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## A new taxon in *Cololejeunea* subgenus *Chondriolejeunea* (Lejeuneaceae, Hepaticae) from Yunnan, China

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### Abstract

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The subgenus *Chondriolejeunea* of genus *Cololejeunea* previously containing 2 species and 1 variety, is distributed in Borneo, Malaya, New Guinea and Thailand. A new subspecies from Yunnan, China, *Cololejeunea shimizui* N. Kitag. subsp. *shihuishanensis* is described and illustrated. It primarily differs from other members of the subgenus in the absence of spinose cells at the margin of leaf lobe. A key to all known taxa of this subgenus is provided and a distribution map of taxa of this subgenus is also presented with a new record of *C. pseudo-stipulata* from New Caledonia.

*Key words:* China, *Chondriolejeunea*, *Cololejeunea*, distribution, new taxon, SEM, spore.

### Introduction

*Cololejeunea*, a large genus of Lejeuneaceae, occurs in a range of habitats. According to Schuster (1963), this genus comprises 11 subgenera in which a monotypic subgenus *Chondriolejeunea* was proposed by Benedix (1953) on the basis of the New Guinean *Cololejeunea pseudostipulata* Schiffn. Kitagawa (1969) added a new species (*Cololejeunea shimizui* N. Kitag.) and a new variety (*C. shimizui* var. *phangngana* N. Kitag.) to this subgenus. Tixier (1973) described *Cololejeunea chinii* Tixier from the same locality of *C. shimizui* N. Kitag. As concluded by Kitagawa (1981) and agreed by the present authors, no differences exist between *C. chinii* and *C. shimizui*. According to Kitagawa (1969), this subgenus is characterized by the filiform plants, shell-shaped, concave, triangular-ovate leaf lobes with spinose marginal cells, the conspicuous dorsal papillae, and the large foliaceous stylus. The subgenus *Chondriolejeunea* is classified according to dorsal protrusion of leaf cell at leaf surface and leaf margin. During our studies on Chinese *Cololejeunea*, we found an interesting taxon which clearly belongs to *Chondriolejeunea*. However, it differs from other members of the subgenus in the absence of spinose cells at the margin of leaf lobe. Here we describe it as a new subspecies of *C. shimizui*.

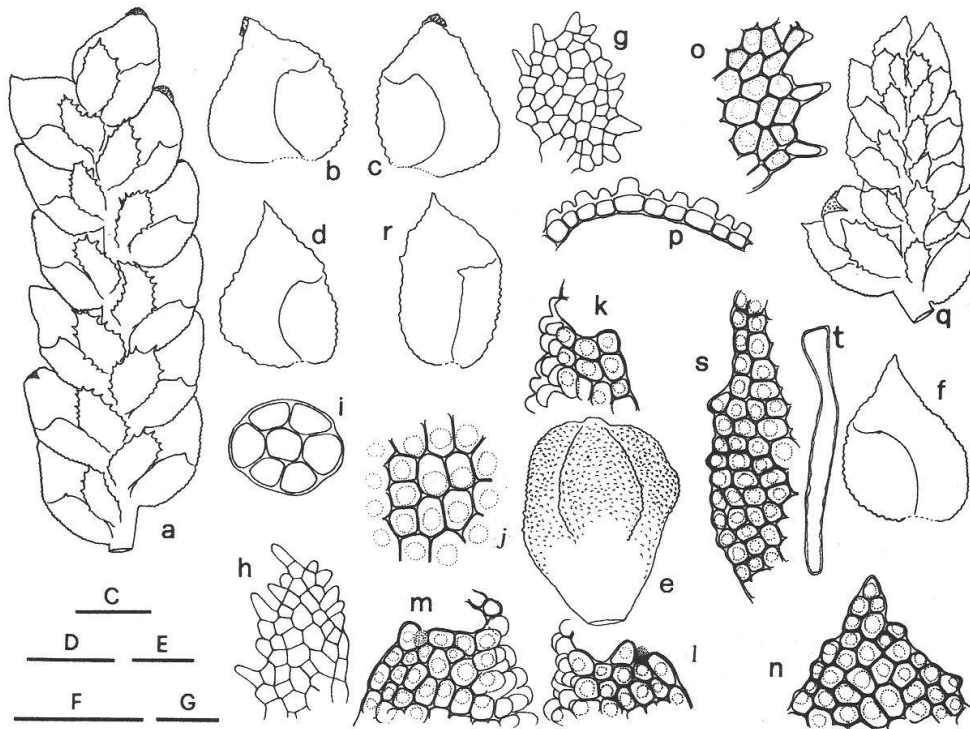
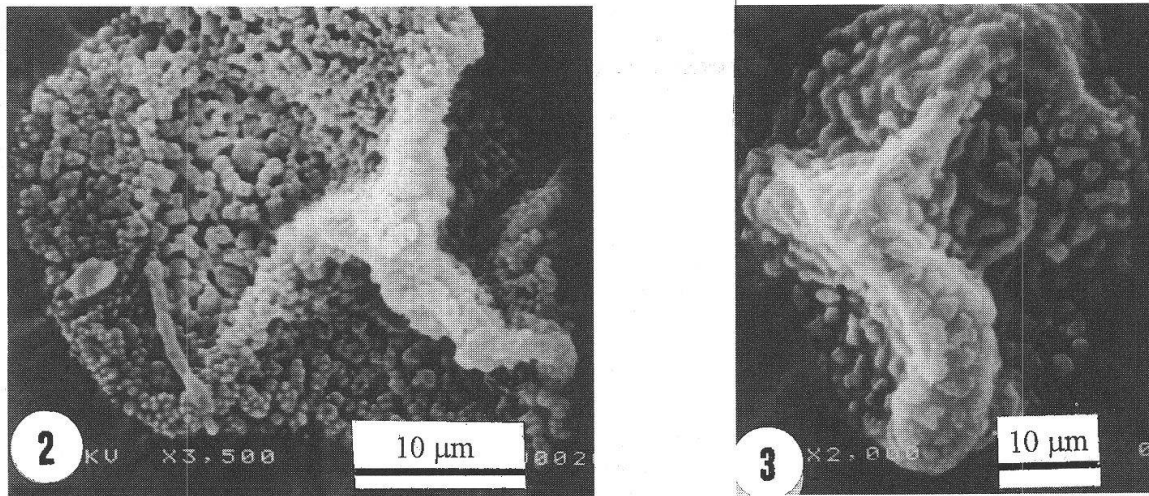


Fig. 1. *Cololejeunea shimizui* subsp. *shihuishanensis* M. L. So & R. L. Zhu (from holotype). a: portion of plant, ventral view. b–d, f: leaves, ventral side. e: perianth, ventral view. g, h: stili. i: transverse section of stem. j: median cells of leaf lobe. k–m: apices of leaf lobules. n: apex of leaf lobe. o: marginal cells of stylus. p: portion of cross-section of leaf lobe. q: young female plant, ventral view. r: female bract, ventral side. s: portion of dorsal margin of leaf lobe. t: elater. Scale bars: C=0.2 mm (e); D=0.05 mm (i–p, s); E=0.05 mm (g, h, t); F=0.3 mm (a, q); G=0.1 mm (b–d, f, r).

*Cololejeunea shimizui* N. Kitag. subsp. *shihuishanensis* M. L. So & R. L. Zhu, subsp. nov. (Fig. 1)

Autoica. Planta minuta. Caulis irregulariter sparsim ramosus. Folia dense imbricata, asymmetrica, valde concava, triangulari-ovata, apice acuta, marginibus papillatis-crenulatatis. Lobulus magnus, oblongo-ovatus, inflatus, apice truncato, bidentato, dente angulari obtuso, unicellulari, mediano uni- vel bicellulari. Cellulae folii hexagonae, mediae 12–20×13–25  $\mu\text{m}$ , trigonis nullis. Papilla magna, globosa. Stylus magnus, foliaceus, margine serrata.

Autoicous. Plants pale yellow in herbarium, filiform, loosely clinging onto mosses, forming a large patch. Stems up to 7 mm long, 0.06–0.76 mm in diameter, (0.32–)0.36–0.44 (–0.48) mm wide with leaves, sparsely irregularly branched, transverse section of stem with 6 rows of cortical cells (16–24×19–26  $\mu\text{m}$ ) around a single medullary cell (18–19×22  $\mu\text{m}$ ). Vegetative branches of *Lejeunea*-type. Rhizoids rather rare, hyaline, usually fasciculate. Asexual reproductive organs not seen. Leaves densely imbricate, diverging from stem at an angle of approximately 45°. Leaf lobes triangular-ovate, strongly concave, 0.24–0.30 mm long, 0.18–0.25 mm wide, apices acute, usually somewhat incurved, terminal cell short, 12–18 (–21)×8–11  $\mu\text{m}$ , margin crenulate to entire. Marginal cells of leaf lobe quadrate, 10–16×9–13  $\mu\text{m}$ , walls thin, lumens large; median cells quadrate to rectangular, 13–25×12–20  $\mu\text{m}$ , walls thin, trigones indistinct, intermediate thickenings absent; basal cells similar to median



Figs. 2–3. Spores. 2: *Cololejeunea shimizui* N. Kitag. s. str.; 3: *C. shimizui* subsp. *shihuishanensis* M. L. So & R. L. Zhu. 2 from Kitagawa M 15807; 3 from Zang 4648.

cells in shape and size. Dorsal papilla 1 per leaf cell, large, short-cylindrical, 10–14  $\mu\text{m}$  in diameter and 5–8  $\mu\text{m}$  high, rounded at apex. Leaf lobules ovate in outline, large, strongly inflated, ca. 1/2 length of leaf lobe, free margin slightly inrolled, keel arched, crenulate by protrusions of cells, ventral surface papillose, each cell with a short-cylindrical protrusion, apex truncate, angular tooth unicellular, usually obsolete, median tooth 1–2 (–3) cells long, usually horizontally spreading, hyaline papilla small, 6–12 $\times$ 6–7  $\mu\text{m}$ , situated between median tooth and angular tooth. Stylus very large, ovate in outline, foliaceous, 0.16–0.20 mm long, 0.11–0.18 mm wide, contiguous, slightly connate to leaf lobule at base, margin serrulate to crenulate, marginal cells thin-walled except for the apex, lumen large, median cells with a large conical papilla. Underleaves absent. Androecia similar to normal vegetative branches, usually proliferating vegetatively at apex. Gynoecia terminal on long or short branches, with 1 innovation, bracts similar to leaves in shape, ca. 0.3–0.46 mm long, 0.16–0.20 mm wide, bract lobules oblong in outline, 0.24 mm long, 0.12 mm wide, ca. 1/2 length of bract lobe. Perianth obovate, ca. 0.44–0.60 mm long, 0.3–0.5 mm wide, (4–)5-keeled, strongly papillose on surface except its base, beak indistinct. Capsules dehiscent from the apex down into 4 valves when mature, valves non-recurving; capsule wall smooth on surface; seta articulate. Spores irregular in shape, 20–44 $\times$ 34–70  $\mu\text{m}$ , finely papillose under light microscope; elters ca. 160  $\mu\text{m}$  long, 8–18  $\mu\text{m}$  wide, walls slightly irregularly thickened, spiral thickenings hardly visible.

Type: China, Yunnan, Heko, Xiaonanxi, Shihuishan, on rocks, 30 Dec. 1974, M. Zang 4648 (holotype: HSNU; isotypes: IFP, JE, KUN, Herb. Kitagawa).

Important features of this new subspecies are the (1) entire to crenulate margin of leaf lobe, (2) unicellular angular tooth (second tooth) and 1–2 (–3)-celled median tooth (first tooth), (3) large leaf lobule with a non-constricted apex, and (4) strongly concave and densely imbricate leaves. The new subspecies is clearly placed within *Cololejeunea shimizui*, because they share the same features including plants filiform, rigid, branches sparse, dorsal papillae of leaf lobe, leaf lobule and stylus all conical, stylus foliaceous with numerous marginal cilia, and transverse section of stem 6 cortical-celled. However, this subspecies can be distinguished by the absence of spinose marginal cells of leaf lobe, larger leaf cells, and non-constricted apex of leaf lobule.

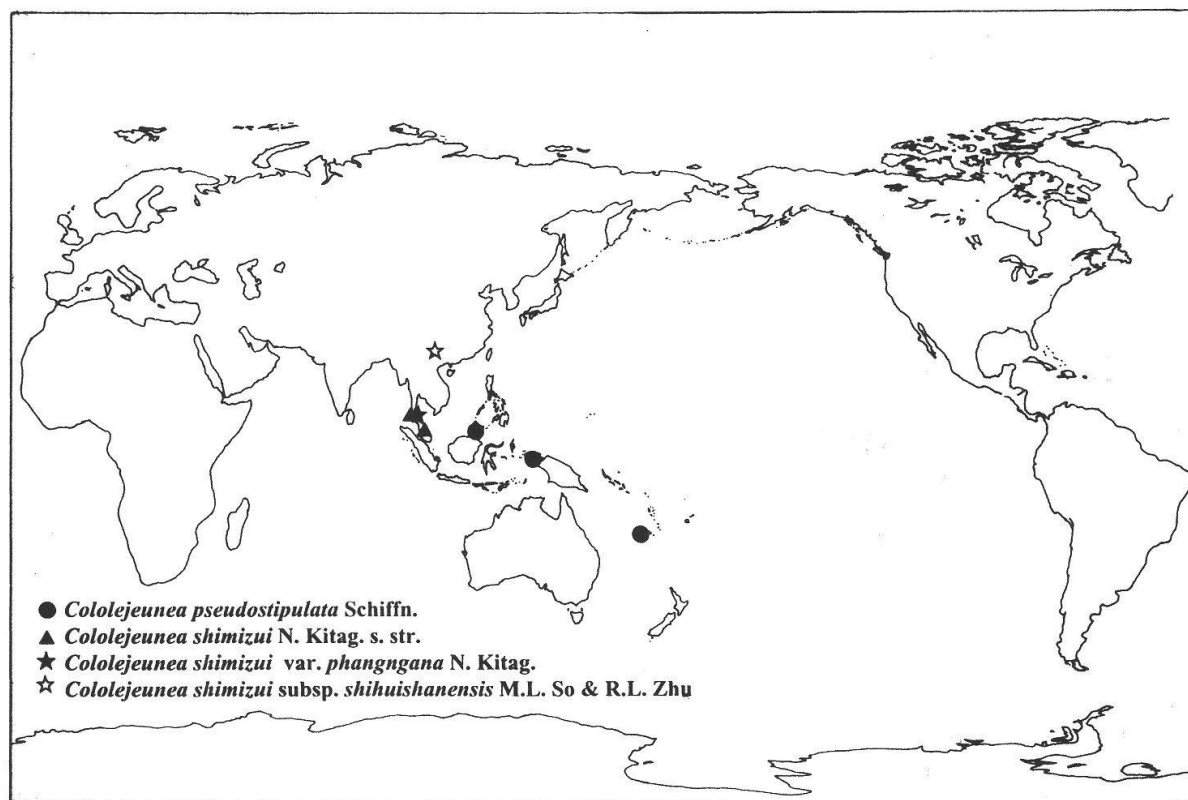


Fig. 4. Distribution of the known taxa of subgenus *Chondriolejeunea*.

Spores of *Cololejeunea shimizui* N. Kitag. s. str. and *C. shimizui* subsp. *shihuishanensis* were observed under light microscope (LM) and SEM. Under LM, they are all irregular in shape, with surface finely papillose. No distinct differences in spores can be detected between the two under LM. However, slight differences under SEM can be found. In *C. shimizui* spores usually have densely irregularly-striate to short-cylindrical protrusions whose apical surface are usually stellate (Fig. 2). In *C. shimizui* subsp. *shihuishanensis*, however, striate to short-cylindrical protrusions on spore surface usually are distant, and nearly smooth on its surface but papillose at its margin (Fig. 3). The striate protrusions of spores in *C. shimizui* subsp. *shihuishanensis* are also longer than those of *C. shimizui* (up to 6.5  $\mu\text{m}$  long in *C. shimizui* subsp. *shihuishanensis*, and less than 3.0  $\mu\text{m}$  long in *C. shimizui*). *C. shimizui* var. *phangngana* is known only in the sterile condition from the type locality.

The taxa of *Chondriolejeunea* appear to be rare. Mizutani (1970) and Menzel (1988) reported *Cololejeunea pseudostipulata* for Borneo, and Piippo (1994) listed it as an endemic species of the Malesian region. *Cololejeunea shimizui* is known from Malaya and Thailand (Kitagawa 1969, Tixier 1973). *C. shimizui* var. *phangngana* is known only from Thailand. *C. shimizui* subsp. *shihuishanensis* is known only at the type locality. The range of the subgenus *Chondriolejeunea* now includes New Caledonia (new record of *C. pseudostipulata*, voucher specimen: Mackee 40490, JE), New Guinea, Borneo, Malaya, Thailand and China (Yunnan). Yunnan, thus is the northernmost locality for this subgenus, as shown in Fig. 4. The known taxa of *Chondriolejeunea* are all epilithic and epiphytic, usually in limestone regions.

*Chondriolejeunea* is a natural group, which is well characterized and easily separated from other subgenera of *Cololejeunea* by the scarcely branched, filiform plants, the strong-



ly concave leaves, and large, foliaceous stylus with spinose margin. It is closely related to the subgenus *Cololejeunea* in which several species, such as *Cololejeunea ornata* A. Evans, usually found in calcareous habitat, also have roughened surface of leaf lobule, and papillose stylus. Tixier (1973) discussed the systematic position of the subgenus *Chondriolejeunea*, and regarded it as between the genera *Drepanolejeunea* and *Cololejeunea*. However, our studies reveal no close relationship between *Chondriolejeunea* and *Drepanolejeunea*. The stem structure (7 cortical cells + 3 medullary cells), the presence of underleaves, apical structure of leaf lobule, perianth morphology, and plant habit of *Drepanolejeunea* are quite different from those of *Chondriolejeunea*. As Kitagawa (1969) stressed, the taxa of the subgenus *Chondriolejeunea* exhibit a definite affinity to *Cololejeunea* in the stem anatomy, structure of leaf lobule, form of perianth, structure of gemmae and the absence of underleaves. Elaters, spore shape, and its surface structures of *C. shimizui* N. Kitag. s. str. and *C. shimizui* subsp. *shihuishanensis* well agree with those of other subgenera of the genus *Cololejeunea*.

The subgenus *Chondriolejeunea* now includes two species, one variety and one subspecies which can be distinguished by the following key:

1. Dorsal papillae of leaf cells stellate *Cololejeunea pseudostipulata* Schiffn.
1. Dorsal papillae of leaf cells conical 2
  2. Spinose cells present at leaf margin; apex of leaf lobule usually strongly constricted; angular tooth large, 2–4 cells long, 2–3 cells wide at base, (rarely 1 cell long and wide), usually almost reaching the dorsal margin; terminal cell of leaf lobe ± spinose; leaf-cells small (median cells 8–19×7–16 μm); leaves remote to slightly imbricate, rarely densely imbricate; plants 0.25–0.35 (–0.4) mm wide with leaves 3
  2. Spinose cells absent at leaf margin; apex of leaf lobule non-constricted; angular tooth small, unicellular, usually obsolete; terminal cell of leaf lobe short, usually not spinose; leaf-cells large (median cells 13–25×12–20 μm); leaves usually densely imbricate; plants (0.30–)0.36–0.44 (–0.48) mm wide with leaves  
*Cololejeunea shimizui* subsp. *shihuishanensis* M. L. So & R. L. Zhu
3. Marginal cilia of leaves usually forked; dorsal papillae of leaf-cells obpyriform or bottle-shaped; spinose cells at the margin of leaf and stylus with extremely thick walls, and very small lumens *Cololejeunea shimizui* N. Kitag. var. *phangngana* N. Kitag.
3. Marginal cilia of leaves usually not forked; dorsal papillae of leaf-cells short-cylindrical; spinose cells at the margin of leaf and stylus usually with thin to thick walls, and small to relatively large lumens *Cololejeunea shimizui* N. Kitag. s. str.

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