

A new species and a new record of *Cololejeunea* (Lejeuneaceae, Marchantiophyta) from Andaman & Nicobar Islands, India

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Abstract – A new species of *Cololejeunea* (Spruce) Schiffn., *C. andamanensis* sp. nov. is described from South Andaman Island. *Cololejeunea pseudoschmidtii* Tixier, previously known only from China, Malaysia, Philippines and Vietnam, is reported from South Andaman Island and the Great Nicobar Biosphere Reserve in the Nicobar group of the Islands of India.

***Cololejeunea andamanensis* / *Cololejeunea pseudoschmidtii* / South Andaman / Great Nicobar**

INTRODUCTION

Cololejeunea (Spruce) Schiffn. is represented in India by 51 species, with centers of diversity in the Eastern Himalaya (including the North-eastern states) (42 species), Western Ghats (29 species) and the Andaman & Nicobar Islands (nine species) (Tixier, 1967; Zhu & So, 2001; Joshi, 2001; Asthana & Srivastava, 2003; Singh *et al.*, 2006; Daniels & Daniel, 2009; Das & Singh, 2009; Dey *et al.*, 2008, 2010; Daniels, 2010; Asthana & Shukla, 2010; Singh *et al.*, 2010a, 2010b; Asthana & Sahu, 2011; Dey & Singh, 2007, 2008, 2011, 2012; Manju *et al.*, 2012; Singh & Barbhuiya, 2012, 2013; Asthana & Alam, 2013; Singh & Singh, 2013). The Western Himalaya (two species) and the Central Indian region (one species) are the only other biogeographical regions of the country from where the genus has been recorded so far.

The first record of *Cololejeunea* from Andaman & Nicobar Islands was published by Stephani (1895), who described *C. jelinekii* Steph. and *C. lanciloba* Steph. from the Nicobar Islands. Later Stephani (1916) described *Physocolea acinacifolia* Steph. [= *C. acinacifolia* (Steph.) N. Kitag.] from Andaman Islands which was later synonymised with *C. longifolia* (Mitt.) Benedix ex Mizut. (Tixier, 1985). Benedix (1953) reported *C. appresa* (A. Evans) Benedix from Andaman Islands. Zhu and So (1999, 2001) mentioned *C. desciscens* Steph. and *C. tenella* Benedix from Andaman Islands, but Asthana and Srivastava (2003) excluded them in their revision of Indian *Cololejeunea*. Later, however, Singh *et al.* (2006, 2010b) recorded *C. desciscens* from Andaman Islands based on fresh collections. Joshi

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(2001) reported *C. haskarliana* (Lehm. & Lindenb.) Schiffn. and *C. minutissima* (Sm.) Schiffn. from Andaman Islands. Recently, Singh *et al.* (2010b) recorded *C. gottschei* (Steph.) Mizut. from Andaman Islands.

During recent studies on the liverworts of Andaman & Nicobar Islands, the authors recognized two interesting populations of *Cololejeunea*. The first one belongs to subgenus *Pedinolejeunea* Benedix ex Mizut, but differs from all previously described species. It is thus described as a new species. The other one belongs to *Cololejeunea pseudoschmidtii* Tixier. This species has been reported from China, Malaysia, the Philippines and Vietnam (Tixier, 1972, 1977; Zhu, 1995) but not from India. With the present additions, 53 species of *Cololejeunea* are known from India.

DESCRIPTION AND DISCUSSION

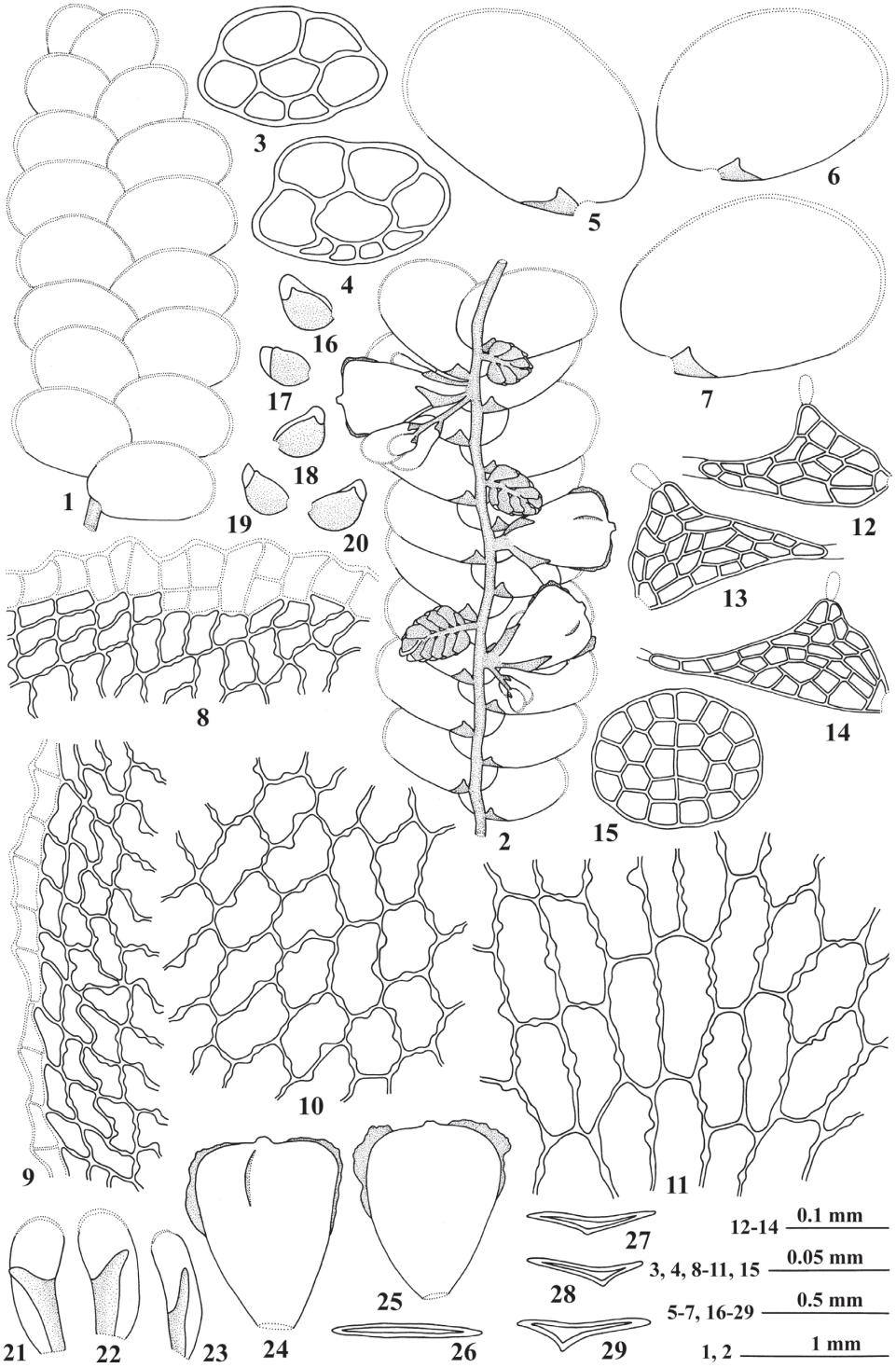
Cololejeunea andamanensis M.Dey & D.K.Singh, *sp. nov.*

Figs 1-29

HOLOTYPE: INDIA: Andaman & Nicobar Islands, South Andaman, Motor Bhanji, Chidiatapu, c. 17 m, 11°34'269" N, 92°40'356" E, 04 Feb. 2014, D.K. Singh 61611 (CAL).

Plants pale yellow to brownish-yellow (dried herbarium material), closely appressed to substratum, 5-14 mm long, 1.3-1.8 mm wide; branching *Lejeunea*-type, irregular. Stem ovoid to subelliptical in transverse section, 50-58 × 80-90 μm, 3 cells across the diameter; cortical cells 6-8, rectangulate-polygonal, 7-23 × 10-38 μm, thin-walled; medullary cell 1, polygonal, 17-23 × 25-33 μm, thin-walled; ventral merophytes of stem 2-4 cells wide. Rhizoids few, fasciculate on ventral stem surface, hyaline. Leaves closely imbricate, incubously inserted, obliquely spreading; leaf lobe subelliptical to oblong, 0.9-1.1 mm long, 0.6-0.7 mm wide, apex rounded, margin finely denticulate with *Allorgella*-type denticulations, apical margin bordered by 1-2 rows of hyaline cells, dorsal margin bordered by 1 row of hyaline cells, ventral margin lacking such hyaline cells, dorsal margin arched, ventral margin slightly arched to nearly straight; hyaline apical leaf cells rectangulate, 12-33 × 7-15 μm; hyaline marginal leaf cells rectangulate, 5-18 × 10-25 μm; median leaf cells polygonal, 28-43 × 20-30 μm; basal leaf cells elongated, polygonal, 42-60 × 12-25 μm; walls thin with minute or small trigones, intermediate thickenings nodulose, subnodulose or irregular, 1-3 along each side of wall; leaf surface smooth; oil-bodies not seen; leaf lobule slightly inflated, small, 1/6-1/5 as long as the leaf lobe, triangular, consisting of about 12-32 cells, 0.17-0.20 mm long, 0.09-0.12 mm wide; apical tooth one cell long, 1-2 cells wide; hyaline papilla oblong, present at the apex of tooth; keel nearly straight, smooth; stylus unicellular. Gemmae discoid, on the ventral surface of leaf lobe, 18-26-celled, 42-68 × 50-83 μm, without adhesive cells.

Figs 1-29. *Cololejeunea andamanensis* M.Dey & D.K.Singh. **1.** A portion of plant in dorsal view; **2.** The same in ventral view (rhizoids not drawn); **3, 4.** Transverse sections of stem; **5-7.** Leaves; **8.** Apical leaf cells; **9.** Marginal leaf cells; **10.** Median leaf cells; **11.** Basal leaf cells; **12-14.** Leaf lobules; **15.** A gemma; **16-20.** Male bracts; **21-23.** Female bracts; **24.** A perianth in ventral view; **25.** The same in dorsal view; **26-29.** Transverse sections of perianth. [All drawn from Holotype].



Monoicous. Androecia terminal on lateral branches; bracts in 2-8 pairs, densely imbricate; bract lobe ovate, 0.19-0.25 mm long, 0.12-0.16 mm wide; bract lobule strongly inflated, almost as long as the bract lobe. Gynoecia terminal with, or rarely without, a single subfloral innovation; bract lobe oblong, 0.33-0.55 mm long, 0.12-0.21 mm wide, apex rounded-rounded obtuse, apical margin bordered by 1(-2) rows of hyaline cells; bract lobule about 2/3 as long as the bract lobe, apex subacute; perianth obovate-obcordate, 0.63-0.83 mm long, 0.53-0.70 mm wide, strongly dorsoventrally flattened with 2 winged lateral keels and (0-)1 low ventral keel; beak short, 1 cell long. Mature sporophytes not seen.

Habitat: Epiphyllous, growing on palm leaves in moist and shady environments.

Distribution: India (South Andaman Island), probably endemic.

Cololejeunea andamanensis resembles *C. saroltae* Pócs in general appearance, monoicy; leaf lobes with *Allorgella*-type denticulations, apical and dorsal margins bordered by 1-2 rows of hyaline cells; thin-walled leaf cells with small trigones; very small leaf lobules with an 1-2-celled apical tooth; unicellular styli; androecia with 2-8 pairs of densely imbricate bracts; and similarly shaped female bracts. However, *C. saroltae* differs from *C. andamanensis* in having much slender stems with a diameter of only 40-50 μm , a only one cell wide ventral merophyte; leaf cell walls without intermediate thickenings; rectangular leaf lobules with the hyaline papilla present at the proximal base of the tooth and perianths with strongly auriculate lateral keels (Pócs, 2012; Table 1). *Cololejeunea andamanensis* also resembles *C. subminutilobula* Mizut., but gametophytes of the latter species are only 2-5 mm long and 0.6-1.0 mm wide, with 40-50 μm thick stems and a one cell wide ventral merophyte. *Allorgella*-type marginal denticulations, intermediate cell wall thickenings and the wing on lateral perianth keels are lacking; the lobule of the female bracts is 1/5-1/2 as long as the lobe (Mizutani, 1984; Table 1).

Cololejeunea pseudoschmidtii Tixier, *Gard. Bull. Singapore* 26: 145 (1972).

Figs 30-49

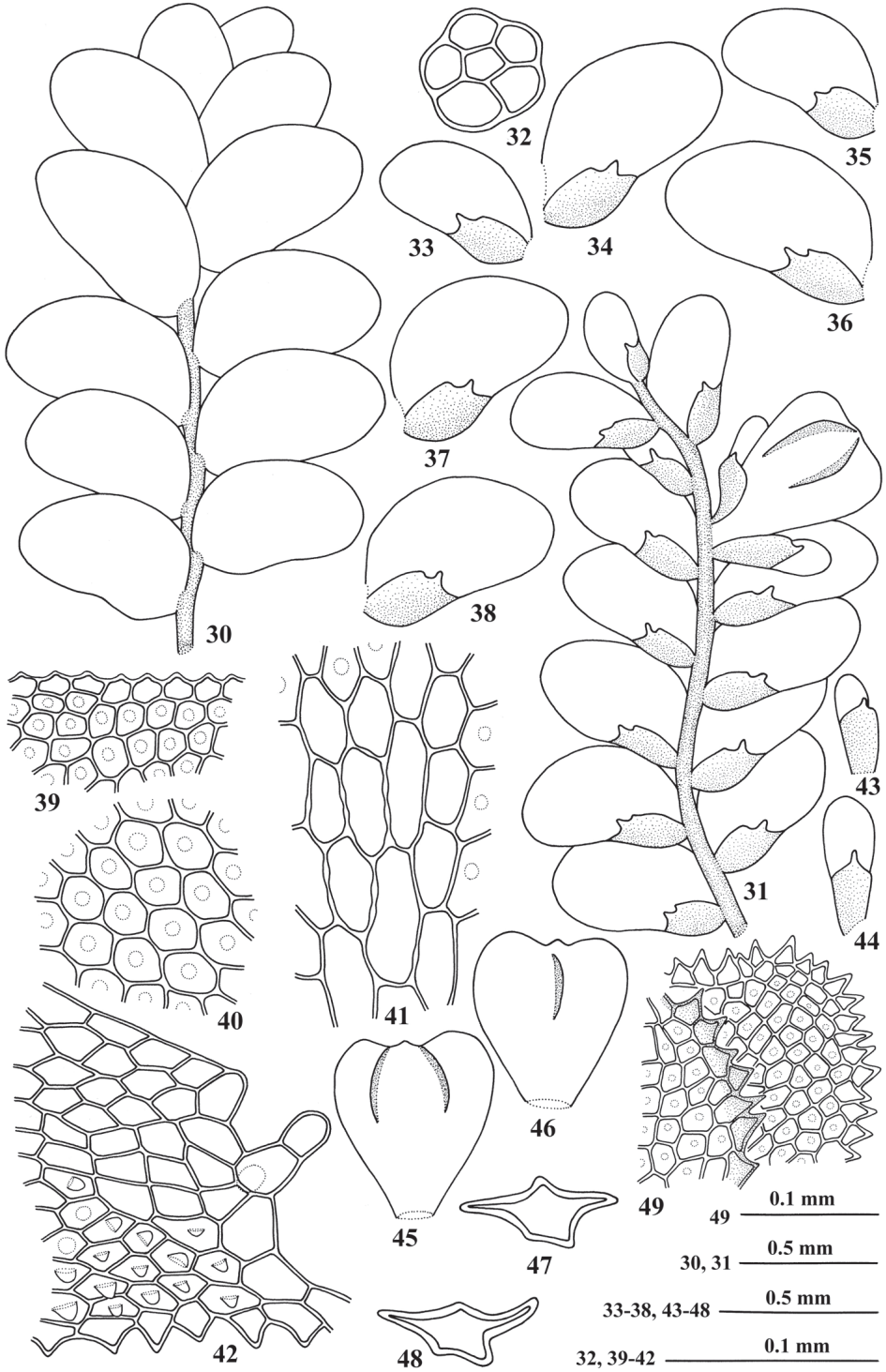
Plants light green when fresh, yellowish green in herbarium specimens; shoot 4-6 mm long, 1.1-1.5 mm wide; branching *Lejeunea*-type, irregular, sparse. Stem suborbicular to orbicular in transverse section, 57-65 μm , 3 cells across the diameter; cortical cells 5, rectangulate-polygonal, 15-28 \times 20-33 μm , thin-walled; medullary cell 1, pentagonal, 12-15 \times 15-18 μm , thin-walled; ventral merophyte 1 cell wide. Rhizoids few, fasciculate on ventral surface of stem, hyaline. Leaves loosely imbricate-contiguous, incubously inserted, obliquely spreading; leaf lobe oblong-ovate, 0.51-0.72 mm long, 0.28-0.41 mm wide, apex rounded to rounded obtuse, margin finely denticulate, dorsal margin arched, ventral margin slightly arched to nearly straight; apical leaf cells rectangular-polygonal, 7-13 \times 12-18 μm ; median leaf cells hexagonal-polygonal, 22-33 \times 17-23 μm ; basal leaf cells elongated, polygonal, 37-65 \times 17-25 μm ; walls thin with small trigones, intermediate thickenings absent in marginal and median cells, frequent in basal cells; dorsal protrusion of leaf cells shortly spinose, 5.0-8.7 μm in diameter, 1 per cell, absent in basal leaf cells; oil-bodies not seen; leaf lobule inflated, 1/3-2/5 as long as the leaf lobe, ovate, 0.22-0.32 mm long, 0.14-0.17 mm wide, bidentate; first tooth 3 cells long, 3-4 cells wide at base, uniseriate above; second tooth unicellular, triangular; hyaline papilla subspherical to oval, present at the inner surface of first tooth; shortly spinose dorsal protrusion present on the surface of lobule towards keel; keel slightly arched, spinose; stylus unicellular. Gemmae absent.

Table 1. A comparative analysis of morphological characters of *Cololejeunea andamanensis* and its allied species

<i>Taxonomic characters</i>	<i>C. andamanensis</i>	<i>C. saroltae</i>	<i>C. subminutilobula</i>
Plant size	5-14 mm long, 1.3-1.8 mm wide	Up to 11 mm long, 1.2-1.5 mm wide	2-5 mm long, 0.6-1.0 mm wide
Stem anatomy	50.0-57.5 × 80-90 µm; ventral merophytes 2-4 cells wide	40-50 µm; ventral merophyte 1 cell wide	40-50 µm; ventral merophyte 1 cell wide
Leaf size	0.9-1.1 mm long, 0.6-0.7 mm wide	0.64-0.96 mm long, 0.45-0.56 mm wide	0.38-0.5 mm long, 0.34-0.4 mm wide
Leaf margin	with <i>Allorgella</i> -type denticulations; apical and dorsal margins bordered by hyaline cells	with <i>Allorgella</i> -type denticulations; apical and dorsal margins bordered by hyaline cells	without <i>Allorgella</i> -type denticulations; apical and dorsal margins bordered by hyaline cells
Leaf cells	with 1-3 nodulose, subnodulose or irregular intermediate thickenings along each side of wall	Intermediate thickenings absent	Intermediate thickenings absent
Lobule	Triangular, apical tooth 1 cell long, 1-2 cells wide; hyaline papilla present at apex of tooth	Rectangular, apical tooth 1-2 cells long; hyaline papilla present at proximal base of tooth	Triangular, apical tooth 1-2 cells long; hyaline papilla present at apex of tooth
Stylus	Unicellular	Unicellular	Unicellular
Sexuality	Autoicous	Autoicous	Autoicous
Androecia	on lateral branches; male bracts in 2-8 pairs	on lateral branches; male bracts in 2-8 pairs	on lateral branches; male bracts in 1-10 pairs
Gynoecia	with or rarely without, a single sub floral innovation	with a single sub floral innovation	with a single sub floral innovation
Female bracts	bract lobe oblong with hyaline margin; bract lobule about 2/3 as long as lobe	bract lobe oblong with hyaline margin; bract lobule 1/2-2/3 as long as bract lobe	bract lobe oblong or obovate with hyaline margin; bract lobule 1/5-1/2 as long as bract lobe
Perianth	obovate-obcordate; lateral keels non auriculate	cordate; lateral keels strongly auriculate	obcordate; lateral keels slightly auriculate

Dioicous. Androecial branches not seen. Gynoecia terminal with a single subfloral innovation; bract lobe oblong, 0.31-0.42 mm long, 0.13-0.16 mm wide, apex rounded-obtuse, margin crenulate, surface shortly spinose; bract lobule 1/2-2/3 as long as the bract lobe, apex with a single tooth; perianth obcordate, 0.4-0.6 mm long, 0.37-0.50 mm wide, slightly dorsoventrally flattened, surface shortly spinose; keels 5 (2 lateral, 2 ventral, 1 dorsal), margin of keels denticulate; beak short, 1 cell long. Mature sporophytes not seen.

Habitat: Epiphyllous, growing on leaves of *Calamus andamanicus* Kurz and *Garcinia nervosa* Miq. in moist and shady environments, in association with *Caudalejeunea recurvistipula* (Gottsche) Schiffn., *Cheilolejeunea trapezia* (Nees) Kachroo & R.M.Schust., *Cololejeunea floccosa* (Lehm. & Lindenb.) Schiffn.,



C. lanciloba Steph., *Colura ari* (Steph.) Steph., *Drepanolejeunea pentadactyla* (Mont.) Steph., *Lejeunea anisophylla* Mont., *Leptolejeunea epiphylla* (Mitt.) Steph., *L. maculata* (Mitt.) Schiffn., *Lopholejeunea sikkimensis* Steph., *Microlejeunea punctiformis* (Taylor) Steph., *Radula acuminata* Steph., *R. protensa* Lindenb. and *R. tjobodensis* K.I.Goebel.

Distribution: India (South Andaman Island, Great Nicobar Island), China, Malaysia, Philippines, Vietnam.

Specimens examined: INDIA: Andaman & Nicobar Islands, South Andaman, Motor Bhanji, Chidiatapu, near water stream, c. 19 m, 11°32'995" N, 92°40'420" E, 04 Feb. 2014, *D.K. Singh 61614D* (CAL); Campbell Bay, Great Nicobar Biosphere Reserve (GNBR), East-West Road, 15.5 km, 06°59'146" N, 93°51'923" E, 06 April 2013, *C. Murugan 61512G* (CAL); GNBR, Navy dera, Stream side, c. 48 m, 07°08'114" N, 93°52'931" E, 09 April 2013, *C. Murugan 61529C, 61530C, 61531B* (CAL); Campbell Bay, GNBR, 07°00'219" N, 93°52'794" E, 07 Feb. 2014, *D.K. Singh 61645E* (CAL); Campbell Bay, c. 56 m, 07°00'282" N, 93°52'765" E, 07 Feb. 2014, *D.K. Singh 61647C, 61648G, 61650F, 61651F, 61652G* (CAL).

The Indian plants of *C. pseudoschmidtii* have more delicate stems and slightly smaller leaves as those from the Philippines, Malaysia and Vietnam, which have up to 100 µm thick stems with 0.9 mm long and 0.5 mm wide leaves (Tixier, 1972, 1977, 1985). Otherwise the Indian plants correspond to the descriptions provided by Tixier.

Cololejeunea pseudoschmidtii belongs to subgenus *Cololejeunea* Spruce. It differs from the Indian species of this subgenus in having a 3 rather than 1-2(-3) cells long first lobule tooth as well as lobules with shortly spinose dorsal protrusions (Tixier, 1972, 1977; Zhu, 1995; Asthana & Srivastava, 2003; Dey & Singh, 2011, 2012; Singh & Barbhuiya 2013; Singh & Singh 2013).

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◀ Figs 30-49. *Cololejeunea pseudoschmidtii* Tixier. **30.** A portion of plant in dorsal view; **31.** The same in ventral view (rhizoids not drawn); **32.** Transverse section of stem; **33-38.** Leaves; **39.** Apical leaf cells; **40.** Median leaf cells; **41.** Basal leaf cells; **42.** Apex of leaf lobule; **43, 44.** Female bracts; **45.** A perianth in ventral view; **46.** The same in dorsal view; **47, 48.** Transverse sections of perianth; **49.** A portion of perianth with a lateral and a ventral keel (enlarged) showing denticulate surface [All drawn from *C. Murugan 61530C*].

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