

Four Species of Pottiaceous Mosses newly Recorded from Eastern Himalaya

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पूर्वी हिमालय से नवीन अभिलेखित पोटेसियस मॉस की चार जातियां

पामेला साहा, मो. निहाल अजीज एवं देबब्रता मैती

सारांश

भारत के पूर्वी हिमालय में दार्जिलिंग से प्रथम बार पोटेसिएसी कुल की चार जातियों *एनोइक्टैंग्युम एस्टिवम*, *ब्रायोएरिथ्रोफिल्लम इन्इक्वैलिफोलियम*, *डिडायमोडोन इरोसडेन्टीकुलेटस*, *डिडायमोडोन फल्लैक्स* का अभिलेखन किया गया है। प्रस्तुत शोध पत्र में इन सभी जातियों का वर्णिकी विवरण अन्य महत्वपूर्ण आंकड़ों के साथ प्रस्तुत किया गया है।

ABSTRACT

Four species of the family Pottiaceae, viz. *Anoetangium aestivum*, *Bryoerythrophyllum inaequalifolium*, *Didymodon erosodenticulatus* and *Didymodon fallax* have been newly recorded for the first time from Darjeeling district in Eastern Himalaya. Detailed descriptions of all the four taxa along with other relevant data are provided here.

Keywords: Acrocarpic Mosses, *Anoetangium*, *Bryoerythrophyllum*, Darjeeling district, *Didymodon*, New records.

INTRODUCTION

During recent plant collection trips to different localities of Darjeeling Himalaya, some interesting moss specimens were collected. After comprehensive literature study (Chen, 1941; Gangulee, 1972; Chopra, 1975; Aziz and Vohra, 2008; Xing-jiang & al., 2001) and critical examination of the specimens revealed that they belong to *Anoetangium aestivum* (Hedw.) Mitt., *Bryoerythrophyllum inaequalifolium* (Taylor) R.H. Zander, *Didymodon erosodenticulatus* (Müll. Hal.) K. Saito and *D. fallax* (Hedw.) R.H. Zander. All these members belong to the acrocarpic moss family Pottiaceae. These mosses were found to be new to Darjeeling district, and are hitherto unreported from Eastern Himalaya as well. The family Pottiaceae, represented by about 2000 species under 76 genera (Zander, 1993) or about 1339

species under 90 genera (Crosby & al. 1999) worldwide, is mostly confined to the temperate regions of the world though some species and genera are found in tropical and arctic regions (Zander, 1993). Aziz and Vohra (2008) recognized 130 species under 29 genera from India. The members are chiefly distributed in the Himalayas, though a significant numbers are also recorded from the Western Ghats. In Eastern Himalaya the family is represented by 51 species under 20 genera. West Bengal harbours about 28 species under 14 genera, exclusively concentrated in the Darjeeling Himalaya. Authors had earlier reported *Bryoerythrophyllum gymnostomum* (Broth.) P.C. Chen from West Bengal (Ellis & al., 2016). The present finding increases the number of species in Eastern Himalaya to 55 and in West Bengal to 33.

Detailed descriptions of the aforementioned four species along with other relevant data are given as follows.

MATERIALS AND METHODS

Specimens were collected from different localities of Darjeeling Himalaya. Properly preserved and dried specimens are deposited at CAL. The morphological descriptions of the newly discovered species are based on freshly collected specimens. Morpho-taxonomic investigations of the specimens were performed under Leica DFC550 Stereo zoom microscope and Olympus CX41 biological microscope. Drawings were prepared with drawing attachment of Olympus CX41 microscope. Photomicrographs were captured with the help of Nikon Eclipse Ni-U compound microscope. A brief taxonomic description and line drawing and photomicrographs are provided. Relevant literatures were consulted for confirmation of the identity of the taxa.

TAXONOMIC TREATMENT

Anoetangium aestivum (Hedw.) Mitt., J. Linn. Soc., Bot. 12: 175. 1869; Xing-jiang & al. in Xing-jiang & Crosby, Moss Fl. China 2: 121. 2001; Aziz & Vohra, Pottiaceae of India 23. 2008. *Gymnostomum aestivum* Hedw., Sp. Musc. 32. 1801. (Figs. 1 & 3 a-g)

Plants slender, forming dense tuft, greenish above, brown below; stems erect, 5–9 mm high, 1 mm wide along with leaves, rounded-triangular in transverse section, monopodially branched; branches 3–7 mm long; central strand present with undifferentiated hyalodermis; leaves curled and crisped with hooked apices on drying, erect-spreading when moist, lanceolate to broad-lanceolate, 0.8–1.1 × 0.15–0.2 mm, acute to shortly acuminate at apex, crenulate along upper $\frac{2}{3}$ of margins, entire along lower $\frac{1}{3}$; median cells quadrate to irregularly quadrate, 2–4 × 1–3 µm, thick-walled, pale, papillose; papillae 2–5, C-shaped or rounded; basal cells elongate to rectangular, 3–10 × 2–4 µm, thick-walled, smooth, pellucid; marginal cells short quadrate; costa 20 µm wide at base, percurrent or ending below apex; deuter median with 3–4 rounded cells; abaxial stereid band present, adaxial band absent. Gemma ovoid, 37.5–45 × 25–32.5 µm, stalked, brown.

Habitat and Ecology: Grows on cement pillars, commonly associated with *Hymenostylium aurantiacum* Mitt., *Hyophila involuta* (Hook.) A. Jaeger, *Brachymenium capitulatum* (Mitt.) Kindb. and *Anomobryum julaceum* (Schrad. ex P. Gaertn., B. Mey. & Scherb.) Schimp., at an elevation of c. 2134 m in Darjeeling district.

Distribution: India: Himachal Pradesh, Jammu and Kashmir, Tamil Nadu, Uttarakhand and West Bengal (Darjeeling); Africa, America, Australia, Caucasus, Europe, Japan, Nepal, New Zealand, Philippines, Sri Lanka and West Indies.

Specimen examined: West Bengal: Darjeeling, on way to Padmaja Naidu Himalayan Zoological Park, 27°03'31"N,

88°15'16"E, c. 2134 m, 10.9. 2011, Pamela Saha 64046c (CAL).

Notes: The genus *Anoetangium* Schwaegr. comprises of 47 to 50 species (Zander 1993; Crosby & al. 1999) worldwide. In Indian Eastern Himalayan region four species have been recognised in the present study. Aziz and Vohra (2008) recorded three species viz. *Anoetangium sikkimense* Aziz & Vohra, *A. stracheyanum* Mitt. and *A. thomsonii* Mitt. from Darjeeling in the Eastern Himalaya. The present discovery of *A. aestivum* from this region brings the species number under this genus to four in the Darjeeling. Previously the species was reported from Himachal Pradesh, Jammu and Kashmir and Uttarakhand of Western Himalaya and Tamil Nadu of South India. This is the first report of occurrence of the species in Darjeeling district as well as Eastern Himalaya.

Anoetangium aestivum often form a dense tuft. This species is characterized by its ovate-lanceolate leaves, costa always ending below the leaf apex and leaf margins crenulate at the shoulder portion of the leaf base.

Bryoerythrophyllum inaequalifolium (Taylor) R.H. Zander, Bryologist 83: 232. 1980; Aziz & Vohra, Pottiaceae of India 171. 2008. (Figs. 2 & 3 h-n)

Plants slender, forming loose tufts, green above, brown below; stems erect, 5–9 mm high, 0.3–0.5 mm wide with leaves, rounded in transverse section; central strand present; epidermis distinct; leaves appressed to stem with curled apices on drying, erect when moist, ovate to ovate-lanceolate, 0.7–1 × 0.4–0.5 mm, densely arranged on obtuse apex; recurved in upper $\frac{2}{3}$ portion from above base at margins, entire at base; ovate at base, slightly sheathing; laminal cells quadrate to rounded-quadrate, 2–4 × 1–3 µm, thick-walled; papillose; papillae 2–5, round to C-shaped; basal cells quadrate to rectangular, 2–9 × 1.5–3 µm, thick-walled, smooth; costa 40–42 µm wide at base, evenly thick throughout, percurrent or ending below apex; deuter median of 4–6 cells, both the stereid band present, adaxial highly reduced.

Gemma numerous, spherical to elliptical, 20–22 µm, unicellular or multicellular, reddish-brown.

Habitat and Ecology: Plants grow on the rocks, usually associated with *Hymenostylium aurantiacum* Mitt., *Hyophila involuta* (Hook.) A. Jaeger and *Didymodon fallax* (Hedw.) R.H. Zander, sometime it is found to grow solely on the rock, in temperate evergreen forest at the elevations ranging from 2134–2344 m in Darjeeling.

Distribution: India: Himachal Pradesh, Tamil Nadu and West Bengal; China, Colombia, Ecuador, Indonesia, Nepal, North America.

Specimen examined: West Bengal: Darjeeling, on the way to Padmaja Naidu Himalayan Zoological Park,

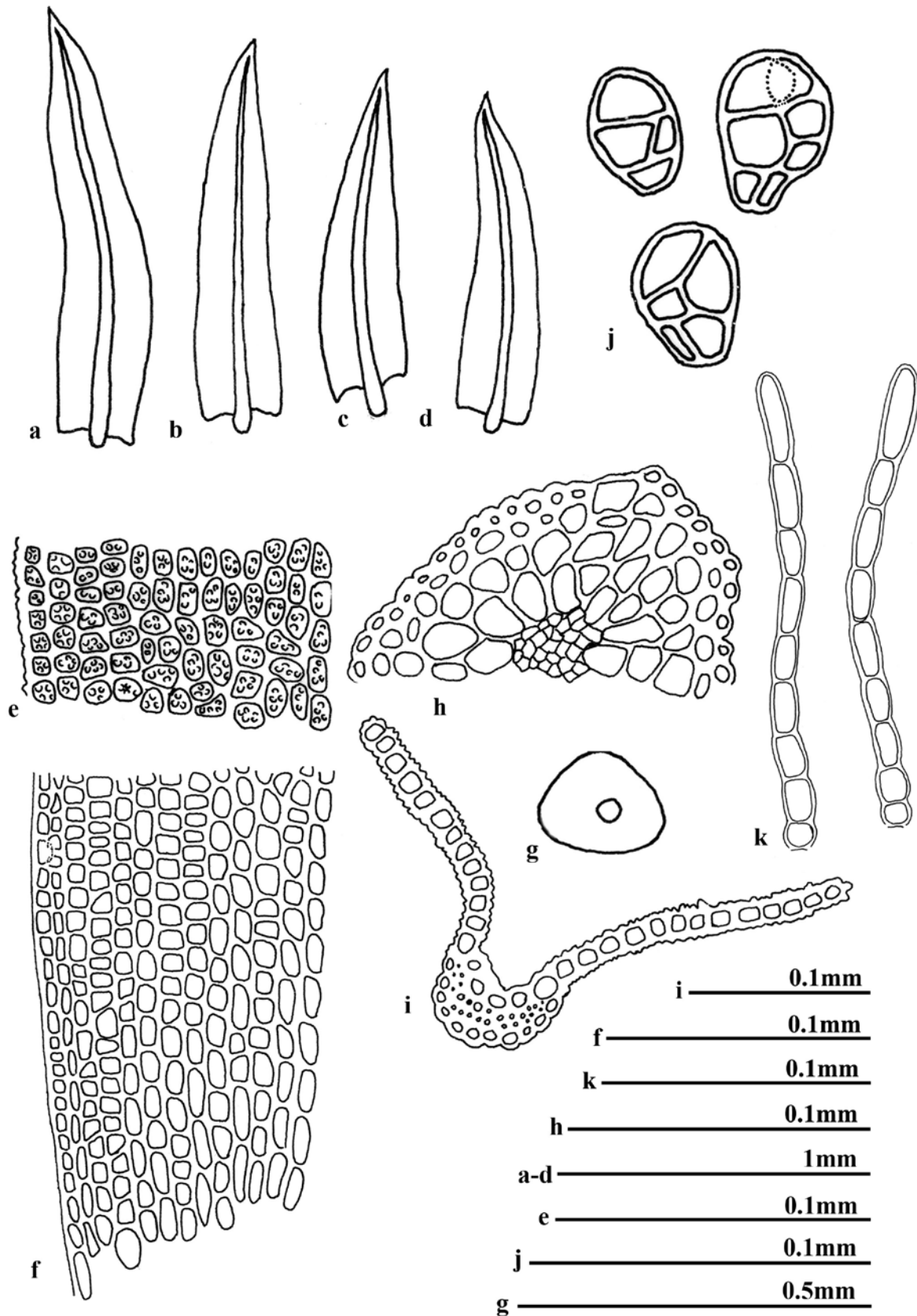


Fig. 1. *Anoetangium aestivum* (Hedw.) Mitt.: **a-d.** leaves, **e.** leaf marginal and median cells, **f.** leaf basal cells, **g-h.** transverse section of stem, **i.** transverse section of leaf, **j.** gemma, **k.** axillary hairs (from Pamela Saha 64046c)

27°03'31"N 88°15'16"E, c. 2134 m, 9. 9. 2011, *Pamela Saha* 64044b (CAL).

Notes: The genus *Bryoerythrophyllum* consists of 27 to 28 species (Zander, 1993; Crosby & al. 1999) worldwide. Lal (2005) recorded nine taxa in India, while Aziz and Vohra (2008) recognized five species from India as well as from Eastern Himalaya. Gangulee (1972) reported two taxa from Darjeeling district, viz. *Bryoerythrophyllum ferrugineum* Gangulee and *B. yunnanense* (Herz.) Chen var. *noguchianum* Gangulee. The former is considered as synonym of *Didymodon nigrescens* (Mitt.) K. Saito and the later one is treated as synonym of *Bryoerythrophyllum wallichii* (Mitt.) Chen. *Bryoerythrophyllum gymnostomum* (Broth.) Chen was reported earlier from West Bengal (Ellis & al. 2016), so the present discovery of *B. inaequalifolium* increases the number of species to six in Eastern Himalaya and three under the genus *Bryoerythrophyllum* in West Bengal as well as in Darjeeling district.

Previously the species had been reported from Himachal Pradesh of Western Himalaya and Tamil Nadu of South India. This is the first report of its occurrence in Darjeeling district as well as in Eastern Himalaya. The species can be easily identified by: small loose tufts forming plants; leaves ovate to ovate-lanceolate, appressed to stem when dry, apex obtuse, margin recurved at upper $\frac{2}{3}$ portion, entire at base.

Didymodon erosodenticulatus (Müll. Hal.) K. Saito, J. Hattori Bot. Lab. 39: 504. 1975; Xing-jiang & al. in Xing-jiang & Crosby, Moss Fl. China 2: 160. 2001; Aziz & Vohra, Pottiaceae of India 180. 2008. *Barbula erosodenticulata* Müll. Hal., Nuov. Giron. Bot. Ital. n. ser., 3: 102. 1896. (Figs. 4 & 6 a-f)

Plants robust, forming loose tufts, reddish; stems erect, 1.3–2.5 cm high, 2–3 mm wide with leaves, rounded-triangular in transverse section, simple or branched; branches 3–5 mm long; central strand present; epidermis thick-walled; leaves crisped and carinate on drying, erect-spreading when moist, ovate-lanceolate, 2.5–3 × 0.4–0.5 mm; apex acuminate, serrated in upper $\frac{2}{3}$ portion of margins, recurved in lower $\frac{1}{3}$ portion, decurrent at base from a wide sheath narrowing to a lanceolate lamina; laminal cells rounded to irregularly quadrate, 5–15 × 5–10 µm, thick-walled, thickened at corners, papillose, pale brown; papillae 1-2, C-shaped; basal cells irregularly oblong, 20–37.5 × 10–17.5 µm, thick-walled, papillose, pale brown; papillae 1-2, C-shaped; costa thick, 82.5–95 µm wide at base, percurrent or ending below apex, reddish-brown; deuter median of 4-6 cells, both the stereidal bands present, adaxial weak.

Dioicous; seta erect, twisted clockwise above, reddish-brown; capsule erect, cylindrical, 1.5–1.8 × 0.4–0.7 mm,

brown; exothecial cells oblong to rectangular, thick-walled, yellowish-brown; peristome teeth 16, undivided or sometimes divided into two unequal or equal halves, papillose to sparsely papillose, brown; spores rounded, papillose, brown.

Habitat and Ecology: Grows on humus, associated with *Plagiothecium paleaceum* (Mitt.) A. Jaeger, in the temperate evergreen forest, at c. 2284 m elevation in Darjeeling district.

Distribution: India: Uttarakhand and West Bengal; China, Japan, Nepal.

Specimen examined: West Bengal: Darjeeling, on way to Gorkhey, 27°11'09.04"N, 88°4'18.63"E, c. 2284 m, 30.10.2012, *Pamela Saha* 64388b (CAL).

Notes: *D. erosodenticulatus* had been reported only from Uttarakhand of Western Himalaya. In this study the species has been encountered from Darjeeling district, West Bengal for the first time and this is also the first report of its occurrence in the Eastern Himalaya. The species is characterised by: robust plants with rounded-triangular stem in transverse section; leaves carinate when dry, leaf margins serrate in upper $\frac{2}{3}$ portion and recurved in the lower $\frac{1}{3}$ portion, base decurrent, from a wide sheathing base narrowed to a lanceolate lamina.

Didymodon fallax (Hedw.) R.H. Zander, Phytologia 41(1): 28. 1978; Xing-jiang & al., in Xing-jiang & Crosby, Moss Fl. China 2: 162. 2001; Aziz & Vohra, Pottiaceae of India 200. 2008. *Barbula fallax* Hedw., Sp. Musc. 120. 1801. (Figs. 5 & 6 g-k)

Plants slender, forming loose tufts, green above, brown below; stems erect, 1–2 cm high, 1–2 mm wide with leaves; rounded in transverse section, simple or branched; central strand present; epidermis distinct; leaves crisped, erect, appressed to stem on drying, spreading when moist, ovate-lanceolate, 2–2.5 × 0.4–0.5 mm, apex acuminate; margins entire above, recurved below; laminal cells irregularly rounded-quadrate, 5–10 × 5–7.5 µm, thick-walled; papillose; papillae one, covering entire lumen; basal cells short-rectangular to oblong, 7.5–25 × 5–20 µm, thick-walled, pellucid; costa thick, 55–65 µm wide at base, percurrent or ending below apex, reddish-brown; deuter median of 4-5 cells, both stereidal bands well developed to adaxial almost absent.

Dioicous; seta erect, reddish-brown; capsule erect, cylindrical, 1.5–2 × 0.3–0.35 mm, brown; exothecial cells oblong to rectangular, thick-walled, yellowish-brown; peristome teeth 16, papillose, brown; spores rounded, 7.5–10 µm, papillose, brown.

Habitat and Ecology: Grows on rock associated with *Anomobryum julaceum* (Schr. ex P. Gaertn., B. Mey. & Scherb.) Schimp. and *Funaria hygrometrica*

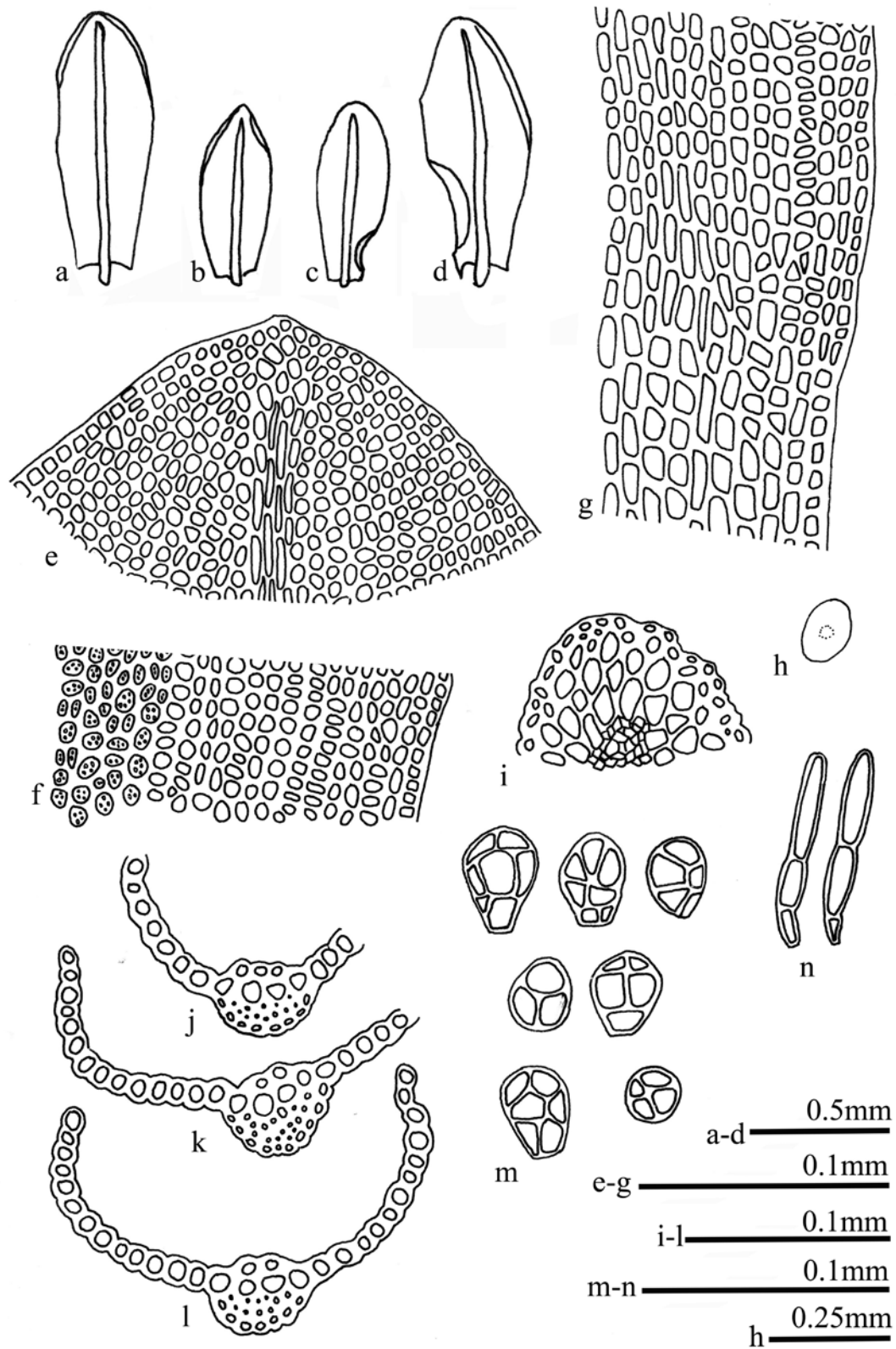


Fig. 2. *Bryoerythrophyllum inaequalifolium* (Taylor) R.H. Zander: **a-d.** leaves, **e.** leaf apical cells, **f.** leaf marginal and median cells, **g.** leaf basal cells, **h-i.** transverse section of stem, **j-l.** transverse section of leaves, **m.** gemma, **n.** axillary hairs (from Pamela Saha 64044b).



Fig. 3: a–g: *Anoetangium aestivum* (Hedw.) Mitt.: a. dry plants, b. wet plants, c–d. leaves, e. leaf apical cells, f. leaf marginal and median cells, g. leaf basal cells (from Pamela Saha 64046c); h–n: *Bryoerythrophyllum inaequalifolium* (Taylor) R.H. Zander: h. dry plants, i. wet plant, j–k. leaves, l. leaf apical cells, m. leaf marginal and median cells, n. leaf basal cells (from Pamela Saha 64044b).

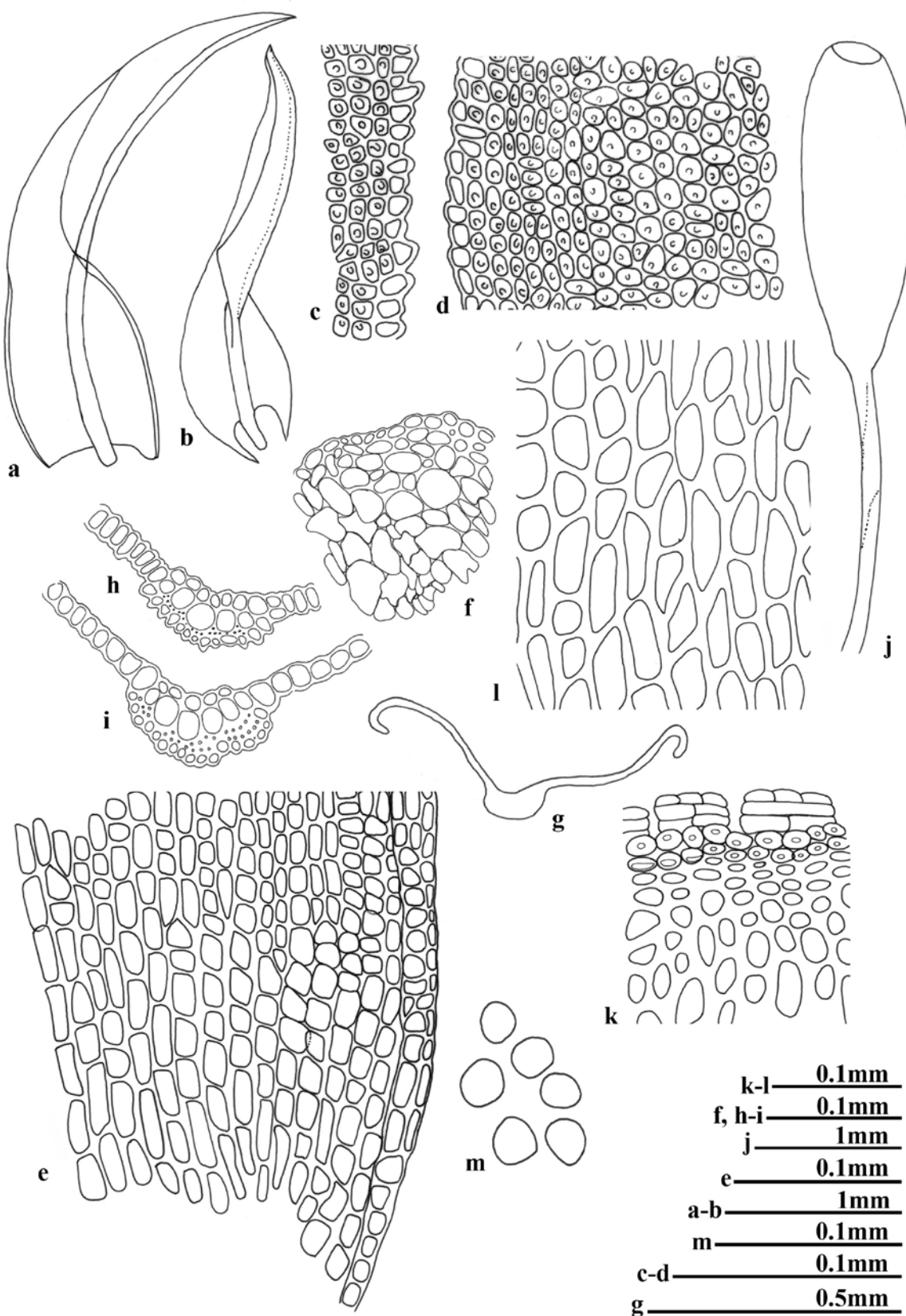


Fig. 4. *Didymodon erosodenticulatus* (Mull. Hal.) K. Saito: **a-b.** leaves, **c.** leaf marginal cells, **d.** leaf marginal and median cells, **e.** leaf basal cells, **f.** transverse section of stem, **g-i.** transverse section of leaves, **j.** capsule, **k.** cells of annulus, **l.** exothecial cells, **m.** spores (from Pamela Saha 64388b).

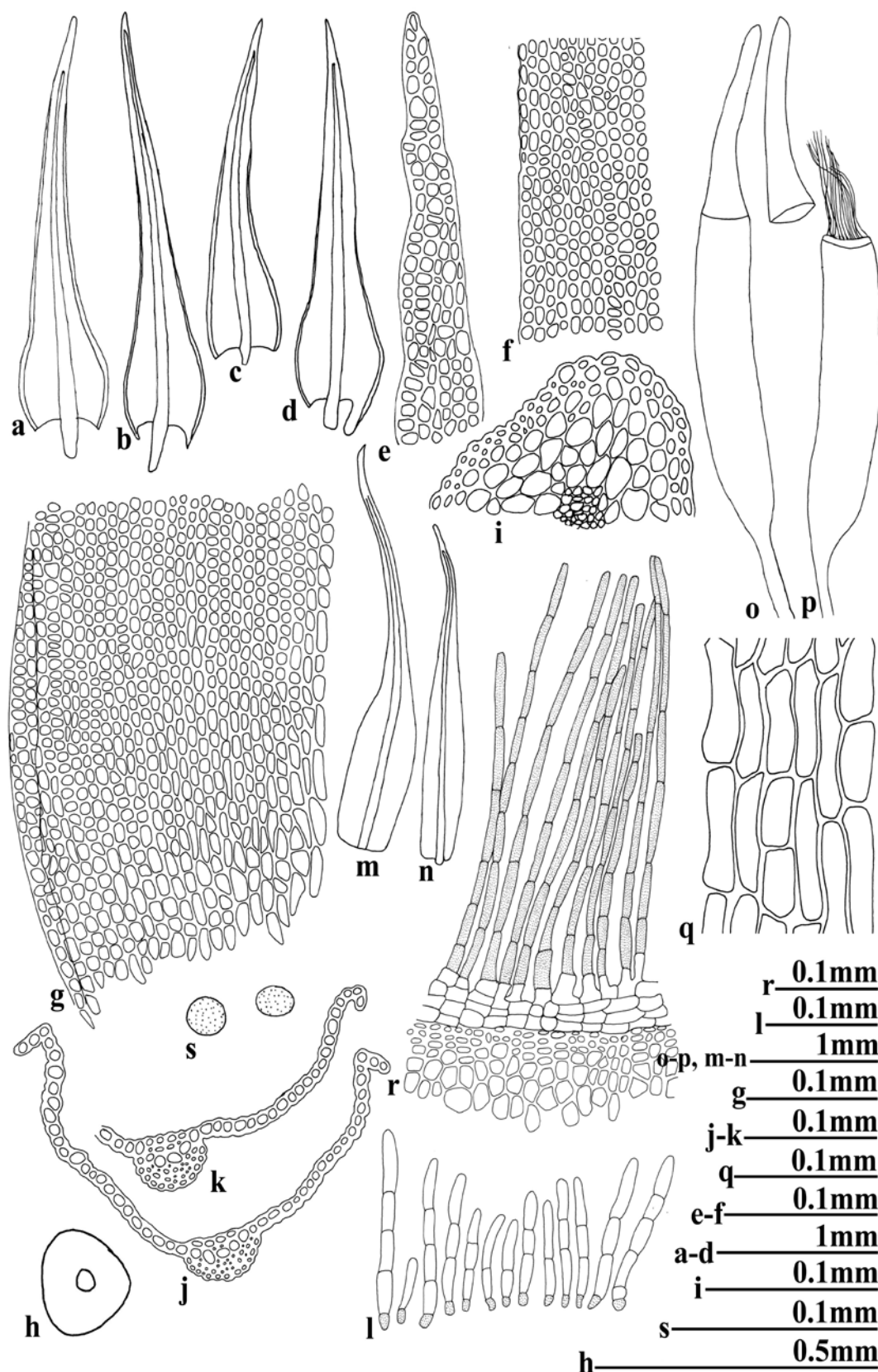


Fig. 5: *Didymodon fallax* (Hedw.) R.H. Zander: **a-d.** leaves, **e.** leaf apical cells, **f.** leaf median cells, **g.** leaf basal cells, **h-i.** transverse section of stem, **j-k.** transverse section of leaves, **l.** axillary hairs, **m-n.** perichaetial leaves, **o.** capsule, **p.** capsule showing peristome teeth and operculum, **q.** exothecial cells, **r.** peristome teeth, **s.** spores (from Pamela Saha 64008c).



Fig. 6: **a–f:** *Didymodon erosodenticulatus* (Müll. Hal.) K. Saito: **a.** dry plants, **b.** wet plants, **c.** leaf, **d.** leaf apical cells, **e.** leaf marginal and median cells, **f.** leaf basal cells (from Pamela Saha 64388b); **g–k:** *Didymodon fallax* (Hedw.) R.H. Zander: **g.** wet plants, **h.** leaf, **i.** excurrent costa, **j.** leaf marginal and median cells, **k.** leaf basal cells (from Pamela Saha 64008).

Hedw.; on rock in shade, in association with *Funaria hygrometrica* Hedw., *Trachypus bicolor* Reinw. & Hornsch., *Anomobryum julaceum* (Schrad. ex P. Gaertn., B. Mey. & Scherb.) Schimp.; on humus over rock; on soil, in association with *Funaria hygrometrica* Hedw., *Anomobryum julaceum* (Schrad. ex P. Gaertn., B. Mey. & Scherb.) Schimp.; on rock, in the same colony with *Brachythecium procumbens* (Mitt.) A. Jaeger and *Hymenostylium aurantiacum* Mitt., at elevations ranging from 2000–2444 m in Darjeeling district.

Distribution: India: Himachal Pradesh, Jammu & Kashmir, Uttarakhand and West Bengal; British Columbia, China, Europe, Faroes, Greenland, Japan, Madeira, Morocco, North Africa, North America, Pakistan and Tunis.

Specimens examined: West Bengal: Darjeeling, on way to Mahakal Mandir, 27°02'47.30"N, 88°16'03.53.44" E, c. 2142 m, 6.9.2011, *Pamela Saha* 64005, 64008c, 64010b (CAL); Darjeeling town, 6.9.2011, *Pamela Saha* 64016c; Darjeeling town, on the way to Jalapahar, 27°01'10.15" N, 88°15'26.35" E, c. 2321 m, 7.9.2011, *Pamela Saha* 64022 (CAL); Llyod Botanic Garden, 27°04'46"N, 88°26'29"E, c. 2000 m, 2.12.2011, *Pamela Saha* 64113c (CAL); on the way to Tiger Hill, 26°59'09.28" N, 88°17'15.39" E, c. 2444 m, 20.7.2012, *Pamela Saha* 64202b (CAL).

Notes: *D. fallax* had been reported from Jammu & Kashmir, Himachal Pradesh and Uttarakhand of Western Himalaya. In this study the species has been recorded from Darjeeling district, West Bengal for the first time and this is also the first report of its occurrence in the Eastern Himalaya. The species is characterised by: plants thin; leaves ovate-lanceolate but margins entire above, recurved below; costa percurrent or ending below apex.

The genus *Didymodon* Hedw. consists of 121 species (Crosby & al., 1999), whereas, Zander (1993) recognized 122 species worldwide. Aziz and Vohra (2008) recognized 16 species from India and nine species from Eastern Himalaya. The present report of *D. erosodenticulatus* and *D. fallax* increases the number of species to 11 for Eastern Himalaya and five in Darjeeling district as well as West Bengal.

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