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***Burmeistera quimiensis* (Lobelioideae, Campanulaceae): A new species from the Cordillera del Cóndor range in southeast Ecuador**

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Abstract

A new taxon belonging to the genus *Burmeistera* (Campanulaceae, Lobelioideae) is described from El Quimi Biological Reserve in Morona Santiago Province, southeast Ecuador. *Burmeistera quimiensis* is characterized by its red-violet stems and veins, spiral phyllotaxy, bullate, ascending leaves with a revolute margin, puberulous abaxial leaf surface, cupuliform hypanthia, and thick-walled white to red-violet fruits with reflexed pedicels. Photos of the new species are given, as well as a distribution map of known collection localities, and its relationships with other species are discussed.

Resumen

Un taxón nuevo del género *Burmeistera* (Campanulaceae, Lobelioideae) es descrito de la Reserva Biológica El Quimi, en la provincia de Morona Santiago, en el sur-este del Ecuador. *Burmeistera quimiensis* se caracteriza por sus tallos y venas rojo-violetas, arreglo espiralado, hojas ascendentes y buladas con el margen revuelto, la superficie abaxial es pubérrula, hipantio cupuliforme, y frutos con el pedicelo reflexo y paredes gruesas blancas a rojo-violetas. En este artículo se presentan imágenes de esta nueva especie, así como también un mapa de su distribución y se discuten las relaciones con sus congéneres.

Keywords: Andean tepuy, biodiversity, elfin forest, Girón-Paute Valley, Hollín Formation, taxonomy

Introduction

The Neotropical genus *Burmeistera* H.Karst. & Triana in Triana (1854: 13) (Campanulaceae) consists of approximately 120 species occurring from Guatemala to Peru (Uribe-Convers *et al.* 2017, Vallejo *et al.* 2018). The highest concentrations of species occur near the center of this distribution, with ca. 60 species in Colombia, ca. 40 in Ecuador, and ca. 21 along the Cordillera de Talamanca range in Panama and Costa Rica (Ulloa Ulloa *et al.* 2017).

Burmeistera is placed in Campanulaceae subfamily Lobelioideae, sister to the genera *Centropogon* Presl (1836: 48) and *Siphocampylus* Pohl (1831: 104) (Antonelli 2008, Knox *et al.* 2008, Lagomarsino *et al.* 2014). Traditionally, *Burmeistera* and *Centropogon* have been differentiated from *Siphocampylus* by the presence of berries versus dry dehiscent capsules. Molecular work has shown that this character has arisen several times in the group, revealing that the genera *Centropogon* and *Siphocampylus* are not monophyletic (Lagomarsino *et al.* 2014). However the monophyly of *Burmeistera* has been shown repeatedly (Antonelli 2008, Knox *et al.* 2008, Lagomarsino *et al.* 2014). *Burmeistera* is further differentiated from *Centropogon* and *Siphocampylus* by having generally ebracteolate pedicels, an inflated corolla opening, a wider fused anther tube opening, a deciduous corolla and androecium (vs. persistent as fruits develop after fertilization), and isodiametric seeds (Lagomarsino *et al.* 2014, Lammers 1998, Triana 1854).

Species of *Burmeistera* are often multi-stemmed, herbaceous, scandent shrubs with branches more than six meters long that sprawl on other vegetation. However, a smaller number of species, such as the new species described here, are predominantly terrestrial, non-sprawling, with erect branches reaching, at most, 1 to 2 meters in height. Most

Burmeistera are bat pollinated, as evidenced by the inflated corolla opening, dull flower colors, skunky flower odors, and long pedicels, all traits associated with a bat-pollination syndrome (Muchhala 2006).

Throughout the distribution of the genus, *Burmeistera* species are primarily found in cloud forests from 1000 to 2500 m, often in narrowly restricted ranges. In Ecuador, the majority of species (~95%) are found in the northern half of the country, with species diversity dropping significantly in the southernmost provinces (Jeppesen 1981, Lammers 2007). Only eight species are known to occur south of the 2nd parallel south (the circle of latitude 2 degrees south of the equator), which roughly cuts the country in half. Of these eight species, six are widespread common species that are also found north of the 2nd parallel south. This latitude corresponds to the Girón-Paute Valley, a transverse deep dry valley that is a known geographical barrier for plant distributions (Jørgensen *et al.* 1995, Paredes-Burneo *et al.* 2018, Quintana *et al.* 2017). The new species described here is restricted to the area south of the Girón-Paute Valley.

Here, we present a complete description of the new species, accompanied by a discussion of its collection history, relationships, and ecology, as well as an assessment of its conservation status. Photographs of the new species and a distribution map of known collections are provided.

Materials and Methods

This study is based on: (1) collections and field observations of individuals during the 2019 botanical exploration of the El Quimi Reserve by CP, NZ and AJP; (2) review of relevant literature as well as type images of *Burmeistera* available at JSTOR Global Plants (<http://plants.jstor.org/>) and online herbaria; and (3) examination of collections available at MO, and QCA. The conservation status assessment is based on IUCN (2017) criteria.

Taxonomy

Burmeistera quimiensis Mashburn & Á.J.Pérez, *sp. nov.* Figures 1–3.

Type:—ECUADOR. Morona Santiago: Cantón Gualaquiza, Parroquia Bomboiza, Reserva Biológica El Quimi, cumbre de la meseta de El Quimi, suelos de arenisca, sendero y alrededores entre el campamento Río Cristalino y la frontera con Perú, 1900–2200 m, 03°31'05"S, 78°23'28"W, 24 January 2019 (fl, fr), Á. J. Pérez, C. Persson, N. Zapata & W. Santillán 11518 (holotype, QCA!; isotype, MO!).

Diagnosis:—*Burmeistera quimiensis* is differentiated from all other species of *Burmeistera* in its unique combination of: red-violet stems and veins; spiral phyllotaxy; ascending, bullate leaves with a revolute margin; puberulous abaxial leaf surface; cupuliform hypanthium; and white to red-violet fruits.

Herbaceous shrubs with 1–5 erect stems, reaching ca. 1 m in height. *Latex* white. *Stems* 3–6 mm wide throughout, red-violet, puberulous, basally defoliated. *Leaves* alternate, spiral, ascending, bullate, drying with a dark-violet tinge, the internodes 15–25 mm long; petioles 5–10 mm long, red-violet, puberulous; lamina 35–70 × 10–27 mm, elliptic to obovate, the base attenuate, the apex obtuse to rounded, the margin shallow callose-dentate, revolute, the teeth intramarginal; adaxial surface dark green, sometimes tinged dark violet, glabrous, glossy; abaxial surface lighter green with red-violet veins, puberulous; venation rectipinnate, sometimes branching just before the margin, the primary and secondary veins prominently raised, the tertiary veins visible. *Flowers* 25–31 mm long, solitary in the upper leaf axils; pedicels at anthesis ca. 60 mm long, ascending, in fruit 70–80 mm long, reflexed, pale green to red-violet, glabrous to puberulous; hypanthium 5–6 × 4.5–6 mm, cupuliform, light green tinged with red-violet, glabrous, the ridges smooth; calyx lobes 3–5 × 1–2 mm, ascending to patent at anthesis, deltate to ligulate, light green tinged with red-violet, glabrous, the margin shallow callose-serrate with 5–11 teeth, red-violet, the apex obtuse; corolla basally red-violet, becoming pale green distally, glabrous; corolla tube 3–4 mm wide basally, the throat narrowing to 2–3 mm wide; corolla lobes ligulate, the margins smooth, the two dorsal lobes 10–13 × 2–3.5 mm, falcate, arched forwards, the dorsal sinus 12–15 mm from the corolla base, the two lateral lobes 7–8 × 2–3 mm, falcate, slightly recurved, the ventral lobe 5–6 × 3–4 mm, slightly recurved, the ventral sinus 7–10 mm from the corolla base; androecium 19–25 mm long, exerted 12–16 mm from the ventral opening, the filament tube pale red-violet, puberulous with white hairs, the anther tube ca. 7 × 3 mm, violet, puberulous with tan hairs, all five anther tips glabrous to sparsely pubescent; the style and stigma unknown. *Fruits* ca. 30 × 30 mm, globose, thick-walled, spongy, entirely white to red-violet; seeds 0.5–0.9 mm long, elliptic, light brown, the surface shallowly foveate.

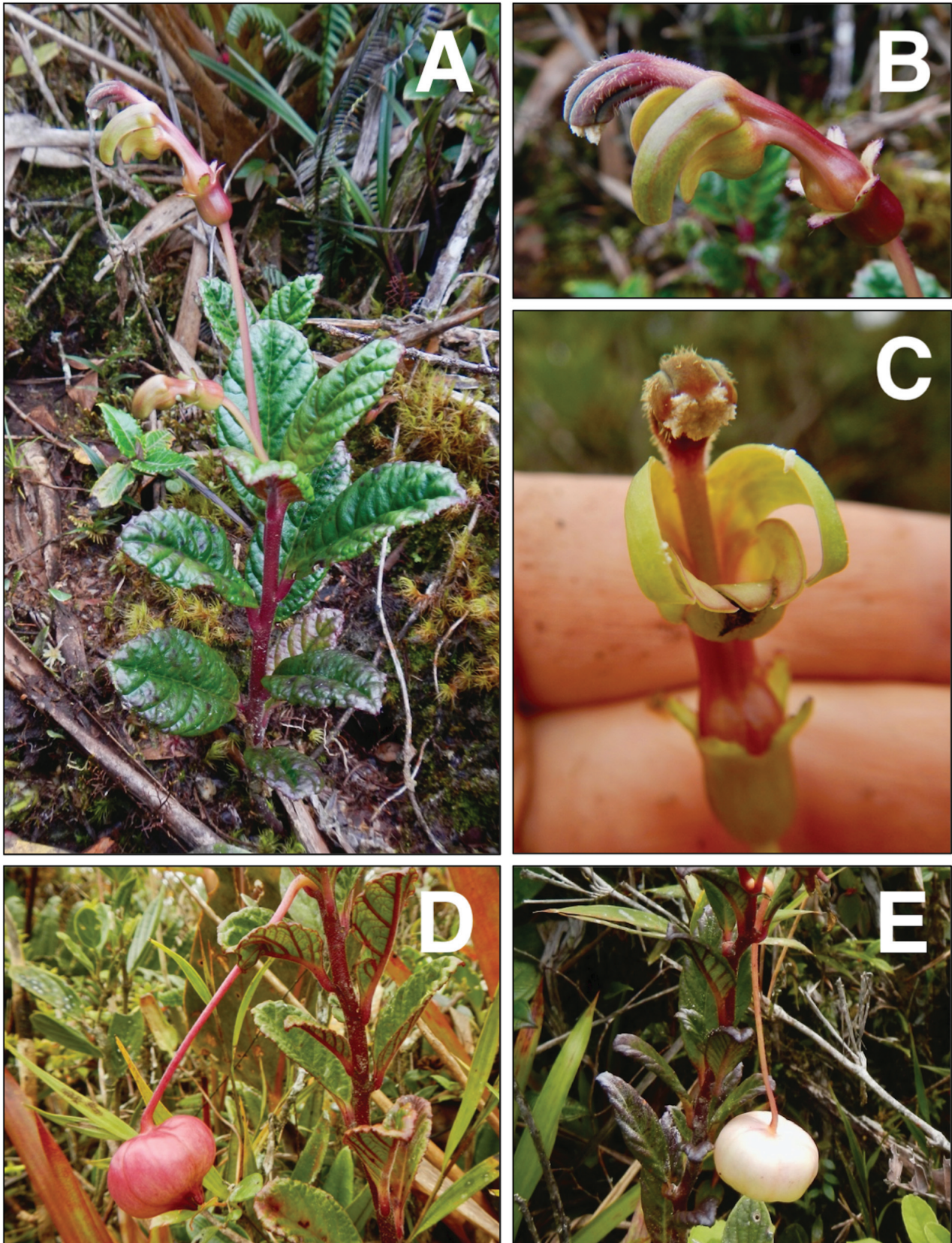


FIGURE 1. *Burmeistera quimiensis* Mashburn & Á.J.Pérez, *sp. nov.* **A.** View of adaxial leaf surface and erect flowers. **B.** Lateral view of a flower in male stage with pollen load at anther tube orifice. **C.** Ventral view of a flower in male stage with pollen load at anther tube orifice. **D.** View of red-violet veins on abaxial leaf surface and red-violet fruits. **E.** View of white fruits and reflexed position of the fruits. A, B, D, E from AP 11518, C from AP 11442. Photographs by Álvaro J. Pérez.



FIGURE 2. The first known collection of *Burmeistera quimiensis* made by Alwyn Gentry on July 21, 1993, during his last field trip.

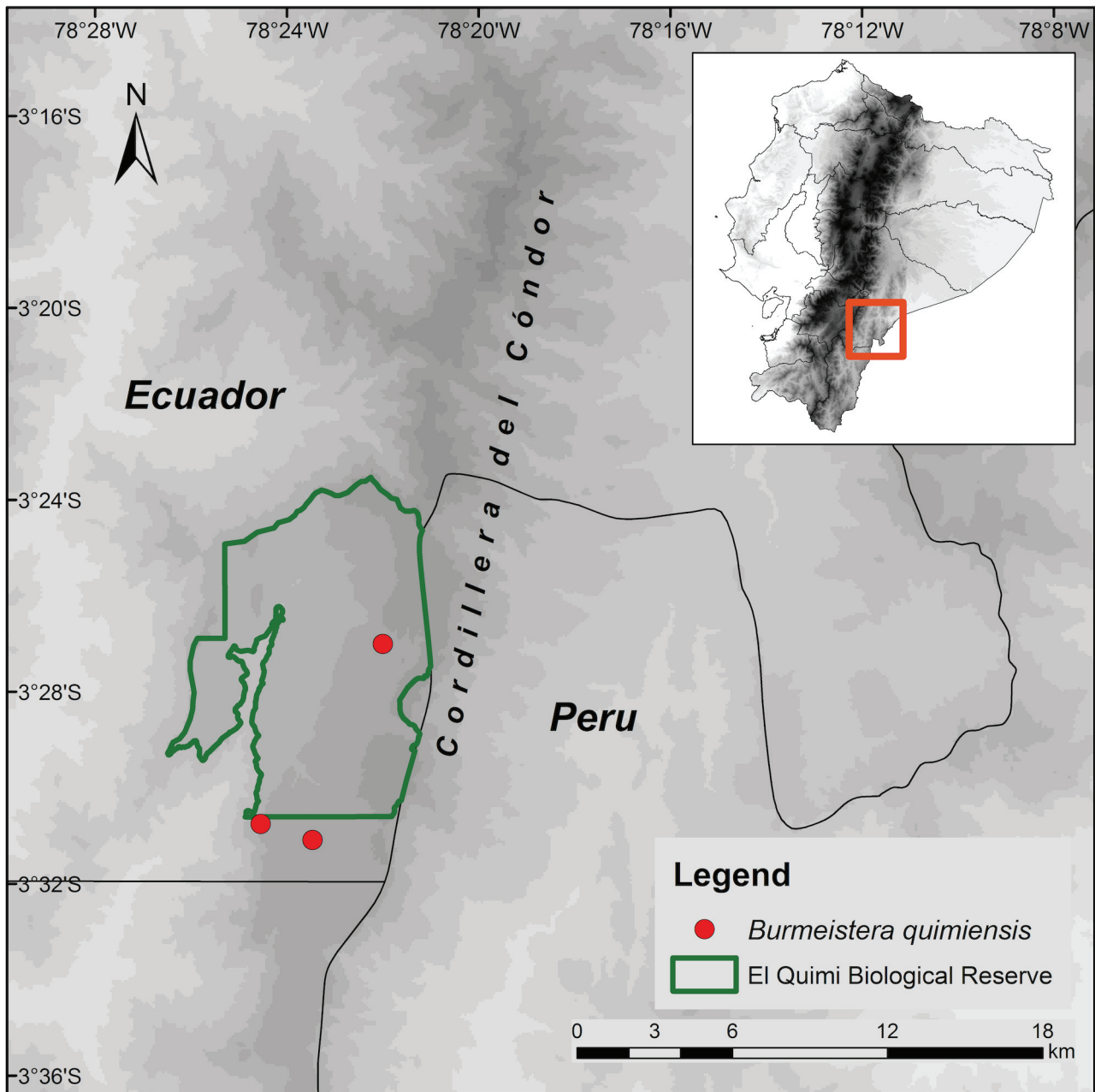


FIGURE 3. Collections of *Burmeistera quimiensis* along the Cordillera del Cóndor range in Morona-Santiago province, Ecuador.

Etymology and discovery:—The specific epithet refers to the Reserva Biológica El Quimi which encompasses a portion of the Cordillera del Cóndor in southeast Ecuador. The first collection of this species was made in 1993 during a Rapid Assessment Program to the Cordillera del Cóndor. This trip was the first scientific exploration of the area by researchers from Conservation International and Escuela Politécnica Nacional, and the team was supported by the Ecuadorian Army. The group named the collecting area ‘Achupallas Camp’ for the dominance of the many terrestrial bromeliads (Schulenberg & Awbrey 1997). Alwyn H. Gentry, the leading botanist of the expedition, made one collection of this species (Figure 2). More recently, botanical fieldwork was carried out in and around El Quimi Biological Reserve in January 2019. The team was led by botanists from the Pontificia Universidad Católica del Ecuador (Herbarium QCA) with support from the University of Göteborg (Herbarium GB). The expedition resulted in the first collections of flowering material, which allowed for the description of this species.

Distribution, habitat and ecology:—Specimens of *B. quimiensis* have only been collected from the Cordillera del Cóndor, a chain of mountains running 150 km north-south along the border of Ecuador and Peru (Figure 3). This mountain range is isolated from the main Andean range and is geologically distinct, formed with an intermixture of limestone, quartzitic sandstone, and igneous rock of the Hollín Formation (Gregory-Wodzicki 2000; Neill 2005).

Individual mountains jut up from the surrounding forest, effectively creating geological islands with distinct forest patches. As a result, *B. quimiensis* is endemic and thus far only known from forests within and immediately surrounding El Quimi Biological Reserve in the Cordillera del Cóndor region. The geology of these mountains is similar to the tepuis of the Guyana shield in northwest South America. In fact, a number of angiosperm genera once thought to be endemic to the tepuis of the Guyana shield have also been found along the Cordillera del Cóndor (Berry *et al.* 1995; Schulenberg & Awbrey 1997).

The ecosystem of the Cordillera del Cóndor is an open tepui-like bromeliad sward and elfin forest at 1900–2200 m, with a hyper-humid environment on wet soil covered by abundant organic matter. According to the Ministerio del Ambiente de Ecuador (2015), this locality lies within a much larger zone dominated by evergreen mountain forest with sandstone plains surrounding the Cordillera del Cóndor (bosque siempreverde montano sobre mesetas de arenisca de la Cordillera del Cóndor, BsMa01).

The location of the Cordillera del Cóndor along the border of Ecuador and Peru indicates that *B. quimiensis* may also occur in Peru. If so, the species would likely occur within Ichigkat Muja—Cordillera del Cóndor National Park in Peru, which borders El Quimi Biological Reserve along the Ecuador-Peru border. However, to date the only known collections of this species come from within and around El Quimi Biological Reserve in Ecuador, a protected area that was officially designated in 2006.

Burmeistera quimiensis joins *Burmeistera draconis* Á.J.Pérez & Muchhala in Vallejo *et al.* (2018: 267) and *Burmeistera zamorensis* Muchhala & Á.J.Pérez (2015: 36) as the only species with ranges restricted to south of the Girón-Paute Valley.

Phenology:—*Burmeistera quimiensis* has been collected with flowers in January and with fruits in January, July, and December. This species is likely similar to most *Burmeistera* by flowering year-round, though more collections are necessary for verification.

Conservation status:—This extremely rare species is only known from the broad plateau with quartzitic sandstones of the Hollín Formation in and around the El Quimi Biological Reserve, a protected area of 9276 hectares. The surrounding areas are currently threatened by an ongoing open-pit copper mine of the ‘Mirador Project’, which has already caused deforestation of an area of about 1300 hectares (Mazabanda *et al.* 2018 (interactive maps), Vandegrift *et al.* 2018). Given this, we proposed ranking this species as Vulnerable (Vu).

Discussion:—Despite being known from only a handful of collections, the distinctive morphology of *B. quimiensis* sets it apart from any other species of *Burmeistera*. However, this fact also makes it difficult to determine its closest relatives without performing molecular analysis. The flowers of *B. quimiensis* are similar in size to those of *Burmeistera zamorensis*, which occurs south of *B. quimiensis* in Zamora-Chinchipe province. These two species are easily differentiated with vegetative features: the leaves of *B. zamorensis* are ovate-lanceolate with a long drip tip, while those of *B. quimiensis* are obovate with an obtuse to rounded apex. A few other species of *Burmeistera* in Ecuador have white fruits, including *Burmeistera huacamayensis* Jeppesen (1981: 22), which has also been collected in Morona-Santiago province. Again, these species can be differentiated easily with vegetative characters: the leaves of *B. huacamayensis* are narrowly lanceolate with a long drip tip, while those of *B. quimiensis* are obovate with an obtuse to rounded apex.

Additional specimens examined:—ECUADOR. Morona Santiago: Cantón Gualaquiza, Campamento Achupallas, Cordillera del Cóndor, 15 km east of Gualaquiza, 2090 m, 03°27’S, 78°22’W, 21 July 1993, *A. Gentry 80302* (MO!); Cantón Gualaquiza, Cordillera del Cóndor, cresta de la Cordillera, arriba del Valle de Río Quimi, 2000 m, 03°30’45’’S, 78°24’33’’W, 11 December 2000, *M. Cuascota et al. 268* (MO!); Cantón Gualaquiza, Parroquia Bomboiza, Reserva Biológica El Quimi, sendero y alrededores entre el campamento Río Cristalino y la frontera con Perú, sector de El Laberinto, 1900–2200 m, 03°31’05’’S, 78°23’28’’W, 24 January 2019, *N. Zapata et al. 553* (QCA!, MO!); Cantón Gualaquiza, Parroquia Bomboiza, Reserva Biológica El Quimi, sendero y alrededores entre el campamento Río Cristalino y la frontera con Perú, sector de El Laberinto, 1900–2200 m, 03°31’05’’S, 78°23’28’’W, 24 January 2019, *Á. J. Pérez et al. 11442* (QCA!, MO!); Cantón Gualaquiza, Parroquia Bomboiza, Reserva Biológica El Quimi, sendero y alrededores entre el campamento Río Cristalino y la frontera con Perú, 1900–2200 m, 03°31’05’’S, 78°23’28’’W, 26 January 2019, *N. Zapata et al. 564* (QCA!).

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