

## **LEJEUNEA POCSIANA (LEJEUNEACEAE, MARCHANTIOPHYTA), A NEW SPECIES WITH ROBUST STEMS AND TWO LOBULAR TEETH FROM FIJI**

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**Abstract:** *Lejeunea pocsiana*, a new species from Fiji, is described and illustrated. It is characterized by its large size, robust stems, ventral merophyte 4–8 cells wide, broadly ovate to triangular-ovate leaves with a rounded leaf apex, subquadrate and almost flat lobules with two distinctly differentiated teeth, bifid underleaves with cordate to slightly auriculate bases, and leaf cells with smooth cuticle and poorly developed trigones. A key to *Lejeunea* species that have robust stems with a (3–)4–8-cell-wide ventral merophyte is presented.

**Keywords:** Hepaticae, *Lejeunea catinulifera*, liverworts, *Lejeunea konratii*, the Pacific islands

### **INTRODUCTION**

*Lejeunea* Lib. is one of the largest and most diverse genera within the family Lejeuneaceae, comprising about 400 currently accepted species worldwide (Söderström *et al.* 2016). The majority of the species are distributed in tropical and subtropical regions, with the number decreasing as latitude increases (Zhu and So 2001; Heinrich *et al.* 2013; Wang *et al.* 2017). Fiji Islands, located in the South Pacific Ocean, is an important distribution area for *Lejeunea* species. Hitherto, 30 species, two subspecies and two varieties of the genus are known from the islands, including two recently described new endemics: *Lejeunea konratii* G.E.Lee & Pócs and *L. heinrichsii* G.E.Lee *et al.* (Söderström *et al.* 2011; Pócs and Wei



2017; Lee and Pócs 2018; Lee *et al.* 2019; Lee and Pócs 2022). As a common group in tropical forests, new taxa of *Lejeunea* species could still be expected.

While examining *Lejeunea* specimens collected on Fiji Islands by Prof. Tamás Pócs and his wife in 2003, an interesting species of the genus was discovered. Its remarkable characters include robust stems, ventral merophyte 4–8 cells wide, broadly ovate to triangular-ovate leaf lobes which are usually wider than long, subquadrate and almost flat lobules with two distinct teeth, and large underleaves strongly sinuately inserted to stem. The unique combination of characters does not match any currently known *Lejeunea* species. The unknown species is therefore described and illustrated here as a species new to science.

## MATERIALS AND METHODS

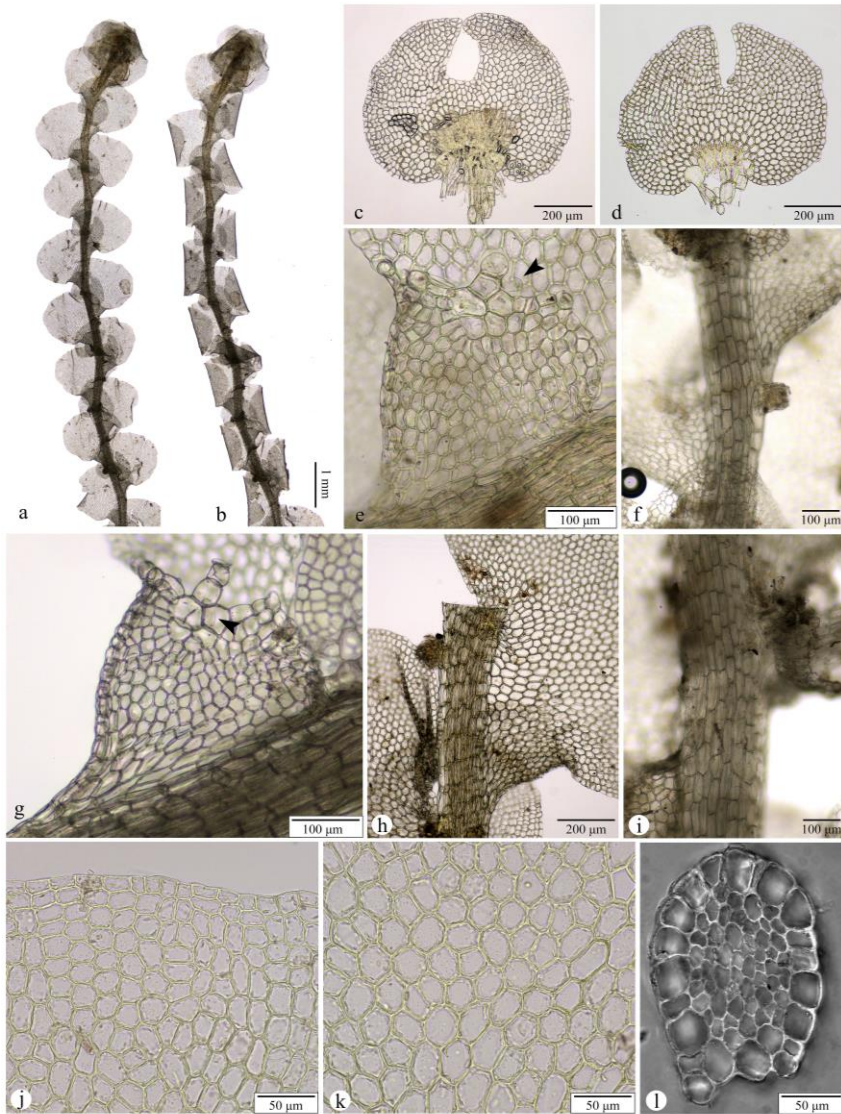
This study was based on material from Taveuni Island, Fiji. The morphological and anatomical characteristics were observed and photographed using an Olympus SZX7 stereomicroscope and an Olympus BX43 light microscope equipped with a digital camera (Mshot MH125). The line drawings were made with the aid of a drawing tube.

## RESULTS

*Lejeunea pocsiana* Y.M.Weï & R.L.Zhu, *sp. nov.* (Figures 1, 2)

Type: FIJI. Central part of Taveuni Island, Des Voeux Peak, 16°50.638' S, 179°57.991' W, alt. 1180–1194 m, 27 Aug. 2003, S. & T. Pócs 03278/O(B) (holotype HSNU, isotype EGR).

The new species is similar to *Lejeunea konratii* G.E.Lee & Pócs, but differs in the broadly ovate to triangular-ovate leaf lobes that are usually wider than long (leaf lobes suborbicular in *L. konratii*), leaf lobules broadly subquadrate with a distinct second tooth (leaf lobules ovate, second tooth reduced in *L. konratii*), and the free margin of leaf lobule flat (free margin incurved fully in *L. konratii*) (*Lejeunea konratii* data from Lee and Pócs 2018).

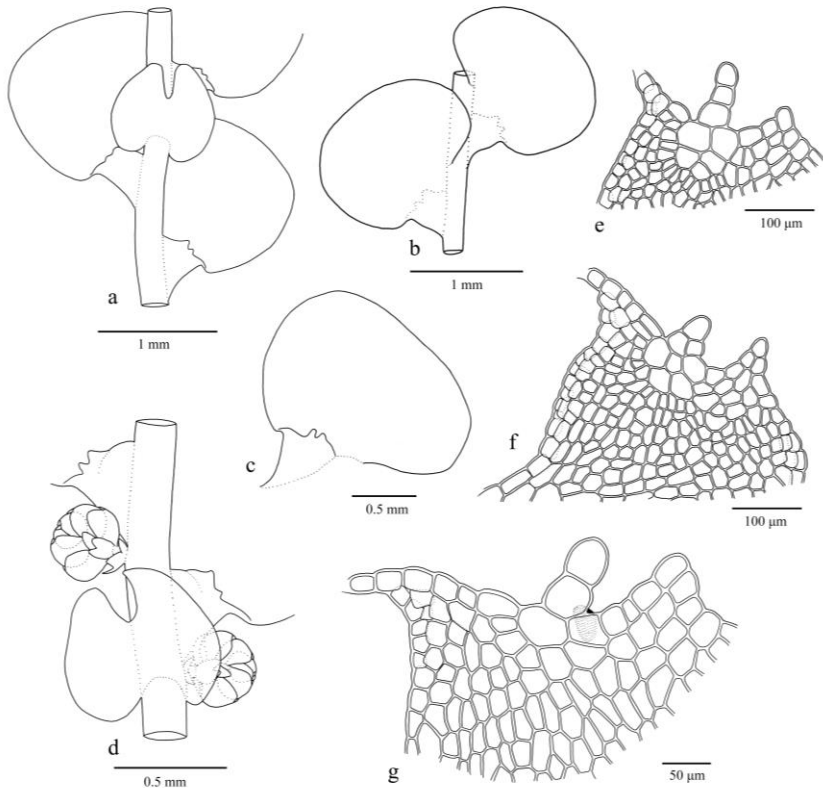


**Figure 1.** *Lejeunea pocsiiana*. **a.** Plant with leaves, apex flattened. **b.** Plant with folded leaves in dry state. **c–d.** Underleaves. **e–g.** Hyaline papillae of leaf lobules (arrow). **f.** Portion of branch, ventral view. **h.** Leaf base, dorsal view. **i:** Portion of stem, ventral view. **j.** Marginal cells of leaf lobe. **k.** Median cells of leaf lobe. **l.** Transverse section of stem. All from *S. & T. Pócs 03278/O(B)* (holotype).

Dioicous? Plants pale yellow in herbarium, up to 2 cm long. Shoots 1.8–3.2 mm wide, irregularly branched, branches of the *Lejeunea*-type, leaf sequence of vegetative branches lejeuneoid. Stems 170–270  $\mu\text{m}$  in diameter, in transverse section oblong, 16–24 rows of cortical cells surrounding 53–95 smaller medullary cells, cortical cells subquadrate to oblong, 20–33  $\times$  16–27  $\mu\text{m}$ , medullary cells oblong to hexagonal, 10–19  $\times$  7–14  $\mu\text{m}$ ; ventral merophyte 4–8(–10) cells wide. Rhizoids at base of underleaves, few, tufted, usually hyaline, rhizoid disc absent. Leaves loosely imbricate to distant, diverging from stem at an angle of ca. 45°; leaf lobes broadly ovate to triangular-ovate, flat, but the upper part usually folded when dry, 1.00–1.70 mm long, 1.10–1.85 mm wide, apex rounded, margin entire, dorsal margin arched, ampliate at base; leaf lobules broadly subquadrate, the half attached to the stem slightly inflated, the other half flat, ca. 1/4 as long as the lobes, lateral free margin somewhat incurved in the lower part, apex truncate, with two teeth seen in situ, first tooth 1–3 cells long, 1–2 cells wide, usually with a group of 4–5 large cells below the first tooth, second tooth blunt or triangular, unicellular or 2–3 cells long and 2 cells wide, keel slightly arched or straight, smooth, decurrent at base; hyaline papilla oblong, 36–48  $\times$  20–27  $\mu\text{m}$ , situated at the base of first tooth, totally or partly exposed, or hidden on the inner side. Cells of leaf lobe thin-walled, trigones small, indistinct or simple-triangular, intermediate thickenings usually absent, occasionally poorly developed in basal cells; margin cells quadrate to rectangular, 12–23  $\times$  9–20  $\mu\text{m}$ , median cells hexagonal, 29–45  $\times$  17–36  $\mu\text{m}$ , basal cells similar to median ones in shape, but slightly larger; cuticle smooth. Oil bodies and ocelli not seen. Underleaves distant, wider than long, 3–4 times as wide as stem, bilobed to ca. 1/2 their length, lobes broadly triangular, obtuse at apex, sinus narrow to wide, insertion line deeply arched, base cordate to slightly auriculate, attached to either side of the stem by a large cell. Androecia terminal on short lateral branches, bracts in 2–3 pairs, hypostatic, strongly swollen and imbricate, shortly and subequally bifid, lobe 0.12–0.16 mm long, 0.11–0.15 mm wide, apex rounded, lobule slightly smaller than the lobe, bracteoles 1–2, only at the basal portion of androecium, smaller than ordinary underleaves, the uppermost bracteole usually vestigial, triangular, unlobed. Gynoecia and asexual reproduction not seen.

**Etymology.** *Lejeunea pocsiiana* is named in honor of Prof. Tamás Pócs, a respectable bryologist and the collector of the type specimen, in celebration of his 90<sup>th</sup> birthday.

**Ecology and distribution.** *Lejeunea pocsiiana* is thus far only known from Taveuni Island, Fiji, where it occurs in 1.5–2.5 m tall bush formed by a pachycaul Asteraceae on the summit of the island at ca. 1180 to 1194 m.



**Figure 2.** *Lejeunea pocsiiana*. **a:** Portion of shoot, ventral view. **b:** Portion of shoot, dorsal view. **c:** Leaf. **d:** Portion of shoot with androecia. **e:** Apex of leaf lobule. **f:** Leaf lobule. **g:** Apex of leaf lobule with a hyaline papilla. All from S. & T. Pócs 03278/0(B) (holotype).

## DISCUSSION

The typical leaf lobules of the genus *Lejeunea* are inflated with obsolete second tooth and unicellular first tooth at the apex, and with a hyaline papilla situated at the proximal side of the first tooth (He 1996; Zhu and So 2001). In Asia and the Pacific islands, sixteen *Lejeunea* species are so far known with a pluricellular first tooth (Lee and Pócs 2018). Out of these 16 species, the present new species *L. pocsiana* is most similar to *L. konratii* known only from Fiji (Lee and Pócs 2018); both species share a relatively large plant size, robust stems, the first tooth of leaf lobule 1–3 cells long, large underleaves with deeply arched insertion, smooth cuticle, and indistinct trigones. *Lejeunea konratii*, however, differs in the ovate leaf lobes which are longer than wide, the inflated leaf lobules with fully incurved free margin, and the reduced second tooth of leaf lobule. Moreover, the leaves of *L. konratii* are more densely imbricate and usually slightly incurved at the apex, never folded (usually folded when dry in *L. pocsiana*, Figure 1b). *Lejeunea konratii*, from which only female plants are known, possesses a very characteristic perianth with 2-winged, auriculate and undulate keels (Lee and Pócs 2018). In *L. pocsiana* only male plants were found. The discovery of female plants with mature perianths in *L. pocsiana* and molecular studies will probably help to better understand the relationship between these two similar taxa found only in Fiji.

The Neotropical *L. catinulifera* Spruce also has a multicellular first tooth of leaf lobule (Reiner-Drehwald 2005a). *Lejeunea catinulifera* is highly variable in lobular morphology, however, it is readily distinguished from *L. pocsiana* by the unlobed or shallowly bifid underleaves and the thinner stems with a 2-cell-wide ventral merophyte.

Besides the pluricellular first tooth, another remarkable feature of *Lejeunea pocsiana* is its robust stem structure. In the genus *Lejeunea*, only 11 species have robust stems (ventral merophyte 4–8 cells wide), including six Neotropical species and five species known from Asia and Oceania (Verma and Srivastava 2007; Singh and Pócs 2016; Wei *et al.* 2018; Lee and Pócs 2018; Lee *et al.* 2018). With the addition of the new species described here, the number of *Lejeunea* species with similar robust stems is raised to 12.

PRELIMINARY KEY TO ALL KNOWN SPECIES OF *LEJEUNEA* WITH ROBUST STEMS (VENTRAL MEROPHYTE 4–8 CELLS WIDE)

- 1 Underleaves undivided; known from Costa Rica and Panama (Reiner-Drehwald 2005a).....**1**  
     .....*L. reflexistipula* var. *costaricensis* (Steph.) M.E.Reiner
- Underleaves bifid.....**2**
- 2 Leaf lobes apiculate to acute at apex; known from New Guinea (Lee *et al.* 2018).....*L. tjibodensis* (Steph.) G.E.Lee & Heinrichs
- Leaf lobes rounded to rounded-obtuse at apex.....**3**
- 3 Insertion line of underleaf straight or weakly curved.....**4**
- Insertion line of underleaf arched.....**8**
- 4 Leaf lobes attached to the stem by a long insertion line, length almost equal to the leaf width; tooth of leaf lobule multicellular, linear, triangular, or laminar.....**5**
- Leaf lobes attached to the stem by a short insertion line, length less than half of the leaf width; tooth of leaf lobule unicellular or undefined.....**6**
- 5 Leaf lobes obovate-rounded; underleaves 1.8–3 times as wide as the stem; known only from Brazil (Reiner-Drehwald 2000 as *Neopotamolejeunea uleana* (Steph.) M.E.Reiner).....  
     .....*L. juruana* Gradst. & M.E.Reiner
- Leaf lobes ovate; underleaves 3–6 times as wide as the stem; known from Guatemala, Jamaica, ?Cuba (Reiner-Drehwald 2000 as *Neopotamolejeunea tenera* (Sw.) M.E.Reiner; Gradstein and Reiner-Drehwald 2007).....  
     .....*L. tenera* (Sw.) Gottsche, Lindenb. & Nees
- 6 Leaf lobules developed, ovate, with blunt first tooth and second tooth; perianths keels mamilliose; known only from India (Verma and Srivastava 2007 as *Taxilejeunea ghatensis* P.K.Verma & S.C.Srivast; Singh and Pócs 2016).....  
     .....*L. ghatensis* (P.K.Verma & S.C.Srivast) Sushil K.Singh & Pócs  
**Note:** In view of inconsistencies between the description and illustration in Verma and Srivastava (2007), the brief morphological summary of *Lejeunea ghatensis* presented here was mainly based on its illustration.
- Leaf lobules strongly reduced (if developed, rectangular), with a single tooth; perianths keels smooth.....**7**

- 7 Plants 1.1–2.2 mm wide; leaf lobes ovate, gradually narrowed to the apex; known from Ecuador and southern Brazil (Gradstein and Reiner-Drehwald 2007; Gradstein 2021).....  
 ..... ***L. topoensis*** Gradst. & M.E.Reiner
- Plants small, 0.8–1.2 mm wide; leaf lobes oblong, not gradually narrowed to the apex; known from China (Taiwan), Nepal, Sri Lanka, and Thailand (Mizutani 1963; Zhu and Long 2003; Lai *et al.* 2008; Wang *et al.* 2011)..... ***L. riparia*** Mitt.
- 8 Length of leaf insertion equals the width of the leaf; leaf lobules strongly reduced; underleaves with cuneate bases; known from Brazil and Venezuela (Reiner-Drehwald 1999 as *Potamolejeunea polyantha* (Mont.) M.E.Reiner; Bastos and Gradstein 2020)..... ***L. polyantha*** Mont.
- Length of leaf insertion ca. half the width of the leaf; leaf lobules usually well developed; underleaves with cordate or auriculate bases..... **9**
- 9 Underleaves bifid to 1/5–1/4; male bracteoles present throughout the androecium; known from Colombia, Costa Rica, Ecuador, and Panama (Reiner-Drehwald 2005b; Gradstein 2021)..... ***L. rotundifolia*** Mitt.
- Underleaves bifid to 1/3–1/2; male bracteoles present only at the base of the androecium (but androecia unknown in *L. konrattii*); known from Fiji and Papua New Guinea..... **10**
- 10 Leaf lobules subquadrate, with well developed first tooth and second tooth; known only from Fiji.....  
 ..... ***L. pocsiana*** Y.M.Weï & R.L.Zhu
- Leaf lobules ovate to subovate, with well developed first tooth and obsolete second tooth..... **11**
- 11 Leaf lobes triangular-ovate, spreading from stem at an angle of 45°–60°; first tooth of leaf lobules unicellular; perianth with 5 (or 6) crenate, weakly winged keels; known only from Papua New Guinea (Wei *et al.* 2018).....  
 ..... ***L. streimannii*** Y.M.Weï & R.L.Zhu
- Leaf lobes suborbicular, spreading from stem at an angle of 60°–80°; first tooth of leaf lobules (1–) 2 cells long; perianth with 2-winged, auriculate and undulate keels; known only from Fiji (Lee and Pócs 2018)..... ***L. konrattii*** G.E.Lee & Pócs



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