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Research article

The Bryophyte flora of Taşeli Plateau (Antalya-Karaman-Mersin/Turkey)

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Abstract: In this study, the bryophyte flora of Taşeli Plateau (Antalya-Karaman-Mersin/Turkey) was investigated. As a result of the identification of bryophyte specimens collected from study area in different habitat and vegetation periods between the years 2018 and 2020, a total of 227 taxa (1 hornwort, 25 liverworts and 201 mosses) were determined belonging to 44 families and 96 genera. Among them, 24 are new for the C12 square according to the Turkish bryophytes grid-square system. While Pottiaceae (49 taxa), Brachytheciaceae (32 taxa) and Bryaceae (20 taxa) are the largest families in the Taşeli Plateau, *Ptychostomum* (14 taxa), *Orthotrichum* (12 taxa) and *Grimmia* (11 taxa) are the richest genera. Taxa in the floristic list, along with ecological characteristics and life forms were evaluated.

Keywords: Bryophytes, Flora, Mosses, Taşeli Plateau, Turkey.

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Introduction

Bryophytes are the earliest land plants in the phylogenetic systematics of the Plantae (Gensel, 2008). They can live on the different substrate (soil, rock and tree trunk etc.) in anywhere from the equator to the poles, where there is water and moisture (Vanderpoorten & Goffinet, 2009). Bryophytes are the second largest group after vascular plants in terms of phytological diversity in Turkey as well as in the world (Gökler, 2018). Furthermore, Turkey, located at the intersection of three phytogeographical region (Mediterranean, Euro-Siberian and Irano-Turanian), in terms of bryo-diversity is the richest among the neighbors in Southwest Asia (Ezer et al., 2021).

With the studies in recent years, researchers have contributed to the Bryophyte Flora of Turkey and added a number of new bryophyte records (Erata & Batan, 2020; Unan et al., 2020, Uygur et al., 2020; 2021; Erata et al., 2021; Kırmacı et al., 2021; Ursavaş et al., 2021; Keskin at al., 2021). Addition of new bryophyte taxa to Turkey's bryoflora are obvious outcome of the new detailed studies.

Taşeli Plateau which is located in the Mediterranean Phytogeographic Region in the southern part of Turkey has the status of Key Biodiversity Area determined by Doğa Association (Eken et al., 2006). Although various studies have been carried out on vascular plants in the Taşeli Plateau (Sümbül & Erik, 1988a, 1988b, 1990a, 1990b), no study on bryophytes has been conducted. With the present study, it is aimed to reveal the bryophyte flora of the Taşeli Plateau and to contribute to the Bryophyte Flora of Turkey.

Materials and Methods

Study area

Taşeli Plateau, located at the intersection of Antalya-Karaman-Mersin Provinces, is a carstic plateau. Because of its rich biodiversity and the high proportion of endemism, it is a vulnerable area. Sümbül and Erik (1988a) are identified 1099 vascular plant taxa in the Taşeli Plateau. Among them, 213 taxa are endemic. Especially, *Asphodeline sertachiae* Tuzlacı, *Eryngium*

isauricum Contandr. & Quézel and *Scorzonera longiana* Sümbül are only found on the Taşeli Plateau worldwide.

The highest altitude of study area is Bahadır Hill (2313 m). Yund Mountain (2227 m) and Kızıl Mountain (2184 m) are other important altitudes (Eken et al., 2006) (Figure 1).

Carbonate rocks which were formed during Mid-Miocene and Jurassic-Cretaceous periods and, schist and metamorphic rocks which were formed Paleozoic period are easily distinguished in Taşeli Plateau. Reef limestone (Mut Formation) and marl intercalations (Köselerli Formation) are the most common forms that are found in the mid-northern parts of plateau. In the southern parts of plateau, especially towards Anamur and Bozyazı Districts, there are widespread late-Jurassic and early-Cretaceous carbonate rocks (Cihandere limestone) (Yetiş, 2002).

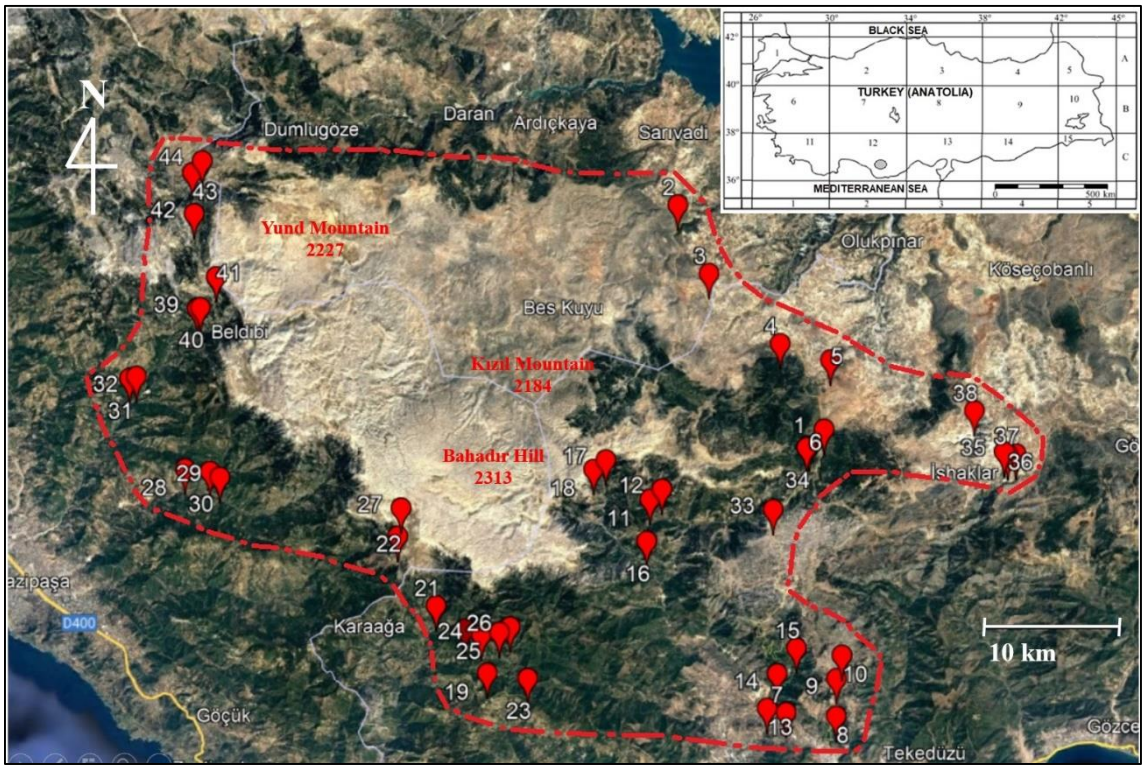

Figure 1. The study area (modified from Google Earth) and grid system of Turkey which was adopted by Henderson (1961).

Steppe and rock vegetation types are extremely common in the large parts of study area. Other vegetation types seen in Taşeli Plateau are forest and hygrophyte vegetations. Forests form *Pinus brutia* Ten., *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe, *Cedrus libani* A.Rich. and *Abies cilicica* (Antoine & Kotschy) Carrière. Other conifer species are *Juniperus excelsa* M. Bieb., *Juniperus oxycedrus* L. and *Juniperus drupacea* Labill. In addition, there are the species which are mostly Mediterranean elements such as *Platanus orientalis* L., *Juglans regia* L. *Quercus coccifera* L., *Quercus trojana* Webb and *Quercus infectoria* Oliv. (Sümbül & Erik, 1988a).

There are Anamur and Gülnar Meteorology Stations near of research area. Anamur is in southern part, Gülnar is in eastern part of study area. According to data of Anamur Meteorology Station, it has rainy and warm Mediterranean climate (Akman, 2011). The mean annual temperature is 19.4 ºC. The highest mean temperature is 33.0 ºC in August, and the lowest is 8.2 ºC in January. The mean annual precipitation is 928,3 mm. According to data of the Gülnar Meteorology Station, it has low rainy and cool Mediterranean climate (Akman, 2011). The mean annual temperature is 13.4 ºC. The highest mean temperature is 30.2 ºC in August, the lowest is 0.4 ºC in January. The mean annual precipitation is 762.8 mm (Figure 2).

Data source

Bryophyte specimens, the material of this study, were collected from various substrate and habitat, in the total of 44 localities of Taşeli Plateau, in different vegetation periods between 2018 and 2020 (Table 1).

Bryophyte specimens were identified using various floras, revisions and monographs studies (Zander, 1993; Paton, 1999; Moñoz, 2000; Pedrotti, 2001; Greven, 2003;

Smith 2004; Ignatova & Moñoz, 2004; Kürschner & Frey, 2020). Taxonomic status of taxa and arrangement of the nomenclature in the floristic list follow Hodgetts et al. (2020). The status of new records for C12 square and Turkey were determined reviewing relevant literature (Everest & Ellis, 1999, 2003; Özenoğlu Kiremit et al., 2007; Özenoğlu-Kiremit & Keçeli, 2009; Kırmacı & Özçelik, 2010; Batan & Özdemir, 2011; Özçelik et al., 2016; Batan & Özdemir, 2016; Erdağ & Kürschner, 2017; Ursavaş & Keçeli, 2020; Kürschner & Frey, 2020). Ecological characteristics and life forms of the taxa were given according to Dierssen (2001) and Hill et al. (2007). Voucher specimens were deposited in the herbarium of Biology Department, Faculty of Science, Niğde Ömer Halisdemir University, Turkey. For each taxon, localities, substrate, life form and ecological characteristics were presented in the floristic list. The new records for the C12 grid-square are marked with asterix (*) in the floristic list.

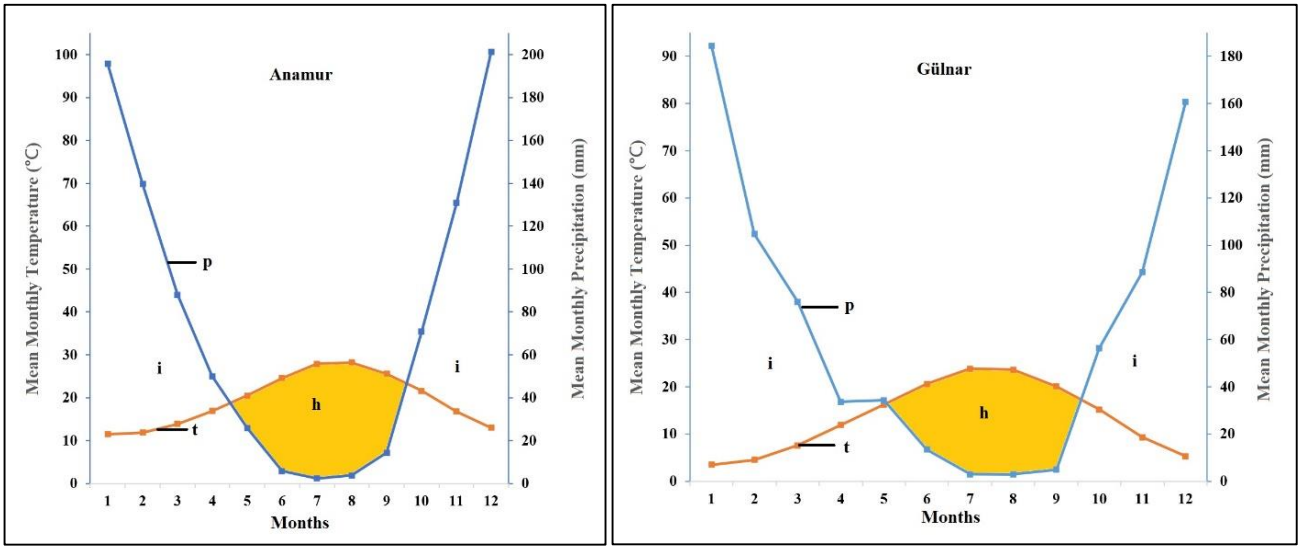

Figure 2. The ombro-thermic climatic diagram of Anamur and Gülnar meteorology stations (p: precipitation, t: temperature, i: humid season, h: arid season).

Table 1. Locality details.

LN	Date	Locations	Altitude (m)
1	04.08.2018	**Mersin:** Anamur, Ermenek-Anamur road, Abanoz Plateau, 36°19'54.87"N / 32°57'16.24"E	1350
2	22.09.2018	**Karaman:** Ermenek-Abanoz road, 36°28'50.27"N / 32°50'39.56"E	1440
3	22.09.2018	**Mersin:** Anamur, Abanoz-Ermenek road, 36°26'7.61"N / 32°52'1.93"E	1550
4	22.09.2018	**Mersin:** Anamur, Abanoz-Ermenek road, 36°23'17.84"N / 32°55'19.21"E	1450
5	22.09.2018	**Mersin:** Anamur, Ermenek-Abanoz road, 36°22'35.19"N / 32°56'28.06"E	1420
6	22.09.2018	**Mersin:** Anamur, Ermenek exit of Abanoz, 36°19'17.07"N / 32°56'31.17"E	1400
7	29.01.2019	**Mersin:** Bozyazı, Evciler Village exit, 36°8'59.17"N / 32°54'54.65"E	130
8	29.01.2019	**Mersin:** Bozyazı, Kömürler Village road, 36°8'45.89"N / 32°57'18.65"E	240
9	29.01.2019	**Mersin:** Bozyazı, north of Kömürler Village, 36°10'13.42"N / 32°57'23.44"E	700
10	29.01.2019	**Mersin:** Bozyazı, Kozağacı Plataeu road, junction of Sıtmalı Village, 36°11'7.17"N / 32°57'41.91"E	950
11	30.01.2019	**Mersin:** Anamur, Boğuntu Village entrance, 36°17'27.83"N / 32°48'46.29"E	810
12	30.01.2019	**Mersin,** Anamur, Boğuntu Village, Çukurabanoz entrance, 36°17'50.48"N / 32°49'22.25"E	600
13	22.03.2019	**Mersin:** Bozyazı, Evciler Village, 36° 9'10.80"N / 32°54'0.61"E	100
14	22.03.2019	**Mersin:** Bozyazı, between Evciler Village and Ormancık Village 36°10'30.38"N / 32°54'33.20"E	300
15	22.03.2019	**Mersin:** Anamur, Anamur-Ermenek road, 36°11'28.19"N / 32°55'31.86"E	350
16	22.03.2019	**Mersin:** Anamur, Boğuntu Village road, Vadi trout facility surrounding, 36°15'50.62"N / 32°48'32.53"E	250
17	22.03.2019	**Mersin:** Anamur, Sugözü Village entrance, 36°19'3.22"N / 32°46'43.85"E	695
18	22.03.2019	**Mersin:** Anamur, Sugözü Village, 36°18'42.21"N / 32°46'7.25"E	795
19	23.03.2019	**Mersin:** Anamur, Güngören Village road, 36°10'57.26"N / 32°40'38.69"E	1060
20	23.03.2019	**Mersin:** Anamur, Güngören Village road, Mani fountain surrounding, 36°12'42.36"N / 32°39'39.91"E	890
21	23.03.2019	**Mersin:** Anamur, Güngören Village entrance, 36°13'38.51"N / 32°38'18.71"E	480
22	23.03.2019	**Mersin:** Anamur, Güngören Village-Kaş Plateau road, 36°16'23.33"N / 32°36'35.17"E	1400
23	28.06.2019	**Mersin:** Anamur, Sarıdana-Kükür Village road above, 36°10'41.4732"N / 32°42'34.8516"E	980

24	28.06.2019	**Mersin:** Anamur, Upper Kükür Village road 36°12'26.3772"N / 32°40'25.8672"E	900
25	28.06.2019	**Mersin:** Anamur, Upper Kükür Village, 36°12'31.25"N / 32°41'18.15"E	740
26	28.06.2019	**Mersin:** Anamur, Upper Kükür Village, 36°12'42.91"N / 32°41'49.68"E	600
27	28.06.2019	**Antalya:** Gazipaşa, Kaş Plateau, 36°17'28.6584"N / 32°36'47.7864"E	1950
28	29.06.2019	**Antalya:** Gazipaşa, Çığlık Village road, 36°19'17.80"N / 32°26'28.02"E	270
29	29.06.2019	**Antalya:** Gazipaşa, Çığlık Village road, 36°18'55.5084"N / 32°28'7.6764"E	380
30	29.06.2019	**Antalya:** Gazipaşa- Çığlık Village, Graveyard place, 36°19'9.6924"N / 32°27'39.7944"E	320
31	29.06.2019	**Antalya:** Gazipaşa, Sugözü Village road, 36°22'52.84"N / 32°23'56.06"E	250
32	29.06.2019	**Antalya:** Gazipaşa, Sugözü Village road, 36°22'56.8992"N / 32°24'15.9696"E	280
33	30.06.2019	**Mersin:** Anamur, Abanoz Plateau road, 36°16'52.8779"N / 32°54'40.2228"E	1640
34	30.06.2019	**Mersin:** Anamur, Ermenek exit of Abanoz Plateau, 36°19'13.764"N / 32°56'23,8992"E	1420
35	22.08.2019	**Mersin:** Gülnar, Ishaklar Village, Güldürgü Canyon road, 36°18'45.8532"N / 33°5'53.3436"E	1150
36	22.08.2019	**Mersin:** Gülnar, Ishaklar Village, Güldürgü Canyon road, fountain surrounding, 36°18'38.8476"N / 33°6'2.9844"E	1100
37	22.08.2019	**Mersin:** Gülnar, Ishaklar Village, Güldürgü Canyon, 36°18'39.5748"N / 33°6'26.6292"E	1050
38	22.08.2019	**Mersin:** Bozyazı, Dere Village, trout facility surrounding, 36°20'23.9388"N / 33°4'31.8504"E	1100
39	08.06.2020	**Antalya:** Gazipaşa, Sugözü Village, 36°25'30.22"N / 32°27'18.77"E	750
40	08.06.2020	**Antalya:** Gazipaşa, Sugözü Village, fountain surrounding, 36°25'32.07"N / 32°27'28.06"E	750
41	08.06.2020	**Antalya:** Gazipaşa, Sugözü Village above, 36°26'42.53"N / 32°28'17.46"E	1375
42	08.06.2020	**Antalya:** Gazipaşa, Sugözü Village above, Plateau surrounding, 36°29'11.44N 32°27'19.49"E	1425
43	08.06.2020	**Antalya:** Gazipaşa, Uzunpiladan road 36°30'47.04"N / 32°27'18.28"E	1450
44	08.06.2020	**Antalya:** Gazipaşa, junction of Uzunpiladan and Kızılgüney road, 36°31'14.04"N / 32°27'47.96"E	1210

Results

As a result of the study, a total of 227 taxa belonging to 44 families and 96 genera were determined (Table 2). Anthocerotophyta is represented by 1 species belonging to 1 family and 1 genus, Marchantiophyta is represented by 25 taxa belonging to 17 families and 20 genera and Bryophyta is represented by 201 (144 taxa are acrocarpous, 57 taxa are pleurocarpous) taxa belonging to 26 families and 75 genera. The distribution of according to families of taxa determined in the study area was given in Table 3.

Table 2. Floristic list. (Substrate: rock (r), soil (s), *Abies cilicica* (Ac), *Cedrus libani* (Cl), *Juglans regia* (Jr), *Platanus orientalis* (Po), *Quercus infectoria* (Qi), *Juniperus oxycedrus* (Jo), *Pinus brutia* (Pb), *Pinus nigra* subsp. *pallasiana* (Pn), congrate (c). Life form (LF): Solitary creeping (Sc), Mat, smooth (Ms), Mat, thalloid (Mt), Turf (Tf), Tuft (Tuft). Acidity (pH): Acidophytic (A), Subneutrophytic (S), Basiphytic (B), Neutrophytic (N). Humidity (H): hygrophytic (h), mesophytic (m), xerophytic (x), tolerant to desiccation (td). Light (L): photophytic (p), sciophytic (sc). m: meter).

Families	Taxa	Locality number	Substrate	LF	pH	H
Anthocerotophyta						
Notothyladaceae	*Phaeoceros laevis* (L.) Prosk.	21,23	s	Mt	A	h
Marchantiophyta						
Cephaloziellaceae	*Cephaloziella baumgartneri* Schiffn	13,33	s	Sc	S	m
	C. rubella (Nees) Wamst.	19	s	Ms	A	m
	**C. stellulifera* (Taylor ex Carrington et Pearson) Croz	23	s	Ms	A	m
Jungermanniaceae	*Jungermannia atrovirens* Dumort	37	s, r, Po	Ms	A	h
	Mesoptychia badensis (Gottsche ex Rabenh.) L.Söderstr. & Váňa	17,36,37	s, r	Ms	S	h
Southbyaceae	*Gongylanthus ericetorum* (Raddi) Nees	7,8,14,36,37	s, r	Sc	A	h
	Southbya tophacea (Spruce) Spruce	32,37	s, r	Ms	S	h
Furullaniaceae	*Frullania dilatata* (L.) Dumort.	9,19,20,21,23,24,25,26,28,29, 30,32	s, r, Qi, Po	Ms	S	x
Lejeuneaceae	*Lejeunea cavifolia* (Ehrh.) Lindb.	29	Po	Ms	S	m
Porellaceae	*Porella pinnata* L.	5,33	r	Ms	S	h
	P. platyphylla (L.) Pfeiff.	20,24,25,26	s, r, Po	Fa	S	m
Metzgeriaceae	*Metzgeria furcata* (L.) Corda	21,24,26,29	s, r, Qi	Mt	A	m
Fossombroniaceae	*Fossombronia pusilla* (L.) Nees	7,8,9,23	s, r	Sc	A	h
Petalophyllaceae	*Petalophyllum ralfsii* (Wilson) Nees & Gottsche	21	s, r	St	S	h
Pelliaceae	*Apopellia endiviifolia* (Dicks.) Nebel & D. Quandt	37	r	Mt	S	h
	Pellia epiphylla (L.) Corda	7,8,13,14,29,36, 37,38,40	s, r	Mt	A	h

	P. neesiana (Gottsche) Limpr.	37	r, Po	Mt	A	h
Lunulariaceae	*Lunularia cruciata* (L.) Lindb.	7,14,16,21,23,25,29	s, r	Mt	S	m
Aytoniaceae	*Reboulia hemisphaerica* (L.) Raddi	7,8,13,14,19,20,23,24,27,29	s, r	Mt	B	h
Conocephalaceae	*Conocephalum conicum* (L.) Dumort.	37	r	Mt	B	h
Marchantiaceae	*Marchantia polymorpha* subsp. *montivagans* Bischl. & Boissel. Dub.	37,38	s, r	Mt	A	h
Ricciaceae	*Riccia gougetiana* Durieu & Mont.	7	s	St	S	h
	R. sorocarpa Bisch. subsp.	9	s	St	A	m
Targioniaceae	*Targionia hypophylla* L. subsp.	8,13,14,24	s	Mt	A	h
Sphaerocarpaceae	**Sphaerocarpos michelii* Bellardi	13	s	St	S	h
Bryophyta						
Encalyptaceae	*Encalypta vulgaris* Hedw.	2,3,4,5,12,16,19,22,23,24,39	s, r, Jr	Tuft	S	x
Funariaceae	*Entosthodon muhlenbergii* (Turner) Fife	13	s	Tf	B	h
	E. pulchellus (H. Philib.) Brugues	13	s, r	Tf	B	x
	Funaria hygrometrica Hedw.	4,10,13,14,38	s, r	Tuft	A	m
Timmiellaceae	*Timmiella anomala* (Bruch & Schimp.) Limpr.	9,20,23	s	Tf	S	x
	T. barbuloides (Brid.) Mönk.	8,13,14,1,21,29	s, r	Tf	B	x
Dicranellaceae	*Dicranella crispa* (Hedw.) Schimp	38	r	Tf	A	m
	D. heteromalla (Hedw.) Schimp.	16,20,29	s, r	Tf	S	m
	D. howei Renauld & Cardot	7,8,9,11,13,14,15,16,17,18,19 ,20,24,28	s, r	Tf	B	x
	**D. rufescens* (Dicks.) Schimp.	37	r	Tf	A	h
	D. varia (Hedw.) Schimp.	23,24,29,31,37	s, r	Tf	B	h
Fissidentaceae	*Fissidens dubius* P. Beauv.	17,25	s	Tf	S	m
	F. taxifolius Hedw.	14,16,20,21,23,24,28,29	s, r, Po	Tf	A	m
	F. arnoldii R. Ruthe	14,15,24	s, r	Tf	B	td
	F. bryoides Hedw.	8,13,14,16,17,23,24	s	Tf	A	h
	F. crispus Mont.	8,13,14,15,16,17,29,36, 40	s, r	Tf	S	m
	F. curvatus Hornsch.	8,23,38	s	Ts	S	m
	**F. incurvus* Starke ex Röhl	7,11,24	s, r	Tf	A	x
	F. viridulus (Sw. ex anon.) Wahlenb.	7,8	s, r	Tf	S	m
	F. celticus Paton	8,28	s	Ts	A	m
	F. exilis Hedw.	8,16,23	s, r	Ts	A	h
Rhabdoweisiaceae	*Dicranoweisia cirrata* (Hedw.) Lindb.	1,23,24,30	Qi, Pb, Pn	Tf	B	m
Ditrichaceae	*Ceratodon purpureus* subsp. *stenocarpus* (Bruch & Schimp. ex Müll.Hal.) Dixon	27	s	Tf	A	m
	Cheilothela chloropus (Brid.) Broth	7,14	s, r	Tf	S	x
	Pleuridium acuminatum Lindb.	13	s	Tf	S	h
Pottiaceae	**Aloina aloides* (Schultz) Kindb.	13,23	s	Ts	S	x
	A. rigida (Hedw.) Limpr.	8,9	s	Ts	B	x
	Barbula unguiculata Hedw.	1,8,9,11,12,17,19,20,21,22,23 ,25,26,27,28,39,42,43	s, r	Tf	A	h
	Cinclidotus aquaticus (Hedw.) Bruch & Schimp.	31	r	At	S	h
	C. pachylomoides Bizot	28	Po	At	N	h
	C. riparius (Brid.) Arn.	18,28,31	r	At	S	h
	Crossidium squamiferum var. *pottioideum* (De Not.) Monk.	9,26	r	Tf	B	x
	Dialytrichia mucronata (Brid.) Broth.	18,28	r, Po	Tuft	S	h
	Didymodon acutus (Brid.) K.Saito	2,8,11,13,14,15,16,29,32	s, r	Tf	B	m
	D. cordatus Jur.	2,7,8,16,17,20,28,32	s, r, Qi	Tf	B	m
	D. insulanus (De Not.) M.O. Hill	1,5,9,10,11,13,17,19,20,22,23 ,25,26,28,31,34,39,42,43	s, r	Tf	S	m
	D. luridus Hornsch. ex Spreng	9,14,21,25,28,31,32,37	s, r, Po	Tf	B	x
	**D. rigidulus* Hedw.	7,8,9,10,23,25	s, r	Tuft	S	x
	D. tophaceus (Brid.) Lisa	7,8,9,12,13,20	s, r,	Tf	B	h

	D. vinealis (Brid.) R.H. Zander	1,5,6,10,13,14,19,20,23,24,26,28,31,32,34,38	s, r, Ac, Qi	Tuft	S	x
	Microbryum davallianum (Sm.) R.H. Zander	9	s	Ts	S	h
	Pseudocrossidium revolutum (Brid.) R.H. Zander	2,14	s, r	Tf	B	x
	Pterygoneurum ovatum (Hedw.) Dixon	3	s, r	Tf	B	x
	Syntrichia caninervis var. *gypsophila* (J.J.Arnrnan ex G.Roth) Ochyra	34	r	Tf	S	x
	S. handelii (Schiffn.) S. Agnew & Vondracek	33,34	r, Qi	Tf	B	x
	S. montana Nees	10,31,34	r	Tf	S	x
	S. princeps (De Not.) Mitt.	10,30	r	Tf	A	x
	S. ruraliformis (Besch.) Mans.	2,3,4,5,12,34	r	Tf	S	x
	S. ruralis (Hedw.) F. Weber & D. Mohr	1,2,3,4,5,6,9,10,11,12,16,19,20,22,25,27,33,39,41,42,43	s, r, Ac	Tf	S	x
	S. virescens (De Not.) Ochyra	2,3,4,5,9,33,34	s, r, Ac	Tf	S	x
	Tortula acaulon var. *pilifera* (Hedw.) R.H. Zander	27	s	Tf	S	m
	T. atrovirens (Sm.) Lindb.	7,25,26	s, r	Tf	S	x
	T. brevissima Schiffn.	12,18,20,25,28	r	Tf	S	m
	T. cuneifolia (Dicks.) Turner	7,9,13,19	s, r	Tf	S	x
	T. inermis (Brid.) Mont.	4,5,9,12,14,17,19,23,27,33	s, r	Tf	S	x
	T. marginata (Bruch & Schimp.) Spruce	8,14	r	Tuft	B	m
	T. muralis L. ex Hedw.	1,4,7,8,9,11,12,13,25,26,27,28	s, r	Tf	S	m
	T. subulata Hedw.	4,24,27	s, r	Tuft	S	x
	Streblotrichum. convolutum var. *commutatum* (Jur.) J.J. Amann	27	s	Tf	S	x
	S. convolutum (Hedw.) P. Beauv. var. *convolutum*	4,5,7,9,12,14,16,17,19,25,31,34	s, r	Tf	S	m
	Eucladium verticillatum (With.) Bruch & Schimp.	11,14,17,20,21,29,32,37	s, r	Tf	S	h
	Gymnostomum aeruginosum Sm.	8,13,14,23,26,34,37,40,44	s, r, Ac	Tf	S	h
	G. calcareum Nees & Hornsch.	1,8,9,11,24,37	s, r	Tf	B	h
	G. viridulum Brid.	8,9,11,25	s, r	Tf	B	x
	Tortella humilis (Hedw.) Jenn.	5,7,15,17,21,31	s, r	Tf	S	x
	T. nitida (Lindb.) Broth.	21,32	s, r	Cu	S	x
	T. squarrosa (Brid.) Limpr	4,7,13,14,17,24,28	s, r, Qi	Tf	B	x
	T. tortuosa (Hedw.) Limpr.	5,8,11,14,15,16,18,33,34	r	Tuft	B	x
	Trichostomum brachydontium Bruch	5,7,8,15,16,26,28	s, r, Po, c	Tf	B	m
	T. crispulum Bruch	5,9,11,15,16,25	s, r	Tf	B	m
	Weissia brachycarpa (Nees & Hornsch.) Jur.	13,16,19,20,23,27	s	Tf	S	x
	W. condensa (Voit) Lindb.	4,8,10,15,20,23,24,27,2832,33,39,40,41,44	s, r	Tf	S	x
	W. controversa Hedw. var. *controversa*	8,13,14,17,24,25,27,28,33	s, r	Tf	S	x
	W. controversa var. *crispata* (Nees & Hornsch.) Nyholm	24,28	s, r	Tf	S	x
Seligeriaceae	**Seligeria recurvata* (Hedw.) Bruch & Schimp.	37	r	Ts	S	h
Grimmiaceae	*Grimmia anodon* Bruch & Schimp.	33	r	Cu	S	x
	G. dissimulata E. Maier	7,9,11,13,14,19,25,26,28	s, r	Cu	S	x
	G. elatior Bruch ex Bals. Criv. & De Not.	4,7,9,13,16,19,20,24,25,26	s, r, Qi	Cu	A	h
	G. elongata Kaulf.	1,13,26	s, r	Cu	A	h
	G. leavigata (Brid.) Brid.	26	r	Cu	A	x
	**G. lisae* De Not.	1,5,7,9,23,24,26,28	s, r	Tf	A	h
	G. longirostris Hook.	13,23,26,28	r	Cu	A	m
	G. meridionalis (Müll. Hall.) E. Maier	5,7,13,15,19,28	s, r, Po	Cu	A	m
	G. pulvinata (Hedw.) Sm.	1,2,3,4,5,6,7,8,9,10,11,12,16,18,20,23,24,25,26,28,30,33,34,39,41,42,43,44	s, r, Ac, Pb, Qi	Cu	A	x
	G. tergestina Tomm. ex Bruch & Schimp.	4,10	s, r	Cu	S	x
	G. trichophylla Grev.	7,26	s, r	Cu	A	h
	Schistidium apocarpum (Hedw.) Bruch & Schimp.	20,24,25,30,33,34	s, r, Po	Tf	B	x
	S. atrofuscum (Schimp.) Limpr.	2,5,27	s, r	Cu	B	x
	S. confertum (Funck) Bruch & Schimp.	1,2,3,4,5,25,33,34,35,43,41	s, r	Cu	S	x

	****S. confusum* H.H. Blom	5,27	s, r	Cu	B	x
	S. flaccidum (De Not.) Ochyra	2,3,27	s, r	Cu	S	x
	**S. platyphyllum* (Mitt.) H.Perss.	2,4,5,12,33	s, r	At	S	h
	S. rivulare (Bridel) Podpera	1,5,27,32	s, r	At	A	h
	S. trichodon (Brid.) Poelt	27	s	Tf	S	x
Bartramiaceae	*Bartramia aprica* Müll.Hal.	7,8,13,14,19,21,23,26	s, r	Tuft	A	x
	Philonotis capillaris Lindb.	21	s	Tf	S	h
	P. calcarea (Bruch & Schimp.) Schimp.	36	s	Tf	B	h
	P. fontana (Hedw.) Brid	41	r	Tf	S	h
Bryaceae	*Bryum argenteum* Hedw.	7,12,26	s, r	Tf	S	m
	B. canariense Brid.	7,11	s	Tf	S	x
	B. dichotomum Hedw.	2,3,4,7,8,12,13,14,18,20,21,23,24,25,26,28	s.r	Tf	S	m
	**B. klinggraeffii* Schimp.	23	s	Tf	S	h
	Imbribryum alpinum (Huds. ex With.) N. Pedersen	18	r	Tf	B	m
	I. mildeanum (Jur.) J.R. Spence	9,20,37	s, r	Cu	S	h
	Ptychostomum capillare (Hedw.) Holyoak & N. Pedersen	1,5,7,8,10,11,12,13,15,20,22,23,24,25,26,28,30,31,34,39,42	s, r, Ac, Pb, Po	Tf	S	m
	P. cernuum (Brid.) Hornsch.	11,13	s	Tf	S	h
	P. compactum Hornsch.	4,7,11,12,34	s, r	Tf	S	m
	P. donianum (Grev.) D.T.Holyoak & N.Pedersen	17,21	s, r	Tf	S	m
	**P. elegans* (Nees) D. Bell & Holyoak	19	s	Tuft	B	m
	P. imbricatulum (Müll. Hal.) Holyoak & N. Pedersen	5,8,10,13,19,20,23,28,33	s, r	Tf	S	x
	P. inclinatum (Sw. ex Brid.) J.R. Spence	4,23,28,27,28	s, r	Tf	B	h
	P. kunzei (Homsch.) J.R. Spence	12,34	s, Ac	Tf	S	m
	P. marratii (Hook.f. & Wilson) J.R. Spence	7	s	Tuft	S	h
	P. moravicum (Podp.) Ros & Mazimpaka	7,8,10,13,14,20,21,34	s, r, Qi, Pb	Tf	S	m
	P. pseudotriquetrum (Hedw.) J.R. Spence & H.P. Ramsay ex Holyoak & N. Pedersen	7,23	s	Tf	S	h
	**P. rubens* (Mitt.) Holyoak & N. Pedersen	12	s	Tf	A	m
	P. torquescens (Bruch & Schimp.) Ros & Mazimpaka	4,5,7,8,9,11,12,13,14,15,16,19,20,23,25,28,29,32,34,42	s, r, Jr, Po, Pb, Qi	Tf	B	x
	P. turbinatum (Hedw.) J.R. Spence	24,28	s	Tf	A	x
Mniaceae	*Pohlia elongata* Hedw. var. *elongata*	20,32,36,37,38,40,44	s, r	Tf	A	m
	P. elongata var. *greenii* (Brid.) A.J.E.Sm.	29,30	s	Tf	A	m
	P. melanodon (Brid.) A.J.Shaw	29,37	s, r	Tf	S	h
	Epipterygium tozeri (Grev.) Lindb.	7,13	s	Ts	S	m
	Plagiomnium elatum (Bruch & Schimp.) T.J. Kop.	18,29	s	Tuft	S	h
	P. ellipticum (Brid.) T.J. Kop.	38	r	Tf	S	h
	P. undulatum (Hedw.) T.J. Kop	21,29	r	Tf	A	h
Orthotrichaceae	*Lewinskya acuminata* (H. Philib.) F. Lara, Garillet & Goffinet	21	Jr	Cu	S	x
	L. affinis (Schrad. ex Brid.) F.Lara, Garillet & Goffinet	2,5	Ac	Cu	S	m
	L. rupestris (Schleich. *Ex* Schwägr.) F. Lara, Garilleti & Goffinet	1,4,5,23	r, Ac	Cu	A	x
	L. speciosa (Nees) F. Lara, Garilleti & Goffinet	1,5,6,21,24,25,43	r, Ac, Jr, Qi	Cu	S	x
	L. striata (Hedw.) F. Lara, Garilleti & Goffinet	26	s	Cu	B	m
	Orthotrichum alpestre Hornsch. Ex bruch & Schimp.	10	Qi	Cu	A	x
	O. anomalum Hedw.	2,10,15,18,20,30,31,34	r, Ac, Po	Cu	S	x
	O. bistratosum (Schiffn.) Guerra	2,4,9,11,20,24,25,26,30,33,34,43	r, Qi	Cu	S	x
	O. cupulatum var. *cupulatum* Hoffm. ex Brid.	2,4,5,9,10,11,12,18,20,23,25,31,33,43	s, r, Pb	Cu	S	x
	O. cupulatum var. *riparium* Huebener	25	r	Cu	S	h
	O. diaphanum Brid.	9,12,34,38	r, Po	Cu	S	x
	O. hispanicum F.Lara, Garilleti & Mazimpaka	4,5,6	s, r, Ac	Cu	S	x
	O. pallens Bruch ex Brid.	2,38	Ac Po	Cu	S	x

	O. pumilum Sw. ex anon.	2,3,34	r	Cu	S	x
	O. scanicum Grönvall	25	Qi	Cu	A	x
	O. stellatum Brid.	32	Po	Cu	S	m
	O. tenellum Bruch ex Brid.	2,4,12,21,24,25,29,34	s, r, Jo, Jr, Qi	Cu	S	x
	Pulvigera lyellii (Hook. & Taylor) Plášek, Sawicki & Ochyra	1,2,3,4,5,6,9,10,12,25,30,33,43	r, Jo Ac, Qi, Pb	Tuft	S	x
	Zygodon catarinoi C. Garcia, F. Lara, Sergio & Sim:Sim	21,30,32	Qi, Po	Tf	S	m
Plagiotheciaceae	**Plagiothecium laetum* Schimp.	7	s	Ms	A	m
Fabroniaceae	*Fabronia pusilla* Raddi	23	s	We	S	x
Pterigynandraceae	*Pterigynandrum filiforme* Hedw.	1,5,6,28,33	Ac, Cl	Ms	S	m
Habrodontaceae	*Habrodon perpusillus* (De Not.) Lindb.	9,12,21,25,29	s, r, Qi, Jr,	Mr	S	h
Amblystegiaceae	*Cratoneuron filicinum* (Hedw.) Spruce	38	r	We	B	h
	Palustriella commutata (Hedw.) Ochyra	29,37,38,40,41	r, Po	We	B	h
	Amblystegium serpens (Hedw.) Schimp.	25,28,37	s, Qi	Mr	S	h
	**Campylium bambergeri* (Schimp.) Hedenäs, Schlesak & D. Quandt	24,26,28,29,32	s, r, Qi, Po	Ms	B	h
	**Drepanium fastigiatum* (Hampe) C.E.O. Jensen	16,20,26	s, r, Qi	Ms	S	m
	**Drepanocladus sordidus* (Mull.Hal.) Hedenäs	38	s	Mr	S	h
	Hygroamblystegium varium (Hedw.) Monk.	36	s	Mr	S	m
	Leptodictyum riparium (Hedw.) Warnst.	17	s	Mr	S	h
Scorpidiaceae	**Scorpidium revolvens* (Sw. ex anon.) Hedenas	17	s	We	S	h
Pseudoleskeellaceae	*Pseudoleskeella nervosa* (Brid.) Nyholm	17,18,36,38	s, r, Po	Mr	B	m
Brachytheciaceae	*Eurhynchium striatum* (Hedw.) Schimp	28,29	r, Po	We	A	h
	Rhynchostegium confertum (Dicks.) Schirnp.	7,8,10,13,15,17,19,21,29	s, r, ço	Mr	S	h
	R. megapolitanum (Blandow ex F. Weber & D. Mohr)	7,8,9,12,13,14,15,16,20,32	s, r, ço, Qi, Po	Mr	S	h
	R. riparioides (Hedw.) Dixon	7,12,15,17,21,23,25,28,29,30,31,32,37,40,44	s, r, Po, Qi	Ms	A	h
	Scorpiurium circinatum (Bruch) M. Fleisch. & Loeske	7,11,12,13,14,15,16,20,21,24,25,26,28,29,31,32	s, r, ço, Po, Qi	Mr	B	x
	S. sendtneri (Schimp.) M.Fleisch.	20,28,31,32	s, r, Po	Mr	S	x
	Microeurhynchium pumilum (Wilson) Ignatov & Vanderpoorten	20,21,29,37	s, r, Po	Mr	S	x
	Oxyrrhynchium hians (Hedw.) Loeske	7,8,28,31	s, r	Mr	A	h
	O. schleicheri (R. Hedw.) Röll	8,16,24	s	Mr	A	h
	O. speciosum (Brid.) Warnst.	7,13,16,23,24,25,26,32,37	s, r, Po	Mr	A	h
	Rhynchostegiella curviseta (Brid.) Limpr.	13,14,28,31,32,37	s, r, Pb, Po	Ms	A	h
	R. litorea (De Not.) Limpr.	1,5,13,16,20,21,23,28,37	s, r, Qi	Mr	B	h
	R. tenella (Dicks.) Limpr.	5,11,16,19,21	s, ço, Qi	Ms	S	h
	Brachytheciastrum trachypodium (Brid.) Ignatov & Huttunen	1,23	r, Ac	Mr	A	m
	B. velutinum (Hedw.) Ignatov & Huttunen	1,10,23,24,25	r, ço, Pb, Qi	Mr	A	x
	Brachythecium albicans (Hedw.) Schimp.	42	r	We	A	m
	B. geheebii Milde	33	r	Mr	S	m
	B. glareosum (Bruch ex Spruce) Schimp	5,23,19,24,27,34	s, r, Qi	Mr	S	m
	B. mildeanum (Schimp.) Schimp	20,21	s, Qi	We	S	h
	B. rivulare Schimp.	21	r	Mr	S	a
	B. rutabulum (Hedw.) Schimp.	21,23,29	r, Qi, Po	Mr	A	m
	B. salebrosum (Hoffm. *ex* F. Weber & D. Mohr) Schimp.	4	s	Mr	S	m
	Homalothecium aureum (Spruce) H.Rob.	11,12,14,20,21,32	s, r, ço, Po, Qi	Mr	B	x
	H. lutescens (Hedw.) H. Rob.	1,5,9,10,11,19,28,32,42	s, r, Po	We	S	x
	H. philippeanum (Spruce) Schimp.	1,2,3,4,5,6,33,34	r, ço,Ac	Mr	B	x
	H. sericeum (Hedw.) Schimp.	9,11,20,21,23,24,25,26,29,30	s, r, Qi, Po	Mr	B	x
	Kindbergia praelonga (Hedw.) Ochyra	14,16,21,26,28,29	s, r	Mr	A	h
	Sciuro-hypnum plumosum (Hedw.) Ignatov & Huttunen	21,23	r, Jr	We	A	m
	S. populeum (Hedw.) Ignatov	24,33	s, Po	We	A	m
	S. starkei (Brid.) Ignatov & Huttunen	21,29	s, Pb, Qi	Mr	S	m

	Scleropodium cespitans (Müll. Hal.) L.F.Koch	8,11,13,14,20,23,24,25,26,28,37	s, r, Po	Ms	S	m
	S. touretii (Brid.) L.F.Koch	7,8,13,14,15,19,20,21,23,24,26,28,32,37,40	s, r, Po, Qi	Mr	A	x
Hypnaceae	**Hypnum andoi* A.J.E. Sm.	28	Po	Ms	A	m
	H. cupressiforme var. *cupressiforme* Hedw.	11,19,21,23,24,30	s, r, Qi, Po, Pb	Ms	S	x
	H. cupressiforme var. *lacunosum* Brid.	32	Po	Ms	S	x
	H. resupinatum Taylor	20,21,26,29	s, Qi, Pb, Po	Mr	A	m
	**H. revolutum* (Mitt.) Lindb.	11,24,28	s, r, Qi	Mr	S	m
Pylaisiaceae	**Homomallium incurvatum* (Schrad. ex Brid.) Loeske	25	s	Mr	S	m
Leucodontaceae	*Leucodon sciuroides* (Hedw.) Schwägr	9,10,19,20,21,23,25,28,29,30,32,34	s, r, Qi, Pb, Po, Jr	Mr	A	x
	Nogopterium gracile (Hedw.) Crosby & W.R. Buck	1,9,10,11,16,20,21,24,25,26,28,31,42	s, r, k, Po, Pb	Mr	S	x
Neckeraceae	*Alleniella complanata* (Hedw.) S. Olsson, Enroth & D. Quandt	24	r	Fa	S	x
	Leptodon smithii (Hedw.) F. Weber & D. Mohr	9,10,25,26,28	r, Po	Fa	S	x
	Neckera menziesii Drumm.	1,5,6,34	r, Ac	Fa	S	m

Table 3. The distribution of the taxa according to the families.

Family	**Number of taxa**	**Percentage of taxa according to total number of taxa (%)**
Pottiaceae	49	21.59
Brachytheciaceae	32	14.10
Bryaceae	20	8.81
Grimmiaceae	19	8.37
Orthotrichaceae	19	8.37
Fissidentaceae	10	4.41
Amblystegiaceae	8	3.52
Mniaceae	7	3.08
Dicranellaceae	5	2.20
Hypnaceae	5	2.20
Bartramiaceae	4	1.76
Ditrichaceae	3	1.32
Funariaceae	3	1.32
Cephaloziellaceae	3	1.32
Pelliaceae	3	1.32
Neckeraceae	3	1.32
Jungermanniaceae	2	0.88
Southbyaceae	2	0.88
Porellaceae	2	0.88
Ricciaceae	2	0.88
Timmiellaceae	2	0.88
Leucodontaceae	2	0.88
Notothyladaceae	1	0.44
Furullaniaceae	1	0.44
Lejeuneaceae	1	0.44
Metzgeriaceae	1	0.44
Fossombroniaceae	1	0.44
Petalophyllaceae	1	0.44
Lunulariaceae	1	0.44
Aytoniaceae	1	0.44
Conocephalaceae	1	0.44
Marchantiaceae	1	0.44
Targioniaceae	1	0.44
Sphaerocarpaceae	1	0.44
Seligeriaceae	1	0.44

Pylaisiaceae	1	0.44
Encalyptaceae	1	0.44
Habrodontaceae	1	0.44
Pterigynandraceae	1	0.44
Plagiotheciaceae	1	0.44
Scorpidiaceae	1	0.44
Rhabdoweisiaceae	1	0.44
Fabroniaceae	1	0.44
Pseudoleskeellaceae	1	0.44
Total	**227**	**100**

Discussion and Conclusions

The acrocarpous moss family Pottiaceae (49 taxa) is the richest family in terms of taxa numbers in the study area. Pottiaceae, contains many desiccation-tolerant members, is characteristic primarily in Mediterranean Basin (Zander, 1993; Szűcs et al., 2017). Therefore, this result is not surprising for the Taşeli Plateau. The pleurocarpous moss family Brachytheciaceae (32 taxa) was the second largest family in the study area, because of the forest floor with more humid habitats provides suitable shelters especially for the meso-hygrophytic family members. Along with this, the forest floors and humid rocky habitats in the study area is inhabited by mesophytic members of the Bryaceae (20 taxa). Other species-rich families in the study area are Grimmiaceae (19), Orthotrichaceae (19), Fissidentaceae (10), Amblystegiaceae (8), Mniaceae (7), Dicranellaceae (5) and Hypnaceae (5).

Ptychostomum, its members grow on soil, rocks and bark, was the widespread genus in Taşeli Plateau with a total of 14 species. *Orthotrichum* was second common and abundant genus in the study area with a total of 12 taxa. *Orthotrichum* members, most of which are drought tolerant, grow as small pads on tree trunks and on the rock surfaces. The genus was represented by a total 12 taxa in the Taşeli Plateau. Another drought-resistant genus *Grimmia*, mostly of members grow on rocks at low to high altitudes on all continents (Karakaş & Ezer, 2017), represented by a total of 11 species in the study area. *Fissidens* (10), *Schistidium* (8), *Tortula* (8), *Didymodon* (7), *Syntrichia* (7) and *Brachythecium* (7) are other common genera in the Taşeli Plateau. Members of these genera can withstand extremely harsh environments, as they are broad tolerance members with the ability to adapt to different habitats and environments.

The most common species in the study area are *Barbula unquiculata*, *Didymodon insulanus*, *Syntrichia ruralis*, *Grimmia pulvinata*, *Ptychostomum capillare*, *P. torquescens* and *Scorpiurium circinatum*. These species were collected mostly on soil and rock surfaces, besides the ones collected on tree trunks.

When the environmental acidity preferred by the taxa in their habitats is considered; it was determined that 54.63% had subneutrophyte, 25.99% had acidophyte, 18.94% had basiphyte and 0.44% had neutrophyte characters (Figure 3).

When the moisture tendencies and water requirements of the taxa were evaluated, it was determined that 36.56% had xerophyte, 33.04% hygrophyte and 29.96% mesophyte characters (Figure 3). These results showed that humid, semi-arid and xeric habitats coexist in the Taşeli Plateau.

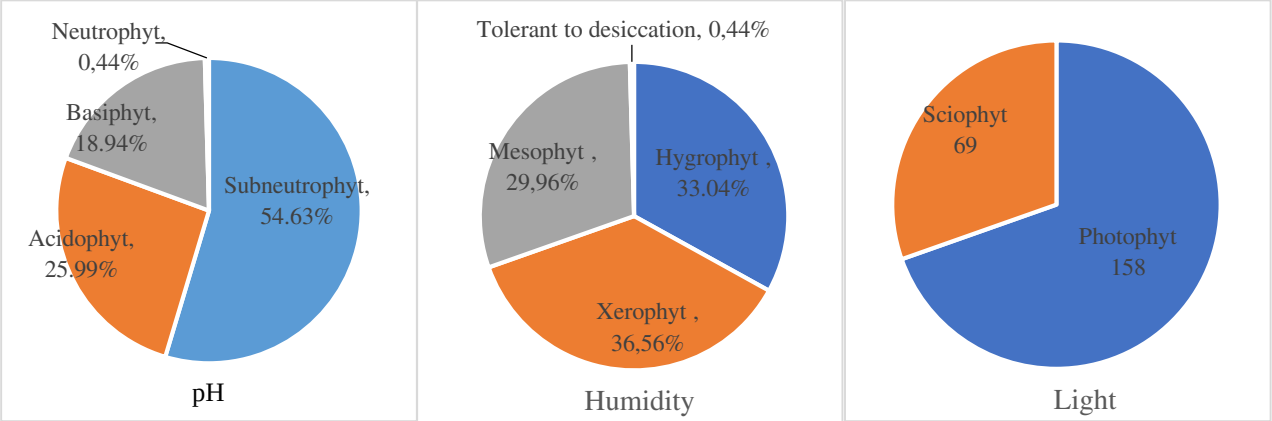

Figure 3. Taxa's humidity, acidity, and light preferences.

When the light requirements of the taxa were analyzed; it was determined that 158 taxa are photophytes and 69 taxa are sciophytes (Figure 3). While the photophytes are common on calcareous rocks in open areas of the plateau, sciophytes are common on soil and rock under the humid forest floor and also on barks.

According to life forms analysis of taxa, the life form type turfs with 85 taxa take the first place. The life forms cushion and mat-rough take the second place with 33 taxa, while mat-smooths take the third place with 19 taxa. The dominance of xerophytic acrocarpous mosses in the study area brought along the dominance of turf and cushion type life forms. Other life form types are seen respectively: Tuft (13 taxa), weft (10 taxa), mat-thalloid (10 taxa), turf-scattered (8 taxa), aquatic trailing (5 taxa), solitary thalloid (4 taxa), fan (4 taxa) and solitary creeping (3 taxa) (Figure 4).

According to the classification of taxa's regarding their substrate preferences, it is seen that, 166 taxa spread on soil, 161 taxa spread on rock and 85 taxa grow on tree trunk. Among all, 66 taxa were found on soil and rock; 47 taxa were found on soil, rock and tree trunk; 18 taxa were found on rock and tree trunk; 7 taxa were found on soil and tree trunk; 46 taxa were collected exclusively from soil surfaces, 30 taxa were collected exclusively from rock surfaces; 13 taxa were collected exclusively from tree trunk (Figure 5). Since steppe and rocky habitats cover wide range of the study area, mostly of taxa were collected from soil and rock. In addition, the fact that the trees in the study area are mostly bark-shedding conifers has affected the substrate preference distributions of bryophytes in the Taşeli Plateau.

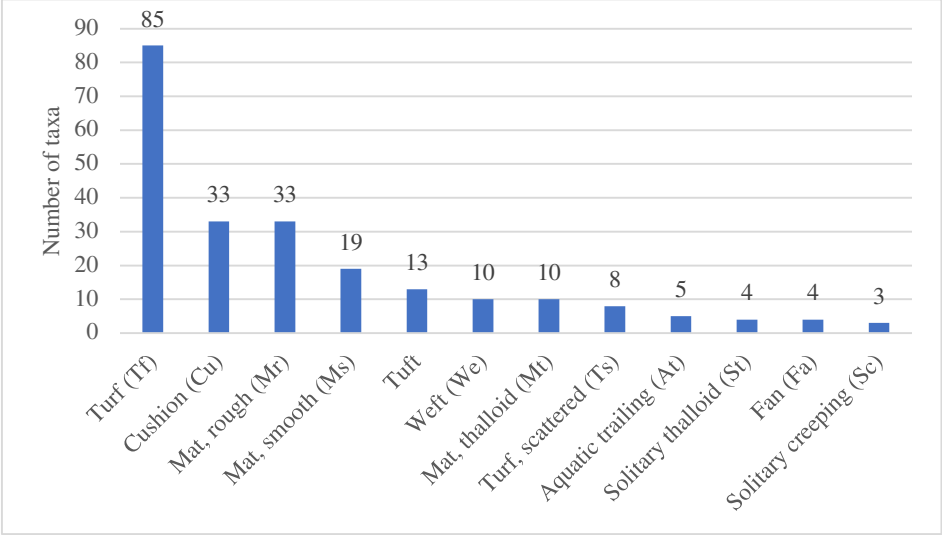

Figure 4. Life forms spectrum of taxa.

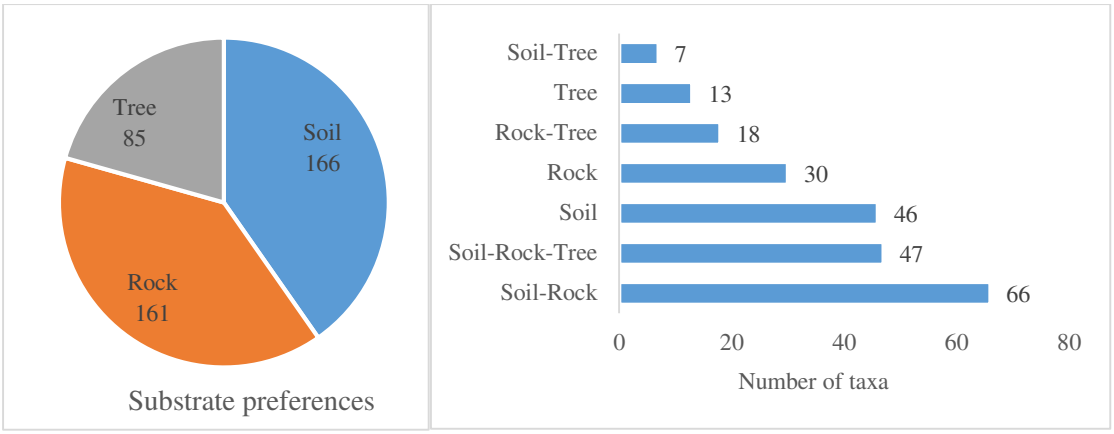

Figure 5. Taxa's substrate preferences.

When the phorophyte preferences of the epiphytic taxa in the floristic list were evaluated, *Platanus orientalis* was the most preferred phorophyte species by epiphytic bryophytes (Figure 6).

According to the grid-square system adopted by Henderson (1961) for Turkey, the study area is located in C12 square. A total of 24 taxa determined from study area are new for C12 square. Among them, *Fissidens celticus* and *Ptychostomum marratii* were recorded for the first time in Turkey during the present study (Uygur et al., 2020b; 2021). Moreover, *Dicranella crispa* and *Schistidium confusum* were recorded for the second time in Turkey during this study (Uygur et al., 2020a). *Dicranella crispa* has been recorded for the first time by Batan et al. (2019) from Ardahan Province, *Schistidium confusum* has been recorded for the first time by Uyar et al. (2018) from Sakarya Province. It is very important that these taxa have been recorded for the first time in the Mediterranean Region of Turkey.

The fact that Taşeli Plateau, located in the Mediterranean Phytogeographical Region, has different vegetation types and rough terrains, has led to the existence of different habitats and, accordingly, a wide variety of microhabitats. Moreover, southern part of study area has rainy Mediterranean climate, while inner part of study area has low rainy and semi-arid Mediterranean climate. Thus, the various habitats and climatic conditions seen in the study area have brought about phytological diversity.

In conclusion, the bryophyte flora of Taşeli Plateau reflects the typical climatic conditions, characterized by hot and drought summers and, cool and moist winters, and typical vegetation of the Mediterranean Region of Turkey.

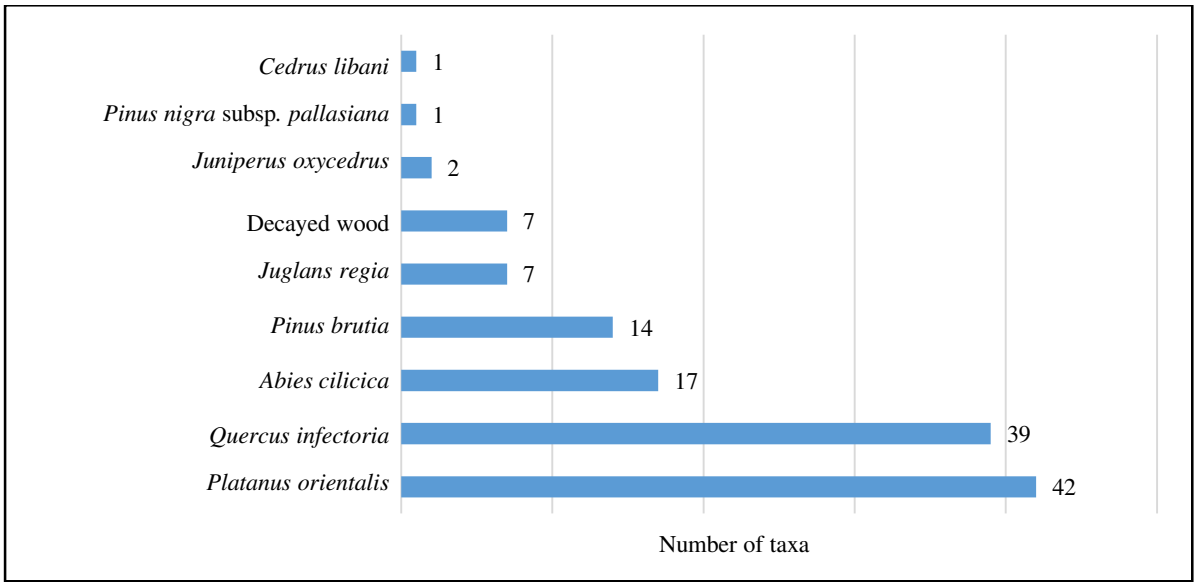

Figure 6. Epiphytic taxa's phorophyte preferences.

Ethical Approval

No need to ethical approval for this study.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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