

## THREE BRYOPHYTE SPECIES NEW TO TÜRKIYE AND SOUTHWEST ASIA

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### Abstract

As a result of extensive bryophyte surveys across the different parts of the Karçal Mountain, Türkiye's first biosphere reserve area, Artvin region (Caucasus) in the East Black Sea region of Türkiye, *Jungermannia pumila*, *Scapania uliginosa* and *Heterocladium flaccidum* found as new to Türkiye. Moreover, these taxa are the first time reported for bryophyte flora of South-West Asia in this paper. Descriptions, illustrations, distributions, ecological characteristics, and comparisons with morphologically similar taxa were also provided.

### Introduction

The Karçal Mountains, which range from the Çoruh Valley to the Georgian border, start at 500 m and reach an altitude of 3545 m. (Fig. 1). Sub-Mediterranean climate prevails in the Çoruh Valley, while the northern part of the Karçal Mountains has a Black Sea climate. In the southern part of the Karçal Mountains, a climate where Sub-Mediterranean and continental climates intersect is present, with the effect coming from the Çoruh Valley, and continental climate prevails in the eastern part and the higher parts of the Karçal Mountains (Eminağaoğlu, 2015; Fig. 1).

There are three different vegetation types of the research area: forest, subalpine, and alpine. The dominant vegetation is forest vegetation that, covered by mixed forests dominated that *Abies nordmanniana* (Steven) Spach subsp. *nordmanniana*, *Picea orientalis* (L.) Peterm., *Ulmus glabra* Huds., *Castanea sativa* Mill., *Fagus orientalis* Lipsky, *Quercus petraea* (Matt.) Liebl. subsp. *iberica* (Steven ex M.Bieb.) Krassiln., *Alnus glutinosa* (L.) Gaertner, *Populus tremula* L., *Salix caucasica* Andersson, *Carpinus betulus* L., *Corylus avellana* L., *Rhododendron luteum* Sweet, *R. ponticum* L., *Prunus laurocerasus* L., *Rubus platyphyllos* C. Koch., *Crataegus microphylla* C. Koch., *C. monogyna* subsp. *monogyna* Jacq., *Ilex colchica* Pojark., *Acer campestre* var. *campestre* L. and *Fraxinus angustifolia* subsp. *oxycarpa* (Willd.) Franco & Rocha Afonso (Eminağaoğlu, 2015; Yılmaz, 2016; Fig. 2).

The Camili Biosphere Reserve Area including Karçal Mountain was included in the World Network of Biosphere Reserves by the International Co-ordinating Council of the Programme MaB in 2005, and it subsequently became the first and only biosphere reserve area in Türkiye (Mittermeier *et al.*, 2005; Url 1, in <https://en.unesco.org/biosphere/eu-na>). The reserve is located in North-Eastern Türkiye (Fig. 1) and covers altitudes ranging from 400 to 3500 m, with an area of 25.222 hectares (Pouya and Demireş Özkul, 2010). The Camili Valley (inc. Karçal Mountain) is part of the Caucasus region, which is one of the 34 biodiversity hotspots in the world (Mittermeier *et al.*, 2005; Türkmen, 2023).

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There are few studies (Kürschner *et al.*, 2012) on the bryophytes of the Karçal Mountain, so it was chosen as the study area for the project and this study contains data from the project.

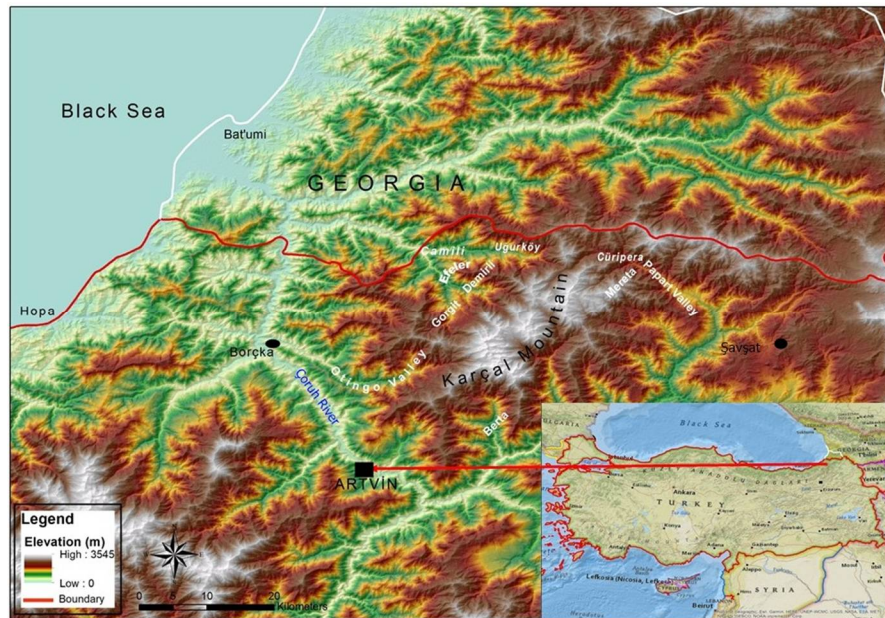


Fig. 1. Map of Reserach Area.



Fig. 2. a) Merata plateau; *Abies nordmanniana* (Steven) Spach subsp. *nordmanniana*, *Picea orientalis* (L.) Peterm. b) Balçıköy plateau: *Populus tremula* L., *Picea orientalis* (L.) Peterm.

### Material and Methods

The bryophyte samples were collected from different localities (various habitats and substrates) from the Karçal Mountain (Artvin) in 2022. The UTM VGS84 coordinate system was used to determine the coordinates. The bryophytes were identified by consulting keys (Smith, 1996, 2004; Paton, 1999; Damsholt, 2002; Frey *et al.*, 2006; Guerra *et al.*, 2018; Lüth, 2019; Hugonnot and Chavoutier, 2021). The status of these taxa was evaluated by reviewing the related literature for Türkiye (Ros *et al.*, 2013; Erdağ and Kürschner, 2017; Hodgetts and Lockhart, 2020; Kürschner and Frey, 2020), and Southwest Asia (Kürschner and Frey, 2020). The study of Hodgetts *et al.* (2020) was followed in terms of nomenclature and synonyms. Voucher specimens of bryophyte taxa are kept in the private bryophyte collections of the author (Batan), Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University, Trabzon, Türkiye.

### Results and Discussion

#### *Jungermannia pumila* With.

(Fig. 3)

Plants small, bright, or yellowish-green to dark brownish. Shoot 4-6 mm long. Rhizoids are abundant and colorless. Leaves  $0.3 \times 1.2$  mm wide and  $0.5 \times 1.4$  mm long, distant or almost imbricate spreading, elliptical to lanceolate or ovate to rotundate, rounded at apex. Oil-bodies 2-6(8) per cell. Gemmae absent.

*J. pumila* resembles *J. atrovirens* Dumort, and *Jungermannia eucordifolia* Schljakov; however, *J. pumila* can be distinguished from them by its parvicous inflorescences and mostly oval leaves. *J. pumila* is similar to *J. borealis* Damsh. & Vána. This species differs from *J. borealis* in leaves usually being elliptical to ovate (Paton, 1999; Damsholt, 2002; Frey, *et al.*, 2006; Lüth, 2019; Hugonnot and Chavoutier, 2021).

*Ecology:* *J. pumila* grows in patches on damp, often shaded rocks. Also often as a pioneer on new surfaces of sandstone or even granite. Mostly at the base of stones and rock walls in small streams (Damsholt, 2002). Also, it occurs on moist or wet, mildly basic to acid, often shaded rocks and boulders, on thin soil over rocks, on sandy, gravelly or peaty soil and on silt or detritus on banks and rocks including limestone. Often near running water and sometimes intermittently submerged, and frequently as a pioneer species on soft-textured siliceous rock (PATON 1999; DIERBEN 2001). Turkish specimens of three bryophytes were collected from Merata plateau, Karçal Mountain, Artvin (Türkiye), on sandy, gravelly soil, near running water, associated with *Scapania irrigua* (Nees) Nees, *Diplophyllum taxifolium* (Wahlenb.) Dumort., *Solenostoma gracillimum* (Sm.) R.M.Schust., *Philonotis fontana* (Hedw.) Brid., *Platyhypnum smithii* (Sw.) Ochyra and *Ptychostomum schleicheri* (DC.) J.R.Spence ex D.Bell & Holyoak.

*Distribution:* Faroe Islands, Finland, Iceland, Norway, Sweden, Great Britain, Ireland, Northern Ireland, Andorra, Canary Islands, Corsica, France, Italy, Madeira, Portugal, Sicily, Spain, Austria, Belgium, Czech Republic, Germany, Luxembourg, Poland, Slovakia, Switzerland, Albania, Bosnia-Herzegovina, Croatia, Hungary, Montenegro, North Macedonia, Romania, Serbia, Slovenia, Caucasus (in Europe), Arctic Russia, Central Russia, NE Russia, NW Russia, South Urals, Ukraine, Sicily, Tanzania, Macaronesia, Greenland, North America, Japan (Paton, 1999; Damsholt, 2002; Hodgetts and Lockhart, 2020). New to Türkiye and South-West Asia (Kürschner and Frey, 2020).

*Specimen examined:* TÜRKİYE, (Artvin Province): Borçka, (Karçal mountain), Merata plateau, on sandy, gravelly soil, near running water, (38T) 0254903 E, 4591109 N, Altitude: 2154 m a.s.l., 26 July 2022, leg. N. Batan, H. Erata, det N. Batan and H. Erata, Batan 1619.



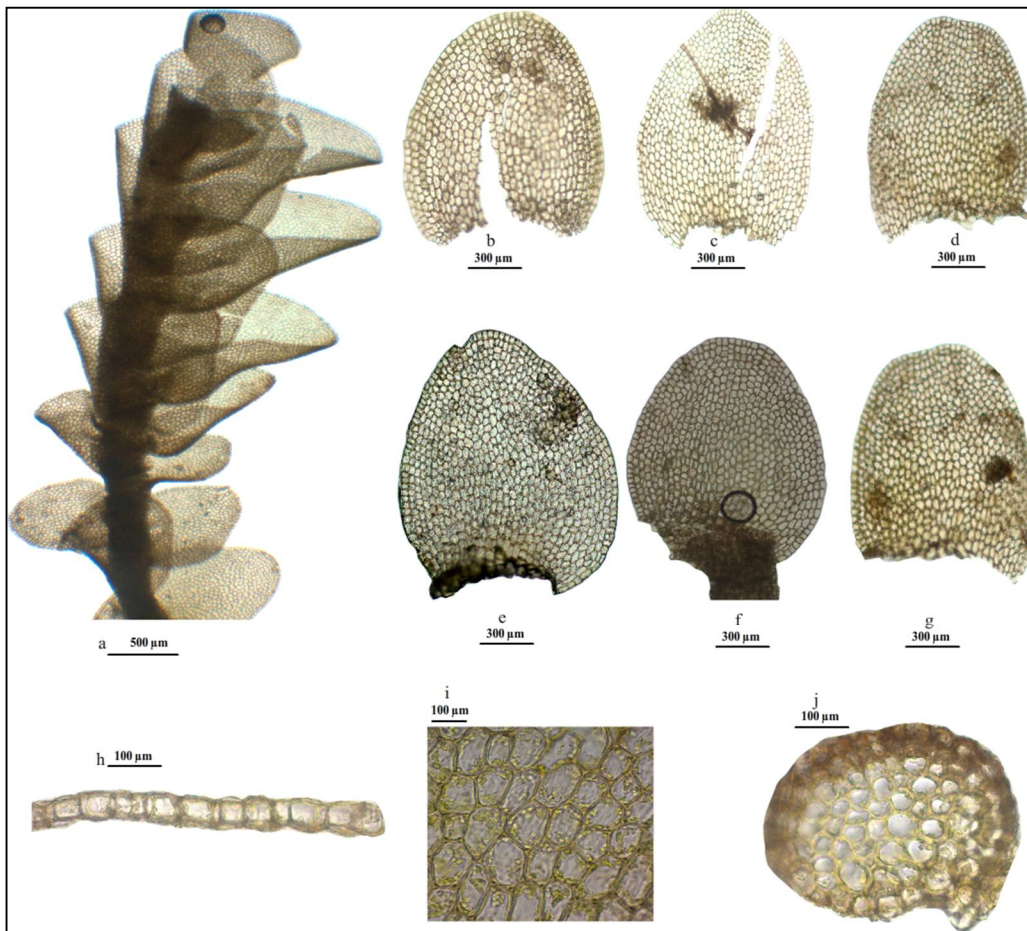


Fig. 3. *Jungermannia pumila* With.: a) Shoots (in dry conditions), b-g) Leaves, h) Cross section of leaf, i) Mid-leaf cells, j) Cross section of stem. From Batan 1619.

***Scapania uliginosa* (Sw. ex Lindenb.) Dumort.**

(Fig. 4)

Plant robust, brownish red, dark brown, pupish red, up to 10 cm tall. Leaves imbricate, subequally bilobed, margins almost entire. Ventral and dorsal lobes similar and dorsal lobe 0.5 the size of the ventral lobe. Ventral lobe strongly convex and incurved, apex rounded to obtuse. Dorsal lobe consistently broadly rounded to reniform, convex and long-decurrent, apex rounded to obtuse. Keel curved. Marginal cells thick-walled. Cells in middle ventral lobe thin walled, 22-32 µm wide, trigones absent or very minute. The shape of middle cells variable variable, either rounded, rectangular or quadrate. Oil bodies 2-6 per cell. Gemmae rare and greenish to reddish, ellipsoid when present but not seen in Turkish specimens from Karçal Mountain.

*Scapania uliginosa* (Sw. ex Lindenb.) Dumort. is morphologically and ecologically similar to *S. undulata* (L.) Dumort. but differs in having the differences in the form of dorsal lobes and decurrence of the leaves. The dorsal lobes of *S. uliginosa* are consistently broadly rounded to reniform, convex and long-decurrent.. Also, *S. uliginosa* (Sw. ex Lindenb.) Dumort. is similar to *S. paludosa* (Müll.Frib.) Müll.Frib. but *S. uliginosa* differs from *S. paludosa* in the reddish-brown

color, dorsal lobes are strongly convex and broadly round to reniform, and leaf margins are almost entire (Paton, 1999; Damsholt, 2002; Frey *et al.*, 2006).

*Ecology:* *S. uliginosa* grows in swelling mats in rills in the upper end of small streams and flushes, submerged or emergent in cold springs, occasionally on wet rocks in late snow areas, on lake shores in boggy ground and in gullies, very rarely on soil (Smith, 1996; Paton, 1999; Dierßen, 2001; Damsholt, 2002; Frey *et al.*, 2006). Turkish specimens associated with *Cephalozia bicuspidata* (L.) Dumort., *Imbriobryum alpinum* (Huds. ex With.) N.Pedersen, *Philonotis seriata* Mitt., *Ptychostomum pseudotriquetrum* (Hedw.) J.R.Spence & H.P.Ramsay ex Holyoak & N.Pedersen, *Philonotis marchica* (Hedw.) Brid., *Platyhypnum duriusculum* (De Not.) Ochyra, *Pellia epiphylla* (L.) Corda.

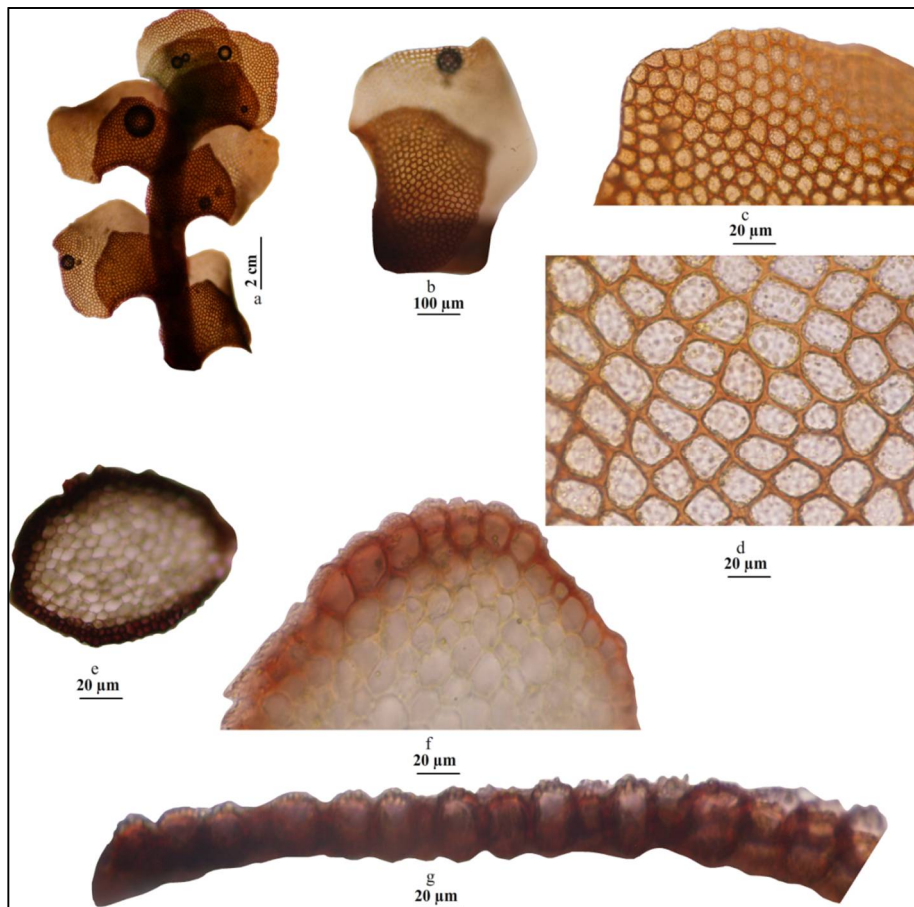


Fig. 4. *Scapania uliginosa* (Sw. ex Lindenb.) Dumort: a) Shoots (wet), b) Leaf, c) Leaf apex, d) Mid-leaf cells, e-f) Stem cross section, g) Leaf cross section. From Batan 1625.

*Distribution:* Previously known from Faroe Islands, Finland, Ireland, Norway, Svalbard, Sweden, Great Britain, France, Italy, Spain, Austria, Czech Republic, Germany, Liechtenstein, Poland, Slovakia, Switzerland, Bulgaria, Romania, NE Russia, NW Russia, South Urals,

Ukraine; Siberia; Asia (Japan); America (N. America, Greenland, Aleutian Islands) (Smith, 1996; Paton, 1999; Hodgetts and Lockhart, 2020). New to Türkiye and South-West Asia (Kürschner and Frey, 2020).

*Specimen examined:* TÜRKİYE, (Artvin Province): Borçka, (Karçal mountain), Çikünet plateau, on wet rock, near running water, (38T) 0250577 E, 4583011 N, Altitude: 2473 m a.s.l., 23 August 2022, leg. N. Batan, H. Erata, det T. Ezer, Batan 1625.

***Heterocladium flaccidum*** (Schimp.) A.J.E.Sm.

(Fig. 5)

Plants 2–2.5 cm long, very slender and form dull green patches. Shoots are 0.5–0.7 mm long. Stem and branch leaves are similar. Stem leaves 225–280  $\mu\text{m}$   $\times$  60–105  $\mu\text{m}$ . Leaves ovate-lanceolate to lanceolate, acute at apex. Leaf margins are roughly toothed. Leaf cells shape variable, rectangle, quadrate or hexagonal, papillose. Costa is very short, double, or absent.

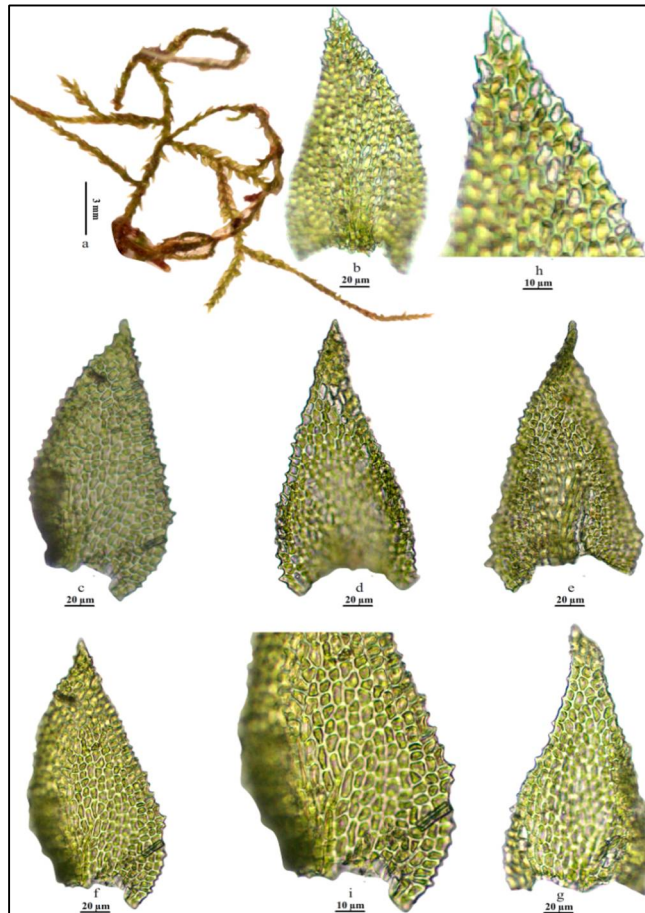


Fig. 5. *Heterocladium flaccidum* (Schimp.) A.J.E.Sm.: a) Shoots (dry), b-g) Leaves, g) Leaf apex, h) Lower part of leaf and Mid-leaf cells. From Batan 1621.

*H. flaccidum* is morphologically similar to *H. wulfsbergii* I.Hagen. but different in terms of having very short costa, double, or absent. In contrast, *H. wulfsbergii* has usually single costa. *H.*

*flaccidum* is also close to *H. heteropterum* (Brid.) Schimp., but it differs from the latter species by very slender patches and mid-leaf cells 1–2 times as long as wide. (Smith, 2004; Frey *et al.*, 2006).

**Ecology:** *H. flaccidum* grows on deeply shaded, in drier habitats mildly to strongly basic rocks in woods and ravines, very rarely on soil (Dierben, 2001; Smith, 2004; Frey *et al.*, 2006; Hugonnot *et al.*, 2020). Turkish specimens were collected from Otingo Valley, Balcıköy plateau, Karçal Mountain, Artvin (Türkiye), on rock, associated with the liverworts *Barbilophozia barbata* (Schmidel ex Schreb.) Loeske., *Radula lindenbergiana* Gottsche ex C.Hartm., *Sphenolobus minutus* (Schreb. ex D.Crantz) Berggr. and the mosses *Hymenoloma crispulum* (Hedw.) Ochyra, *Tortella tortuosa* (Hedw.) Limpr., *Grimmia hartmanii* Schimp., *Saelania glaucescens* (Hedw.) Broth., *Encalypta microstoma* Bals.-Criv. & De Not. and *Fissidens adianthoides* Hedw.

**Distribution:** Previously known from Norway, Sweden, Channel Islands, Great Britain, Portugal, Spain, Belgium, France, Ireland, Northern Ireland, Azores, Corsicas, Austria, Germany, Luxembourg, Switzerland, England, Caucasus (Georgia), North Africa (Tunisia) (Smith, 2004; Hugonnot *et al.*, 2020; Hodgetts and Lockhart, 2020). New to Türkiye and South-West Asia (Kürschner and Frey, 2020).

**Specimens examined:** TÜRKİYE (Artvin Province): Borçka, Balcıköy plateau, on rock, (37T) 0746269 E, 4581042 N, Altitude: 2095-2150 m a.s.l., 22 May 2022, leg. N. Batan, H. Erata, det. N. Batan, H. Erata, Batan 1621.

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