

Mosses of the Egyptian conservation areas: III. Two new Pottiaceae records to Saint Catherine Protected Area and Egypt

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Two species of Pottiaceae; *Anoetangium handelii* Schiffn. and *Hymenostylium crassinervium* Broth. & Dix. are recorded here for the first time from Egypt (Saint Catherine Protected area, Southern Sinai). *Anoetangium* Schwägr is a new genus to Egypt. Descriptions, illustrations, and distribution comments on both species are given.

Key words: *Anoetangium*, Conservation areas, Egypt, *Hymenostylium*, New records, Pottiaceae, Saint Catherine, Sinai.

Running Title: New Pottiaceae records to Egypt.

Introduction

Pottiaceae represent more than 10% of moss species known from the whole world and is considered the largest family of the acrocarpous mosses (Buck & Goffinet, 2000). In Egypt, Pottiaceae represents about 48% (82 taxa) of the known moss flora which consists of 170 taxa (El-Saadawi *et al.*, 2013) and about 47% (39 taxa) of the known moss flora of Saint Catherine Protected area in Southern Sinai (Fig. 1) which consists of 82 taxa (Abou Salama, 2001; El-Saadawi *et al.*, 2003).

The Sinai Peninsula lies in the arid belt of North Africa and belongs to the Saharan Mediterranean area with a true desert climate (Deepak, 2011).

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Also, it lies in the low rain belt of Egypt with an average rainfall of 57 mm a year, but water channels are found almost throughout the year in certain parts of some of Saint Catherine wadis. The high mountains in the Saint Catherine area receive higher amounts of precipitation (100 mm a year) as rain and snow (Ayyad *et al.*, 2000).

According to Mansi (1988) there is a wide difference in temperature between summer and winter. August is the hottest month, with a mean temperature of 25.4°C and January is the coldest month, having a mean temperature of 8.7 °C. Minimum temperatures of less than -6 °C are of frequent occurrence between November and March in that part (the high mountains) of Sinai. The relative humidity in this area is below 40% in all seasons, therefore, similar to the dry deserts of Egypt. In the southern part of Sinai the basement rocks occupy more than 80% of the area, and are mainly of granitic composition. There are also metamorphic rocks in certain places (Soliman, 1986).

Saint Catherine area was established in 1988 as a protected area. It is situated in the southern part of Sinai (Fig. 1) between 33° 58' to 34° 00' East and 28° 26' to 28° 34' North. It is one of Egypt's largest protected areas and includes the country's highest mountains. Moustafa & Klopatek (1995), mentioned six types of land forms in Saint Catherine Protected area namely: slopes, terraces, gorges, ridges, plains and wadis. Wadis are one of the most important and clearly defined ecosystems in the southern part of Sinai. They act as drainage systems collecting water from catchment areas and from habitats favorable for moss growth. The wadis in Saint Catherine are very narrow, have steep slopes, are short in length and occur at elevations between 1500-2100 m.

The furtherance of our knowledge about the moss flora (precisely Pottiaceae) of this protected area seemed worthwhile. For this purpose this study was conducted regarding some samples collected earlier from Saint Catherine Protected area and kept at CAIA but never investigated before like many other samples in this herbarium. The investigation of these samples is the aim of this work which is at the same time the third in a series on mosses of conservation areas of Egypt (see Abou Salama, 2000; El-Saadawi *et al.*, 2013).

Materials

Nine herbarium samples collected during 1982 from two wadis in the Saint Catherine Protected area (sample number is followed by the acronym "U"). Samples are kept in the Herbarium, Ain Shams University (CAIA). (Fig. 1).

- Wadi Abo Zaytouna: samples *100bU*, *101cU*, *102cU*, *104bU*, *104cU*, *104eU* & *106 bU*, collected on red or yellow sandy soil, 26 April 1982; Usama Abou Salama (CAIA).

- Wadi Talaa: samples *114aU* and *114cU*, collected on red sandy soil, 26 April 1982; Usama Abou Salama (CAIA).

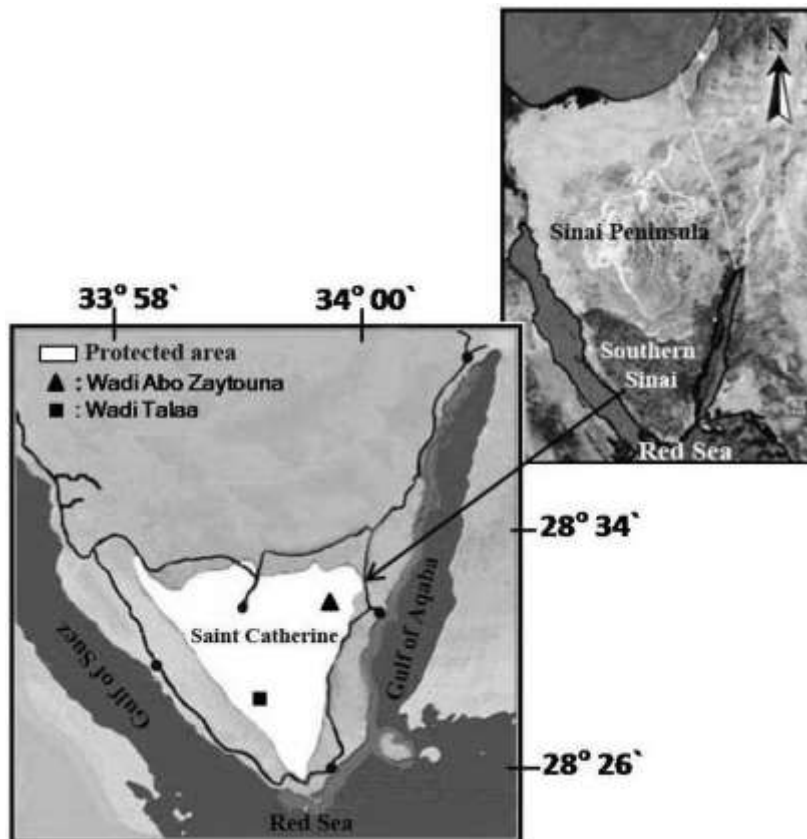


Fig. 1. Map showing the location of Saint Catherine protected area in Southern Sinai; ■: indicates the location of wadi Talaa, ▲: the location of wadi Abo Zaytouna.

Results

The identification of the nine herbarium samples showed the presence of 5 Pottiaceae species namely: *Anoetangium handelii* Schiffn. *Gymnostomum aeruginosum* Sm., *Hymenostylium crassinervium* Broth. & Dix., *Tortula inermis* (Brid.) Mont. and *Weissia controversa* Hedw. Two of these species (*Anoetangium handelii*, (114cU) and *Hymenostylium crassinervium* (100bU, 101cU, U102c, 104bU & 106bU) are new records to Egypt. Moreover, this find represents the first record of a species belonging to *Anoetangium* Schwägr in this country (this raised the number of moss genera known from Egypt from 54 to 55). *Gymnostomum aeruginosum*, *Tortula inermis* and *Weissia controversa* are represented in 3 of these 9 investigated samples (104eU, 104cU and 114aU respectively), in addition to their presence in earlier samples also from Saint Catherine area therefore they are old records to this area (Abou Salama, 1985; Abou Salama, 2001; El-Saadawi *et al.*, 2003). The total number of mosses of Egypt and Saint Catherine area is raised to 172 and 84 taxa respectively. The two new records are described, illustrated, and commented upon below.

Description

***Anoetangium handelii* Schiffn. (Plate 1)**

Plants sterile, yellowish-green, up to 0.4 cm high. Stem branched or unbranched, rounded to slightly angular in cross section (Plate 1: Fig. 7), central strand poorly developed, or absent, sclerodermis highly differentiated. Leaves erecto-patent when moist (Plate 1: Fig. 1), keeled, appressed to erect, concave when dry, condensed to a rosette at stem apex, squarrose spreading at mid and below, broad ovate with decurrent base (Plate 1: Fig. 2), 0.4-0.5 (0.6) mm long, 0.2-0.3 mm wide; apex blunt, obtuse to broad acute; margins plane above, \pm recurved below, weakly crenulate to papillose; costa stout 22-24 μ m wide (Plate 1: Fig. 2), ending by few cells below apex (Plate 1: Fig. 3), ventral and dorsal superficial cells elongated above middle part of leaf, semicircular in cross section, only one stereid band dorsally and guide cells apparently ventrally (Plate 1: Fig. 5, 6); upper lamina cells quadrate, short rectangular, or irregular (Plate 1: Fig. 3), 4-6 (8) μ m long, 4-6 μ m wide, weakly papillose, incrassate; basal lamina cells quadrate, subquadrate or short rectangular (Plate 1: Fig. 4), 6-10 (12) μ m long, (6) 8-10 μ m wide, weakly papillose, \pm incrassate.

***Hymenostylium crassinervium* Broth. & Dix. (Plate 2)**

Plants sterile, yellowish brown, up to 2.2 cm high. Stem usually branched, semirounded in cross section, central strand poorly developed or absent, sclerodermis highly differentiated (Plate 2: Fig. 8). Leaves crowded at upper portion of branches, \pm spreading below, erecto-patent to erect when moist (Plate 2: Fig. 1), concave to keeled or \pm cucullate, erect-incurved, slightly crisped, occasionally twisted appressed when dry, long ligulate-lanceolate to linear (Plate 2: Fig. 2, 3), 1.7-1.8 mm long, 0.2-(0.3) mm wide slightly widened toward base; apex acute; margins plane, weakly papillose or nearly entire; costa ending by 2-5 cells below apex (Plate 2: Fig. 4), stout 50-60 μm wide above and 76 μm wide below, ventral and dorsal superficial cells quadrate to subquadrate above middle part of leaf, semicircular in cross section (Plate 2: Fig. 6), dorsal steried band larger than ventral one, with 2 guides at middle part of leaf (Plate 2: Fig. 7), 5 guides below, papillose; upper lamina cells short rectangular, rounded, irregularly quadrate (Plate 2: Fig. 4), 8-10 (12) μm long, 6-8 μm wide, become smaller toward margins, with dense papillae on both sides, papillae multifid, highly incrassate; basal lamina cells differentiated in a rectangular group or extending upward along the margins elongated rectangular (Plate 2: Fig. 5), (14) 20-32 (46) μm long, (6) 8-10 μm wide, papillose, highly incrassate.

Distribution Remarks

Following to the world distribution areas proposed by Wijk *et al.* (1959), the most remarkable species treated in this paper have the following distributions (Fig. 2).

This is the first record of *Anoetangium* Schwägr in Egypt, while, *Hymenostylium* Brid. is already represented by one species namely; *Hymenostylium recurvirostrum* (Hedw.) Dixon; from Southern Sinai (El-Saadawi *et al.*, 2003). *Hymenostylium crassinervium* can be differentiated from the latter species by acute apex and erecto-patent to erect leaves when moist.

The two, newly recorded, taxa are quite similar to those recorded from other parts of the world; however, *Anoetangium handelii*, in Israel has gemmae borne on branched axillary stalks while in Egypt no such gemmae were detected.

It is not surprising to find *Anoetangium handelii* in Saint Catherine Protected area since this area belongs to As.5 in which this species is known to exist in many of its countries including some Mediterranean ones as Turkey and Israel (see Ros *et al.*, 2013). It's worth mentioning that in the

Mediterranean area *Anoetangium* is represented by only one other species namely: *Anoetangium aestivum* (Hedw.) Mitt. found in Algeria, Canary Islands, Corsica, France, Italy, Madeira, Morocco, Spain and Turkey (Ros *et al.*, 2013). However, *Anoetangium* is represented by 47 accepted species world-wide (Zander, 1993).

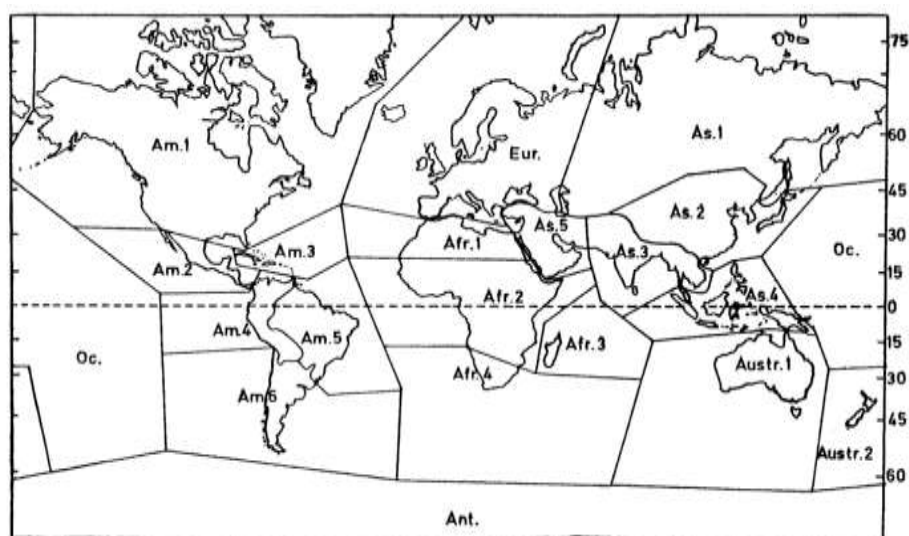


Fig. 2. A map showing phytogeographical regions of mosses of the world (after index Muscorum; Wijk *et al.*, 1959). **Afr.2-** Central Africa, Saint Helena Islands; **Afr.4-** S. Africa, Kergulen Islands; **Am.1-** N. America, Greenland, Allutian Islands, Bermudez; **Am.2-** Central America; **As.5-** Asiatic part of the Middle-East, including Cyprus; **Eur-** Europe. For explanations of other regions not referred to in this paper see index Muscorum, (1959).

On the other hand the record of *Hymenostylium crassinervium* in Egypt is considered a good find because it represents the only record in the whole Mediterranean basin (Ros *et al.*, 2013) and because it extends the northern most limit of the geographic range of this species from 21° 0' 0" N (in Oman) to 28° 34' 0" N (in Egypt). It's worth mentioning that in the Mediterranean area *Hymenostylium* is represented by 3 species and two varieties namely: *Hymenostylium hildebrandtii* (Müll.Hal.) R.H.Zander (found in Morocco), *H. recurvirostrum* (Hedw.) Dixon (found in Albania, Algeria, Balears, Bosnia-Herzegovina, Bulgaria, Croatia, Egypt, Greece,

Israel, Corsica, France, Madeira, Morocco, Montenegro, Spain, Sicily and Slovenia), *H. recurvirostrum* var. *recurvirostrum* (found in Greece, Italy, Lebanon, Morocco, Sicily and Turkey) and *H. recurvirostrum* var. *insigne* (Dixon) E.B.Bartram (found in Spain). However, *Hymenostylium* is represented by 18 accepted species world-wide (Zander, 1993).

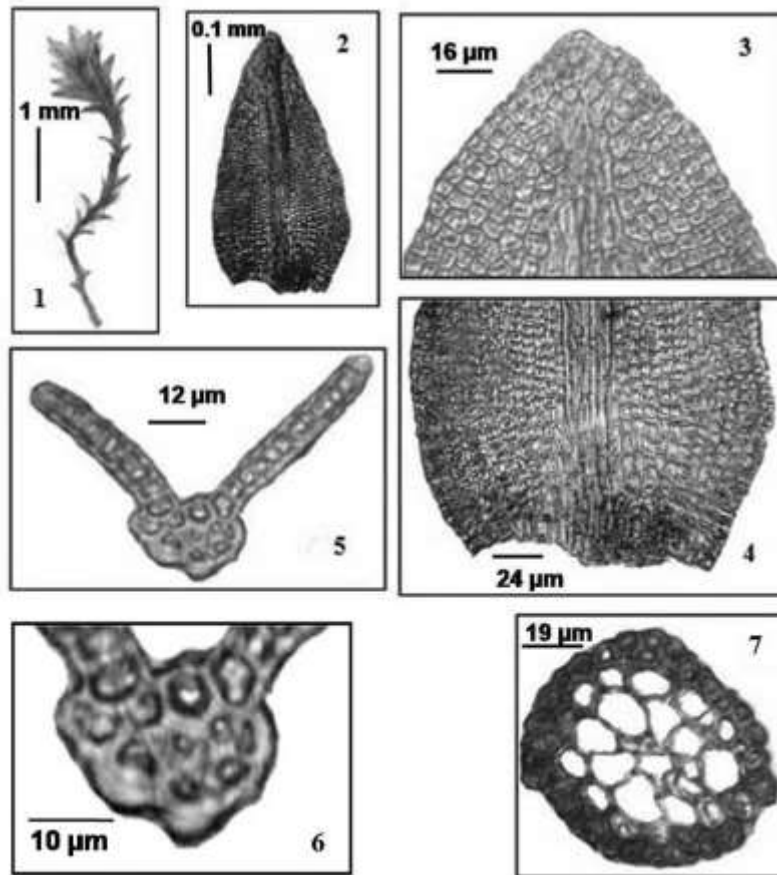


Plate 1. *Anoctangium handelii*; 1. Gametophyte. 2. Leaf. 3. Leaf apex. 4. Leaf base. 5. T.S. at middle part of leaf. 6. T.S. of enlarged costa at the middle of a leaf. 7. T.S. of stem.

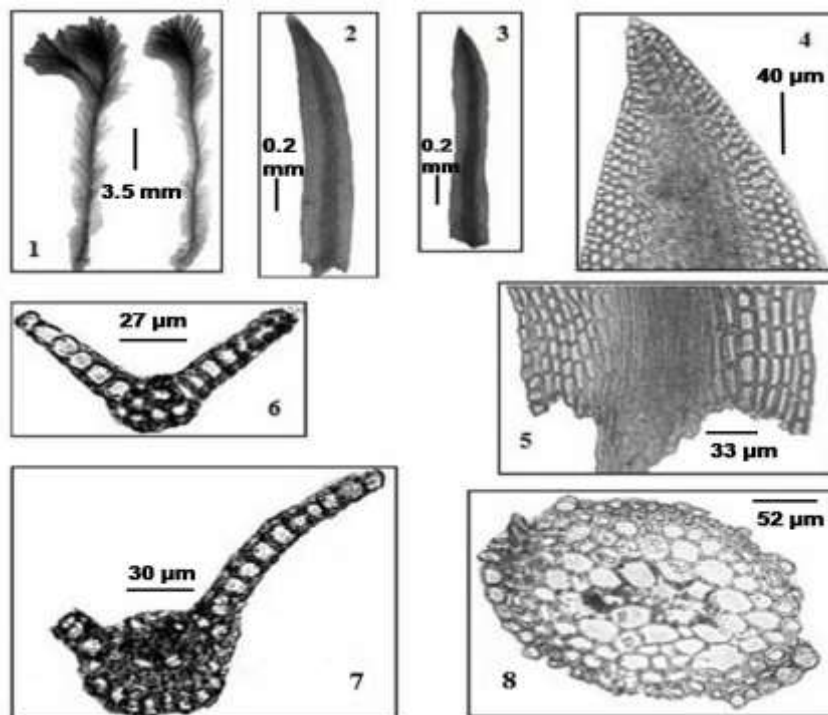


Plate 2: *Hymenostylium crassinervium*; **1.** Gametophyte. **2.** Leaf. **3.** Another leaf. **4.** Apex of leaf of Fig. 3. **5.** Base of leaf of Fig. 3. **6.** T.S. at upper part of leaf. **7.** T.S. at middle part of leaf showing lamina cells of one side. **8.** T.S. of stem.

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