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The genus *Ceratolejeunea* (Lejeuneaceae, Hepaticae) in China

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Abstract – The genus *Ceratolejeunea* (Lejeuneaceae, Hepaticae) in China is reviewed. Two species, *Ceratolejeunea belangeriana* (Gottsche) Steph. and *C. minor* Mizut., the latter a new record for China, are present. Illustrations and description of *Ceratolejeunea minor* are also presented.

***Ceratolejeunea belangeriana* / *C. cornuta* / *C. minor* / *C. sinensis* / China / Hainan / Lejeuneaceae / new record**

INTRODUCTION

The genus *Ceratolejeunea* J.B. Jack & Steph. was established by Jack and Stephani (1892), based on *Ceratolejeunea grandiloba* J.B. Jack & Steph. from the Colombian Andes. The pale brown cell walls, transverse section of stem with seven cortical cells and over four medullary ones, usual presence of ocelli in leaf lobes, curved apical tooth of the leaf lobule with a proximal hyaline papilla, pycnolejeuneoid leaf sequence of gynoecial innovations, horn-like projections of the perianth, tendency to form utricles on branches, and usual absence of vegetative reproductive organs are the main characteristics of *Ceratolejeunea*.

Ceratolejeunea is nested in a robust clade with *Drepanolejeunea* (Spruce) Schiffn., *Leptolejeunea* (Spruce) Schiffn., *Lepidolejeunea* R.M. Schust., *Lejeunea* Lib., and various members of the tribe *Cololejeuneeae* (Wilson *et al.*, 2004). The genus is easily confused with *Drepanolejeunea*. The latter, however, is distinguished by the stem with seven rows of cortical cells and three rows of medullary cells, usual presence of cladia, and absence of utricles on branches. Tropical America with 23 species is the center of diversity of the genus (Dauphin, 2003).

Three species of *Ceratolejeunea* were reported from China (Piippo, 1990): *C. belangeriana* (Gottsche) Steph., *C. cornuta* (Lindenb.) Steph., and *C. sinensis* P.C. Chen & P.C. Wu. However, no taxonomic revision of the genus is available for China. Here we present a revision of *Ceratolejeunea* in China, leading to the recognition of two species. *Ceratolejeunea sinensis* may be an extreme phase of *Drepanolejeunea erecta* (Zhu & So, 2001). *Ceratolejeunea minor* Mizut., known previously only from the type locality in Borneo, is newly reported for China. *Ceratolejeunea cornuta* is excluded from the Chinese hepatic flora.

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KEY TO SPECIES OF *CERATOLEJEUNEA* IN CHINA

1. Leaf lobules *ca* 1/5 as long as leaf lobes; underleaves large, mostly reniform, insertion line of underleaf strongly arched; horn-like projections of perianth 1/3/-1/2 as long as perianth; trigones large; *Allorgella*-type leaf denticulations (tooth formed by two adjacent cells, cf. Thiers, 1992; Zhu & So, 1998, 2001) absent; upper surface of perianth mostly mammillose . . . . . 1. *C. belangeriana*
1. Leaf lobules *ca* 1/3 as long as leaf lobes; underleaves small, suborbicular, insertion line of underleaf almost transverse; horn-like projections of perianth indistinct; trigones small; weak *Allorgella*-type leaf denticulations usually present; upper surface of perianth smooth . . . . . 2. *C. minor*

1. *Ceratolejeunea belangeriana* (Gottsche) Steph., *Sp. Hepat.* 5: 396. 1913.

≡ *Lejeunea belangeriana* Gottsche *in* Gottsche *et al.*, *Syn. Hepat.*: 398. 1845. **Type**: Mauritius. " in insula Franciae (Belanger in Hb L[ehmann])," *Belanger s.n.* (holotype: S).

= *Lejeunea oceanica* Mitt. i Seemann, *Fl. Vit.*: 414. 1871. ≡ *Ceratolejeunea oceanica* (Mitt.) Steph., *Sp. Hepat.* 4: 428. 1913. **Type**: Samoa. *T. Powell s.n.* (holotype: NY).

= *Ceratolejeunea exocellata* Herzog *in* Herzog & Noguchi, *J Hattori Bot. Lab.* 14: 47. 1955. **Type**: China. Taiwan, Botel Tobago, *G. H. Schwabe* (holotype: JE).

For further synonyms, see Mizutani (1981).

Illustrations: Herzog & Noguchi (1955, p. 46, Fig 11h-m as *Ceratolejeunea exocellata*); Amakawa (1970, p. 181, Fig. 28 as *C. ryukyuensis* Amakawa); Mizutani (1981, p. 308, Fig. 1 as *C. oceanica* (Mitt.) Steph.).

Ceratolejeunea belangeriana is the most common species of *Ceratolejeunea* in Asia. The main features include 1) large underleaves with truncate or cordate bases, 2) strongly arched insertion of the underleaf, 3) large trigones of leaf cells, 4) small leaf lobules about 1/5 as long as the leaf lobes, and 5) usually mammillose surface of perianth. In China, it is known only from Taiwan.

Habitat: mostly on tree trunks and shrubs, rarely on leaves or on rocks in moist rainforests at low altitudes.

Range: Borneo (Mizutani, 1981 as *C. oceanica*), China (Taiwan), Comores (Grolle, 1995), Cook Islands, Fiji (Miller *et al.*, 1983), Java, Madagascar (Grolle, 1995), Mauritius, New Guinea (Grolle & Piippo, 1984), Philippines (Tan & Engel, 1986), Réunion Island (Grolle, 1995), Ryukyu (Mizutani, 1981 as *C. oceanica*), Samoa (Mizutani, 1981 as *C. oceanica*), Seram (Mizutani, 1987), Seychelles (Grolle, 1995), Solomon Islands (Grolle & Piippo, 1984), Tahiti (Mizutani, 1981 as *C. oceanica),* and Thailand. The record from Tanzania (Usambara) is erroneous (cf. Wigginton & Grolle, 1996), that from Australia (Windolf, 1987; Bolin & Henderson, 2002) is doubtful (cf. McCarthy, 2003).

Representative specimens examined: Cook Islands. 1899, *Cheeseman s.n.* (G, in the packet of *Lopholejeunea wiltensii*?). Indonesia. Java, Mt. Salak, in silvis primaevis ad latus septentr. ad *Polypodium accedens* Bl., Regio nubium, ±1000 m, epiphyllous, 31 Dec. 1893, *Schiffner 3268* (GOET, U). Malaysia. Johore, G. Ophir, in decliv. Siprem., Padang Batoe Versus, 1100-1395 m, April 1930, *Verdoorn 87* (GOET, U). Thailand. *Larsen et al. 3414* (NY as *Ceratolejeunea emarginata* Steph.).

2. *Ceratolejeunea minor* Mizut., *J. Hattori Bot. Lab.* 49: 311. 1981. (Fig. 1)

Type: Malaysia. Sabah, N of Mt. Kinabalu, Mt. Templer, on sandstone, *Meijer 10091* (holotype: L).

Autoicous. Plants brown in the dried condition. Stem 2-8 mm long, 60-100 μm in diameter, 0.8-1.2 mm wide with leaves, irregularly branched, branching of the *Lejeunea* type, leaf sequence of lateral branches lejeuneoid, transverse section of stem 7 cortical cells and 8-11 medullary cells, cortical cells quadrate to rectangular, medullary cells ± subisodiametric. Ventral merophytes of stem 2 cells wide. Rhizoids at base of underleaves, numerous, tufted, usually hyaline, rhizoid disc absent. Leaves imbricate, sometimes contiguous, diverging from stem at an angle of 45-70°. Leaf lobes irregularly ovate, usually somewhat falcate, 0.45-0.70 mm long, 0.40-0.55 mm wide, apex rounded or very rarely apiculate, usually incurved, margin with weak *Allorgella*-type denticulations, or almost entire, dorsal margin usually strongly arched. Leaf lobules ovate, strongly inflated, (1/4-)1/3 as long as the leaf lobes, lateral free margin slightly incurved, bordered by 4-5 linear to rectangular cells, apex usually constricted, with a unicellular, somewhat curved apical tooth towards leaf apex, keel almost arched, smooth or slightly crenulate owing to mammillose cells, hyaline papilla oblong or pyriform, *ca* 20 × 10 μm, situated at the proximal side of apical tooth. Leaf cells thin-walled to moderately thickened, trigones usually small, intermediate thickenings infrequent. Marginal cells of leaf lobe quadrate to rectangular, 10-17 × 8-13 μm, median cells ± isodiametric, 19-30 × 15-22 μm, basal cells isodiametric to rectangular, 22-40 × 12-14 μm, dorsal cuticle smooth. Vitta absent. Ocelli (1-) 2 (-3), forming a transverse row at base of leaf lobe (suprabasal type). Oil bodies not seen. Underleaves remote, suborbicular, 1.5-2.0 times as wide as stem, bilobed to 1/4-1/3 underleaf length, sinus usually narrowly V-shaped, lobes narrowly triangular, acute at apex, 4-7 cells long, 4-6 cells wide at base, inner margin nearly entire, outer lateral margin entire (but usually with a blunt tooth in the type material), insertion almost transverse, base cuneate. Androecia usually on elongate branches or on main shoots, terminal, bracts 2-3 pairs, hypostatic, 0.28-0.35 mm long, 0.20-0.30 mm wide, apex rounded, bract lobule almost as large as bract lobe, keel rounded, usually crenulate owing to mammillose cells, antheridia not seen, bracteoles 1-2, borne only at the base of the androecium. Gynoecia on short or long branches, with one pycnolejeuneoid innovation, innovation not again bearing an innovation, bracts oblong-ovate, *ca* 0.65 mm long, 0.24-0.33 mm wide, apical margin usually irregularly denticulate, apex rounded to acute, bract lobule oblong-ovate or lingulate, 2/3-4/5 as long as the bract lobe, keels *ca* 1/3 as long as the bract lobules, apex acute or obtuse, bracteole oblong-ovate, *ca* 2/3 as long as the perianth, 0.34-0.50 mm long, 0.20-0.25 mm wide, bilobed to *ca* 1/3 its length at apex, entire or slightly denticulate at margin, lobes narrowly triangular or lanceolate, apex acute, sinus acute. Perianth emergent, obovate, 0.40-0.65 mm long, 0.30-0.38 mm wide at apex, with 4 sharp keels (2 lateral keels and 2 ventral keels, dorsal keel usually indistinct), beak 1 cell long, horns indistinct, upper surface of perianth smooth. Capsule not seen. Asexual reproductive organs not seen.

Ceratolejeunea minor is readily separated from other members of *Ceratolejeunea* by the obovate perianth without distinct horns, small bilobed underleaves with an almost transverse insertion line, cuneate bases of underleaves, and usual presence of weak *Allorgella*-type denticulations at leaf margins (Fig. 1h). It was known previously only from type locality. In the type collection, underleaves bear 1-2 small teeth at lateral margin, but they are entire in the Chinese material (Fig. 1: a, f). In leaf cells, larger leaf lobules, and small under-

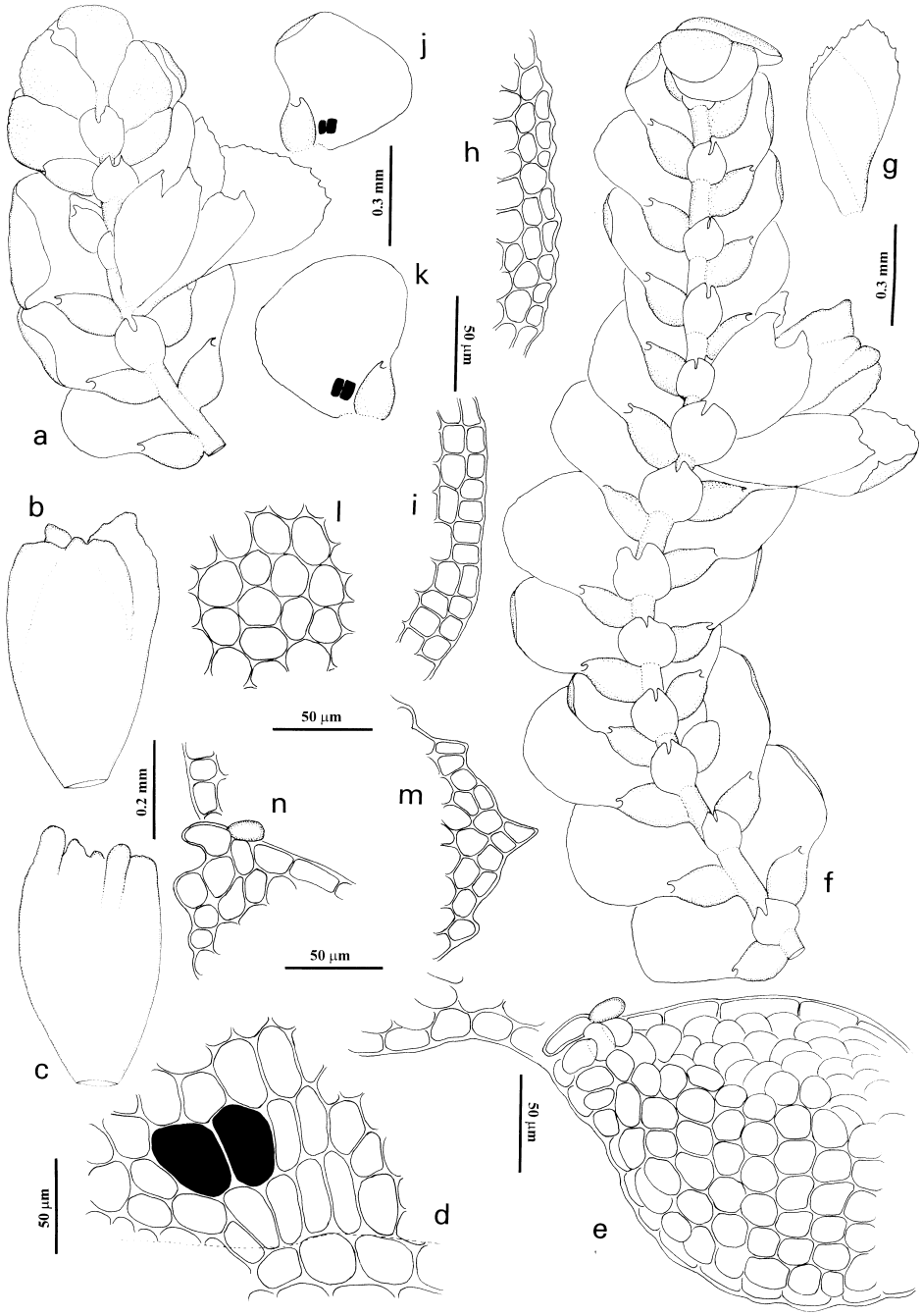

Fig. 1. *Ceratolejeunea minor* Mizut. **a**. Portion of plant, showing autoicous condition, ventral view. **b, c**. Perianths, b, ventral view, c, dorsal view. **d**. Basal cells of leaf lobe, showing two ocelli. **e**. Leaf lobule. **f**. Portion of plant with a gynoecium, ventral view. **g**. Female bract, dorsal view. **h, i**. Marginal cells of leaf lobe. **j, k**. Leaves, ventral view. **l**. Median cells of leaf lobe. **m**. Apex of female bract lobe. **n**. Apex of leaf lobule. All drawn from *D.-K. Li 04753 p.p.* (HSNU).

leaves with an almost transverse insertion line, *Ceratolejeunea minor* is similar to *C. moniliata* Herzog, known from Borneo, Malay Pen., New Guinea, and Sumatra (Mizutani, 1981). The latter, however, differs in moniliate ocelli of the leaf lobe, very long horns of perianth, and absence of *Allorgella*-type denticulation at leaf margins. *Ceratolejeunea singapurensis* (Lindenb.) Schiffn. also resembles *C. minor.* The former is separated by the arched insertion line of the underleaf, mammillose surface of the perianth, and large trigones of leaf cells, small leaf lobules ca. 1/5 as long as the leaf lobes.

Habitat: On sandstone and tree trunk.

Range: China (Hainan) and Malaysia (Sabah).

Additional specimen examined: China. Hainan, Diaoluoshan, Xinanlinchang, 930 m, *D.-K. Li 04753 p.p.* (HSNU).

EXCLUDED SPECIES

Ceratolejeunea cornuta (Lindenb.) Steph. *in* Engler, *Pflanzenw. Ost-Afrikas C*: 65. 1895.

≡ *Jungermannia cornuta* Lindenb., *Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.* 14 (Suppl.): 23. 1829. ≡ *Lejeunea cornuta* (Lindenb.) Nees, *Nat. Europ. Leberm.* 3: 278. 1838. ≡ *Colura cornuta* (Lindenb.) Trevis., *Mem. Reale Ist. Lombardo Sci*., Ser. 3, *Cl. Sci. Mat*., 4: 402. 1887. **Type**. Jamaica, on *Grammitis serrulatus*, *Swartz s. n.* (holotype: W).

Ceratolejeunea cornuta was first recorded in Wu *et al.* (1984) as "type" species of the genus *Ceratolejeunea*. There is no material of this species from China. For a full treatment of this species see Dauphin (2003).

Ceratolejeunea sinensis P.C. Chen & P.C. Wu, *Acta Phytotax. Sin*. 9: 232. 1964.

Type: China. Yunnan, "Meng-hai, 1300 m alt., on the leaves of trees," 22 Feb. 1957, *W.-S. Hsu 6034*$^{-2}$ (holotype: PE).

Ceratolejeunea sinensis may be an extreme phase of *Drepanolejeunea erecta* (Steph.) Grolle (Zhu & So, 2001).

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