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Bryophytes on the Archaeological Site of Tilmen Höyük, Gaziantep (Turkey)

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Abstract: A typical flora from an archaeological site reported first time from the southern-east part of Turkey by this study. Bryophytes on the wall remains with basaltic rocks, soil surface, patch sides and on the stems of vascular plants were surveyed between 2006-2007. The survey revealed 45 bryophyte taxa of which 7 liverworts and 38 were mosses. All taxa of bryophytes in Tilmen höyük are belonging to 28 genera and 20 families. According to the life form analysis of total flora in study site, short turf determined as the most dominant life form. Also, the distribution of species in relation to the actual vascular vegetation and local abiotic conditions were discussed. Most of bryophytes taxa in the flora are xerophytic and these are naturally adapted to the summer drought of Mediterranean climate.

Key words: Bryoflora, archaeological site, wall flora, Tilmen Höyük, Turkey

INTRODUCTION

Archaeological remains provide many different habitats that can be suitable for bryophytes. However, not much is known about bryophytes flora of ruins and archaeological sites. Although, contributions on the bryophytes flora of Turkey increased over last decades, but most of these contributions have focused on the western and northern parts of Turkey where the condition of boreal climate dominate (Özdemir, 2001; Erdag, 2002; Özenoğlu and Gökler, 2002; Abay and Çetin, 2003; Erdag and Kürschner, 2005; Keçeli and Çetin, 2006; Uyar and Çetin, 2006; Savaroğlu and Tokur, 2006). Southern and eastern parts of Turkey under Mediterranean climate are still poorly known as bryologically, significant discoveries and contributions to the bryoflora from this region are possible by future studies involving the inventory of natural lands and archaeological sites. There are a few studies that are mostly reporting some bryophytes collections, along the Mediterranean regions of the southern parts of Turkey, as contribution to the bryoflora of Turkey (Everest and Ellis, 1999, 2003). These studies focused on the collections from natural habitats. Although Turkey is one of the few countries all over the world in aspect having a rich biodiversity and archaeological sites, there isn't a study deal with the bryoflora of archaeological sites at the regional and national level.

We hope that this study will take attention of bryologist to the archaeological sites for the new contributions and interesting records at future.

MATERIALS AND METHODS

Tilmen Höyük is located at the edge of the fertile crescent (Fig. 1), the first area of the old world where in 10.000 BP humans started to cultivate crops and to abandon the gatherer and hunter way of life. It is one of the biggest tumulus with the elevation from 426 to 441 m and it encloses a plain area approximately 5 hectares (Fig. 1) at the eastern part of Islahiye, Gaziantep. It was excavated between 1959 and 1972 by U. Bahadır Alkım, exposing a long sequence from the Late Chalcolithic through to the end of the Bronze Age. Tilmen Höyük determined as the capital of a native realm which was appurtenant to Halpa Kingdom that was an important kingdom on the last period of 3000 BP (Alkım, 1968). The palace complex with a temple, inner and outer strong defense walls with basaltic materials, surrounding the city (Biteli *et al.*, 2007).

The study site takes part within the semi-arid Mediterranean climate regime with hot and dry summers. The annual average of precipitation is 850.7 mm and fall within a short season, according to the data obtained from Islahiye meteorology station. Dry period is very long which runs typically from May to September. Snowfall rarely occurs between December and February. The annual average of temperature is 16.7°C (Fig. 2).

The archaeological site of Tilmen Höyük is very near to Amanos Mountains which is one of the most important hot spot with its high endemic vascular plant ratio. Some of these endemics, such as *Alcea apterocarpa*, *Rumex amanus*, *Carduus rechingeranus*, *Onopordum*

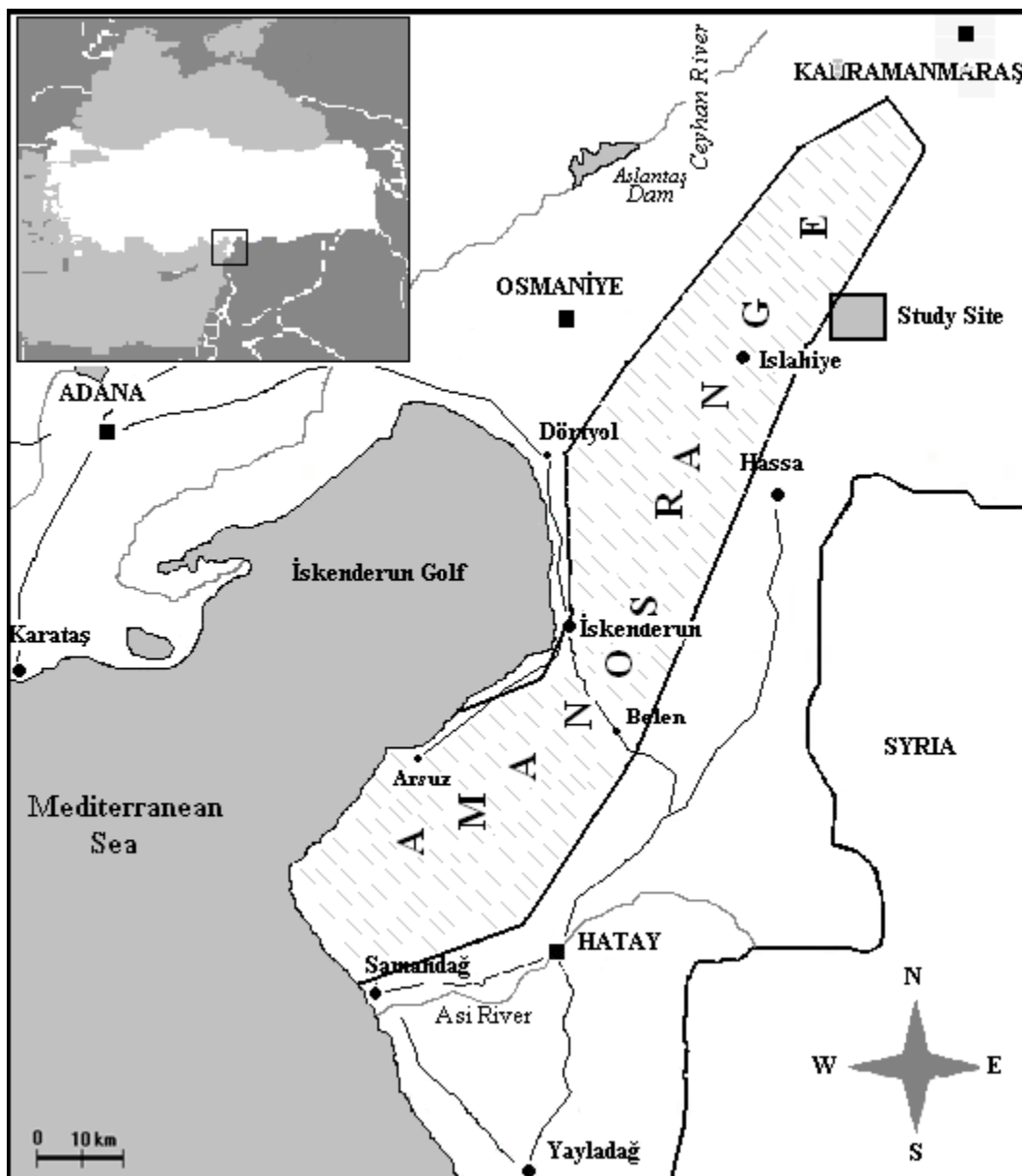


Fig. 1: Topographic map of study site

boissieri, *Trifolium aintabiense* and *Erodium micropetalum*, were also observed in archaeological site. The Amanos mountain mark the southern end of the Anatolian diagonal which is a remarkable floristic line crossing inner Anatolia. In aspect phytogeography, study site takes part in transzone between Mediterranean and Irano-Turanian phytogeographical region. In archaeological site and its surroundings, the anthropogenic factors have an important role in the formation of vascular floristic composition. Overgrazing,

Agriculture and clearing the woody vegetation for fuel are the main dominant factors on the vegetation structure. Most common tree and shrub species are *Crataegus aronia*, *Ulmus minor*, *Prunus spinosa*, *Paliurus spinachristi*, *Quercus coccifera*, *Cianura erecta* and *Jasminum fruticans* in archaeological site. Open places in study site occupied by herb vegetation including *Vicia villosa*, *Hordeum spontaneum*, *Hordeum bulbosum*, *Notobasis syriaca*, *Asphodelus aestivus*, *Vicia hybrida* and *Lathyrus annuus*.

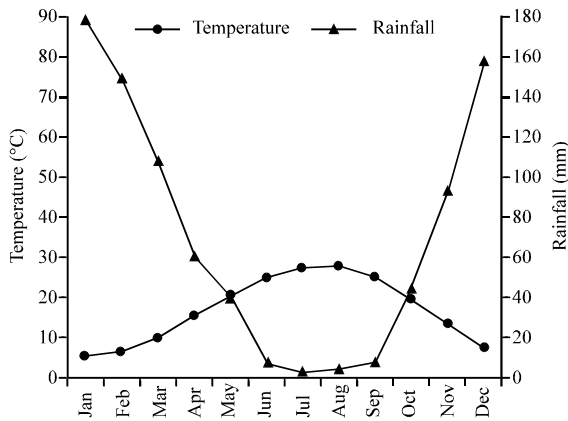


Fig. 2: Ombro-thermic climatic diagram for the study site

Bryophytes samples were collected from wall remains, soil surface and stems of trees in archaeological site and nearest surroundings between 2006 and 2007. The collected specimens were kept in standard collecting envelopes including information of their collection number, moisture, exposure, substratum, the date of collecting, etc. The moss specimens collected from study site were identified using appropriate literatures which are widely using by European and Turkish bryologist (Smith, 1980; Nyholm, 1981; Crum and Anderson, 1981; Arnell, 1981; Erdag and Kürschner, 2002). Other specimens belonging to liverworts were identified according to Arnell (1981), Smith (1991) and Watson (1981).

Arrangement of taxa in the list of study site flora follows the system which is proposed by Hill *et al.* (2006). In addition, the distribution of species in regional scale for Turkey was determined by reviewing the recent literatures (Kürschner and Erdağ, 2005; Everest and Ellis, 1999, 2003; Uyar and Çetin, 2004).

RESULTS AND DISCUSSION

The total number of bryophytes growing spontaneously on and around the wall remains, soil surface and on the stems of trees is 45 taxa belonging to 28 genera and 20 families. A big part of bryoflora composed by mosses (38 taxa) and the presence and abundance of their species vary greatly, depending on the site conditions. Among them, 15 taxa were recorded only on the basaltic wall remains and 17 taxa recorded from the both surface of soil and basaltic wall remains, whereas 12 taxa were found only on the soil surfaces in study site. *Pyramidula tetragona* (Brid) Brid. was recorded first time

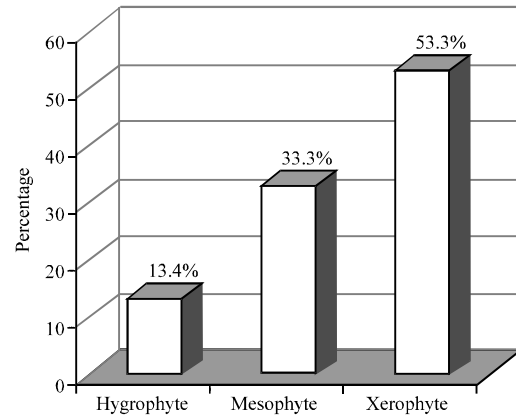


Fig. 3: The percentage of bryophyte according to the humidity preferential in study site

as a new member of Turkish bryoflora by Kara *et al.* (2008). It has been cited for many European countries, in some of which being classified as threatened according to ECCB (1995).

The bryoflora of study site (except liverworts) tend to prefer mainly basaltic wall remains and surfaces of thin soil between archaeological remains (Table 1). The basaltic materials with porous surfaces in archaeological wall remains provide many different habitats as suitable shelters for bryophytes in dry areas which are exposed directly to the sunlight and wind. Like the rest of eastern Mediterranean part of Turkey (Everest and Ellis, 1999, 2003), the Pottiaceae is the most species-rich family in Timen Höyük (Table 2), with 12 species in 6 genera. It contains many species tolerant to long drought season, not surprisingly several species are among the most common and abundant in the study site. One of them is *Syntrichia princeps* and occurs nearly through the all corners of the archaeological site and it can be easily recognized along the wall remains, tree stems and soil surfaces. Another 3 species of *Syntrichia* and the genera of *Tortula* (2 species), *Didymon* (3 species) in Pottiaceae family are xerophytic taxa and very common in the study site on both dry wall and soil surfaces (Fig. 3). The second richest family is Grimmiaceae, it is represented in the study site with 6 species of the *Grimmia* genera which is specifically common on the wall remains under xeric conditions. Brachytheciaceae (4 species) is another abundant and common moss family on the basaltic materials of the wall remains and soil surfaces in the archaeological site of Tilmen Höyük. While three of them are common on both soil and wall remains, only *Fabronia ciliaris* and *Homalothecium aureum* prefer wall remains as their habitats.

Table 1: The list of bryoflora and ecological properties

Families	Bryophyta		Substrate			Life form
	Taxa	Humidity	S	R	T	
Hepaticopsida						
Aytoniaceae	<i>Reboulia hemisphaerica</i> (L.) Raddi	Hygrophyte	+			Ma
Lunulariaceae	<i>Lunularia cruciata</i> (L.) Dum. ex Lindb.	Mesophyte	+			Ma
Targoniaceae	<i>Targonia hypophylla</i> L.	Hygrophyte	+			Ma
Codoniaceae	<i>Fossombronia pusilla</i> (L.) Nees.	Hygrophyte	+			Ma
Ricciaceae	<i>Riccia nigrella</i> D.C.	Hygrophyte	+			An
	<i>R. sorocarpa</i> Bisch.	Mesophyte	+			An
Sphaerocarpaceae	<i>Sphaerocarpos texanus</i> Aust.	Hygrophyte	+			An
Bryopsida						
Funariaceae	<i>Funaria hygrometrica</i> Hedw.	Mesophyte	+			sT
	<i>Pyramidula tetragona</i> (Brid.) Brid.	Hygrophyte	+			An
Grimmiaceae	<i>Grimmia dissimulata</i> E. Maier	Xerophyte		+		Cu
	<i>G. laevigata</i> (Brid.) Brid.	Xerophyte		+		Cu
	<i>G. lisae</i> De Not.	Xerophyte		+		Cu
	<i>G. ovalis</i> (Hedw.) Lindb.	Xerophyte		+		Cu
	<i>G. pulvinata</i> (Hedw.) Sm.	Xerophyte		+		Cu
	<i>G. trichophylla</i> Grev.	Xerophyte		+		Cu
Fissidentaceae	<i>Fissidens viridulus</i> (Sw. ex anon) Wahlenb.	Mesophyte	+			Fa
Ditrichaceae	<i>Ceratodon purpureus</i> (Hedw.) Brid.	Mesophyte	+	+		sT
Pottiaceae	<i>Timmiella barbuloidea</i> (Brid.) Mönk.	Xerophyte	+			tT
	<i>Pleurochaete squarrosa</i> (Brid.) Lindb.	Xerophyte	+			tT
	<i>Crossidium squamiferum</i> (Viv.) Jur.	Xerophyte		+		sP
	<i>Didymodon acutus</i> (Brid.) K.Saito	Mesophyte	+	+		sT
	<i>D. fallax</i> (Hedw.) R.H. Zander	Mesophyte	+	+		sT
	<i>D. vinealis</i> (Brid.) R.H. Zander	Xerophyte	+	+		sT
	<i>Syntrichia montana</i> Nees	Xerophyte	+	+		sT
	<i>S. princeps</i> (De Not.) Mitt.	Mesophyte	+	+	+	tT
	<i>S. ruralis</i> (Hedw.) F. Weber and D. Mohr	Mesophyte	+	+		tT
	<i>Tortula cuneifolia</i> (Dicks.) Turner	Xerophyte	+	+		sT
	<i>T. inermis</i> (Brid.) Mont.	Xerophyte	+	+		sT
	<i>T. muralis</i> Hedw.	Mesophyte	+	+		sT
Orthotrichaceae	<i>Orthotrichum anomalum</i> Hedw.	Xerophyte		+		Cu
	<i>O. diaphanum</i> Schrad. ex Brid.	Xerophyte			+	Cu
	<i>O. rupestre</i> Schleich ex Schwägr.	Xerophyte		+		Cu
Hedwigiaceae	<i>Hedwigia ciliata</i> var. <i>ciliata</i> (Hedw.) P. Beauv.	Xerophyte		+		We
	<i>H. ciliata</i> (Hedw.) P. Beauv. var. <i>leucophæa</i> Bruch and Schimp.	Xerophyte		+		We
Bartramiaceae	<i>Bartramia stricta</i> Brid.	Xerophyte	+	+		sT
Bryaceae	<i>Bryum argenteum</i> Hedw.	Mesophyte	+	+		sT
	<i>B. capillare</i> Hedw.	Mesophyte	+	+		sT
Brachytheciaceae	<i>Scorpiurium circinatum</i> (Bruch) M. Fleisch. and Loeske	Xerophyte	+	+		We
	<i>Rhynchostegium megalopolitanum</i> (Blandow ex F. Weber and D. Mohr) Schimp.	Xerophyte	+	+		We
	<i>Homalothecium aureum</i> (Spruce) H. Rob.	Xerophyte		+		We
	<i>H. sericeum</i> (Hedw.) Schimp.	Xerophyte	+	+		We
Fabriaceae	<i>Fabronia ciliaris</i> (Brid.) Brid.	Mesophyte		+		We
Leucodontaceae	<i>Antitrichia californica</i> Sull.	Xerophyte		+		Ta
Leptodontaceae	<i>Leptodon smithii</i> (Hedw.) F. Weber and D. Mohr	Mesophyte		+		Fa
Lembophyllaceae	<i>Isoetecium myosuroides</i> Brid.	Mesophyte	+	+		We

Ma: Mat, An: Annual, sT: Short turf, tT: Tall turf, Cu: Cushion, sP: Solitary plant, We: Weft, Ta: Tail, Fa: Fan, S: Soil, R: Rock, T: Tree

Table 2: The first four richest bryophyte families in the study site

Families	Taxa	Percentage of taxa according to total number of taxa
Pottiaceae	12	27.27
Grimmiaceae	6	13.63
Brachytheciaceae	4	9.08
Orthotrichaceae	3	6.81
Total	25	56.79

The number of hygrophyte and ephemeral species and their abundance in the archaeological site is very poor because of arid conditions with long and dry summer season (Fig. 3). Only soil surfaces at the northern part of

the study site inhabits a few hygrophyte and ephemeral species belonging to liverworts and mosses species in the families of *Sphaerocarpaceae* and *Funariaceae*. Only two epiphytic species were recorded in our study site. One of them (*Orthotrichum anomalum*) covers trunk of *Ulmus minor* at the northern side.

Various studies concerning the bryophyte communities show that there is a strong connection between life forms and the ecological factors affecting the habitat (Kürschner and Parolly, 1999; Kürschner *et al.*, 1998; Mägdefrau, 1982). Life forms of plant taxa in the

Table 3: The percentage of life forms in the bryoflora of Tilmen

Life forms	The percentage of life forms (%)
Short turf	26.6
Cushion	20.0
Weft	17.7
Mat	8.8
Tall turf	8.8
Annual	8.8
Fan	4.4
Solitary plant	2.2
Tail	2.2

bryoflora of Tilmen Höyük reflects the typical dry climatological conditions of Mediterranean region. The most represented life forms in bryoflora of study site are short turf (sT) (28%), cushion (Cu) (21%) and weft (We) (16%). The life forms sT and Cu belong to the acrocarphic bryophytes which are growing under xerophytic and photophytic conditions (Kürschner, 2004). On the other hand, mosses species with Weft (We) life form are pleurocarphic bryophytes that grow in more humid, shaded and hygrophytic conditions (Kürschner, 2004). Other life forms such as Mat (Ma), Tail (Ta) of pleurocarpus mosses represented in study site with a low ratio and abundance (Table 3).

The mosses and liverworts flora of Tilmen Höyük is an example of an archaeological site along south-eastern Mediterranean part of Turkey. Present study site is also take parts in a geographical area not known well bryologically and still under exploring.

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