.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
60. *O. speciosum* (Brid.) Warnst.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Brachythecium Schimp.
61. *Brachythecium glareosum* (Bruch ex Spruce) Schimp.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
62. *B. rutabulum* (Hedw.) Schimp.
Loc.: 1, 2, 3; on tree bark, on rock, on soil.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Eurhynchiastrum Ignatov & Huttunen
63. *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen.
Loc.: 2, 3; on tree bark.

Ecological Characteristics: Mesophyte, photophyte, subneutrophyte.
Sciuro-hypnum (Hampe) Hampe
64. *Sciuro-hypnum plumosum* (Hedw.) Ignatov & Huttunen.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Mesophyte, photophyte, acidophyte.
65. *S. populeum* (Hedw.) Ignatov & Huttunen.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Mesophyte, photophyte, acidophyte.
Hypnaceae Schimp.
Hypnum Hedw.
66. *Hypnum andoi* A.J.E. Sm.
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Mesophyte, sciophyte, acidophyte.
67. *H. cupressiforme* Hedw.
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Xerophyte, photophyte, subneutrophyte.
68. *H. jutlandicum* Holmen & E.Warncke
Loc.: 1, 3, 4; on soil.
Ecological Characteristics: Mesophyte, photophyte, acidophyte.
Pylaisiaceae Schimp.
Calliergonella Loeske
69. *Calliergonella cuspidata* (Hedw.) Loeske.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Cryphaeaceae Schimp.
Cryphaea D.Mohr
70. (+) *Cryphaea heteromalla* (Hedw.) D.Mohr
Loc.: 2, 3; on tree bark (*Populus* sp.).
Ecological Characteristics: Hygrophyte, sciophyte, acidophyte.
Neckeraceae Schimp.
Alleniella S.Olsson, Enroth & D.Quandt
71. *Alleniella complanata* (Hedw.) S.Olsson, Enroth & D.Quandt
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
Exsertotheca S.Olsson, Enroth & D.Quandt
72. *Exsertotheca crispa* (Hedw.) S.Olsson, Enroth & D.Quandt.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.
Thamnobryum Nieuwl.
73. *Thamnobryum alopecurum* (Hedw.) Gangulee.
Loc.: 2, 3; on tree bark.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Myuriaceae M.Fleisch.
Ctenidium (Schimp.) Mitt.
74. *Ctenidium molluscum* (Hedw.) Mitt.
Loc.: 1, 2, 5; on rock.
Ecological Characteristics: Hygrophyte, sciophyte, subneutrophyte.
Anomodontaceae Kindb.
Anomodon Hook. & Taylor
75. *Anomodon viticulosus* (Hedw.) Hook. & Taylor.

Loc.: 2, 3; on tree bark.
Ecological Characteristics: Mesophyte, sciophyte, subneutrophyte.

4. CONCLUSION

The distribution and percentage of the identified species and subspecies according to families were separately analyzed for liverworts and mosses.

For liverworts, the families with the highest number of taxa were Jungermanniaceae (3), Pelliaceae (2), Frullaniaceae (1), Porellaceae (1), Radulaceae (1), Aneuraceae (1), Metzgeriaceae (1), Cephaloziaceae (1), Lunulariaceae (1), Conocephalaceae (1), and Marchantiaceae (1). In addition, one hornwort family (Anthocerotaceae) is represented by one taxon on the plant list (*Anthoceros punctatus*).

Floristical data from the study area show that the Jungermanniaceae family, with the highest number of taxa (3), is in first place with a percentage of 21.42%, followed by the Pelliaceae family with 2 taxa at 14.28%. The families Radulaceae, Aneuraceae, Metzgeriaceae, Cephaloziaceae, Lunulariaceae, Conocephalaceae, and Marchantiaceae, each with one taxon and 7.14%, follow these.

For mosses, the families with the most taxa were Brachytheciaceae (13), Pottiaceae (10), Mniaceae (7), Amblystegiaceae (6), Bryaceae (5), Orthotrichaceae (3), Hypnaceae (3), Neckeraceae (3), Polytrichaceae (2), Dicranellaceae (2), Encalyptaceae (1), Fissidentaceae (1), Pylaisiaceae (1), Cryphaeaceae (1), Myuriaceae (1), and Anomodontaceae (1).

The results show that the Brachytheciaceae family, with the highest number of taxa (13), is in the first place with a percentage of 21.66%, followed by the Pottiaceae family with 10 taxa at 16.66%, Mniaceae with 7 taxa at 11.66%, and Amblystegiaceae with 6 taxa at 10%. The Bryaceae family, with 5 taxa, is in the fifth place with 8.33%.

Families with 3 taxa, including Orthotrichaceae, Hypnaceae, and Neckeraceae, are in the sixth place with 5%. The families Polytrichaceae and Dicranellaceae, each with 2 taxa, are in the seventh place with 3.33%, and families with 1 taxon each, including Encalyptaceae, Fissidentaceae, Pylaisiaceae, Cryphaeaceae, Myuriaceae, and Anomodontaceae, are in the last place with 1.66%.

According to the study results, bryophyte species (liverworts, hornworts, and mosses) were compared based on their pH requirements, light utilization, and moisture needs in their habitat. The results show that 53.3% of the bryophyte species are subneutral (pH = 5.7-7), 32%

are acidophilic (pH < 5.7), and 14.66% are basiphilic (pH > 7). This indicates that most of the identified bryophyte species prefer neutral areas.

It was found that 72% of the identified bryophyte species are sciophytes, occurring in shaded environments in dense forests, while 28% are photophytes, found at forest edges and in open or semi-shaded areas.

It was also found that 49.33% of the bryophyte species are hygrophytes, 35% are mesophytes, and 13.33% are xerophytes. Given the climate and precipitation of the study area, it is logical that there is a high proportion of hygrophyte and mesophyte species. The presence of xerophytic species is consistent with the results in semi-arid regions.

In conclusion, this study, aimed at determining bryophyte biodiversity, examined samples collected from 5 different localities along Sera Lake Nature Park in Trabzon. This has contributed to the knowledge of bryophyte diversity in one more area of the Eastern Black Sea Region.

According to the results, *Cryphaea heteromalla* from the Cryphaeaceae family is new to the A4 grid-square in Türkiye. Additionally, *Aneura pinguis* is a new record for Trabzon, and all other species are new records for Sera Lake Nature Park. The study indicates that Sera Lake Nature Park has a rich bryofloristic diversity.

DECLARATIONS

There is no conflict of interest between the authors.

AUTHORS' CONTRIBUTIONS

All of the authors have contributed significantly to the paper. The study was designed by NB and KY. Sample collection was carried out by KY, and NB. Taxa identification was performed by KY, NB and ZGY. The manuscript was written by NB, EA, HE and ZGY. All of the authors have read, approved and agreed to the published version of the manuscript.

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REFERENCES

Abay, G., Batan, N., & Özdemir, T. (2016). Bryophyte Checklist of Rize, North-East Turkey. *Arctoa*, 25, 386-392.

Batan, N., & Özdemir, T. (2011). Mersin (C12), Trabzon ve Gümüşhane (A4)'den bazı karayosunu (musci) kayıtları. *Turkish Journal of Forestry*, 12(2), 104-109

Batan, N., & Özdemir, T. (2013a). Contributions to the moss flora of the Caucasian part (Artvin Province) of Turkey. *Turkish Journal of Botany*, 37, 375-388

Batan, N., & Özdemir, T. (2013b). Bryoflora of Dernekpazarı district of Trabzon (Turkey) province. *Biological Diversity and Conservation*, 6(2), 45-49

Brugués, M., Cros, R. M., & Guerra, J. (2007). Flora Briofitica Ibérica Volume I, Uniersidad de Murcia. Sociedad Espanola de Briyologia Murcia. Murcia.

Brugués, M., & Guerra, J. (2015). Flora Briofitica Ibérica VoIume 2, Uniersidad de Murcia, ISBN: 84-608-2198-4, Sociedad Espanola de Briyologia Murcia. Murcia.

Casas, C., Brugués, M., Cros, M. R., Sérgio, C., & Infante, M. (2009). Handbook of Liverworts and Hornworts of The Iberian Peninsula and The Balearic Islands, ISBN: 978-84 92583-55-3, 177 p, Institut D‟estudis Catalans, Spain.

Crum, A. H., & Anderson, E. L. (1981). Mosses of Eastern North America. Columbia University Press. Newyork.

Cortini Pedrotti, C. (2001). Flora dei muschi d‟Italia, Sphagnopsida, Andreaopsida, Bryopsida (I parte). ISBN: 88-7287-250-2, Antonio Delfino Editore Medicina-Scienze, Roma.

Cortini Pedrotti, C. (2006). Flora dei muschi d‟Italia, Bryopsida (II parte). ISBN: 88-7287-370-3, Antonio Delfino Editore Medicina-Scienze, Roma.

Çavuş, A. (2014). Trabzon'da doğa turizmi açısından değerlendirilmesi gereken turistik bir alan: Sera Gölü. *Türk Coğrafya Dergisi*, 63, 43-49

Dierßen, K. (2001). Distribution, Ecological Amplitude and Phytosociological Characterization of European Bryophytes, Bryophytorum Bibliotheca, Berlin: J. Cramer, vol. 56.

Erata, H., Özen, Ö., Batan, N., & Özdemir, T. (2017). Karadeniz Teknik Üniversitesi Kanuni Kampüsü Briyofit Florası. *Anatolian Bryology*, 3(1), 9-18.

Erata, H., Batan, N., & Özdemir, T. (2018). The Bryophyte Flora of Sis Mountain (Giresun-Trabzon, Turkey), *Anatolian Bryology*, 4(1), 46-64

Erata, H., Batan, N., Özen, Ö., & Alataş, M. (2020a). Contributions to the bryophyte flora of Şalpazarı and Tonya districts (Trabzon, Turkey). *Phytologia Balcanica*, 26(1), 71-79.

Erata, H., Batan, N., Alataş, M., & Özen, Ö. (2020b). Bryophytes records from Maçka District (Trabzon Province-Turkey). *Lindbergia*, 43: linbg.01127.

Erata, H., Alataş, M., Batan, N., & Ezer, T. (2021). Contributions to the Bryophyte Flora of Altındere Valley (Trabzon, Turkey). Acta Biologica Turcica, 34(4), 186-196.

Erata, H., Batan, N., Alataş, M., & Özen, Ö. (2022). Çaykara ilçesi (Trabzon, Türkiye) Briyofit Florasına Katkılar. *Anatolian Bryology*, 8(2), 131-139

Frey, W., Frahm, J. P., Fischer, E., & Lobin, W. (2006). The liverworts, mosses and ferns of Europe. Harley Books, Essex.

Guerra, J., Cano, M. J., & Cros R.M. (2006). Flora Briofitica Ibérica VoIume 3. Uniersidad de Murcia, Murcia: Sociedad Española de Briología.

Guerra, J. Brugués, M., Cano, M. J. & Cros, R. M. (2010). Flora Briofitica Ibérica VoIume 4. Uniersidad de Murcia, Murcia: Sociedad Española de Briología.

Guerra, J. Cano, M. J., & Brugués, M. (2014). Flora Briofitica Ibérica VoIume 5, Uniersidad de Murcia, Murcia: Sociedad Española de Briología.

Guerra, J. Cano, M. J., & Brugués, M. (2018). Flora Briofitica Ibérica VoIume 6, Uniersidad de Murcia, Murcia: Sociedad Española de Briología.

Güneroğlu, N. & Pektaş, S. (2022). Sera Gölü Tabiat Parkı'nın Kullanıcı Memnuniyeti Açısından Değerlendirilmesi. *Ormancılık Araştırma Dergisi*, 9, 124-132.

Hedenäs, L. (1992). Flora of Maderian Pleurocarpous Mosses (Isobryales, Hypnobryales, Hookeriales), ISBN: 3-443-62016-7, Bryophytorum Bibliotheca, Band, 1992.

Hodgetts, N. G., Söderström, L., Blockeel, T. L., Caspari, S., Ignatov, M. S., Konstantinova, N. A.,....Porley, R. D. (2020). An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus. *Journal of Bryology*, 42(1), 1-116.

Karahasanoğlu, S. (2019). Ülkemizde Tabiat Parklarının Korunan Alan Statüsü Olarak Önemi ve Sera Gölü (Trabzon) Örneğinde İrdelenmesi. Karadeniz Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Yüsek Lisans Tezi, Trabzon.

Kürschner, H., & Frey, W. (2020). Liverworts, mosses and hornworts of Southwest Asia (Marchantiophyta, Anthoceratophyta, Bryophyta). *Nova Hedwigia*, 149, 1-267.

Lüth, M. (2019). Mosses of Europe–A Photographic Flora Set of 3 Volumes, ISBN 978-3-00-062952-5, 1360 pp.

Nyholm, E. (1986). Illustrated Flora of Nordic Mosses, Fasc. 1. Fissidentaceae-Seligeriaceae, 1-72, The Nordic Bryological Society, Lund.

Nyholm, E. (1989). Illustrated Flora of Nordic Mosses, Fasc. 2. Pottiaceae- Splachnaceae-Schistostegaceae, 75-141, The Nordic Bryological Society, Lund.

Nyholm, E. (1993). Illustrated Flora of Nordic Mosses, Fasc. 3. Bryaceae-Rhodobryaceae Mniaceae-Cinclidiaceae-Plagiomniaceae. 145-244, The Nordic Bryological Society, Lund.

Nyholm, E. (1998). Illustrated Flora of Nordic Mosses, Fasc. 4. Aulacomniaceae- Meesiaceae-Catocopiaceae-Bartramiaceae-Timmiaceae-Encalyptaceae-Grimmiaceae-Ptychomitriaceae-Hedwigiaceae-Orthotrichaceae. 145-244, The Nordic Bryological Society, Lund.

Özdemir, T., & Batan, N. (2017a). The Bryophyte Checklist of Trabzon Province of Turkey. *Arctoa*, 26(1), 58-67.

Özdemir, T., & Batan, N. (2017b). Bryophyte Checklist of Giresun, North East Turkey. *Anatolian Bryology*, 3(1), 1-8.

Özen, Ö., Erata, H., Batan, N., & Alataş, M. (2019). Contributions to The Bryophyte Flora of Hayrat District (Trabzon-Turkey). *Anatolian Bryology,* 5(2), 107-113.

Paton, J. (1999). The Liverworts Flora of the British Isles, ISBN: 0-946589-60-7, 626 pp, Harley Books. England.

Smith, A. J. E. (1996). The Liverworts of Britain and Ireland. Cambridge University Press. Cambridge.

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

URL-1. (2024, May 20). From https://earth.google.com/web/