SHORT COMMUNICATION

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

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

26 March 2020 | Vol. 12 | No. 4 | Pages: 15481–15488
DOI: 10.11609/jott.4418.12.4.15481-15488
Three moss families (Bryopsida: Calymperaceae, Hyopterygiaceae, & Pterobryaceae): new distribution records to bryoflora of Andhra Pradesh, India

Ananthaneni Sreenath 1, Midigesi Anil Kumar 2, Paradesi Anjaneyulu 3 & Boyina Ravi Prasad Rao 4

1-4 Biodiversity Conservation Division, Department of Botany, Sri Krishnadevaraya University, Anantapuramu, Andhra Pradesh 515003, India.

1 sreenathbcdl@gmail.com, 2 anilbcdl@gmail.com, 3 paradesianjineyulu@gmail.com, 4 biodiversityravi@gmail.com (corresponding author)

Abstract: Our investigation of the bryoflora of Andhra Pradesh carried out during 2015–19 resulted in three new records of moss families: Calymperaceae, Hyopterygiaceae, and Pterobryaceae represented by Calymperes tenerum, Hyopterygium 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 Hyopterygium tamarisci (Sw.) Brid. ex Müll.Hal. (Hyopterygiaceae, 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). Hyopterygiaceae comprises five genera and 33 species (The Plant List 2013), of which four genera and 13 species are represented in India; Hyopterygium 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, Hyopterygiaceae, 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 using sharp knife and brought to the laboratory in labeled zip lock
polythene cover, air dried at room temperature and preserved in brown paper packets (12×18 cm) with detailed label (10×17 cm). 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) 19 mm, 100 segments in 1 cm. 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**

**Calypnepes 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. Gahats 56–57. 2003.

Plants small, tufted or forming mats up to 3–7 mm high, green to dark green-colored. Stem usually notbraching, 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 cancellatae 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 udarrii* V. Nath & Ajit P. Singh. (Frullianaceae). 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, 508 m, 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).

**Hypopterigium 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. Gahats 123–124. 2003.

Plants small to medium-sized, main stem to 5 cm long creeping, secondary stem erect, dendraoid to 2.5 cm 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-abovate 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, hylane to 50–145 x 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 ⅜ 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 ⅜ of the leaf length, sometimes percurrent, just below the leaf tip or whole length of the leaf. Gemmae present as axillary buds. Sporophtye not seen in this specimens. Microscopic photographs and illustrations for the species (Image 2, A–G; Figure 2, A–G).

**Habitat:** Racophilous on wet tocks near aquatic areas, found associated with *Hetiroscyphus hylanus*
New distribution records to bryoflora of Andhra Pradesh

Image 1. *Calymperes temerum* 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 cacellinae 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 cacellinae cells | H & I—Gemmiferous Leaf tips | J & K—Gemmae.
New distribution records to bryoflora of Andhra Pradesh

Sreenath et al.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 March 2020 | 12(4): 15481–15488

**Specimens examined:** 55201-A (SKU) 21.x.2018, 18.360°N & 83.041°E, 1,280m, Galkonda, on the way of Ananthagiri to Sunkarimetta, 1.5km near Galkonda view point from Ananthagiri, 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 et al. (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 leaftips. *Calymperes tenerum* Mull.Hal., an acrocarpous moss is distributed South America, Africa, southern and southeastern Asia, Pacific Islands; and currently recorded only from one locality in Andhra Pradesh. Hypopterygiaceae, characterized by plants with dendroid habit are pleurocarpous mosses. *Hypopterygium tamarisci* (Sw.) Brd. ex Müll. Hall. 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.
© Ananthaneni Sreenath & B.R.P. Rao.
Figure 2. A – G: *Hypopterigium 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.
New distribution records to bryoflora of Andhra Pradesh  Sreenath et al.

References

Alam, A. (2015). Moss Flora of India: An Updated Summary of Taxa. GRIN Publisher, Germany, 195pp.

Bureshi, P. (1931). A census of Indian mosses with a practical key to genera. Records Botanical Survey of India 13(1): 1–135pp.

Chopra, R.S. (1975). Taxonomy of Indian mosses, CSIR publications & Information directorate, New Delhi, 397–398pp.

Dandotiya, D.H., Govindapyari, S. Suman & P.L. Uniyal (2011). Check list of the Bryophytes of India, Archive for Bryology 88: 1–126.

Daniels, A.E.D (2003). Studies on Bryoflora of southern Western Ghats, Tamil Nadu, India. PhD Thesis. Department of Botany, Manonmaniam Sundaranar University, vi+370pp.

Ellis, L.T. (1989). A taxonomic revision of Calymperes in Southern India and neighbouring islands. Journal of Bryology 15: 697–737. https://doi.org/10.1179/jbr.1989.15.4.697

Fife, A.J. & P.J. De Lange (2009) Calymperes tenuer Mull. Hal. (Calymperaceae) on the Chatham Islands, New Zealand. Australasian Bryological Newsletter 57: 14–16.

Foreau, G. (1964). Some south Indian mosses. Journal of the Bombay Natural History Society 61: 223–226.

Frego, K.A. (2007). Bryophytes as potential indicators of forest integrity. Forest Ecology and Management 242: 65–75.

Gungulee, H.C. (1969–1972). Mosses of Eastern India and adjacent regions, a monograph, Vol-1 [Fasc. 1-3] Calcutta, xix+830pp.

IUCN (2001). IUCN Red List Categories and Criteria: Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland and Cambridge, 32pp. http://iucnredlist.org/documents/redlist_cats_crit_en.pdf

Manjula, C.N. & C.N. Manju (2016). Genus Fissidens Hedw. (Fissidentaceae; Bryophyta) from Eastern Ghats of Andhra Pradesh, India. Cryptogam Biodiversity and Assessment 1(2): 1–15.

Missouri Botanical Garden (2019). Missouri botanical garden. http://www.tropicos.org. (Accessed on 8 August 2019).

Pande, P., P. Srivastava & A.K. Astana (2019). Addition of two pleurocarpous mosses to the Bryoflora of South India. Indian Journal of Forestry 42(1): 99–103.

Pullaiah, T., A.S.V. Kumar, S.S. Rani & M. Sowghandhika (2012). Bryophyte Diversity in Guntur district, Andhra Pradesh. Journal of the Indian Botanical Society 91(1–3): 264–271.

Rao, R.S., S. Sudhakar & P. Venkanna (1999). Flora of East Godavari District. The Indian National Trust for Art and Culture Heritage (INTACH), Andhra Pradesh State Chapter, Hyderabad, xi+947pp.

Reese, W.D. & M.A.H. Mohamed (1985). A synopsis of Calymperes (Musci: Calymperaceae) in Malaysia and adjacent regions. The Bryologist 88: 98–109.

Rani, S.S., T. Pullaiah, D. Ramanjaneyulu & M. Sowghandika (2011). Bryophyte diversity in Kurnool District, Andhra Pradesh. Journal of Economic and Taxonomic Botany 36(3): 674–679.

Rani, S.S., M. Sowghandhika, B. Suseela, K.S. Nagesh & T. Pullaiah (2011). Additions to the bryoflora of southern peninsular India. Journal of the Indian Botanical Society 90(1&2): 75–79.

Rani, S.S., M. Sowghandhika, T.V.K. Kumar & T. Pullaiah (2012). Bryophyte Diversity in East Godavari district, Andhra Pradesh. Journal of Plant Science Research 28(1): 101–109.

Rani, S.S., M. Sowghandhika, K.S. Nagesh, B. Suseela & T. Pullaiah (2014). Bryophytes of Andhra Pradesh. Bishen Singh Mahendra Pal Singh, Dehra Dun, iii+279pp.

Sowghandika, M. (2010). Bryophytes in Visakhapatnam District, Andhra Pradesh. PhD Thesis. Department of Botany, Sri Krishnadevaraya University, ix+220pp.

Sowghandika, M., S.S. Rani, B. Suseela & T. Pullaiah (2011). Musci in Visakhapatnam district of Andhra Pradesh. The Plant List (2013). http://www.thelatlist.org. Accessed on 08 August 2019.
Conservation Application

Do wildlife crimes against less charismatic species go unnoticed? A case study of Golden Jackal Canis aureus Linnaeus, 1758 poaching and trade in India
– Malaika Mathew Chowla, Arjun Srivastha, Priya Singh, Iravatee Majgaonkar, Sushma Sharma, Girish Punjabi & Aditya Banerjee, Pp. 15414–15413

Hazards of wind turbines on avifauna - a preliminary appraisal within the Indian context
– Himika Deb, Tanmay Sanyal, Anilava Kaviraj & Subrata Saha, Pp. 15414–15425

Analysis of stereotypic behaviour and enhanced management in captive Northern Giraffe Giraffa camelopardalis housed at Zoological Garden Alipore, Kolkata
– Tushar Pramod Kulkarni, Pp. 15426–15435

A new species of shieldtail snake (Reptilia: Squamata: Uropeltidae) from Kolli Hill complex, southern Eastern Ghats, peninsular India
– S.R. Ganesh & N.S. Achyuthan, Pp. 15436–15442

The insect fauna of Tenompok Forest Reserve in Sabah, Malaysia
– Arthur Y.C. Chung, Vivianne Paul & Steven Bosuang, Pp. 15443–15459

Additions of woody climbers (Lianas) to the flora of Manipur, India
– Longjam Malemnganbee Chanu & Debjyoti Bhattacharyya, Pp. 15489–15492

Notes

New to Myanmar: the Rosy Starling Pastor roseus (Aves: Passeriformes: Sturnidae) in the Hkakabo Razi Landscape
– Sai Sein Lin Oo, Myint Kyaw, Nay Myo Hlaing & Swen C. Renner, Pp. 15493–15494

New records of Heloderma alvarezi (Wiegmann, 1829) (Sauria: Helodermatidae) on the coast of Oaxaca and increases to its distribution in Mexico
– Jesús García-Grajales, Rodrigo Arrazola Bohórquez, María Arely Penguilly Macías & Alejandra Buenrostro Silva, Pp. 15495–15498

Description of a new subspecies of the genus Microcercoterms Silvestri, 1901 (Amphipterygidae: Termitidae: Isoperta) and the first record of another termite species from Meghalaya, India
– Khirod Sankar Das & Sudipta Choudhury, Pp. 15499–15502

A new record of the hoverfly genus Dasyosyrphus Enderlein, 1938 (Insecta: Diptera: Syrphidae) from India
– Jayita Sengupta, Atanu Naskar, Aniruddha Maity, Panchanan Parui, Sumit Homchaudhuri & Dhriti Banerjee, Pp. 15503–15506

First record of Banded Lineblue Prosotas aluta Druce, 1873 (Insecta: Lepidoptera: Lycaenidae) from Bangladesh
– Rajib Dey, Ibrahim Khalil Al Haider, Sajib Rudra & M. Rafiqul Islam, Pp. 15507–15509

Notes on Ptilomera aegriodes (Hemiptera: Heteroptera: Gerridae) from Eastern Ghats, India
– J. Deepa, A. Narahari, M. Karuthapandi, S. Jadhav & C. Shiva Shankar, Pp. 15510–15513

Didymocarpus bhutanicus W.T. Wang (Gesneriaceae): a new addition to the herbs of India
– Subhajit Lahiri, Sudhansu Sekhar Dash, Monalisa Das & Bipin Kumar Shankar, Pp. 15514–15517

Rediscovery of Epilobium trichophyllum Hausskn.: a rare and endemic plant from Sikkim Himalaya, India
– David L. Biate & Dinesh K. Agrawala, Pp. 15518–15521

Additions of woody climbers (Lianas) to the flora of Manipur, India
– Longjam Malemnganbee Chanu & Debjyoti Bhattacharyya, Pp. 15522–15529

Molecular characterization of stinkhorn fungus Aseroe coccinea Imazeki et Yoshimi ex Kasuya 2007 (Basidiomycota: Agaricomycetes: Phallales) from India
– Vivek Bobade & Neelesh Dahanukar, Pp. 15530–15534