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Philonotis pomangium (Bartramiaceae, Bryophyta): An addition to the Bryoflora of Peru

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Summary: *Philonotis pomangium* is a neotropical species recorded from Argentina, Bolivia and Brazil. It is characterized by the ovate-lanceolate leaves, laminal cell quadrate at the base, papillose at the distal angles, and propagules present (brood branches). During the revision of the genus *Philonotis* in southern South America some samples collected in Peru agreed with *P. pomangium,* a species not recorded for the country. In addition, the study of the type specimens of *Philonotis boliviensis* was performed, and it is proposed as a new synonym of *P. pomangium.* A description, photomicrographs on OM and SEM, comments on the species, and a comparative table for related *Philonotis* species of Peru are here presented. The Neotropical distribution of *P. pomangium* is depicted in a map.

Key words: *Bartramia pomangium*, Bolivia, Cusco, *Philonotis boliviensis*.

Resumen: *Philonotis pomangium* (Bartramiaceae, Bryophyta): una adición a la flora briológica de Perú. *Philonotis pomangium* es una especie neotropical registrada para Argentina, Bolivia y Brasil. Se caracteriza por las hojas ovado-lanceoladas, células de la lámina cuadradas hacia la base, papilosas en el ángulo distal, y propágulos presentes (tipo "brood branches"). Durante la revisión del género *Philonotis* en el sur de Sudamérica, algunos especímenes coleccionados en Perú coinciden con *P. pomangium,* una especie registrada por primera vez para el país. Adicionalmente, se estudió el ejemplar tipo de *Philonotis boliviensis*, y se la propone aquí como un nuevo sinónimo de *P. pomangium*. Se presenta una descripción detallada, fotomicrografías en MO y MEB, comentarios sobre la especie y una tabla comparativa de las especies emparentadas de *Philonotis* del Perú. La distribución Neotropical de *P. pomangium* se ilustra en un mapa.

Palabras clave: *Bartramia pomangium*, Bolivia, Cusco, *Philonotis boliviensis*.

Introduction

Peru is the third largest South American country, covering almost 1.3 million square kilometers, extending from the equator to 17° 20' south latitude, and from the westernmost tip of the South American continent at Punta Pariñas east to 70° west longitude in its Amazonian region. The country is often divided into three zones: the eastern Amazonian region; the mountainous Andean region; and the coastal region, narrow, mostly desert trip along the Pacific Ocean (Brako & Zarucchi, 1993). Despite the extension of the country and the richness of environments, the bryophyte flora of this area has been poorly studied. Only few floristic or related articles have been published (Robinson, 1967; Hegewald & Hegewald, 1985; Griffin & Hegewald, 1986; Menzel, 1986; Zander, 1986; Menzel & Schultze-Motel, 1987), and the most recent summary of the mosses from Peru was performed by Menzel (1992). He recorded 889 species of mosses, of which 19 belong to *Philonotis* Brid., a genus of the Bartramiaceae comprising ca. 180 species worldwide, with 50 taxa in the Neotropics (Churchill & Linares, 1995; Delgadillo *et al.,* 1995; Gradstein *et al*., 2001). This genus is easily recognized by the small size of the plants

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[exceptionally large in *P. vagans* (Hook. f. & Wilson) Mitt.], the ovate to lanceolate leaves, laminal cells quadrate to rectangular, papillose to prorate generally at the angles, capsules ovoid to sub-globose, rugose to strongly furrowed when dry, and reniform clavate spores (Allen, 1999). It is commonly found growing on rocks or soil, usually associated with wet sites such as stream banks or seeps, from near sea level to 4700 m (Gradstein *et al.,* 2001; Jimenez & Suárez, 2015, 2016; Jimenez *et al*., 2014, 2016).

As part of the project entitled "Biosystematics and phylogeny of the species of *Philonotis* Brid. (Bartramiaceae, Bryophyta) from Southern South America" some samples collected in Peru perfectly matched *Philonotis pomangium* (Müll. Hal.) Kindb., a species described by Müller based on samples collected in Argentina, and never registered after its description. In this work *P. pomangium* is recorded as new for Peru.

In addition, the analysis of the type specimen of *Philonotis boliviensis* Herzog., a species described by Herzog based on samples collected in Bolivia, was found to be conspecific with *P. pomangium,* and it is proposed here as a new synonym.

Materials and Methods

We studied type specimens and other herbarium collections from BM, F, H, JE, LIL, NY, PC, SP, in addition to our own collections deposited in CTES and LIL. The specimens were studied morphologically with conventional techniques for bryophytes and mounted in Hoyer's solution (Anderson, 1954). Microscopic characters were analyzed by using light microscopy (OM) Leica Model CME, and scanning electron microscopy (SEM) JEOL 5800 LV operating at 20 KV. The SEM images were obtained from samples fixed in FAA, critical-point dried, and then mounted on double-sided tape and coated with gold.

Results

Philonotis pomangium (Müll. Hal.) Kindb. Enum. Bryin. Exot., Suppl. 1, 93. 1889 ≡ *Bartramia pomangium* Müll. Hal. Linnaea 43: 417. 1882. Type: Argentina, San Andrés, in declivibus, 16-IX-1873, Lorentz s/n. Rio Seco, in der Flussaue, 17-IX-1873, Anon. s/n (*Syntypes* BM! BM000960312; JE) Fig. 1-4

= *Philonotis boliviensis* Herzog. Biblioth. Bot. 88: 17. 9. 1920. Type: Bolivia. An Erdhängen bei Incacorral, ca. 2200 m, Herzog 5102. (*Isotype* H!) **syn. nov.**

= *Philonotis rupicola* Müll. Hal. Index Bryologicus 928. 1897. **nom. nud**. based on: Brasil. Santa Catharina, Orleans, IX-1889, Ule 35 (PC! PC0133544, PC0133545, PC0133546, PC0133490, PC0133491, PC0133492, PC0133493).

Plants small to medium size, yellowish-green, growing in dense turfs. **Stems** red, densely tomentose below, branched in sub-floral whorls, 0.6-2.1 cm long, transverse section rounded to hexagonal, sclerodermis in 2 rows; central strand well developed, axillary hairs 2-celled, brown basal cell short, apical cell hyaline and globose to less often sub-globose, 12-23 µm long. **Leaves** erect when dry, erect-spreading when wet, secund, ovate-lanceolate; 0.6-1.1 × 0.3-0.4 mm, apex acuminate; margins simple-serrate, strongly recurved appearing double to triple serrate throughout; costae robust and well defined, 33-88 µm wide, percurrent to short-excurrent; section of costae with 2 guide cells, dorsal and ventral epidermis present; upper laminal cells rectangular to oblong-rectangular, 17-35 × 5-14 µm, basal cells quadrate to rectangular, 13-28 × 7-22 µm, with well defined rounded papillae located at distal angles, sub-distal at base and turning distal at the apex. **Propagules** presents, abundant. Microphyllous branches consist of yellow to brownish stalks, about half of the length of the propagule, ended on a rosette of yellow to brownish, lanceolate and acute leaves. **Dioicous**. **Perichaetia** gemmiform; perichaetial leaves, 1.3-1.7 × 0.3-0.4 mm. **Perigonia** not seen. **Setae** erect, reddish-brown, 1.3-1.8 cm long. **Capsule** erect to horizontal, globose to sub-globose, reddish-brown, 1.1-1.4 mm, furrowed when dry, striated when wet; exothecial cells quadrate to oblong-rectangular, irregularly arranged, thick-walled, 40-63 × 28-40 µm; stomata present at base, cryptopores; annulus absent. **Operculum** conic. **Peristome** double, reddish-brown; exostome teeth lanceolate, bordered, 294-325 × 95-103

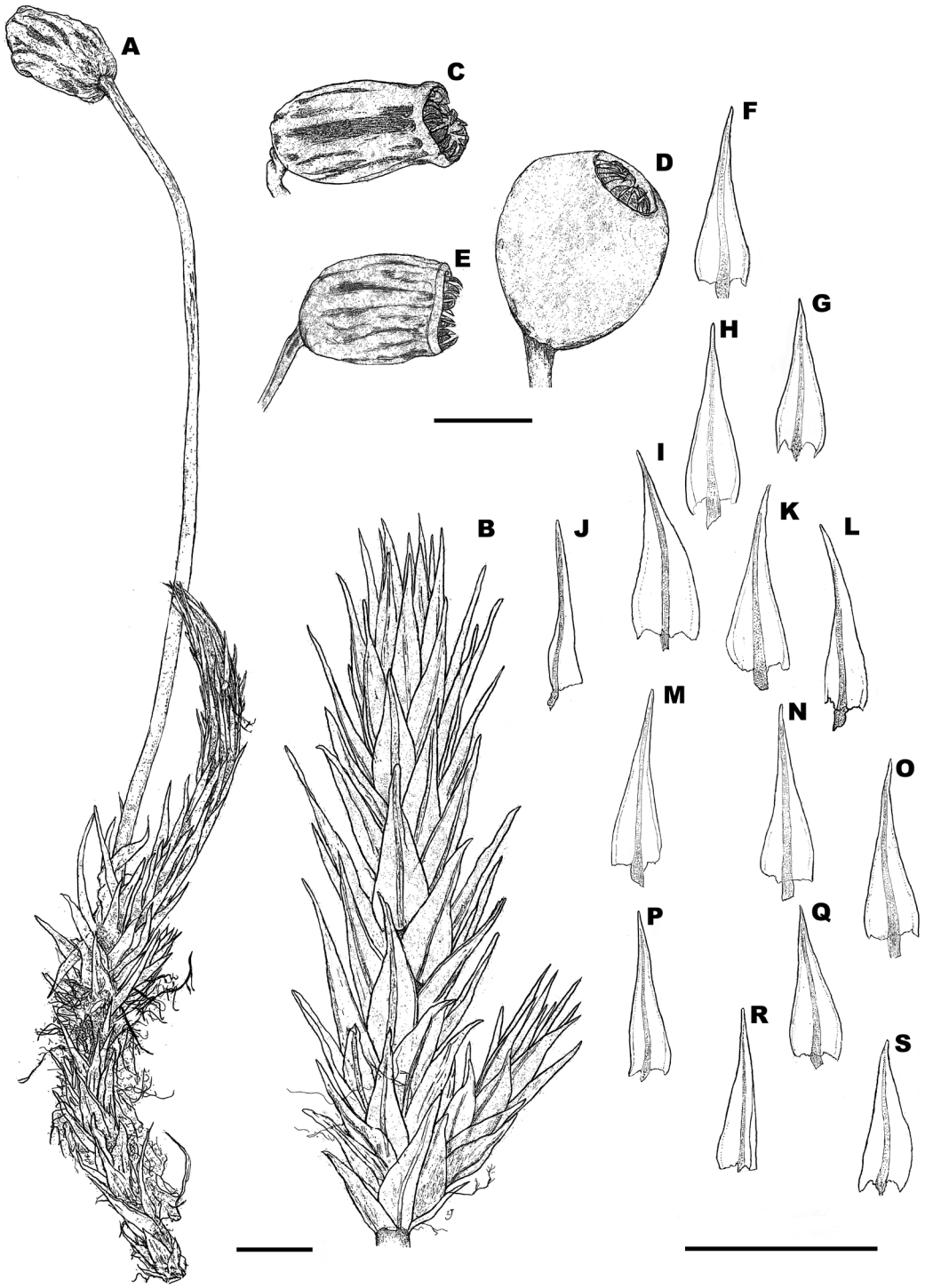

Fig. 1. A. Habit in dry condition. B. Plant in wet condition. C-E. Capsule in dry condition. D. Capsule in wet condition. F-S. Vegetative leaves. Scale bar: 1 mm. (Jimenez 613, CTES). Illustration: Inés Jaume.

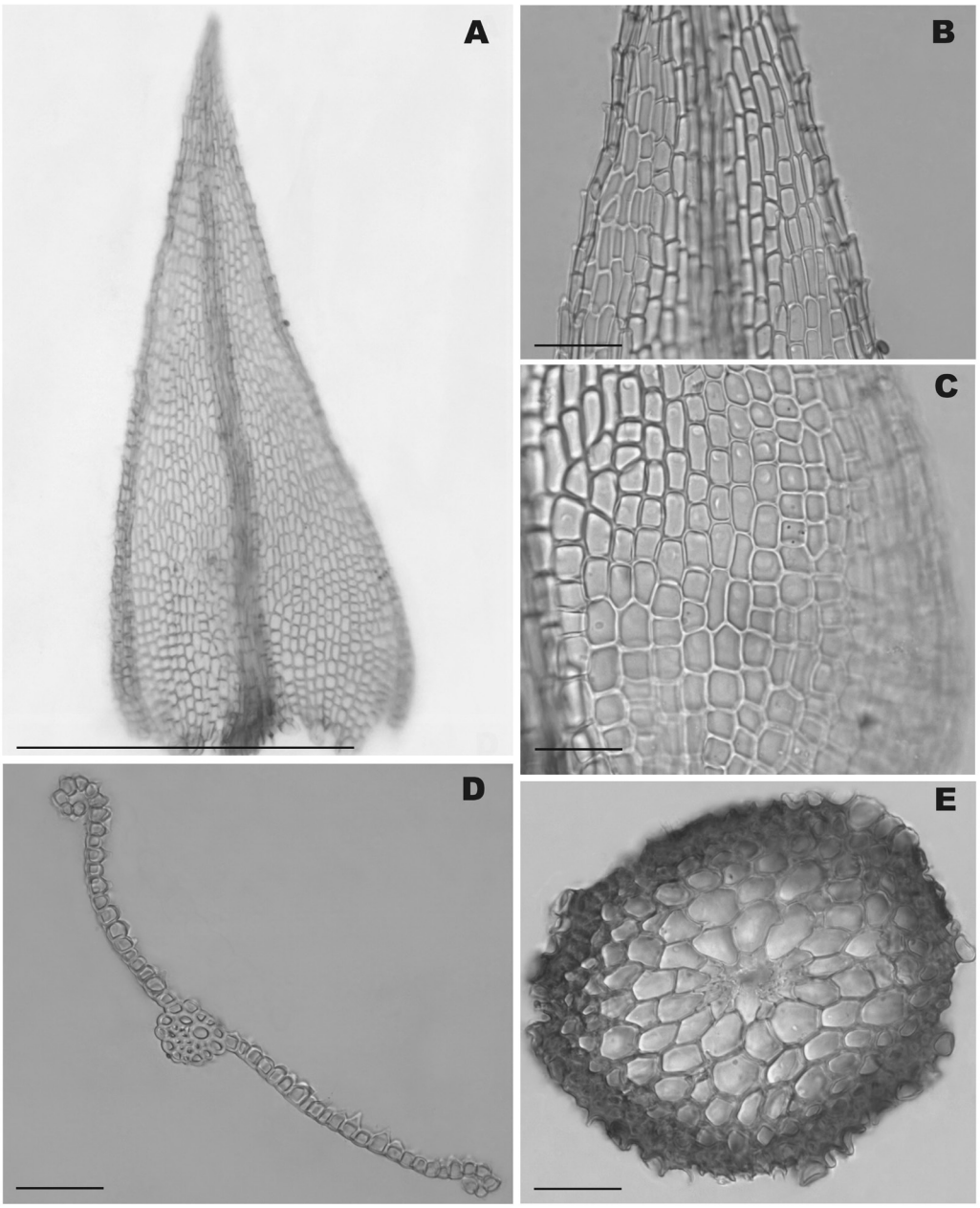

Fig. 2. A. Leaf. B. Apex of the leaf. D. Transversal section of the leaf. E. Transversal section of the stem. Scale bars: A: 1 mm. B-E 0.1 mm (Schiavone 1262, LIL).

µm, outer surface coarsely verrucose above, finely and densely spinulose below, inner surface densely spinulose; endostome segments 240-262 × 100-105 µm, yellow, coarsely papillose throughout, basal membrane long, cilia 1, short. **Spores** reniform, yellowish-brown, 22-28 µm diameter; densely clavate, clavae 1.2-1.7 µm long, clustered at the level of the capitae in homogeneous distributed groups. **Calyptrae** not seen.

Examined material. PERÚ. *Provincia Urubamba: Depto. Cuzco*, Aguas Calientes, sobre muro al costado del río Urubamba, abundante, húmedo y sombrío, 05-

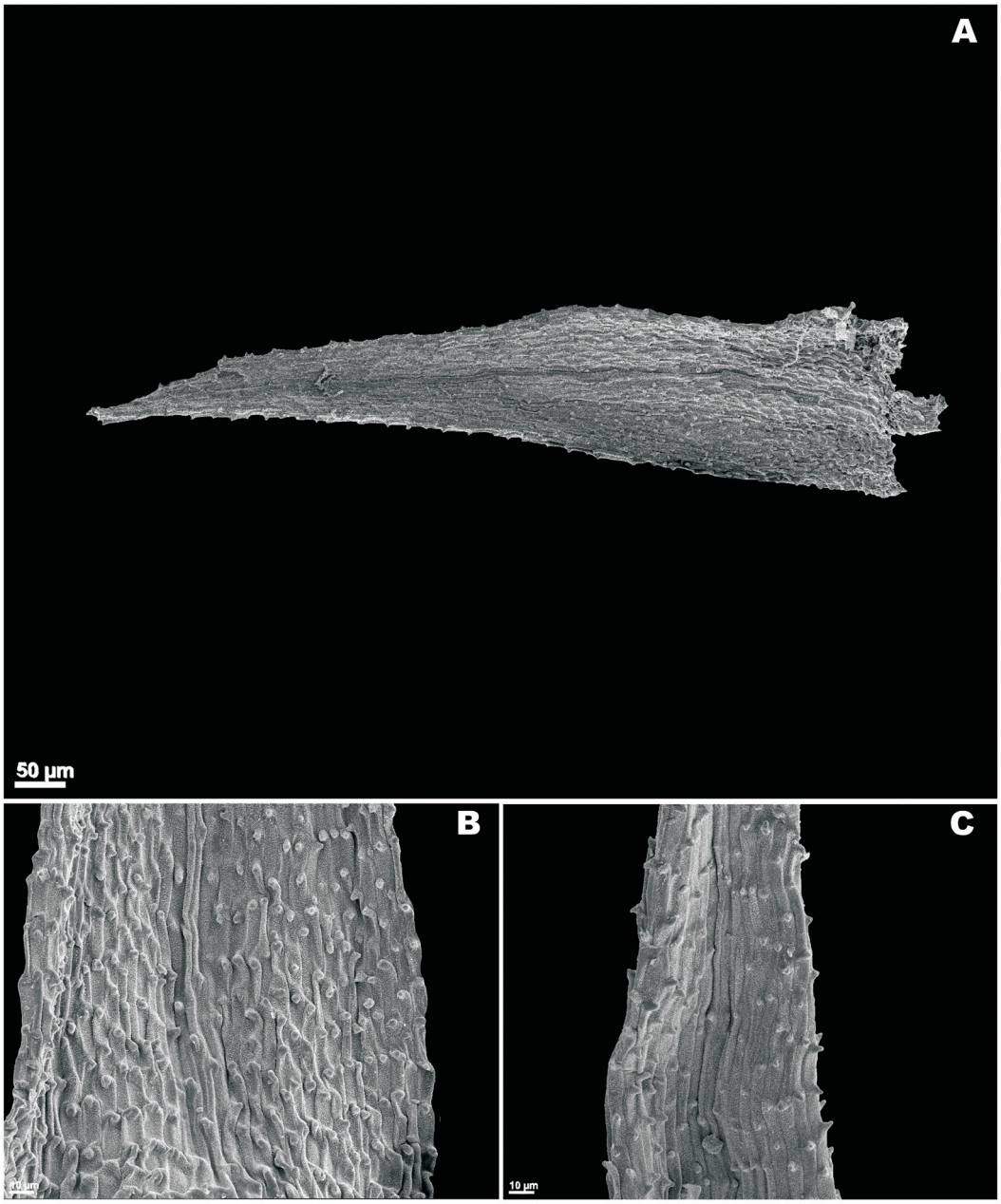

Fig. 3. A. Leaf. B. Base of the leaf. C. Apex of the leaf (Yano & Andrade Lima 2558, SP).

IV-2013, Jimenez 611 (CTES). Sobre rocas, al costado del camino que recorre el río Urubamba, abundante, húmedo y sombrío, 06-IV-2013, Jimenez 631 (CTES).

Additional examined material. ARGENTINA. *Misiones: Puerto Iguazú,* Parque Nacional Iguazú, saxícola en talud del Salto Bossetti, abundante, húmedo y sombrío, 02/III/2013, Jimenez 525 (CTES). *Salta*, Parque Nacional Baritú, camino a Lipeo, en talud, 04/VII/2013, G. Suárez 1732 (CTES, LIL). *Tucumán*: Ruta Provincial 307, km 15,5, sobre suelo al lado del camino, 29-IV-1994, Schiavone

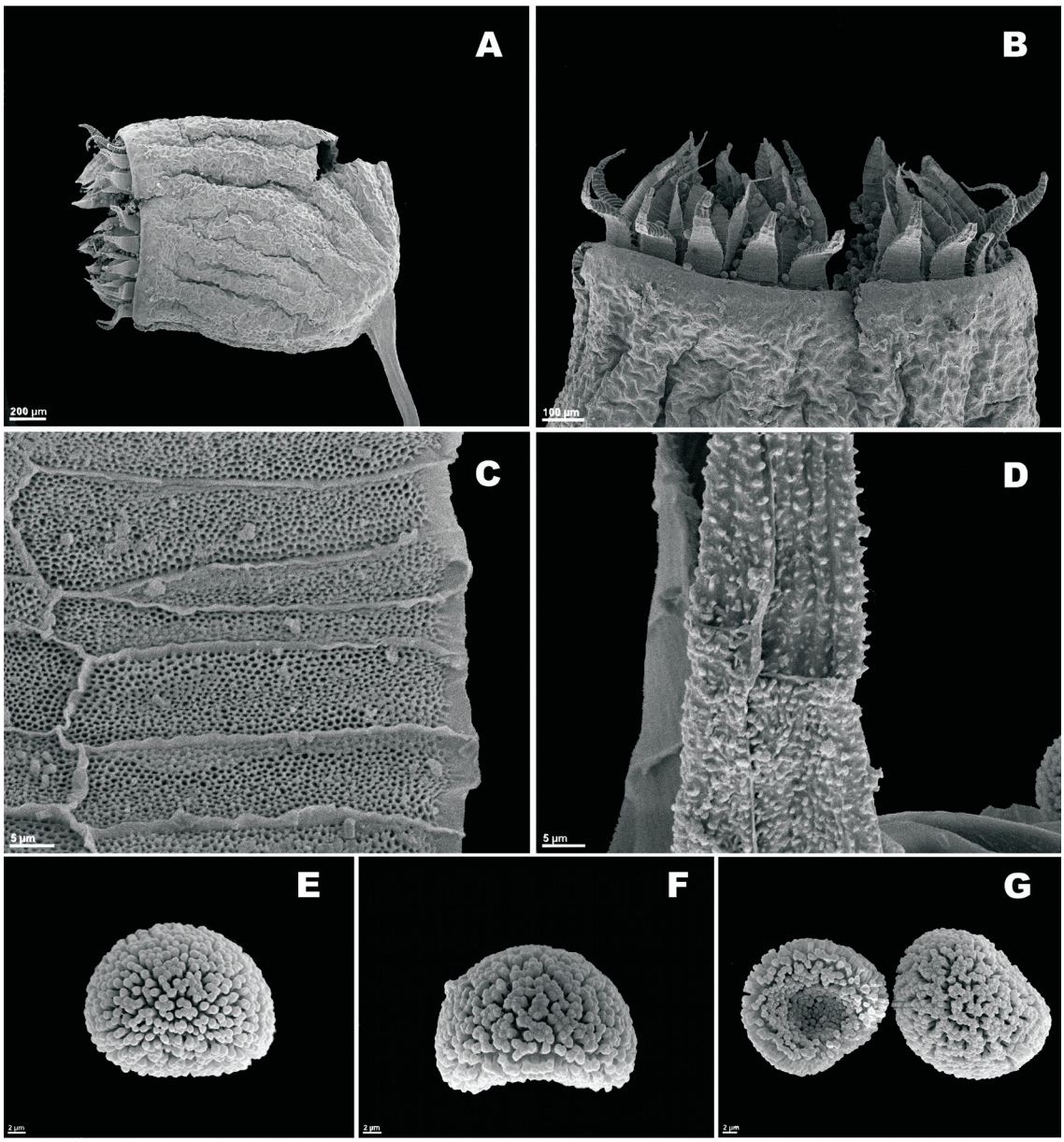

Fig. 4. A. Capsule. B. Peristome. C. Base of the exostome. D. Apex of the exostome. E. Spore in distal view. F. Spore in equatorial view. G. Spores in proximal and distal view (left-right) (Yano & Andrade Lima 2558, SP).

1262 (LIL). BOLIVIA. *Chiquitos*: base of Serranía Santiago in canyon along the Río Roboré from the piscine of Roboré N to where the canyon narrows down and becomes impassable, 18º18'S 59º44'W, 260 m, riverine habitat with dripping cliffs, seeps and springs in a sandstone canyon surrounded by arid forest on the rims, with grass roots in seepy crack in rock of otherwise dry river bed, 28-VIII-1985, Lewis 85-1181 (F). BRAZIL. *Pernambuco*: municipio de Cabo, Engenho Pantorra, no barranco úmido da estrada perto da plantação de cana de açucar, 23-VIII-1980, Yano & Andrade Lima 2558 (SP).

Habitat and Distribution. It is a Neotropical species, distributed in northern Argentina, Bolivia, Brazil and now recorded for Perú (Fig. 5). It is commonly associated with rocky slopes on the margins of streams and rivers, often covered by vegetation, and profusely fruiting.

Taxonomical Treatment. Philonotis pomangium is a species described by Müller in 1882 as *Bartramia pomangium* Müll. Hal. and transferred to *Philonotis* by Kindberg (1889). It is characterized by the ovate-lanceolate leaves, concave at the base, apex acuminate, margins serrate, strongly recurved, appearing double to triple serrate, laminal cells with broad and prominent papillae at distal angles, sometimes sub-apical; with abundant propagules (brood braches). Despite the need of selecting a lectotype, only one of the two syntypes mentioned in the original description (the one from "Río Seco", sterile, but well preserved), was available for study. This sample perfectly matched the diagnostic characters of the species.

Philonotis boliviensis was described by Herzog in 1920 based on samples collected in Bolivia. The type specimen (housed at H, complete and well preserved) shows the exact same diagnostics characters than those that define *P. pomangium,* so it is proposed here as a new synonym.

Discussion

Concerning the species occurring in Peru, *Philonotis pomangium* is closely related to *P.*

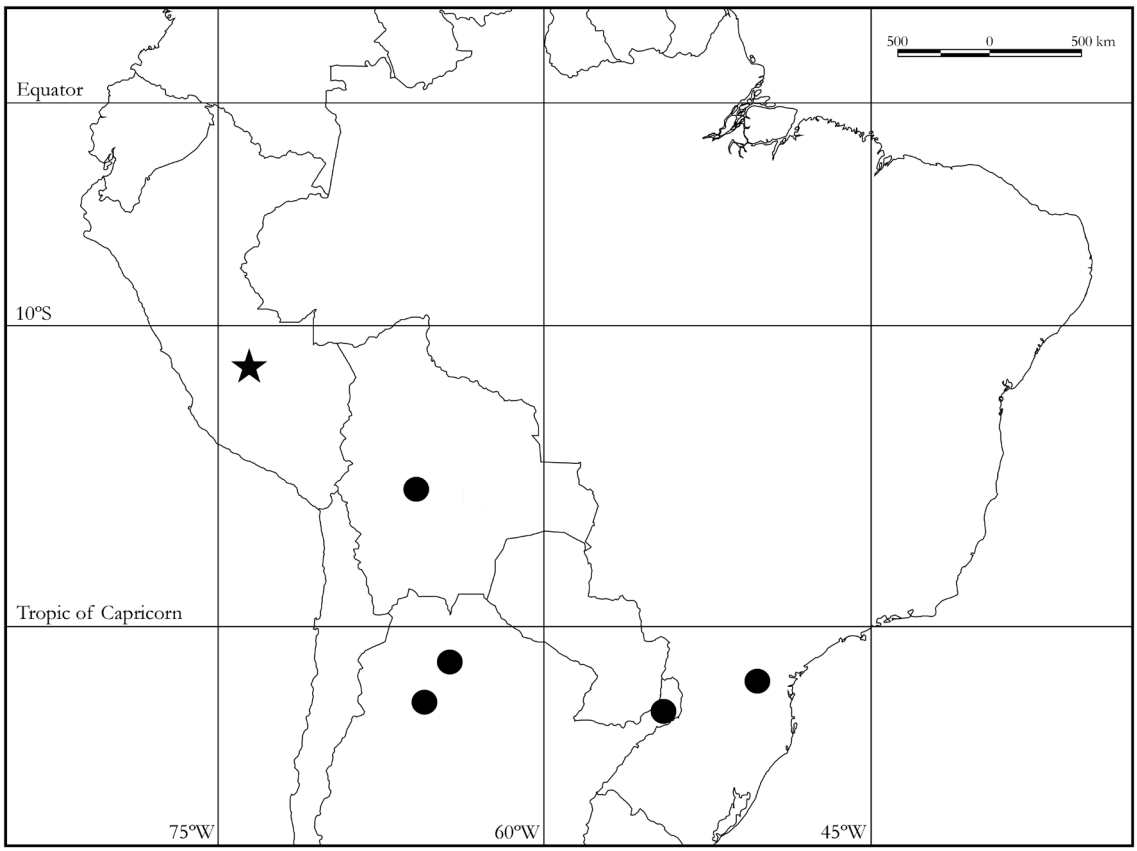

Fig. 5. Ditribution map of *Philonotis pomangium.* References: circle: previously known records. Star: new record.

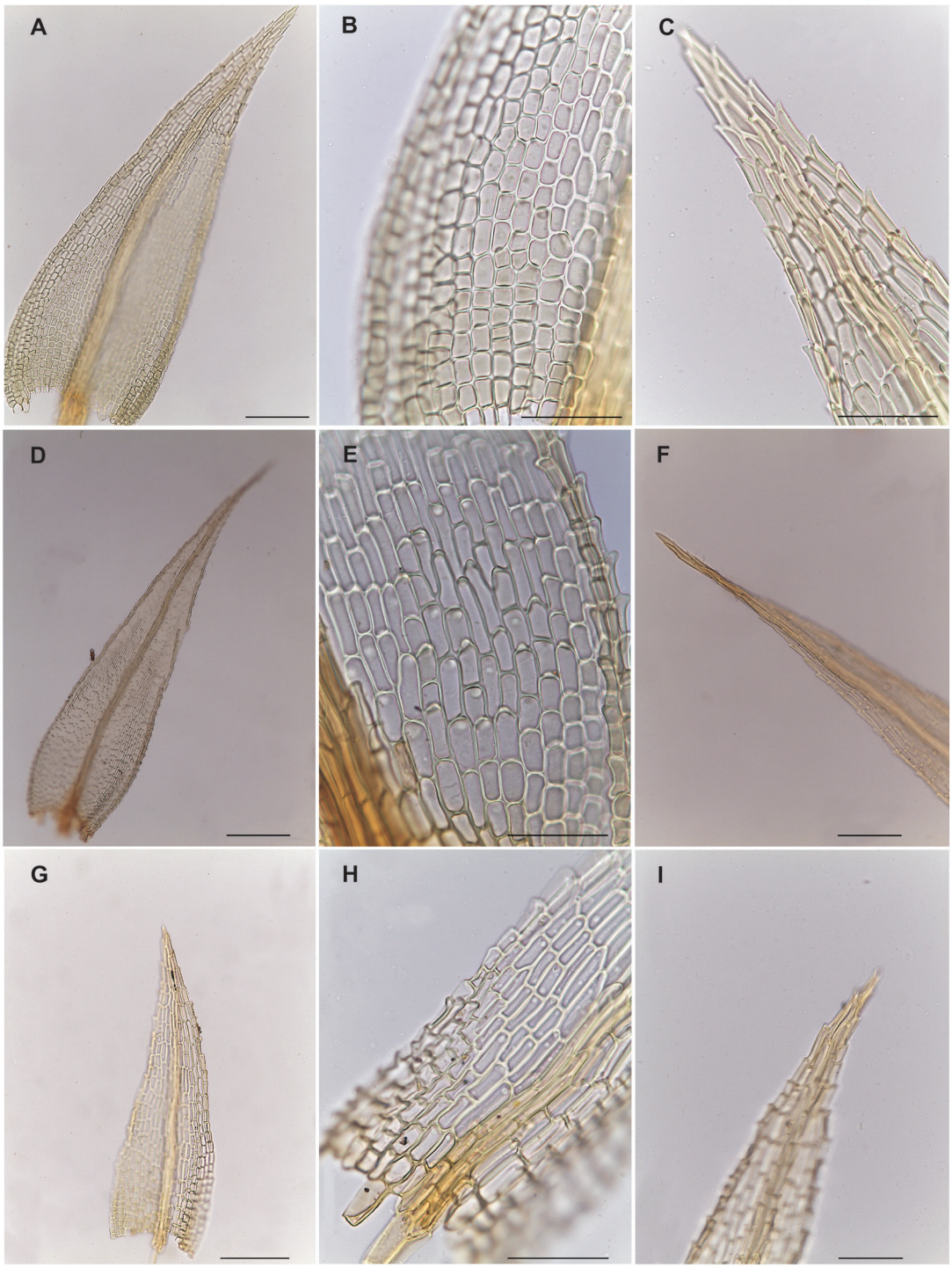

Fig. 6. Comparative lamina of leafs of *P. pomangium* with related species from Peru. *P. pomangium.* A. Leaf shape. B. Leaf base. C. Leaf apex. (Jimenez 611, CTES). *P. sphaericarpa.* D. Leaf shape. E. Leaf base. F. Leaf apex (Schiavone 2478, LIL). *P. uncinata.* G. Leaf shape. H. Leaf base. I. Leaf apex. Scale bars: D: 200 µm. A-F-G: 100 µm. B-C-E-H-J: 50 µm (Jimenez 621, CTES).

Table 1. Table summarizing diagnostic characters of related species with *P. pomangium*

Characters/Spp.	*P. pomangium*	*P. sphaericarpa*	*P. uncinata*
Leaf shape	Ovate-lanceolate leaves	Lanceolate leaves	Lanceolate leaves
Margin	Strongly recurved – double-triple serrate	Strongly recurved - double-triple serrate	Recurved - Simple to double serrate at the apex
Costae	Percurrent to excurrent	Percurrent to long excurrent	Percurrent to excurrent
Laminal cells	Quadrate to rectangular	Long-rectangular to linear	Oblong-rectangular to linear-rectangular
Papillae	Wide – At distal to sub-apical at the base	Narrow – At distal angle	Narrow – At distal angle

sphaericarpa and *P. uncinata*. *Philonotis pomangium* and *P. sphaericarpa* share the strongly recurved leaf margins, the distal position of the papillae, and the propaguliferous condition. However, *P. pomangium* differs from *P. sphaericarpa* in the ovate-lanceolate shape of the leaves of the former versus the lanceolate leaves of the latter; the quadrate to rectangular laminal cells at the base of the leaf on *P. pomangium* versus the long-rectangular laminal cells in *P. sphaericarpa*; and the broad and prominent papillae, sometimes sub-apical at the base of the leaves in *P. pomangium* against the narrow, sharp papillae always at the distal angle of *P. sphaericarpa*.

Philonotis pomangium and *P. uncinata* share the American distribution pattern, the percurrent to excurrent costae, and the propaguliferous condition; but differ in the lanceolate leaves, weakly recurved margins, simple to double serrate, and the oblong-rectangular to linear-rectangular laminal cells present in *P. uncinata,* against the ovate-lanceolate leaves, strongly recurved margins, double to triple serrate, quadrate to rectangular laminal cells of *P. pomangium* (see table 1, Fig. 6).

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