

THREE NEW RECORDS OF LIVERWORTS FOR HIMALAYAN REGION FROM MEHAO WILDLIFE SANCTUARY, ARUNACHAL PRADESH

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ABSTRACT

Three liverworts, *Lophocolea muricata* (Lehm.) Nees (Geocalycaceae), *Cololejeunea jelinekii* Steph. and *C. nilgiriensis* G. Asthana & S.C.Srivast. (Lejeuneaceae) are described from Mehao Wildlife Sanctuary, Arunachal Pradesh. All the species are being reported for the first time from the Himalayan region.

Keywords : *Cololejeunea jelinekii*, *Cololejeunea nilgiriensis*, *Lophocolea muricata*, Himalaya region, Liverworts, New Records.

INTRODUCTION

The ongoing taxonomic studies on the liverworts of Mehao Wildlife Sanctuary, Arunachal Pradesh revealed the occurrence of *Lophocolea muricata* (Lehm.) Nees (Geocalycaceae), *Cololejeunea jelinekii* Steph. and *C. nilgiriensis* G. Asthana & S.C.Srivast. (Lejeuneaceae). Of these, while *Lophocolea muricata* and *Cololejeunea nilgiriensis* are so far known in Indian bryoflora from Western Ghats (Srivastava & Srivastava, 2002; Asthana & Srivastava, 2003) only, *Cololejeunea jelinekii* is known from Nicobar Islands (Asthana & Srivastava, 2003). The same are described and illustrated for the first time from Himalayan region in general and the state of Arunachal Pradesh in particular.

DESCRIPTION AND DISCUSSION

Key to the species

- 1a. Leaves simple, succubous, sub-opposite to opposite, ventrally free or united narrowly to broadly with adjoining underleaf bases on one or both sides; female bracts and bracteoles often larger or as large as the leaves and underleaves; whole plant surface covered with acute spines ... 1. *Lophocolea muricata*
- 1b. Leaves complicate bilobed, incubous, alternate, ventrally free; underleaves absent; female bracts sometimes similar to vegetative leaves or larger, bracteoles absent; leaf surface covered with blunt or subacute papillae ... 2
- 2a. Leaves slightly contiguous – distant, widely – slightly obliquely spreading; lobules up to 2/5 of lobe length, first tooth 1-2-celled, second tooth blunt; gemmae present ... 2. *Cololejeunea jelinekii*
- 2b. Leaves distant, obliquely spreading; lobules c. 1/2 or more than 1/2 of lobe length, first tooth 1-celled, second tooth subacute – obtuse, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X'; gemmae absent ... 3. *Cololejeunea nilgiriensis*

1. *Lophocolea muricata* (Lehm.) Nees in Gottsche & al., Syn. hepat. 169. 1845; Abha Srivast. & S.C.Srivast., Indian Geocalycaceae 162. 2002. *Jungermannia muricata* Lehm. in Linnaea 4 : 363. 1829.

Chiloscyphus muricatus (Lehm.) J.J.Engel & R.M.Schust. in Nova Hedwigia 39 : 419. 1984. (Figs. 1; 4 A, B).

Plants delicate, prostrate, light yellowish green - pale brownish green, 7 - 10 mm long, 1.07 - 1.3 mm wide, rarely branched; branches lateral intercalary. Stem dorso-ventrally symmetrical, dorsal surface spinose, oval in outline in cross section, $0.1 - 0.2 \times 0.15 - 0.2$ mm, 8 - 10 cells across; cells undifferentiated, subquadrate-rectangulate - ovate, thin-walled; cortical cells $8 - 20 \times 8 - 18$ μ m; medullary cells $8 - 28 \times 8 - 24$ μ m. Leaves alternate, imbricate, obliquely inserted, adaxially convex, ovate - quadrate to subtrapezoid, 0.4 - 0.9 mm long, 0.3 - 0.5 mm wide, bilobed, sometimes 3-lobed; lobes unequal, 8 - 17- cells long, 1 - 2-cells uniseriate at apex, 5 - 13 cells wide at base; dorsal margin straight, ventral margin slightly arched, margin and dorsal leaf surface covered with erect, acute spines; spines 1 - 3-cells long; leaf cells undifferentiated, subquadrate - polygonal, thin-walled with minute, triradiate trigones; apical lobe cells $10 - 16 \times 12 - 16$ μ m; marginal leaf cells $14 - 18 \times 10 - 14$ μ m; median leaf cells $14 - 26 \times 8 - 18$ μ m; basal leaf cells $22 - 40 \times 12 - 22$ μ m. Underleaves distant, free or connate with the adjoining leaves on one side of its base only, 0.2 - 0.37 mm long, 0.18 - 0.33 mm wide, bilobed up to 1/3 - 1/2 of underleaf length; lobes slightly divergent, narrow, 8 - 16 cells long, 4 - 9 cells wide at base, (2-) 3 - 6 cells uniseriate at apex, sinus narrow; lamina 4 - 7-cells long, 12 - 20-cells wide, with or without 1(-2) tooth at one or both lateral margins, tooth (1) 2 - 3 cells long, uniseriate throughout, a hyaline cell present at the apex of the lobes of teeth; entire margin and surface of underleaves covered with acute, 1-2-celled spines. Rhizoids in bunch at underleaves bases, branched at apices.

Dioecious. Male plants not seen. Gynoecia terminal on main shoot; bracts oblong, 0.5 - 0.6 mm long, 0.3 - 0.4 mm wide, bilobed, surface and margin covered with spines; bracteoles ovate, 0.4 - 0.5 mm long, 0.31 - 0.36 mm broad, bilobed 1/3 - 1/2 of its length, margins and surface covered with spines; perianth oblong, cylindrical, 0.9 - 1.2 mm long, 0.5 - 0.6 mm wide, mouth broad, 1/4 trilobed, 3-plicate; plicae extending up to 1/2 of perianth length from base towards apex; margins and surface covered with spines. Mature sporophyte not seen.

Habitat : Epiphytic, growing in moist and shady conditions in temperate forests.

Distribution : India : [Eastern Himalaya (Arunachal Pradesh - present study), Western Ghats (Tamil Nadu)], Indonesia, New Guinea, New Zealand, Australia, Africa (Srivastava & Srivastava, 2002).

Specimens examined : India : Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley district, Mehao Wildlife Sanctuary, Mayodia Top, c. 2850 m, 18.11.2000, D.K. Singh 98220 (BSD); Mehao Lake - Gahori camp, c. 2450 m, 25.11.2000, D.K. Singh 98434 (BSD).

Lophocolea muricata is characterized by dioecious, light yellowish green - pale brownish green plants with all parts densely covered with erect, acute spines (Fig. 4 A, B); obliquely inserted, adaxially convex, ovate - quadrate to subtrapezoid leaves (Fig. 1 : 4 - 12); underleaves, either free or connate at base with adjoining leaves only on one side (Fig. 1 : 17 - 22) and oblong, cylindrical, 3-plicate perianth with plicae extending up to 1/2 the perianth length from base (Fig. 1 : 1, 2). The species was so far known in Indian bryoflora from Western Ghats alone.

2. Cololejeunea jelinekii Steph. in Hedwigia 34 : 249. 1995; G. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 60 : 64. 2003. *Leptocolea jelinekii* (Steph.) Steph. in Sp. hepat. 5 : 851. 1916. (Figs. 2; 4 C, D).

Plants yellowish green in herbarium, appressed to the substratum, minute, 1.3 - 3.5 mm long, 0.5 - 0.65 mm wide, pinnately branched. Stem in cross section suborbicular - elliptic in outline, 0.04 - 0.05 mm; cortical cells in 5 (- 6) vertical rows, quadrangular - obtrapezoid, $16.0 - 26.0 \times 12.0 - 22.0$ μ m, thin-walled; medullary cell 1, polygonal, $12.0 - 14.0 \times 14.0 - 16.0$ μ m; ventral merophytes 3 cells wide. Leaves incubous, alternate, slightly contiguous - distant, widely - slightly obliquely spreading at an angle of 30 - 40° from the stem; leaf lobes oblong-ovate, 0.2 - 0.4 mm long, 0.16 - 0.27 mm wide, apex widely - narrowly obtuse, rounded; margin crenate due to projecting cells, dorsal margin arched, ventral margin nearly straight - slightly wavy; leaf cells dorsally papillose, thin-walled with indistinct trigones, intermediate thickenings absent; dorsal papillae blunt, 8.0 - 12.0 μ m high; apical leaf cells rectangular - quadrate, $8.0 - 14.0 \times 8.0 - 12.0$ μ m; median leaf cells polygonal, $10.0 - 14.0 \times 12.0 - 20.0$ μ m; basal leaf cells polygonal, slightly elongated, $24.0 - 46.0 \times 14.0 - 20.0$ μ m; lobules ovate, inflated, 0.11 - 0.15 mm long, 0.06 - 0.09 mm wide, up to 2/5 of lobe length,

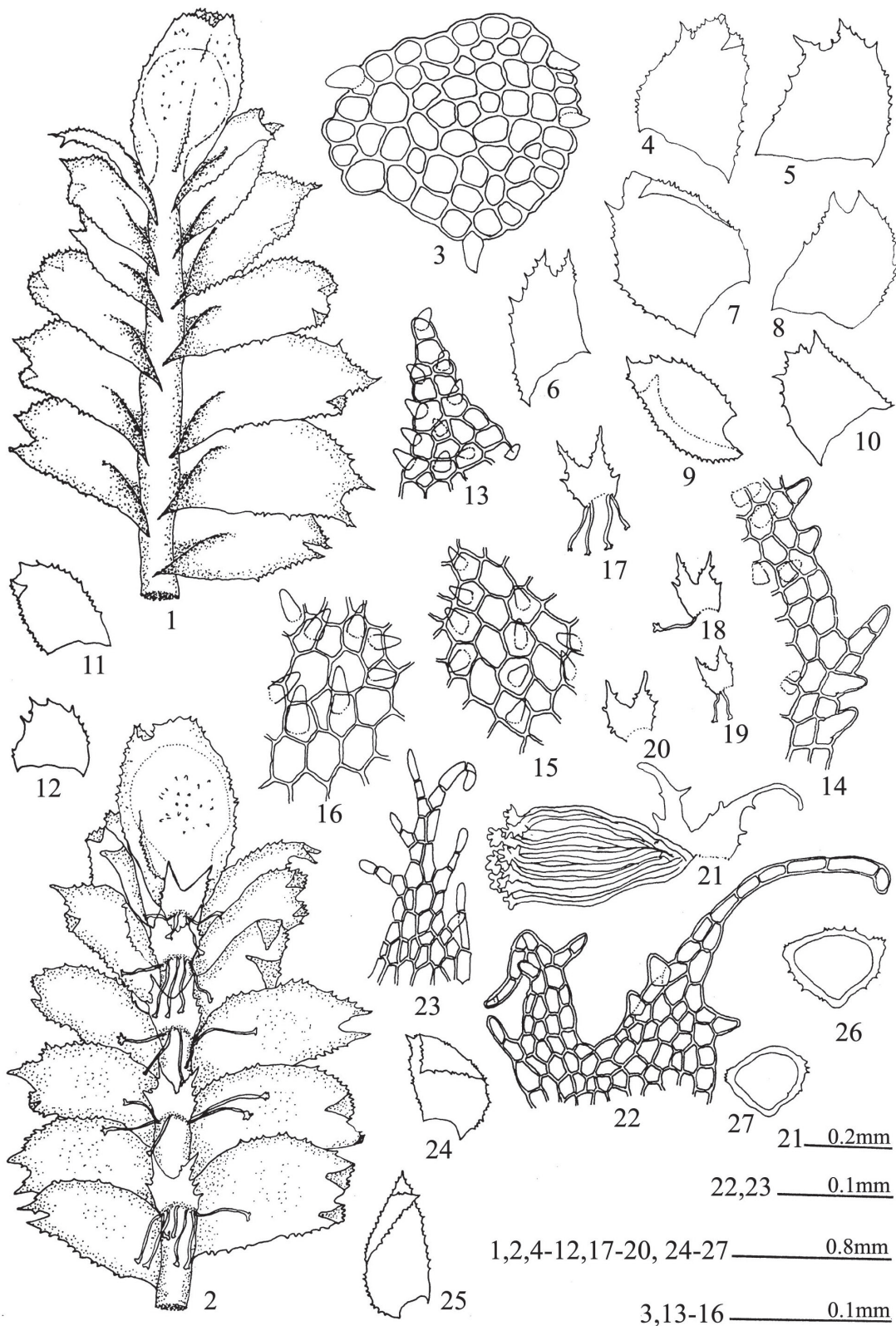


Fig. 1. *Lophocolea muricata* (Lehm.) Nees : 1. A portion of female plant with perianth in dorsal view; 2. The same in ventral view; 3. T. S. of stem; 4-12. Leaves; 13. Apical lobe cells of leaf; 14. Marginal cells of leaf; 15. Median cells of leaf; 16. Basal cells of leaf; 17-20. Underleaves; 21. The same enlarged showing fasciculated rhizoids at the base; 22. The same enlarged; 23. Apical cells of underleaf lobe; 24 & 25. Female bracts; 26 & 27. T.S. of perianth.

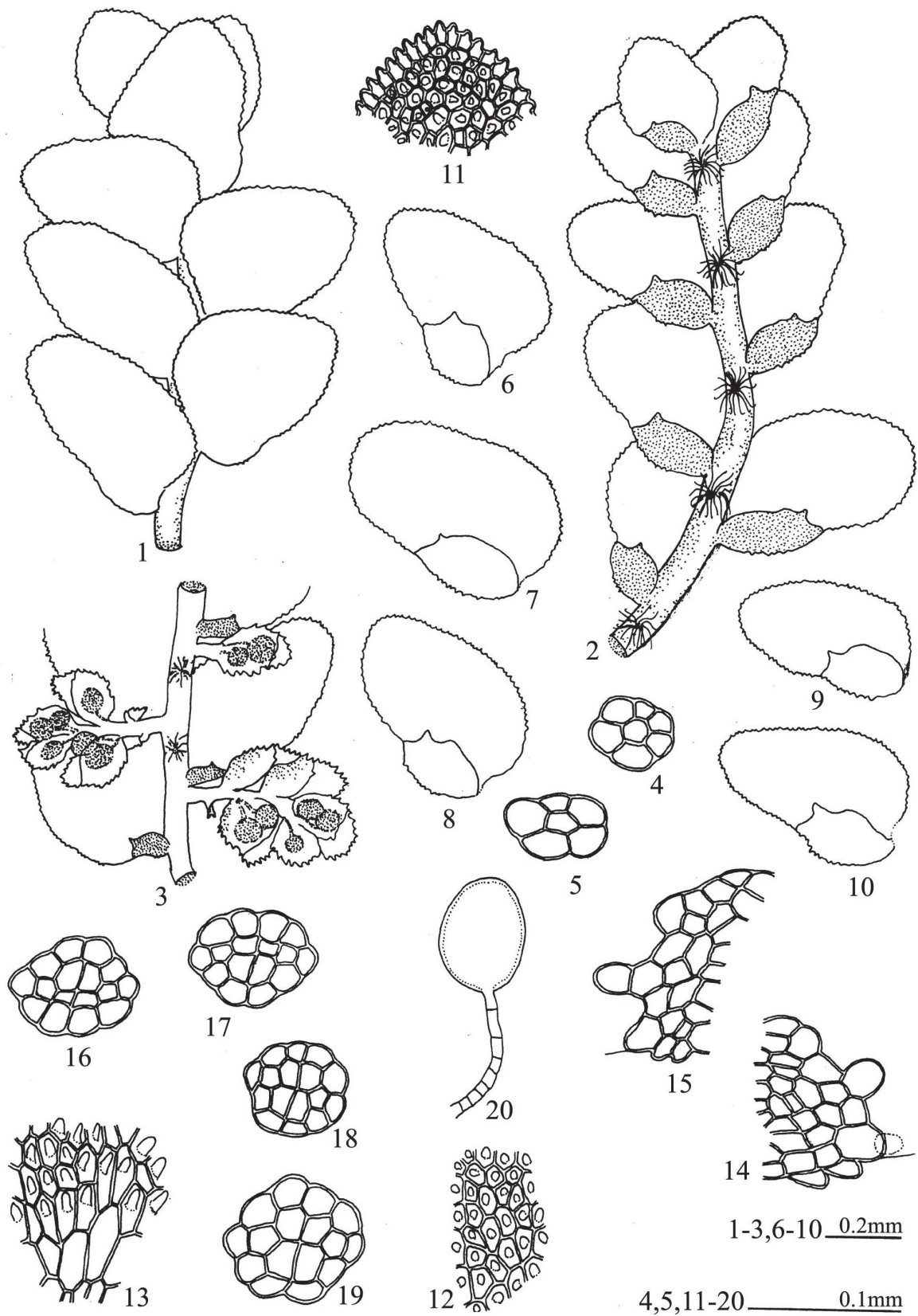


Fig. 2. *Cololejeunea jelinekii* Steph. : 1. A portion of vegetative plant in dorsal view; 2. The same in ventral view; 3. A portion of male plant with androecial branch in ventral view; 4 & 5. T. S. of stem; 6 - 10. Leaves; 11. Apical cells of leaf; 12. Median cells of leaf; 13. Basal cells of leaf; 14 & 15. Leaf lobules; 16-19. Gemmae; 20. A single antheridium.

2-dentate, first tooth prominent, angular, 1 -2-celled, second tooth blunt, 1-celled, hyaline papillae indistinct. Rhizoids fasciculate, hyaline, forming rhizoidal disc on ventral stem surface. Gemmae present on dorsal leaf lamina, discoid, 64 - 84 µm in diameter, with 3 mamilllose adhesive cells.

Monoecious (?). Androecia terminal on short lateral branches; male bracts in 3 - 4 pairs, ovate, inflated, margin crenate; antheridia 1 - 2 per bract, globose, c. 60 µm in diameter, stalk uniseriate, 8 - 9 cells long. Gynoecia not seen.

Habitat : Epiphyllous, growing densely all over the angiosperm leaf surface under moist and shady conditions.

Distribution : India : [Eastern Himalaya (Arunachal Pradesh - present study); Andaman & Nicobar Islands (Nicobar Islands)], Malaysia, New Guinea (Asthana & Srivastava, 2003).

Specimens examined : India, Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley, Mehao Wildlife Sanctuary, 4 km from Tewarigaon towards Mayodia, c. 2000 m, 20.02.2006, *M. Dey & S. Das* 38618, 38619, 38620, 38622, 38623, 38624, 38625, 38626, 38627 (CAL); 2 km from Tewarigaon towards Mayodia, c. 1700 m, 20.02.2006, *M. Dey & S. Das* 38628, 38634, 38637 (CAL); 1 km from Tewarigaon towards Mayodia, c. 1500 m, 20.02.2006, *M. Dey & S. Das* 38639, 38640, 38641, 38642, 38643, 38645, 38648, 38649 (CAL); Tewarigaon, c. 1500 m, 20.02.2006, *M. Dey & S. Das* 38658, 38659, 38660 (CAL).

Cololejeunea jelinekii, belonging to the subgenus *Cololejeunea* Benedix., is characterized by minute plants with oblong-ovate leaves (**Fig. 2 : 6 - 10**); densely papillose leaf surface (**Fig. 2 : 11 - 13**; **Fig. 4C, D**); 1 - 2-celled first tooth of lobule (**Fig. 2 : 14, 15**); discoid gemmae with three mamilllose cells (**Fig. 2 : 16 - 19**); terminal male inflorescence on short lateral branches with inflated male bracts bearing 1 - 2-antheridia (**Fig. 2 : 3**). Earlier the species was known in Indian bryoflora from Nicobar Islands only.

3. *Cololejeunea nilgiriensis* G. Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60 : 27. 2003. (**Figs. 3; 4E, F**).

Plants whitish - light yellowish green in herbarium, appressed to the substratum, minute, 1.5 - 2.0 mm long, 0.5 - 0.6 mm wide, rarely branched. Stem in cross section triangular - elliptic in outline, 0.04 - 0.05 mm; cortical cells in 5 vertical rows, quadrangular - obtapezoid, 14.0 - 20.0 × 8.0 - 14.0 µm, thin-walled; medullary cell 1, polygonal, 12.0 - 14.0 × 8.0 - 10.0 µm; ventral merophytes 2-cells wide. Leaves incubous, alternate, distant, obliquely spreading from stem at an angle of 30 - 40°; leaf lobes oblong-ovate, 0.2 - 0.3 mm long, 0.12 - 0.16 mm wide, apex narrowly rounded; margin crenate due to projecting cells, dorsal margin arched, ventral margin nearly straight; leaf cells dorsally papillose, thin-walled with feeble trigones; intermediate thickenings absent; marginal spinose leaf cells quadrangular, 14.0 - 20.0 × 12.0 - 14.0 µm; median leaf cells polygonal, 10.0 - 20.0 × 12.0 - 22.0 µm; basal leaf cells polygonal, slightly longer than median cells, 20.0 - 56.0 × 10.0 - 14.0 µm; lobules large, ovate, inflated, 0.12 - 0.16 mm long, 0.06 - 0.10 mm wide, c. 1/2 or more than 1/2 of lobe length, 2-dentate; first tooth angular, 1-celled, second tooth subacute - obtuse, also 1-celled, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X'; lobule margin crenulate. Rhizoids fasciculate, hyaline, forming rhizoidal disc on ventral stem surface. Gemmae absent. Fertile plants not seen.

Habitat : Epiphyllous, growing on angiosperm leaf surfaces under moist and shady conditions.

Distribution : India : [Eastern Himalaya (Arunachal Pradesh - present study), Western Ghats (Tamil Nadu)], endemic (Asthana & Srivastava, 2003).

Specimen examined : India : Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley, Mehao Wildlife Sanctuary, 6 km from Tewarigaon towards Mayodia, c. 2000 m, 20.02.2006, *S. Das & M. Dey* 38609 (CAL).

Cololejeunea nilgiriensis, belonging to the subgenus *Aphanolejeunea* (A. Evans) Benedix., is characterized by whitish - light yellowish green plants with oblong-ovate leaves with narrowly rounded apex and crenate margin (**Fig. 3 : 5 - 10**); densely papillose leaf surface (**Fig. 3 : 11 - 13**; **Fig. 4E, F**); large, ovate lobule, c. 1/2 or more than 1/2 of lobe length; angular, 1-celled first tooth and subacute - obtuse, 1-celled second tooth, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X' (**Fig. 3 : 14 - 16**). The species is endemic to India and was so far known from Western Ghats alone.

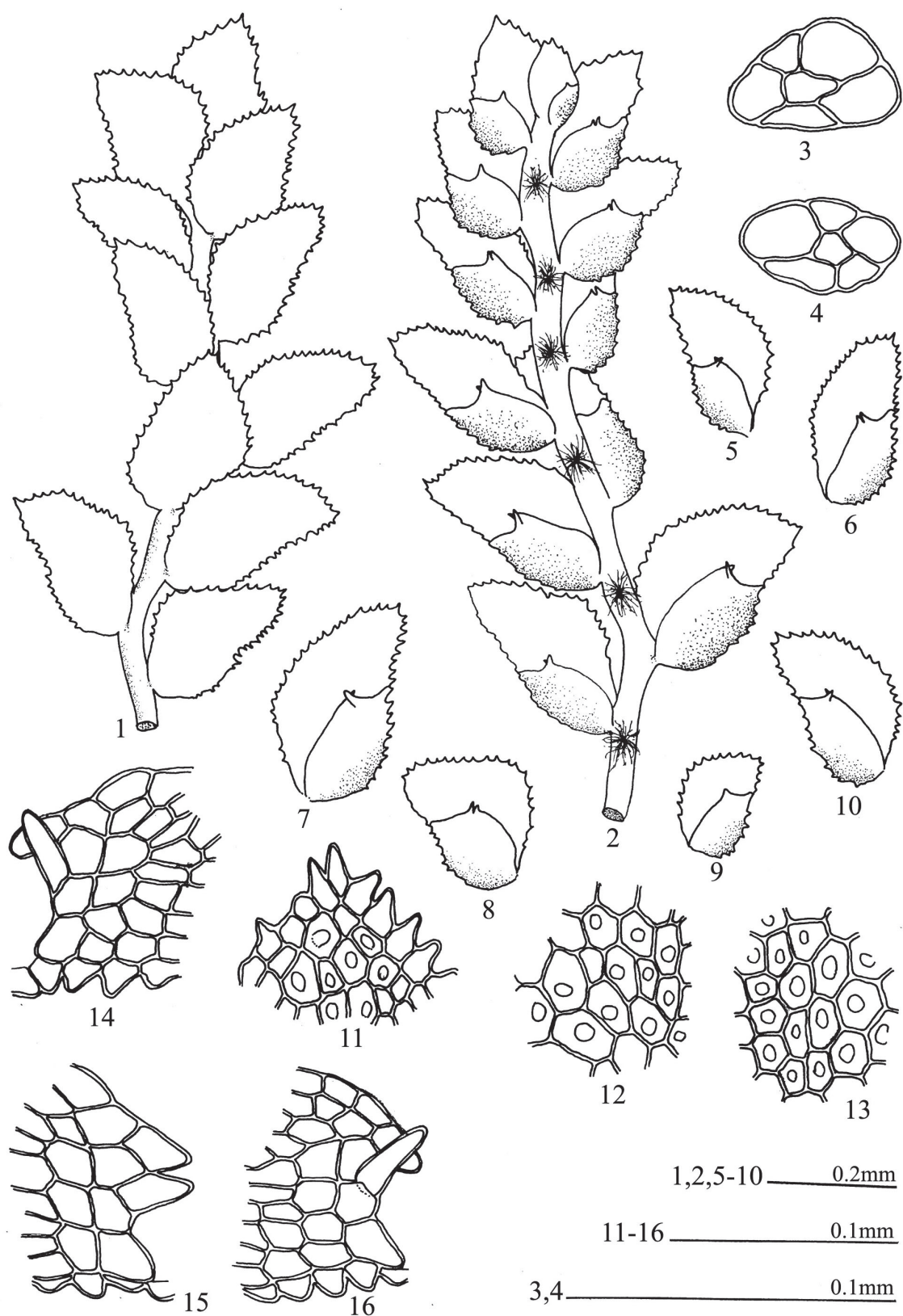


Fig. 3. *Cololejeunea nilgiriensis* G. Asthana & S.C. Srivast. : 1. A portion of vegetative plant in dorsal view; 2. The same in ventral view; 3 & 4. T.S. of stem; 5-10. Leaves; 11. Apical cells of leaf; 12. Median cells of leaf; 13. Basal cells of leaf; 14-16. Leaf lobules.

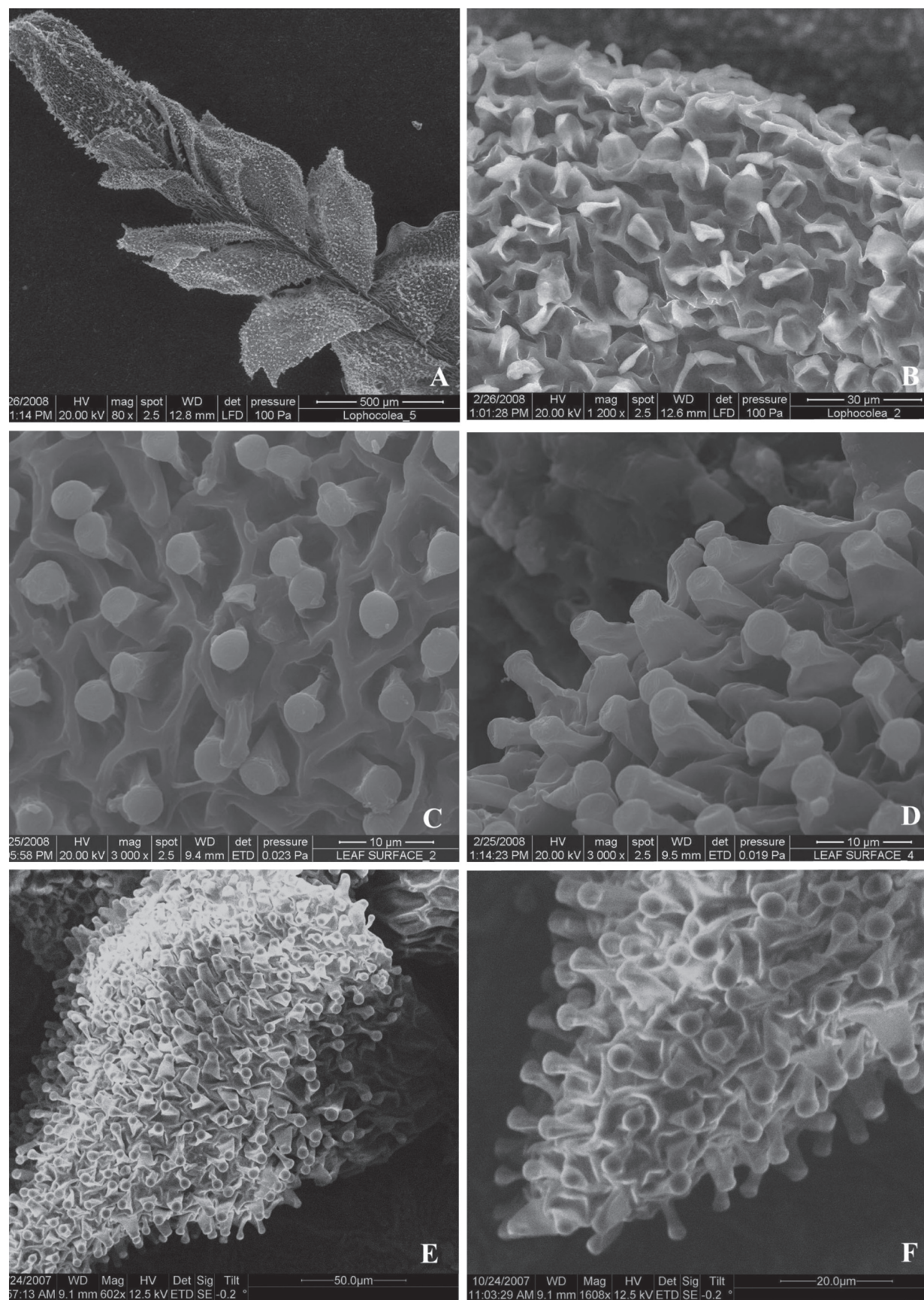
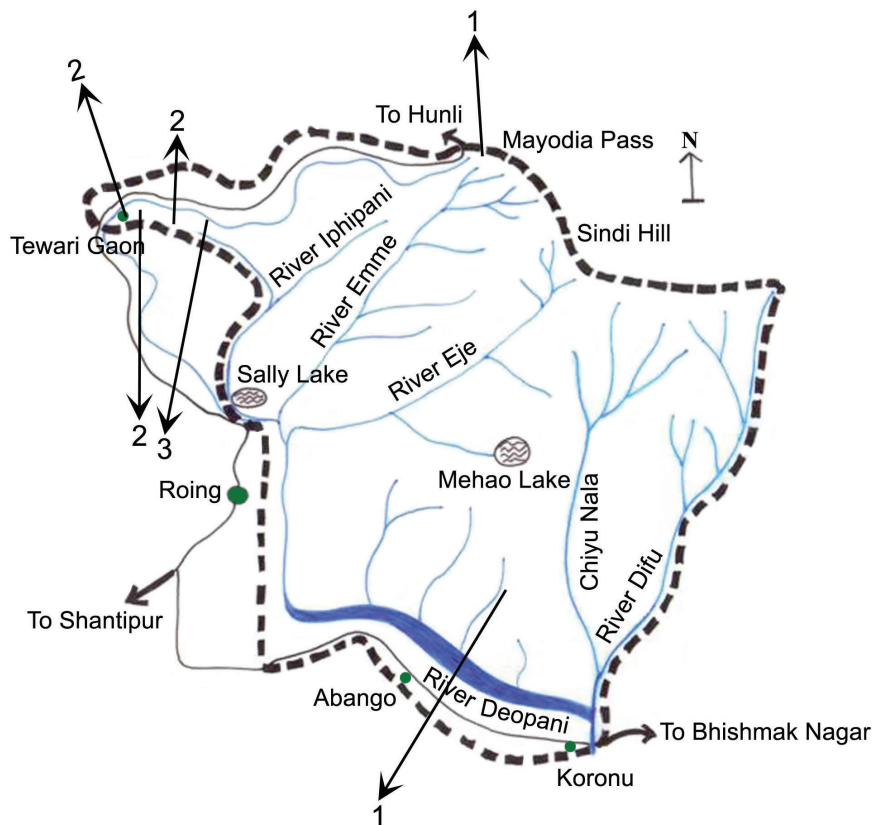


Fig. 4. : Scanning Electron Microscope photographs of plants and leaf surface: A. A portion of the plant of *Lophocolea muricata* with perianth; B. A portion of the leaf of the same enlarged; C & D. *Cololejeunea jelinekii*; E & F. *Cololejeunea nilgiriensis*.



Map of Mehao WLS showing distribution of 1. *Lophocolea muricata*; 2. *Cololejeunea jelinekii* and *Cololejeunea nilgiriensis* (not to scale).

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मेहाओ वन्यजीव अभयारण्य, अरुणाचल प्रदेश से हिमालय क्षेत्र के लिए लिवरवर्ट्स के तीन नये अभिलेख

सुदीपा दास एवं डी.के. सिंह

सार संक्षेप

मेहाओ वन्यजीव अभयारण्य से तीन प्रहरिता (लिवरवर्ट्स) लोफोकोलिआ म्युरिकेटा नीस (जिओकेलिकेसी), कोलोलिज्यूनिआ जेलिनेकी एवं कोलोलिज्यूनिआ नीलगिरिएंसिस (लेज्युनिएसी) के वर्णन किये गये हैं। हिमालय क्षेत्र से इन सभी जातियों की पहली रिपोर्ट है।