

A SYNOPSIS OF THE FAMILY POTTIACEAE (BRYOPHYTA) OF KERALA, INDIA

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Abstract: The Pottiaceae are one of the dominant acrocarpic moss family of India with 26 genera and 130 species. The present paper is a synopsis of the family Pottiaceae in Kerala State. Here we report 18 species distributed among 13 genera such as *Anoetangium aestivum*, *A. bicolor*, *Barbula tenuirostris*, *B. indica*, *Hyophila involuta*, *H. nymaniana*, *Hymenostylium recurvirostrum*, *Hymenostomum edentulum*, *Indopottia zanderii*, *Oxystegus cylindricus*, *Pottia bryoides*, *Scopelophila cataractae*, *S. ligulata*, *Syntrichia fragilis*, *T. muralis*, *Tortella tortuosa*, *Trichostomum wayanadense* and *T. crispulum*. Among these one species viz., *Pottia bryoides* is a new record for India. *Scopelophila ligulata* is widely known as “copper moss” but this species was not recorded yet from Peninsular India. This report is then new to Peninsular India. Two species viz; *Barbula tenuirostris* Brid. and *Syntrichia fragilis* (Tayl.) Ochyra. are new records for Kerala and *Indopottia zanderii* is endemic to Western Ghats.

Introduction

Pottiaceae is one of the largest families of the acrocarpic Indian mosses. It is a highly diversified family inhabiting all climatic zones from plains to the higher altitudes. The collection of members of Pottiaceae were began with the work of Griffith (1842), who travelled widely in Assam and adjacent regions and described 4 species of Pottiaceae. In Eastern

India and adjacent regions, the family Pottiaceae are distributed with 73 species among 24 genera (Gangulee, 1969-1980). Vohra *et al.* (1982) described 14 species under 10 genera from Silent Valley National Park of Kerala. In Central India, the family Pottiaceae are represented by 8 species (Nath, *et al.*, 2011). In Nair *et al.* in 2005 Pottiaceae are represented by 10 species under nine genera from Wayanad district in Western Ghats. Among the 10 species, *Trichostomum wayanadense* is reported as new and it was endemic to Western Ghats. A checklist of bryophyte taxa reported from Kerala have been represented by Manju *et al.* in 2008. This list reports 17 taxa of Pottiaceae members to Kerala.

In India the Pottiaceae are represented by 5 subfamilies; Eucladoideae including 4 genera viz; *Anoetangium*, *Molendoa*, *Gymnostomum*, *Hymenostylium*; Trichostomoideae including 5 genera viz; *Oxystegus*, *Tortella*, *Scopelophila*, *Hymenostomum*, *Trichostomum*; Barbuloideae including 8 genera viz; *Hyophila*, *Barbula*, *Gheebia*, *Bellibarbula*, *Semibarbula*, *Prionidium*, *Bryoerythrophyllum*, *Didymodon*; Pottioideae including 4 genera viz; *Indopottia*, *Merceya*, *Weisiopsis* and *Desmatodon* and Lepidotontoideae including *Leptodontium* (Aziz & Vohra, 2008). In Kerala Pottiaceae is represented with 13 genera viz; *Scopelophila*, *Pottia*, *Anoetangium*, *Oxystegus*, *Hyophila*, *Barbula*, *Semibarbula*, *Syntrichia*, *Hymenostomum*, *Tortula*, *Hymenostylium*, *Tortella*, *Trichostomum* and *Indopottia* and by 19 species. Among these *Pottia bryoides* (Dicks.) Mitt. is a new record for India, which is collected from New Amarambalam Reserve Forest of Nilambur area. *Scopelophila ligulata* (Spruce) Spruce is widely known as “copper moss” in America. In India this species is misidentified as *Merceya ligulata*, *Scopelophila duthiei* and *Scopelophila simlaensis* which were collected from North- East India. Hence, the present report is a new record for Peninsular India. Two species viz. *Barbula tenuirostris* Brid. and *Syntrichia fragilis* (Tayl.) Ochyra. are new records for Kerala. *Oxystegus cylindricus* (Bruch. *ex* Brid.) Hilp. and *Hyophila involuta* (Hook.) A.Jaeger are widely distributed in high and low altitudes areas of Kerala. *Trichostomum wayanadense* Nair *et al.* (2005) is an endemic species of Western Ghats and *Indopottia zanderii* Daniels *et al.* (2010) is an endemic genus of Kerala. *Anoetangium bicolor* Renauld & Cardot, is found only in Western Himalayas and Kerala. *Hyophila involuta* is recorded from all districts.

The family Pottiaceae is well recognized by haplolepidous, papillose, filamentous peristome which may be erect or in some cases spirally twisted and also by quadrate papillose laminar cells (Aziz & Vohra, 2008).

They are characterized by small to large, robust to slender in dense compact to loose tufts, rarely calcicolous, green, yellowish green to yellowish-brown above, dark brown to blackish-brown below. Stem erect, sometimes procumbent or decumbent, brownish, reddish-brown to blackish brown, radiculous below, simple to branched, branches mostly sympodial. Leaves when dry crisped to curled, erect to appressed with hooked and incurved apices, when moist erect to erect spreading, densely arranged on the stem, forming a sort of rosette, linear-lanceolate to lanceolate, spatulate, obovate and ligulate.

The present study reports 18 species distributed among 13 genera in Kerala. For each species representative specimens with the following data are included as far as possible; brief description, locality, habitat, altitude, collectors name, collection number and range of the species. The following acronyms are used – MCN (Manju C. Nair), VV (Vidya, V.), KPR (K.P. Rajesh), PVM (P.V. Madhusoodanan), SEK (Shaji E.K.), WLS (Wildlife Sanctuary)

Taxonomic Observations

Key to the species of *Anoectangium*

- 1a. Costa excurrent, stem loosely covered with leaves, light greenish
A. aestivum
- 1b. Costa percurrent, stem densely covered with leaves, yellowish green
A. bicolor

Anoectangium aestivum (Hedw.) Mitt., J. Linn. Soc. Bot. 12: 175. 1869.

Plants yellowish green, occur as dense tufts, dark brown at base, stem erect, 9 mm-1.1 cm long, margin serrate, costa prominent ends where the leaf tip ends, slightly excurrent tip, 0.57-0.60 mm long, 0.09-0.12 mm wide; leaf tip cells are thickly packed, papillose, hexagonal 7.5 µm; leaf middle cells are thickly packed, papillose, hexagonal; leaf basal are papillose, hexagonal, loosely packed, 10 x 3.5 µm; cells at costal region elongated, rectangular, papillose, loosely arranged; cells at marginal region small hexagonal, papillose, arranged thickly (Fig. 1 A-F).

Habitat & Distribution: On rocks and on earth banks. Distributed in India (Kerala) China, Japan, Philippines, New Zealand, Europe and North and South America.

Specimen examined : India, Kerala, Munnar (1200 m) *MCN 87276* (CALI).

Anoetangium bicolor Renauld & Cardot, Bull. Soc. Bot. Belgium 14(1): 19. 1905.

Plants yellowish-green, seen in dense tufts, stem branched, 0.6-1 cm long, densely covered with leaves, leaf lanceolate, yellowish-green above, reddish brown below, 2-4 mm long, 0.21-0.23mm wide; costa strong, percurrent, margin serrated, apex acute, cells upto 1.2 x 0.3 μm , basal cells rectangular, smooth, 40 x 8 μm , shorter and slightly papillose near margin (Fig. 1. G-J).

Habitat & Distribution: On earth banks in Tea estate. This species is recorded only from the Western Himalayas and Kerala only.

Specimen examined: India, Kerala, Wayanad, Chembra estate (1060m) *MCN 120239* (CALI).

Key to the species of *Barbula*

- 1a. Leaves ovate to spatulate, costa light yellow, leaf tip cells irregularly shaped *B. indica*
- 1b. Leaves lanceolate, costa light greenish, leaf tip cells hexagonal *B. tenuirostris*

Barbula indica (Hook.) Spreng., Syst. Veg. 2: 72. 1824.

Syn.: *Semibarbula orientalis* (F.Weber) Wilk & Margad., Taxon 8(2): 75. 1959.

Plants pale greenish, seen in dense tufts, stem branched, 0.9-1.3 cm long; leaves ovate–spatulate with serrated margin, 0.1-0.2 mm long and 0.26-0.28 mm wide, slightly excurrent midrib, costa strong, light greenish; leaf tip cells irregularly shaped, thickly arranged, papillose 5-8 μm ; leaf middle cells round, thickly packed, papillose; leaf basal cells are polygonal cells, thickly packed, smooth, 25 x 10 μm ; leaf cells at costal region are small rectangular, smooth, thickly arranged; leaf cells at margin are elongated rectangular cell, smooth, hyaline, thickly arranged (Fig. 2. A-I; Fig. 12 A&B).

Habitat & Distribution: It is found almost everywhere, on roadsides, earth banks, rock crevices, moist bricks, rotten logs and on concrete walls in moist deciduous forests. . Found on soil along with *Cheilolejeunea*, *Cyathodium* and *Lopholejeunea subfusca*. In India this species is distributed only in Kerala, South India (Kerala), North east India (Darjeeling, Arunachal Pradesh, Bengal, Orissa),

Sri Lanka, China, Japan, Korea, Nepal, New Guinea, Pakistan, Myanmar, Celebes, Taiwan, Malaysia, Siam, Papua New Guinea, Philippines, Colombia, Mexico, Africa and America, rare in Europe. **Specimen examined:** Kasaragod, Parappa (30 m) *KPR 87007* (CALI) Kerala, Kozhikode, Peruvannamuzhi, (50m), Deepa 4725 (ZGC, CALI); VV 938 (ZGC); Wayanad, Kurichiad Range (858 m) MCN 84653, Tholpetty range (860 m) MCN 84591, Begur (850 m) MCN 84586 (CALI).

Barbula tenuirostris Brid., Bryol. Univ. 1: 826. 1827.

Plant yellowish green, seen in dense tufts, branched, 6-8 mm long, leaves lanceolate, 1-2 mm long, 0.14-0.16 mm wide, light greenish, costa brownish, prominent, excurrent, margin wavy; leaf tip cells thickly arranged, hexagonal cells, papillose 7-8 μm ; leaf middle cells thickly arranged, papillose, hexagonal cells; leaf basal cells thickly arranged, rectangular, papillose, 11-35 x 5-11 μm ; cells at costal region elongated, loosely arranged, rectangular; smooth cells at marginal region rectangular, not elongated, loosely arranged, smooth (Fig. 2. J-R).

Habitat & Distribution: On earth banks. A widely distributed species in India (Western Himalaya, Plains of Uttarpradesh, Madhya Pradesh, Bihar, West-Bengal Plains, Darjeeling, Arunachal Pradesh, Tamil Nadu), East Nepal, Sri Lanka, Myanmar, China, Japan, Thailand, Vietnam, Malaysia, Java, Singapore, New Guinea, Philippines, Taiwan.

Specimen/s examined: Malappuram, Vazhayur (20 m) *Ganga 106414* (CALI); VV 926 (ZGC).

Note: The present collection is a new record for Kerala.

Key to the species of *Hyophila*

- 1a. Costa percurrent, leaves lingulate to spathulate, leaf base wider
H. involuta
- 1b. Costa excurrent, leaves ovate to lanceolate, leaf base narrow
H. nymaniana

Hyophila involuta (Hook.) A. Jaeger, Ber. Senckenberg. Naturf. Ges. 1871-72: 356. 1873.

Plants yellowish green, erect, simple or branched, 4-6 mm long, upper leaves spreading in rosettes, leaves erect spreading, ligulate to

spathulate; upto 2 mm long, 0.22-0.33 mm wide; costa prominent, strong, ends at the leaf tip. Leaf marginal cell serrated at the tip, apex broadly pointed, wider at base. Leaf tip cells small, hexagonal, papillose cells, 6-10 μm ; middle cells thickly packed, small, hexagonal with papillose cells; basal cells elongated and smooth, colourless; leaf cell near costa region large and elongated; leaf cell marginal region densely arranged and elongated with papillose cells. Sporophyte on main stem, 1-1.5 cm long, seta long, 7-10 mm; capsule cylindrical, 1-2 mm long (Fig. 3. A-N; Fig. 12 D&E).

Habitat & Distribution: It is seen in a variety of habitats such as on soil, rocks, logs, crevices of rocks, walls etc. from low to high altitudes. It is also found on termite mount. It is a widely distributed species from lower to high altitudes. Africa, Asia [China, India: Andaman and Nicobar Islands; central India (Achanakmar – Amarkantak Biosphere Reserve, Gujarat, Mt. Abu, PBR); eastern Himalaya (Arunachal Pradesh, Assam, Darjeeling, Meghalaya, W Bengal, Sikkim); Punjab and west Rajasthan Plains (Rajasthan); Gangetic plains (Bengal Plains, Jharkhand, Uttar Pradesh); S India (Karnataka, Tamil Nadu, Kerala); western Himalaya (Himachal Pradesh, Uttarakhand), Indonesia, Japan, Jordan, Malaysia, Mali, Oman, Philippines, Sri Lanka, Taiwan, Thailand], Europe, North America, Oceania, South America. A widely distributes species on earth.

Specimen/s examined: India, Kerala, Calicut, Mananjira, (msl) *MCN 76073*, Naduvannur, Malappuram (30 m), *Ganga 106360* (ZGC); C.U. Campus, Malappuram (40 m) *SEK 99242*; Chelari, Malappuram (40 m) *PVM 106352*, Ozhuvathadam, Idukki (1300 m) *Shaji 120587*, Thattekkad, Kottayam (msl) *KPR 106488*, Thalassery (150 m) *PVM 84697a*, Ambalappara, Kannur (1100 m) *KPR 99785*, Kumarakam (msl) *KPR 120386*, Aralam WLS, Kannur (250 m) *KPR 106684*, Hairpin area, Wayanad (700 m) *MCN 80084*, Soochippara, Wayand (760 m) *MCN 87080*, Sulthan Bathery, Wayanad (929 m) *MCN 84362*, MG University Campus, Kottayam (40m) *KPR 120381*, Sabarimala, Pathanamthitta (600 m) *SEK 120683* (CALI); Kozhikode, Arts College Campus, (sea level) *VV 921*; ZGC Campus (40 m) *VV 941* (ZGC), Kakkavayal (100 m) *VV 924* (ZGC); Malappuram, University Campus (40 m) *VV 925*; Olavanna (sea level) *VV 937*; ZGC Campus (40 m) *VV 938* (ZGC); Ernakulam, Kombara (sea level) *VV 923,924* (ZGC).

Note: This is a widely distributed species on the earth. The misidentification of several species into various names have synonymised by various authors.

Hyophila nymaniana (M.Fleisch.) Menzel, Willdenowia 22: 198. 1992.

Plant yellowish green, simple, seen in dense tufts, 1.3-1.6 cm long; leaves ovate-lanceolate, narrower base, margin wavy; strong costa, brownish, excurrent tip, leaf 2-8 mm long, 0.74-0.77 mm wide; leaf tip cells are thickly arranged, hexagonal papillose; leaf middle cells thickly arranged, papillose, hexagonal 5-8 μm ; leaf basal cells elongated, rectangular, papillose; 20 x 10 μm ; at the excurrent tip 7 cells are present, leaf cell at costal region elongated, rectangular; leaf cell at the margin small, thickly packed, hexagonal, papillose; sporophyte 1.7-1.8 cm long, seta long, 1.5-1.6 cm, capsule 2-3 mm long; spores light brownish, round, thin walled, 4 μm in diameter (Fig. 4. A-J; Fig. 12 F).

Habitat & Distribution: On earth cuttings and cement walls in moist deciduous forests and in homestead areas. Africa, Asia [China, India: central India (Orissa, Achanakmar – Amarkantak Biosphere Reserve, Gujarat, PBR); Gangetic plains (Uttar Pradesh, Orissa); S India (Kerala, Wayanad, Idukki; Tamil Nadu: Palni Hills; Karnataka); Western Himalaya (Uttarakhand), Indonesia, Philippines, Thailand], North America.

Specimens examined: Pathanamthitta, Sabarimala (600 m) SEK 120683; Wayanad, Kurichiad range (858 m) MCN 84550, Dottapalam (816 m) MCN 84528b (CALI).

Hymenostomum edentulum (Mitt.) Besch., Bull. Soc. Bot. Fr. 34: 95. 1887.

Plant yellowish green, forming dense mats on soil; stem simple or branched, branches erect, 2-5 mm long, densely covered with leaves, leaves lanceolate, apex narrow pointed, upto 2 mm long, margin serrated, costa prominent, excurrent; cell at base yellowish, smooth, upto 10 x 20 μm near costa, shorter towards margin, upper cells rounded, papillose, upto 9 μm wide, densely papillose; at the excurrent portion 8 cells are present; sporophyte upto 4 mm long, seta erect, upto 3 mm long, capsule erect, upto 1 mm long (Fig. 12 C).

Habitat & Distribution: On earth banks. This is an Indo-Pacific species found distributed in South India (Nilgiri hills, Palni hills, Madras,

Chembra hills), Andaman & Nicobar Islands, Sri Lanka, China, North Vietnam, Taiwan, Java, Philippines and New Caledonia.

Specimen examined: India, Kerala, Chinnar WLS, Palaputty (1500 m) *MCN 87288* (CALI).

Hymenostylium recurvirostrum (Hedw.) Dixon, Rev. Bryol. Lichenol. 6: 96. 1933.

Plants yellowish green, seen in dense tufts, up to 3 mm long, leaves curled when dry, linear lanceolate, base broad, leaf 2 mm long, 0.24-0.26 mm wide, margin wavy, apex acute, costa prominent, strong, ends before leaf tip, cells at the tip of the leaf thickly arranged, papillose, rounded; cells at the middle of leaf loosely arranged, papillose, rounded, 6-8 μm ; leaf basal cells rectangular, elongated, smooth, loosely arranged; leaf cell at the costal region elongated rectangular cells, smooth, 40 x 15-20 μm leaf cell present at marginal region hexagonal, smooth, 20 x 10-30 μm ; seta long, erect, 6-8 mm. Capsule erect, dark brown 1 mm, spores long, globose, dark brownish, 5-7 μm in diameter (Fig. 5 A-H).

Habitat & Distribution: On rocky patches in semi-evergreen forests. It is distributed in Kerala, North-east India (Western Himalaya, Kashmir, Kumaon, Khasi hills, Kangra, Ladakh, Mussoorie, Sikkim), Temperate Eurasia, Myanmar, New Zealand, New Guinea, Philippines, Pakistan and Western Tibet. **Specimen examined:** Wayanad, Soochippara (767 m) *MCN 87084* (CALI).

Oxystegus cylindricus (Bruch. ex Brid.) Hilp., Beih. Bot. Centralbl. 50: 620. 1933.

Plants yellowish green, in loose tufts; stem dark, slender, 6-8 mm long, leaves fragile, spreading, elongate, lanceolate, 2-3 mm long, 0.37-0.47 mm wide, yellowish, costa prominent, ends before tip, margin smooth, leaf base broad; cells at tip slightly elongated, rounded, papillose, middle cells small, hexagonal papillose, small intercellular spaces, basal cells elongated, smooth, rectangular 20-25 x 4-6 μm ; leaf cell at the costal region large, elongated, not papillose; basal marginal cells densely arranged, rectangular, smooth; sporophyte 7-10 mm, seta long, 5-6 mm, capsule 2-3 mm long, spores rounded ca. 1.1 μm , in diameter, light brownish (Fig. 5. I-T; Fig. 12 G).

Habitat: On small rocky patches in semi-evergreen forests and grassland.

Distribution: Temperate Eurasia. This species is common at high altitudes. It is distributed in Kerala, North-east India (Darjeeling, Naga hills, Khasi hills, Sikkim), Nepal.

Specimen/s examined: Kannur, Aralam WLS, Ambalappara (1450 m) *KPR 99764*; Soochippara (760 m) *MCN 87091*, Manikkunnumala, Near MSSRF (960 m) *MCN 120299* (CALI).

Pottia bryoides (Dicks.) Mitt., Ann. Mag. Nat. Hist., ser. 2, 8: 311. 1851.

Plant light yellowish, seen in dense tufts, 3-5 mm long, branching simple; leaf lingulate-lanceolate, margin entire, costa prominent, excurrent, apex hair pointed, upto 1.4 mm long, 46-48 μm wide, leaf tip cells quadrangular, papillose, arranged with intercellular spaces, 8-9 x 4-5 μm , leaf middle cells rectangular, papillose, thick walled, 10-13 x 6-9 μm , leaf basal cells rectangular, transparent, smooth, 16-20 x 6-9 μm . Sporophyte at the tip of gametophyte, seta short, 4-6 mm long, capsule globose, erect, spores numerous (Fig. 6 A-G; Fig. 12 H).

Habitat: On earth banks.

Distribution: India (Kerala); Southern Europe, Kazakhstan, United States (Arizona, Colorado).

Specimen Examined: Malappuram, Nilambur, New Amarambalam Reserve Forest (1100 m) *KPR 109007* (CALI).

Note: Earlier only one species of *Pottia* was known from India viz., *Pottia watsonii* R.S.Chopra, collected from Palni hills. The present collection of *Pottia bryoides* is the first record of the species from India and the genus is the first addition to Kerala.

Key to the species of *Scopelophila*

1a. Plants up to 1 mm long, leaves lanceolate, cells near costa hexagonal with slightly large intercellular spaces

S. cataractae

1b. Plant 3-4 mm long, leaves cauline, cells near costa elongated without intercellular spaces

S. ligulata

Scopelophila cataractae (Mitt.) Broth., Engl. & Prantl, Nat. Pflanzenfam 1(3): 436. 1902.

Plants yellowish green, seen in loose tufts, up to 1 mm long, about 5-6 leaves in a single plant, leaves lanceolate, margin entire, costa narrow, percurrent, leaf 0.7-0.8 mm long, 0.11-0.14 mm wide, acute to short-acuminate, smooth; lower leaves smaller; leaf tip cells hexagonal, papillose; leaf middle cells hexagonal, thickly packed, not papillose; leaf basal cells hexagonal, with inter cellular spaces, smooth; 10 x 5 µm; upper cells 3-5 µm diagonally; cells near costa hexagonal with slightly large intercellular spaces, smooth; marginal cells rectangular, smooth. Sporophyte not observed (Fig. 13 A).

Habitat: Seen in sandy soil near riverine areas, mostly in mineral rich areas in semi-evergreen forests.

Specimen examined: India, Kerala, Wayanad, Chandanathode (900 m) *MCN 80112* (CALI).

Distribution: It is widely distributed in the warmer parts of all continents as North, Central & South America, Africa, Asia through to China and probably introduced to atlantic Europe. In India, it is distributed in North India (Nainital, Kumaon Himalaya), Kerala (Wayanad).

Scopelophila ligulata (Spruce) Spruce, J. Bot. 19: 14. 1881.

Plant small, yellowish green, with sparse brown rhizoids, 3-4 mm long, leaves cauline, 2-3 mm long, 62-64 µm wide, costa percurrent, brownish black proximally, possibly associated with iron in the soil; margins usually bordered by thick-walled cells; apex obtuse to acute; leaf tip cells and middle cells small, hexagonal, thickly packed, upto 3 µm in diameter, papillose, leaf basal cells elongated rectangular, often extending beyond mid leaf, smooth, 16-19 x 2-3 µm; cells near costa elongated without intercellular spaces, costa with 1 layer of parenchymatous cells adaxial to the stereid band, distal lamina cells isodiametric (Fig. 8 A-F).

Habitat: On sandy soil and rock near river.

Distribution: Almost cosmopolitan species. India (Western Himalayas, Darjeeling as *Merceya ligulata*, China, Nepal, Japan, Costa Rica, Japan, Mexico, Papua New Guinea, Philippines, United States, Guatemala, Ecuador, Bolivia, Europe in the Alps and Pyrenees, Taiwan, Thailand.

Specimen examined: Malappuram, Nilambur, New Amarambalam Reserve Forest (1200 m) *KPR 109006* (CALI, ZGC).

Note: This is a widely known “copper moss” in America (Shaw & Anderson, 1988). In India this species is misidentified as *Merceya ligulata*, *Scopelophila duthiei* and *Scopelophila simlaensis* (Bruehl, 1932). The present report is a new record for Peninsular India.

Syntrichia fragilis (Tayl.) Ochyra., *Fragm. Florist. Geobot.* 37: 212. 1992.

Syn.: *Tortula schmidii* (C.Mueller) Borth., *Nat. Pflanzenfam.* 1(3): 434. 1902.

Plants dark brownish, occur in dense tufts, stem erect, 2.5-3 cm long, lower portion covered with dark brownish rhizoids, leaf dark brownish, costa prominent, excurrent, margin entire, 4-5 mm long, 0.7-0.8 mm wide, leaf tip cells thickly arranged, hexagonal, papillose, 8-11 μm ; leaf middle cells thickly arranged, hexagonal, papillose; leaf basal cells elongated quadrangular cells, smooth, 41-70 x 14 μm ; cells at the costal region are large elongated cells, smooth; cells at the margin are small elongated, not papillose (Fig. 9 A-G; Fig. 13 C).

Habitat: On rocky patches.

Specimen examined: India, Kerala, Parambikulam Tiger Reserve (1400 m) *MCN 106726* (CALI); Kozhikode, Vilangad – Nadapuram (40 m) *MCN 99674* (CALI)..

Distribution: India (Tamil Nadu, Karnataka, Kerala), China, Central & Western Asia, all over Africa, rare in Europe, sothern part of North America, Bolivia, Chile, Columbia and Argentina.

Note: The present collections are new records for Kerala.

Key to the species of *Trichostomum*

1a. Costa excurrent, leaf margin slightly wavy, leaves crowded

T. wayanadense

1b. Costa percurrent, leaf margin smooth, leaves loosely arranged

T. crispulum

Trichostomum crispulum Bruch., *Flora* 12: 395. 4. 1829.

Plants yellowish green, seen in dense tufts, brown at the base, 1.2-1.5 cm long, pale yellowish, slightly rolled at the tip, lanceolate, midrib prominent, ends before the tip, margin entire, 1-2 mm long,

0.2-0.3 mm wide, leaf tip cells thickly arranged, polygonal, papillose 6-8 μm ; leaf middle cells thickly packed, polygonal, papillose; leaf basal cells elongated, with large intercellular spaces, smooth, 24-26 x 11-13 μm ; cells near costal-region elongated, with large intercellular spaces, smooth, hyaline, cells at marginal region elongated with intercellular spaces, not papillose (Fig. 10 A-I).

Trichostomum wayanadense Manju, Rajesh & Madhus. Bryo. Wayanad. W. Ghats. 119-2005.

Plants yellowish green, seen in dense tufts, 5-7 mm long; leaves crowded, narrow, lanceolate, margin slightly wavy; costa strong, slightly excurrent, 0.19-0.3 mm long, 0.47-0.59 mm wide; base of leaf achlorophyllous, cells at upper part irregularly rounded to hexagonal, papillose, chlorophyllous, up to 10-12 x 7-10 μm ; middle cells are quadrate thickly packed, papillose; basal cells elongated, rectangular, smooth, 43-48 x 10-15 μm , leaf base slightly bulged; cells near costa broad and elongate, 62-68 x 20-25 μm ; marginal cells elongate (Fig. 10 J-N; Fig. 13 E).

Habitat: On logs in moist deciduous forest.

Specimen examined: India, Kerala, Wayanad, Ponkuzhi (903 m) MCN 84373 (CALI).

Distribution: Endemic to Western Ghats.

Note: Nair *et al.* (2005) described this species from Wayanad district as new to science.

Tortula muralis Hedw., Sp. Musc. Frond. 123. 1801.

Plants yellowish green, small, stem erect, brownish, 3-5 cm long; leaf lanceolate, 2-3 mm long, 0.3-0.4 mm wide, light green coloured; costa prominent, yellowish brown, costa extended beyond the leaf tip, margin entire, margin yellowish brown; cells at the leaf tip are small, rounded, papillose, 6-8 μm , cells at the leaf middle are round, thickly arranged, papillose; leaf basal cells elongated, quadrate, smooth, 27-32 x 8-11 μm ; cells at costal region large, elongate, smooth, hyaline; basal cells at marginal region small, elongated, smooth; sporophyte 1-1.6 cm long, seta long, 0.7-1.3 cm long, capsule brownish-red, 3-4 mm long; spore light brownish, double layered, rounded, 3-4 μm in diameter (Fig. 11 A-I; Fig. 13 D).

Habitat: On rocks.

Specimen examined: India, Kerala, Palakkad, Parambikulam (1400 m) MCN 106722 (CALI).

Distribution: India, Kerala (Palakkad; Parambikulam Tiger Reserve), North-east India (Sikkim, Garhwal, Kulu), central Asia, Caucasus, Europe and North America.

Note: Manju & Rajesh (2011) reported this species as new record for Peninsular India.

Tortella tortuosa (Hedw.) Limpr., Laubm. Deutschl., 1: 604. 1888.

Plant yellowish green in colour, seen in dense tufts, stem erect, 6-8 mm long; leaves curved, lanceolate, narrow, broad at base, light brown costa, prominent, excurrent, at the excurrent portion 9 cells are present, leaf margin crenulate at apex, leaf upto 5 mm long, 0.28-0.42 mm wide, leaf tip cells are rounded to quadrate, upto 8 μ m, thickly packed, papillose cells; basal cells elongate, rectangular, 45-54 x 6-8 μ m, thin walled, hyaline (Fig. 8 G-K).

Habitat: On tree trunk.

Specimen examined: Trivandrum, Chemunji (814 m) *Stephen Sequeria 106316 a* (CALI).

Distribution : India (Kerala, Tami Nadu, Kashmir, Uttarakhand), East Nepal, China, Japan, North America, Europe, Caucasus, Algeria, Morocco, Iran.

Indopotia zanderi A.E.D. Daniels, R.D.A. Raja & P. Daniel, J. Bryol. (2010) 32: 216-219.

Plants forming mats, not glossy, golden brown to brown. Stems decumbent, simple, rarely branched, 5–15 mm long, with scale leaves and rhizoids in lower side. Leaves dense, without much change when dry, obovate or lingulate, 1–2 x 0.3–0.5 mm, characteristically folded at apex; margins plane without border, flat, entire, often undulate, irregularly toothed at apex; costa ending a little below apex. Laminal cells weakly convex on both surfaces, epapillate, irregularly rounded-quadrate above, 8–16 x 6–12 μ m, irregularly elongate-rectangular below, 48–92 x 8–32 μ m; Sexual condition autoicous. Perigonia terminal, bud-like. Perichaetia terminal, similar to vegetative leaves, 2.5–3.0 x 0.5–0.8 mm. Sporophytes terminal, in pairs, rarely single. Setae short, 0.3–0.7 mm long. Capsules mostly declinate, dark brown; theca 0.8–1.2 x 0.3–0.5 mm, ovoid, operculum long-rostrate, 0.9–1.1 mm long, peristome absent, spores globose, 30–36 μ m, papillose, dark orange-brown.

Habitat: Lignicolous, in association with *Syrrhopodon spiculosus* Hook. & Grev. and corticolous, in moist evergreen forests, 980–1070 m.
Distribution: W. Ghats, Kerala, Silent Valley National Park.
Note: Description based on the original author.

Discussion

Pottiaceae is an acrocarpic moss family widely distributed in almost all the microhabitats and ranges from low to high altitude areas. They are well adapted to varying climatic conditions. Within the eight bryogeographical zones of the country the Pottiaceae is the most abundant family. In Western Ghats the dominant genera are *Anoetangium*, *Barbula* and *Hyophila*. The central Indian region is dominated by genera like *Weissia*, *Barbula*, *Hyophila* and *Anoetangium*, about 22 species of Pottiaceae have been reported to occur from the various localities there (Chaudhary et al. 2006, Chaudhary and Sharma 2007, Nath and Gupta 2007, 2008, Aziz and Vohra 2008, Nath and Bansal 2009). Among the different taxa the most widely distributed species are *Barbula indica*, *Hyophila nymaniana* and *Hyophila involuta*, which are found in all the bryogeographical zones of India. The frequency of occurrence of Pottiaceae members are wider than other acrocarpic moss families such as Fissidentaceae, Bryaceae and Dicranaceae. The genus *Hyophila* Brid. has emerged as the most frequent one among the 14 genera investigated during present study.

From Kerala 18 species of Pottiaceae members are described among 13 genera such as *Anoetangium aestivum*, *A. bicolor*, *Barbula tenuirostris*, *B. indica*, *Hyophila involuta*, *H. nymaniana*, *Hymenostylium recurvirostrum*, *Hymenostomum edentulum*, *Indopottia zanderii*, *Oxystegus cylindricus*, *Pottia bryoides*, *Syntrichia fragilis*, *Scopelophila cataractae*, *S. ligulata*, *T. muralis*, *Tortella tortuosa*, *Trichostomum wayanadense* and *T. crispulum*. Among these one species viz., *Pottia bryoides* is a new record for India. *Scopelophila cataractae* and *Scopelophila ligulata* are widely known as “copper moss” in Northern Indian region, but *S. ligulata* is not recorded from Peninsular India. This report forms a new record of occurrence to Peninsular India. Two species viz; *Barbula tenuirostris* Brid. and *Syntrichia fragilis* (Tayl.) Ochyra. are new records for Kerala and *Indopottia zanderii* which is described here based on the original description is an endemic to genus to Western Ghats.

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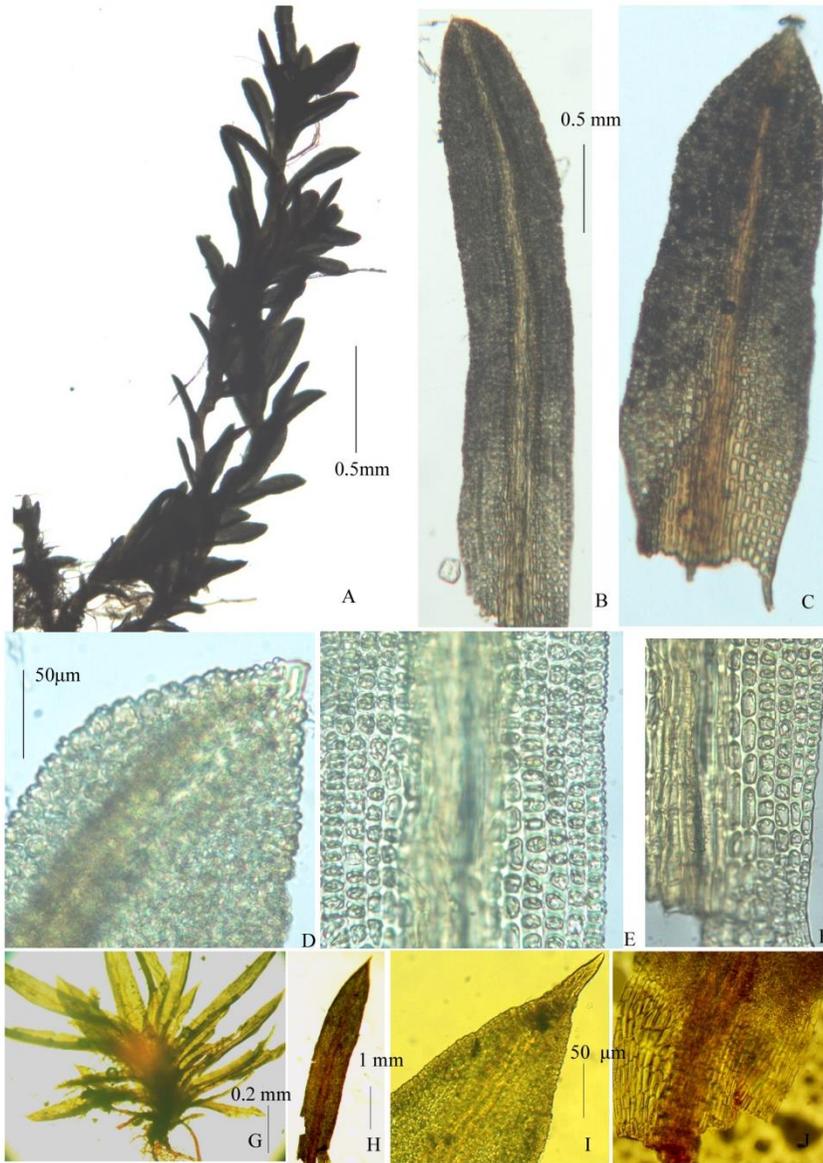


Fig. 1 A-F. *Anoetangium aestivum* A. Dry habit, B&C. Leaf, D. Leaf tip cells, E. Leaf middle cells, F. Leaf basal cells ; G-J. *Anoetangium bicolor*, G. Habit, H. Leaf, I. Leaf tip, J. Leaf base (B&C, D&F, I&J same size)

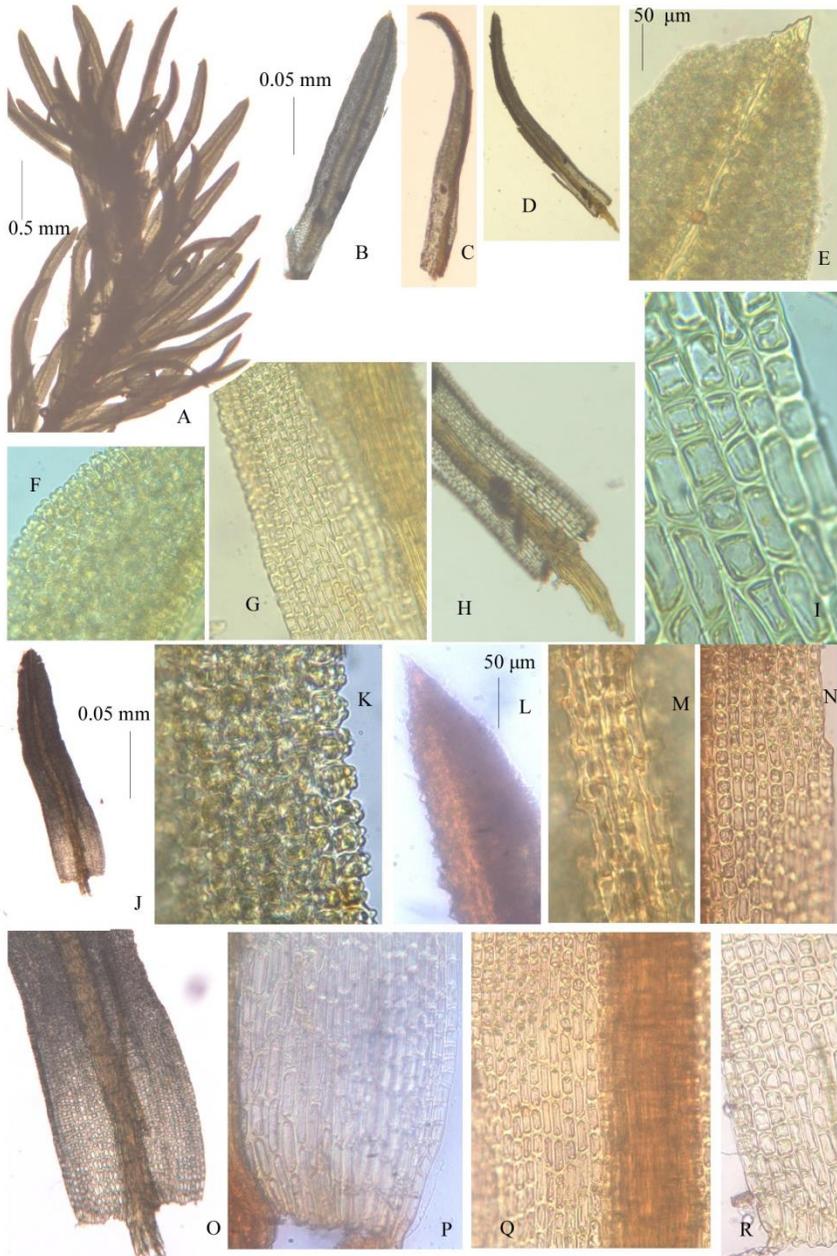


Fig. 2 A-I. *Barbula indica*, A. Habit, B-D. Leaf, E. Leaf tip, F. Leaf tip marginal cells, G. Leaf middle cells, H. Leaf base, I. Leaf basal cells; J-R. *Barbula tenuirostris*, J. Leaf, K. Leaf tip marginal cells, L. Leaf tip, M. Costa, N. Middle marginal cells, O. Leaf base, P-R. Basal cells (B-D, E-I, K-R same size)

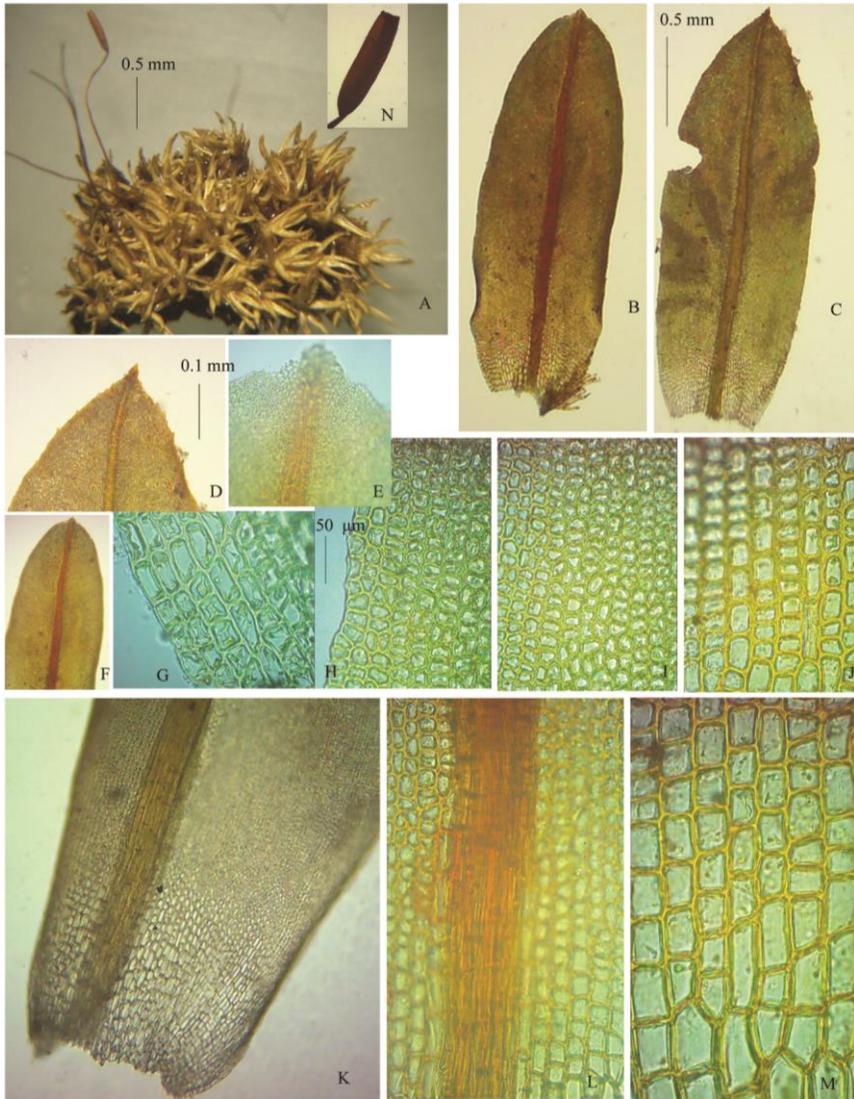


Fig. 3 A-N. *Hyophila involuta*, A. Dry habit, B&C Leaf, D-F. Leaf tip, G&H. Marginal cells, I. Leaf tip cells, J. Above basal cells, K. Basal region, L. Cells near costa, M. Basal cells, N. Capsule (B-C, D-F, G-M same size)



Fig. 4. A-J. *Hyophila nymaniana*, A7B. Leaf, C. Leaf tip, D. Leaf base, E&F. Leaf tip cells, G. Middle marginal cells, H-J. Basal marginal cells (A-D & E-J same size)

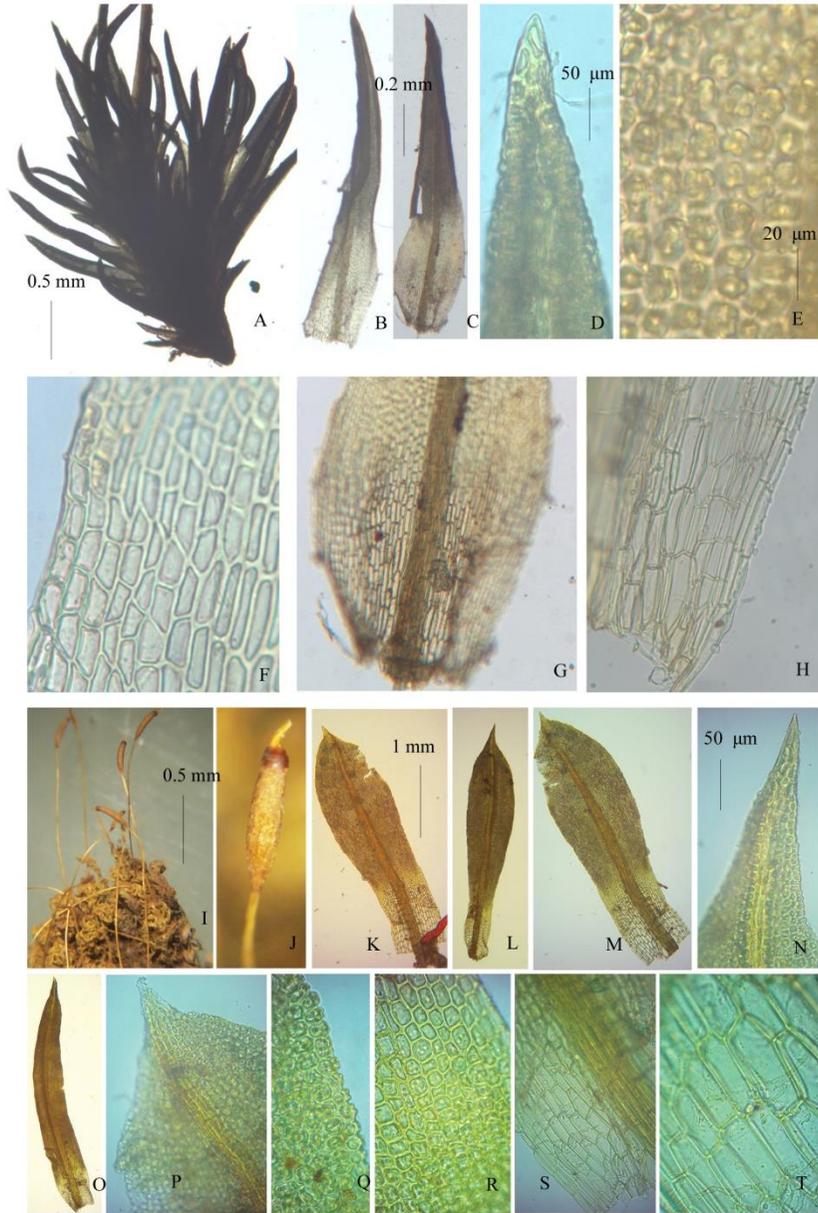


Fig. 5 A-H. *Hymenostylium recurvirostre*, A. Habit, B&C. Leaves, D. Leaf tip, E. Leaf tip cells, F. Leaf basal marginal cells, G. Basal leaf portion, H. Leaf basal cells; I-T. *Oxystegus cylindricus*, I. Habit, J. Capsule, K-M, O. Leaves, N, P. Leaf tip, Q. Leaf margin at tip, R. Middle leaf cells, S&T. Basal cells (B-D, E-H, K-M&O, N, P-T same size)

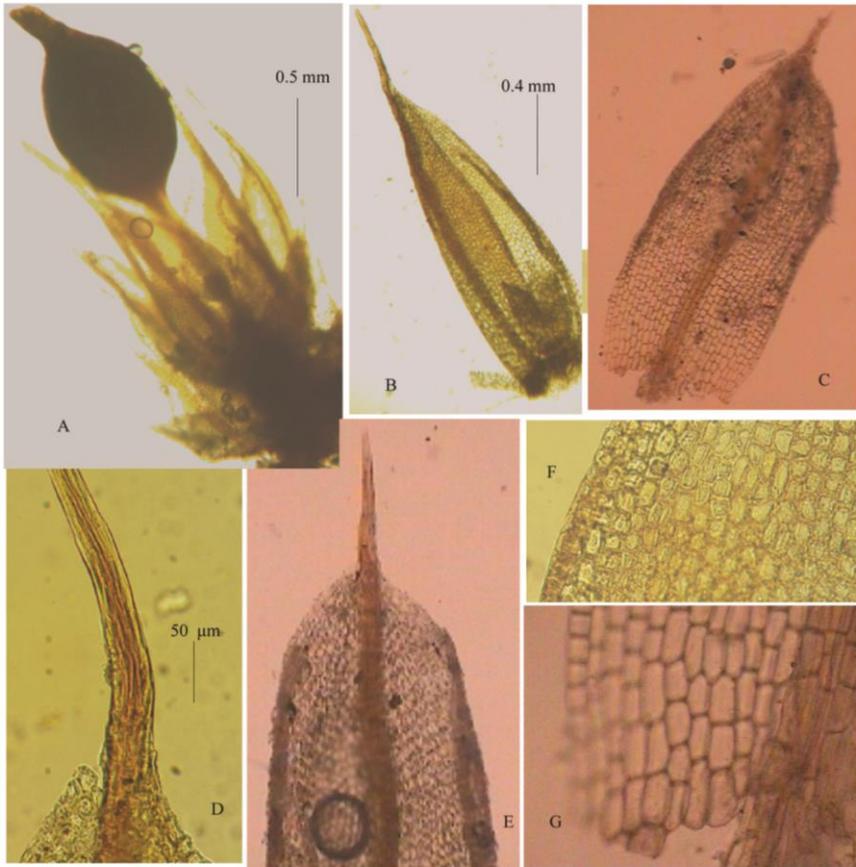


Fig. 6 A-G. *Pottia bryoides*, A. Habit with capsule, B&C. Leaves, D. Excurrent costa, E. Leaf tip, F. Marginal cells, G. Basal cells (D-G same size)

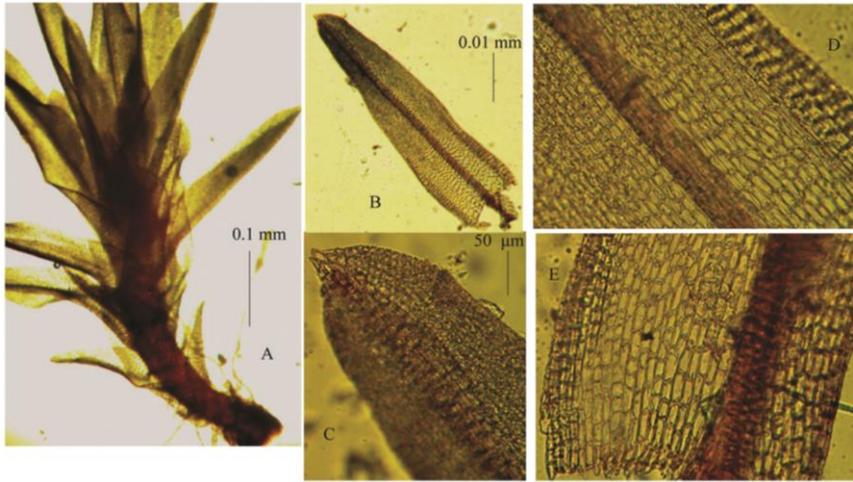


Fig. 7. A-E. *Semibarbula orientalis*, A-Habit, B. Leaf, C. Leaf tip cells, D. Leaf middle cells, E. Leaf basal cells (C-E same size).

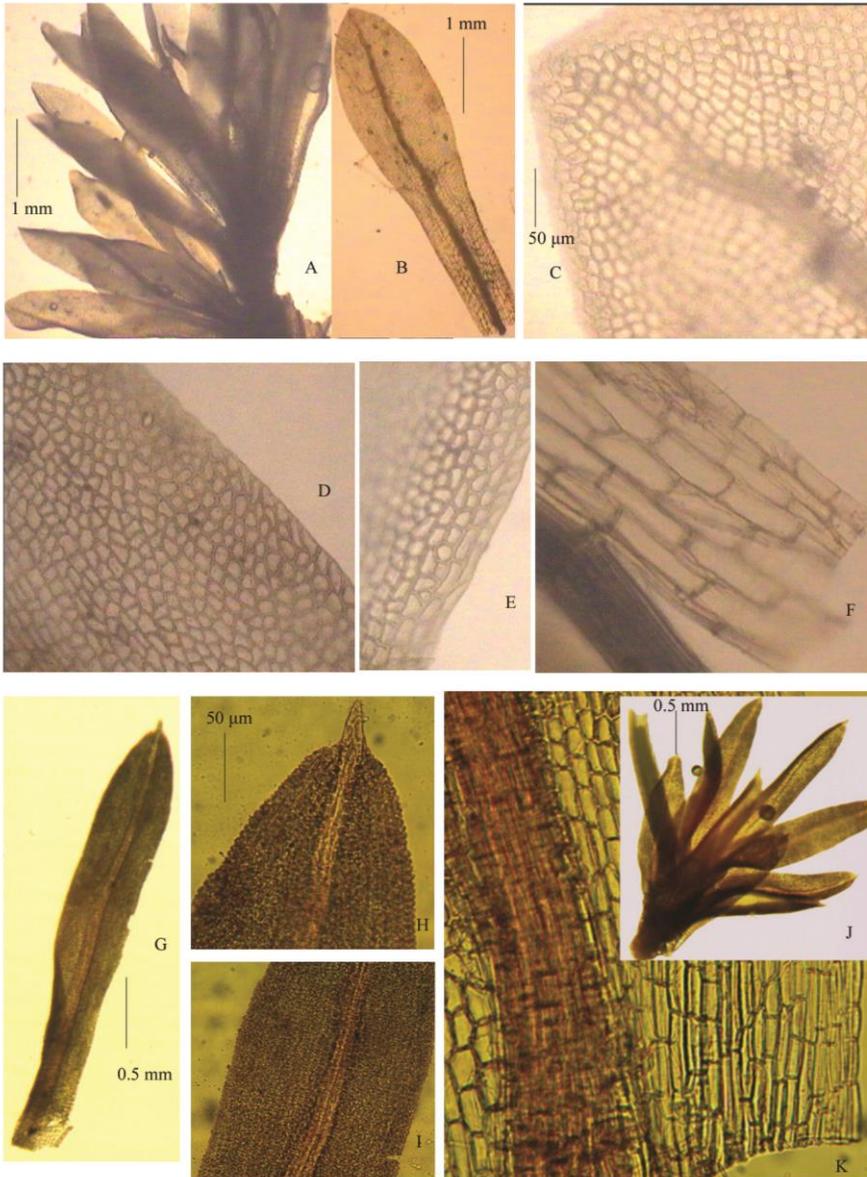


Fig. 8. A-F. *Scopelophila ligulata*, A. Habit, B. Leaf, C. Leaf tip, D. Leaf marginal cells at tip, E. Leaf margin above base, F. Leaf basal cells; G-K. *Tortella tortuosa*, G. Leaf, H. Leaf tip, I. Leaf middle cells, J. Habit, K. Leaf basal cells (C-F, H-I, K same size).

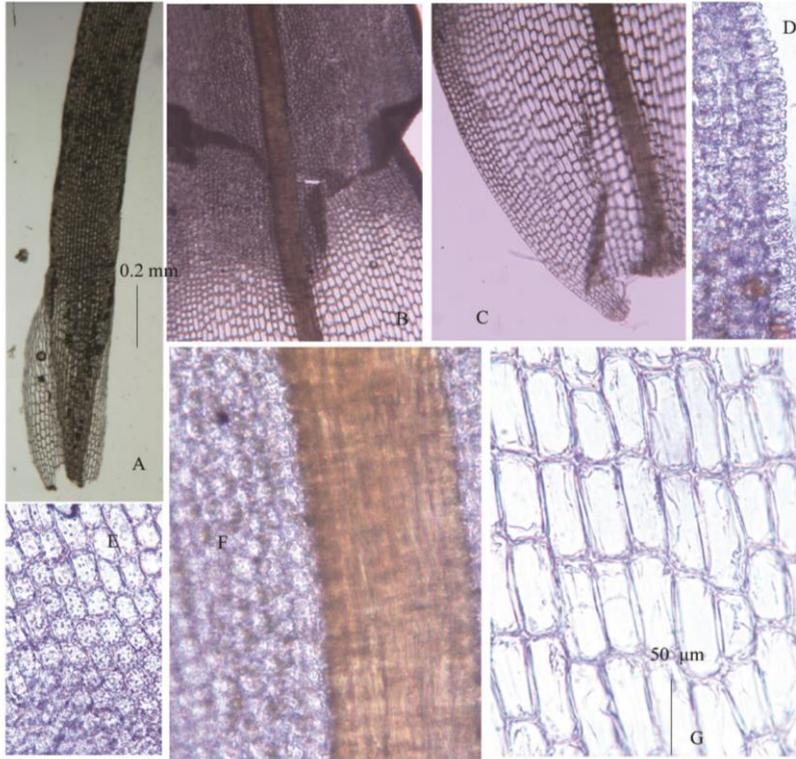


Fig. 9. A-G. *Syntrichia fragilis*, A. Leaf base, B. Leaf middle portion, C. Leaf base cells enlarged, D. Leaf tip marginal cells, E. Leaf cells at middle, F. Cells near costa, G. Basal cells (A-C, D-G same size)

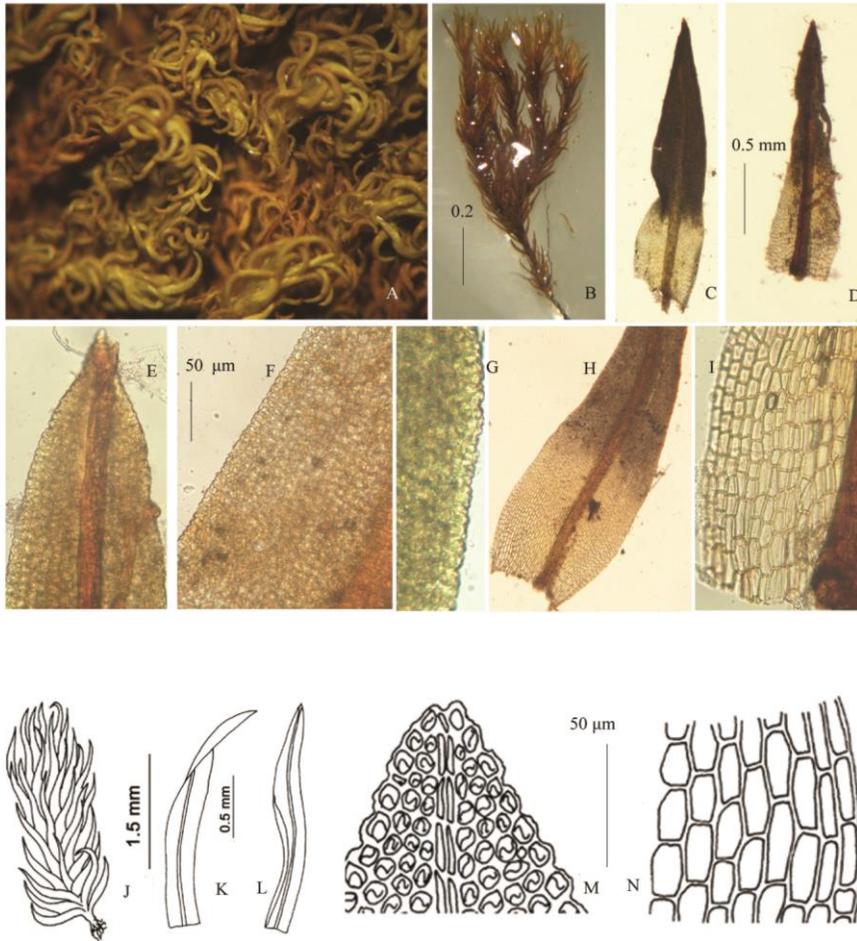


Fig. 10. A-I. *Trichostomum crispulum*, A. Dry habit, B. Wet habit, C&D. Leaves, E. Leaf tip, F. Leaf marginal cells, G. Leaf margin enlarged, H. Leaf base, I. Leaf basal cells enlarged; J-N. *Trichostomum wayanadense*, J. Habit, K&L. Leaves, M. Leaf tip, N. Leaf basal cells (A-B, C-D, E-I, M&N same size)

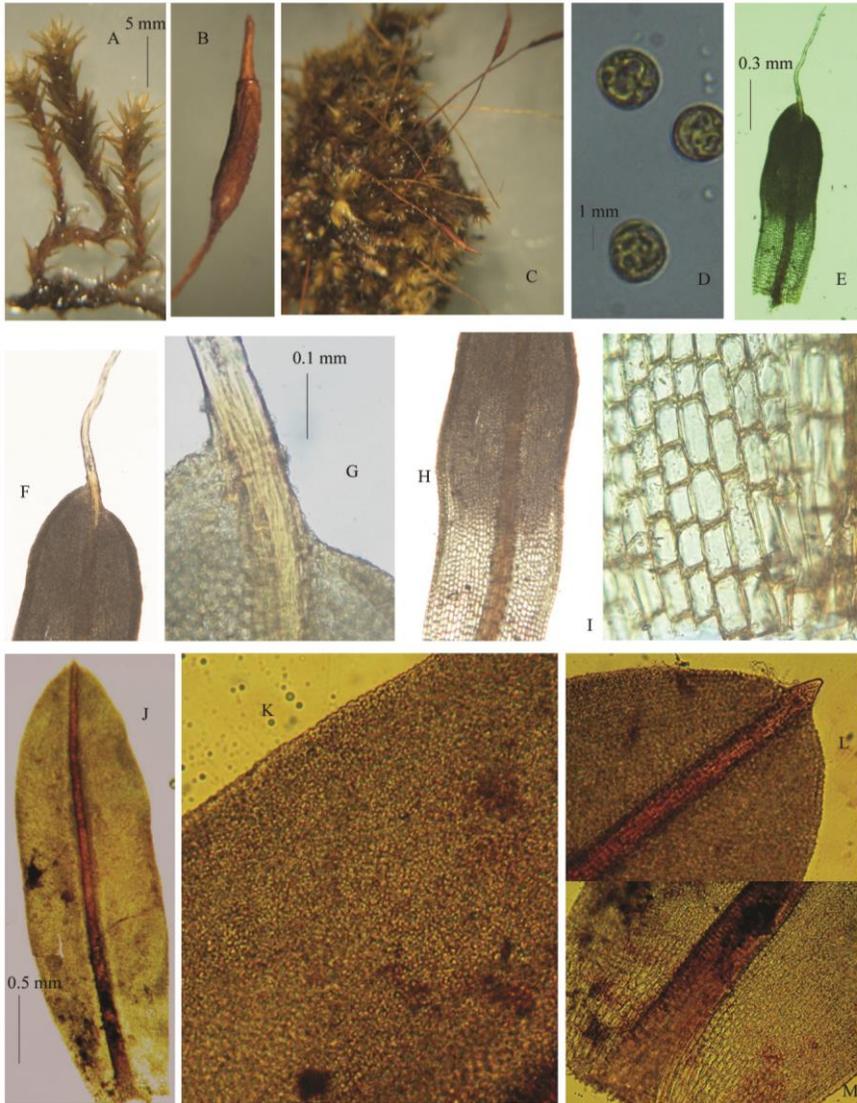


Fig. 11. A-I. *Tortula muralis*, A. Habit, B. Capsule, C. Dry habit, D. Spores, E. Leaf, F. Leaf tip with long costa, G. Leaf tip cells, H. Leaf base, I. Leaf basal cells; J-M. *Tortula schmidtii*, J. Leaf, K. Marginal cells, L. Leaf tip cells, M. Leaf basal cells (A-C, E-F, G-I, J-M same size)



Fig. 12. A. *Barbula indica*, B. *Barbula indica* habit with sporophyte, C. *Hymenostomum edentulum*, D. *Hyophila involuta*, E. Capsule enlarged, F. *Hyophila nymaniana*, G. *Oxystegus cylindricus*, H. *Pottia bryoides*

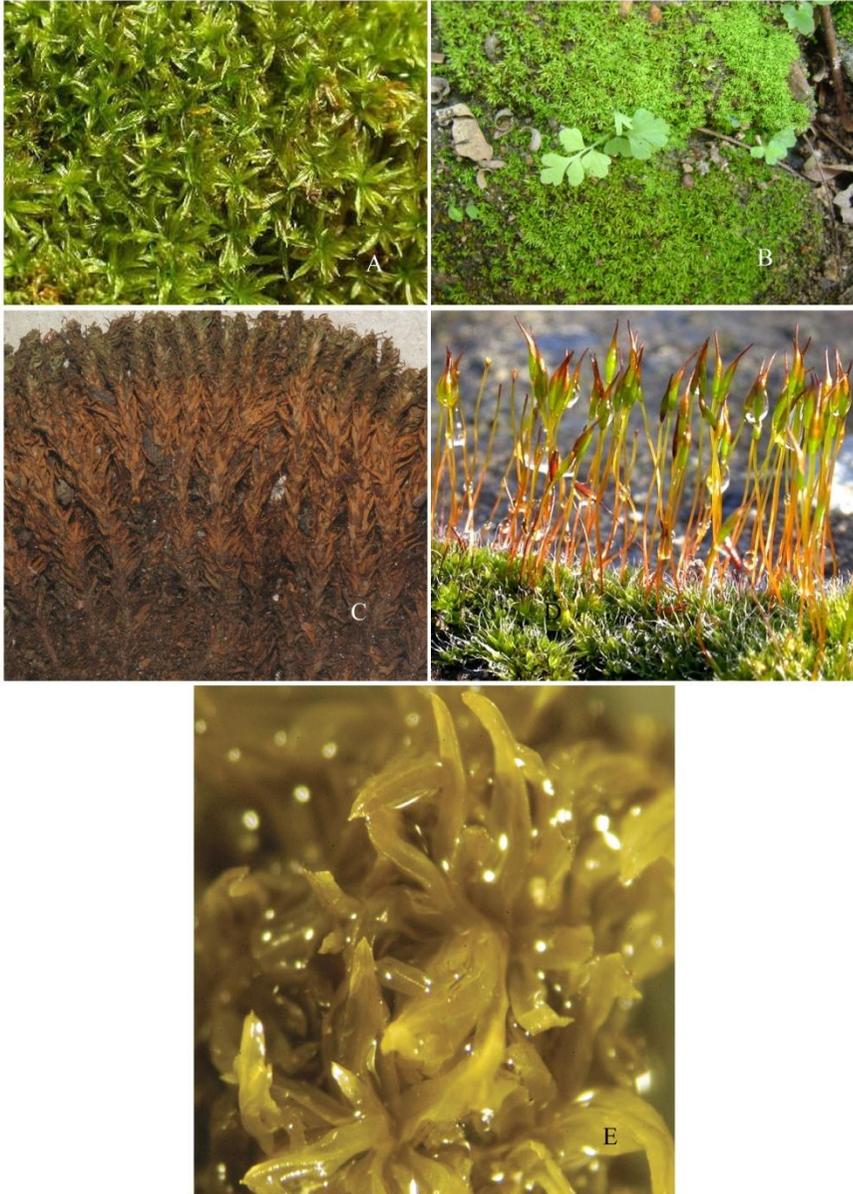


Fig. 13. A. *Scopelophila cataractae*, B. *Semibarbula orientalis*, C. *Syntrichia fragilis*, D. *Tortula muralis*, E. *Trichostomum wayanadense*

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