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Liverwort (Marchantiophyta) and Hornwort (Anthocerotophyta) Flora of Yenice District (Çanakkale): New Floristic Findings from the Northern Part of Mount Ida (Kaz Dağı)

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Abstract

The Yenice district of Çanakkale stands out due to its diverse land features, being part of the Kaz Dağı (Mount Ida), its expansive coniferous and deciduous forests, and its potential for high biological diversity and endemism. It also provides highly suitable habitats for liverworts. However, the absence of legally protected areas highlights the need for a detailed assessment of the region's biodiversity. Liverworts are key components of floristic biological richness. Nevertheless, studies on the liverwort flora in both Çanakkale province and Yenice district are quite limited. Based on these considerations, this study aimed to investigate the liverwort flora of the Yenice district. During the study, a total of 295 liverwort specimens were collected from 74 different sites representative of the district's various regions. The collected specimens were identified using appropriate methods and preserved as herbarium material. As a result of the study, 29 liverwort species from 17 families and 1 hornwort species were identified from the area. Of the identified species, 7 taxa are new records for the B6 grid square according to Henderson's grid system (1961), and 13 taxa are new records for Çanakkale province.

Keywords: Liverworts, Marchantiophyta, Anthocerothophyta, Flora, Yenice, Hornworts, Türkiye

Yenice İlçesi (Çanakkale) Ciğerotları (Marchantiophyta) ve Boynuzotları (Anthocerotophyta) Florası: Kaz Dağının Kuzey Bölümünden Yeni Floristik Bulgular

Öz

Çanakkale'nin Yenice ilçesi, farklı tiplerde arazi özelliklerine sahip olması, Kaz Dağı ekosisteminin bir parçası olması, ibreli ve yaprak döken geniş ormanlara sahip olması, biyolojik çeşitlilik ve endemizm oranının yüksek olma potansiyeli taşıması, ciğerotları için son derece uygun habitatlara sahip olması ile dikkat çekmektedir. Buna rağmen yasal mevzuatlarla korunan alanlarının olmaması bu bölgedeki biyolojik çeşitliliğinin detaylı bir şekilde ortaya konulması ihtiyacını göstermektedir. Ciğerotları da floristik biyolojik zenginliğin önemli birer unsurudur. Bununla birlikte gerek Çanakkale ilinde gerekse Yenice ilçesinde ciğerotları florası konusunda yapılan çalışmalar oldukça kısıtlıdır. Bu sebeplerden yola çıkarak gerçekleştirilen bu çalışma ile Yenice ilçesinin ciğerotları florası araştırılmıştır. Çalışma boyunca Yenice ilçesinin çeşitli bölgelerinde alanı temsil edebilecek özellikte toplamda 74 farklı noktadan 295 ciğerotu örneği toplanmıştır. Toplanan örnekler uygun yöntemlerle teşhis edilerek herbaryum materyali haline getirilmiştir. Yapılan çalışmanın sonucunda alandan toplam 17 familyaya ait 29 ciğerotu türü ile 1 boynuzotu türü tespit edilmiştir. Tespit edilen ciğerotlarından 7 takson Henderson kareleme sistemine (1961) göre B6 karesi için, 13 ciğerotu taksonu ise Çanakkale ili için yeni kayıttır.

Anahtar kelimeler: Ciğerotları, Marchantiophyta, Boynuzotları, Anthocerotophyta, Flora, Yenice, Türkiye

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1. Introduction

Türkiye, which is located in a highly significant geographical region, is remarkably rich in terms of biological diversity. Its geography, location, ecology, climate, soil and geological features, elevation differences, as well as the presence of wetlands and coastal areas are among the primary factors contributing to this biological richness. However, further research is needed to fully uncover the potential of this biodiversity (Alataş and Ursavaş, 2019; Ursavaş and Keçeli, 2019a; Keçeli et al. 2011a).

Bryophytes form the second-largest group of terrestrial plants in terms of the number of taxa, following seed plants. Initially, bryophytes were classically studied under three classes (Hepaticae, Anthocerotae and Musci) within the division Bryophyta. However, following recent molecular phylogeny studies, they are now classified under three separate divisions (Goffinet and Shaw, 2009): These divisions are:

- Marchantiophyta (Liverworts, approximately 5000 species),
- Anthocerotophyta (Hornworts, approximately 150 species),
- Bryophyta (Mosses, approximately 13000-15000 species) (Goffinet and Shaw, 2009).

Liverworts have a broad distribution across the globe, from tropical regions, where sufficient moisture supports their survival, to te subantarctic and subarctic regions. Although liverworts are considered terrestrial plants, they can also be found along water edges and sometimes entirely submerged in water. Liverworts are widespread particularly in regions with humid climates, shaded areas, and freshwater edges. In addition, bryophytes can also survive in extreme conditions, such as arid environments where soil and moisture are scarce. Bryophytes are found in areas where many plants cannot survive, such as tree bark and exposed rock surfaces (Schofield, 2001).

Based on these characteristics, it is believed that the Yenice district of Çanakkale provides an exceptionally suitable geography for the habitat formation of liverworts. Yenice District is located in the southern Marmara region of the Marmara region, in the inland areas of the Biga Peninsula. It is situated in the southeast of Çanakkale province. With a surface area of 1367 km², Yenice is the largest district in Çanakkale. It is bordered by Balıkesir to the east and south, Bayramiç to the southwest, Çan to the west and northwest, and Biga to the north (Figure 1) (URL 1).

In the Yenice district, part of the terrain is volcanic, with widespread crystalline schists. In some areas, bedrock is limestone. Specifically, the region around Pazarköy is a continuation of Kazdağı (Mount Ida) (Figure 2). As a result, volcanic terrains, limestone terrains, schistous terrains, as well as granite and gneiss formations are frequently encountered in Yenice. Quaternary-aged alluvium is observed in the plains (Anonymous, 1999).

The terrain of Yenice district, like the Biga Peninsula it is part of, consists of low-elevation, rugged areas. The altitude of the district center is 276m above sea level. The main elevations in the district include Aladağ (963 m), Sakar Mountain (Asar 929 m), and Güre Mountain in the north of the district. Asar Mountain extends along east-west ridges in the southern part of the district, with a fragmented appearance due to its valleys. Yenice district also features broad plains situated between the mountains, which are tectonic in origin, having formed due to the collapse of the Earth's crust. These plains were created by the accumulation of alluvium brought by rivers into the areas where the crust has fractured and collapsed. The presence of the North Anatolian Fault passes through Yenice indicates that these plains are of tectonic origin. Among these plains, the Yenice and Agonya plains are connected by a natural passage. Surrounded by elevations, these plains can also be referred to as intermontane plains. The Agonya plain covers a large area between Kalkım, Hamdibey, and Pazarköy, stretching in a narrow strip towards the southwest for 25-30 km. In the small section of the Agonya plain around Pazarköy, there are alluvial soils, while other areas are covered by azonal (young) soils, which lack a distinct genetic layer, meaning there is no differentiation in the topsoil section. These soils, referred to as colluvial, resemble alluvial soils in their formation, but differ in that their soil layers are not homogeneous and often have gravelly sublayers. These soils are suitable for agriculture (Anonymous, 1999).

Figure 1. Location of Yenice District (Adopted from URL 2)

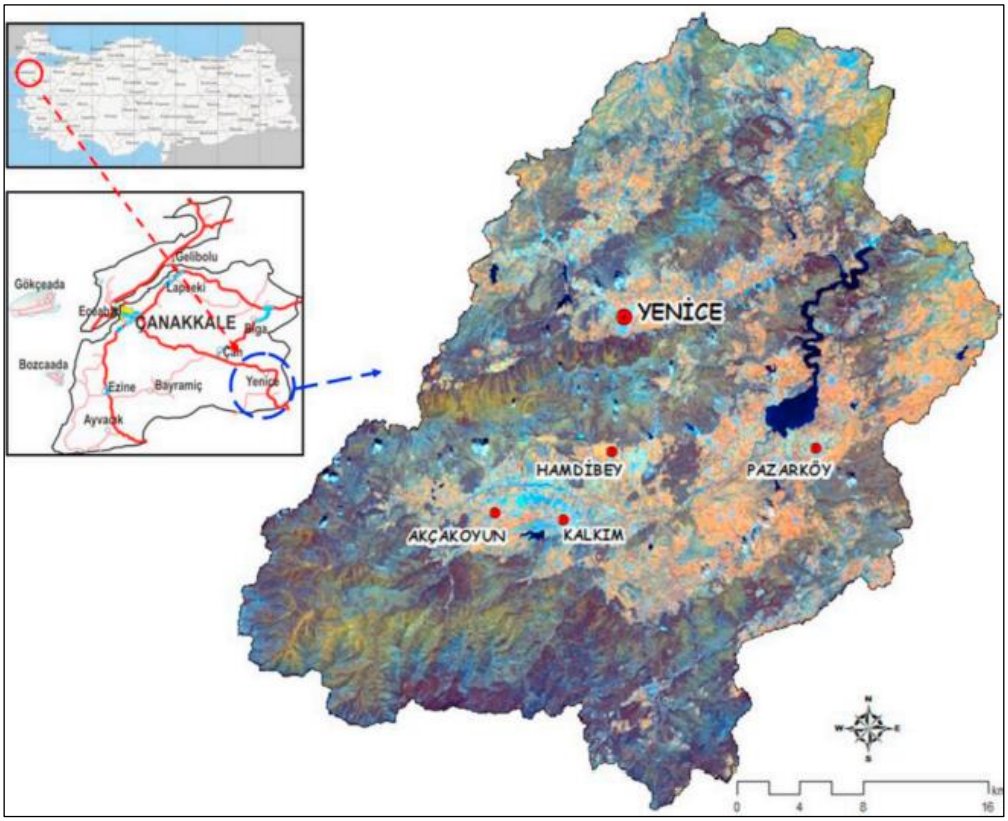

Figure 1. Yenice District (Ayhan et.al, 2020)

In terms of climate, the district experiences the Marmara climate, which is a mix of Mediterranean, Black Sea, and continental climates. This is reflected in the vegetation, as plant species typical of the Mediterranean, Black Sea, and continental climates can all be found in the district. Mediterranean climate characteristics are more pronounced in the southern parts of the district. However, due to the influence of latitude and continentality, the Mediterranean climate has lost some of its features in this region. Summers in these areas are dry and hot, while winters are mild and rainy. The climate around the district center is more continental, while the rest of the district experiences the Marmara climate. Summers are mild and dry, while winters are cold and rainy (Anonymous, 1999; Ursavaş and Keçeli, 2021).

January is the coldest month and July is the hottest. The district receives moderate rainfall, with an annual average of approximately 600-700 mm. Of this rainfall, 15.8% occurs in spring, 15.5% in summer, 50% in autumn, and 18.7% in winter. December is the wettest month, while August is the driest. Frost days are recorded from October to April. Winds in the district predominantly blow from the northeast and southwest, with occasional strong southwesterly winds (Anonymous, 1999).

Small streams originate from the district's lands, forming the headwaters of the Gönen River and Kocaçay. These streams flow into the Sea of Marmara, giving the rivers in Yenice an open basin characteristic. The Gönen River flows southwest to northeast, then turns north, eventually receiving the Yenice stream from the northwest before flowing northeast again. The tributaries of the Gönen River swell in winter and flood, while their flow significantly decreases in summer. The streams in Yenice are mainly fed by rain and snowmelt (Anonymous, 1999).

One of the most notable features of the Yenice district is its vegetation and land use (Figure 3). Forest areas cover 90,628 ha of the district's land, accounting for 66.2%. Consequently, forests are closely tied to the livelihoods of many local settlements, providing partial economic support. There are two Forest Management Directorates within the district. Due to the influence of elevation, and thus varying microclimatic and growth conditions, different tree species and mixed forest communities can be found in the forested areas. In some parts of the forests, single-species communities dominate (such as *Abies nordmanniana* subsp. *equi-trojani* (Asch. & Sint. ex Boiss.) Coode & Cullen) and *Pinus nigra* J.F.Arnold communities), while in other areas, mixed forests of broad-leaved and coniferous species are common (Anonymous, 1999).

The region's forests contain species typical of the Mediterranean, Black Sea and continental climates. The main tree species in the district's forests are: Turkish pine (*Pinus brutia* Ten.), black pine (*Pinus nigra* J.F.Arnold), oak species (*Quercus cerris* L., *Q. petraea* (Matt.) Liebl., *Q. frainetto* Ten.), chestnut (*Castanea sativa* Mill.), Kazdağı fir (*Abies nordmanniana* subsp. *equi-trojani* (Asch. & Sint. ex Boiss.) Coode & Cullen), hornbeam (*Carpinus betulus* L.), oriental beech (*Fagus orientalis* Lipsky), oriental plane (*Platanus orientalis* L.), alder (*Alnus glutinosa* (L.) Gaertn.), elm (*Ulmus minor* Mill.), ash (*Fraxinus excelsior* L.), silver linden (*Tilia tomentosa* Moench), hazel (*Corylus avellena* L. and *C. maxima* Mill.), strawberry tree (*Arbutus unedo* L.), Grecian strawberry tree (*Arbutus andrachne* L.), tree heath (*Erica arborea* L. and *E. manipuliflora* Salisb.), cornelian cherry (*Cornus mas* L.), laurel (*Laurus nobilis* L.), rockrose (*Cistus creticus* L. and *C. salviifolius* L.), dog rose (*Rosa canina* L.), spring clematis (*Clematis cirrhosa* L.), English ivy (*Hedera helix* L.), blackberry (*Rubus canescens* DC. and *R. caesius* L.), and stinging nettle (*Urtica dioica* L.) (Anonymous, 1999).

The Yenice district of Çanakkale province, selected as the research area, stands out as part of the Kaz Dağı (Mount Ida) ecosystem, which is recognized for its high biological diversity. In terms of land use, the district's large, forested area, humid climatic characteristics, and diverse topographic features such as rivers, lakes, and valleys create an extremely favorable natural environment for the establishment of habitats for liverworts. Therefore, this region is considered significant in terms of liverwort species diversity. In this context, the primary rationale for this research is the lack of detailed studies on the liverwort flora of the area. The aim is to identify the liverwort flora of the region, contribute to the completion of studies on Türkiye's liverwort flora, and fill a gap in this field.

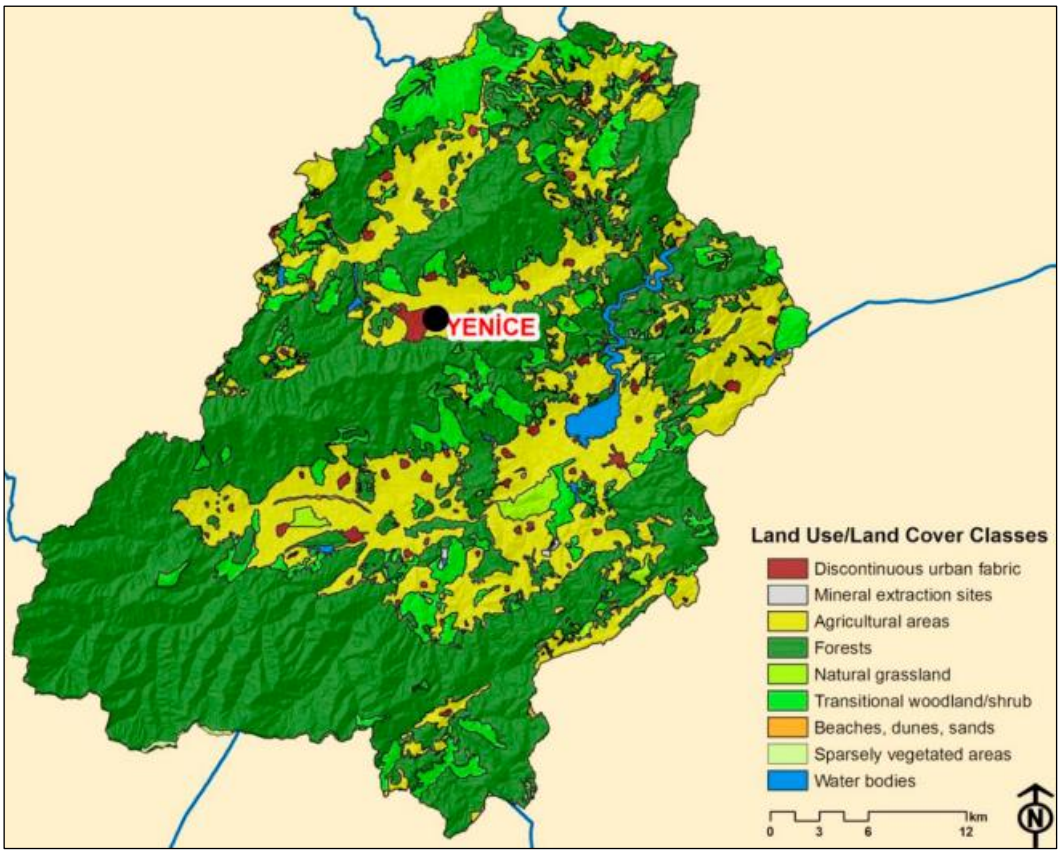

Figure 2. Land use map of Yenice district (Ayhan et.al 2020)

2. Material And Method

The research material consists of liverwort specimens collected from designated stations in the Yenice District spanning February 2021 and February 2023, during various periods characterized by varying vegetation and climatic conditions. The Yenice District, selected as the research area, is located in Türkiye's Marmara Region, and according to Henderson's (1961) grid system, it falls within the B6 grid (Keçeli and Ursavaş, 2019; Figure 4).

During the fieldwork, each selected station was assigned a number. The station's latitude, longitude, and elevation were determined using GPS and recorded along with the station number in the field notebook. These details are provided in Table 1. The Google Earth image and map showing the locations of the stations are presented in Figure 5.

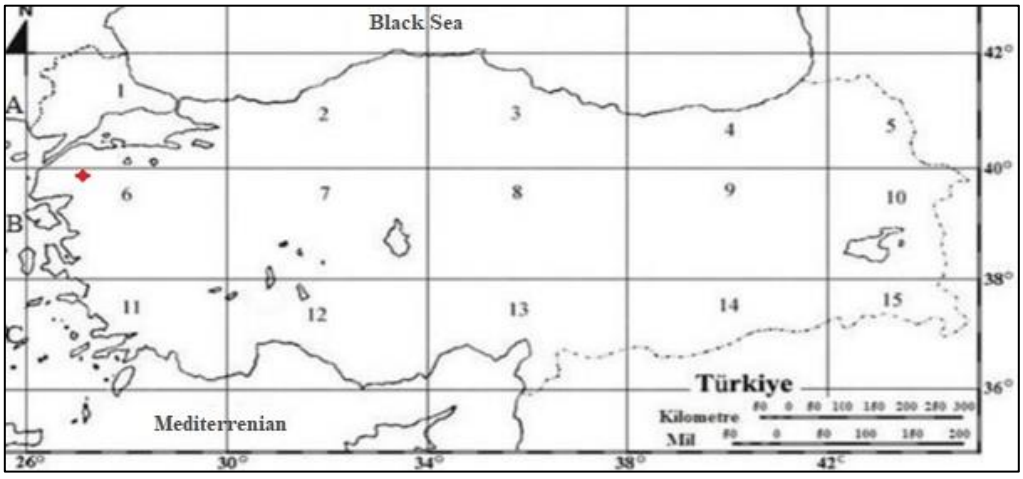

Figure 3. Henderson (1961) grid system and location of the research area

Table 1. Coordinate and altitude information of the stations (according to the “decimal degree system”)

Station No	Latitude	Longitude	Altitude	Location
1	39,94866667	27,21213889	342 m	Between Davutköy and Torhasan Lakes
2	39,94191667	27,17677778	330 m	South of Çınarcık village
3	39,93069444	27,16786111	350 m	Between Çınarcık and Sazak villages
4	39,92755556	27,16763889	426 m	Between Çınarcık and Sazak villages
5	39,92255556	27,16994444	455 m	Between Çınarcık and Sazak villages
6	39,79297222	27,14375	334 m	Southwest of Akköy village
7	39,79136111	27,14369444	371 m	Southwest of Akköy village
8	39,78672222	27,14527778	350 m	Southwest of Akköy village
9	39,85616667	27,09772222	640 m	North of Yukarıçavuş village
10	39,86061111	27,09027778	742 m	North of Yukarıçavuş village
11	39,83668611	27,09608889	404 m	North of Yukarıçavuş village
12	40,01269444	27,287	304 m	Between Sofular and Bekten villages
13	40,01286111	27,28586111	286 m	Between Sofular and Bekten villages
14	39,97405556	27,26027778	330 m	North of Nevruz village
15	39,96541667	27,26063889	382 m	North of Nevruz village
16	39,91636111	27,25983333	391 m	South of Göknar Hotel (Yenice)
17	39,91438889	27,25794444	434 m	South of Göknar Hotel (Yenice)
18	39,91713889	27,25775	350 m	South of Göknar Hotel (Yenice)
19	39,90558333	27,29397222	542 m	2 km north of Namazgah village
20	39,911	27,2985	454 m	3 km north of Namazgah village
21	39,90563889	27,27311111	755 m	Paragliding runway (Southwes of Yenice)
22	39,91619444	27,18408333	506 m	2 km east of Sazak village
23	39,92522222	27,20605556	400 m	South of Davutköy and Torhasan Ponds
24	39,93033333	27,2135	393 m	South of Davutköy and Torhasan Ponds
25	39,93077778	27,21183333	367 m	South of Davutköy and Torhasan Ponds
26	39,94036111	27,22461111	311 m	East of Davutköy Pond
27	39,88919444	27,39877778	150 m	West of Haydaroba village
28	39,90363889	27,39213889	166 m	East of Gümüşler village
29	39,97425	27,45133333	108 m	Northeast of Gönen/Yenice Pond
30	39,75855556	26,97227778	1442 m	Tavşanoynağı fire watchtower
31	39,76802778	26,97116667	1310 m	Dalaksuyu location
32	39,77130556	26,99261111	1066 m	East of Dalaksuyu location
33	39,757	27,02025	527 m	4 km southeast of Dalaksuyu
34	39,77302778	27,11091667	333 m	6 km northwest of Akçakoyun village
35	39,753	27,04713889	456 m	7 km southeast of Dalaksuyu
36	39,76516667	27,12580556	362 m	500 m northwest of İdagonya camping
37	40,01697222	27,23366667	388 m	North of Torhasan village
38	40,03338889	27,24780556	346 m	South of Güveyler Obası
39	39,99255556	27,22855556	292 m	Between Davutköy and Torhasan Villages
40	39,78019444	27,19197222	262 m	Northwest of Karaaydın Village
41	39,77530556	27,18755556	255 m	Northwest of Karaaydın Village

Station No	Latitude	Longitude	Altitude	Location
42	39,77463889	27,17138889	312 m	Northwest of Karaaydın Village
43	39,76186111	27,21480556	295 m	Southwest of Kalabakbaşı village
44	39,75125	27,26330556	301 m	South of Kıraçoba village
45	40,00555556	27,18844444	517 m	Notrh of Yukarıkaraaşık village
46	39,95652778	27,15861111	364 m	Near Çınarcık Pond
47	39,90613889	27,20244444	482 m	Between Yenice town and Sazak village
48	39,89980556	27,20311111	615 m	Between Yenice town and Sazak village
49	39,90177778	27,20363889	626 m	Between Yenice town and Sazak village
50	39,89675	27,22752778	712 m	South of Yenice town. Road to fire watchtower
51	39,88630556	27,23841667	558 m	North of Hamdibey village
52	39,86577778	27,23722222	320 m	North of Hamdibey village
53	39,96827778	27,35886111	260 m	Northwest of Karaköy village
54	39,83622222	27,41811111	276 m	South of Pazarköy village
55	39,82436111	27,43608333	372 m	North of Daralan village
56	39,90719444	27,42255556	293 m	North of Haydaroba village
57	39,846301	27,298899	254 m	Road from Kayatepe village to Hamdibey
58	39,914333	27,199778	358 m	Between Yenice town and Sazak village
59	39,889083	27,174083	614 m	3 km south of Sazak village
60	39,893444	27,144639	542 m	Southwest of Sazak village
61	39,874222	27,102611	798 m	6,5 km southwest of Sazak village
62	40,028639	27,422472	584 m	East of Çamoba village
63	39,731667	27,280889	462 m	North of Armutçuk village
64	39,681889	27,276833	416 m	South of Armutçuk village
65	39,829139	27,044806	563 m	West of Oğlanalanı village
66	39,802944	26,9955	965 m	West of Oğlanalanı village
67	39,908	27,223333	554 m	Southwest of Yenice town
68	39,911722	27,21075	476 m	Southwest of Yenice town
69	39.902.694	27.187.833	508 m	Southeast of Sazak village
70	39.892.444	27.137.385	526 m	Southwest of Sazak village
71	39.882.556	27.176.639	804 m	South of Sazak village
72	39.884.167	27.200.167	482 m	3 km northwest of Hamdibey pond
73	39.766.083	27.219.306	302 m	West of Kalabakbaşı village (Kalkım-Edremit road)
74	39.965.333	27.482.583	584 m	Southeast of Yalıoba village

Figure 5. Google Earth image of sample collection stations

During samples collection in the field, utmost care was taken to avoid damaging the plants, ensuring that their natural structure and appearance were preserved as much as possible. When collecting samples, emphasis was placed on selecting plants that contained reproductive organs. A suitable knife was used to carefully remove the plants, including their rhizoids, from their natural environment without causing damage to their structures. For some well-preserved specimens, photographs were taken in their natural habitat before collection. After the specimens were removed, they were cleaned of soil and debris and placed in sealed plastic bags with labels containing information such as the habitat type, station number, photograph number, and collection date. All efforts were made to ensure that the specimens were not damaged before being transported to the laboratory (Ursavaş and Keçeli, 2019b).

Following the fieldwork, the collected samples were brought to the laboratory, where they were removed from the plastic bags and spread out on clean paper for drying. During the drying process, care was taken to avoid direct exposure to sunlight and air drafts. Once dried, the specimens were placed in pre-prepared envelopes with their labels, and any damaged labels from the plastic bags were rewritten and attached to the envelopes. The information from the labels was also noted on the outside of the envelopes. For the identification of the samples, fundamental flora works and articles were consulted. To prevent the thallose liverwort specimens from darkening, they were identified while still fresh upon return from the field (Ursavaş and Tuttu, 2020)

When numbering the specimens, the first digit indicated the station number where the specimen was collected. The abbreviation following the colon, written in uppercase, represents the habitat type abbreviation listed in Table 2. The word following the habitat type abbreviation indicates the researcher who collected and identified the sample, and the number following this word represents the specimen number (Figure 6).

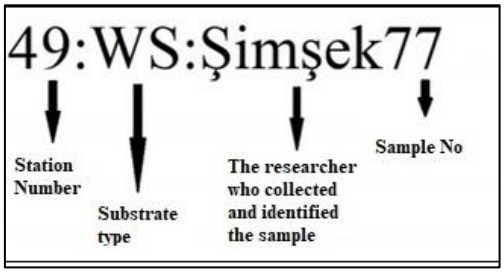

Figure 6. Numbering the samples

Table 1. Substrates and abbreviations

Substrate	Abbreviation
Tree	T
Soil	S
Rock	R
Log	L
Wet Soil	WS
Wet Rock	WR
Wet Log	WL

The identified specimens were placed in envelopes measuring 125 x 160 mm. On the envelopes, information such as the species name, station number, habitat type, photograph number and specimen number was written, thus converting the specimens into herbarium material. In the identification of liverwort specimens collected from the research area, primary floristic works by Petrov (1975), Conrad and Redfearn (1979), Watson (1981), Smith (1996), Paton (1999), Keçeli (2004), Schumaker and Vana (2005), Casas et al. (2009), Atherton et al. (2010), and Crandall-Stotler et al. (2009), along with various articles, were utilized. For the author names of the liverwort species identified as a result of the research, Söderstrom et al. (2016), Hodgetts et al. (2020) and the aforementioned works were primarily referenced. New records for the B6 grid square were verified according to Keçeli et al. (2011b), while new records for Çanakkale province were verified according to Şimşek (2023) and Erdağ and Kürschner (2017).

3. Results

Between February 2021 and February 2023, a total of 26 days of fieldwork was conducted, during which liverwort specimens were collected from 74 different stations. In total, 295 liverwort specimens were identified and turned into herbarium material. As a result of the identification process, one hornwort taxon (*Phaeoceros laevis* (L.) Prosk) and 29 liverwort taxa belonging to 17 families were identified from the area (Table 3). Of the liverwort species, 19 are leafy liverwort taxa, while 10 are thalloid liverwort taxa.

Seven of the identified taxa (*Aneura pinguis* (L.) Dumort., *Mannia gracilis* (F. Weber) D.B. Schill & D.G. Long, *Frullania teneriffae* (F. Weber) Nees, *Pallavicinia lylellii* (Hook.) Gray, *Porella pinnata* L., *Diplophyllum albicans* (L.) Dumort., *Scapania irrigua* (Nees) Nees) are reported for the first time for square B6 according to Henderson's grid system (Keçeli et.al, 2011), and 13 taxa are reported for the first time for the Çanakkale province (*Aneura pinguis* (L.) Dumort., *Diplophyllum albicans* (L.) Dumort., *Frullania teneriffae* (F. Weber) Nees, *Mannia gracilis* (F. Weber) D.B. Schill & D.G. Long, *Marchantia polymorpha* L., *Mesoptychia turbinata* (Raddi) L. Söderstr. & Váňa, *Pallavicinia lyleii* (Hook.) Gray, *Pellia epiphylla* (L.) Corda, *Porella pinnata* L., *Radula complanata* (L.) Dumort., *Radula lindenbergiana* Gottsche ex C. Hartm, *Scapania compacta* (Roth) Dumort., *S. irrigua* (Nees) Nees) (Şimşek, 2023). As a result of the research, the families with the most species were Porellaceae and Scapaniaceae, each with 4 taxa. These were followed by the Lophocoleaceae with 3 taxa.

The species identified from the research area are listed in Table 3 below. To facilitate ease of use for the reader, the families and species are arranged alphabetically. Along with the family and species names in the species list, the specimen numbers for each species are also provided. The first species in the table, marked with an asterisk (*), is *Phaeoceros laevis* (L.) Prosk from the Notothyladaceae family, a hornwort (Anthocerotophyta), while the others are liverwort species (Marchantiophyta). Among the identified liverworts, *Frullania dilatata* (L.) Dumort., *Metzgeria furcata* (L.) Corda, and *Radula complanata* (L.) Dumort. are the most common taxa in the research area.

Table 2. Taxa identified from the research area

Fam. No	Family	Sp. No	Species	Sample(s)
1*	Notothyladaceae*	1*	*Phaeoceros laevis* (L.) Prosk*.	17:S:Şimşek483
2	Aneuraceae	2	*Aneura pinguis* (L.) Dumort.	34:WS: Şimşek565, 34:WS:Şimşek567, 36:S:Şimşek566, 52:WS:Şimşek564
3	Aytoniaceae	3	*Mannia gracilis* (F. Weber) D.B. Schill & D.G. Long (Syn: *Asterella gracilis* (F.Weber) Underw.	1: WR:Şimşek363, 54:T:Şimşek408
		4	*Reboulia hemisphaerica* (L.) Raddi	9:L:Şimşek450, 10:S:Şimşek332, 16:S:Şimşek484
4	Conocephalaceae	5	*Conocephalum conicum* (L.) Dumort.	29:WR:Şimşek460, 32:WS:Şimşek570, 33:R:Şimşek481, 34:WS:Şimşek569, 47:S:Şimşek461, 59:WS:Şimşek659, 65:S:Şimşek660, 72:R:Şimşek525, 73:WR:Şimşek524
5	Fossombroniaceae	6	*Fossombronia pusilla* (L.) Nees	6:S:Şimşek357, 9:S:Şimşek336, 6:WS:Şimşek476, 1:L:Şimşek488, 6:S:Şimşek553, 64:S:Şimşek652
6	Frullaniaceae	7	*Frullania dilatata* (L.) Dumort.	3:T:Şimşek364, 3:T:Şimşek367, 3:T:Şimşek369, 3:T:Şimşek370, 4:T:Şimşek362, 5:T:Şimşek359, 5:T:Şimşek361, 6:T:Şimşek352, 6:T:Şimşek470, 6:T:Şimşek447, 6:T:Şimşek632, 7:T:Şimşek425, 8:T:Şimşek337, 8:T:Şimşek339, 9:T:Şimşek340, 9:L:Şimşek448, 10:T:Şimşek350, 10:T:Şimşek356, 12:T:Şimşek503, 12:T:Şimşek603, 12:T:Şimşek605, 13:L:Şimşek423, 13:WL:Şimşek604, 14:T:Şimşek504, 14:T:Şimşek583, 14:T:Şimşek505, 15:T:Şimşek430, 15:T:Şimşek434, 18:T:Şimşek618, 20:T:Şimşek507, 20:T:Şimşek506, 21:T:Şimşek424, 22:T:Şimşek513, 22:T:Şimşek515, 23:T:Şimşek502, 23:T:Şimşek514, 24:T:Şimşek499, 24:T:Şimşek516, 24:T:Şimşek519, 25:T:Şimşek500, 25:T:Şimşek517, 26:T:Şimşek521, 27:T:Şimşek518, 27:T:Şimşek520, 28:T:Şimşek429, 28:T:Şimşek433, 28:T:Şimşek541, 29:T:Şimşek426, 29:R:Şimşek427, 29:R:Şimşek428, 29:T:Şimşek431, 30:T:Şimşek501, 33:T:Şimşek611, 35:T:Şimşek508, 35:T:Şimşek602, 35:T:Şimşek612, 38:T:Şimşek615, 39:T:Şimşek607, 39:T:Şimşkek610, 40:T:Şimşek585, 40:T:Şimşek606, 40:T:Şimşek608, 40:T:Şimşek640, 41:T:Şimşek609, 42:T:Şimşek613, 43:T:Şimşek599, 43:T:Şimşek614, 44:T:Şimşek616, 45:T:Şimşek495, 45:T:Şimşek496, 45:T:Şimşek497, 45:T:Şimşek498, 46:T:Şimşek414, 46:T:Şimşek435, 46:T:Şimşek437, 49:T:Şimşek442, 49:T:Şimşek453, 50:L:Şimşek418,

Fam. No	Family	Sp. No	Species	Sample(s)
				51:T:Şimşek417, 53:T:Şimşek413, 55:T:Şimşek415, 51:R:Şimşek420, 53:T:Şimşek409, 53:T:Şimşek411, 53:T:Şimşek422, 53:T:Şimşek436, 53:T:Şimşek439, 53:T:Şimşek440, 54:T:Şimşek441, 55:T:Şimşek438, 56:T:Şimşek443, 60:T:Şimşek651, 64:T:Şimşek661, 65:T:Şimşek628, 66:T:Şimşek551, 67:T:Şimşek547, 68:T:Şimşek512, 69:T:Şimşek510, 70:T:Şimşek509, 73:T:Şimşek494, 73:T:Şimşek511, 74:T:Şimşek550
		8	*Frullania teneriffae* (F.Weber) Nees	27:T:Şimşek432, 50:T:Şimşek473
7	Jungermanniaceae	9	*Mesoptychia turbinata* (Raddi) L. Söderstr. & Váňa	29:S:Şimşek477
8	Lejeuneaceae	10	*Lejeunea cavifolia* (Ehrh.) Lindb.	8:R:Şimşek343, 34:WS:Şimşek561, 35:R:Şimşek562, 36:L:Şimşek560, 36:L:Şimşek596, 42:T:Şimşek642
		11	*Lejeunea lamacerina* (Steph.) Schiffn.	8:R:Şimşek341, 13:L:Şimşek591, 46:T:Şimşek465, 54:R:Şimşek489, 56:S:Şimşek458, 60:T:Şimşek657, 73:T:Şimşek479, 73:T:Şimşek490, 73:T:Şimşek492, 73:T:Şimşek533, 73:T:Şimşek543
9	Lophocoleaceae	12	*Chiloscyphus polyanthos* (L.) Corda	34:WS:Şimşek568, 36:S:Şimşek556
		13	*Lophocolea heterophylla* (Schrad.) Dumort.	6:T:Şimşek459
		14	*Lophocolea bidentata* (L.) Dumort.	66:S:Şimşek653
10	Lunulariaceae	15	*Lunularia cruciata* (L.) Dumort. ex Lindb.	1:R:Şimşek365, 1:R:Şimşek368, 2:R:Şimşek366, 9:S:Şimşek334, 9:S:Şimşek345, 13:WS:Şimşek480, 13:WS:Şimşek573, 17:S:Şimşek634, 19:WS:Şimşek619, 35:WS:Şimşek574, 36:S:Şimşek576, 37:WS:Şimşek620, 41:S:Şimşek575, 47:S:Şimşek416, 48:S:Şimşek454, 62:R:Şimşek577, 64:S:Şimşek485, 72:WS:Şimşek530, 73:WS:Şimşek531,
11	Marchantiaceae	16	*Marchantia polymorphya* L.	46:S:Şimşek559, 52:WS:Şimşek412, 64:WR:Şimşek478
12	Metzgeriaceae	17	*Metzgeria furcata* (L.) Corda	6:T:Şimşek353, 6:T:Şimşek446, 6:T:Şimşek467, 6:T:Şimşek469, 6:T:Şimşek633, 8:T:Şimşek338, 9:S:Şimşek335, 10:T:Şimşek347, 10:T:Şimşek348, 10:T:Şimşek354, 11:T:Şimşek617, 31:T:Şimşek592 31:T:Şimşek594, 35:T:Şimşek600, 36:L:Şimşek597, 40:T:Şimşek638, 43:T:Şimşek598, 43:T:Şimşek645, 49:T:Şimşek451, 50:T:Şimşek419, 50:T:Şimşek468, 50:T:Şimşek471, 60:T:Şimşek623, 60:T:Şimşek650, 60:T:Şimşek656, 61:T:Şimşek625, 62:T:Şimşek636,

Fam. No	Family	Sp. No	Species	Sample(s)
				64:T:Şimşek647,65:T:Şimşek646, 65:T:Şimşek655, 66:T:Şimşek552, 67:T:Şimşek546, 70:T:Şimşek545, 74:T:Şimşek549
13	Pallaviciniaceae	18	*Pallavicinia lylellii* (Hook.) Gray	71:WS:Şimşek629, 73:WS:Şimşek527, 73:WS:Şimşek528
14	Pelliaceae	19	*Pellia epiphylla* (L.) Corda	6:S:Şimşek358, 6:WS:Şimşek475, 6:S:Şimşek554, 8:R:Şimşek457, 9:S:Şimşek346, 9:S:Şimşe330, 10:S:Şimşek331, 9:S:Şimşek344, 29:WR:Şimşek529, 32:WR:Şimşek572, 52:WS:Şimşek571, 64:WS:Şimşek487, 73:WS:Şimşek486
15	Plagiochilaceae	20	*Plagiochila porelloides* (Torr. ex Nees) Lindenb.	48:S:Şimşek455
16	Porellaceae	21	*Porella arboris-vitae* (With.) Grolle	8:R:Şimşek342, 42:T:Şimşek641
		22	*Porella cordeana* (Huebener) Moore	31:T:Şimşek482, 31:R:Şimşek555
		23	*Porella pinnata* L.	10:R:Şimşek333, 47:S:Şimşek456, 49:T:Şimşek452, 67:R:Şimşek526
		24	*Porella plathyphylla* (L.) Pfeiff.	9:R:Şimşek351, 21:T:Şimşek 474, 30:L:Şimşek557, 58:T:Şimşek622, 69:T:Şimşek523, 73:T:Şimşek522
17	Radulaceae	25	*Radula complanata* (L.) Dumort.	5:T:Şimşek360, 6:T:Şimşek445, 6:T:Şimşek466, 6:T:Şimşek631, 10:T:Şimşek349, 10:T:Şimşek355, 10:T:Şimşek537, 10:T:Şimşek538, 13:L:Şimşek590, 14:T:Şimşek584, 17:T:Şimşek630, 28:T:Şimşek539, 28:T:Şimşek540, 30:T:Şimşek536, 30:T:Şimşek588, 31:T:Şimşek593, 31:T:Şimşek595, 35:R:Şimşek563, 35:T:Şimşek601, 36:L:Şimşek587, 40:T:Şimşek586, 40:T:Şimşek639, 43:T:Şimşek643, 43:T:Şimşek644, 44:T:Şimşek589, 46:T:Şimşek464, 47:T:Şimşek421, 53:T:Şimşek410, 53:T:Şimşek462, 54:R:Şimşek463, 56:T:Şimşek444, 57:T:Şimşek521, 60:T:Şimşek624, 60:T:Şimşek649, 60:T:Şimşek658, 61:T:Şimşek626, 62:S:Şimşek581, 62:T:Şimşek635, 63:T:Şimşek627, 64:T:Şimşek648, 65:T:Şimşek654, 67:T:Şimşek548, 70:T:Şimşek544, 73:T:Şimşek491, 73:T:Şimşek493, 73:T:Şimşek535, 73:T:Şimşek542
		26	*Radula lindenbergiana* Gottsche ex C.Hartm.	9:L:Şimşek449, 50:T:Şimşek472
18	Scapaniaceae	27	*Diplophyllum albicans* (L.) Dumort.	62:S:Şimşek558, 62:S:Şimşek582, 62:R:Şimşek637
		28	*Scapania compacta* (Roth) Dumort.	62:R:Şimşek578, 64:WS:Şimşek579
		29	*Scapania irrigua* (Nees) Nees	62:R:Şimşek534,
		30	*Scapania undulata* (L.) Dumort.	62:S:Şimşek580, 73:S:Şimşek532

4. Discussion and Conclusion

Liverwort flora research in Türkiye is still ongoing, but these studies have not yet reached a level that represents the entire country and are thus insufficient to produce a comprehensive work such as the "Flora of Türkiye Liverworts." Therefore, there is a need for an increase in liverwort flora studies in regions of the country that have not yet been researched (Ünan et al. 2021).

Liverwort flora research within the boundaries of Çanakkale province is quite limited. Yenice district, located on the northern slopes of Kaz Dağı (Mount Ida), which are known for their significant biological richness, also offers suitable habitats for liverworts. For this reason, this study focused on the liverwort flora of Yenice district, where previously only a few liverwort records had been documented (Şimşek, 2023).

The research was conducted between February 2021 and February 2023 through field, laboratory, and office work. A total of 295 liverwort specimens were collected from 74 different locations across the district, identified, and turned into herbarium material. When selecting the sampling stations, it was aimed to represent the entire district in terms of habitat characteristics and to choose areas where liverworts are most likely to be found.

In the scope of the research, 1 hornwort and 29 liverwort species were identified. This result is the highest number of liverwort species ever identified in studies conducted within Çanakkale province. The findings are presented in Table 4, compared with previous research in Çanakkale and nearby areas. Additionally, the research reported 7 new records for square B6 according to Henderson's grid system (Keçeli et al., 2011b), and 13 new records for the province of Çanakkale (Şimşek, 2023).

Among the identified liverworts, *Frullania teneriffae* (F. Weber) Nees was previously recorded from Ordu province by Özdemir and Batan (2016), while *Pallavicinia lyellii* (Hook.) Carruth. was reported from Rize by Keçeli and Abay (2007). Through this study conducted in the Yenice district of Çanakkale, a new distribution area for these two liverwort taxa outside the Black Sea region has been reported.

During the course of the study, fieldwork was often interrupted by the Covid-19 pandemic and forest fires in the Aegean and Mediterranean regions, with restrictions causing delays. However, alternative field programs were arranged once these difficulties subsided, allowing the study to be completed. Another challenge was that the research was conducted by a single researcher over a large study area, which complicated the work.

Despite challenges posed by the Covid-19 pandemic and regional wildfires, the study was successfully completed, demonstrating the resilience of the research methodology. The results emphasize the need for continued and more detailed floristic studies in this biologically rich region. Additionally, the data collected can serve as a foundation for future phytogeographical and ecological research, further contributing to the understanding of liverworts as bioindicators of ecosystem health.

Table 3. Comparison of species numbers of families with other studies in nearby regions

Liverworts and Hornworts of Yenice District			Liverworts of Kaz Dağı National Park (Gökler and Özenoğlu 1999)			Liverworts and Hornworts of Çanakkale (Gökler 2015)			Liverworts of Ayazma Nature Park and Kazdağı National Park (Arslan et.al, 2015)		
Family	**Taxa**	**Ratio (%)**	**Family**	**Taxa**	**Ratio (%)**	**Family**	**Taxa**	**Ratio (%)**	**Family**	**Taxa**	**Ratio (%)**
Porellaceae	4	13,79	Porellaceae	4	18,18	Porellaceae	4	17,39	Anastrophyllaceae	2	9,09
Scapaniaceae	4	13,79	Lophocoleaceae	3	13,64	Lophocoleaceae	3	13,04	Frullaniaceae	2	9,09
Lophocoleaceae	3	10,34	Aytoniaceae	2	9,09	Aytoniaceae	2	8,70	Jungermanniaceae	2	9,09
Aytoniaceae	2	6,90	Lejeuneaceae	2	9,09	Lejeuneaceae	2	8,70	Lophocoleaceae	2	9,09
Frullaniaceae	2	6,90	Metzgeriaceae	2	9,09	Metzgeriaceae	2	8,70	Porellaceae	2	9,09
Lejeuneaceae	2	6,90	Calypogeiaceae	1	4,55	Pelliaceae	2	8,70	Radulaceae	2	9,09
Radulaceae	2	6,90	Conocephalaceae	1	4,55	Calypogeiaceae	1	4,35	Scapaniaceae	2	9,09
Aneuraceae	1	3,45	Fossombroniace	1	4,55	Conocephalaceae	1	4,35	Aytoniaceae	1	4,55
Conocephalaceae	1	3,45	Frullaniaceae	1	4,55	Fossombroniace	1	4,35	Conocephalaceae	1	4,55
Fossombroniaceae	1	3,45	Lunulariaceae	1	4,55	Frullaniaceae	1	4,35	Lejeuneaceae	1	4,55
Jungermanniaceae	1	3,45	Pelliaceae	1	4,55	Lunulariaceae	1	4,35	Lophoziaceae	1	4,55
Lunulariaceae	1	3,45	Plagiochilaceae	1	4,55	Plagiochilaceae	1	4,35	Lunulariaceae	1	4,55
Marchantiaceae	1	3,45	Scapaniaceae	1	4,55	Scapaniaceae	1	4,35	Metzgeriaceae	1	4,55
Metzgeriaceae	1	3,45	Targioniaceae	1	4,55	Targioniaceae	1	4,35	Pelliaceae	1	4,55
Pallaviciniaceae	1	3,45							Plagiochilaceae	1	4,55
Pelliaceae	1	3,45									
Plagiochilaceae	1	3,45									
TOTAL	**29**	**100**	**TOTAL**	**22**	**100**	**TOTAL**	**23**	**100**	**TOTAL**	**22**	**100**

Declaration

Conflict of interest

The authors have no competing interests to declare regarding the content of this article.

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