

***Drepanolejeunea laciniata* (Lejeuneaceae), a new species from northern Thailand**

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Abstract – *Drepanolejeunea laciniata* Qiong He et R.L. Zhu *sp. nov.*, is described and illustrated from Doi Inthanon National Park, Chom Thong District, Chiang Mai Province, northern Thailand. It is similar to *Drepanolejeunea pulla* (Mitt.) Grolle and *D. erecta* (Steph.) Grolle, but differs mainly in its large leaf lobule that is 1/2-2/3 as long as the leaf lobe, the free lateral lobular margin proximal to the notch bordered by 9-13 rectangular cells, the obovate perianth with dense apical laciniae, and usual presence of median ocelli in the leaf lobe.

Doi Inthanon National Park / *Drepanolejeunea erecta* / *Drepanolejeunea pulla* / epiphyllous liverwort / *Harpalejeunea* / Hepaticae / *Sphagnum bog*

INTRODUCTION

Lejeuneaceae is the largest family of liverworts (Marchantiophyta) with about 1700 currently accepted species distributed among 81 genera (He & Zhu, 2011). *Drepanolejeunea* (Spruce) Schiffn., a mainly tropical and subtropical genus, was established by Schiffner (1893). As the fourth largest genus of Lejeuneaceae (following *Cololejeunea* (Spruce) Schiffn., *Lejeunea* Lib., and *Cheilolejeunea* (Spruce) Schiffn.), it contains about 110 species currently accepted. Most species of the genus are very minute and epiphyllous (Gradstein *et al.*, 2001; Zhu & So, 2001).

During our recent expedition to northern Thailand, we encountered an interesting liverwort on the living leaves of *Rhododendron* in the famous *Sphagnum* bog in Doi Inthanon National Park, Chiang Mai Province (Fig. 1). Detailed observations revealed the usual presence of ocelli in the leaf lobes, a single and strongly curved apical tooth of leaf lobule, pycnolejeunoid gynoeical

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Fig. 1. View of *Rhododendron* covered by dense bryophytes in *Sphagnum* bog in Doi Inthanon National Park, Chiang Mai Province, Thailand. *Drepanolejeunea laciniata* grows on the living leaves and young branches of *Rhododendron*. Photograph Rui-Liang Zhu, 20 Dec. 2011.

innovations, and segmented oil bodies of leaf cells, which are essential features of *Drepanolejeunea*. The Thai plant stands out by the relatively large size (main shoots over 1.2 mm wide), non falcate leaves usually with a subacute apex, rectangular leaf lobules $1/2-2/3$ as long as the leaf lobes, large leaf cells with thin walls and small trigones, obovate perianth with dense laciniae at apex, free lateral lobular margin proximal to the notch bordered by 9-13 rectangular cells, and bilobed underleaves whose lobes are tongue-shaped and erect. It is here described as a species new to science.

TAXONOMIC DESCRIPTION

Drepanolejeunea laciniata Qiong He *et* R.L. Zhu, *sp. nov.*

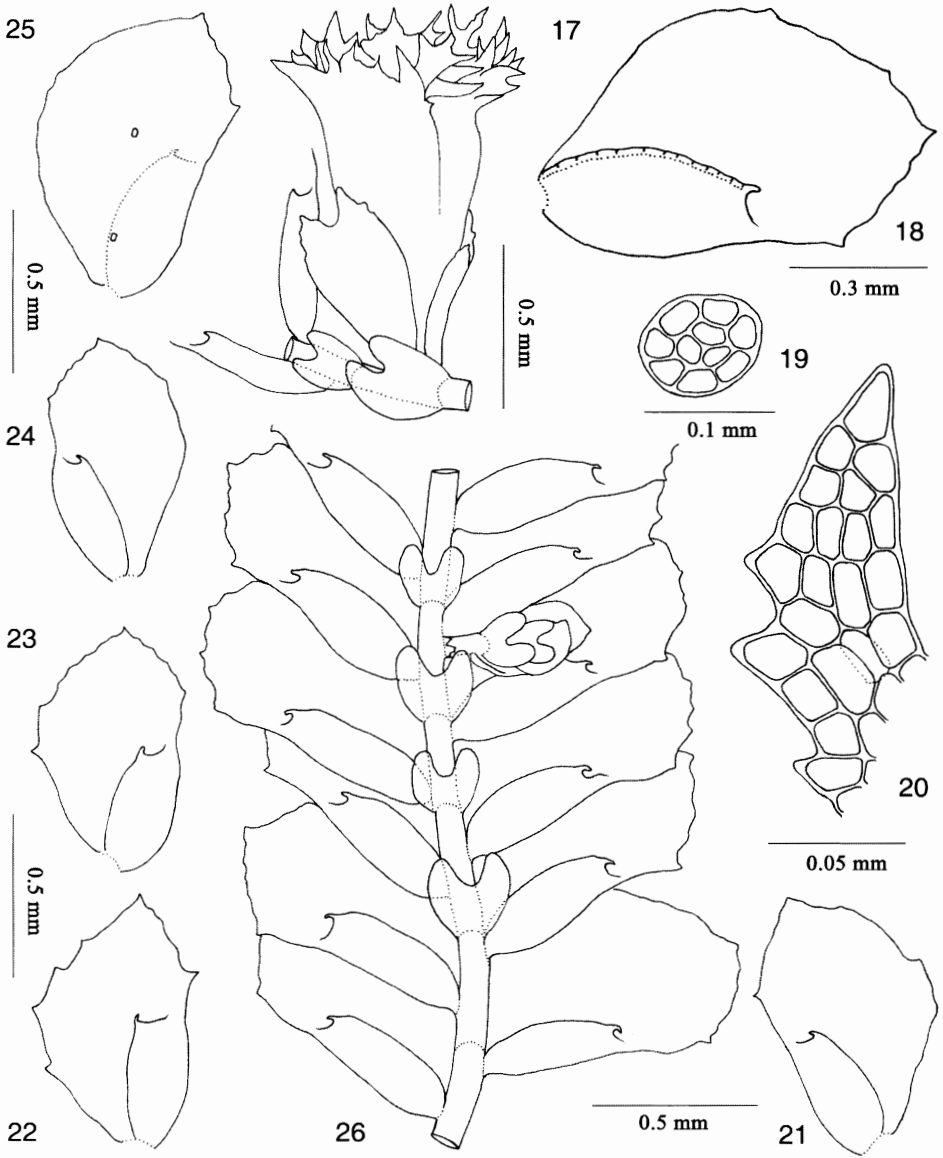
Figs 2-26

Drepanolejeunea laciniata is similar to *D. pulla* (Mitt.) Grolle, but differs by the presence of dense large laciniae on the perianth apex, large leaf lobules $1/2-2/3$ as long as the leaf lobes, and free lateral lobular margin proximal to the notch bordered by 9-13 rectangular cells.

Type: Thailand. Chiang Mai Province: Chom Thong District, Doi Inthanon National Park, summit, *Sphagnum* bog, $18^{\circ}58'914''\text{N}$, $98^{\circ}48'562''\text{E}$, 2530 m, on living leaves of *Rhododendron* sp., 20 Dec. 2011, *Rui-Liang Zhu 20111220-30A* (holotype: HSNU!).



Figs 2-16. *Drepanolejeunea laciniata* Qiong He & R.L. Zhu. 2. Plants, dorsal view. 3. Leaf lobule showing lateral free margin. 4. Apex of leaf lobule showing curved tooth and hyaline papilla. 5. Basal cells of leaf lobe. 6. Plants showing branching. 7. Median cells of leaf lobe. 8. Marginal cells of leaf lobe showing oil bodies. 9. Ocellus (oil bodies disintegrated). 10. Plants on living leaves. 11. Tooth at ventral margin of leaf lobe. 12. Underleaf on branch. 13. Portion of branch showing ocelli. 14. Seta and foot. 15. Elater. 16. Spores. All photographed from R.-L. Zhu 20111220-30A (holotype).



Figs 17-26. *Drepanolejeunea laciniata* Qiong He & R.L. Zhu. **17.** Gynoecium showing pycnolejeuneoid leaf sequence and perianth apex with dense laciniae, ventral view. **18.** Leaf, ventral view, showing free lateral lobular margin proximal to the notch bordered by 12 rectangular cells. **19.** Transverse section of stem. **20.** Lacinia on perianth apex, **21-25.** Leaves, 21-24, ventral view. **26.** Portion of shoot, ventral view. All drawn from *R.-L. Zhu 20111220-30A* (holotype).

Plants yellowish green, 3 to 15 mm long. Shoots 1.0-1.8 mm wide, irregularly pinnately branched, branches *Lejeunea*-type, leaf sequence of vegetative branches lejeuneoid. **Stems** 70-100 μm in diameter, in transverse section with 7 cortical cells and 3 medullary cells; ventral merophyte 2 or 3 cells wide. Rhizoids at base of underleaves, numerous, tufted, usually hyaline, rhizoid disc usually present, horizontally oblong. **Leaves** imbricate, diverging from stem at an angle of 45-80°; leaf lobes slightly asymmetrically obovate, usually somewhat concave, not falcate, 0.80-1.00 mm long, 0.50-0.75 mm wide, margins irregularly dentate or sometimes near entire, apex acute, subacute, or sometimes almost obtuse-rounded, plane or weakly incurved, ventral margin arched, usually with a distinct triangular tooth, dorsal margin arched at middle, almost entire to weakly dentate; leaf lobules rectangular, strongly inflated, 1/2-2/3 as long as the lobes, occasionally reduced on branches, lateral free margin usually slightly incurved (except at apex), proximal to the notch bordered by 9-13 (occasionally 5-7 in branch leaves) rectangular to linear marginal cells, apex slightly constricted, with a unicellular, usually curved apical tooth directed towards leaf apex; keel weakly arched, almost smooth, hyaline papilla oblong to spherical, 15-17 \times 11-15 μm , situated at the proximal base of apical tooth. **Cells** of leaf lobe with thin walls and small trigones, with 1-2 intermediate thickenings per cell wall, at margin quadrate to rectangular, 15-18 \times 12-15 μm , in the middle \pm hexagonal, 22-38 \times 16-24 μm , near base similar to median cells in shape, but slightly larger, 27-45 \times 16-24 μm . **Oil bodies** 3-7 per median cell of leaf lobe, of the compound type, ovoid or spherical, greyish, coarsely segmented, 2.8-8.0 \times 2.5-4.0 μm , granules less than 0.8 μm in diameter. **Ocelli** oblong, 22-28 \times 15-18 μm , (0-) 2-5 per leaf lobe, forming a non-continuous longitudinal series or scattered, 16-24 \times 12-16 μm , suprabasal ocelli 0-1. **Underleaves** remote, slightly longer than wide, 2-3 times as wide as stem, bilobed to 1/2 their length, sinus U-shaped, lobes tongue-shaped, erect, obtuse at apex, 4-5 cells long, 4-6 cells wide at base, inner and outer lateral margin entire, insertion line subtransverse, base cuneate (never cordate).

Dioicous ? (androecium not seen). **Gynoecea** on short or long branches, with 1 pycnolejeuneoid innovation; bract lobe obovate, 0.40-0.60 mm long, 0.20-0.36 mm wide, apex usually subacute, margin weakly dentate, ocelli not known, bract lobule oblong-triangular, 2/3-3/4 as long as the bract lobe, 0.25-0.28 mm long, 0.07-0.08 mm wide, apex acute to obtuse, keel slightly sinuate to straight, 3/4 as long as the lobule; bracteole connate with bracts on both sides at base, oblong, 0.35-0.45 mm long, 0.20-0.25 mm wide at middle, margin usually dentate, occasionally almost entire, bilobed to 1/4-1/3 its length, sinus usually acute. **Perianths** about 1/2 exerted, obovoid, 0.80-0.90 mm long, 0.50-0.65 mm wide at middle, inflated, with 5 keels (2 lateral, 2 ventral, 1 dorsal), dorsal keel a little lower than the others, strongly laciniate at apex, laciniae 5-12 cells long, 3-9 cell wide at base, margin entire to dentate, beak short, 1-2 cells long, ocelli in perianth not seen. **Capsule** spherical, 0.30-0.36 mm in diameter, valves 0.32-0.36 mm long, ca. 0.20 mm wide at middle; seta articulate, 9-11 cells long, with 12 outer cells and 4 inner cells in its transverse section; foot shortly conical, with 2(-3) transversal cell rings. **Elaters** hyaline to light brown in the dry condition, 130-164 μm long, 9-12 μm wide, walls sinuately thickened. **Spores** irregularly oblong in shape, 50-88 \times 20-38 μm , minutely papillose on surface, with 0-7 weak rosettes per facet. **Asexual reproductive organs** not seen.

Etymology: The specific epithet refers to the perianth apex with dense laciniae.

Habitat and distribution: on living leaves and young branches of *Rhododendron* in *Sphagnum* bog in moss forests at about 2530 m; known only from Doi Inthanon National Park, Chom Thong District, Chiang Mai Province. On young branches the new species is usually associated with *Cololejeunea dozyana* (Sande Lac.) Schiffn., *Lejeunea alata* Gottsch., *Leptolejeunea udarii* M.Dey et D.K. Singh., *Lopholejeunea subfusca* (Nees) Schiffn., and *Metzgeria furcata* (L.) Corda. In the epiphyllous collection, *Drepanolejeunea laciniata* is on the living leaves with *Drepanolejeunea angustifolia* (Mitt.) Grolle.

Additional specimen examined: Thailand, Chiang Mai Province: Chom Thong District, Doi Inthanon National Park, summit, 18°58'912"N, 98°48'560" E, 2528 m, on branches of *Rhododendron*, 20 Dec. 2011, Rui-Liang Zhu 20111220-80A (paratype: HSNU).

DISCUSSION

Drepanolejeunea is a diverse pantropical genus. The circumscription of the genus has recently expanded to include *Rhaphidolejeunea* Herzog (Grolle & Zhu, 2000) and *Capillolejeunea* S.W. Arnell (Zhu & Grolle, 2003). The diagnostic features of *Drepanolejeunea* include 1) tiny plants, 2) erect to widely divergent lobes of underleaves, 3) transverse section of stem consisting 7 cortical cells and 3 medullary cells, 4) presence of ocelli at least at base of leaf lobe, 5) proximal hyaline papilla, 6) pycnolejeuneoid leaf sequence of gynoeceal innovation (if present), 7) inflated perianth usually with various projections near apex, and 8) asexual reproduction by means of cladia or caducous leaves. *Drepanolejeunea* is currently divided in four subgenera: *Drepanolejeunea*, *Kolpolejeunea* Grolle, *Pristolejeunea* Grolle, and *Rhaphidolejeunea* (Herzog) Grolle et R.L. Zhu (Grolle, 1976, 1979; Grolle & Zhu, 2000; Zhu & So, 2001). *Drepanolejeunea laciniata* belongs to subg. *Pristolejeunea* Grolle because of the presence of median ocelli in the leaf lobe, single lobular tooth, and free lateral lobular margin proximal to the notch bordered by 9-13 rectangular cells.

Drepanolejeunea laciniata is easily recognized by the dense laciniae on the perianth apex (Fig. 17), large leaf lobules 1/2-2/3 as long as leaf lobes, obovate leaves usually with a distinct tooth at ventral margin (Figs 11, 18, 21, 22, 25), and obtuse apex of underleaf lobes (Figs 12, 26). *Drepanolejeunea laciniata* is similar to *Drepanolejeunea pulla* and *D. erecta*. The three species share many similarities in underleaf form, in basal ocellus, in singular curved lobular tooth, and in other characters. *Drepanolejeunea erecta*, a very common species in East Asia and Himalayas (Zhu & So, 2001), however, is distinguished from *D. laciniata* by the small leaf lobules (*i.e.*, 1/3 as long as leaf lobes), free lateral lobular margin proximal to the notch bordered by only 4(-6) rectangular cells, absence of apical laciniae on the perianth, and the entire or sometimes serrulate margin of the leaf lobe. *Drepanolejeunea pulla*, known only from Sikkim (Grolle, 1979; Grolle & Zhu, 1999), is separated from *D. laciniata* by the small leaf lobule 2/5 as long as leaf lobes, free lateral lobular margin proximal to the notch bordered by six rectangular cells, absence of apical laciniae on the perianth, and more or less serrulate margin of the leaf lobe. *Drepanolejeunea laciniata* is somewhat similar to some species of *Harpalejeunea* (Spruce) Schiffn. in having bilobed underleaves whose lobes are obtuse at apex. *Harpalejeunea*, however, is immediately separated by the lejeuneoid gynoeceal innovation (Gradstein & Schäfer-Verwimp, 2011).

Drepanolejeunea was considered to be a highly apomorphic genus (Schuster, 1996). Schuster (1963) placed *Drepanolejeunea erecta* in *Harpalejeunea* subg. *Ophthalmolejeunea* R.M. Schust., a subgenus based on *Ophthalmolejeunea monophthalma* (\equiv *Drepanolejeunea erecta*). Grolle (1979) transferred *Ophthalmolejeunea* from *Harpalejeunea* to *Drepanolejeunea* because of the pycnolejeuneoid gynoecial innovation. Although Schuster (2001) still treated *Ophthalmolejeunea* as a separate genus, we think that it is appropriate to place both *D. erecta* and *D. laciniata* in *Drepanolejeunea* subg. *Pristolejeunea* Grolle because the differences between *Ophthalmolejeunea* and *Drepanolejeunea* given by Schuster (1963, 2001) are insignificant.

Lejeuneaceae is the most speciose family of liverworts (Marchantiophyta) with a high diversity in southeastern Asia. Only 132 species of Lejeuneaceae were reported in Thailand, including seven species possibly endemic to Thailand (Lai *et al.*, 2008; Pócs & Bernecker, 2009; Kornochalert *et al.*, 2010; Akiyama & Furuki, 2011; He & Zhu, 2011; Kornochalert *et al.*, 2012). The continuous discovery of new species and new records of bryophytes from northern Thailand, especially from the Doi Inthanon National Park (Akiyama & Tsubota, 2009; Chantanaorrapint, 2009; Akiyama *et al.*, 2010; Nathi *et al.*, 2010; Aliyama & Goffinet, 2011) reveal that northern Thailand is an important area for bryophyte diversity investigation. More detailed investigations of bryophytes in northern Thailand, especially in Doi Inthanon may lead to find more interesting lejeuneaceous taxa.

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