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Research Article

ON THE OCCURRENCE OF *SPRUCEANTHUS SEMIREPANDUS* (NEES) VERD. (LEJEUNEACEAE; MARCHANTIOPHYTA) IN WESTERN HIMALAYA, INDIA

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ABSTRACT
The leafy liverwort, *Spruceanthus semirepandus* (Nees) Verd., hitherto known from Eastern Himalaya and South Indian hills is being recorded as new to the Western Himalaya. The occurrence of the species at Munsyari (2200 meters alt.) in Kumaun region of the state of Uttarakhand in Western Himalaya reaffirms the fact that the species has a preference for high altitudes in India. In spite of known variability and plasticity of the species the present population has shown more stability in characters and is being described.

Keywords: *Spruceanthus Semirepandus; Leafy Liverwort; New Record; Western Himalaya*

INTRODUCTION
The ptychanthoid genus, *Spruceanthus* Verd. is an Asiatic element and is widely distributed in the tropical and subtropical regions (Gradstein, 1991). In India, the genus is presently represented by two species, namely, *S. semirepandus* (Nees) Verd. and S. *polymorphus* (Sande Lac.) Verd. The third species, namely, *S. wiggintonii* Daniels, Kariappa & Daniel, which was reported from Western Ghats by Daniels *et al.*, (2010), have recently been, on the basis of detailed morphological and molecular studies, synonymised into another genus, *Ptychanthus striatus* (Lehm. & Linenb.) Nees (Wang *et al.*, 2014). A perusal of literature shows that the two existing species of *Spruceanthus* Verd. are of common occurrence in India and have been reported from various localities in the Eastern Himalaya and South Indian hills (Verdoorn, 1934; Udar & Awashi 1982; Parihar *et al.*, 1994; Singh & Nath, 2007; Dandotiya *et al.*, 2007; Poćs *et al.*, 2007; Manju *et al.*, 2008; Alam, 2012). However, the presence of the genus was not recorded from the Western Himalaya. The checklist of bryophytes by Dandotiya *et al.*, (2007), followed by other floristic studies including Manju *et al.*, (2008) and Alam (2012), have, on the other hand, mention the presence of *S. semirepandus* (Nees) Verd. in the West Himalayan region as well, which is erroneous (personal communications). We, in our recent liverwort collection trip to the Kumaun region in the state of Uttarakhand in Western Himalalya have collected the beautifully growing brownish green and profusely fertile populations of *S. semirepandus* (Nees) Verd. on the older trunks of the oak trees, *Quercus leucotrichophora* A. Camus, from Munsyari (30 ^{0} 3' 50" N; 80^0 14' 12.3" E; 2200m) in Pithoragarh district. The species is therefore described as a new record from this region.

MATERIALS AND METHODS
The morphological studies of specimens were made using Motic BA 210 Digital microscope. The slides of various plant parts including hand sections were mounted in glycerine jelly. The field photographs were taken by Olympus camera. All the specimens are deposited in Duthie Herbarium, Botany Department, University of Allahabad.

Description
Spruceanthus Semirepandus (Nees) Verd.
Ann. Bryol. Suppl. 4: 153 (1934); *Jungermannia semirepanda* Nees, Hepat. Javan. 39 (1830); *Ptychanthus semirepandus* (Nees) Nees, Naturg. Eur. Leberm. 3: 212 (1838); *Lejeunea semirepanda* (Nees) Mitt., Journ. Proc. Linn. Soc. Bot 5: 111 (1861); *Thysananthus rotundistipulus* Steph., Spec. Hepat. 6:566 (1924); Udar & Awasthi , Journal of the Indian Botanical Society 61: 184 (1982).

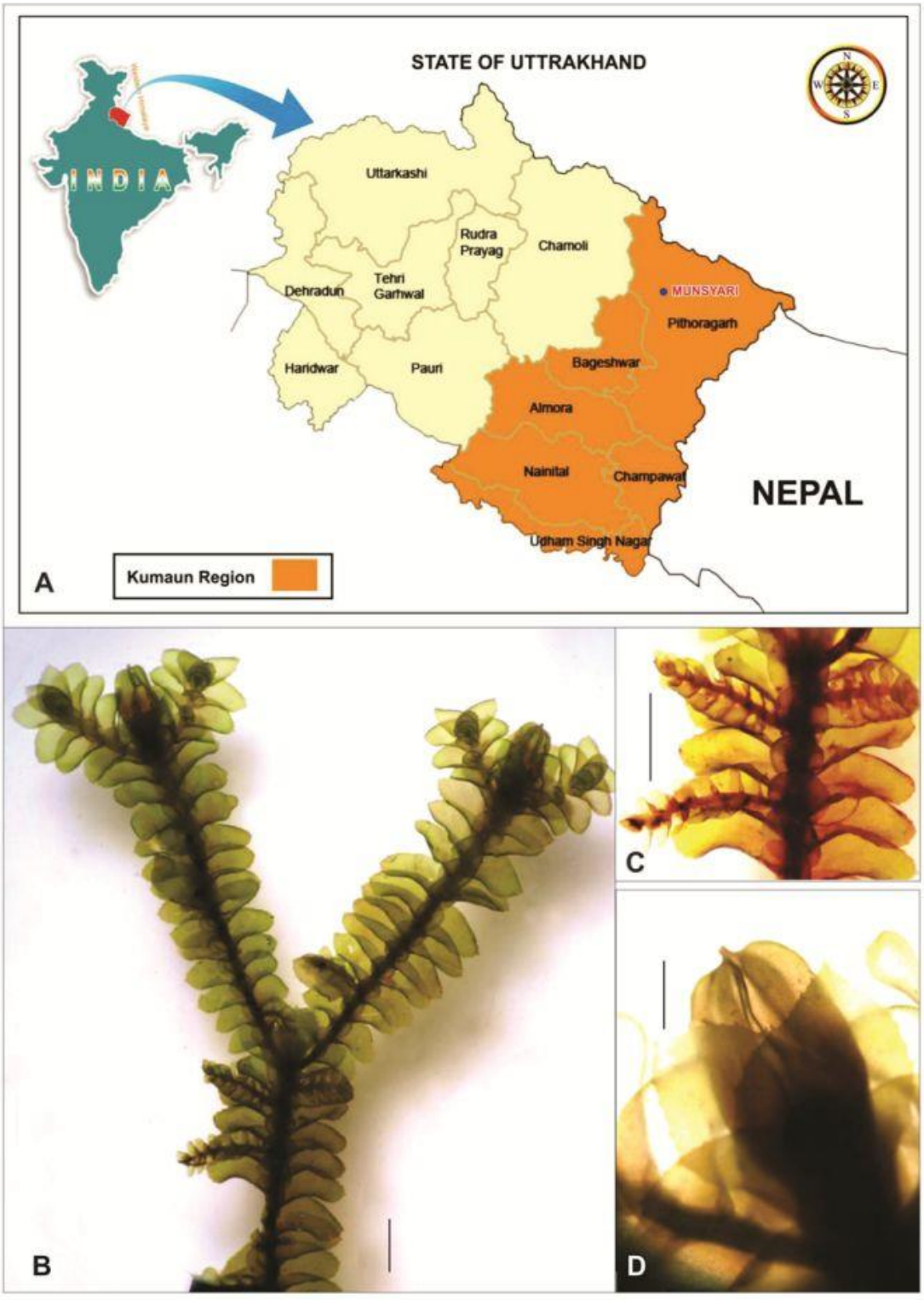

Plate 1 : A. Map of India showing the state of Uttarakhand in Western Himalaya and the collection site, Munsyari (●), in Kumaun region of the state. *Spruceanthus semirepandus* (Nees) Verd. **B.** Part of plant, ventral view; **C.** The androecia, ventral view; **D.** The perianth, dorsal view. (Bar = 2mm)

(Plate 1: B - D and Plate 2: A - R)
Plants robust, 40 – 70 mm long and 1.5 - 3.0 mm wide, brownish green, branching dichotomous, in loose mats. Stem in cross section 0.3 to 0.2 mm, cortex 1-layered, in 30-38 rows, cells 24 x 20 µm, thick walled, darkly pigmented, medullary cells in several layers, cells 30 x 22 µm, larger than cortical cells but with lesser thickenings, trigones distinct. Leaves densely imbricate, incubous and widely spreading. Lobes slightly convex, obliquely ovate, 2.0 – 2.3 mm long and 1.3 – 1.4 mm wide, margin dentate toward apex, the number of marginal teeth per lobe variable from 8 to 13, the size of teeth 2 – 3 celled at base and 1 – 4 celled in height, apex acute, cells thick walled with prominent trigones and intermediate thickenings; Marginal cells subquadrate 8 – 13 x 14 – 20 µm, median cells 13 – 25 x 26 - 35 µm, with trigones, basal cells 17 – 31 x 25 – 60 µm, with intermediate thickenings and large trigones; Oil-bodies 28 – 42 per cell, smooth surfaced, spherical to elliptical, 1.5 – 2.5 µm.
Lobules 1/4 – 1/5 of the lobe length 0.45 – 0.56 mm long and 0.26 – 0.28 mm wide, with two distinct triangular teeth at free margin, hyaline papilla on the inner surface of the first tooth. Under leaves smaller near the base but getting larger towards female inflorescence, orbicular, 0.85 – 1.1 mm long and 0.75 – 0.85 mm wide, margin generally dentate rarely entire, teeth smaller. Autoicous. Male inflorescences on short lateral branches, at right angle to stem, generally terminal but occasionally intercalary due to continued growth of the branch, 5–10 pairs of bracts and 5–10 bracteoles, bracts imbricate, deeply concave and almost equally bilobed with wavy margin and acute apex; bracteoles present throughout the length of the male branch. Female inflorescence terminal on the main branch, always with 2 subfloral innovations; Bract-lobes more dentate than leaf lobes, 2.1 – 2.5 mm long and 1.2 – 1.5 mm wide; Bract-lobules nearly 1/2 or 1/3 the length of bract-lobe, adnate with it or slightly extending beyond the keel, with 1 – 5 teeth; Bracteoles, 2 – 3 or more times as long as under leaves, 2.2 – 2.5 mm long and 1.3 – 1.5 mm wide, oblong to ovate, more dentate than under leaves; Perianth obovate, oblong, 2.3 – 2.5 mm long and 1.1 – 1.3 mm wide, 6 – 10 plicate, plicae smooth, beak prominent. Seta composed of 4 – 5 central rows of cells surrounded by 16 – 17 peripheral rows of cells, central cells 34 – 60 x 30 – 70 µm, radially elongated, peripheral cells 28 – 55 x 43 – 50 µm.
Capsule bi-stratose, cells of outer layer with nodular thickenings at corners; cells of inner layer with pleurifenestrate thickenings. Elater 320 – 335 µm long and 17 – 20 µm wide, with 1– 2 spiral thickening bands. Spores green, spherical to oval, 40 x 50 µm in diameter, minutely papillose, with a distinct granulated zone.

Ecology and Distribution

The species grows on the bark of the old trunks of the oak tree, *Quercus leucotrichophora* A. Camus, in an oak dominated forest along with *Plagiochila parvifolia* Lindenb. and *Ptychanthus striatus* (Lehm. & Lindenb.) Nees.
Type: Indonesia – Java (Mizutani, 1961)
Bhutan, China, Korea, India, Indonesia, Japan, Nepal, New Caledonia, Papua New Guinea, Phillipines Sri Lanka, Taiwan
In India, the species is known from Eastern Himalaya - Sikkim; Meghalaya; Assam; West Bengal and from South India - Malabar; Kudremukh; Nilgiri (Udar & Awasthi 1982; Singh & Nath 2007).

Specimens Examined

India, Western Himalaya, State of Uttarakhand, Kumaun Region, District Pithoragarh, Munsyari (Near TRH): WHKP 0259 L/15, WHKP 0260 L/15, 5th October 2015, leg. S. N. Srivastava & party, det. S. N. Srivastava & M. Rai

RESULTS AND DISCUSSION

Spruceanthus semirepandus (Nees) Verd. is a corticolous leafy liverwort which is widely distributed in tropical and subtropical regions in Asia. In India, the species has been recorded from various localities in the Eastern Himalaya and South Indian hills where it generally grows at high altitudes. The two important accounts of the description of the species are those of Verdoorn (1934) and Udar & Awasthi (1982).

However, both these accounts are based on specimens collected from the aforementioned regions. The present description is based on the specimens collected from the Western Himalaya for the first time.

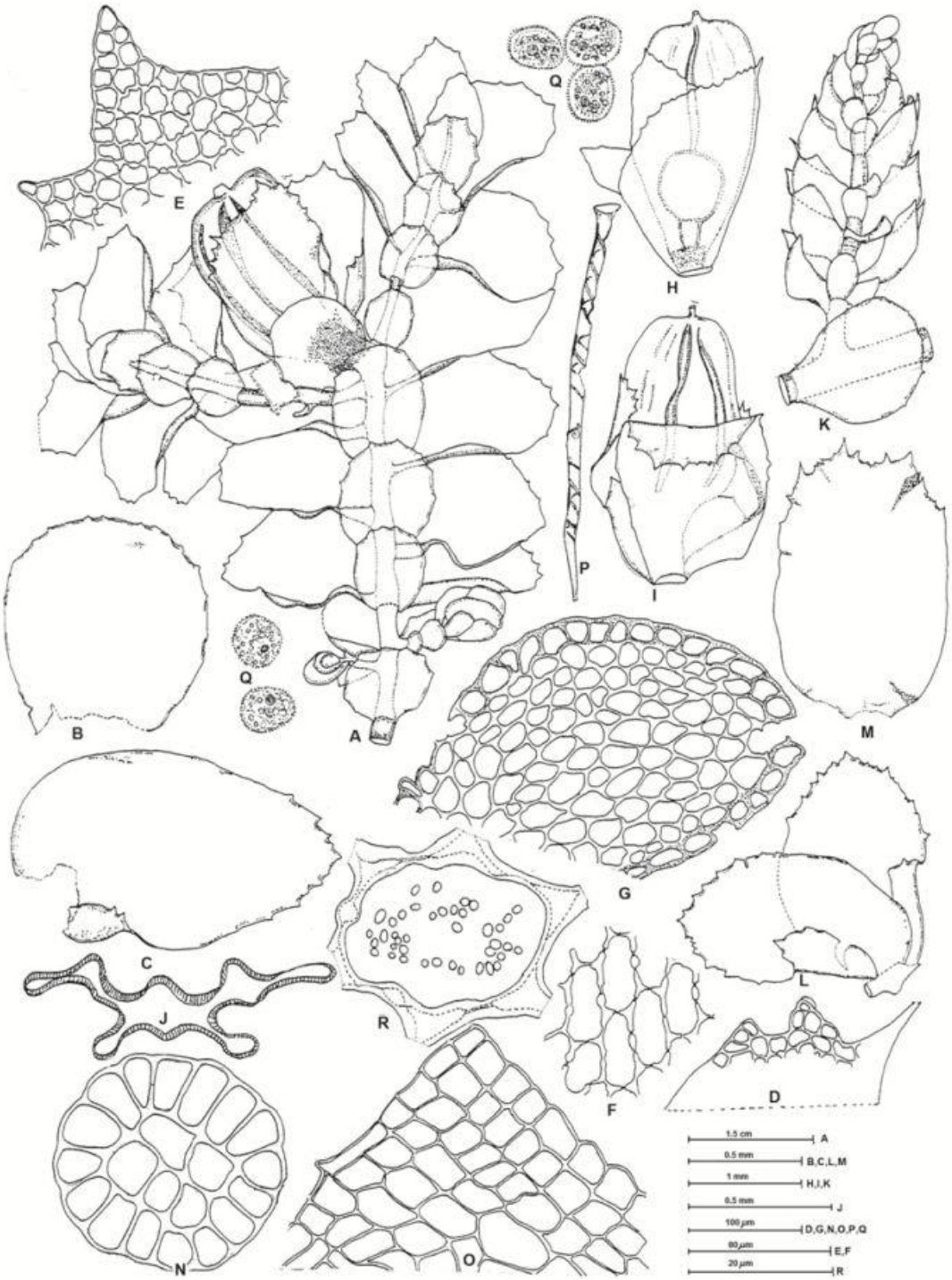

Plate 2 : *Spruceanthus semirepandus* (Nees) Verd. **A.** Part of plant, ventral view; **B.** An amphigastrium; **C.** A leaf; **D.** Margin of leaf-lobule; **E.** Marginal cells of the leaf; **F.** Basal cells of the leaf; **G.** Stem, t.s.; **H.** Perianth, dorsal view; **I.** Perianth, ventral view; J. Perianth, t.s.; **K.** The androecia, ventral view; **L.** The female bracts; **M.** The female bracteole; **N.** Seta, t.s.; **O.** Inner layer of capsule wall; **P.** An elater; **Q.** Spores; **R.** A cell showing oil bodies.

The salient features of the present population includes the following: (i) the female inflorescence is always terminal on the main branch and invariably subtended by two subfloral innovations, the perianth located in the fork of dichotomy; (ii) it is always because of repetitions of such subfloral innovations that a dichotomous appearance of the plants is seen; (iii) the cross section of robust stem shows 30 to 38 darkly pigmented, thick-walled cortical cells in one layer, surrounding several cream-coloured medullary cells which have distinct trigones; (iv) the underleaves are generally dentate and rarely entire whereas the leaves, bracts and bracteoles are always dentate; (v) the lobules always have two distinct triangular teeth at free margin and the hyaline papilla is located on the inner surface of the first tooth (vi) The leaf cells in general have prominent trigones and intermediate thickenings but are more pronounced in the basal cells; (vii) the oil-bodies are more homogeneous (up to 40 or more per leaf cell), small and numerous ; (viii) The androecia developing on short lateral branches are generally terminal but occasionally intercalary, with 5-10 pairs of bracts on each branch; (ix) the obovate perianth is 6-10 plicate and the plicae are smooth; (x) the seta is typical ptychanthoid type with 4-5 central and 16 -17 peripheral cells, the peripheral cells generally not dividing; (xi) the elaters are usually 1-spiralled but occasionally 2-spiralled and the spores are minutely papillose.

The taxon is well known for exhibiting a greater degree of diversity and plasticity in morphological and anatomical details. Udar & Awasthi (1982) critically examined many traits including the branching pattern in the plant, stem anatomy, the degree of dentitions on the leaves and underleaves, the shape and size of teeth on lobules, the thickness details of intermediate thickenings & trigones in cells, and several other taxonomically significant traits in a large number of specimens collected from different locations in Darjeeling in Eastern Himalaya and observed that "Often the variations in the above features in their cumulative expressions in east Himalayan populations, tend to be somewhat stable and seem to represent a different taxon but the overlapping nature of these characters favours their treatment under the same species. On the other hand, the West Himalayan populations exhibit more consistency in many characters though our study is based on populations at one particular site.

Spruceanthus semirepandus (Nees) Verd. is similar to *S. polymorphus* (Sande Lac.) Verd. but differs in having larger and wider plants; larger leaf lobes with acute apex and margin never undulate versus medium-sized plants of lesser width; medium sized leaf lobule with rounded apex and mostly undulate margin (Singh & Nath, 2007).

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