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Cover: Pseudo-flying animals and wind-dependent seed & spore dispersers – made with digital painting in Krita. © Melito Prinson Pinto



***Physcomitrium eurystomum* Sendtn. (Funariaceae: Bryophyta) and
Splachnobryum obtusum (Brid.) Müll. Hal. (Splachnobryaceae: Bryophyta),
two rare moss species from the Western Ghats of Kerala**

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Abstract: *Physcomitrium euryostomum* Sendtn. is a temperate to tropical species, Red Listed in Europe, now collected on the way to Mattupetty from Munnar of Idukki district in the Western Ghats of Kerala. *Splachnobryum obtusum* (Brid.) Müll. Hal. was collected from the lateritic midland of Malappuram district of Kerala. Both these species are of rare occurrence and poorly known in the Western Ghats, hence described in detail with images.

Keywords: Bryological study, conservation, Idukki district, Malappuram district, new records, rare species

Editor: Anonymity requested.

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INTRODUCTION

The bryological studies in the Western Ghats intensified during the past two decades and has resulted in the addition of several species to the area, including new species (Nair et al. 2005; Manju et al. 2008; Manju & Rajesh 2012; Daniels et al. 2018; Daniels & Kariyappa 2019; Daniels & Raja 2020; Mufeed et al. 2021; Manjula et al. 2022). Still there are several areas remaining largely unexplored or underexplored. During our recent bryofloristic exploration in the high-altitude regions of Idukki District in the Western Ghats of Kerala, one moss species of Funariaceae was collected, and was identified as *Physcomitrium eurystomum* Sendtn. This is a widely distributed species in the montane temperate and tropical areas of Europe; tropical Africa; southern, southeastern, & southwestern parts of Asia; and northeastern part of Montenegro; but reported as of scattered occurrence (Dierßen 2001; Papp et al. 2013; Porley 2013; Hodgetts 2015; Stešević et al. 2020). Hodgetts et al. (2019) included this species in the European Red List of Mosses, Liverworts, and Hornworts. It is also known to occur in lower Bengal and Assam in northeastern India and Parasnath Wildlife Sanctuary in Jharkhand in central India (Saha & Singh 2020). In the Western Ghats it is, however, known as a sole collection by Rajeevan (1990) from Puliyanmala in Kulamavu area of Idukki District. Since then, it has not been collected or recorded from the Western Ghats. The present collection is on the way to Mattupetty from Munnar, Idukki District, about 70 km away from the first collection by Rajeevan (1990). A detailed account of this rare and poorly collected species from the Western Ghats is being provided here.

The family Splachnobryaceae include two genera, viz., *Koponobryum* Arts and *Splachnobryum* Müll.Hal. (Arts 2001). More than 50 species are known in this family, however, Arts (2001) accepted only 10 valid species, viz.: *Koponobryum bengalense* (Gangulee) Arts, *Splachnobryum aquaticum* Müll. Hal., *S. assamicum* Dixon, *S. crassinervium* Arts, *S. gracile* Besch., *S. limbatum* D.H.Norris & R.H.Zander, *S. novae-guineae* Broth., *S. obtusum* (Brid.) Müll.Hal., *S. oorschotii* M.Fleisch., and *S. wiemansii* M.Fleisch. Among these *Koponobryum bengalense* (Gangulee) Arts was first described by Gangulee (1974) from Calcutta, India as *Splachnobryum bengalense* Gangulee. Later, Arts (2001) established a new genus, *Koponobryum* Arts to accommodate this species due to its unique characteristics such as acute leaf apex, costa reaching the apex in upper stem leaves, the upper lamina cells with one central papilla

in contrast to the obtuse leaf apex, costa ending one or more cells below apex in upper stem leaves, and all the lamina cells smooth in *Splachnobryum*. In India, the genus *Splachnobryum* was known with seven species, but Arts (2001) recognized only three valid species—*S. aquaticum* Müll.Hal., *S. assamicum* Dixon, and *S. obtusum* (Brid.) Müll.Hal. (Dixon 1937; Gangulee 1974; Chopra 1975; Tewari & Pant 1989, 1990; Arts 2001; Sahu & Asthana 2022). All other species are treated as synonyms; *S. indicum* Hampe & Müll.Hal. and *S. flaccidum* (Hook.) Müll.Hal. under *S. obtusum*., *S. procerrimum* under *S. aquaticum* and *S. synoicum* under *S. assamicum*. *S. pulcherrimum* Dixon et P.de la Varde was treated as invalid due to the absence of description (Blatter & Fernandez 1931). We came across scattered population of *S. obtusum* (Brid.) Müll.Hal. in the lateritic midland of Malappuram District of Kerala. A detailed account of this rare and poorly known species is being provided.

Even though *Splachnobryum obtusum* and *Physcomitrium eurystomum* are mentioned in some literature as reported from Kerala (Manju et al. 2008), the detailed description is lacking. Hence the two species are described in detail with images and its conservation status is discussed.

MATERIAL AND METHODS

Physcomitrium eurystomum was collected during September 2022 from the muddy soil and small rocky stones along land cuttings from Idukki District and *Splachnobryum obtusum* during December 2022 from the lateritic midland terrestrial microhabitat along with *Riccia billardiarii* Mont. & Nees from Malappuram District. The voucher specimens are deposited in the Calicut University Herbarium (CALI). Morpho-anatomical analysis of specimens was studied using stereo dissection microscope (Labomed Luxeo 4z and Olympus SZ) and compound microscope (Labomed LX-400, Leica DM 2000 LED, and Olympus CX2LiLED). Measurements of the plant parts and cells were taken with the help of Magnus Analytics MagVision (version: x64, 4.8.15674.20191008) software.

RESULTS

***Physcomitrium eurystomum* Sendtn.,**
Denkschr. Königl.-Baier. Bot. Ges. Regensburg 3: 142. 1841.-Type: Herb. A.v.Haller, #s.n. (GOET).

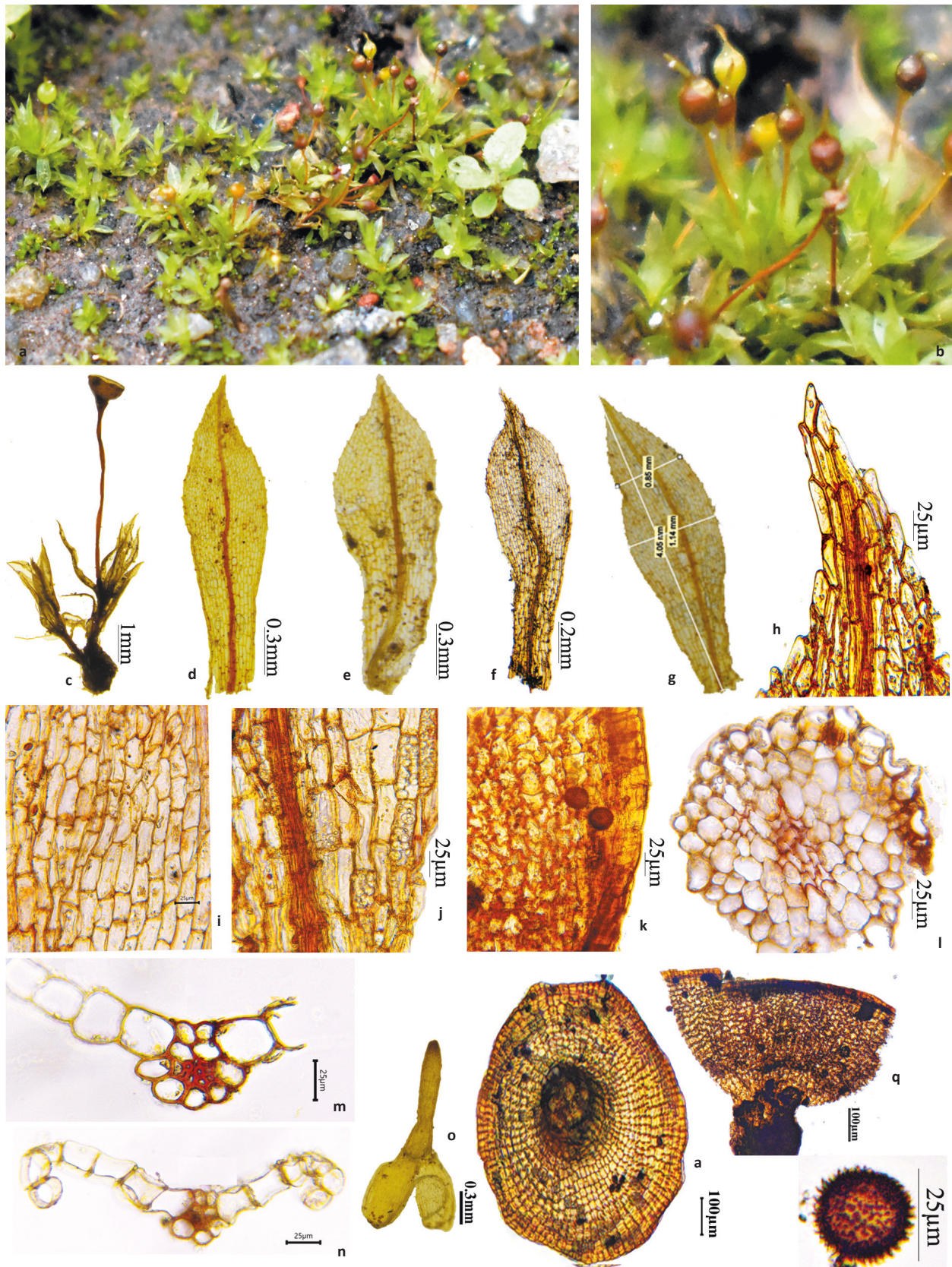


Image 1. *Physcomitrium eurystomum* Sendtn.: a&b—habit with sporophyte | c—single dry plant | d—e—leaves | f—dry leaf | g—perichaetial leaf | h—leaf apex | i—middle cells | j—basal cells | k—capsule wall | l—c.s. of the stem | m&n—c.s. of the leaf | o—calyptra | p—operculum | q—dehiscing capsule. © Authors.

Plants terrestrial, green, erect, gregarious forming small loose mats, short to medium with 3–8 mm high (with sporophyte). Stem slender, ovate in cross section, 0.21–0.25 wide, cells rounded-polygonal, uniseriate thick walled epidermis, epidermal cells 16–24 × 13–21 µm, cortex 3 or 4 layered, thin walled cells, 12–33 × 18–40 µm, medullary cells small polygonal, thin-walled, 3–9 × 8–12 µm. Leaves thin erectopatent-erect spreading, arranged in a rosette, lanceolate to spatulate, 3–5 mm long and 0.8–1.5 mm wide, leaf tip acuminate, costa dark brown, stout at the base, gradually tapers towards tip and percurrent. Laminal cells long rectangular at base, 70–85 × 15–27 µm, median cells rectangular, 20–45 × 15–25 µm, apical cells rectangular, 30–43 × 12–20 µm, marginal cells distinct with narrow elongated cells, shorten towards the tip in a single row, dentate from 1/3rd of the leaf, 35–100 × 12–16 µm. Seta slender, pale orange to dark brown, 4–6 mm long, capsule exerted, brown, short-pyriform, symmetrical, short distinct apophyses, turbinate, capsule mouth wider than urn, 1.5–2 mm long and ± 1 mm wide, peristome absent, operculum convex with wide rim, shortly rostellate, radiating rows of very short rectangular cells, calyptra papery, more or less transparent, not cucullate, caducus, covering the operculum, ±1.5 mm long, with parallel rows of thin rectangular cells, spores small, brown, globose, 24–28 µm in diameter, spinose-papillose. (Figure 1).

Specimen/s examined: India, Kerala, Idukki Dist., on the way to Mattupetty from Munnar (1,700 m), on land cuttings, Mufeed B., 195009, 1 September 2022 (CALI); Puliyanmala (1,200 m), B. Rajeevan 81007, 26 February 1984 (MH!).

Distribution: India (Northeastern India: Western Himalaya, Punjab & western Rajasthan (Gangulee 1974); Central India: Jharkhand (Saha & Singh 2020); Western Ghats (Kerala- (Rajeevan 1990 & present study)); Austria (ECCB 2016); Belarus (Maslovsky 2005); Belgium (ECCB 2016); the Czech Republic (Kučera & Váňa 2003); Estonia (Ingerpuu et al. 2018); Great Britain (Hodgetts 2011); Germany (ECCB 2016); Hungary (Papp et al. 2010), Netherlands (ECCB 2016); Slovakia (Šoltés et al. 2002); Switzerland (BAFU 2011); Bulgaria, Romania, & Turkey (Sabovljević et al. 2001); Slovenia (Martinčič 2016); Serbia (Papp et al. 2013); and Bulgaria & Slovenia (Sabovljević et al. 2008).

Splachnobryum obtusum (Brid.) Müll.Hal., Verh. K.K. Zool.-Bot. Ges. Wien 19: 504. 1869. *Weissia obtusa* Brid., Muscol. Recent. Suppl. 1: 118. 1806.-Type: Sto. Domingo, leg. Poiteau s.n., s.d. (isotype BM). *Splachnobryum indicum* Hampe & Müll.Hal., Linnaea

37: 174. 1873[1872]. *Splachnobryum flaccidum* (Harv.) Braithw., Grevillea 1(2): 28. 1872.

Plants small, 0.7–15 mm long, pale green or yellowish-green, stems simple, numerous rhizoids arise from the base. Leaves erect to spreading, 0.5–1.0 mm long and 0.3–0.5 mm wide, leaves ovate lanceolate to spatulate, upper leaves longer than the lower, apex broadly rounded or obtuse, costa ending near the apex; leaf margin plane, crenulate at apex with overlapping leaf cells. Leaf cells smooth, thin walled, upper cells shorter, nearly quadrate, 8–12 µm, lower cells long and wider, rectangular, 15–50 µm long, 10–12 µm wide, leaf cells at middle oblong-hexagonal, variable in size and orientation of cells, 28–80 µm long and 15–20 µm wide, rhizoidal tubers not observed as reported; cauline gemmae numerous of different shapes and sizes. Reproductive structures not observed (Figure 2).

Specimen/s examined: India, Kerala, Malappuram Dist., Thirurangadi, PSMO College campus (ca. 37 m) terrestrial on disturbed garden soil, 01 November 2022, K.P. Rajesh 194099c; 21 November 2022 Mufeed & Manju 194097 (CALI).

Distribution: India (Northeastern India & Kerala); Africa; Australia; Cuba; Indonesia; Jamaica; Myanmar; Mexico; Malaya; the Philippines; Papua New Guinea; Thailand; USA; West Indies; and Europe (France, Germany, Hungary, United Kingdom, & Macaronesia) (Arts 2001).

DISCUSSION

The genus *Physcomitrium* is earlier known in the Western Ghats with three well known species, viz., *P. coorgense* Broth., collected from Coorg in Karnataka, *P. immersum* Sull collected from Peechi in Kerala and *P. insigne* Dixon & P.de la Varde a southern Indian endemic species collected from Tamil Nadu. The fourth one, *P. eury stomum* was poorly known, as mentioned by Rajeevan (1990) with a single collection record from Kerala. Since then, it was not collected or recorded from the Western Ghats area by any other workers. In India over these years this species was not well recorded from earlier known areas of its occurrence. In Europe it is distributed in about 22 countries of which 15 countries assessed its status, and included in the Red List (Hodgetts et al. 2019) as VU for Europe or EN for European Union. May be due to its smaller size, and short (ephemeral) life cycle it was not recorded properly from the Western Ghats. Considering these points, it is a potential candidate species for assessing the threat

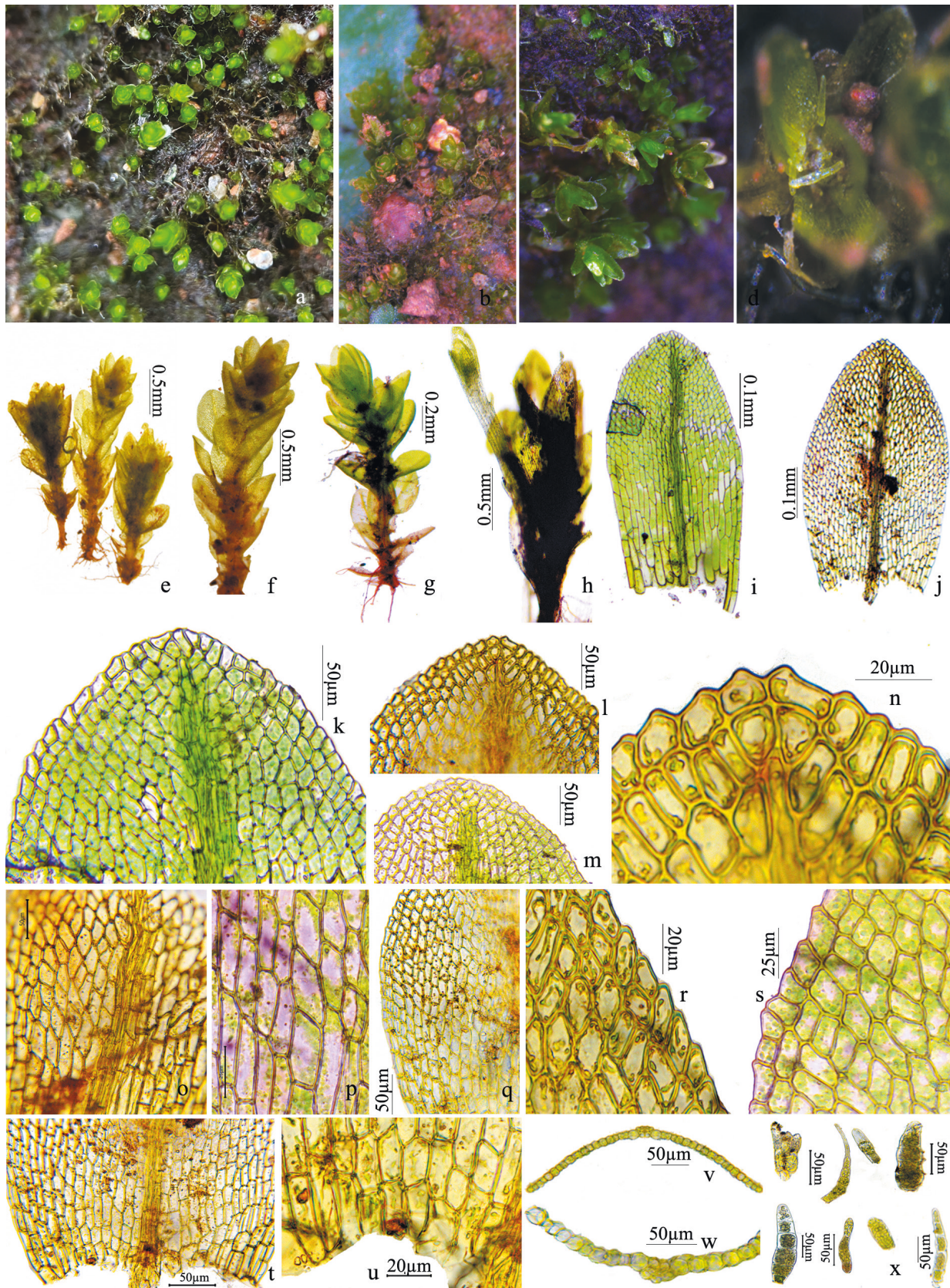


Image 2. *Splachnobryum obtusum* (Brid.) Müll.Hal.: a,b&c—habit | d—habit with gemmae | e,f&g—single habit | h—plants arise from rhizoidal tuber | i—leaves near top | j—leaves near base | k—m—leaf apex | n—leaf cells at tip | o&p—cells at middle | q—leaf marginal cells | r&s—marginal cells at mid leaf in enlarged view | t—leaf base | u—basal cells | v&w—c.s. of leaf | x—different types of gemmae. © Authors.

status in the Western Ghats region or India at large.

The members of *Splachnobryum* are also very small, usually seen in mineral rich soils (Tewari & Pant 1989). The occurrence of *S. obtusum* (Brid.) Müll.Hal. in Kerala was mentioned in some earlier checklist (Manju et al. 2008), based on Rajeevan (1990). However, it is also a poorly known species in Kerala, not collected or recorded frequently. The present record is hence significant.

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