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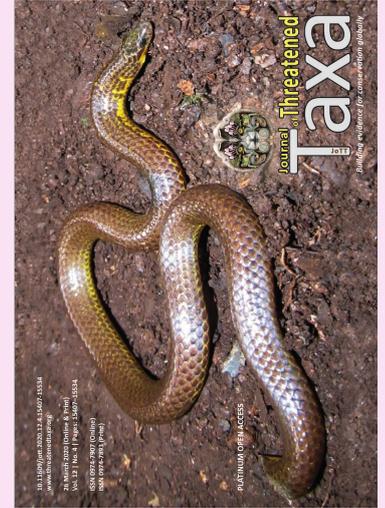
SHORT COMMUNICATION

THREE MOSS FAMILIES (BRYOPSIDA: CALYMPERACEAE, HYOPTERYGIACEAE, & PTEROBRYACEAE): NEW DISTRIBUTION RECORDS TO BRYOFLOORA OF ANDHRA PRADESH, INDIA

Ananthaneni Sreenath, Midigesi Anil Kumar, Paradesi Anjaneyulu & Boyina Ravi Prasad Rao

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Three moss families (Bryopsida: Calymperaceae, Hypopterygiaceae, & Pterobryaceae): new distribution records to bryoflora of Andhra Pradesh, India

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Abstract: Our investigation of the bryoflora of Andhra Pradesh carried out during 2015–19 resulted in three new records of moss families: Calymperaceae, Hypopterygiaceae, and Pterobryaceae represented by *Calymperes tenerum*, *Hypopterygium tamarisci*, and *Pterobryopsis acuminata*, respectively.

Keywords: Bryophyte, Mosses, new records.

Part of bryophyte inventory during June 2016 to September 2018 in the state of Andhra Pradesh, we collected curious moss plant specimens from different forest localities of Andhra Pradesh. After critical study, we identified the specimens collected from the hill tops of Sadasiva Kona, Chittoor District belonging to *Calymperes tenerum* Mull.Hal. (Calymperaceae, Dicranales, Bryopsida); those collected from hills of Galikonda near Sunkarimetta, Visakhapatnam District as *Hypopterygium tamarisci* (Sw.) Brid. ex Müll.Hal. (Hypopterygiaceae, Hookeriales, Bryopsida) and those from the valleys of Vantamamidi near Lambasingi, Visakhapatnam District as *Pterobryopsis acuminata* (Hook.) M. Fleisch. (Pterobryaceae, Hypnales, Bryopsida).

Calymperaceae comprises 19 genera and 1,051 species worldwide (The Plant List 2013), of which

seven genera and 44 species are represented in India; *Calymperes* comprising 342 species are represented by 19 in India (Dandotiya et al. 2011; Alam 2015). Hypopterygiaceae comprises five genera and 33 species (The Plant List 2013), of which four genera and 13 species are represented in India; *Hypopterygium* comprising 27 species is represented by five species in India (Dandotiya et al. 2011). Pterobryaceae comprises 41 genera and 393 species (The Plant List 2013), of which eight genera and 27 species are recorded from India; *Pterobryopsis* comprises 52 species, represented by 12 species in India (Dandotiya et al. 2011).

Perusal of updated literature on bryoflora of Andhra Pradesh (Rani et al. 2014) revealed that till date, representatives of the families Calymperaceae, Hypopterygiaceae, and Pterobryaceae have not been reported from the state of Andhra Pradesh and hence the present collection forms new distribution records of these three families, genera and species for the state.

MATERIALS AND METHODS

The plant materials were collected by using sharp knife and brought to the laboratory in labeled zip lock

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polythene cover, air dried at room temperature and preserved in brown paper packets (12×18 cm) with detailed label (10×17cm). Critical examination of the collected specimens were done by using temporary slides, and plant parts were separated by using micro forceps (Varin) VR-15 curved, VR-11 straight with fine sharp edges. Slides were observed under light microscope (Olympus CH20i), and measurements were taken by using ocular micro meter (Erma) 19mm, 100 segments in 1cm. Field photographs were taken by using Nikon D3300; microscopic photographs were taken by using Moto g3 turboequipped with 13MP camera, 4x wide digital zoom. Different dimensions were measured and identifications were done using standard bryofloras. Description, phenology, distribution, voucher specimen information, microscopic photographs, and illustrations are provided for all the three species. Distribution pertaining to the world is adopted from the Tropicos website (Mussorie Botanical Garden 2019). Voucher specimens are deposited in the Sri Krishnadevaraya University Herbarium, Ananthapuramu (SKU). Abbreviations used for collectors are: AS (Ananthaneni Sreenath), BR (B. Ravi Prasad Rao).

Taxonomic treatment

Calymperes tenerum Mull.Hal. in Linnaea 37: 174. 1872; Bureshi in Rec. Bot. Surv. India 13(1): 32. 1931; Foreau in J. Bombay Nat. Hist. Soc. 61: 223; 1964 Gungulee, Moss. E. India 1(2): 600. 1971; W.D. Reese & Mohamed in Bryologist 88: 106. 1985; Ellis in J. Bryol. 15:712. 1989; Daniels, Bryophytes of Southern W. Ghats 56–57.2003.

Plants small, tufted or forming mats up to 3–7 mm high, green to dark green-colored. Stem usually not branching, very short, without central stand. Leaves curled when dry, erect to spreading when moist; dimorphic. Gemmiferous leaves obovate-lanceolate 1.6–2.8 × 0.6–1.2 mm., non-gemmiferous leaves obovate to oblong ligulate, 1.1–2.1 × 0.7–1.2 mm; leaf cells unipapillose at apex and middle, papilla reducing towards base, apical cells 6–14 × 4–12 μm; hexagonal to quadrate, basal cells 14–43 × 6–8 μm, quadrate, elongate and cancellinae 9–13 rows in side of costa at base; 40–90 × 40–45 μm. Costa smooth on back side, 70–80 μm wide, finely toothed at apex, percurrent to excurrent in non gemmiferous leaves, excurrent in gemmiferous leaves. Gemmae green, radiating stellate, clustered at costal apex, and 130–180 × 33–54 μm with shiny transparent margins and cells having thick chlorophyll. Capsules not seen. Microscopic Photographs & Illustrations for the species (Image 1; Figure 1)

Habitat: Corticolous on *Alphonsea sclerocarpa* (Annonaceae) and found associated with *Frullania udarii* V. Nath & Ajit P. Singh. (Frullaniaceae). Also found on soil covered rock substratum near the host tree.

Specimens examined: 53330-B (SKU) 24.ii.2017, 13.734°N & 79.590°E, 508m, Sadasivakona hill top, Chittoor District, Andhra Pradesh, India, coll. Boyina Ravi Prasad Rao & Ananthaneni Sreenath.

Distribution: Aldabra, Australia (northern Queensland) (Fife & De Lange 2009), Benin Bioko, Brazil, Chagos Archipelago, China, Comoros, Democratic Republic of the Congo, Ghana, Hawaiian Island, India (Andhra Pradesh, Kerala, Tamil Nadu, lower Bengal, southwestern Himalaya), Indonesia, Ivory Coast, Kenya, Madagascar, Malaysia, Maldives, Mauritius, New Zealand, Nigeria, Papua New Guinea, Pacific Islands (Hawaii, Fiji, Tonga Group, Cook Islands, Society Islands, Marquesas, New Caledonia) Philippines, Reunion, Rodrigues, Seychelles, South Africa, Sri Lanka, Tanzania, and United States (Florida).

Hypopterygium tamarisci (Sw.) Bird. ex Mull. Hal.; Syn. Musc. Frond. 2: 8. 1850; *Hypopterygium tenellum* Mull. Hal., Bot. Zeitung (Berlin) 12: 557. 1854; R.S. Chopra, Tax. Indian moss. 397. 1975; Daniels, Bryophytes of Southern W. Ghats 123–124. 2003.

Plants small to medium-sized, main stem to 5cm long creeping, secondary stem erect, dendroid to 2.5cm high, yellowish-green to dark green above and reddish-brown below by dense tomentose. Leaves complanate, asymmetric, arranged in 3 rows, 2 lateral rows and 1 ventral row; lateral leaves ovate-ovate to 0.7–1.1 × 0.5–0.67 mm, acute to short acuminate, finally toothed at apex, entire below at margin, bordered by two rows of limbidium, linear elongated cells, hyaline to 50–145 × 6–11 μm; leaf apical, middle and basal cells are same in size shape, rhomboid-rhomboid hexagonal to 20–36 × 10–22 μm and some cells slightly larger near at costa base to 30–42 × 12–22 μm. Costa single, more or less ½ of the leaf length, ending much below the apex. Ventral leaves orbicular-cordate to 0.43–0.47 × 0.4–0.5 mm; apex acuminate, faintly toothed to entire at margin with border of limbidium, linear elongate hyaline cells similar to lateral leaves. Costa more are less ½ of the leaf length, sometimes percurrent, just below the leaf tip or whole length of the leaf. Gemmae present as axillary buds. Sporophyte not seen in this specimens. Microscopic photographs and illustrations for the species (Image 2, A–G; Figure 2, A–G)

Habitat: Racophilous on wet rocks near aquatic areas, found associated with *Heteroscyphus hylanus*

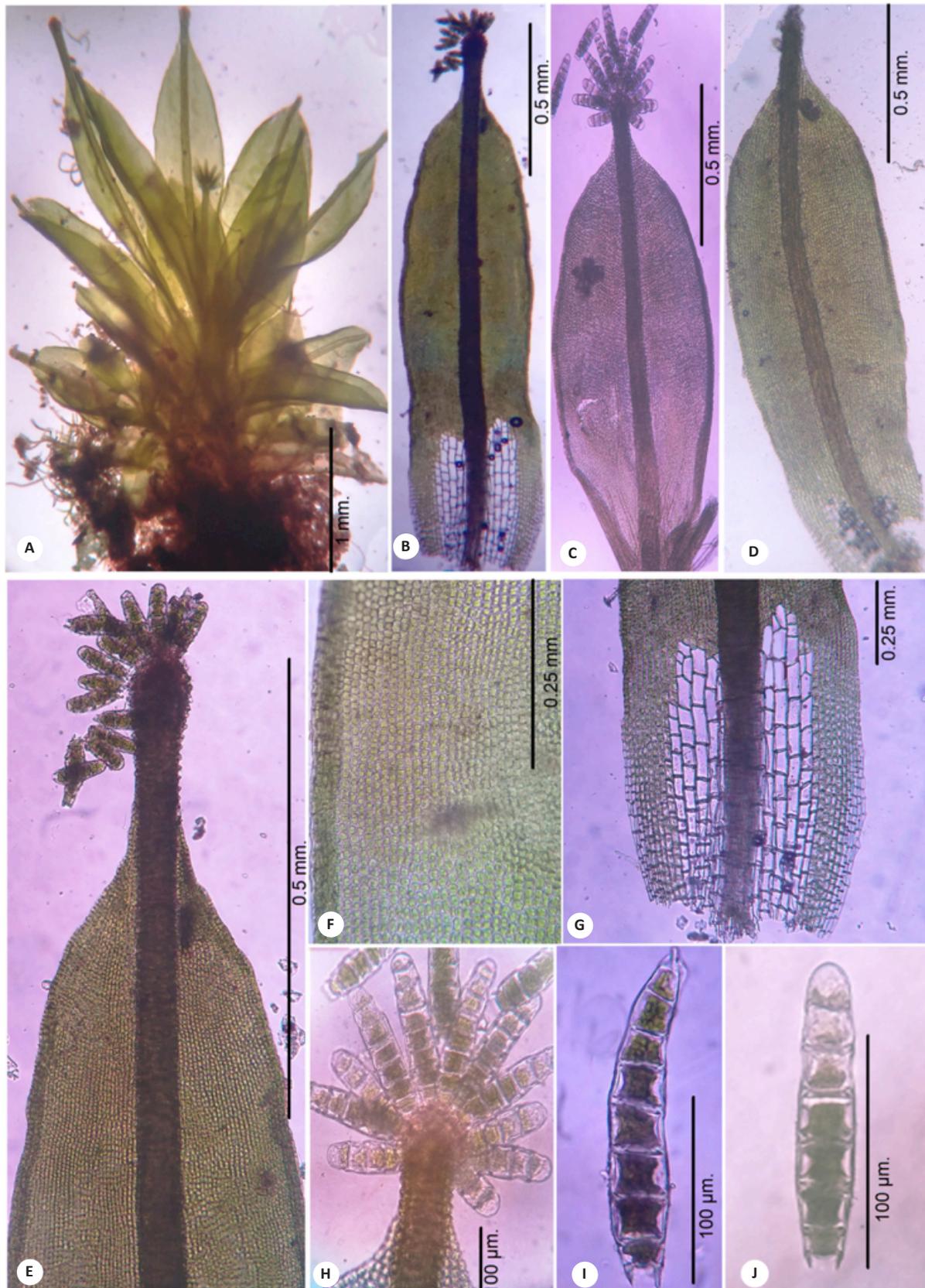


Image 1. *Calymperes tenerum* Mull.Hall.

A—Plant | B & C—Gemmiferous leaves | D—Non gemmiferous leaf | E—Leaf Apical cells | F—Leaf Middle cells | G—Leaf basal cells with acellinae cells | H—Gemmiferous Leaf tip | I & J—Gemmae. © Ananthaneni Sreenath & B.R.P. Rao.

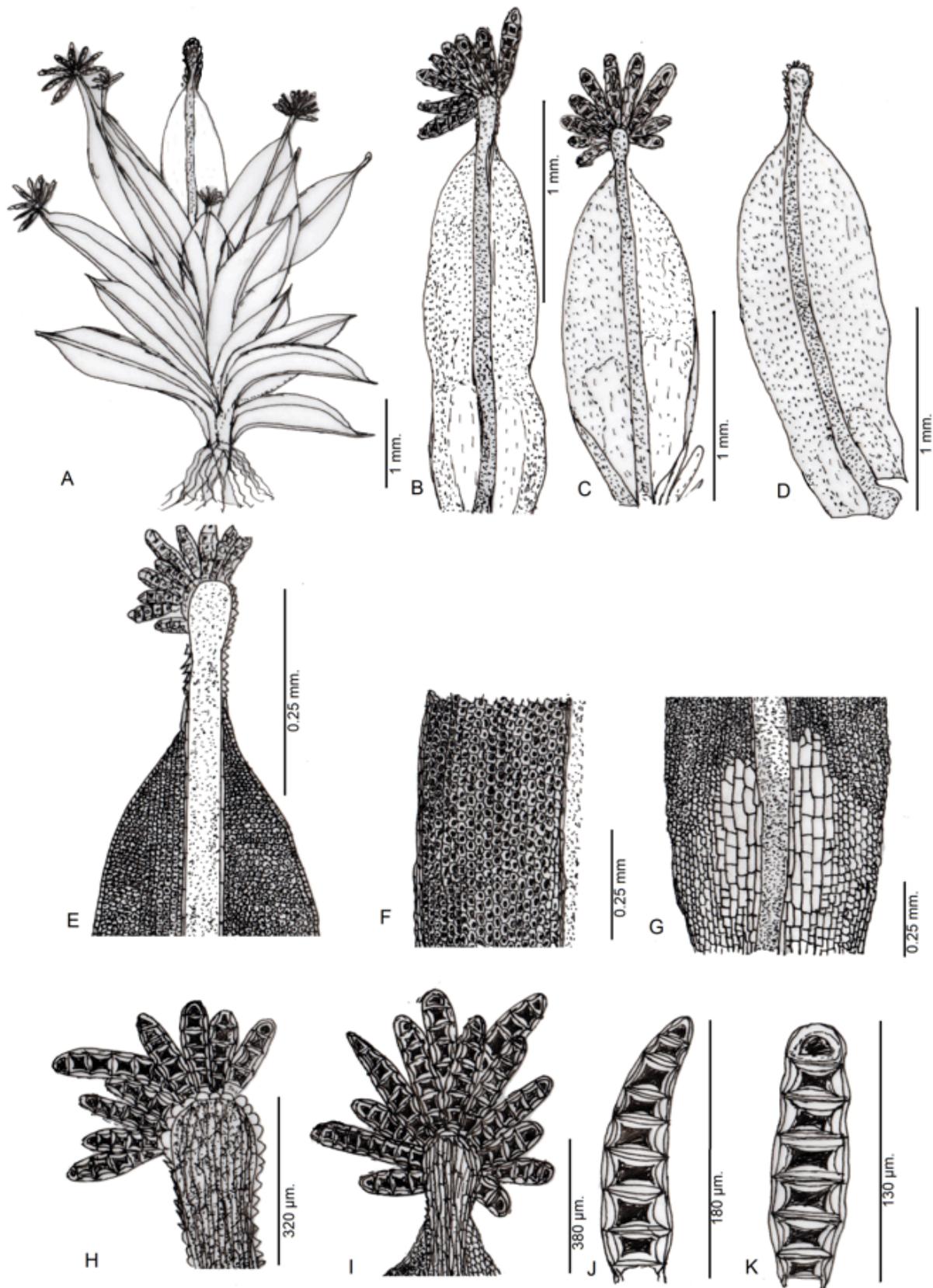


Figure 1. *Calymperes tenerum* Mull. Hall.

A—Plant | B & C—Gemmiferous leaves | D—Non gemmiferous leaf | E—Leaf Apical cells | F—Leaf Middle cells | G—Leaf basal cells with acellinae cells | H & I—Gemmiferous Leaf tips | J & K—Gemmae.

(Geocaliaceae) and *Fissidens* sp. (Fissidentaceae).

Specimens examined: 55201-A (SKU) 21.x.2018, 18.360°N & 83.041°E, 1,280m, Galikonda, on the way of Ananthagiri to Sunkarimetta, 1.5km near Galikonda view point from Ananthagiri, Visakhapatnam District, Andhra Pradesh, India, coll. Boyina Ravi Prasad Rao & Ananthaneni Sreenath.

Distribution: Belize, Bioko, Brazil, Burundi, Cameroon, Caribbean, Comoros, Democratic Republic of the Congo, Eritrea, Ethiopia, Gabon, India (Andhra Pradesh, Kerala and Tamil Nadu), Kenya, Madagascar, Malawi, Mascarene Islands, Mauritius, Mexico, Reunion, Rwanda, Sao Tome, South Africa, Tanzania, Uganda, Zimbabwe.

Note: Although Dandotiya et al. (2011) treated *Hypopterygium tamarisci* (Sw.) Brid. ex Müll. Hal. and *H. tenellum* Müll. Hal. separately, the Plant List (2013) treated the latter as synonym to the former based on Tropicos data.

Pterobryopsis acuminata (Hook.) M. Fleisch. Hedwigia 45: 59. 1905; Gangulee, Mosses of Eastern India 2(5): 1273. 1976; Manju, Eco-systematic studies on bryophytes of Wayanad 259. 2005.

Plants small to medium-sized, main stem to 6cm long creeping, secondary stem sub erect, dendroid, pinnate to 4cm high, secondary branches to 5–7 mm, light yellowish to brown when dry, green to dark green when moist and dark brown below. Leaves concave, densely lamellose, spirally arranged, stem leaves, branch leaves slightly differentiated in shape and shape, stem leaves cordate, orbicular-ovate to 1.28–1.5 × 0.8–0.9 mm; branch leaves ovate to 1.2–1.6 × 0.58–0.64 mm, acute to short acuminate, finally denticulate but not at apex; leaf cells are same in stem and branch leaves; leaf apical, middle, basal and alar cells slightly, differentiated in size, shape; leaf cells thick walled elongated, basal and middle cells to 50–60 × 10–12 µm, apical cells 26–30 × 0.7–10 µm and alar cells differentiated with other all leaf cells, quadrangular to 10–12 × 0.7–1 µm. stem attachment cells transparent and base reddish-brown to golden brown in color. Costa more than ½ of the leaf length, single, ending much below the leaf tip, costa end simple or sometimes furcate. Gemmae absent some. Sporophyte not seen in this specimen. Microscopic photographs and illustrations for the species (Image 2, H–N; Figure 2, H–M)

Habitat: Corticolous on old, wet tree trunks of branching base, found associated with *Stereophyllum* sp. (Plageocheiaceae) and *Erythrodontium julacium* (Erythrodontaceae).

Specimens examined: 53900–B 13.xii.2017, 17.825°N & 82.618°E, 800m, interior forest of Vantamamidi near

Lambasingi, Visakhapatnam District, Andhra Pradesh, India, coll. Boyina Ravi Prasad Rao & Ananthaneni Sreenath.

Distribution: India (Andhra Pradesh, Tamil Nadu, Kerala, Khasia Hills and Sikkim), Indo-Burma, and China.

DISCUSSION

Bryophytes are an important component of plant biomass especially in forests and play a vital role in soil development, nutrient biogeochemical cycling and ecological succession (Frego 2007). Studies on bryophytes are, however, sparse owing to the difficulty in their identification, availability of less literature and as well as high-costs for explorations. Only a few studies are there on bryoflora of Andhra Pradesh and most of the bryophytes of the state were recorded in the past three decades from the state. Past studies on bryoflora of Andhra Pradesh includes: Rao et al. (1999); Sowghandika (2010); Rani et al. (2011a,b, 2012, 2014); Sowghandika et al. (2011); Pullaiah et al. (2012). Perusal of literature (Rani et al. 2014; Manjula & Manju 2016; Pande et al. 2019) revealed the records of 101 taxa (99 species) belonging to 36 families. Owing to the presence of diversified bryophyte habitats in the state and consequently anticipated much more diversity, we explored the state for the past three years intensively. The present records of three bryophyte species are part of the result of this exploration.

Calymperaceae is distinct in Bryopsida with gemmiferous leaf tips. *Calymperes tenerum* Müll. Hal., an acrocarpous moss is distributed South America, Africa, southern and southeastern Asia, Pacific Islands; in India, the species is having discontinuous distribution: in southern peninsular India, southwestern Himalaya and lower Bengal; we could locate it only in one place of Andhra Pradesh. Hypopterygiaceae, characterized by plants with dendroid habit are pleurocarpous mosses. *Hypopterygium tamarisci* (Sw.) Brid. ex Müll. Hal. are distributed in Brazil, Bioko, Mexico, central America, Africa, Indian Ocean Islands, and southeastern Asia; in India, the species is known only from southern peninsular India states; and currently recorded only from one locality in Andhra Pradesh. Pterobryaceae characterized by concave shaped leaves are pleurocarpous mosses. *Pterobryopsis acuminata* (Hook.) M. Fleisch. is recorded only from Indo-Burma, China, and India; in India the species is known from the Eastern Ghats, Kerala, and northeastern India and presently recorded only from one locality in Andhra Pradesh. All the three species reported as new records to states are not falling in any threatened categories (IUCN 2001).

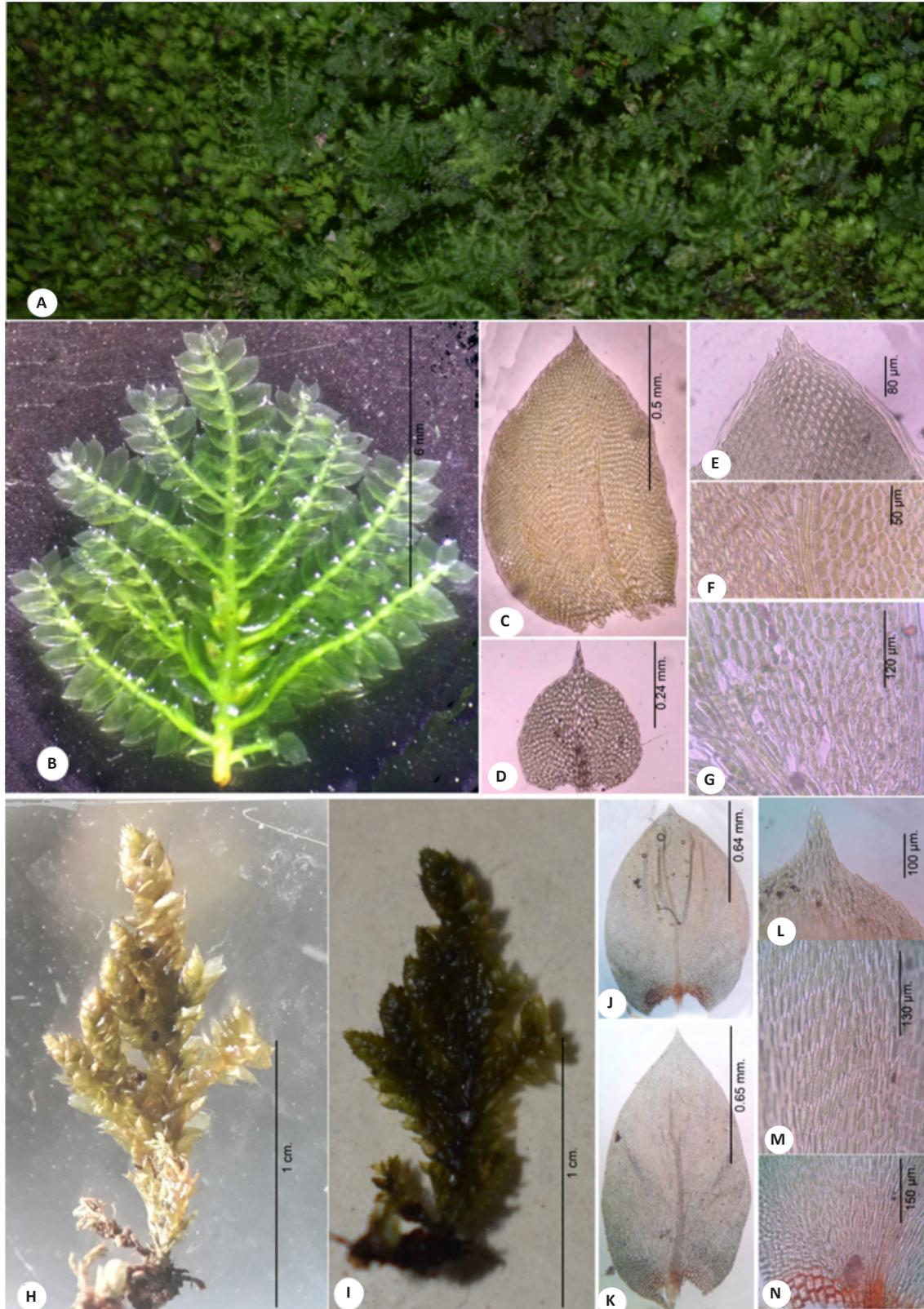


Image 2. A–G: *Hypopterigium tamarisci* (Sw.) Bird. ex Mull. Hal.: A—Single branch | B—Elongated view of apical portion | C—Lateral leaf | D—Ventral leaf | E—Leaf apical cells | F—Leaf middle cells | G—Leaf basal cells.
 H–N: *Pterobryopsis acuminata* (Hook) M. Fleisch.: H—Dry plant | I—Wet plant | J—Stem leaf | K—Branch leaf | L—Leaf apical cells | M—Leaf middle cells | N—Leaf basal and alar cells.
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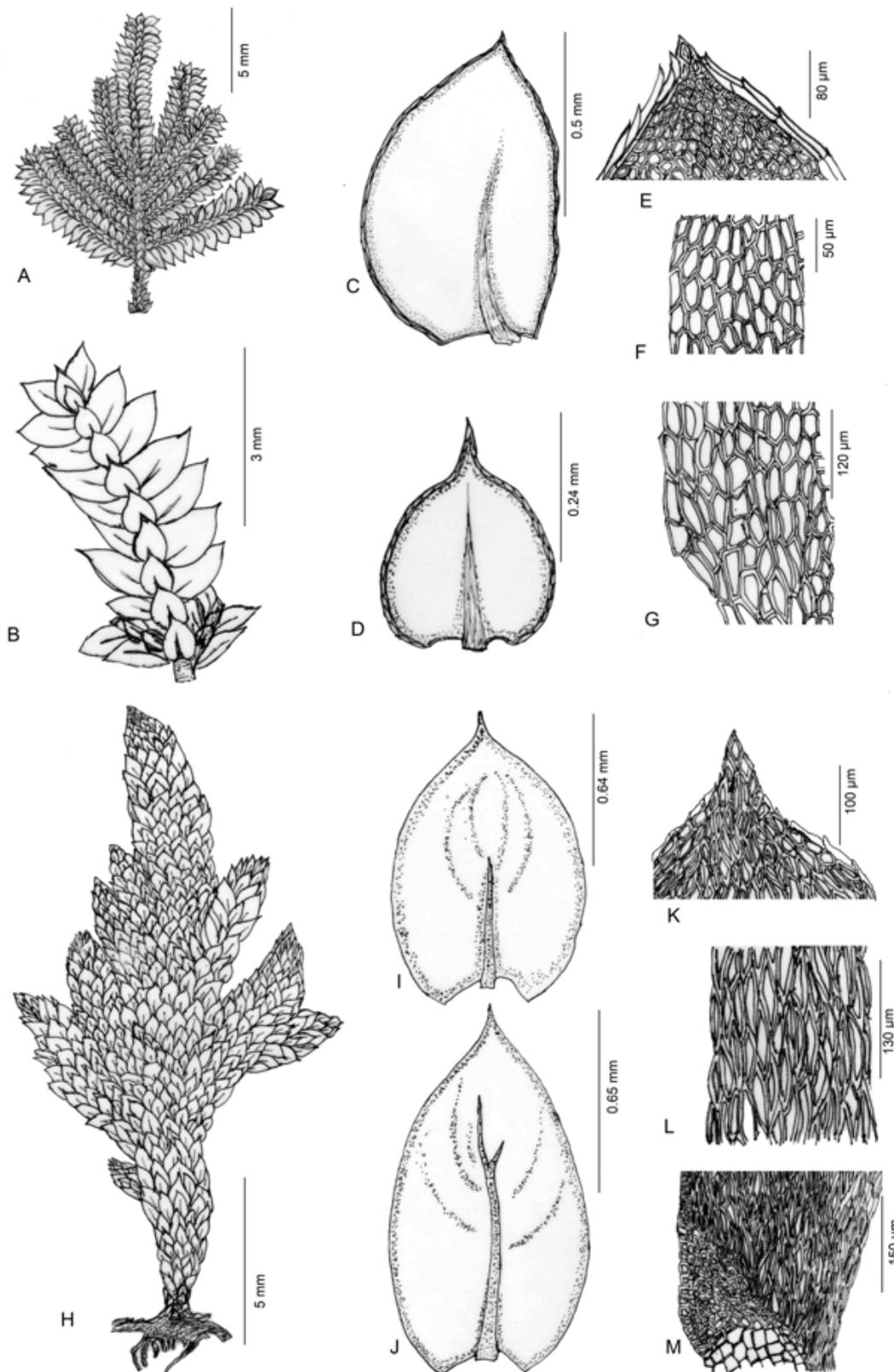


Figure 2. A – G: *Hypopterygium tamarisci* (Sw.) Bird. ex Mull. Hal.

A—Natural habit with single branch | B—Apical portion of plant elongated view | C—Lateral leaf | D—Ventral leaf | E—Leaf apical cells | F—Leaf middle cells | G—Leaf basal cells

H—M: *Pterobryopsis acuminata* (Hook) M. Fleisch.

H—Single branch | I—Stem leaf | J—Branch leaf | K—Leaf apical cells | L—Leaf middle cells | M—Leaf basal and alar cells.

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