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An unusual new ropy-stemmed species of *Burmeistera* from the Western Cordillera of the Colombian Andes

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Abstract

Burmeistera (Lobelioideae: Campanulaceae) is the third-largest genus within the centropogonid clade, primarily adapted for bat pollination. The genus is exceptionally rich in the Western Cordillera of the Andes, where recent botanical explorations resulted in the descriptions of several new species. Here, we describe a new species of *Burmeistera* from the Pacific region of Colombia within the Western Cordillera of the Northern Andes that is characterized by unusually long, hanging, rope-like shoots and inflated fruits.

Key words: Andes, centropogonids, inflated berries, Neotropics, Pacific region, Valle del Cauca, Western Cordillera

Introduction

Burmeistera H.Karst. & Triana (1855:13), comprising approximately 140 species, is found across Central America (Guatemala, Honduras, Costa Rica, and Panamá) and South America (Colombia, Ecuador, Venezuela, and Peru) (Mashburn, 2019; González, 2023). This genus belongs to the centropogonid clade (Lobelioideae Juss.: Campanulaceae Juss.), alongside two other genera—*Centropogon* C.Presl. (1836:48) and *Siphocampylus* Pohl (1831:104) (Lagomarsino *et al.*, 2017). The centropogonids have undergone one of the fastest angiosperm radiations in the Andes, after originating only in the late Pliocene (Lagomarsino *et al.*, 2014; Bagley *et al.*, 2020).

The recent discovery of numerous *Burmeistera* species highlights a historical lack of attention to this genus (Table S1). In the past two decades alone, over forty new species have been described, while the majority of *Centropogon* and *Siphocampylus* species were described in the nineteenth and twentieth centuries (Table S1). More than eighty percent of *Burmeistera*'s diversity is concentrated in Colombia and Ecuador, with the highest diversity and highest levels of sympatry found in the Western Cordillera of the Colombian Andes (González, 2023).

Burmeistera species display both terrestrial and climbing growth habits, with some even being described as lianaceous (Mashburn, 2019). The climbing species always maintain a connection to the ground, thus are nomadic climbers, although collectors often mistakenly record them as epiphytes (Mashburn, 2019; González, 2023). Although there are several *Burmeistera* species that qualify facultatively as both terrestrial and climbers, an exclusively epiphytic *Burmeistera* has not been documented to date (Mashburn, 2019; González, 2023).

A notable distinguishing feature of certain *Burmeistera* species compared to their sister genera is the presence of inflated berries, a berry type that is characterized by an empty air cavity bounded by a thinner fruit wall with dull coloration (Mashburn, 2019). The inflated berries are represented by ¼th of the species diversity in the genus, whereas the remaining ¾th possess fleshy berries. These fleshy berries are brightly colored and likely dispersed primarily by birds and bats (Castaño *et al.*, 2018), whereas inflated berries primarily rely on gravity for dispersal, occasionally aided by small mammals (Gamba *et al.*, 2017).

In this study, we describe a novel *Burmeistera* species from the Western Cordillera of the Colombian Andes, in a region influenced by the flora of the Chocó biogeographical region. This species is distinguished by its inflated berries,

a characteristic that is more widespread among species on the eastern slopes of the Andes (Ashokan *et al.*, *in prep.*). Additionally, the species features a distinctive elongated and flexible stem, resembling a rope that hangs from the host trees. Our research underscores the importance of preserving and studying the Western Cordillera of the Colombian Andes as it is renowned for its unparalleled floral and faunal diversity within the Neotropics.

Materials and methods

We examined all available *Burmeistera* protologues, including monographs and revisions, spanning Karsten & Triana (1854) to González (2023). Herbarium collections, including type specimens, were consulted at various institutions such as CUVC, MO, QCA and US (see Index Herbariorum: <https://sweetgum.nybg.org/science/ih/>). Additionally, we made use of online databases, including the Global Plants (<https://plants.jstor.org/>), Kew Herbarium Catalogue (<http://apps.kew.org/herbcat/>), Muséum national d'Histoire naturelle (<https://science.mnhn.fr/>), Smithsonian Institution (<https://www.si.edu/>), and Tropicos (<https://www.tropicos.org/home>).

Field collection expeditions were conducted in Valle del Cauca, Colombia, between 2018 and 2024. The collection of metadata involved the recording of morphological, phenological, and ecological characteristics, as detailed by Mashburn (2019) and Mashburn *et al.* (2021). Morphological measurements were conducted using both traditional rulers and digital calipers (Muchhala, 2006, 2007; Mashburn, 2019). Our collections included dried specimens, spirit samples, and leaf tissues preserved in silica for further research.

Taxonomic treatment

Burmeistera funicula Zuluaga, Ashokan & Muchhala, *sp. nov.* (Figure 1)

Type:—Colombia. Valle del Cauca: municipio Dagua, corregimiento El Queremal, Parque Nacional Natural Farallones de Cali, trail from Las Antenas to Cerro Tokio, 2097 m, 03°28'51.24"N, 76°43'23.52"W, 14 February 2024 (fl., fr.), *Alejandro Zuluaga, Ajith Ashokan, Nathan Muchhala & Luis Carlos Mamian 6285* (holotype, CUVC!; isotypes, COL!, MO!).

Diagnosis:—*Burmeistera funicula* is characterized by strictly epiphytic growth habit, long ropy stem up to 10 m long, large flowers (up to 42 mm) with widely exerted staminal column (24.5–26.5 mm), and inflated berries. Further, *B. funicula* is differentiated from *B. salicifolia* Garzón, Luteyn & F.González (2014:165) by the cupular, puberulent hypanthium (vs. subglobose, glabrous), green with maroon tinge floral coloration (vs. uniformly green), puberulent corolla lobes (vs. glabrous), acute leaf apex (vs. acuminate) and smaller lamina (10–40 mm vs. 55–130 mm); and from *B. xerampelina* E.Wimm. (1931:59) by type (inflated vs fleshy) and size (35–45 × 40–65 mm vs. 10–28 × 10–14 mm) of berries, cupular hypanthium (vs. obconic), lengths of dorsal (33–36 vs. 10–15 mm), lateral (31–34 vs. 7–14 mm), ventral (31–33.5 vs. 8–14 mm) corolla lobes, floral pedicel (12–18 vs. 60–160 mm) and lamina (10–40 × 8–21 vs. 40–100 × 20–44 mm).

Description

Epiphytic herbs, perennial, reaching c. 10 m altitude on the host; latex white. Stems green tinged with pink, shallowly zigzag, up to 2 mm wide on terminal branches, glabrous, several meters long, internodes 5–10 mm long. Leaves alternate, distichous; petiole green to violet, 2–6 mm, glabrous basally, becoming pubescent towards the lamina, especially abaxially, with white indument, unbranched; lamina elliptic to lanceolate, 10–40 × 8–21 mm, base obtuse to rounded, apex acute and slightly mucronate, margins shallowly callose-serrate, teeth intramarginal; adaxial surface bullate, dark green, glabrous; abaxial surface light to dark shades of maroon, pubescent with white hairs; venation reticulate, primary vein prominent, raised above, secondary veins slightly raised, tertiary veins barely visible or not visible. Pedicels yellow-green tinged with light brown, 12–18 mm long at anthesis, 20–40 mm long in fruit, dotted with short white hairs. Flowers axillary and solitary, bent at the union between the corolla tube and the lobes, rostrate (beak-like) apex appendage on unopened buds, reaching 2–3 mm long; hypanthium light green tinged with light maroon, cupuliform, 5–10 × 6–9 mm, puberulent, white indument; calyx lobes light green tinged with maroon, lingulate, ascending to patent at anthesis, 2–3 × 1–2.5 mm, glabrous, margins shallowly callose-serrate, apex obtuse; corolla pale green suffused with light maroon, glabrous, puberulous before anthesis; corolla tube 10–12 mm long, 5–7 mm wide basally, throat narrowing to 3–4 mm wide; corolla lobes lanceolate, margins smooth, dorsal lobes 33–36 × 4–5 mm,

straight (not falcate), arched forward, dorsal sinus c. 21.5 mm from the corolla base, lateral lobes 31–34 × 5.5–8 mm, straight (not falcate), slightly recurved, ventral lobe c. 31–33.5 × 5.5–8 mm, ventral sinus c. 13 mm from the corolla base; androecium c. 30 mm, exerted c. 25.5 mm from the ventral opening, filament tube green white, glabrous, c. 18 mm long, anther tube green with purple lines along the sutures, glabrous, c. 10.5 mm, all (5) anther tips glabrous; style unknown; stigma hairy. Berry maturing creamy white or light green outside, interior white, globose or hemispheroidal, grooved, 35–45 × 40–65 mm, inflated, latex white; seeds brown, broadly elliptic, ca. 1 mm, surface glossy, shallowly fusiform.

Etymology:—The specific epithet, *funicula*, refers to the long, thread or rope-like stems that hang from the trees.

Phenology:—Like many *Burmeistera* species, *B. funicula* flowers and sets fruit throughout the year (A. Zuluaga pers. observ.). Both flowering and fruiting specimens have been collected in January, February, March and July.

Distribution:—The few collections of *B. funicula* come from the same locality in Valle del Cauca Department, along the Western Cordillera of the Andes, within the Farallones de Cali National Natural Park, around elevations between 2097 and 2150 meters above sea level.

Pollination ecology:—*Burmeistera funicula* exhibits floral characteristics that strongly suggest selection for bat pollination (chiropterophily). Specifically, flowers are dull green tinged with maroon, and the corolla opening is wide, suggesting a close fit with a bat's head (Muchhala 2006, 2007).

Community ecology:—Angiosperms representing the tree habit in the community included species from the following genera—*Wettinia* Poepp. ex Endl., *Aiphanes* Willd. (Arecaceae), *Clusia* Plum. ex L. (Clusiaceae), *Weinmannia* L. (Cunoniaceae), *Sloanea* L. (Elaeocarpaceae), and an unidentified genus belonging to Melastomataceae. Also, herbaceous or shrubby species representing families such as Araceae (*Anthurium* sp., *Philodendron* sp., *Stenospermation* sp.), Ericaceae (*Cavendishia* sp.), Gesneriaceae, Marcgraviaceae, and Piperaceae (*Piper* sp.) were observed in the vicinity.

Conservation status and IUCN preliminary assessment:—Presently, the known population is not under any threat as it occurs within a national natural park. As this species is currently known only from the type locality, we categorize it as data deficient (DD) following the IUCN guidelines (IUCN Standards and Petitions Subcommittee, 2024).

Phylogenomic placement:—Based on our latest phylogenomic analysis (Ashokan *et al.*, *in prep.*), the new species is placed sister to *B. salicifolia* Garzón, Luteyn & F.González, which together are sister to *B. xerampelina* E.Wimm. This clade of three species, in turn, is sister to a clade containing *B. serraniaguae* Garzón & F.González (2012:319), *B. diazii* Garzón & F.González (2014:254), and *B. glauca* (E.Wimm.) Gleason (1925:98).

Notes:—*Burmeistera funicula* can be distinguished from the rest of the *Burmeistera* species for its remarkable pliant, ropy stem (i.e., fully flexible rather than stiff) that reaches up to 10 m long. It is also the only known species with a fully epiphytic habit: all others are herbaceous or scandent, always maintaining a connection with the ground (Mashburn, 2019; González, 2023). Further, *B. funicula* is characterized by a strictly epiphytic growth habit, relatively large flowers (35–42 mm) with highly exerted staminal columns (c. 25.5 mm), purple lines on the anther tube, and white inflated berries. *Burmeistera funicula* bears a certain resemblance to *B. salicifolia*, also native to the Western Cordillera in Colombia, notably in their shared traits of inflated, white, and oblate berries, straight (not falcate) corolla lobes, as well as the reticulate secondary veins and intramarginal veins (Table 1). However, the two species are distinguished by their hypanthium shape (cupular in *B. funicula* vs. subglobose in *B. salicifolia*), hypanthium texture (puberulent in *B. funicula* vs. glabrous in *B. salicifolia*), corolla color (green with maroon tinge in *B. funicula* vs. uniformly green in *B. salicifolia*), corolla texture (puberulent in *B. funicula* vs. glabrous in *B. salicifolia*), leaf apex (acute in *B. funicula* vs. acuminate in *B. salicifolia*) and lamina size (extending up to c. 130 mm in *B. salicifolia* vs. c. 40 mm in *B. funicula*). Furthermore, *B. salicifolia* displays shorter measurements in lateral corolla lobe length (around 24.5 mm), ventral corolla lobe length (c. 20 mm), anther tube (c. 5 mm), and staminal column exertion length (c. 15.3 mm) compared to *B. funicula* (Table 1). Notably, the flower pedicel is longer in *B. salicifolia*, measuring c. 70 mm, which is nearly five times the length observed in *B. funicula* (c. 14.5 mm).

Burmeistera funicula could also be confused with *B. xerampelina* from Valle del Cauca in the Western Cordillera, for its nearly straight corolla lobes, the lengths of its floral tube, filament and anther (Table 1), as well as the shape of the leaf base and apex. However, *B. xerampelina* can be distinguished by its fleshy berries, the size of the berries (10–28 × 10–14 mm), its obconic hypanthium, its shorter corolla lobes—dorsal (10–15 mm), lateral (7–14 mm), ventral (8–14 mm), and its much longer pedicel (60–160 mm) and lamina (40–100 mm). Finally, *B. xerampelina* can also be differentiated from *B. funicula* by their shortly exerted staminal column (10.98 vs. ~25.5 mm; Table 1).

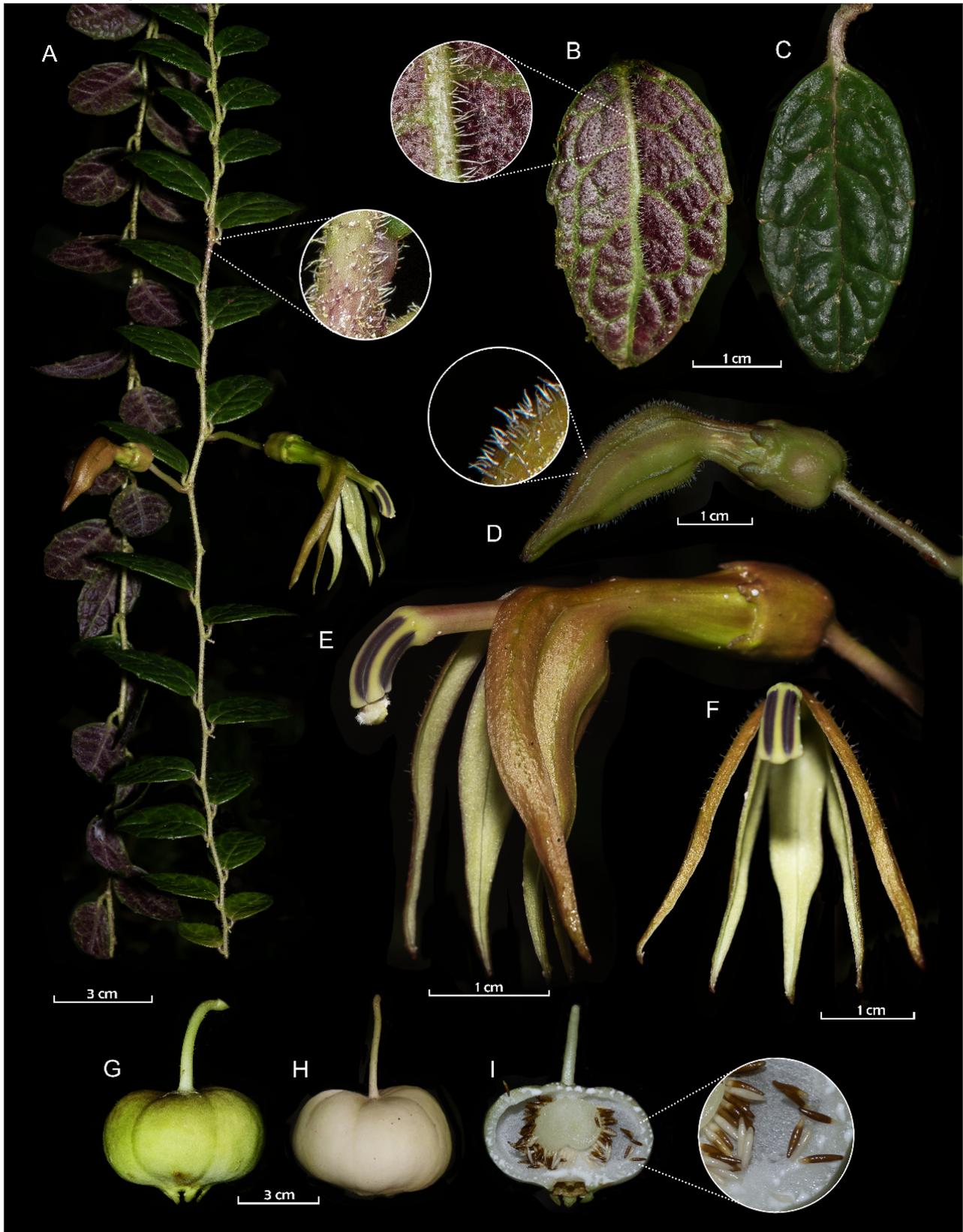


FIGURE 1. *Burmeistera funicula* Zuluaga, Ashokan & Muchhala, *sp. nov.* (A) branches revealing abaxial and adaxial surface of leaves with an unopened flower bud and an opened flower (B) abaxial surface of a leaf (C) adaxial surface of a leaf (D) an unopened flower bud (E) lateral view of an opened flower (F) front view of an opened flower (G) unripe berry (H) ripe berry (I) cross-section of mature berry with seeds arranged in an axile placentation. Picture Credit: Alejandro Zuluaga.



FIGURE 2. Species morphologically and phylogenetically related to *B. funicula*. **A.** Open flower and **B.** fruit of *Burmeistera xerampelina* E. Wimm. **C.** Open flower of *B. serraniaguae* Garzón & F. González **D.** Isotype of *B. salicifolia* Garzón, Luteyn & F. González from NYBG (Novon 23: 2014). Picture Credit: A to C. Nathan Muchhala.

TABLE 1. Morphological measurements and other diagnostic features of *Burmeistera funiculata* Zuluaga, Ashokan & Muchhala, sp. nov., and the comparison with its closest allies. *The size denotes length (mm) by width (mm).

Attributes	<i>B. funiculata</i> Zuluaga, Ashokan & Muchhala, sp. nov.	<i>B. salicifolia</i> Garzón, Luteyn & F. González	<i>B. xerampelina</i> Garzón & F. González	<i>B. serraniquae</i> Garzón & F. González	<i>B. dinzii</i> Garzón & F. González	<i>B. glauca</i> (E. Wimm.) Gleason	<i>B. fuchsoides</i> Garzón & F. González	<i>B. resupinata</i> Zahlbr.	<i>B. heilbornii</i> (E. Wimm.) Mashburn
Distribution	Colombia: Valle del Cauca (Western Cordillera)	Colombia: Chocó, Valle del Cauca (Western Cordillera)	Colombia: Valle del Cauca (Western Cordillera)	Colombia: Antioquia, Cauca, Chocó, Risaralda, Valle del Cauca (Western and Central Cordilleras)	Colombia: Antioquia (Western and Central Cordilleras)	Panamá: Chiriquí; Costa Rica: Bolívar	Colombia: Antioquia, Cauca, Chocó, Risaralda, Valle del Cauca (Western and Central Cordilleras)	Ecuador: Pichincha	Ecuador: Imbabura, Pichincha
Elevation range (m)	2097–2150	1600–2200	1100–2400	890–2700	1800–2750	1700–2500	150–3300	1000–2500	2600–3100
Petiole length (mm)	2–6	2–9	3–12	6–15	5–15	4–7	0.5–2	4–12	4–8
Lamina size* (mm)	10–40 × 8–21	55–130 × 10–22	40–100 × 20–44	50–80 × 20–40	40–60 × 25–30	27–50 × 12–25	6–20 × 3–7	70–90 × 10–25	45–95 × 15–40
Venation type	reticulate, intramarginal vein present	higher order venation markedly reticulate, intramarginal vein present	secondary veins 6 to 11 per side, slightly conspicuous beneath, intramarginal vein lacking	secondary veins 9 to 12 per side, higher order venation loosely reticulate, intramarginal vein present, discontinuous	secondary veins 7 to 8 (rarely to 12) per side, higher order venation markedly reticulate beneath, intramarginal vein lacking	not available	secondary veins 8 to 11 per side, higher order veins reticulate, intramarginal vein present, discontinuous	venation pinnate with secondary veins terminating in a thin submarginal collecting vein 0.5 mm from the margin, the primary vein prominent raised, the secondary veins thin, the tertiary veins barely visible	venation pinnate; the secondary veins terminating connecting to a submarginal collecting vein 0.5–1 mm below the margin, the primary vein prominent, the secondary veins thin, the tertiary veins visible
Pedicel length (flower; mm)	12–18 (15)	60–80	60–160	65–80	65–75	50–90	40–70	40–43	27
Pedicel length (fruit; mm)	20–40 (30)	not available	not available	not available	not available	not available	not available	40–43	27–30
Hypanthium size (mm)	5–10 × 6–9	8–10 × 6–8	7–12 × 4–6	5–7 × 4–5	5–7 × 5–6	5	6–9 × 5–8	8–10 × 5–8	10 × 8
Hypanthium shape	cupular	subglobose	obconic	obconic	obconic	in anthesis cylindrical, basally rounded, flaring at the summit	subglobose to urceolate	obconical	obconical
Calyx lobe size (mm)	2–3 × 1.0–2.5	1–2 × 2–3	1–1.5 × 1.0–1.5	13–16 × 1–2	13–16 × 2–3	1.5–2.5	5–11 × 2–4	2–5 × 1	5–6 × 1–2
Dorsal corolla lobe size (mm)	33–36 × 4–5	24–35 × 2–5	10–15 × 3–5	11–15 × 2–4	8–9 × 2–4	10–12	8–10 × 5–8	28 × 3	26 × 5

.....continued on the next page

TABLE 1 (Continued)

Attributes	<i>B. funiculata</i> Zuluaga, Ashokan & Muchhala, sp. nov.	<i>B. salicifolia</i> Garzón, Luteyn & F. González	<i>B. xerampelina</i> E. Wimm.	<i>B. serraniaguae</i> Garzón & F. González	<i>B. diazii</i> Garzón & F. González	<i>B. glauca</i> (E. Wimm.) Gleason	<i>B. fuchsioides</i> Garzón & F. González	<i>B. resupinata</i> Zahlbr.	<i>B. heilbornii</i> (E. Wimm.) Mashburn
<i>Lateral corolla lobe size (mm)</i>	31–34 × 5.5–8	20–23 × 2–5	7–14 × 3–4	7–9 × 4–6	5–7 × 2–3	6–8	4–6 × 4–5	18 × 3	17 × 6
<i>Ventral corolla lobe size (mm)</i>	31–33.5 × 5.5–8	18–22 × 2–5	8–14 × 3	6–8 × 1.5–2.5	5–6 × 2–3	5–6	4–5 × 5–6	not available	not available
<i>Corolla color</i>	green with maroon tinge	uniformly green	green suffused with purple	pale pinkish to purple suffused with green	green with a few purple spots	greenish, purplish or russet red	green, green tinted reddish, yellowish, dark pink or red	green with violet tinged margins	green
<i>Corolla texture</i>	puberulent	glabrous	glabrous except for the sparsely puberulous floral buds	glabrous	sparsely puberulous	glabrous	glabrescent to puberulous	glabrous to sparsely puberulent	glabrous
<i>Floral tube length (mm)</i>	5–7 (6)	15–20	6–7	11–16	9–13	not available	17–22	not available	not available
<i>Filament length (mm)</i>	18	15–20	15–18	20–30	22–24	20	27–30	not available	not available
<i>Anther tube length</i>	10–11	4–6	4–6	5–6	4–6	3.5–5.5	4–7	not available	not available
<i>Staminal column exertion length (mm)</i>	24.5–26.5	15.3	10.98	23.2	21.8	21.5	not available	36	37
<i>Berry size (mm)</i>	35–45 × 40–65	25–38 × 35–40	10–28 × 10–14	10–25 × 12–14	8–11 × 7–10	45 × 40	15–25 × 1.5–2.5	25 × 15	34 × 18
<i>Seed length (mm)</i>	2.5–7 (4.75)	not available	not available	not available	not available	not available	not available	not available	not available
<i>Berry type</i>	inflated	inflated	fleshy	fleshy	fleshy	inflated	inflated	fleshy	fleshy
<i>Berry color</i>	white	white	white or pink	pink	green suffused with purple	magenta	green, yellow or maroon	bright pink	pink to pale violet
<i>Berry shape</i>	oblate	oblate	obovoid to oblong-cylindric	pyriform	broadly obconic	oblong-ovoid with a truncate apex	globose to pyriform	globose	oblong

Another species that might be mistaken for *B. funicula* is *B. serraniaguae* Garzón & F.González. *Burmeistera serraniaguae* is native to the sub-Andean and Andean forests of both Western and Central cordilleras, and it shares similarities in staminal column exertion length, hypanthium length, calyx lobe length, and presence of intramarginal veins. However, *B. serraniaguae* can be distinguished by its fleshy and pyriform berries, obconic hypanthium, shorter corolla lobes (dorsal: 11–15 mm, lateral: 7–9 mm, and ventral: 6–8 mm), pale pinkish to purple flowers, with a greenish suffusion, as well as much longer flower pedicel (65–80 mm) and bigger lamina size (50–80 × 20–40 mm; Table 1).

Paratypes:—COLOMBIA. **Valle del Cauca:** municipio Dagua, Parque Nacional Farallones de Cali, along the trail that goes uphill from “Tokio” camp, 2124 m, 03°28′44.06” N, 76°43′22.47” W, 11 January 2019, N. Muchhala, A. Zuluaga & M. Llano 573 (CUVC, COL); trail from Las Antenas to Cerro Tokio. 2097 m, 03°28′51.24”N, 76°43′23.52”W, 11 June 2023 (fl., fr.). A. Zuluaga *et al.* 5935 (CUVC, COL, HUA, MO).

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Supplementary Information

TABLE S1. Species discovery data for three centropogonid genera starting their taxonomic inception. The final count refers to the number of validly published species names in each of the three genera.

Genus	Time interval					Final count (Tropicos, 2024)	Accepted species count (POWO, 2024)	Latest publication
	1801– 1850	1851– 1900	1901– 1950	1951– 2000	2001– 2024			
<i>Burmeistera</i> H.Karst. & Triana (First species description in 1855)	0	14	86	44	43	187	136	2024
<i>Centropogon</i> C.Presl (First species description in 1825)	30	50	328	55	8	471	212	2012
<i>Siphocampylus</i> Pohl (First species description in 1831)	109	80	231	48	12	480	237	2022