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## Six Species of Pottiaceae (Pottiales, Bryopsida), Additions to Peninsular India

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### Abstract

Six species of Pottiaceae viz., *Barbula marginatula* C. Muell. ex. Gangulee, *Hyophila kurziana* Gangulee, *Hyophila perannulata* Ren. et Card, *Tortella alpicola* Dixon, *Tortella fragilis* (Hook. & Wilson) Limpr. and *Weissia wimmeriana* (Sendtn.) Bruch & Schimp, collected from different localities of Andhra Pradesh, being reported as new distributional records to Peninsular India.

### Article Info

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### Keywords

*Acrocorpous mosses*, Pottiaceae.

### Introduction

The Peninsular India bounded on the west by the Arabian Sea, on the east by the Bay of Bengal and on the north by the Vindhya and Satpura ranges extended over 16 lakh km<sup>2</sup>. The peninsular upland forms the largest physiographic division of India, bounded by the Aravallis in the North West, Hazaribagh and Rajmahal Hills in the northeast, the Western Ghats (Sahayadri Mountains) in the west and the Eastern Ghats in the east. The highest peak of Peninsular India is Anamudi, 2695 m above sea level. The study area, Andhra Pradesh covers about 162, 970 sq. km and comprises 13 districts, four of which constitute Rayalaseema region and remaining nine districts, coastal Andhra Pradesh. The state comprises, 17.86 per cent of forest cover (FSI 2019) and harbor over 180 waterfalls, rich in bryoflora.

Extensive field explorations conducted for bryophytes in the state of Andhra Pradesh during June 2016 to

February 2020 yielded some curious acrocarpous moss specimens which after critical investigation identified as *Barbula marginatula* C. Muell. ex. Gangulee, *Hyophila kurziana* Gangulee, *Hyophila perannulata* Ren. et Card, *Tortella alpicola* Dixon, *Tortella fragilis* (Hook. & Wilson) Limpr. and *Weissia wimmeriana* (Sendtn.) Bruch & Schimp. Perusal of literature (Daniels, 2010; Dandotiya *et al.*, 2011; Sandhya Rani *et al.*, 2014; Alam 2015; Alam *et al.*, 2015; Mishra *et al.*, 2016; Magdum *et al.*, 2018, Singh *et al.*, 2018; Sreenath & B.R.P. Rao 2019 A & B; Bryophytes of Kerala 2020) revealed that these species were not recorded so far from any locality in Peninsular India and hence form new records.

### Materials and Methods

Extensive field explorations were conducted in all districts of Andhra Pradesh during 2016-2020. The corticolous plant material was collected by using sharp edged knife and terrestrial specimens were scraped by

using manually bent and sharpened flat spoon. The collected specimens were placed in zip lock polythene cover with labeled field number. Field observations were recorded in the field notes and live photographs were taken using Nikon D3300. Collected material brought to the laboratory, made it air dried at room temperature and preserved them in brown paper packets (12 × 18 cm) with detailed label (10 × 17cm). Critical examination of the specimens was 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), light stereo microscope (Olympus SZ61) and micro measurements were taken by using ocular micro meter (ERMA). Photographs were taken by using Moto g3 turbo and Samsung on6 equipped with 13 MP. Identification of the specimens was done by using standard floras. Descriptions, habitat and ecology, voucher specimens' information, field photographs were provided for the species. Voucher specimens are deposited in Sri Krishnadevaraya University Herbarium (SKU), Ananthapuramu. Abbreviations used for the collectors: AS (Ananthaneni Sreenath) and BR (Boyina Ravi Prasad Rao); Districts: ATP (Ananthapuramu); CTR (Chittoor); EG (East Godavari); KDP (Kadapa); KNL (Kurnool); NLR (Nellore); PKSM (Prakasam); VSKP (Visakhapatnam); WG (West Godavari) and Important Areas: GBM (Gundlabrahmeswaram); MPCA (Medicinal Plant Conservation Area); NLM (Nallamalais); PKNP (Papikondalu National Park); RF (Reserve Forest); WLS (Wild Life Sanctuary).

## Results and Discussion

*Barbula marginatula* C. Muell. ex. Gangulee in Nov Hedwigia, 12: 424. 1966; *Barbula marginatula* C. Mull. In Gen. Musc. Fr.: 426. 1900. nom. nud. Gangulee, Moss. E. India 1(3): 699 – 700. 1972.

Plants small to medium, erect unbranched, up to 1 cm high, green to dark green above, brownish to yellowish-brown below, covered with erectopatent leaves, leaves are not much changed or crispate when dry; long carinate to ligulate from wider base, 2 – 2.8 × 0.4 – 0.45 mm. Costa light yellowish-brown, up to 50 µm wide at base, extended in to a short apiculus. A characteristic margin of 1 – 3 rows (two rows in the most part) of smooth, leaf cells rectangular, pellucid, 22 – 28 × 4 – 6 µm borders the leaf from base to a little below apex. Leaf apical cells irregularly quadrate, incrassate, papillose (very densely in upper middle), 6 – 8 µm wide. basal cells thin walled, transparent, smooth, rectangular, 50 – 56 × 12 – 17 µm

near costa. Perichaetial leaves shorter than vegetative leaves, not otherwise differentiated. Sporophytes present on apical portion of the plant. Seta slender, straight, up to 1.2 cm long, yellow above, orange at base. Capsule erect, cylindrical, light brown, 0.9 – 1.2 mm long × 0.2 – 0.25 mm in diameter wide. Peristome teeth light brown, long filiform, papillose, spirally wound. Spores yellowish brown, smooth to pellucid, rounded to 14 µm in diameter.

## Habitat and ecology

Terricolous or saxicolous on soil covered rock substratum in moist deciduous forest, associated with other pottiaceae members.

## Distribution

World: Burma and India: Sikkim and west Bengal.

## Specimens examined

VSKP Dt., on the way to Galikonda from Ratnagiri, 28 Nov. 2016, 52215, BR & AS; Simhachalam hills, 23 Oct. 2018, 55252A, AS; ATP Dt., Ramagiri Gold Mines area, 05 Dec. 2019, 57097B, AS.

*Hyophila kurziana* Gangulee in Nova Hedwigia, 12: 422. 1966; Gangulee Mosses Eas. India. 1(3): 689 – 690. 1971.

Plants small, variable in size, fertile plants up to 3 mm high and sterile plants up to 6 mm, radiculose, erect shoots with red rhizoids, on the lower part of stems. Leaves erectopatent, crispate and incurved when dry, spatulate from a short, oblong, erect, equally wide base, carinate, 1.8 – 2.5 × 0.5 – 0.56 mm; apex pointed, acute, margin flat, unbroken, sometimes very feebly indented near tip. Costa prominent, brown, upto 125 µm wide at base, percurrent or getting diffused in an apiculus.

Lamina cells chlorophyllose, highly papillose, obscure, irregularly rounded-quadrate. Short base with smooth pellucid, rectangular cells upto 48 – 56 × 18 – 20 µm, becoming smaller towards tip and narrower towards margin. Sporophyte apical, erect, brown upto 1.2 cm high. Capsule brown, erect, cylindrical, with a slightly asymmetrical, short neck, 1.8 – 2.5 mm long × 0.3 – 0.36 mm in diameter wide at the base. Short, conical beaked operculum. Peristome absent. Spores light brown, pellucid, rather irregular, rounded upto 25 µm in diameter.

### Habitat and ecology

Rupicolous, on moist rocks near water areas, monodominant.

### Specimens examined

NLR Dt., on the way of Penchalakona WF, 06 Feb. 2017, 52267, AS; KDP Dt., LM WLS, Lankamala RF, 01 Dec. 2019, 57053, AS.

### Distribution

World: Endemic to India: Darjeeling and Manipur.

*Hyophila perannulata* Ren. et Card. in Bull. Soc. R. Bot. Belg., 34(2): 60. 1896; *Hyophiladecolyii* Broth. in Par. in. index Bryol. Suppl. 190. 1990; Gangulee, Mosses Eas. India. 1(3): 684-685.1971.

Plants small, dioicous, caespitose, green, usually simple plants upto 8 mm high, showing proliferation from tips so that leaves are in interrupted clusters, presenting an annulated appearance.

Leaves erectopatient to spreading, curled and involute when dry, broadly ligulate,  $2.8 - 3.5 \times 0.45 - 0.52$  mm wide in the rectangular, hyaline, sheathing base (about 1/3 of the leaf in length), up to 0.7 mm wide in the upper lamina, apex broadly acuminate in a mucro; margin unbroken and usually flat when moist, not denticulate. Costa light brown, up to 115  $\mu$ m wide at base, excurrent in the mucro.

Apical leaf cells chlorophyllose, irregularly rounded-hexagonal, multipapillate, obscure, 8 – 9  $\mu$ m in diameters wide (shorter  $\pm$  7  $\mu$ m wide near tip); upper margin shows a row of transverse, mildly crenulate cells. Leaf base formed of lax, thin walled, smooth, pellucid, 70 -80  $\times$  10 – 11  $\mu$ m near costa base, becoming shorter and narrower towards margin. Sporophyte apical, erect, up to 1.4 cm long, yellowish. Capsule brown, erect, cylindrical and sometimes slightly curved, 2. 2 – 2.5 mm long  $\times$  0.4 – 0.5 mm in diameter. Peristome absent. Spores light brown, finely papillose, up to 25  $\mu$ m in diameter.

### Habitat and ecology

Terricolous or rupicolous on moist rocks or cement walls in semi or dry deciduous forests, associated with other mosses or monodominant.

### Distribution

World: Endemic to India: Assam, Manipur, Meghalaya and West Bengal.

### Specimens examined

VSKP Dt., hill tops of Simhachalam, 23 Oct. 2018, 55252B & 55256B, AS; KDP Dt., Nitya Pooja Kona, 02 Dec. 2019, 57057, AS.

*Tortella alpicola* Dixon, Ann. Bryol. 3: 54. 1929; Chopra R.S. Tax. of Indian mosses: 122. 1975.

Plants small to medium, yellowish-green to green above, brown below. Stem slender up to 1.5 cm high, usually branched or unbranched, leaves fragile, closely to loosely arranged. Leaves erect to spreading when moist, except the youngest plants, leaves usually fallen, incurved-circinate and weakly contorted when dry; gradually long-lanceolate  $4 - 6 \times 0.4 - 0.5$  mm, with undifferentiated base, margin plane or in some leaves weakly undulate, narrowly acuminate apex, costa short excurrent, Leaf basal cells hyaline with thin walls, rectangular, 18 – 23  $\times$  16 – 19  $\mu$ m, shortening towards top; one layer of transparent marginal cells (becoming short upwards) persists to a little behind apex. Upper lamina cells chlorophyllose, highly papillose and obscure, comes down to the leaf base forming a V-shaped notch, irregularly quadrate, 8 – 10  $\mu$ m wide in diameter; perichaetial leaves shown distinct difference in dry condition, long-lanceolate to linear-lanceolate with fragile tip. Sporophytes are not seen.

### Habitat and ecology

Terricolous, on soil cuttings of deep shade in semi-evergreen forests, associated with *Asterella kashiana* (Aytoniaceae).

### Distribution

World: Canada, Italy, Russian Federation, United States and India: Kashmir and Western Himalaya.

### Specimens examined

EG Dt., Amruthadhara WF, 22 Nov. 2018, 55809B, AS; EG Dt., PKNP near Vaali and Sugreevula MPCA, near Vaali and Sugreevula temple, 22 Nov. 2018, 55827B; 55829B; 55832B; 55833D; 55835B & 55839B, AS.

*Tortella fragilis* (Hook. & Wilson) Limpr., Laubm. Deutschl. 1: 606 1888; *Didymodon fragilis* Hook. & Wils. in Drumen, in Musci Bor. Am: 127. 1828; *Tortula fragilis* (Hook. & Wils.) Wils. in Hook. J. Bot. 3: 437. 1841; *Trichostomum fragile* (Hook & Wills.) C. Mull. in Syn. 1: 586. 1849; *Barbula fragilis* (Hook & Wills.) B.S.G. in Bryol. Eur., 6: 157, 639. 1855. hom. illeg.; *Campylous hartmanii* Schimp. ex. C. et. R. Hartman in Bot. Not. 1855: 49. 1855; *Tortula drummondii* Mitt. in Musc. Ind. Or.: 27. 1859; *Barbula drummondii* (Mitt.) Mild. In. Bryol. Siles. 1: 124. 1869; *Mollia fragilis* (Hook. & Wills.) Lindb. in Musc. Scand. n. 21. 1879; *Trichostomum lanchobasis* C. Muell. in N. Giorn. Bot. Ital. n. Ser., 3: 102. 1896; Gangulee, Mosses Eas. India and adjacent regions. 1(3): 664 – 665. 1972.

Plants medium to large, elongated, unbranched plants up to 3 cm high, yellowish green to green above, brownish to reddish-brown below, with covered by reddish tomentose. Uniformly covered by erectopate and erectospreading canaliculate leaves which are slightly curled with raised tips and more appressed to stem when dry.

Leaves 5 – 7 × 0.6 – 0.85 mm, transparent erect, sheathing, concave base into a carinate, falcate-spreading, pointed subula; margin smooth and flat, often wavy at base, folded in the top part; pointed at apex almost smooth. Costa of a deeper color, up to 115 µm wide at base, excurrent in a transparent tip. Leaf basal cells hyaline with thin walls, rectangular, 20 – 26 × 18 – 20 µm, shortening towards top; one layer of transparent marginal cells (becoming short upwards) persists to a little behind apex. Upper lamina cells chlorophyllose, highly papillose and obscure, comes down to the leaf base forming a V-shaped notch, irregularly quadrate, 8 – 10 µm wide, 2 or 3 layers thick in the subula. Sporophyte not seen.

### Habitat and ecology

Found on soils in moist and dry places of moist and dry deciduous forests, associated with *Asterella angusta* and other mosses.

### Distribution

World: Antarctica, Canada, China, Democratic Republic of the Congo, Greenland, Hawaiian Isl, Japan, Lesotho, Mongolia, New Zealand, Rwanda, South Africa, United States and India: Kashmir, Sikkim and Western Himalaya.

### Specimens examined

VSKP Dt., Gudem, 27 Nov. 2017, 53849B, AS.

*Weissia wimmeriana* (Sendtn.) Bruch & Schimp., Bryol. Eur. 1: 64 (fasc. 33 – 36 Mon. 4.1) 1846; Chopra R.S. Tax. of Indian mosses: 125. 1975.

Plants small, yellowish green to green above, brown below, stem erect up to 7 mm high. Leaves erect to spreading when moist, curled to crumpled when dry, densely arranged, large at apical portion of plat, linear-lanceolate, 1.4 – 2 × 0.3 – 0.35 mm, leaf and margin slightly undulate, margin involute to serrulate above, entire at base apex cucullate (or) hooded, leaf cells quadrate to hexagonal, apical leaf cells 14 – 17 × 8 – 11 µm, middle cells hexagonal to rounded, 8 – 11 µm in diameter wide, basal cells slightly narrower rectangular, pointed ends, 42 – 48 × 7 – 9 µm. Costa prominent, strong, brown, excurrent. Sporophytes present on apical portion of plant. Seta erect, light reddish brown, up to 6 mm long. Capsule erect, reddish brown, urn up to 0.8 – 1.2 × 0.4 – 0.5 mm in diameter. Operculum conical with elongated and slightly bent at apex, up to 1 mm high. Calyptra cucullate, it covers almost to the base of the capsule, peristome absent. Spores warty, rounded to red-brown to 18 µm in diameter.

### Habitat and ecology

Terricolous on moist soil, near water streams, moist and dry deciduous forests, monodominant or sometimes associated with *Riccia sorocarpa* (Ricciaceae).

### Distribution

World: Europe, Pakistan and India: Kashmir

**Plate.1** Legend: A - D. *Barbula marginatula* C. Muell. ex. Gangulee, E & F. *Hyophila kurziana* Gangulee, G – H. *Hyophila perannulata* Ren. et Card, J. *Tortella alpicola* Dixon, K. *Tortellafragilis* (Hook. & Wilson) Limpr. and L – N. *Weissia wimmeriana* (Sendtn.) Bruch & Schimp.



**Specimens examined**

NLR Dt., hill top of Penchalakona, 07 Feb. 2017, 52273C; 52275; 52278; 52282E; 52284C & 52286B, BR & AS; CTR Dt., Rangampeta RF, 21 Feb. 2017, 53305B,

AS; CTR Dt., Kondalloadaram RF, 22 Feb. 2017, 53308, AS; CTR Dt., near Krishna BilasaPuramu, Nagulakona RF, 23 Feb. 2017, 53320, BR & AS; CTR Dt., Kailasakona hill top, 25 Feb. 2017, 53334B & 53336, AS; PKSM Dt., NLM, Yerragondapalem Range, on the

way of Palutla, near Bavipenta Basecamp, 26 Oct. 2017, 53646, BR & AS; Palutla, 26 Oct. 2017, 53649, AS; PKSM Dt., NLM, ca. 40 km interior in NLM near Krishna River, Palanka WF, 27 Oct. 2017, 53654 & 53655A, BR & AS; KNL Dt., NLM, GBM WLS, Nagula Gundam near GBM, 29 Dec. 2017, 53958B, AS; PKSM Dt., NLM, Chinnarutla, 05 Feb. 2018, 53977, AS; WG Dt., Polavaram RF, near Polavaram project area, 11 Feb. 2018, 53979B & 53981, AS; NLR Dt., hill top of Penchalakona, near koneru, 13 Nov. 2018, 55275, AS; EG Dt., near Rampachodavaram, hill tops of Gopalapatnam reservoir, 21 Nov. 2018, 55298, AS; EG Dt., PKNP, near Vaali and Sugreevulateple, Vaali and Sugreevula MPCA, 22 Nov. 2018, 55824B, AS; ATP Dt., Samrajyamkonda, 55887B; 55888B & 55891B, AS.

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