

**CERATOLEJEUNEA BELANGERIANA (LEJEUNEACEAE),  
NEW TO INDIA FROM THE WESTERN GHATS**

R. SREEBHA, K. C. KARIYAPPA and A. E. D. DANIELS\*

*Bryology Laboratory, Department of Botany and Research Centre  
Scott Christian College (Autonomous), Nagercoil – 629 003, Tamil Nadu, India*  
\*E-mail: [dulipdaniels@yahoo.co.uk](mailto:dulipdaniels@yahoo.co.uk)

(Received 27 October, 2014; Accepted 10 November, 2014)

*Ceratolejeunea belangeriana* is added here to the liverwort flora of India from the Indira Gandhi National Park, Anamalais in the Western Ghats. A brief description together with illustrations are provided.

Key words: *Ceratolejeunea belangeriana*, *C. oceanica*, *C. singapurensis*, liverworts, Western Ghats

## INTRODUCTION

The genus *Ceratolejeunea* (Spruce) Schiffn., containing about 46 species, has a world-wide, predominantly tropical distribution, with its greatest diversity in the Neotropics (23 species). Currently, about 11 species are recognised from Africa and 10 from Asia. However, only the neotropical species have been monographed recently, so that the true number of species in Africa and Asia (and Oceania) is uncertain. The genus appears to be rare in the Indian subcontinent, with only one species, *C. singapurensis* (Lindenb.) Schiffn., hitherto confirmed from India (a single collection from Wayanad District in the Western Ghats in Kerala State: Udar and Shaheen 1985) and none from Sri Lanka. Stephani (1913: 441) included the Andaman Islands in the distribution of *C. singapurensis*, but this record was not mentioned by Mizutani (1981) and it remained unconfirmed.

Having searched for bryophytes in the Indira Gandhi National Park, Anamalais in Coimbatore District A. E. D. Daniels and K. C. Kariyappa made two collections of a Lejeuneaceae species, whose brown colour and distinc-

tive horned perianths (several of which were present in the collections) suggested that a species of *Ceratolejeunea* was to hand. Later examination showed that the collections should be assigned to *C. belangeriana* (Gottsche) Steph. The plant was found growing on a tree trunk, mixed with the moss *Homaliodendron flabellatum* (Sm.) M. Fleisch. and the liverworts *Frullania moniliata* (Reinw., Blume et Nees) Mont. subsp. *obscura* Verd. and a *Plagiochila* sp. in moist evergreen forests of Valparai at an altitude of ca 1,040 m.

The Anamalais plants have been assigned to *C. belangeriana* (Gottsche) Steph. on the basis of the long perianth horns (1/3–1/2 the length of the perianth), dentate female bracts, perianth longly exerted and attenuate at the base (appearing semi-stalked) and large underleaves with a deep, U-shaped sinus. A description is provided below, together with 35 figures.

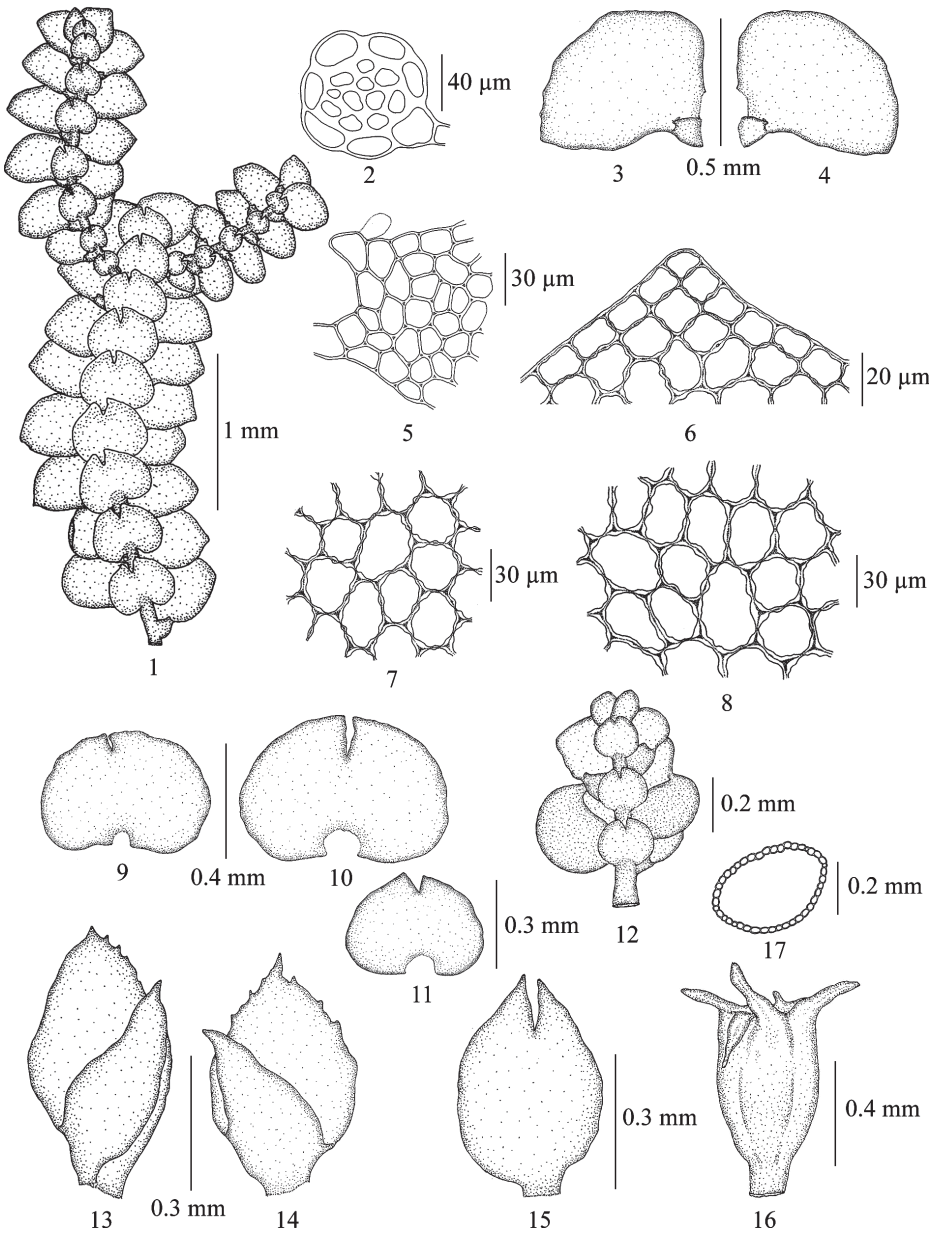
*Ceratolejeunea belangeriana* (Gottsche) Steph., Sp. Hepat.5: 396. 1913.  
(Figs 1–35)

Basionym: *Lejeunea belangeriana* Gottsche in Gottsche *et al.*, Syn. Hepat.: 398. 1845. – Type: Mauritius, *Bélangier* s.n. (G ex hb. Lehmann).

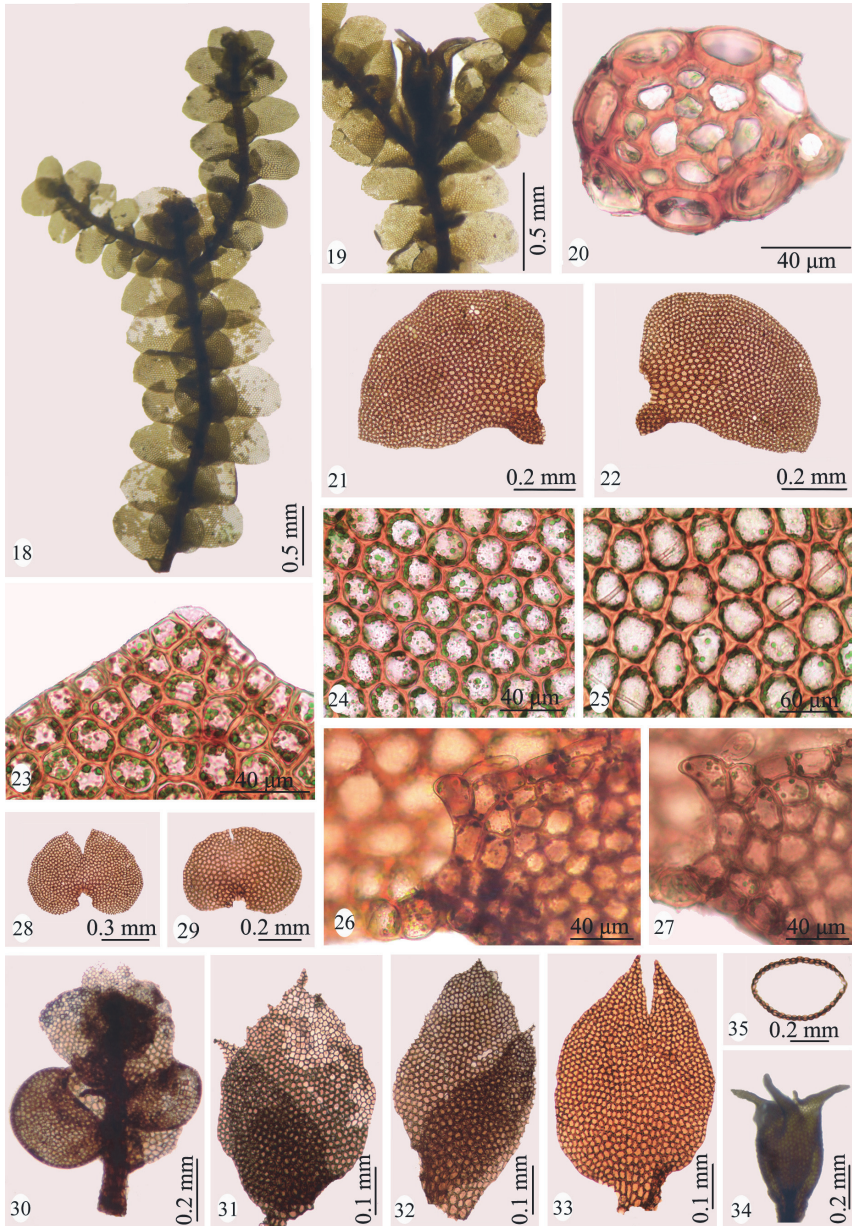
= *Lejeunea oceanica* Mitt., in Seem., Fl. Vit.: 414. 1871. ≡ *Ceratolejeunea oceanica* (Mitt.) Steph., Bot. Jarhb. Syst. 23: 310. 1897; syn. fide Grolle and Piippo (1984). – Types: Oceania: Samoa, *Powell* s.n.; Society Is., Raiatea Is., *Collie* s.n. (G, NY).

Further synonymy in Grolle (1995), Mizutani (1981) and Pócs (2011).

Plants autoicous, brown, with a dull sheen. Shoots 6–15 mm long, prostrate, irregularly branched; stems 80–100 µm diam., 6 cells wide; epidermis of 7 thick walled cells enclosing ca 11–12, smaller, thick walled medullary cells. Rhizoids fasciculate. Leaves imbricate to contiguous, wide-spreading, the lobes asymmetrically ovate, 0.45–0.75 × 0.35–0.65 mm, sinuate at margin, acute and sometimes incurved at apex, occasionally with a few blunt teeth; cells thick walled, with large trigones and intermediate thickenings; apical cells 14–20 × 12–16 µm; median cells 20–32 × 16–28 µm; basal cells 24–40 × 20–32 µm; ocelli not observed; cuticle smooth; lobules 1/5 as long as leaf, ovate, inflated, constricted at apex, toothed; tooth 1-celled, blunt, with a hyaline papilla at its proximal side; keel arched; utricles absent at bases of branches. Underleaves loosely imbricate to distant, 0.3–0.5 × 0.45–0.75 mm, 4–6 times as wide as stem, reniform to orbicular, 2-lobed to ca 2/5 at apex, incurved at lateral margin with deeply sinuate insertions. Androecium on branches, capitate; bracts 2 pairs, loosely imbricate, ca 0.8 mm long; bracteoles at base of androecium, ca 0.2 × 0.25 mm long. Gynoecium on short or long branches, with 1 or 2 pycnolejeuneoid innovations, which are again floriferous; bract lobes ovate, 0.5–0.6 × 0.3–0.4 mm, the distal margin dentate, acute at apex; bract lobules ca 3/4 as long as lobe, 0.4–0.45 × 0.23–0.28 mm, oblong-lanceolate, margin



Figs 1–17. *Ceratolejeunea belangeriana* (Gottsche) Steph. – 1 = portion of plant; 2 = cross section of stem; 3–4 = leaves; 5 = leaf lobule cells; 6 = leaf apical cells; 7 = leaf median cells; 8 = leaf basal cells; 9–11 = underleaves; 12 = male inflorescence; 13–14 = female bracts; 15 = female bracteole; 16 = perianth; 17 = cross section of perianth (drawn from Daniels, A. E. D. and Kariyappa, K. C., 9289)



Figs 18–35. *Ceratolejeunea oceanica* (Mitt.) Steph. – 18 = portion of plant; 19 = with perianth; 20 = cross section of stem; 21–22 = leaves; 23 = leaf apical cells; 24 = leaf median cells; 25 = leaf basal cells; 26–27 = leaf lobule apical cells with hyaline papilla; 28–29 = underleaves; 30 = male inflorescence; 31–32 = female bracts; 33 = female bracteole; 34 = perianth; 35 = cross section of perianth (from Daniels, A. E. D. and Kariyappa, K. C., 9289)

sinuate, acute at apex; keel *ca* 1/4 as long as lobule; bracteoles ovate, 0.4–0.5 × 0.3–0.35 mm, connate at base with bract lobules on either side, 2-lobed for *ca* 1/3 at apex, margin sinuate. Perianths 3/4 to almost completely exerted above bracteoles, oblong or oblong-ovate (excluding horns), inflated, attenuate at base (appearing semi-stalked), 0.8–1.0 × 0.45–0.48 mm, mamilliose on surface above; horns 4, erect or divergent, 0.3–0.32 mm high, 1/3–1/2 as long as perianth; beak 3- or 4-celled.

Habitat: Corticolous, in evergreen forests, *ca* 1,040 m.

Distribution: Comores, Madagascar, Mauritius, Réunion, Seychelles, India: Western Ghats of Tamil Nadu. Indomalaya (from Thailand to the Philippines), Japan (Ryukyu Islands), Taiwan (Orchid Island also known as Botel Tobago), Melanesia, New Guinea, Samoa, Polynesia and Tahiti Island.

Specimens examined: Western Ghats, Tamil Nadu, Coimbatore Dist., Anamalais, Valparai, in evergreen forest. Alt.: *ca* 1,040 m a.s.l. Coll.: A. E. D. Daniels and K. C. Kariyappa (9289, 9290), 19 February, 2013 (SCCN).

## DISCUSSION

Characters attributed to *C. belangeriana* by Mizutani (1981, as *C. oceanica* (Mitt.) Steph.), include the large trigones and intermediate thickenings of the cell walls of the leaf lobes, the reniform to orbicular underleaves 4 to 6 times as wide as the stem, with a deep sinus, female bract lobes distinctly toothed towards the apex, and perianths with 4 long horns. Mizutani (1981) also described *Ceratolejeunea singapurensis*, which he considered could be differentiated from *C. oceanica* (= *C. belangeriana*) by the oblong leaf lobes with rounded apices and entire margins, entire margins of female bracts and bracteole, short perianth horns and smaller underleaves. He considered it to be closely related to *C. oceanica* and possibly an extreme form of it. Udar and Shaheen (1985) stated that *C. singapurensis* could be distinguished from *C. oceanica* by its smaller size, leaf lobes rarely with 1–2 teeth near the apex, leaf apices flat or slightly incurved, and the “characteristic short [perianth] horns”. They also acknowledged the closeness of *C. singapurensis* and *C. oceanica* by commenting that in other features, their Kerala specimen appeared to occupy an intermediate position.

The present Anamalais material shows a few overlapping characters between *C. belangeriana* and *C. singapurensis*, particularly in the distinctiveness of the trigones and intermediate thickenings. There are leaf cells with large, swollen trigones and others with smaller but distinct trigones; some with very small trigones and devoid of any intermediate thickenings. Similarly, the number of male bracts varies from 1 to 3 and rarely 6 pairs in *C. singapurensis*, whereas it is 2 to 6 pairs in *C. belangeriana*. In the present material, the number

of male bracts was found to be 2 pairs, the leaf lobes were ovate with or without 3 blunt teeth at apical margin, flat or distinctly incurved at apex. We have been unable to study the Kerala collection of *C. singapurensis* (LWU 6018/82) and compare it with our material. Nonetheless, it is clear that both species are highly variable and can hardly be distinguished if the specimens are sterile. However, presence of very short and erect perianth horns can be attributed to *C. singapurensis* and long and erect to divergent ones to *C. belangeriana*. Since the present material possesses long perianth horns that are erect to divergent, it is best identified as *C. belangeriana*.

*Ceratolejeunea belangeriana* closely resembles the tropical Afro-American species, *C. cornuta* (Lindenb.) Steph. Characters attributed to *C. cornuta* by Dauphin (2003), include the large trigones and intermediate thickenings of the cell walls of the leaf lobes, the reniform to orbicular underleaves 4 to 6 times as wide as the stem, with a deep sinus, female bract lobes distinctly toothed towards the apex, and perianths with 4 long horns. The only difference between the two species appears to be in the degree of exsertion of the perianth from the perichaetial bracts. In *C. belangeriana*, the perianth has an attenuate base that exserts the perianth 1/2–3/4 above the perichaetial leaves, whereas the perianth of *C. cornuta* is exserted up to only 1/2 its length. Pócs (2011) considered that further studies of Asian and Oceanic populations of *C. belangeriana* are required to determine whether it really merits recognition at species level, and if the exsertion of the perianth proves to be the only difference between the two species, then *C. belangeriana* would be best treated as a subspecies of *C. cornuta*.

#### KEY TO THE INDIAN *CERATOLEJEUNEA* SPECIES

- 1a Underleaves to 6 times as wide as stem, reniform to orbicular, with a deep sinus; lobe of female bract dentate in distal part; perianth horns 1/3–1/2 as long as perianth *C. belangeriana*
- 1b Underleaves to 4 times as wide as stem, orbicular, with a shallow sinus; lobe of female bract entire; perianth horns 1/5 as long as perianth *C. singapurensis*

\*

*Acknowledgements* – We thank the Tamil Nadu State Forest Department for permission to explore the study area. AEDD thanks the Department of Science and Technology (DST), New Delhi, for financial assistance, M. J. Wigginton, Peterborough, England and Prof T. Pócs, Hungary, for comments and help with literature, and the Principal, Scott Christian College, Tamil Nadu, India, for facilities.

## REFERENCES

- Dauphin, G. (2003): *Ceratolejeunea*. – *Flora Neotropica Monograph* **90**: 1–86.
- Grolle, R. (1995): The Hepaticae and Anthocerotae of the East African islands. An annotated catalogue. – *Bryophyt. Biblioth.* **48**: 1–178.
- Grolle, R. and Piippo, S. (1984): Annotated catalogue of Western Melanesian bryophytes I. Hepaticae and Anthocerotae. – *Acta Bot. Fenn.* **125**: 1–86.
- Miller, H. A., Whittier, H. O. and Whittier, B. A. (1983): *Prodromus florum hepaticarum Polynesiae*. Catalogue of Hepaticae and Anthocerotae. – *Bryophyt. Biblioth.* **25**: 15.
- Mizutani, M. (1981): Notes on the Lejeuneaceae. 5. Some Asiatic species of the genus *Ceratolejeunea*. – *J. Hattori Bot. Lab.* **49**: 305–318.
- Pócs, T. (2011): East African bryophytes XXIX. The *Ceratolejeunea* (Lejeuneaceae) species of the Indian Ocean Islands. – *Polish Bot. J.* **56**: 131–153.
- Stephani, F. (1913): *Species Hepaticarum*. Vol. 5. – George & Cie, Lyon, pp. 177–448.
- Udar, R. and Shaheen, F. (1985): The genus *Ceratolejeunea* in India. – *J. Indian Bot. Soc.* **64**: 400–402.