

***Polytrichadelphus spinosus* (Polytrichaceae, Bryophyta), a new species from Colombia**

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Abstract – The new moss species *Polytrichadelphus spinosus* A.M. Aponte-R. & Uribe is described and its diagnostic features are illustrated. It is recognized by the small teeth on the abaxial leaf surface, particularly on the costa, from the apex to the sheath, the pyriform to round apical cells of the lamellae, the broad shoulders and the stomata distributed almost over the entire capsule. It occurs in western Colombia, in the departments of Chocó, Risaralda, Huila, Putumayo, Valle del Cauca and Nariño, predominantly in montane forests slopes in open to disturbed forests. A table contrasting the new and sympatric species of *Polytrichadelphus* is presented.

Taxonomy / Polytrichales / Colombian Andes / montane forests / Neotropics

Resumen – *Polytrichadelphus spinosus* A.M. Aponte-R. & Uribe, una nueva especie de musgo de Colombia es descrita y sus características diagnósticas son ilustradas. Se reconoce por las espinas que se encuentran en la superficie abaxial de la hoja, particularmente sobre la costa, desde el ápice hasta incluso la vaina, así como por la forma piriforme a redondeada de las células apicales de las lamelas, la superficie amplia de los hombros y la distribución de los estomas que ocupan casi la totalidad de la cápsula. Se encuentra en el occidente de Colombia, en los departamentos de Chocó, Risaralda, Huila, Putumayo, Valle del Cauca y Nariño, predominantemente sobre taludes en bosques intervenidos. Se presentan, una ilustración y el mapa de la distribución, acompañados por una tabla comparativa que permite el reconocimiento de especies de *Polytrichadelphus*.

Musgos / taxonomía / Andes de Colombia / bosques montanos

INTRODUCTION

The genus *Polytrichadelphus* was described by Mitten (1860) based on specimens from New Zealand and Australia. It is characterized by the inclined and biangular capsules, which are commonly plane or concave above and convex below, the leaf sheath, in tropical species, exhibits an orange band (Gradstein *et al.*, 2001), and the apical cells of the lamella are pyriform. *Polytrichadelphus* is distributed

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across the Pacific, extending from Sulawesi to Papua New Guinea and New Zealand, and from southern South America to Costa Rica (Proctor, 1992). Several authors have highlighted the need for a taxonomic revision of the genus in the tropical Andes, which harbor a large number of species and may represent a secondary center of speciation (Smith, 1971). About 22 species of *Polytrichadelphus* have been described or reported from the New World tropics, but many of them with doubtful taxonomic status and delimitation due to gametophytic variability and polymorphism within and between populations (Proctor, 1992; Gradstein *et al.*, 2001; Churchill, 2009). Actually, we think the number of four or five species is more realistic.

During the study of the Polytrichaceae of Colombia (Aponte & Uribe, 2017), we discovered several specimens of *Polytrichadelphus* with a leaf arrangement distinct of that from other species: the leaves are widely spaced rather than imbricate, and the limb is somewhat recurved when dry. Moreover, the gametophytes are dark green, contrasting with the dark reddish-brown color of most species of the genus. Closer examination revealed the presence of numerous small teeth on the abaxial surface of the limb from the apex to the distal portion of the sheathing base (Figs 2, 12). This character distinguishes this specimen from all other Polytrichaceae. Furthermore, the leaves in cross section do not present any differentiation among limb cells (Fig. 4), and the shoulder area is very wide and formed of rounded cells (Fig. 5). These specimens are here proposed to represent a hitherto undescribed species.

MATERIAL AND METHODS

Specimens were rehydrated and examined under a light microscope (Olympus CH20) and dissecting microscope (Leica GZ6). Drawings were completed using a drawing tube.

TAXONOMIC TREATMENT

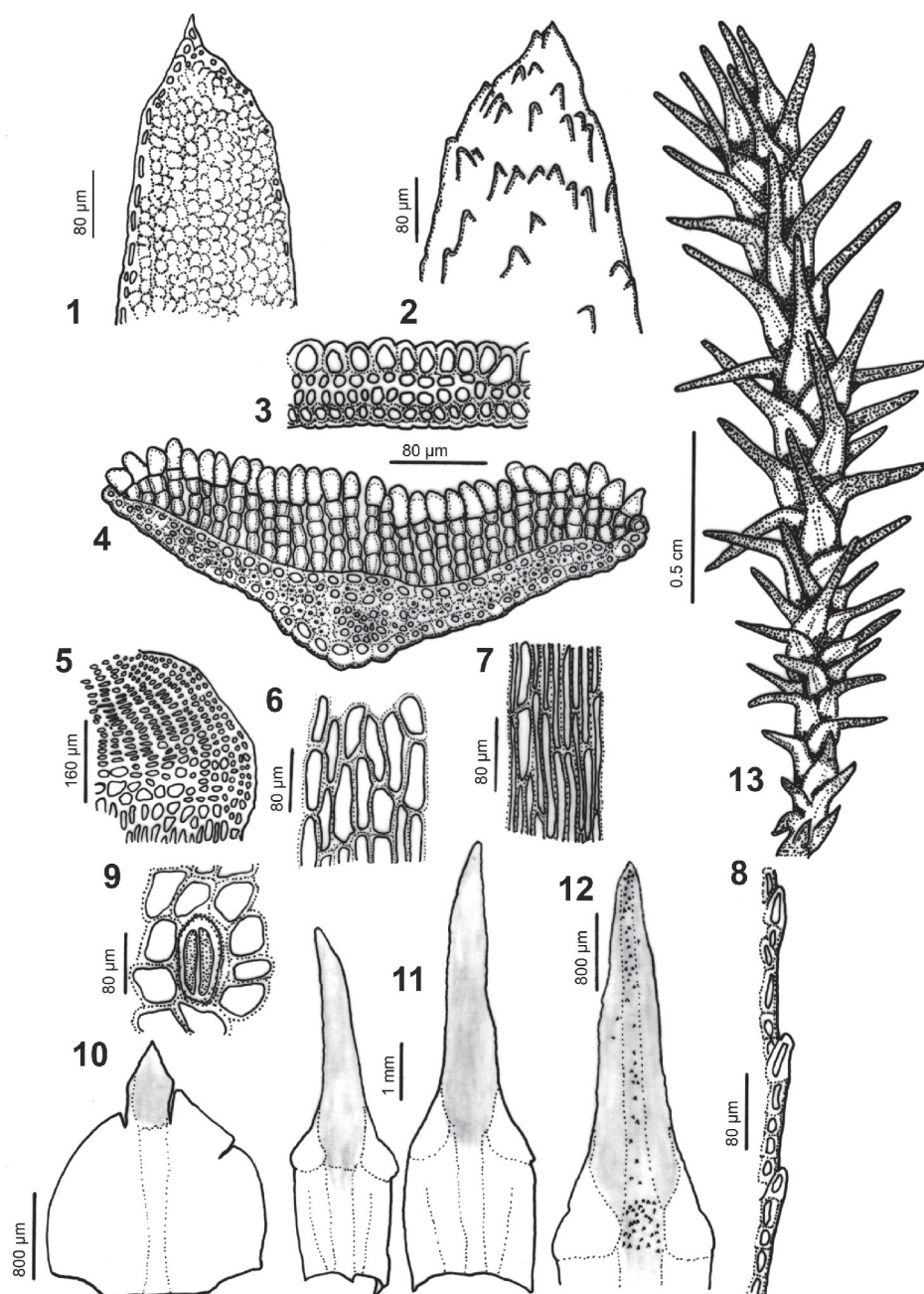
Polytrichadelphus spinosus A.M. Aponte-R. & Uribe, *sp. nov.*

Figs 1-13

Type: COLOMBIA: Nariño, Junín-Tumaco road, 6-11 km W of Junín. Roadside thickets and forest edge. Elev. 850-1030 m. 27 February 1979, *Luteyn & Lebrun-Luteyn 6891* (Holotype: COL, Isotype: NY).

Diagnosis: The new species is diagnosed by the teeth on the abaxial surface of the limb (Figs 2, 12), the broad shoulders composed of rounded cells (Fig. 4), the pyriform to round apical cells of the lamellae (Figs 3, 4), and the stomata (Fig. 9) distributed over almost the entire capsule.

Plants medium to small size, up to 4 cm, dark green to brown. Stems erect, forming mats or solitary. **Rhizome** well developed, round in cross section, 250-400 µm in diameter, central strand trilobate to round, cells reddish and thick-walled. **Rhizoids** abundant, hyaline. **Stem** simple, irregular, round in cross-section, 350-450 µm in diameter, with a red to orange central strand; in young stems, an outer



Figs 1-13. *Polytrichadelphus spinosus* A.M. Aponte-R. & Uribe. 1. Leaf apex (ventral view). 2. Leaf apex (dorsal view). 3. Lamellae (lateral view). 4. Cross section of the limb (middle zone). 5. Shoulder cells. 6. Sheathing base cells (middle zone). 7. Sheathing base cells (near the costa). 8. Limb margin (middle zone). 9. Stoma (in the capsule). 10. Leaf from perichaetium (middle zone). 11. Leaves of the gametophyte. 12. Leaf limb and part of the sheathing base (dorsal view). 13. Vegetative plant. (All from Luteyn 6891).

layer of large cells evident near the apex. **Leaves** patent and limb twisted when dry, erect to patent and flat when moist, 3-3.5 mm long, 0.6-0.8 mm wide in the middle area and 1-1.5 mm wide at the base, deltoid, differentiated into sheathing base and limb (Figs 11, 12); limb flat, 2-2.5 mm long; margins toothed (Fig. 8); unicellular teeth 100-400 μm , in the distal $\frac{3}{4}$ of leaf limb, closely spaced toward the apex and more irregularly dispersed at the base; the apex acute or acuminate (Figs 1, 2); sheathing base almost entirely orange, occasionally with a fold between the central strand and the margin (Figs 6, 7); costa strong, dentate or spiny on the underside of the shoulders and occasionally on part of the sheathing base (Figs 2, 12); lamellae on the nerve and part of the laminae; in cross-section, 40-55 lamella rows, 3-4 cells high, differentiated apical lamellar cell, pyriform to rounded square, smooth, 10-14 μm wide (Figs 3, 4). Ventral epidermis cells thick-walled, 6-10 \times 8-12 μm ; with 1-4 stereids bands above and below the guide cells; large, thick-walled but non-rigid guide cells, 6-10 \times 8-10 μm ; leptoids in several layers, wide; hydroids evident; cells of the dorsal epidermis with rounded to rectangular lumen, 6-8 \times 6-10 μm ; rectangular limb cells, 14-24 \times 4-8 μm ; rectangular sheathing base cells elongated, 80-130 \times 10-14 μm , occasionally appearing papillose; shoulder cells rectangular to isodiametric, 6-10 \times 15-28 μm .

Diocious. Perichaetium lateral; abundant and persistent archegonia; perichaetial leaves differentiated, 5.5-7.5 \times 1.0-2.5 mm, apex acute or aristate, margins winged and toothed; paraphyses abundant, usually filiform, sometimes with two parallel cells. **Perigonium** terminal; abundant, antheridia cylindrical, 0.4-0.6 mm long; perigonial leaves differentiated, orbicular or ovate (Fig. 10), 5-10 \times 1.5-4 mm, acute apex, margins dentate; paraphyses clavate, brown, abundant, upper half with 2-4 parallel cells.

Sporophyte solitary; seta smooth, red or brown, 3-6 cm long, straight; **capsule** bi-angled, horizontal, 5-7 mm long; exothecial cells rectangular or polygonal, with thickened walls, 15-35 \times 15-25 μm . **Stomata** present on almost the entire exothecium, immersed, 70-80 \times 40-50 μm (Fig. 9); peristome simple, teeth 64, 100-130 \times 40-70 μm ; operculum rostrate, reddish to brown, 2 \times 2-3 mm. **Calyptra** cucullate, up to 7 mm long, orange or brown, glabrous with spines at the apex. **Spores** spherical, 10-15 μm in diameter.

Etymology: The epithet "*spinosus*" refers to teeth or spines on the abaxial surface of the leaf, from the apex to the middle area of the sheath. These spines are dispersed, solitary or in groups of up to six.

Distribution and ecology: *Polytrichadelphus spinosus* is known only from Colombia where it occurs in the departments of Chocó, Huila, Nariño, Putumayo, Risaralda and Valle del Cauca (Fig. 14), between 850 and 2200 m elevation. It grows on bare soil, often in slopes, in open premontane to lower montane secondary forests.

DISCUSSION

Polytrichadelphus spinosus is easily recognized by the presence of spines (or teeth) on the abaxial surface of the limb on the nerve and extending to the upper part of the sheathing base (Figs 2, 12). These projections vary from strong (solid) and abundant in clusters to sparsely dispersed and pale. This feature is more easily seen when examining the abaxial surface of the limb after the lamellae have been

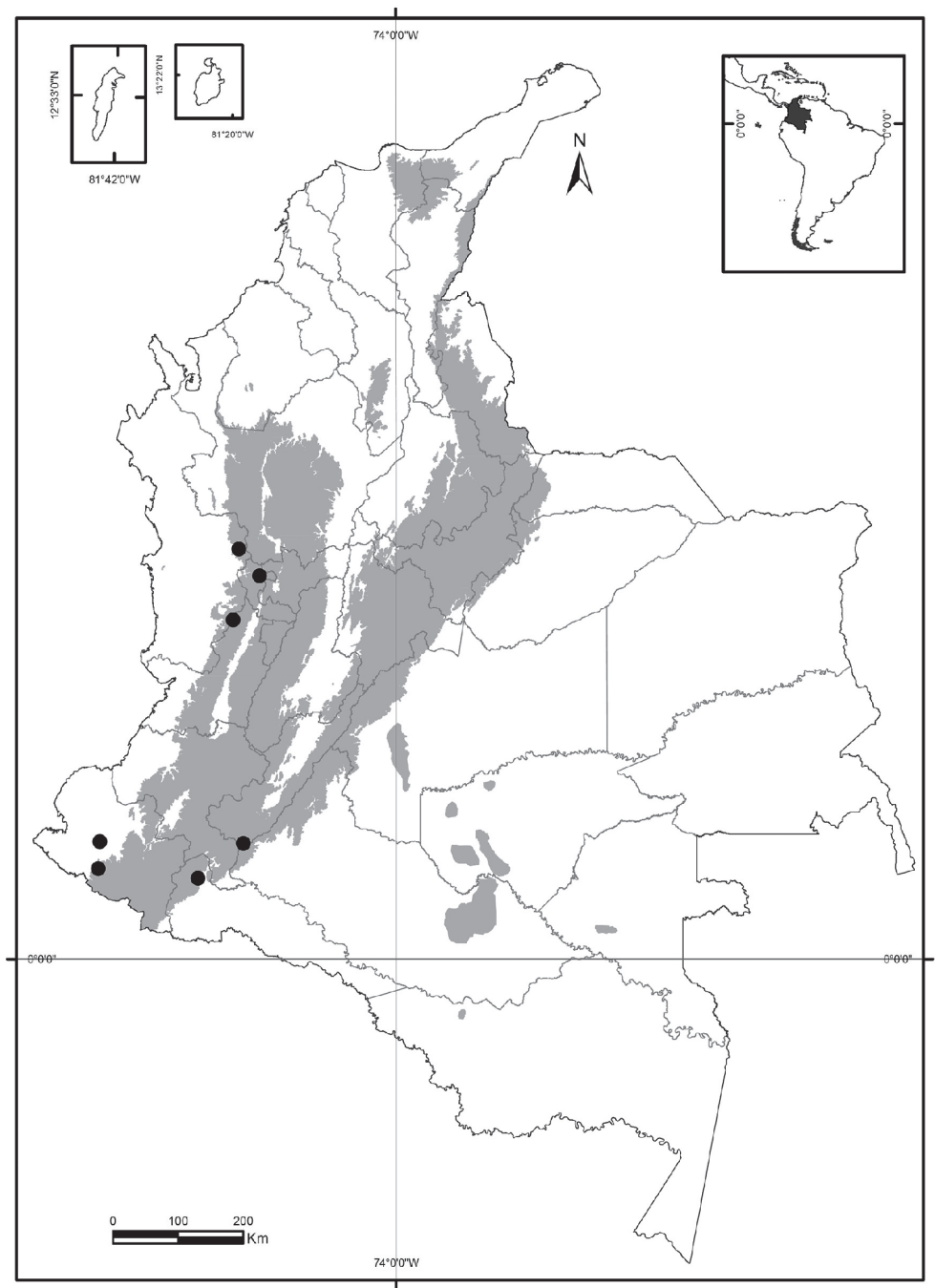


Fig. 14. Geographic distribution of *Polytrichadelphus spinosus* in the Andes Cordilleras in Colombia (gray).

Table 1. Comparison of morphological characters among *Polytrichadelphus* species recognized in Colombia (Aponte & Uribe, 2017) and *P. spinosus* sp. nov.

	<i>P. spinosus</i>	<i>P. longisetus</i>	<i>P. giganteus</i>	<i>P. ciliatus</i>
Margin ornamentation	Unicellular teeth	Entire to multicellular toothed	Unicellular teeth or groups of cells forming an irregular margin with bumps	Hyaline ciliate
Abaxial surface of the limb	From strong to slightly spinose. Spines even on the sheathing base	Generally entire, occasionally with projections, near the apex	Spinose or roughened near the apex	Entire or smooth
Shoulder area	Very broad, above the sheathing base	Scarcely undifferentiated to wide	Scarcely broadened	Scarcely broadened
Size of the gametophyte	Small to medium-sized	Very small to large	Large and robust	Large and robust
Form of the apical cells of the lamellae	Pyriform to rounded	Pyriform, narrow apex	Pyriform, narrow apex	Pyriform, narrow apex
Laminae apex form	Acute	Acute to aristate	Broadly acute	Acute to acuminate
Placement of the stomas in the capsules	Almost the entire surface of the capsule	Extending to the lower half	Mostly restricted to the base	Extending to the lower half
Color of the sheathing base	Almost totally pale orange	Up to 3/4 of the surface orange, the rest yellow	Up to 4/5 of the surface orange, the rest yellow	Up to 1/2 of the surface orange, Clearly delineated. The rest yellow

removed. Another remarkable morphological feature is the “shoulder region”, which is very wide and exceeds the width of the sheathing base (Fig. 11) in comparison to that of other species of *Polytrichadelphus* in Colombia (Table 1). The lamina of this region is made up of thickened, colorless to greenish yellow cells with the lumen broader than in other species of the genus.

The leaf bases are erect to the stem and the limb is sometimes twisted, differing from the other species in Colombia (Table 1). Intransverse section the limb shows no obvious tissue differentiation; except for the conducting cells being of different size (Fig. 4). Similarly tissues of the stem or the rhizome show no clear internal differentiation, except for the central conducting tissue and the cortex within the latter. Typically, the color of the sheath shows a gradient of orange that begins in the area near the leaf limb and extends to the junction between the leaf and the stem, while the other Colombian species of *Polytrichadelphus* (Table 1) are characterized by the pigmentation are mostly circular and well delimited.

Additional specimens examined: COLOMBIA. CHOCÓ: El Carmen, 95 km SO del desvío hacia El Carmen en la carretera a Quibdó. 1140 m, 5°55'N, 76°16'W, 19 Julio 1986. *Churchill et al.*, 14440 (HUA-NY); HUILA: Acevedo, macizo colombiano. Cuenca del Rio Suaza. PNN Cueva de los Guacharos, sitio El Robledal. 1800 m, 1°36'21, 4" N, 76°6'16" W, 29 Noviembre 2001, *Castillo 2623a* (COL); NARINO: Barbacoas, 3 km from Junin towards Altaquer, on road Pasto-Tumaco, 1100 m, 1°19'N, 78°07'W, 3 June 1986. *Sipman et al.*,

33366 (COL-NY); PUTUMAYO: Mocoa. Carretera Mocoa-San Francisco (Valle del Sibundoy). 2000 m, 1°4'16" N, 76°44'24" W. 27 Octubre 2013. *Marín et al.*, 758 (SINCHI); RISARALDA: West side of cord. Occidental, along trail from Jeguadas to Puerto de Oro. W of Mistrato, 1600 m, 26 July 1992. *Frahm* 92175 (COL); VALLE DEL CAUCA: El Cairo, Las Amarillas, frontera Valle-Choco, cord. Occidental, Serranía de Los Paraguas, cerca de la base del Cerro del Inglés. 2125 m, 29 Marzo 1988. *Silverstone et al.*, 3781 (NY).

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REFERENCES

- APONTE-R. A. & URIBE-M. J., 2017 — Revisión de la familia Polytrichaceae (Bryophyta) para Colombia. *Boletín de la Sociedad Argentina de Botánica* 52(2): 209-250.
- CHURCHILL S.P., 2009 — Moss diversity and endemism of the tropical Andes. *Annals of the Missouri botanical garden* 96: 434-449.
- GRADSTEIN S.R., CHURCHILL S.P. & SALAZAR-ALLEN N., 2001 — Guide to the bryophytes to tropical America. *Memoirs of the New York botanical garden* 86: 1-577.
- MITTEN W., 1860 — Descriptions of some new species of Musci from New Zealand and other parts of the Southern Hemisphere, together with an enumeration of the species collected in Tasmania by William Archer, arranged upon the plan proposed in the Musci Indiae Orientalis (1859). *Journal of the proceedings of Linnean society, Botany* 4: 64-100.
- PROCTOR M.C.F., 1992 — Scanning electron microscopy of lamella-margin characters and the phytogeography of the genus *Polytrichadelphus*. *Journal of Bryology* 17: 317-323.
- SMITH G., 1971 — A conspectus of the genera of Polytrichaceae. *Memoirs of the New York botanical garden* 21: 1-83.