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Two new moss records in the family Grimmiaceae from Turkey, Southwest Asia

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Abstract

Grimmia incurva Schwägr. and *Schistidium umbrosum* (J.E.Zetterst.) H.H. Blom (Grimmiaceae) are reported for the first time from Turkey, Southwest Asia. Turkish plants are described and illustrated from material collected from Göllüdağ Volcano in the Central Anatolia (Niğde) which has a semi-arid, continental climate with a severe frost period in winter.

Introduction

The genus *Grimmia* is one of the largest groups in the acrocarpous moss family Grimmiaceae. Species of *Grimmia* are often difficult to identify (Ignatova and Muñoz 2004), and likewise the genus *Schistidium* has a reputation for being taxonomically difficult. The genus *Schistidium* currently comprises around 120 species (McIntosh 2007), while *Grimmia* contains about 95 species (Hastings and Greven 2007).

Grimmia species grow on rocks at low to high altitudes on all continents, and most of them are drought resistant. Therefore, they can withstand extremely harsh cold and dry climates (Ignatova and Muñoz 2004). According to Ros et al. (2013) 29 species of *Grimmia* have been reported for Turkey. Here we report *Grimmia incurva* Schwägr. new for Turkey, taking to 30 the number of *Grimmia* species reported for this country.

Members of the genus *Schistidium* generally grow on nutrient-rich rocks in arctic to temperate regions (Batan et al. 2013). Nineteen species of *Schistidium* have been reported for Turkey (Kürschner and Erdağ 2005, Townsend 2005, Tonguç Yayıntaş 2008, 2014, Kürschner and Frey 2011, Batan et al. 2013). *Schistidium umbrosum* (J.E.Zetterst.) H.H. Blom increases this total by one. Description and illustration of the species further contributes to the moss flora of Turkey.

Material and Methods

This study is based on specimens collected from Göllüdağ Volcano in the Central Anatolia (Niğde) in May 2015 (Fig. 1) and now held in the Herbarium of Niğde University. The specimens were identified using relevant literature (Blom 1996, Cortini-Pedrotti 2001, Greven, 1995, 2003, Hastings and Greven 2007, Ignatova and Muñoz 2004, Nyholm 1998, McIntosh 2007, Smith 2004).

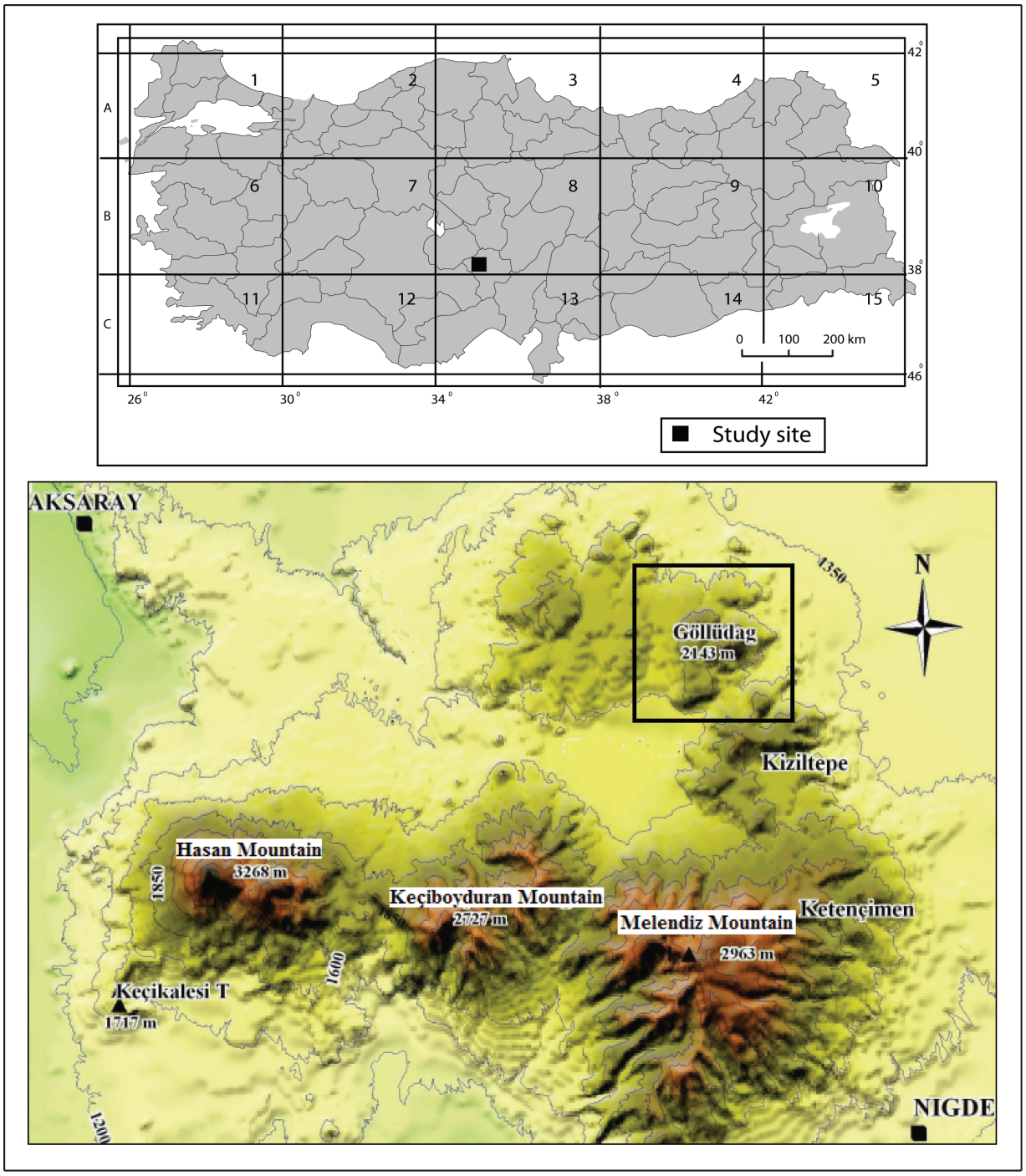

Figure 1. Göllüdağ Volcano region (modified from Bayer Altın 2010)

Taxonomy

***Grimmia incurva* Schwägr.** Species Muscorum Frondosorum, Schwägrichen, Christian Friedrich Supplementum Primum 1: 90. 1811.

Synonyms: *G. contorta* (Wahlenb.) Arnott, *G. curvifolia* Lindb., *G. hagenii* Kaurin, *G. torngakiana* Bras. & Hed., *G. uncinata* Kaulf.

Description of the Turkish specimens: Plants form dark green to blackish rounded cushions. *Stems* erect 1–2.5 cm long, occasionally 1–2 branched. *Leaves* oblong, linear to lanceolate, 2–3 mm long and 0.5 mm wide, incurved and moderately contorted and crisped when dry, spreading when moist, tapering to acuminate, with short hyaline apex, sharply keeled distally, margins plane in distal part of leaf, recurved below on one side; *lamina* mostly bistratose, unistratose near costa and in basal part of leaf; *costa* differentiated, semi-circular

in cross-section; upper leaf cells subquadrate, 8–12 µm; *mid-leaf cells* rectangular, moderately sinuose and incrassate; *basal marginal cells* elongate with thin walls and the basal juxtacostal cells are elongate rectangular with thick and porose longitudinal walls. Observed specimens were sterile, no perichaetia, antheridia, or sporophytes. **Fig. 2 (1–9)**.

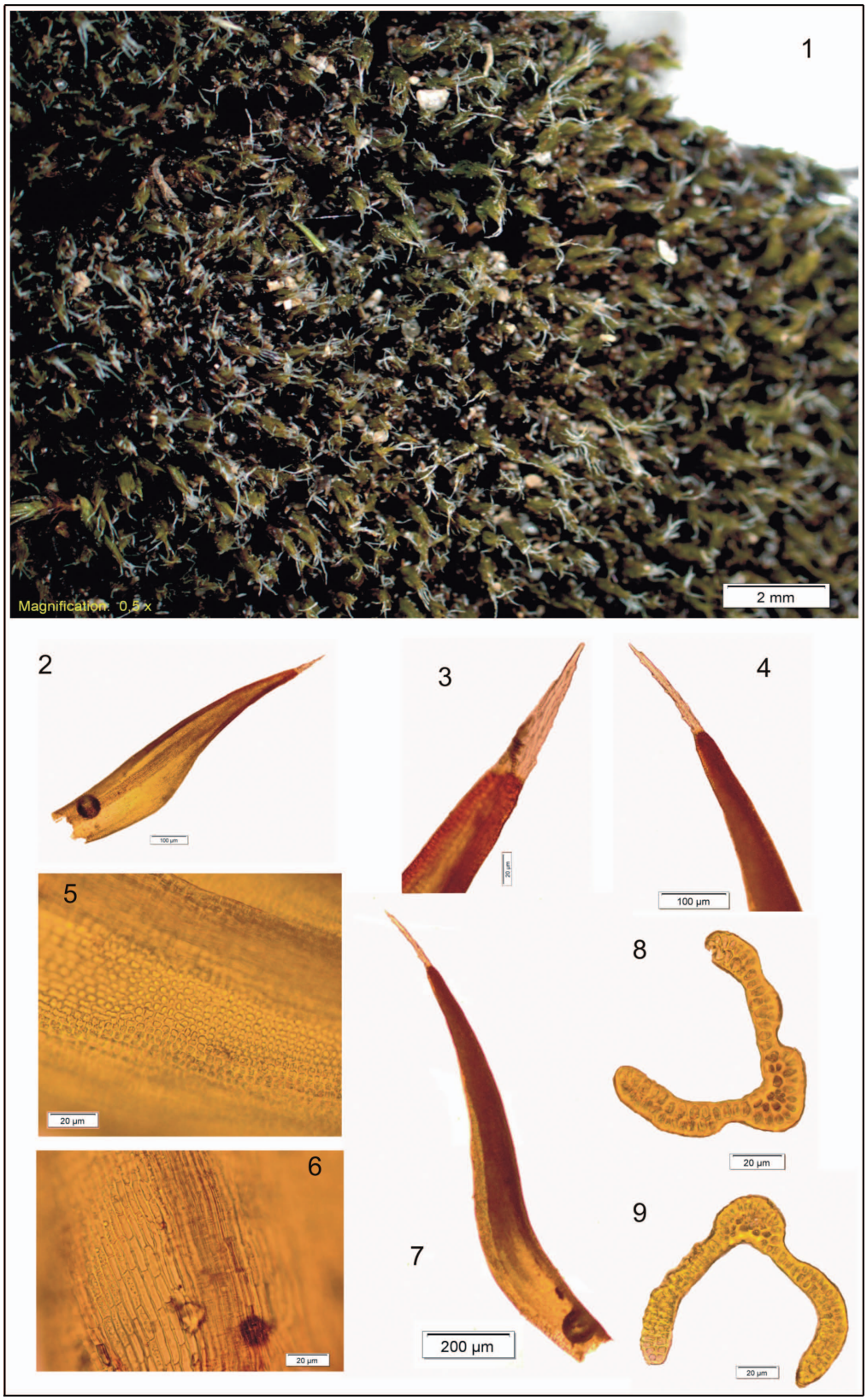

Figure 2. ***Grimmia incurva*** **(Ezer 1780);** 1, habit; 2 and 7, leaf; 3 and 4, leaf apex with hyaline hair-point; 5, upper laminal cells; 6, basal cells; 8 and 9, leaf cross-sections. Scale bars shown.

Specimen examined: Turkey: Central Anatolia: Niğde: Göllüdağ Volcano, Aşağıseki place, on basaltic rock, alt. c. 1729 m, (38° 16' 49.60" N, 34° 33' 01.20" E), *Karakaş 64* and *Ezer 1780*, 19 May 2015 (Herbarium of Niğde University).

According to the literature (Greven 1995, 2003, Ignatova and Muñoz 2004, Hastings and Greven 2007, Smith 2004), this species is dioicious; *capsules* very rare, emergent to exserted obloid, yellowish; *setae* arcuate when moist, 2–3 mm long; *operculum* rostellate with short beak; *peristome teeth* orange and strongly perforated; *spores* 10–12 µm; *calyptra* mitrate.

Grimmia donniana Smith, *G. elongata* G. Kaulfuss and *G. fuscolutea* Hook., are similar species to *G. incurva*. Linear-lanceolate, contorted to almost crisped leaves with a short hair-point are characteristic of *G. incurva* while *G. fuscolutea* has slightly flexuose leaves with a long hair-point. *Grimmia elongata* has a unistratose lamina, whereas lamina of *G. incurva* is mostly bistratose, unistratose near costa and in basal part of leaf. Also, *Grimmia donniana* has thin-walled basal marginal cells and usually numerous exserted capsules. *Grimmia incurva* may superficially resemble *Andreaea* members and *Dicranoweisia crispula* in the field, but *G. incurva* differs from them by the presence of short hair-points. Comparison of the main different and similar characters between Turkish specimens and some other collections are listed in Table 1.

Table 1. Comparison of Turkish *Grimmia incurva* specimens and other collections.

	Turkish plants	Russian plants (Ignatova and Muñoz 2004)	European plants (Greven 1995)	North American plants (Hastings and Greven 2007)
Plants	dark green to blackish, 1–2.5 cm long	dark green or blackish-green, (1–)2–3 cm long	dark green or blackish-green, 1–3 cm long	green to blackish, 1–2 cm
Leaves shape	oblong, linear to lanceolate	linear-laceolate	linear	oblong to linear-lanceolate
Leaf length	2–3 x 0.5 mm	(1–)2.5–3(–4) x (0.3–) 0.4-0.6 mm	2–5 mm	2.5–4.5 x 0.3–0.5 mm
Hyaline hair-point	short	short to absent	short	short, occasionally long
Lamina	mostly bistratose, unistratose near costa	mostly bistratose in distal 1/3, unistratose near costa	partly bistratose above	distal laminal cells 1-stratose, margins and apex 2-stratose
Costa	semi-circular in cross-section	strongly prominent dorsally, semi-circular in cross-section, with 2 ventral epidermal cells	projecting on dorsal side	projecting on abaxial side
Upper and mid-leaf cells	subquadrate, moderately sinuose and incrassate, 8–12 µm	subquadrate, slightly sinuose walls, 9-14 µm	shortly rectangular, sinuosely incrassate, 9–15 µm	rectangular, slightly sinuose, thick-walled
Basal marginal cells	elongate with thin walls	slightly shorter	rectangular, hyaline	short to long rectangular, thin-walled
Basal juxtacostal cells	elongate rectangular with thick and porose longitudinal walls	elongate rectangular with thick and porose longitudinal walls and transverse walls	nodular thickenings	long rectangular, thick-walled
Sporophyte	unknown	rare	regularly present	occasionally present

Ecology and distribution: *Grimmia incurva* usually grows on acidic rock at moderate to high elevations. It is one of the characteristic species of the alliance Andreaeion rupestris (Greven 1995, Dierssen 2001). In Turkey *Grimmia incurva* was collected on basaltic rock surface from Göllüdağ Volcano (Niğde). It was found together with the moss species *Bryum dunense* A. J. E. Sm & H. Whitehouse and *Grimmia orbicularis* Bruch ex Wilson. *Grimmia incurva* is distributed in Europe (Austria, Azores, Bulgaria, France, Germany, Italy, Macedonia, Scotland, Slovakia, Spain, Sweden, Switzerland), Asia (Central China, Japan, Mongolia, Russia (Altai Mts., Caucasia, Chukotka, Kamchatka, Khabarovsk Territory, Kola Peninsula, Magadan Province, Middle and South Urals, Yakutia), America (Mexico, North America), and Greenland (Greven 1995, 2003, Ros et al. 2013, Ignatova and Muñoz 2004, Hastings and Greven 2007).

***Schistidium umbrosum* (J.E.Zetterst.) H.H. Blom.** Blom, Hans Haavardsholm, Bryophytorum Bibliotheca 49: 125. 1996.

Basionym: *Grimmia apocarpa* fo. *umbrosa* J.E.Zetterst.

Description of the Turkish specimens: Plants form small, dense cushion or tufts, greyish green or olivaceous-green in upper parts, brown to black in lower parts. *Stems* slender, up to 2.5 cm, intricately branched, central strand distinct. *Leaves* sharply keeled in upper part, slightly curved or straight, acute, 1.7 mm long, 0.6 mm wide, hair point very shortly decurrent, 0.3 mm, rather coarse, shortly decurrent, sharply spinulose-denticulate; margins smooth, recurved towards apex, bistratose in upper part; *lamina* smooth, unistratose, less frequently bistratose in upper part; *laminal cells* irregular in shape, thick-walled, sinuose, upper leaf cells 8 µm wide, oval to shortly oblong; *basal leaf cells* incrassate, rectangular, 25–30 µm; *costa* widened above and central parts, widened just below apex, excurrent or percurrent, smooth or with few low papillae near apex; *sporophytes* common, and immersed; *seta* thick, 0.25 mm long; *capsule* orange-brown, cupulate, 0.7 x 0.8 mm; *exothecial cells* thin-walled, isodiametric and transversely elongated; *peristome teeth* orange-brown to brownish red, recurved, from broad base and abruptly contracted to a fine point, 280–310 µm long, strongly perforated, coarsely papillose; *spores* 12–14 µm, finely granulose. **Fig. 3 (1–13)**.

Specimens examined: Central Anatolia. Niğde: Göllüdağ Volcano, Sarıkaya place, on basaltic rock, alt. c. 1936 m, (38° 15' 52.60" N 34° 33' 57.50" E), *Karakaş 90* and *Ezer 1789*, 6 September 2015 (Herbarium of Niğde University).

Schistidium umbrosum is closely related to *S. pulchrum* which was reported for Turkey from the Erciyes Mountain by Kara et al. (2014). *Schistidium pulchrum* has an oblong-cylindrical urn, whereas *Schistidium umbrosum* has a cupulate, obovoid, or subsphaerical urn. Also, the dull reddish-brown strongly perforated and coarsely papillose peristome teeth of *S. umbrosum* distinguish this species from *S. pulchrum*. Comparison of the main different and similar characters between Turkish specimens and some other collections of *S. umbrosum* are listed in Table 2.

Table 2. Comparison of Turkish *Schistidium umbrosum* specimens and other collections.

	Turkish plants	Norwegian and Swedish plants (Blom 1996)	Nordic plants (Nyholm 1998)
Plants	small, up to 2.5 cm	small, 0.8–3.5 cm	small, 0.8–3.5 cm
Leaves	1.7 x 0.6 mm, sharply keeled in upper part	(1.0–)1.2–1.9(–2.1) x (0.3)0.4–0.75 mm, sharply keeled in upper part	(1.0–)1.2–1.9(–2.1) x (0.3)0.4–0.75 mm, sharply keeled in upper part
Hair point	very shortly decurrent, 0.3 mm	not or very shortly decurrent, 0–0.4(–0.7) mm	not or very shortly decurrent, 0–0.4(–0.7) mm
Margins	smooth, bistratose in upper part	smooth or rarely denticulate in apical part, in upper and central parts bistratose	smooth, rarely denticulate below apex, in upper and central parts bistratose
Lamina	smooth, unistratose, less frequently bistratose in upper part	smooth, in upper and central parts unistratose with few to several bistratose spots	smooth, unistratose or patly bistratose in upper part
Laminal cells	irregular in shape, thick-walled, sinuose	gradually becoming shorter towards apex, irregular in shape, thick-walled, ± sinuose	irregular in shape (transversely ovate to shortly oblong), incrassate, ± sinuose
Upper leaf cells	8 µm wide, oval to shortly oblong	(6)7–9 µm, transversely oval to shortly oblong	(6)7–9 µm wide
Basal leaf cells	rectangular, 25–30 µm long	shortly oblong, up to 20–41 µm	up to 20–40 µm
Costa	widened just below apex, excurrent or percurrent	often widened just below apex, excurrent or rarely percurrent	often widened just below apex
Sporophytes	common, and immersed	commonly present, mostly deeply immersed	unreported
Urn	orange-brown, cupulate, 0.7 x 0.8 mm	straw yellow to light orange-brown, cupulate or broadly ovoid, 0.55–0.75–1.0 x 0.5–0.8 mm	straw yellow to light orange-brown, cupulate or broadly ovoid, 0.55–1.0 x 0.5–0.8 mm
Exothecial cells	thin-walled, isodiametric and transversely elongated	In patches of short transversely rectangular, square and shortly rectangular, thin-walled	predominantly isodiametric and transversely elongated
Peristome teeth	orange-brown to brownish red, recurved, strongly perforated, 280–310 µm	dull, dark orange-brown to brownish red, ± straight and twisted once around the axis, strongly perforated to fenestrate in upper half, (260)280–390 (–420) µm	dark orange-brown to brownish red, strongly perforated in upper half, (260)280–390(–420) µm
Spores	12–14 µm, finely granulose	(8)10–13(–15) µm, finely granulose	10–13(–15) µm, finely granulose

Figure 3. ***Schistidium umbrosum*** **(Ezer 1780)*;*** 1, habit; 2, sporophyte; 3, peristome teeth; 4, urn; 5 and 8, leaves; 6, median leaf cells; 7, basal leaf cells; 9, cross-section of costa; 10, perichaetial leaf; 11 and 12, leaf cross-section; 13, leaf apex. Scale bars shown.

Ecology and distribution: *Schistidium umbrosum* is subneutrophytic [pH 5.7–7.0 (–7,5)], mesophytic, sciophytic. The species prefers vertical or overhanging cliffs of base-rich rocks like hard schists and calcareous sandstone in the subalpine and alpine regions. It is one of the characteristic species of the alliance Grimmion tergestinae (Nyholm 1998, Dierssen 2001). In Turkey *Schistidium umbrosum* was collected on basaltic rock surface from Göllüdağ Volcano (Niğde). It was found together with the moss species *Grimmia alpestris* (Web. & Mohr) Schleich. and *Pseudoleskea incurvata* (Hedw.) Loeske. *Schistidium umbrosum* is distributed in the Alps, Austria, Bosnia-Herzegovina, Canada, Central Norway, Georgia, Greenland, Montenegro, Northern Sweden, NW Finland, North America, Slovakia, Svalbard, and Switzerland (Blom 1996, Nyholm 1998, Ros et al. 2013).

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