Confirmation of Doubtful Moss Records of Fissidens fontanus, Grimmia orbicularis and Schistidium apocarpum from Egypt

Sahar I. A. El-Sakaty*, Mohamed F. A. Ali and Manal I. Khalil
El-Saadawi Archegoniate lab, Botany Department, Faculty of Science, Ain Shams University. El-Khalifa El-Maamoun Street, Abbassia, Cairo, 11566, Egypt.
*E-mail: Sahar_Elsakaty@sci.asu.edu.eg

INTRODUCTION

Historically, the reporting of moss diversity in Egypt started back to Delile in 1812. By now the moss flora of Egypt comprises approximately two hundred taxa. Twenty-six of these moss taxa were primarily collected before 1904 as a single record, by foreign scientists, without herbarium specimens, illustration, and description. Expeditions to different phytogeographical territories in Egypt were projected to confirm old reports and record undiscovered taxa. Upon investigation, it was determined that three moss species out of the 26 single records have been confirmed to be present after a century. *Fissidens fontanus* (Bach. Pyl.) Steud., was the only taxon reported with no locality, in this work, it is reported from Nile Nubia territory raising the total number from this territory to 10. *Grimmia orbicularis* Bruch ex Wilson and *Schistidium apocarpum* (Hedw.) Bruch & Schimp are reported from the mountains of South Sinai establishing their habitats in this territory. In addition, the precise locations, descriptions, and photographs of those three taxa are provided.
Racomitrium aciculare (Hedw.) Brid., Rhynchostegiella tenella (Dicks.) Limpr., Schistidum apocarpum (Hedw.) Bruch & Schimp., Syntrichia rigescens (Broth. & Geh. in Broth.) Ochyra, Tortula kneuckeri Broth. & Geh., Weissia longifolia Mitt. f.d. Crundw. & Nyholm. Ten out of them are recorded from South Sinai territory (S.), three from Oasis, two from Cairo and one from each of Nile Nubia (Nn.), Nile Vally and the west Mediterranean coast. Only Fissidens fontanus without any particular locality in the original publications (Brotherus 1924), is cited only as Egypt. (El-Saadawi et al. 2015, Taha & Khalil 2023).

This work aims to confirm and provide descriptions, natural photographs, habitats, and distribution in the world of three of such single recorded taxa namely: Fissidens fontanus, Grimmia orbicularis and Schistidium apocarpum, which in-rich the moss flora of Egypt and solve the doubtful about these ancient records.

**MATERIALS AND METHODS**

Plant materials of these three taxa were observed between samples, which were collected by the second author from different phytogeographical territories (Nile Delta, Nile Nubia, Nile Valley, Oasis, and Sinai). Excursions were done between April 2021 and April 2023.

The Three taxa are described in detail to demonstrate the range of variation in morphological and anatomical features. Measurements were taken using an ocular micrometer of whole plants, stems, leaves and sporophyte (if present) either on a stereomicroscope for plant habit or a compound microscope for other plant organs and cross sections.

Distribution in the phytogeographical territories of Egypt was based on El-Saadawi et al. (2015) and distribution in the world was given from global biodiversity information facility data (GBIF) (GBIF 2024), floristic regions of the world was based on Index Muscorum (Crosby & Bauer 1983). Names of taxa were validated using the Tropicos database (Tropicos 2024).

**RESULTS AND DISCUSSION**

The careful examination resulted in the recording of three taxa: Fissidens fontanus, Grimmia orbicularis and Schistidium apocarpum. F. fontanus was reported by Brotherus (1924) as a previous collection from Egypt with no precise location. G. orbicularis was reported by Lorentz (1867), while Schistidium apocarpum was reported by Hart (1891) and both taxa were from South Sinai. This confirmed the presence of S. apocarpum in Egypt where it was reported as a single record and doubtful collection before 1962 by Ros et al. (2013). Determining the locality of F. fontanus increased the number of recorded taxa from Nile Nubia to 10. The following are the descriptions, habitats, and distribution.

**Fissidens fontanus (Bach. Pyl.) Steud. (Fig.1)**

Plants aquatic, large, available part 25 mm long, green to yellowish green, feather-like. Stem sub-round, central strand absent, inner cortical cells large, irregularly thickened at corners, outer cortical cells small, incrassate, 150-200 μm in diameter. Leaves distant, spreading wet and dry; lanceolate to linear-lanceolate, (2.5) 5-7 mm L x 0.5-0.7 mm W; acute to obtuse; margins ± entire, not bordered; costa ending many cells before apex, 50-75 μm wide; dorsal laminal cells narrowing toward leaf base, not reaching stem; vaginant lamina less than half the length of leaf, equal or termination of one blade submarginal. upper and middle laminal cells unistratose, quadrate to short-oblong to hexagonal, smooth, slightly bulging, ± incrassate, 17.5 – 25 μm L x 15-17 μm W in dorsal and ventral laminae, juxtapcostal cells larger than middle laminal cells.
Locality: 24°05'04.6"N – 32°53'23.3"E, Feryal Ferry Boat, Aswan. Herbarium no.: CAIA-Nn-78.
Habitat: shaded, submerged in the river Nile polluted with boat wastes, on the walls of the Ferry.
Distribution in phytogeographic territories in Egypt: unknown, Now Nn.
Distribution in the world: Afr. 1, 4; Am. 1, 2, 3, 5; As. 5; Austr. 1, 2 and Eur.

Grimmia orbicularis Bruch ex Wilson (Fig. 2)
Dusty greenish black hoary when dry, up to 1 cm high. Leaves erect, appressed when dry, erect-patent when moist, lanceolate-elliptical to lanceolate, keeled, abruptly narrowed to hyaline point in upper leaves; margins recurved on one or both sides at middle of leaf; hyaline points ½ - 1 length of lamina, smooth or slightly denticulate; costa well
defined, in section 2 cells wide adaxially; basal cells rectangular 3-5 times as long as wide middle laminal cells quadrate or quadrate-rectangular, incrassate, sinuose, unistratose sometimes bistratose at margin, pellucid, 10–12 μm wide in mid-leaf.

Locality: 28°32'55.0" N – 33°58'54.8" E, the road to Saint Katherine Mountain, near Saint Katherine Monastery, South Sinai. Herbarium no.: CAIA-S-325 & CAIA-S-326.

Habitat: on the sand in a shaded place below a large rock.

Distribution in phytogeographic territories in Egypt; S

Distribution in the world: Afr1, 4; Am1; As 3, 5; Austr 1, 2; Eur.

Schistidium apocarpum (Hedw.) Bruch & Schimp. (Fig.3)

Plant 0.6 – 1.0 cm, with central strand. Epidermal cells of stems strongly incrassate with small lumens. Leaves erect or curved, sometimes subsecund when dry, ovate-lanceolate to lanceolate, sharply keeled above, 1.4 – 1.8 mm length x 0.35 – 0.5 mm width, bistratose in striae distally; margins recurved ± throughout or to just before the apex, entire or sparsely bluntly toothed towards apex; apices acute or sub-obtuse; costa percurrent, occasionally decurrent; costa smooth or with sparse low papillae on abaxial side above; basal marginal cells quadrate at margins to rectangular near costa, 25 – 42.5 μm length x 10-12.5 μm width,
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smooth, sinuose towards margin. Middle laminal cells rounded-quadrate to shortly rectangular, incrassate, usually sinuose, smooth mostly 8–10 μm wide. Sporophyte present: capsule immersed inside gametophyte, dark red to brown, short-cylindric, widest at the mouth, 0.8 mm; exothecial cells usually quadrate, sometimes mixed with short-elongate or oblate cells, thin-walled, usually trigonous; stomata present; peristome patent to slightly incurved, twisted, 230 – 350 μm, red, densely papillose, usually perforated. Spores 12.5 μm, granulose or smooth.

Locality: 28°32′52.8″ N – 33°58′12.0″ E, Farsh El-Louza, Saint Katherine Mountain, South Sinai. Herbarium no.: CAIA-S-338c & CAIA-S-339c

Habitat: on rocks in a slightly wet shaded place, inside mountain crevices.

Distribution in phytogeographic territories in Egypt; S

Distribution in the world: Afr 1, 2, 3, 4; Am 1, 2, 3, 4, 6; Antarctica; As 1, 2, 5; Austr 1, 2; Eur.

Fig. 3: A. Plant; B & C. Stem leaves; D. Middle laminal cells; E. Leaf apex; F. Leaf Base; G. Leaf cross-section; H. Stem cross-section; I. Capsule; J. Exothecial cells; K. Peristome teeth; L. Spore.
Declarations:
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ARABIC SUMMARY

تأكيد تسجيل نوعان غير المؤكد تواجدهم ضمن الحزازيات القائمة المصرية

Fissidens fontanus, Grimmia orbicularis and Schistidium apocarpum

سحر إبراهيم علي السقطي*، محمد فرج أبو الحمد علي، منال إبراهيم خليل

معمل أ.د. وجي السعدي للأرشيجونات، قسم النبات، كلية العلوم، جامعة عين شمس

يعود تاريخ توثيق تنوع الحزازيات القائمة في مصر إلى عام 1812 Delile، وتضمن القوائم الحالية الآن ما يقرب من مائتي نوع. ستة وعشرون نوع منهم سجل مرة واحدة فقط قبل عام 1904. من قبل علماء أجانب، وكانت هذه العينات بدون سجل معيتيحي أو صور توضيحية أو وصف. ومن خلال إجراء رحلات استكشافية إلى مناطق جغرافية مختلفة في مصر، تم التحقق من وجود ثلاثة أنواع جديدة، يتم تسجيلها في الأنواع غير المكتشفة.

Fissidens fontanus (Bach. Pyl.) Steud. هو نوع المسجل بدون موقع محدد، وتم التأكيد من وجوده في البيئة المصرية بعد قرن من الزمان. كان هو النوع الوحيد المسجل بدون موقع محدد. وفي هذه الدراسة، تم تسجيل وجودة Grimmia orbicularis (Bruch & Schimp) Bruch ex Wilson في منطقة نوبيا النيل مما رفع العدد الإجمالي من هذه المنطقة إلى عشرة أنواع. في حين تم تسجيل نوع Schistidium apocarpum (Hedw.) Bruch & Schimp من جبال جنوب سيناء. بالإضافة إلى ذلك، تم ذكر الموقع الدقيق والوصف والصور الفوتوغرافية لهذه الأنواع الثلاثة.