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DOI: 10.26672/anatolianbryology.1136373

Anatolian Bryology  
Anadolu Briyoloji  
Dergisi  
Research Article  
e-ISSN:2458-8474  
Online



## The Bryophyte Flora of Van Lake and Environs (Van/Türkiye)

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Received: 27 June 2022

Revised: 21 July 2022

Accepted: 6 September 2022

### Abstract

As a result of the identification of 800 envelope bryophyte specimens, 175 taxa were recorded from the research area. No hornwort taxa could be detected and only 7 taxa liverwort belong to 5 genera were collected from the area. Factors affecting the low number of liverworts can be listed as limited habitat diversity, poor water resources, high ultraviolet, rapid evaporation and poor vegetation. Mosses are represented by 168 taxa in 67 genera belonging to 17 families. Pottiaceae, Brachytheciaceae, Orthotrichaceae, Grimmiaceae, and Bryaceae which have more than ten taxa are the most species-rich families in the research area. These families, which mostly contain xerophilous taxa, are compatible with the climate of the region. Taxa, such as *Asterella saccata* and *Orthotrichum cupulatum* var. *fuscum* which were recently given as new records for Turkey from the research area, reveal the bryophyte diversity potential of the region. Studies to be carried out in areas that are relatively less known in terms of bryophytes, such as Eastern Anatolia, are extremely important in terms of understanding the diversity of bryophytes in the country. In this regard, the present study provides important information on the diversity of bryophytes in Eastern Anatolia.

**Keywords:** Bryophyte, *Asterella*, xerophilous, ultraviolet, Eastern Anatolia, Türkiye

## Van Gölü ve Çevresinin Briyofit Florası (Van/Türkiye)

### Öz

800 zarf karayosunu örneğinin teşhis edilmesi sonucunda, araştırma alanından, 175 takson kaydedilmiştir. Alandan 5 cinse ait 7 takson ciğerotu kaydedilmiş, herhangi bir boynuzlu ot taksonuna rastlanmamıştır. Ciğer otlarının az sayıda olmasına etki eden faktörler, sınırlı habitat çeşitliliği, zayıf su kaynakları, yüksek ultraviyole, hızlı buharlaşma ve düşük bitki örtüsü olarak sıralanabilir. Alanda, yapraklı karayosunları 17 familyaya ait 67 cins ve 168 takson ile temsil edilmektedir. Ondan fazla taksona sahip familyalar, Pottiaceae, Brachytheciaceae, Orthotrichaceae, Grimmiaceae ve Bryaceae olarak sıralanmaktadır. Çoğunlukla kseroofil taksonlar içeren bu familyalar bölgenin iklimi ile uyumludur. Araştırma alanından Türkiye için son zamanlarda yeni kayıt olarak verilen *Asterella saccata* ve *Orthotrichum cupulatum* var. *fuscum* gibi taksonların bulunması bölgenin karayosunları çeşitliliğini potansiyelini ortaya koymaktadır. Doğu Anadolu gibi karayosunları açısından nispeten daha az bilinen bölgelerde yapılacak araştırma gezileri, ülkemizdeki karayosunları çeşitliliğinin anlaşılması açısından son derece önemlidir. Bu anlamda mevcut çalışma, Doğu Anadolu karayosunlarının çeşitliliği hakkında önemli bilgiler sunmaktadır.

**Anahtar kelimeler:** Karayosunları, *Asterella*, Kurakçıl, *Ultraviyole*, Doğu Anadolu, Türkiye

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To cite this article: Kırmacı M. Özenoğlu H. Armağan M. Aslan G. Çatak U. 2022. The Bryophyte Flora of Van Lake and Environs (Van/Türkiye. *Anatolian Bryology*. 8:2, 73-85.



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## 1. Introduction

In recent years, bryofloristic studies are increasingly being conducted to determine the diversity of Bryophytes in unknown areas of Turkey. Nevertheless, few studies have been carried out in the Eastern Anatolia region, which includes our study area, and the Southeastern Anatolia (Schiffner, 1913; Henderson, 1957, 1958; Henderson and Prentice, 1969; Papp, 2007; Alataş et al., 2019, 2020; Uyar et al., 2020; Alataş and Ursavaş, 2021; Kırmacı et al., 2021a, 2021b; Uygur et al., 2022).

The present study was planned and completed in order to determine the bryophyte flora of Van Lake and its surroundings. We hope that the study will contribute to understanding the bryophyte diversity of the Eastern Anatolia region.

## 2. Material and Method

**The investigated area:** The study area is in the Irano-Turanian phytogeographical region and is located within the borders of Bitlis (its districts Tatvan and Adicevaz) and Van (its districts Edremit, Erciş, İpekyolu, Tuşba, and Gevaş). Keçikıran, Pirreşit, Süphan, Nemrut, Karz (Garez), Kavuşşahap, Alacabük (Pelli) and Çadır (Artos) mountains are the most important landmarks in the research area. Van Lake is located in a volcanic terrain made up of basalt volcanic rock. Engil, Karasu, Bendimahı and Zilan are the main streams feeding the lake in the basin. There are many relatively small streams in the basin that are completely dry in the summer. The Bendimahı Delta, one of the important wetlands of Turkey, covers a 230-hectare area in the northern part of

the lake. In addition, Çiriş, Turna, Batmış and Aygır lakes are other important wetlands around the study area.

A steppe formation is dominant in the research area. Plantation of trees such as *Salix alba* L. and *Populus alba* L. are seen around settlement areas. Oak communities are seen in a narrow area, especially in the southern part of Van Lake (d. Gevaş). Some shrubs and trees such as *Amygdalus communis* L., *Cotoneaster nummularius* Fisch. & C.A.Mey., *Salix caprea* L., *Ribes orientale* Desf., *Rosa canina* L., *Rosa boissieri* Crép., *Rosa pulverulenta* M.Bieb., and *Rosa orientalis* A.Dupont ex Ser. are other taxa common in the research area. In the marshes and reeds on the shores of Lake Van, *Phragmites australis* (Cav.) Trin. ex Steud. sometimes forms communities in which *Typha latifolia* L., *Typha angustifolia* L., *Schoenoplectus tabernaemontani* (C.C.Gmel.) Palla, *Bolboschoenus maritimus* Palla, and various species were found.

A cold and temperate climate prevails in the research area. There is more precipitation in winter than in summer. The most precipitation falls in the spring months and the driest month is August. The annual average temperature is between 8-10 degrees. The variation in annual temperature is approximately 26 degrees. The warmest month is August, while the coldest is February (Table 1). In order to understand the general climatic situation of the study area, climate diagrams of Tatvan (Bitlis) and Edremit (Van) districts are given in Figures 1.

Table 1. Climatic data of some settlements in the research area.

	Köppen-Geiger climate classification	The annual temperature average	The annual rainfall average	Lowest precipitation	Most precipitation	The hottest month of the year	The lowest month of the year	The variation in annual temperature
Van	<u>Dsa</u>	8.4 °C	431 mm	August, 6 mm	March, 59 mm	August, 22.1 °C	January, -4.5 °C	26.6 °C
Tatvan	<u>Dsa</u>	8.3 °C	839 mm	August, 5 mm	April, 124 mm	August, 22.0 °C	January, -4.3 °C	26.3 °C
Ahlat	<u>Dsa</u>	8.9 °C	621 mm	August, 7 mm	April, 87 mm	August, 22.5 °C	January, -3.6 °C	26.1 °C
Gevaş	<u>Dsb</u>	8.3 °C	662 mm	August, 11 mm	April, 91 mm	August, 22.0 °C	January, -4.1 °C	26.1 °C
Erciş	<u>Csa</u>	10.4 °C	564 mm	August, 7 mm	April, 73 mm	August, 23.8 °C	January, -1.8 °C	25.6 °C

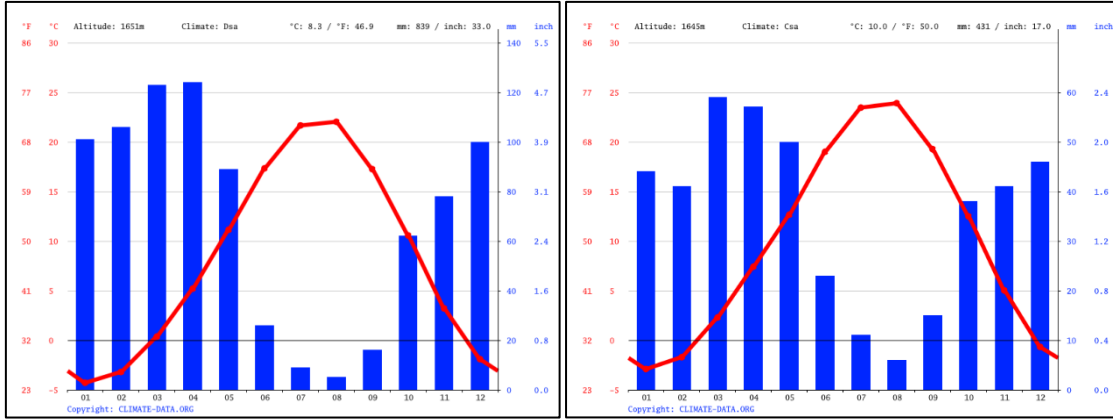


Figure 1. Climate diagrams of Tatvan (Bitlis) and Edremit (Van) (URL 1)

**Methods:** The research material consists of bryophytes collected from Lake Van and its surroundings between 2018 and 2021. During this period, a total of 69 localities were visited in different seasons and 800 envelope plant specimens were collected. Collecting localities of

bryophyte samples are shown in figure 2 and listed below. The nomenclature of bryophytes was arranged according to Hodgetts et al. (2020). Also, all names were checked from Tropicos web page (URL 2).

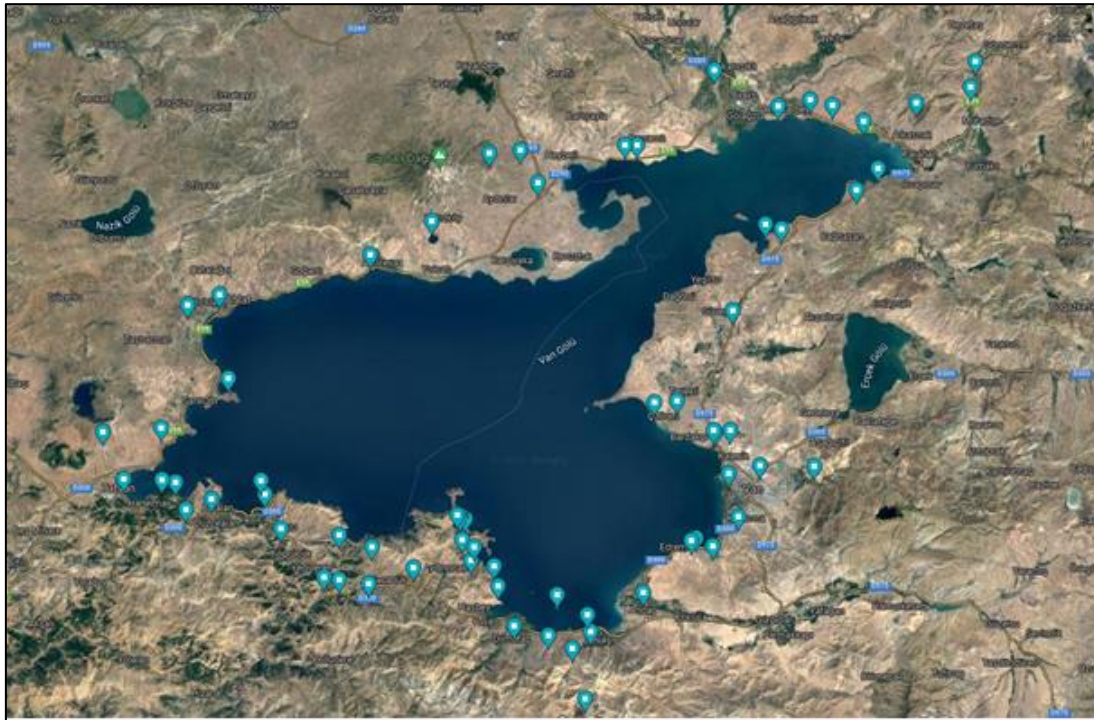


Figure 2. Study area with collecting localities

**Collected Localities:**

1. Van: Tuşba, Kalecik Village, 38° 33' 45.1" N 43° 20' 00.7" E, 1728m., 13.09.2018.
2. Van: Tuşba, Centenary University Campus, 38° 33' 44.6" N 43° 18' 15.9" E, 1665 m., 13.09.2018.
3. Van: Tuşba, southeast of Topaktaş Village, 38° 36' 8.4" N 43° 14' 33.14" E, 1675 m., 13.09.2018.
4. Van: Tuşba, west of Çitören Village, The side of Van Lake, 38° 35' 58.3" N 43° 12' 12.9" E, 1700 m., 13.09.2018.
5. Van: Tuşba, between Van and Erciş, Çakırbey Village, 38° 54' 48.7" N 43° 35' 18.3" E, 1694 m., 13.09.2018.
6. Van: Muradiye, Kemerköprü Village, Şeytan Bridge, 39° 01' 21.8" N 43° 44' 51" E, 1746 m., 13.09.2018.

7. Van: Muradiye, Muradiye Waterfall, 39° 03' 24.8" N 43° 45' 21" E, 1815 m., 13.09.2018.
8. Van: Gevaş, Altınsaç Village, 38° 24' 20.1" N 42° 53' 34.3" E, 1675 m., 14.09.2018.
9. Van: Gevaş, between İnköy and Altınsaç, 1 km to Altınsaç Village, 38° 26' 53.5" N 42° 51' 49.9" E, 1700 m., 14.09.2018.
10. Van: Gevaş, between İnköy and Altınsaç, 9 km to Altınsaç Village, 38° 26' 48.5" N 42° 52' 10" E, 1690 m., 14.09.2018.
11. Van: Gevaş, between İnköy and Altınsaç, 8 km to Altınsaç Village, 38° 26' 36.2" N 42° 52' 41.9" E, 1775 m., 14.09.2018.
12. Van: İpekyolu, west of Van Castle, 38°30'14.86"N 43°19'52.55"E, 1656 m., 14.09.2018.
13. Bitlis: Tatvan, Yelkenli Village, 38° 28' 36.1" N 42° 32' 0.2" E, 1680 m., 15.09.2018.
14. Bitlis: Ahlat, Selçuklu Cemetery, Keş Stream Valley, 38° 44' 39.8" N 42° 27' 17.4" E, 1725 m., 15.09.2018.
15. Van: Erciş, Çatakdişi Village, 39° 02' 39.9" N 43° 18' 25.6" E, 1665 m., 15.09.2018.
16. Van: Edremit, 38° 25' 3" N 43° 16' 28" E, 1750 m., 11.05.2019.
17. Van: Edremit, between Çiçekli and Gevaş, 38° 20' 35" N 43° 11' 21" E, 1640 m., 11.05.2019.
18. Van: Akdamar Island, 38° 20' 28,72" N 43° 02' 07,89" E, 1681 m., 11.05.2019.
19. Van: Gevaş, Dokuz Ağaç Village, 38° 17' 9" N 43° 1' 14" E, 1880 m., 11.05.2019.
20. Van: Gevaş, roadside, picnic area, 38° 18' 54" N 43° 5' 8" E, 1600 m., 11.05.2019.
21. Van: Gevaş, between Yoldöndü and Altınsaç, 38° 21' 8,7" N 42° 56' 5" E, 1760 m., 12.05.2019.
22. Van: between Göründü and Altınsaç, 38° 22' 47" N 42° 55' 41" E, 1660 m., 12.05.2019.
23. Van: South of Altınsaç Village, 38° 23' 12" N 42° 53' 17" E, 1870 m., 12.05.2019.
24. Van: Altınsaç Church, 38° 24' 54,7" N 42° 52' 20,3" E, 1990 m., 12.05.2019.
25. Van: Near İnköy, 38° 26' 36,7" N 42° 52' 7" E, 1905 m., 12.05.2019.
26. Van: Tuşba, 38° 43' 19" N 43° 20' 20" E, 1700 m., 13.05.2019.
27. Van: Tuşba, northeast of Lake Van, 38° 53' 6" N 43° 33' 5" E, 1720 m., 13.05.2019.
28. Van: Tuşba, 39° 00' 19" N 43° 28' 16" E, 1650 m., 13.05.2019.
29. Van: Erciş, 38° 56' 39" N 43° 10' 23" E, 1650 m., 13.05.2019.
30. Bitlis: Adilcevaz, 38° 55' 54" N 42° 2' 58" E, 1670 m., 13.05.2019.
31. Bitlis: Adilcevaz, Aygırgölü Village, 38° 50' 36" N 42° 49' 14" E, 1930 m., 13.05.2019.
32. Bitlis, 38° 7' 13" N 43° 6' 58" E, 2120 m., 14.05.2019.
33. Bitlis: Adilcevaz, Uzuntekne Village, 38° 12' 2" N 48° 5' 0" E, 2240 m., 14.05.2019.
34. Bitlis: Tatvan, North of Yediveren Village, 38° 25' 15,4" N 42° 39' 37,9" E, 1830 m., 02.11.19.
35. Bitlis: East of Tatvan, on Hanelmalı road, 38° 29' 44,9" N 42° 21' 19,8" E, 1710 m., 02.11.19.
36. Bitlis: Between Tatvan Hancılar and Tokaçlı Village, 38° 29' 33,7" N 42° 22' 46,7" E, 1730 m., 02.11.19.
37. Bitlis: Between Tatvan, Balaban and Nohutlu, 38° 21' 19,8" N 42° 42' 44,1" E, 1854 m., 03.11.19.
38. Bitlis: Tatvan, Dağdibi Village, 38° 24' 17,3" N 42° 43' 04,1" E, 1945 m., 03.11.19.
39. Bitlis: Tatvan, Dilmetaş Village, 38° 17' 55,2" N 42° 57' 40,2" E, 1770 m., 03.11.19.
40. Van: Gevaş, 38° 16' 08,4" N 43° 03' 41,1" E, 1900 m., 04.11.19.
41. Van: Gevaş, 38° 17' 29,6" N 43° 05' 34,4" E, 1770 m., 04.11.19.
42. Van: Erciş, North of Alkasnak Village, 39° 00' 2,7" N 43° 39' 14,3" E, 1920 m., 04.11.19.
43. Van: Erciş, Kumluca Village, 38° 50' 15,1" N 43° 23' 38,2" E, 1720 m., 04.11.19.
44. Van: Tuşba, 38° 33' 33,8" N 43° 18' 29,5" E, 1674 m., 27.03.21.
45. Van: Edremit, Kavurma Village, 38° 26' 45,8" N 43° 20' 52,4" E, 1670 m., 27.03.21.
46. Van: Edremit, Elmalık, 38° 24' 22,7" N 43° 18' 15,4" E, 1780 m., 27.03.21.
47. Van: Toprakkale, 38° 30' 52,3" N 43° 23' 4,6" E, 1760 m., 27.03.21.
48. Van: İpekyolu, Kavuncu, 38° 30' 48,60" N 43° 28' 40,40" E, 1910 m., 27.03.21.
49. Van: Tuşba, Gedikbulak (Canık), 38° 49' 54,5" N 43° 25' 18,5" E, 1710 m., 27.03.21.
50. Van: Erciş, Atayurdu Facilities, 38° 58' 37,8" N 43° 33' 52,9" E, 1665 m., 28.03.21.

51. Van: Erciş, Aşağı Kozluca Village, 38° 54' 55,0" N 43° 30' 31,8" E, 1740 m., 28.03.21. Loc: 56  
LUNULARIACEAE  
[AYÇANAKGİLLER]
52. Van: Erciş, Lake side, 38° 59' 50,50" N 43° 24' 56,6" E, 1670 m., 28.03.21. II. *Lunularia cruciata* (L.) Lindb. [Ayçanak]  
Loc: 13
53. Van: Erciş, 38° 56' 40,6" N 43° 09' 10,1" E, 1680 m., 28.03.21. III. *Asterella saccata* (Wahlenb.) A. Evans  
[Sakallı matarbaş]  
Loc: 66
54. Van: Base of the Süphan Mountain, 38° 53' 39,9" N 43° 00' 09,6" E, 1740 m., 28.03.21. IV. *Reboulia hemisphaerica* (L.) Raddi  
[Yarımbaş]  
Loc: 22, 66
55. Bitlis: Tatvan, Lake side, 38° 29' 57" N 42° 17' 21" E, 1650 m., 28.03.21. RICCIACEAE [ÇATALCIKGİLLER]
56. Van: Van – Bitlis border, Kuskunkıran Pass, 38° 22' 37,7" N 42° 47' 17,3" E, 2200 m., 30.03.21. V. *Riccia papillosa* Moris [Siğilli çatalcık]  
Loc: 66
57. Van: Tatvan, Nohutlu, 38° 21' 38" N 42° 39' 39,2" E, 1760 m., 30.03.21. VI. *Riccia sorocarpa* Bisch. [Bol çatalcık]  
Loc: 26
58. Bitlis: Tatvan, Güntepe Village, 38° 21' 51,1" N 42° 38' 0,35" E, 1760 m., 30.03.21. VII. *Riccia subbifurca* Warnst. ex Croz. [Uzun çatalcık]  
Loc: 66
59. Bitlis: Tatvan, Ulusoy Village, 38° 25' 50,0" N 42° 33' 37,4" E, 1780 m., 30.03.21. **BRYOPHYTA**
60. Van: Reşadiye, 38° 29' 39,9" N 42° 31' 34,6" E, 1675 m., 30.03.21. ENCALYPTACEAE  
[DUVAKLIGİLLER]
61. Van: Gevaş, Balaban Village, 38° 28' 10,1" N 42° 26' 28,5" E, 1760 m., 30.03.21. 1. *Encalypta alpina* Sm [Dağ duvaklısı]  
Loc: 33, 44
62. Bitlis: Tatvan, Güreşçi Village, 38° 27' 20,4" N 42° 23' 51,3" E, 1850 m., 30.03.21. 2. *Encalypta microstoma* Bals.-Criv. & De Not. [Küçük duvaklı]  
Loc: 9
63. Bitlis: Tatvan, Base of the Nemrut Mountain, 38° 33' 35,8" N 42° 15' 17,5" E, 2070 m., 31.03.21. 3. *Encalypta rhapsocarpa* Schwägr. [Koca duvaklı]  
Loc: 29, 32, 33, 65
64. Bitlis: Between Tatvan and Ahlat, 38° 33' 55" N 42° 21' 18,4" E, 1750 m., 31.03.21. 4. *Encalypta streptocarpa* Hedw. [Kıvrık duvaklı]  
Loc: 9, 13, 49, 56, 59, 63, 67
65. Bitlis: Tatvan, Adabağ Village, 38° 37' 55,6" N 42° 28' 12,8" E, 1690 m., 31.03.21. 5. *Encalypta vulgaris* Hedw. [Duvaklı]  
Loc: 1, 4, 9, 13, 16, 19, 22, 28, 59
66. Bitlis: Ahlat, Yeniköprü Village, 38° 43' 48,9" N 42° 24' 01,9" E, 1750 m., 31.03.21. FUNARIACEAE [KEPÇEBAŞGİLLER]
67. Bitlis: Adilcevaz, 38° 47' 54,7" N 42° 42' 50,7" E, 1700 m., 31.03.21. 6. *Entosthodon attenuatus* (Dicks.) Bryhn  
[Uzun topuzcuklu]  
Loc: 56
7. *Entosthodon convexus* (Spruce) Brugués  
[Şiş topuzcuklu]  
Loc: 7, 22
8. *Entosthodon pulchellus* (H. Philib.) Brugués [Bol topuzcuklu]  
Loc: 19, 22, 25
9. *Funaria hygrometrica* Hedw. [Kepçebaş]  
Loc: 6, 12, 13, 17, 19, 23, 50, 52, 56, 59, 62, 67

All taxa were identified using related flora and revision studies and kept in the Herbarium of Aydın Adnan Menderes University.

### 3. Results

As a result of the identification of 800 envelope bryophyte specimens, 175 taxa (168 mosses and 7 liverworts) were recorded from the research area.

#### Floristic list:

#### MARCHANTIOPHYTA

- PELLIACEAE [SUPULCUĞUGİLLER]  
I. *Pellia epiphylla* (L.) Corda [Supulcuğu]

- DISTICHIACEAE  
[ÇATALDIŞGİLLER]  
10. *Distichium capillaceum* (Hedw.) Bruch & Schimp. [Ayrıkça]  
Loc: 9, 22
- DICRANELACEAE  
[İNCELİKGİLLER]  
11. *Dicranella heteromalla* (Hedw.) Schimp.  
[Kıvrık incelik]

- Loc: 66  
POTTIACEAE [POTURCUKGİLLER]
12. *Acaulon muticum* (Hedw.) Müll. Hal. [Boncukçuk]  
Loc: 19, 59
13. *Barbula unguiculata* Hedw. [Fırçacık]  
Loc: 13, 24, 26, 32, 44
14. *Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen [Aluçlu]  
Loc: 44
15. *Cinclidotus danubicus* Schiffn. & Baumgartner [Bol gergefli]  
Loc: 6, 41
16. *Cinclidotus fontinaloides* (Hedw.) P. Beauv. [Gergefli]  
Loc: 29
17. *Cinclidotus riparius* (Host ex Brid.) Arn. [Saplı gergefli]  
Loc: 29
18. *Crossidium crassinervium* (De Not.) Jur. [Kaba kartpulcuk]  
Loc: 49, 50, 55, 59, 61, 63
19. *Crossidium squamiferum* (Viv.) Jur. [Kartpulcuk]  
Loc: 1, 4, 16, 19, 28, 58, 61, 62
20. *Didymodon acutus* (Brid.) K. Saito [Sivri ikizcik]  
Loc: 1, 4, 9, 13, 38, 49, 66, 67
21. *Didymodon insulanus* (De Not.) M.O. Hill [Uzun ikizcik]  
Loc: 9, 16, 38, 39, 44, 66, 67
22. *Didymodon luridus* Hornsch. [Bol ikizcik]  
Loc: 4, 9, 13, 14, 19, 22, 25, 30, 33, 38, 44, 48, 49, 60, 66
23. *Didymodon rigidulus* Hedw. [Boncuklu ikizcik]  
Loc: 9
24. *Didymodon tophaceus* (Brid.) Lisa [Çok ikizcik]  
Loc: 7, 13, 17, 25
25. *Didymodon umbrosus* (Müll. Hal.) R.H.Zander [Dalgalı ikizcik]  
Loc: 9, 17, 66
26. *Didymodon vinealis* (Brid.) R.H. Zander [İkizcik]  
Loc: 9, 13, 25, 60, 66
27. *Eucladium verticillatum* (With.) Bruch & Schimp. [Sızincık]  
Loc: 7, 25, 60, 66
28. *Gymnostomum aeruginosum* Sm. [Damlacık]  
Loc: 13
29. *Gymnostomum calcareum* Nees & Hornsch. [Kireç damlacık]  
Loc: 7, 9
30. *Gymnostomum viridulum* Brid. [Yeşil damlacık]  
Loc: 7
31. *Gyroweisia tenuis* (Hedw.) Schimp. [Dilcikli]  
Loc: 7, 13, 66
32. *Henediella heimii* (Hedw.) R.H. Zander [Yalınçık]  
Loc: 18
33. *Hydrogonium bolleanum* (Müll. Hal.) A.Jaeger [Dere fırçacığı]  
Loc: 39
34. *Microbryum starckeanum* (Hedw.) R.H. Zander [Küfecik]  
Loc: 29, 62
35. *Pottiopsis caespitosa* (Bruch ex Brid.) Blockeel A.J.M. Sm. [Poturcuk]  
Loc: 22
36. *Pseudocrossidium hornschurchianum* (Schultz) R.H. Zander [Dönükçe]  
Loc: 13, 49, 54, 67
37. *Pseudocrossidium obtusulum* (Lindb.) H.A.Crum & L.E.Anderson [Küt dönükçe]  
Loc: 16, 19, 28, 44
38. *Pseudocrossidium revolutum* (Brid.) R.H. Zander [Kıvrık dönükçe]  
Loc: 49
39. *Pterygoneurum ovatum* (Hedw.) Dixon [Atkılca]  
Loc: 1, 17, 19, 20, 28, 31, 33, 47, 48, 49, 50, 51, 54, 56, 59, 61
40. *Streblotrichum convolutum* (Hedw.) P. Beauv. [Bol fırçacık]  
Loc: 21, 66
41. *Streblotrichum convolutum* var. *commutatum* (Jur) J.J.Amann [Yoz fırçacık]  
Loc: 66
42. *Syntrichia calcicola* J.J. Amann [Kireç ulduzu]  
Loc: 19, 33
43. *Syntrichia caninervis* Mitt. [Katlı ulduz]  
Loc: 16, 17, 22, 24, 28, 38
44. *Syntrichia caninervis* var. *gypsophila* (J.J. Amann ex G. Roth) Ochyra [Kurak ulduz]  
Loc: 1, 4, 7, 9, 13, 16, 21, 22, 24, 25, 28, 29, 33, 38, 47, 48, 49, 56, 59, 67
45. *Syntrichia handelii* (Schiffn.) S. Agnew & Vondr. [Öz ulduz]  
Loc: 1, 4, 6, 9, 21, 28
46. *Syntrichia laevipila* Brid. [Ağaç ulduzu]  
Loc: 5
47. *Syntrichia montana* Nees [Bol ulduz]  
Loc: 13, 17, 36, 47, 65
48. *Syntrichia norvegica* F. Weber [Ala ulduz]  
Loc: 24

49. *Syntrichia papillosissima* (Copp.) Loeske  
[Uzun ulduz]  
Loc: 16, 22, 45
50. *Syntrichia princeps* (De Not.) Mitt. [Kaba ulduz]  
Loc: 10, 17, 19, 25, 36, 37, 38, 39, 42, 46, 61, 64
51. *Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr [Ulduz]  
Loc: 1, 4, 5, 7, 8, 9, 11, 13, 14, 17, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 32, 33, 36, 37, 38, 39, 40, 42, 43, 44, 46, 48, 50, 51, 52, 54, 56, 58, 59, 60, 61, 62, 64, 65, 67
52. *Syntrichia ruraliformis* (Besch.) Mans. [Sivri ulduz]  
Loc: 9, 32, 48, 56, 67
53. *Syntrichia sinensis* (Müll. Hal.) Ochyra [Çin ulduzu]  
Loc: 4, 12, 21
54. *Syntrichia subpapillosissima* (Bizot & R.B.Pierrot ex W.A. Kramer) M.T. Gallego & J. Guerra [Zarif ulduz]  
Loc: 5, 6, 9, 16, 19, 24, 25, 26, 28, 29, 38, 39, 41, 44, 47, 50, 52, 53, 56, 60, 63, 66, 67
55. *Syntrichia virescens* (De Not.) Ochyra [Küçük ulduz]  
Loc: 5, 8, 14, 44, 52, 59
56. *Tortella humilis* (Hedw.) Jenn. [Bodur camtaban]  
Loc: 9, 13, 16
57. *Tortella inflexa* (Bruch) Broth. [Çukur camtaban]  
Loc: 13
58. *Tortella tortuosa* (Hedw.) Limpr. [Camtaban]  
Loc: 9, 13, 14, 22, 23, 24, 42
59. *Tortula acaulon* (With.) R.H. Zander [Cüce kurucan]  
Loc: 7, 19, 22, 28, 44, 59
60. *Tortula atrovirens* (Sm.) Lindb. [Küt kurucan]  
Loc: 6, 7, 19, 56
61. *Tortula brevissima* Schiffin. [Narin kurucan]  
Loc: 7, 8, 9, 12, 13, 14, 19, 21, 25, 32, 52, 60, 67
62. *Tortula cuneifolia* (Dicks.) Turner [Seyrek kurucan]  
Loc: 20, 33
63. *Tortula inermis* (Brid.) Mont. [Tüysüz kurucan]  
Loc: 1, 9, 13, 14, 16, 17, 19, 20, 21, 22, 24, 25, 28, 38, 39, 42, 44, 47, 48, 50, 63, 64, 67
64. *Tortula mucronifolia* Schwägr. [Kel kurucan]  
Loc: 17, 28, 39, 42, 43
65. *Tortula muralis* Hedw. var. *muralis* [Kurucan]  
Loc: 1, 4, 8, 17, 19, 20, 21, 23, 47, 48, 50, 52, 59, 60, 61, 63, 64, 65, 67
66. *Tortula muralis* var. *aestiva* Hedw. [Köse kurucan]  
Loc: 48, 67
67. *Tortula revolvens* (Schimp.) G. Roth [Katlı kurucan]  
Loc: 6, 14, 20, 44
68. *Tortula subulata* Hedw. [Biz kurucan]  
Loc: 13, 16, 21, 24, 28, 29, 33, 34, 37, 41, 50, 59, 61, 64, 66
69. *Tortula vahliana* (Schultz) Mont. [Efe kurucan]  
Loc: 23
70. *Trichostomum brachydontium* Bruch [Dik kayıkçık]  
Loc: 24, 59
71. *Trichostomum crispulum* Bruch [Kayıkçık]  
Loc: 22, 60, 66
72. *Weissia brachycarpa* (Nees & Hornsch.) Jur. [Katlı kıvrıkcıklı]  
Loc: 49, 66
73. *Weissia condensa* (Voit) Lindb. [Bol kıvrıkcıklı]  
Loc: 7, 19, 22
74. *Weissia controversa* Hedw. [Kıvrıkcıklı]  
Loc: 1, 9, 13
- GRIMMIACEAE  
[YASTIKÇIKGİLLER]
75. *Coscinodon cribrosus* (Hedw.) Spruce [Kıvrımcıklı]  
Loc: 48, 52, 59, 63, 65, 66
76. *Grimmia anodon* Bruch & Schimp. [Düz yastıkçık]  
Loc: 1, 4, 6, 9, 16, 19, 20, 21, 22, 28, 33, 38, 42, 44, 49, 52, 55
77. *Grimmia elongata* Kaulf. [Boylu yastıkçık]  
Loc: 24, 29, 32, 52
78. *Grimmia funalis* (Schwägr.) Bruch & Schimp. [Sarı yastıkçık]  
Loc: 24, 32, 48, 65
79. *Grimmia laevigata* (Brid.) Brid. [Akça yastıkçık]  
Loc: 6, 29, 32, 38, 39, 41, 44, 45, 53, 56
80. *Grimmia montana* Bruch & Schimp. [Dağlı yastıkçık]  
Loc: 44
81. *Grimmia ovalis* (Hedw.) Lindb. [Katlı yastıkçık]  
Loc: 6, 9, 17, 29, 32, 38, 44, 49, 53, 54, 56, 59, 63, 65, 67
82. *Grimmia pulvinata* (Hedw.) Sm. [Yastıkçık]

- Loc: 8, 13, 14, 19, 20, 21, 24, 29, 32, 33, 37, 38, 41, 42, 45, 52, 53, 56, 59, 60, 61, 63, 65, 66, 67
83. *Grimmia trichophylla* Grev. [Bol yastıkçık]  
Loc: 52
84. *Schistidium apocarpum* (Hedw.) Bruch & Schimp [Aldışli]  
Loc: 6, 9, 13, 21, 22, 24, 48, 59, 60, 65
85. *Schistidium atrofusum* (Schimp.) Limpr. [Esmer aldişli]  
Loc: 9
86. *Schistidium confertum* (Funck) Bruch & Schimp. [Pek aldişli]  
Loc: 9, 16, 28, 41
87. *Schistidium dupretii* (Thér.) W.A. Weber [Mesut aldişli]  
Loc: 13
88. *Schistidium flaccidum* (De Not.) Ochyra [Öykü aldişli]  
Loc: 6, 13, 19, 22, 28, 65
89. *Schistidium rivulare* (Brid.) Podp. [Dere aldişli]  
Loc: 6, 21, 42  
BARTRAMIACEAE [KÜRELİGİLLER]
90. *Bartramia aprica* Müll. Hal. [Kürelî]  
Loc: 39, 66
91. *Philonotis caespitosa* Jur. [Kürecik]  
Loc: 42, 44  
BRYACEAE [İLİMİKİLLER]
92. *Bryum argenteum* Hedw. [Boz ılımık]  
Loc: 6, 35, 59
93. *Bryum dichotomum* Hedw. [Al tomurcuklu]  
Loc: 4, 23, 50
94. *Imbriobryum mildeanum* (Jur.) J.R. Spence [Kızılcalı]  
Loc: 67
95. *Ptychostomum capillare* (Hedw.) Holyoak & N. Pedersen [Gülılımık]  
Loc: 9, 13, 56
96. *Ptychostomum compactum* Hornsch. [Pek karayosunu]  
Loc: 19, 26, 39, 44, 56, 59, 66, 67
97. *Ptychostomum creberrimum* (Taylor) J. R. Spence & H.P. Ramsay [Taş karayosunu]  
Loc: 21, 22, 26, 46, 56
98. *Ptychostomum imbricatulum* (Müll. Hall.) Holyoak & N. Pedersen [Pul tomurcuklu]  
Loc: 9, 13, 19, 33, 39, 41, 44, 45, 49, 51, 54, 58, 59, 61, 63, 65, 66, 67
99. *Ptychostomum intermedium* (Brid.) J.R. Spence [Karayosunu]  
Loc: 56
100. *Ptychostomum moravicum* (Podp.) Ros & Mazimpaka [Gür gülılımık]  
Loc: 7
101. *Ptychostomum pseudotriquetrum* (Hedw.) J.R. Spence & H.P. Ramsay ex Holyoak & N. Pedersen [Bol karayosunu]  
Loc: 26
102. *Ptychostomum rubens* (Mitt.) Holyoak & N. Pedersen [Kızıl gülılımık]  
Loc: 40
103. *Ptychostomum torquescens* (Bruch & Schimp.) Ros & Mazimpaka [Kıvrık gülılımık]  
Loc: 67  
MNIACEAE [YIŞILCAGİLLER]
104. *Plagiomnium medium* (Bruch & Schimp.) T.J. Kop. [Orta yışılcalı]  
Loc: 66
105. *Pohlia cruda* (Hedw.) Lindb. [Dik balırcık]  
Loc: 66
106. *Pohlia melanodon* (Brid.) A.J. Shaw [Kara balırcık]  
Loc: 15, 21
107. *Pohlia nutans* (Hedw.) Lindb. [Balırcık]  
Loc: 67
108. *Pohlia wahlenbergii* var. *calcarea* (Wanrst.) E.F. Warb. [Kireç balırcığı]  
Loc: 15  
ORTHOTRICHACEAE [YOSGUNCUKGİLLER]
109. *Lewinskya affinis* (Schrad. ex Brid.) F.Lara, Garilleti & Goffinet [Deli yosguncuk]  
Loc: 5, 8, 10, 24, 33, 36, 43, 59, 60
110. *Lewinskya rupestris* (Schleich. ex Schwägr.) F. Lara, Garilleti & Goffinet [Yosguncuk]  
Loc: 5, 6, 10, 25, 28, 29, 38, 39, 44, 45, 56, 60, 61, 65, 67
111. *Lewinskya speciosa* (Nees) F.Lara, Garilleti & Goffinet [Güz yosguncuk]  
Loc: 8, 10, 33
112. *Lewinskya striata* (Hedw.) F.Lara, Garilleti & Goffinet [Koru yosguncuk]  
Loc: 5, 9
113. *Lewinskya tortidontia* (F.Lara, Garilleti & Mazimpaka) F.Lara, Garilleti & Goffinet [Sedir yosguncuğu]  
Loc: 33
114. *Orthotrichum alpestre* Bruch & Schimp. [Dağ yosguncuk]  
Loc: 5
115. *Orthotrichum anomalum* Hedw. [Taş yosguncuk]  
Loc: 7, 44
116. *Orthotrichum bistratosum* (Schiffn.) Guerra [Katlı yosguncuk]  
Loc: 4, 5, 6, 9, 13, 23, 25, 33, 59, 60
117. *Orthotrichum cupulatum* var. *cupulatum* Brid. [Yosguncuk]



- Loc: 7, 8, 9, 13, 14, 16, 17, 21, 22, 23, 25, 32, 38, 44, 48, 52, 56, 59, 60, 66, 67
118. *Orthotrichum cupulatum* var. *fuscum* (Venturi) Boulay [Esmer Yosguncuk]  
Loc: 44
119. *Orthotrichum cupulatum* var. *riparium* Huebener [Dere yosguncuk]  
Loc: 21, 23
120. *Orthotrichum hispanicum* F. Lara, Gariletti & Mazimpaka [İzli yosguncuk]  
Loc: 5
121. *Orthotrichum macrocephalum* F. Lara, Gariletti & Mazimpaka [Kabuklu yosguncuk]  
Loc: 8, 14, 33, 42
122. *Orthotrichum pallens* Bruch ex Brid. [Soluk yosguncuk]  
Loc: 5, 8, 10, 11, 14, 17, 24, 25, 26, 33, 36, 37, 39, 41, 43, 44
123. *Orthotrichum pulchellum* Brunt. [Kit yosguncuk]  
Loc: 5, 43
124. *Orthotrichum pumilium* Sw. ex. Anon. [Bıdık yosguncuk]  
Loc: 8, 17, 33, 36, 37, 39, 41
125. *Orthotrichum stellatum* Brid. [Yıldız yosguncuk]  
Loc: 7, 10, 11, 25, 36, 37, 39, 48, 59, 60, 61, 64
126. *Orthotrichum tenellum* Bruch ex Brid. [İnce yosguncuk]  
Loc: 5, 7, 17, 33, 36, 42, 48, 59
127. *Pulviger a lyellii* (Hook. & Taylor) Plášek, Sawicki & Ochyra [Paslı yosguncuk]  
Loc: 8
128. *Zygodon rupestris* Schimp. ex Lorentz [Girişik]  
Loc: 5, 8, 11, 17, 36, 39, 43
- HABRODONTACEAE  
[KABUKTÜYÜGİLLER]
129. *Habrodon perpusillus* (De Not.) Lindb. [Kabuktüyü]  
Loc: 7
- AMBLYSTEGIACEAE  
[ÜSÜMGİLLER]
130. *Amblystegium serpens* (Hedw.) Schimp [Üsüm]  
Loc: 12, 14, 17, 24, 33, 39, 40, 41, 42, 59, 60
131. *Conardia compacta* (Drumm. ex Müll. Hal.) H. Rob. [Dişli üsim]  
Loc: 25
132. *Cratoneuron filicinum* (Hedw.) Spruce [Kancacık]  
Loc: 24, 27, 34, 39, 42
133. *Drepanocladus aduncus* (Hedw.) Warnst. [Orakçık]  
Loc: 17
134. *Hygroamblystegium tenax* (Hedw.) Jenn. [Yaşüsüm]  
Loc: 12, 24, 39
135. *Hygroamblystegium varium* (Hedw.) Mönk [Ala yaşüsüm]  
Loc: 7, 21
136. *Leptodictyum riparium* (Hedw.) Warnst. [Islak dereüsümü]  
Loc: 17, 27
137. *Palustriella commutata* (Hedw.) Ochyra [Kancalı]  
Loc: 7, 18, 24, 39, 42, 45
138. *Palustriella decipiens* (De Not.) Ochyra [Sık kancalı]  
Loc: 22
- BRACHYTHECIACEAE  
[ÖSÜMLÜKGİLLER]
139. *Brachythecium albicans* (Hedw.) Schimp. [Ak ösümlük]  
Loc: 9, 11, 16, 25, 26, 39, 41, 42, 59, 60, 61
140. *Brachythecium erythrorrhizon* Schimp. [Kızıl ösümlük]  
Loc: 7
141. *Brachythecium geheebii* Milde [Pek ösümlük]  
Loc: 22
142. *Brachythecium glareosum* (Bruch ex Spruce) Schimp. [Parlak ösümlük]  
Loc: 24
143. *Brachythecium rivulare* Schimp. [Islak ösümlük]  
Loc: 24, 50
144. *Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen [Kadifeli]  
Loc: 5, 8, 11, 13, 16, 17, 21, 22, 23, 24, 26, 39, 45, 59, 60, 64, 66, 67
145. *Cirriphyllum crassinervium* (Taylor) Loeske & M. Fleisch. [Kaba tuğluca]  
Loc: 13, 36, 37, 44
146. *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen [Hunicik]  
Loc: 24
147. *Eurhynchium striatum* (Hedw.) Schimp. [Dikburun]  
Loc: 60
148. *Homalothecium sericeum* (Hedw.) Schimp. [Halıcık]  
Loc: 1, 4, 7, 9, 10, 11, 13, 17, 22, 23, 25, 29, 36, 37, 38, 44, 59, 60, 64, 67
149. *Homalothecium philippeanum* (Spruce) Schimp. [Kaba halıcık]  
Loc: 22, 38
150. *Kindbergia praelonga* (Hedw.) Ochyra [Narince]  
Loc: 25
151. *Oxyrrhynchium hians* (Hedw.) Loeske [İri emzikli]

- Loc: 8  
152. *Oxyrrhynchium shleicheri* (R. Hedw.) Röhl. [Kıvrık emzikli]  
Loc: 8  
153. *Oxyrrhynchium speciosum* (Brid.) Warnst. [Emzikli]  
Loc: 22, 32, 48, 61, 64, 66  
154. *Plasteurhynchium meridionale* (Schimp.) M. Fleisch. [Yoz burunlu]  
Loc: 24  
155. *Rhynchostegiella teneriffae* Dirkse & Bouman [Narin gagalica]  
Loc: 36  
156. *Rhynchostegium confertum* (Dicks.) Schimp. [İnce gagalık]  
Loc: 17  
157. *Rhynchostegium riparioides* (Hedw.) Cardot [Gagalık]  
Loc: 17, 41  
158. *Sciuro-hypnum plumosum* (Hedw.) Ignatov & Huttunen [Tüylü ösümce]  
Loc: 36  
159. *Scleropodium cespitans* (Wilson ex Müll. Hal.) L.F. Koch [Cemrecik]  
Loc: 17, 24, 39, 40, 44, 61  
160. *Scleropodium touretii* (Brid.) L.F. Koch [Bey cemrecik]  
Loc: 41  
161. *Scorpiurium circinatum* (Brid.) M. Fleisch. & Loeske [Kıvrık akrepli]  
Loc: 48  
162. *Scorpiurium sendtneri* (Schimp.) M. Fleisch. [Akrepli]  
Loc: 28, 33  
HYPNACEAE [ORAKLIGİLLER]  
163. *Hypnum cupressiforme* Hedw. [Oraklı]  
Loc: 11  
164. *Hypnum cupressiforme* var. *lacunosum* Brid. [Kaba oraklı]  
Loc: 9, 19  
PYLAISIACEAE  
[GEVREKÇEGİLLER]  
165. *Calliergonella cuspidata* (Hedw.) Loeske [Zarifçik]  
Loc: 39, 40  
ANTITRICHACEAE  
[TELLİCANGİLLER]  
166. *Antitrichia californica* Sull. [Tellican]  
Loc: 33  
LEMBOPHYLLACEAE  
[BALIRLIKİLLER]  
167. *Heterocladium heteropterum* (Brid.) Schimp. [Hoş çaladallı]  
Loc: 7  
168. *Isothecium interludens* Stirt. [Bol balırlık]  
Loc: 17, 24

#### 4. Discussion

No hornwort taxa could be detected from the research area and a very limited number of liverwort (7 taxa) were collected. All identified taxa were thallose liverworts. It is well known that liverworts are more sensitive than mosses to desiccation. Liverwort taxa were underrepresented in the study area because of the limited habitat and water resources that allow liverworts to live outside the south and southeast of the study area, and rapid evaporation due to low vegetation. Depending on species and the evolutionary lineage, liverworts and hornworts are more sensitive to high ultraviolet compared to mosses which have a number of protective strategies. Thus, bryophytes do not constitute a homogeneous functional type with respect to their UV tolerance. Results from a study carried out by Martínez-Abaiagar and Núñez-Olivera (2022) on the effects of UV on bryophytes are in agreement with our opinion. In the study area, mosses are represented by 168 taxa in 67 genera belonging to 17 families (figure 3).

When compared with the records from the regions close to the study area, it is seen that Van Lake and its surroundings are quite rich (Table 2).

Table 2: Comparison of mosses in Lake Van and its surroundings with moss records from regions close to the study area.

Studies	Van Lake and Environs	Iğdır Batan et al. (2014)	Bingöl Alataş et al., (2020)	Baskil Alataş ve Batan, (2017)	Keban Alataş ve Batan, (2015)	Sivrice Alataş et al., (2014)	Palu Alataş ve Ursavaş, (2019)	Van Papp, (2007)
Moss Taxa	168	176	48	54	45	48	47	65

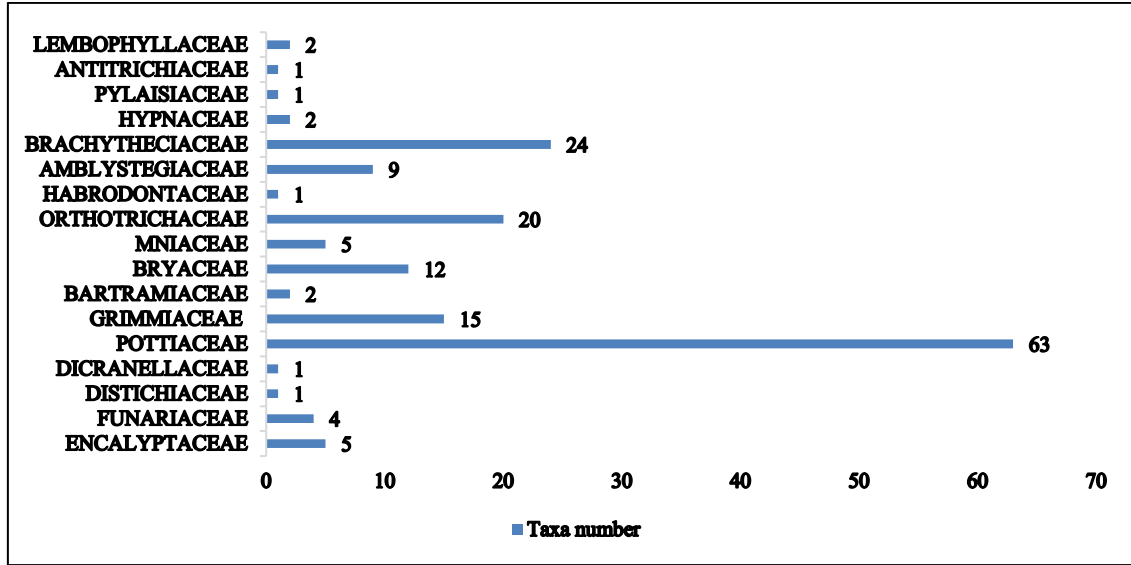


Figure 3. Moss families with taxa number

*Pottiaceae*, *Brachytheciaceae*, *Orthotrichaceae*, *Grimmiaceae*, and *Bryaceae* which have more than ten taxa are the most species-rich families in the research area. These five families constitute 81% of the total flora with the number of species they contain. These families, almost all of which are xeric taxa, are a reflection of the climate of the research area. *Funaria hygrometrica*, *Grimmia anodon*, *Grimmia laevigata*, *Grimmia ovalis* (Hedw.) Lindb., *Grimmia pulvinata* (Hedw.) Sm., *Schistidium apocarpum*, *Didymodon luridus*, *Pterygoneurum ovatum*, *Syntrichia caninervis* var. *gypsophila*, *Syntrichia princeps*, *Syntrichia ruralis*, *Sytrichia subpapillosissima*, *Tortula inermis*, *Tortula muralis*, *Tortula subulata*, *Ptychostomum imbricatum*, *Lewinskya rupestris*, *Orthotrichum bistratosum*, *Orthotrichum cupulatum*, *Orthotrichum pallens*, *Orthotrichum stellatum*, *Amblystegium serpens*, *Brachythecium albicans*, *Brachytheciastrum velutinum* and *Homalothecium sericeum* are very common taxa found in more

than 10 localities; these are well adapted to drought. Although the research area has very poor vegetation, deep crevices formed by rain and melting snow waters provide shelter for many taxa in terms of keeping moisture. Tufa formations, which are frequently found in Western Anatolia (Kırmacı, 2008), were also encountered in the research area. *Didymodon tophaceus*, *Eucladium verticillatum* and *Gymnostomum aeriginosum*, the most well-known plants in these habitats, were similarly collected from the research area.

It is seen that some taxa identified in the research area are quite far from their known distribution localities (Table 3). There is always the possibility that these taxa, which are common in areas with known flora, can also be found in other areas of Anatolia. With the completion of these unknown areas in terms of bryophytes, it will be possible to have clear data about the diversity and distribution areas of bryophytes in Turkey.

Table 3. Some taxa identified from the research area and their known distribution areas (Kürschner and Erdağ, 2020).

Taxa	Previous Distribution localities
<i>Encalypta microstoma</i>	Iğdır, Burdur, Niğde, İçel, Hatay
<i>Enthostodon convexus</i>	Manisa, İzmir, Aydın, Denizli, Muğla, Antalya, Isparta, Konya
<i>Hydrogonium bolleanum</i>	İzmir, Niğde, Denizli, Adana, Burdur, Antalya, Muğla, Hatay, İçel
<i>Streblotrichum convolutum</i> var. <i>commutatum</i>	Zonguldak, Yalova, Amasya, Rize, Balıkesir, Eskişehir, İzmir, Aydın, Denizli, Muğla, Antalya
<i>Henediella heimii</i>	Kırklareli, Rize, Karabük, Trabzon, Amasya, Kocaeli, Rize, Kütahya, İzmir, Eskişehir, Niğde, Adana, Aksaray, Aydın, Burdur, Hatay, Muğla
<i>Weissia brachycarpa</i>	Kayseri, Denizli, Adana, Muğla, Hatay
<i>Orthotrichum hispanicum</i>	Trabzon

In our country, the genus *Cinclidotus* is represented by 9 taxa, 3 of which are endemic (Erdağ and Kürschner, 2011; Ursavaş and Çetin, 2014). *C. danubicus*, *C. fontinaloides* and *C. riparius* were recorded from the research area and they are very important in terms of determining the distribution areas of the taxon.

*Asterella saccata* (Wahlenb.) A. Evans and *Orthotrichum cupulatum* var. *fuscum* (Venturi) Boulay were collected from the study area during the project supported by ADÜ (FEF-18001) and published as new record for Turkey (Kırmacı et al., 2021a, 2021b). These findings reveal the potential of adding more taxa to the country's bryophyte flora with detailed studies of the flora of the region. The common dream of all bryologists is to write the Turkish bryophyte flora book, which can only be written as a result of researching these unknown areas. This study provides important information on the diversity of bryophytes of Eastern Anatolia. It is obvious that the study will guide the researchers working on the subject and contribute to the writing of the bryophyte flora of Turkey.

#### Acknowledgements:

Many thanks to Aydın Adnan Menderes University Scientific Research Projects department (BAP) supported our project (FEF-18001) as financial.

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