# *Lejeunea srivastavae* sp. nov. (Marchantiophyta: Lejeuneaceae), from Nilgiri hills of Western Ghats (India)

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ABSTRACT: A new species of *Lejeunea*, *L. srivastavae,* is described and illustrated as new to science from central part of Nilgiri Mountains of Western Ghats, a global biodiversity Hotspot, India. The species is characterized by large plants size, pale greenish to yellowish green colour, imbricate leaves with large leaf-lobule, contiguous – distant underleaves, 4–5 times as wide as stem and single gynoecial innovation. Details of its morpho-taxonomy, distribution and affinities are provided along with a key to the genus *Lejuenea* species in Nilgiri hills to distinguish it with other known species of the area.

KEY WORDS: *Lejeunea srivastavae*, Lejeuneaceae, new species, Nilgiri Mountains Western Ghats, India.

## INTRODUCTION

The Nilgiri hills of Tamil Nadu are a part of Nilgiri Biosphere Reserve, Western Ghats, India, a biodiversity hot spot and hosts a valuable gene pool and veritable floral diversity. The Nilgiris lies between 10° 1'–11° 47' latitude and 76° 12' to 77° 15' longitude spreading on an area of about 2479 sq. km (see also Hockings, 1989). The area receives southeastern and northwestern monsoon thus making the territory bryologically very rich specially those which grow as epiphyte. Among the dominating liverwort genera, *Lejeunea* holds an important place owing to enormous morpho-diversity as it is often considered as most difficult genus of not only Lejeuneaceae but also entire hepaticae.

The genus is tropical and sub-tropical in distribution with numerous species. It was stabilized by Libert (1820) with two species, *Lejeunea calcarea* Lib. [now *Cololejeunea calcarea* (Lib.) Steph.] and *L. serpillifolia* Lib., creating a problem for type species. However the riddle was solved by Bonner and Miller (1960), who selected *L. serpillifolia* Lib. as type species of *Lejeunea*. The phenotypic diversity exhibited by the genus often misleads the worker to describe different binomials in India and elsewhere. Stephani (1924) documented ca. 180 species of the genus from Africa, Neotropics, Asia and Oceania. Out of this only 8 species were recognized from India. Mitten (1861) reported 34 species of *Lejeunea* from India, however, the generic status of most of them have been changed in recent years. It is interesting to note that till date, a comprehensive monographic account of *Lejeunea* in India is still lacking, and whatsoever information we have, is the compilation of mostly the work of earlier workers and some sporadic observations in recent years. Several checklists have been published from time to time, but the recent and most important ones are those of Parihar (1961), Parihar et al. (1994), and Dandotiya et al. (2011).However, all of them merely gave a compiled list of earlier described species of *Lejeunea* as well other taxa. According to most recent checklist by Dandotiya et al. (2011), around 32 species of *Lejeunea* are now present in India.

As far as the area of Western Ghats is concerned, the first record of *Lejeunea* appeared as *L. neelgherriana* Gottsche described by Gottsche et al. (1844–47) from Nilgiri hills based on Perottet's collection. Mitten (1861) reported *L. cucullata* Nees [an unresolved name now as only *L. cucullata* (Reinw. et al.) Nees is available in records, which is further a synonym of *Metalejeunea cucullata* (Reinw. et al.) Grolle; Source: The plant list, www.theplantlist.org] and *L. minutissima* Dumort. [another doubtful name, a similar entry *L. minutissima* (Sm.) Schiffn. has been found to be synonym of *Cololejeunea minutissima;* Source: The plant list, www.theplantlist.org] from the region while Stephani (1924) reported one more species *L. perrottetii* Steph. from the region. Chopra (1938) in his census of south Indian hepatics included *L. cavifolia* (Ehrh.) Lindb. and *L. lowriana* Stephani from Kotagiri on the basis of Sedgwick's collection. Nair et al. (2006) reported presence of *L. exilis* (Reinw. et al.) Grolle, in Western Ghats, however, this species has not been found in Nilgiri area. Manju et al. (2007) reported 4 species of *Lejeunea* from Kakkayam forests of Western Ghats in Kozhikode district of Kerala, viz., *L. discreta* Lindenb., *L. punctiformis* Taylor, *L. stevensiana* (Steph.) Mizut. and *L. subacuta* Mitt. Manju et al. (2009) also reported *Lejeunea obfusca* Mitt. and *L. eifrigii* Mizut. from Agasthyamalai hills of Western



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Ghats. Manju et al. (2011) further reported *L. cocoes* Mitt., from Kakkavayal reserve Forest of Kerala, a part of western Ghats. Verma and Srivastava (2011) listed 3 endemic species of *Lejeunea* in the list of endemic liverworts in Western Ghats while Alam (2012) reported 4 species of *Lejeunea* from Parsons Valley, Nilgiri hill.

During present studies, observation of several collections of the Nilgiri area revealed presence of a total of 11 species of *Lejeunea* in the Nilgiri area, including a new species described here as *L. srivastavae* sp. nov. The lack of a consolidated account of all the species of any genera in any region, large or small, obviously creates taxonomical problems; hence a key to segregate all the species in the Nilgiri region is being provided in the present study to help the future workers.

Etymology: The new species *L. srivastavae* sp. nov. has been named after Prof. S.C. Srivastava, F.N.A.Sc., an eminent Indian Bryologist and our teacher, who have added new dimensions to Bryological research in India.

**Key to the species of *Lejeunea* in Nilgiri hills**

1. Leaf-lobe with acute apex ……. 2
1. Leaf-lobe with sub-acute to obtuse apex ……. 3
2. Leaf-lobule-lobule 1/2 of the lobe length ……. ***L. neelgherriana***
2. Leaf-lobule 1/6–1/8 of the lobe length ……. ***L. stevensiana***
3. Leaf-lobule dimorphic with reduced and inflated forms, rhizoids from leaf-lobe margin ……. ***L. aloba***
3. Leaf-lobule monomorphic always with inflated form; rhizoids always absent on leaf-lobe margin ……. 4
4. Plants squarrose ……. ***L. perrottetii***
4. Plants flat ……. 5
5. Underleaves small, almost as wide as stem ……. ***L. cocoes***
5. Underleaves large, about 3–4 times as wide as stem ……. 6
6. Leaf-lobe oblong ……. ***L. flava***
6. Leaf-lobe ovate or orbicular ……. 7
7. Plants robust (up to 35 mm long), frequently branched ……. 8
7. Plants small (up to 25 mm long), sparsely branched ……. 9
8. Perianth compressed ……. ***L. caespitosa***
8. Perianth long, ovate – pyriform ……. 10
9. Perianth with mammilose surface ……. ***L. tuberculosa***
9. Perianth with smooth surface ……. ***L. wightii***
10. Leaves usually falcate, sub-erect spreading, leaf-lobule triangular (apex obliquely truncate is also reported by Zhu & So, 2001 in this species), cells below the first tooth of leaf-lobule larger than neighbouring cells ……. ***L. discreta***
10. Leaves never falcate, widely spreading, leaf-lobule broad, cells below the first tooth of leaf-lobule identical to the neighbouring cells ……. ***L. srivastavae* sp. nov.**

## TAXONOMIC TREATMENTS

***Lejeunea srivastavae* sp. nov.** Figs. 1 & 2

*Plantarum magna, de 30 mm longa, pallide viridis; ramis irregulariter pinnatis; cellulae corticalis 7, cellulae medullaris 9–12; folia cum lobulis magna; amphigastria 4–5 temporibus latitudine trunco; gynoecia in brevi lateralibus ramis, cladogynous, inflorescentia monochasial; perianthium ovatis, 5-carinatis ad medium, rostro prominentibus; capsulam murum bistratose, cum nodular crassitiebus; sporarum irregulars, cum minutisspinis; elaters cum deficient unispiral crasso cohortem.*

Typus: INDIA. Western Ghats, Tamil Nadu-Nilgiri hills, Ootacamund (on way to Pykara lake); *ca*. 2100 m; 29.03.2001; *P.K. Verma and A. Alam; 13626/2001* HOLOTYPE (LWU).

Plants in compact patches, pale green to yellowish green, up to 30 mm long, 1.25 mm wide, growth habit deliquescent, ramification pattern irregularly pinnate, branching '*Lejeunea*-type'. Stem 8–9 cells across the diameter, differentiated; cortical cells 7 in number, large, 21 × 13 µm in size; medullary cells 9–12 in number, small, 11 × 13 µm in size. Leaves imbricate, obliquely inserted, widely spreading; leaf-lobe ovate, 0.57–0.61 mm long, 0.39–0.43 mm wide; apex rounded, obtuse; margin entire; antical margin strongly arched up to base; postical margin straight, slightly arched at keel; cells large, trigones prominent, with intermediate nodular thickening, apical cells 8–16 × 8–18 µm in size, median cells 18–27 × 13–28 µm in size, basal cells 24–30 × 13–21 µm in size; cuticle smooth, leaf-lobule large, 1/2 of the lobe length, inflated, ovate, 0.23–0.26 mm long, 0.16–0.18 mm wide, first tooth one celled, obtuse, with hyaline papilla at proximal side; second tooth small and indistinct; oil-bodies small, numerous (10–15); Underleaves contiguous-distant, 3–4 times as wide as stem, ovate, 1.2–1.34 mm long, 0.78–0.90 mm wide, base rounded, bifid 1/3 of the length, sinus narrow, lobes triangular, apex acute to obtuse, margin entire.

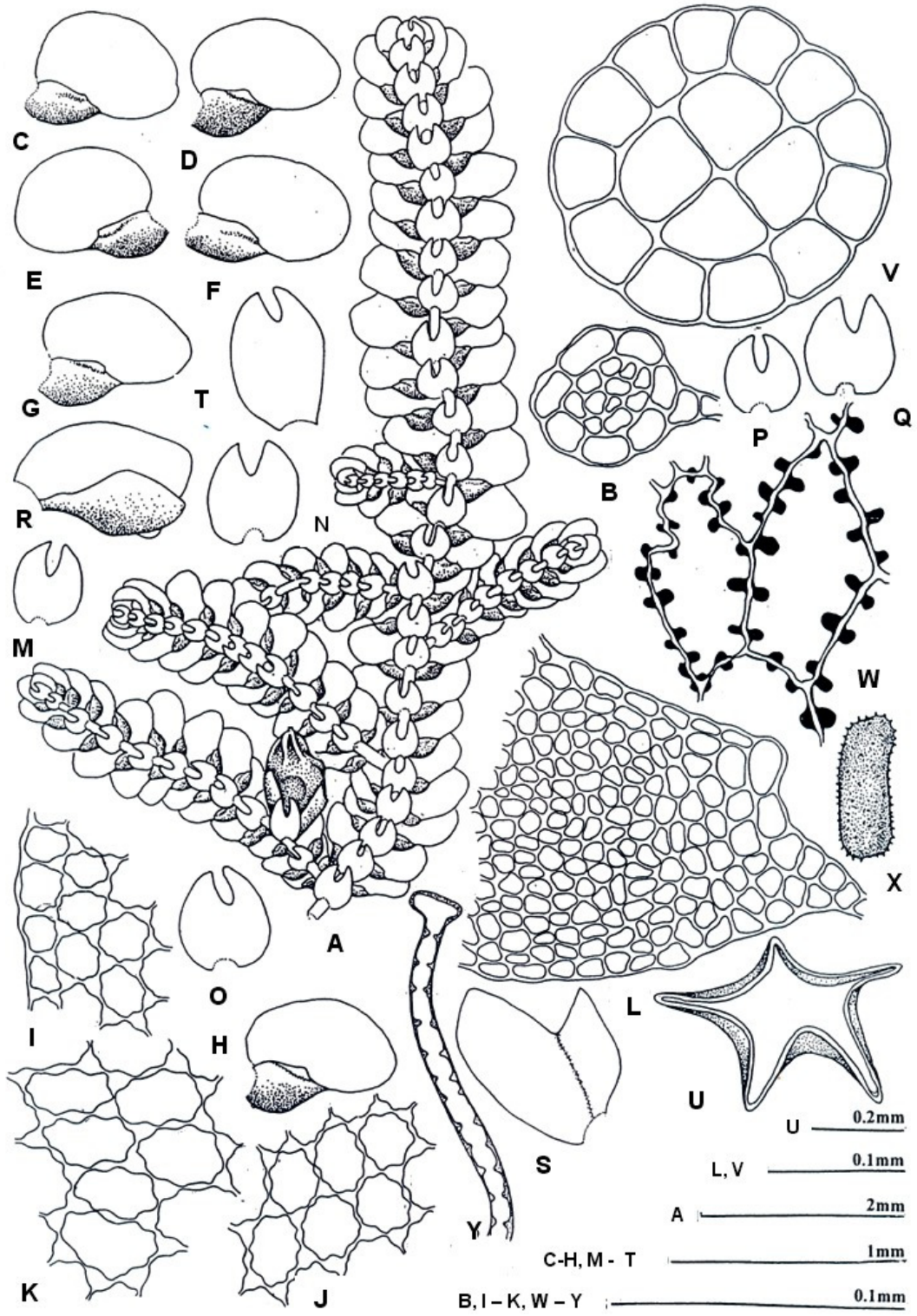
Dioicous. Male plant not seen. Gynoecia on short lateral branches, cladogynous, gynoecial innovation single, innovation leaf sequence lejeuneoid, inflorescence pattern monochasial; female bracts in single pairs; bract-lobe oblong, 0.46–0.52 mm long, 0.30–0.42 mm wide, apex rounded, obtuse; bract-lobule oblong with obtuse apex, 2/3 of the lobe length; bracteole ovate, 0.48–0.50 mm long, 0.32–0.36 mm wide, 1/3 of the length. Perianth ovate, 0.72–0.96 mm long, 0.38–0.46 mmwide, 5-keeled, keels up to middle, beak prominent. Capsule wall bistratose, epidermal and inner wall cells with nodular thickenings. Spores chlorophyllous, irregular, 30–42 × 15–22 µm, with minute spines (immature). Elaters 320–420 µm long 18–20 µm wide, with faint unispiral thickening band.

Type locality: India-Tamil Nadu (Nilgiri hills-Ootacamund).

Range and Distribution: Endemic to India: Tamil Nadu-Nilgiri hills [Ootacamund (Emerald, Glenmorgan, on way to Pykara lake, on way to Pykara waterfalls), Gudulur (Anumapuram, Naduvattam), Mukuruti National Park (Governorsholai, on way to Mukuruti



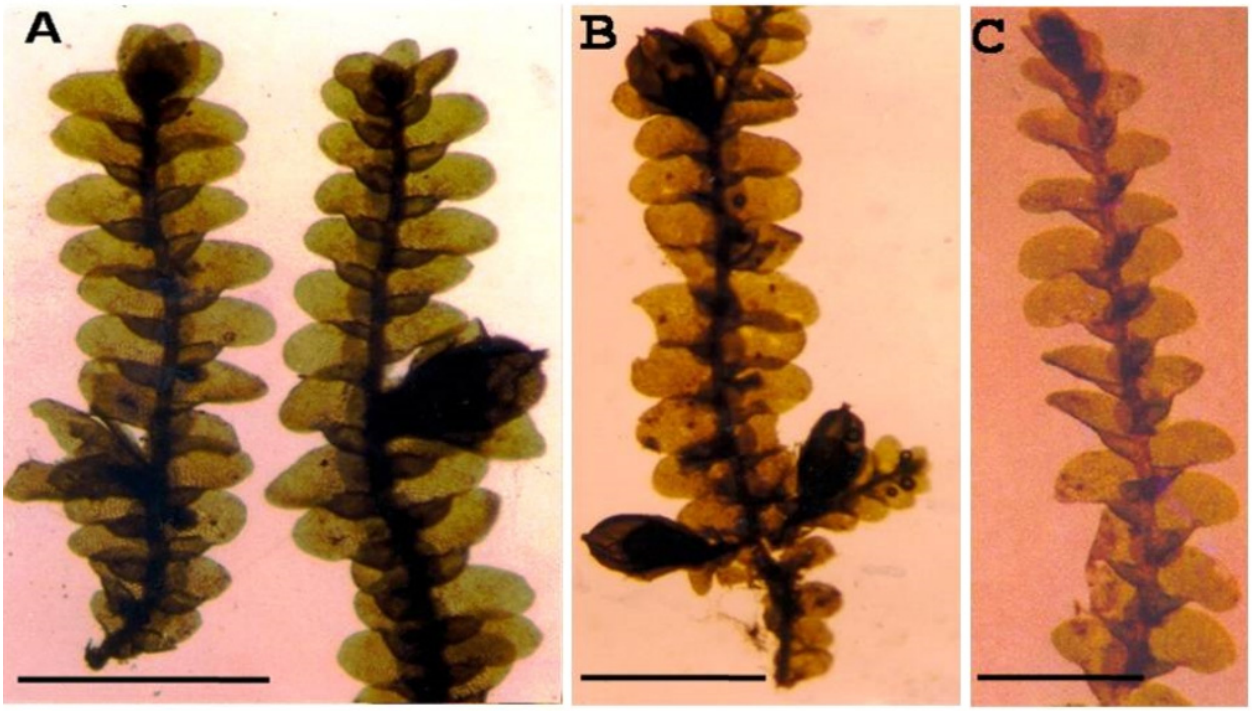
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**Figs. 1.** ***Lejeunea srivastavae*** **sp. nov. A: Habit of plants, ventral view. B: Cross section of stem. C–H: Leaves. I: Apical cells of leaf-lobe. J: Median cells of leaf lobe. K: Basal cells of leaf-lobe. L: Leaf-lobule, cellular. M–Q: Underleaves. R & S: Female bracts. T: Female bracteole. U: Cross section of perianth. V: Cross section of seta. W: Outer layer of capsule wall. X: A spore, Y: An elater (Drawn by P. K. Verma from Typus*; 13626/2001* **– LWU).**



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**Figs.2. A: Habit of plants of *Lejeunea srivastavae* sp. nov, ventral view. B: Habit of *Lejeunea flava*, ventral view, showing lateral perianth. C: Habit of *Lejeunea discreta*, ventral view. (Figs. A . from *Typus*13626/2001 – LWU; Fig. B. from 16348/2002-LWU, Fig. C. from 17116/2003–LWU. all microphotograph taken by P. K. Verma, Bars: A & B = 1.25 mm, C = 26 µm.).**

lake, Parson's valley)].

Ecology: The plants are growing in smooth mats as epiphytic population on tree trunk as well as twigs of angiospermus trees.

Other Specimens examined: ***Lejeunea srivastavae* sp. nov.;** INDIA: Tamil Nadu, Nilgiri hills-Ootacamund (on way to Pykara lake); *ca*. 2100 m.; 29.03.2001; *P.K. Verma and A. Alam; 13631/2001*, *13633/2001*, *13644/2001*, *13650/2001* (LWU). Mukuruti National Park (Mukuruti lake), *ca*. 2200 m.; 29.11.2001; *P.K. Verma and A. Alam; 14536/2001* (LWU). Mukuruti National Park (on way to Mukuruti lake); *ca*. 2200 m.; 29.11.2001; *P.K. Verma and A. Alam; 14538/2001*, *14539/2001*, *14541/2001*, *14544/2001* (LWU).

***Lejeunea discreta* Lindenb**.; South INDIA: Tamil Nadu: Palni hills – Kodaikanal; 1909; G. Andre; Det.: Stephani; TYPUS 14272 (G). Nilgiri Hills – Ootacamund (Dodabetta); *ca.* 2660 m; 8.10.2000; *S. C. Srivastava; 12483/2000*, (LWU).

***Lejeunea flava* (Swatz) Nees as *Eulejeunea flava***; INDIA, Sikkim Himalaya – Kurseong; 1894; Bretandeau; Herb. E. Levier no. 205; 19978 (G). South India: Tamil Nadu: Nilgiri hills – Ootacamund (Dodabetta); *ca.* 2660 m; 08.10.2000; *S.C. Srivastava and party*; *12411/2000*, *12418/2000*, *12423/2000* (LWU).

*Lejeunea srivastavae* closely resembles *L. flava* in appearance and overall morphology however differs significantly in leaf-shape and leaf-lobule size and sexuality. The *L. srivastavae* is having rounded leaf-lobe apex and larger leaf-lobule (Fig. 1; Fig. 2A, while *L. flava* is also having rounded obtuse leaf lobe apex and triangular, small leaf-lobule and monoecious sexuality (Fig. 2B).

The species also resemble *L. discreta* in perianth structure and in appearance but differ in leaves which are usually falcate and sub-erect spreading with triangular leaf-lobule (apex obliquely truncate is also reported by Zhu and So, 2001 in this species) (Fig. 2C). Furthermore, cells below the first tooth of leaf -lobule are larger than neighbouring cells in *L. discreta* while in *L. srivastavae*, leaves are ovate with truncate leaf-lobule and the cells below the first tooth of leaf-lobule are identical to the neighbouring cells. The fresh plants of *L. srivastavae* are dark green in colour, vigorous, underleaves sinus always narrow and gynoecial innovation always single in all populations while in *L. discreta*, fresh plants are light green to yellowish in colour, narrow in shape (never vigorous), underleaves with wide sinus and gynoecial innovation 1–2 in number.

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# *Lejeunea srivastavae* sp. nov.（地錢門：細鱗蘚科）－自印度西高止山脈尼基里山發現之新種

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摘要：本文發表了細鱗蘚屬的一個新種*Lejeunea srivastavae* sp. nov.，發現地點在印度西高止山脈尼基里山，該地同時也是著名的全球生物多樣性熱點。本文附上該種之手繪圖及照片，也提供了分類描述、分布地點和細鱗蘚屬之檢索表，以利此種與該地其他同屬分類群之分辨。

關鍵詞：印度、細鱗蘚屬、細鱗蘚科、尼基里山、坦米爾納德邦、西高止山脈。



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