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Source: *Lindbergia*, 41(1)

Published By: Dutch Bryological and Lichenological Society and Nordic Bryological Society

URL: <https://doi.org/10.25227/linbg.01110>

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Three new species records of leafy liverworts (Marchantiophyta, Jungermanniadae) to Sri Lanka

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Three species of leafy liverworts are reported new to Sri Lanka: *Heteroscyphus planus* (Mitt.) Schiffn. (Lophocoleaceae), *Drepanolejeunea tricornua* Herzog (Lejeuneaceae) and *Ceratolejeunea cornuta* (Lindenb.) Steph. (Lejeuneaceae). Taxonomic descriptions are provided along with figures. Addition of the three new records increases the total number of leafy liverworts of Sri Lanka from 287 to 290.

Leafy liverworts (Marchantiophyta, Jungermanniadae) are one of the least studied groups among Sri Lankan bryophytes. Information on Sri Lankan leafy liverworts to-date is limited to checklists published based on older published literature and some sporadic collections made in the past (Rubasinghe and Long 2014). Twenty-five families, 64 genera and 286 species of leafy liverworts are recorded from Sri Lanka (Long and Rubasinghe 2014). We report three new additions to the Sri Lankan leafy liverwort flora: *Heteroscyphus planus* (Mitt.) Schiffn. (Lophocoleaceae), *Drepanolejeunea tricornua* Herzog (Lejeuneaceae) and *Ceratolejeunea cornuta* (Lindenb.) Steph. (Lejeuneaceae).

1. *Heteroscyphus planus* (Mitt.) Schiffn., Österreichische Botanische Zeitschrift 60: 171. 1910. ≡ *Chiloscyphus planus* Mitt., J. Linn. Soc. Bot. 8: 157. 1865. Type – Japan. Nagasaki, *Oldham s.n.*, ex hb. K (G not seen) (Schiffner 1910, Piippo 1996) (Fig. 1).

Plants dark green, olive green to light green, leafy shoots 10–30 mm long, 1.25–2.5 mm wide, irregularly branched. Rhizoids hyaline, numerous, fasciculate, usually at base of underleaves on ventral side of the stem, occasionally scattered on ventral surface of the stem, rhizoid disc absent. Leaves longitudinally inserted, rarely distant, ovate to oblong, 0.75–1.40 mm long, 0.5–1 mm wide, apex with 0–5 teeth, irregular, 1–4 cell long, 1–2 (3) cell wide at base, lateral margin entire. Leaf cells thin-walled, trigones small to indistinct, marginal cells subquadrate, 0.01–0.025 × 0.01–0.03 mm, median cells hexagonal, 0.015–0.040 × 0.010–0.030 mm,

basal cells same as median cells. Oil bodies 3–8 per cell, compound, hyaline to grayish, finely or coarsely segmented, knobbed. Underleaves very distant, 1–1.5 times wider as stem, strongly sinuately inserted, deeply bilobed, outer lateral margins usually with one tooth at the base, tooth usually 1–2 cells long, lobes 4–6 cells long, 2–4 cells at base, sinus wide, base decurrent, connate with leaves. Sporophyte, androecia, gynoecia and asexual reproductive organs not seen.

Specimens observed. Central Province: Kandy District, Kitulgala, 6°99'34.8"N, 80°40'58.4"E, alt. 380 m, on a small twig of a creeping plant near stream, *Ruklani & Rubasinghe 262–15SR* (PDA); Kitulgala, 6°99'34.8"N, 80°40'58.4"E, alt. 380 m, on a rock surface, mixed with *Heteroscyphus argutus*, and *Bazzania* sp. near stream, *Ruklani & Rubasinghe 263–15SR* (PDA); Southern Province: Galle District, Kanneliya, near Anagimallaella, 6°25'83.8"N, 80°35'14.5"E, alt. 171 m, on rock surface, *Ruklani & Rubasinghe 322–15aSR* (PDA).

Taxonomic note. Six species of the genus *Heteroscyphus* are known from Sri Lanka: *H. argutus* (Reinw., Blume & Nees) Schiffn., *H. fleischeri* (Steph.) D.G.Long & Rubasinghe, *H. perfoliatus* (Mont.) Schiffn., *H. tener* (Steph.) Schiffn., *H. tridentatus* (Sande Lac.) Grolle (Long and Rubasinghe 2014) and *H. aselliformis* (Reinw., Blume & Nees) Schiffn. (Piippo 1990, Giesenhagen 1910).

Heteroscyphus planus closely resembles *H. argutus* (Reinw. et al.) Schiffn. However the latter can be differentiated in having more numerous teeth at leaf apex (Piippo 1996). *Heteroscyphus planus* can be differentiated from the other recorded species of the genus *Heteroscyphus* by the apical leaf margin with 0–5 irregular teeth (Piippo 1996, Zhu and So 2001).

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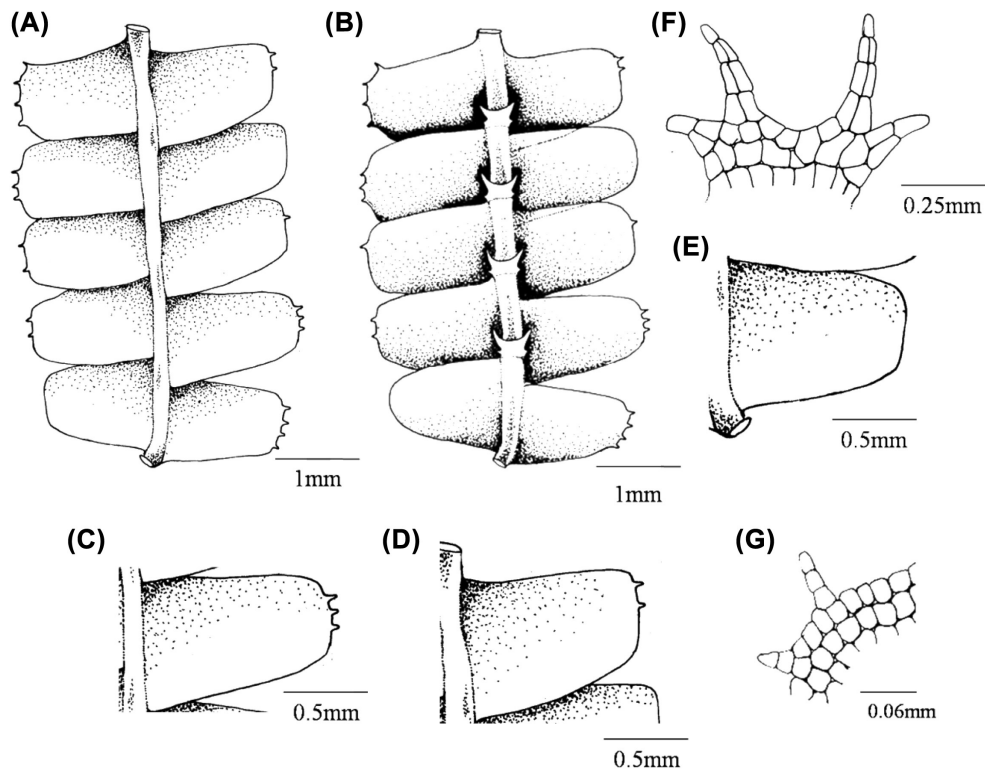


Figure 1. *Heteroscyphus planus* (Mitt.) Schiffn. (A) Part of shoot – dorsal view, (B) part of shoot – ventral view, (C–E) unlobed leaf with marginal dentitions, (F) underleaves, (G) marginal teeth.

Distribution. *Heteroscyphus planus* (Lophocoleaceae) is known from Japan, China (Piippo 1996, Zhu and So 2001), SE Russian Far East (Bakalin 2004, 2010), Nepal (Hattori 1968), Philippines (Tan and Engel 1986) and here from Kitulgala and Kanneliya in Sri Lanka.

2. *Ceratolejeunea cornuta* (Lindenb.) Steph., Die Pflanzenwelt Ost-Afrikas C: 65. 1895. \equiv *Jungermannia cornuta* Lindenb., Acta Nova Acad. Caes. Leop.-Carol. Suppl. 14: 23. 1829. Type – Jamaica. Without locality. On *Grammitis serrulatus*, Swartz s.n. (holotype W, fide Dauphin 2003, not seen) (Stephani 1895) (Fig. 2).

Plants green or brownish green to blackish green, epiphyllous, leafy shoots 0.6–2.0 mm wide. Branching sparse, *Lejeunea*-type. Leaves incubous, ovate with a wide base, mostly asymmetrical, 0.4–0.675 mm long, 0.385–0.625 mm wide, with a large dorsal lobe and a small ventral lobule. Margin near the lobe apex entire or with 0–4 small teeth, 1–2 cells long, one cell or sometimes two cells wide. Marginal leaf cells subquadrate to rectangular, $0.01\text{--}0.027 \times 0.01\text{--}0.017$ mm, median cells isodiametric occasionally elliptical, $0.012\text{--}0.05 \times 0.01\text{--}0.045$ mm, basal cells same as median cells. Leaf lobule usually small ovoid, occasionally enlarged spherical, $1/3$ to $1/5$ of the length of the leaf lobe, free margin plain or involute, apically toothed, single celled, curved, long or short, bulging with a hyaline papillae. Oil bodies present, smooth, spherical to elliptical, *Bazzania*-type, transversely 1–4 septate, usually 2–5 per cell. Ocelli present, large, long hexagonal, $0.037\text{--}0.07 \times 0.018\text{--}0.042$ mm, grayish brown, mostly single and basal-suprabasal. Underleaves large, reniform, margins entire, plane, bifid,

0.15–0.0625 mm long, 0.15–0.7 mm wide. Underleaf lobes slightly acute, ending with a single celled tip, base cordate. Utriculi present, reniform or rounded, solitary or in pairs at the base of branches. Sporophytes, perianths, androecia and gynoecia not seen.

Specimens observed. Southern Province: Galle District, Sinharaja Rain Forest, $6^{\circ}41'05.473''\text{N}$, $80^{\circ}43'47.3''\text{E}$, alt. 639 m on leaves of Bombacaceae, *Ruklani & Rubasinghe 251–15SR* (PDA).

Taxonomic note. *Ceratolejeunea cornuta* is a very variable species, with respect to the length of perianth horns and leaf morphology. The basal-suprabasal ocelli (often one, rarely two), highly reniform, slightly bifid underleaves, paired or singlet occurrence of utriculi at the base of the lateral branchlets are unique characteristics of *C. cornuta* (Evans 1905, Dauphin 2003, Pócs 2011). Recently the species was synonymized with *C. tahitensis* Stephani (known from Tahiti and Philippines) confirming that *C. cornuta* should be considered a pantropical species (Pócs and Chantanaorapint 2015).

Distribution. *Ceratolejeunea cornuta* (Lejeuneaceae) is known from Tropical Africa including Indian Ocean Islands and also commonly found in the neotropical region (Dauphin 2003, Pócs 2011) and here from Sinharaja Rain Forest in Sri Lanka.

3. *Drepanolejeunea tricornua* Herzog, Annales bryologici 9: 124 (1936). Type – Indonesia. Seram, “S.O. Ceram auf. *Oldenhamia auriculata*, bei Wai Tok. 0–100 m, Kornassie

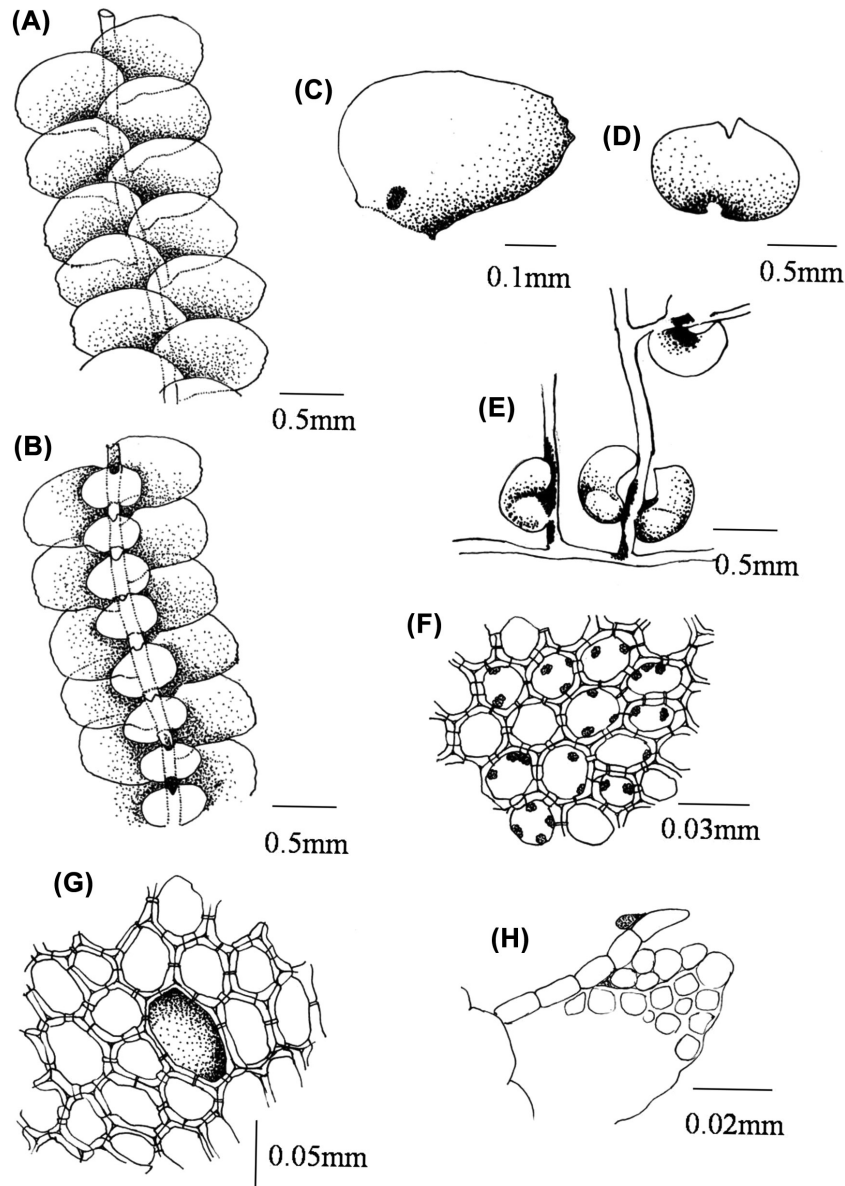


Figure 2. *Ceratolejeunea cornuta* (Lindenb.) Steph. (A) Part of shoot – dorsal view, (B) part of shoot – ventral view, (C) leaf with the basal ocellus, (D) underleaf, (E) paired or single utriculi, (F) median leaf lobe cells with compound oil bodies, (G) ocelli among the cells, (H) hyaline papillae on the terminal tooth like cell of the lobule.

no. 1055/a, 27.2.18 (Herb. H. B. Bog. No 4323 s.n.,)” not seen. (Fig. 3).

Plants light green, leafy shoot 5–20 mm long and 1.0–2.0 mm wide, branching more or less irregular. Rhizoids numerous fasciculate, hyaline and attached at the base of the underleaf, rhizoid disc absent. Leaves incubous, with a large dorsal lobe and a small ventral lobule. Keel connecting lobe and lobule arched and smooth. Leaf lobe ovate to falcate, apex acute, margin serrate with numerous tiny, sharp teeth on both upper and lower margins. Leaf lobe 0.8–0.95 mm long, 0.6–0.725 mm wide. Marginal cells subquadrate, $0.013\text{--}0.022 \times 0.012\text{--}0.018$ mm, median cells hexagonal, $0.025\text{--}0.038 \times 0.014\text{--}0.024$ mm, basal cells similar to median cells in

shape, $0.035\text{--}0.045 \times 0.017\text{--}0.027$ mm. Trigones, very small, intermediate thickenings absent. Ocelli 30–50 per leaf lobe, arranged in to 3–4(5) rows, increasing in size from the apex to the base of the leaf lobe, ocelli near the lobe apex $0.025\text{--}0.037 \times 0.02\text{--}0.03$ mm, median ocelli $0.035\text{--}0.045 \times 0.017\text{--}0.027$ mm, basal ocelli $0.06\text{--}0.07 \times 0.027\text{--}0.037$ mm. Oil bodies present, many per cell, compound type, granular, white-grey. Vitta absent. Leaf lobule strongly inflated, small, oblong, about 1/3rd the length of leaf lobe, lateral free margin incurved, apical free margin bordered by few rectangular to subquadrate cells, tooth small, unicellular, hyaline papilla proximal, oblong. Underleaves distant, lobes spreading horizontally, lanceolate to linear, $0.02\text{--}0.057$ mm long, $0.2\text{--}0.57$ mm wide,

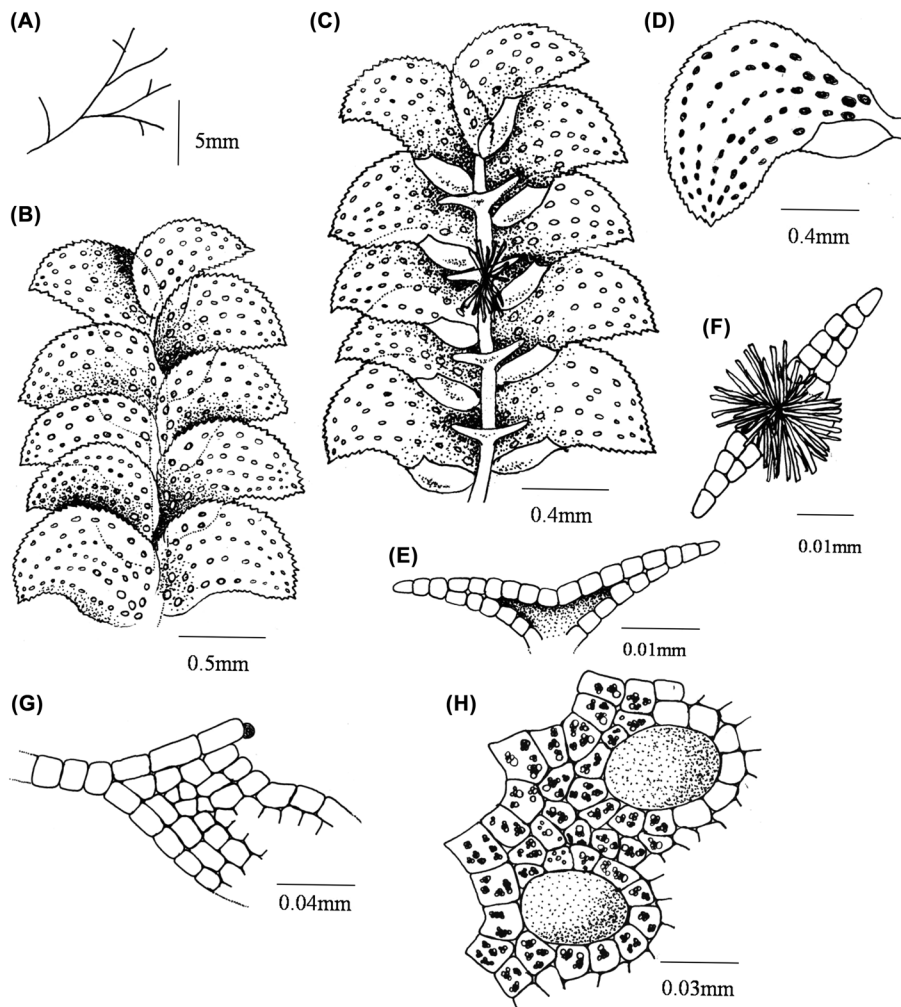


Figure 3. *Drepanolejeunea tricornua* Herzog. (A) Branching pattern of shoot, (B) part of shoot – dorsal view, (C) part of shoot – ventral view, (D) leaf lobe and lobule, (E–F) underleaf, (G) lobule, (H) leaf with normal cells, compound oil bodies and ocelli.

usually of 5–6 linear to rectangular cells. Sporophyte, androecia and gynoecia not seen.

Specimens observed. Southern Province: Galle District, Sinharaja Rain Forest, 6°41'69.7"N, 80°42'40.7"E, alt. 518 m, epiphyllous, especially on leaves of *Canarium zeylanicum* (Burseraceae) mixed with *Drepanolejeunea thwaitesiana*, Ruklani & Rubasinghe 233–15SR (PDA).

Taxonomic note. Nine species and one variety of the genus *Drepanolejeunea* are recorded from Sri Lanka: *D. angustifolia* (Mitt.) Grolle, *D. fissicornua* Steph., *D. fleischeri* (Steph.) Grolle & R.L.Zhu, *D. macrodonta* (Mitt.) Steph., *D. pentadactyla* (Mont.) Steph., *D. tenera* K.I.Goebel, *D. ternatensis* (Gottsche) Schiffn., *D. teysmannii* Steph., *D. thwaitesiana* (Mitt.) Steph., *D. Thwaitesiana* (Mitt.) Steph. var. *zhengii* R. L. Zhu and *D. vesiculosa* (Mitt.) Steph. (Long and Rubasinghe 2014).

Drepanolejeunea tricornua is characterized by sickle shaped (falcate) leaves with dentate- serrate leaf margins, and 3–5 rows of ocelli which appear blackish when fresh (Pócs 2011).

The species is closely related to *D. thwaitesiana*, however *D. tricornua* can be distinguished by its large ocelli ~2 times as large as neighboring cells.

Distribution. The species is known from Cambodia, Indonesia, Borneo, Java, Seram, Fiji Island, New Guinea (Pócs 2011) and Vietnam (Pócs et al. 2013) and here from Sinharaja rain forest in Sri Lanka.

Acknowledgements – The authors wish to thank the staff of the National Herbarium of Peradeniya Botanical Garden, Forest and Wildlife Departments of Sri Lanka for their corporation during the study. *Funding* – Financial assistance by the National Science Foundation, Sri Lanka (grant no: RG/2016/EB/01) is greatly appreciated.

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