

Problematic specimens turn out to be two undescribed species of *Bignonia* (Bignoniaceae)

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Abstract

Bignonia comprises 29 species of lianas characterized by eight phloem wedges, leaves usually 2-foliolate, mostly simple tendrils and opaque seed wings. The analysis of herbarium specimens in preparation for a taxonomic revision of the genus led to the recognition of two new species: (i) *Bignonia cararensis* from Costa Rica, characterized by a thyrses with lateral compound dichasia and lack of interpetiolar ridge, and (ii) *Bignonia sanctae-crucis* from Bolivia and Brazil, distinguishable by its membranous leaflets, membranous calyx and small fruits. We provide detailed descriptions, illustrations, distribution maps, initial conservation status assessments, and comparisons of the newly described taxa with closely related species.

Keywords

Amazonia, Costa Rica, Bignoniaceae, Lianas, Neotropical Flora

Introduction

Bignonia L. is the fifth largest genus in the Neotropical tribe Bignonieae (Bignoniaceae), with 29 species distributed from Argentina to USA (Zuntini et al. 2015). The genus comprises lianas with eight phloem wedges, leaves usually 2-foliolate, prophylls of the axillary buds foliaceous and bromeliad-like (small, decussate, triangular prophylls

resembling a bromeliad), mostly simple tendrils and opaque seed wings (Lohmann and Taylor 2014). Additionally, these plants have showy rather large flowers, pink corollas, and septicidal capsules that contain numerous seeds, usually winged. Molecular studies have found that *Bignonia* is a highly supported clade that combines previously recognized genera, such as *Clytostoma* Miers ex Bureau and *Cydista* Miers (Lohmann 2006). The species of these two former genera share a variety of morphological features, such as variously cylindrical or quadrangular stems, a cupular calyx, dorso-ventrally flattened corollas, and a reduced nectariferous disk, which made their generic identification sometimes difficult. While preparing a monograph of *Bignonia* (Zuntini, Taylor and Lohmann, in prep.), more than 4,000 collections were analyzed and several problematic specimens that had been previously identified in a variety of Bignoniaceae genera were found to belong to *Bignonia*. However before these materials were finally identified to genus, the identity of these specimens was so unclear that they were confused with four different genera, and the flowering and fruiting specimens of each of these new species were considered to belong to different genera. Once identified as *Bignonia*, it became clear that these specimens represent two undescribed species.

These two new species are *Bignonia cararensis* Zuntini from Costa Rica and *Bignonia sanctae-crucis* Zuntini from Bolivia and western Brazil. Within *Bignonia*, these new species are not very similar and are not closely related to each other, however, these species are each similar to previously described species.

With these two new species, *Bignonia* is now composed of 31 species, with no morphological or geographical changes in the circumscription of the genus. Our results highlight the importance of large diverse herbarium collections for understanding the systematics of tropical plants, and also of broadly surveying all the specimens of a group before finalizing monographic studies rather than studying only a selected set of specimens of a given genus.

Methods

Specimens from the following herbaria were examined: CR, F, INB, MO, NY, SPF, USJ (acronyms following Thiers 2015). The morphology descriptions follow mainly Lohmann and Taylor (2014), with additional terminology from Leaf Architecture Working Group (1999), Radford et al. (1974) and Weberling (1989). For indumentum, we follow Nogueira et al. (2013) with each trichome type described separately; peltate glandular trichomes are described according to their density as sparsely, moderately or densely lepidote, and patelliform glandular trichomes are presented here as “glands.” In the descriptions, terms inside parentheses denote rare conditions. The conservation status assessments follow IUCN guidelines (IUCN 2012), with the evaluation of geographic range based on the extent of occurrence (EOO). Distribution maps were prepared using the specimen database that was compiled as part of an ongoing monographic study of the whole genus (Zuntini, Taylor and Lohmann, in prep).

Taxonomic treatment

Bignonia cararensis Zuntini, sp. nov.

urn:lsid:ipni.org:names:77149637-1

Type. Costa Rica. Puntarenas: Reserva Biológica [Parque Nacional] Carara, Sector Quebrada Bonita. Sitio Area administrativa, 09°45.6'N, 084°36.0'W, 20 m, 9 February 1990, *R. Zúñiga 90* (holotype: CR-145925, mounted in two sheets!; isotypes: F!, INB!, MO!). Figure 1.

Diagnosis. This new species is closely related to *Bignonia uleana* (Kraenzl.) L.G.Lohmann, but differs by the absence of interpetiolar ridges, inflorescences with compound dichasia (vs. simple dichasia in *B. uleana*) and fruits up to 14 cm long with cylindrical and delicate spines (vs. longer than 16 cm with triangular and rough spines in *B. uleana*). Table 1.

Description. Lianas. **Stems** solid, cylindrical, not winged, with lenticels, without interpetiolar gland fields, without interpetiolar ridge, puberulous at least at nodes, sparsely lepidote; foliaceous prophylls caducous, cymbiform, ascending, sessile, symmetrical, 1.7–2.0 mm × ca. 1.4 mm, ciliate, sparsely lepidote, without glands; bromeliad-like prophylls present. **Leaves** 2-foliolate; petiole semi-cylindrical, 35.9–46.5 mm, without simple trichomes or puberulous, sparsely lepidote; petiolules semi-cylindrical, 25.0–45.3 mm, without simple trichomes or puberulous, sparsely lepidote; blades concolorous to slightly discolorous, chartaceous, matte, symmetrical, elliptic to widely elliptic, shortly acuminate apically, rounded basally, 17.1–23.4 × 11.0–12.8 cm, on adaxial surface puberulous at base, sparsely lepidote, with glands clustered at apex and few scattered, on abaxial surface without simple trichomes or puberulous on mid and secondary veins, sparsely lepidote, with a few scattered glands; venation pinnate, with tertiary venations mixed opposite-alternate percurrent; tendrils rarely present, simple, without simple trichomes, sparsely lepidote, with simple apex. **Inflorescences** thyrses, terminal, multi-flowered, with lateral dichasia compound and pedunculate, without simple trichomes, sparsely to moderately lepidote, primary axis ca. 255.0 mm long; bracts caducous, narrowly triangular, 1.8–2.1 × 0.5–0.6 mm, without simple trichomes, sparsely lepidote, without glands; pedicels 6.7–14.4 mm, without simple trichomes, sparsely lepidote, without glands. **Flowers** with calyx cupular, 5-toothed, sub-chartaceous, 3.7–5.9 × 4.7–6.4 mm wide at apex, ciliate, moderately lepidote, with a few scattered glands, teeth 0.6–1.4 mm; corolla purple outside, inside color unknown, infundibuliform, dorso-ventrally flattened, membranous, 40.8–75.0 mm, externally sericeous, sparsely lepidote, without glands, internally sericeous at lobes, not lepidote, with stipitate glandular trichomes at base, tube 28.4–52.5 × 2.7–3.3 mm wide at base and 10.9–14.1 mm wide at apex, lobes sub-circular, 9.7–22.0 × 10.7–15.5 mm; androecium didynamous, with stamens included, the largest 16.4–18.6 mm, the shortest 11.2–11.3 mm, without simple trichomes, not lepidote, with stipitate glandular trichomes at base, thecae 3.3–3.5 mm, staminode ca. 4.2 mm; gynoecium 25.5–27.9 mm, ovary cylindrical, verrucose, without simple trichomes, not lepidote, ovules in 2

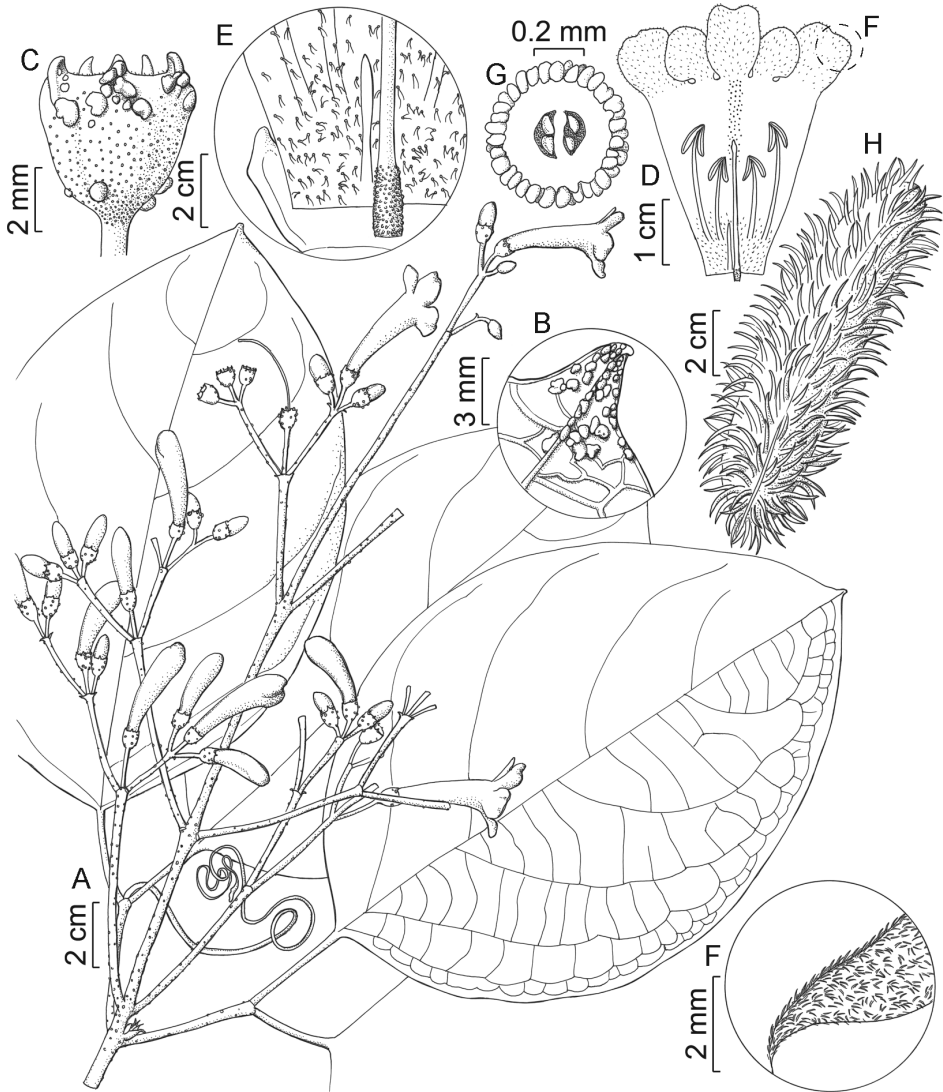


Figure 1. *Bignonia cararensis* Zuntini **A** Flowering branch **B** Gland cluster at leaflet apex on adaxial surface **C** Calyx **D** Opened flower **E** Detail of internal flower base, showing the glandular stipitate trichomes at corolla **F** Detail of the internal sericeous indument of the corolla lobes **G** Ovary cross-section **H** Fruit. Illustrated from *Zuniga 90* (MO) [**A–G**] and *Weinberg s.n.* (MO-3842040) [**H**].

series per locule, style not lepidote; nectariferous disk reduced. **Fruits** inflated, narrowly elliptic, 11.2–14.5 × 3.1–4.0 wide × ca. 1.4 cm thick, valves woody, without ridges, moderately echinate, without simple trichomes, not lepidote, without glands; spines cylindrical, 8.2–13.4 mm. **Seeds** unknown.

Distribution. This species is known only from Parque Nacional Carara, in Puntarenas, Costa Rica, between 20 and 100 m elevation (Fig. 2).

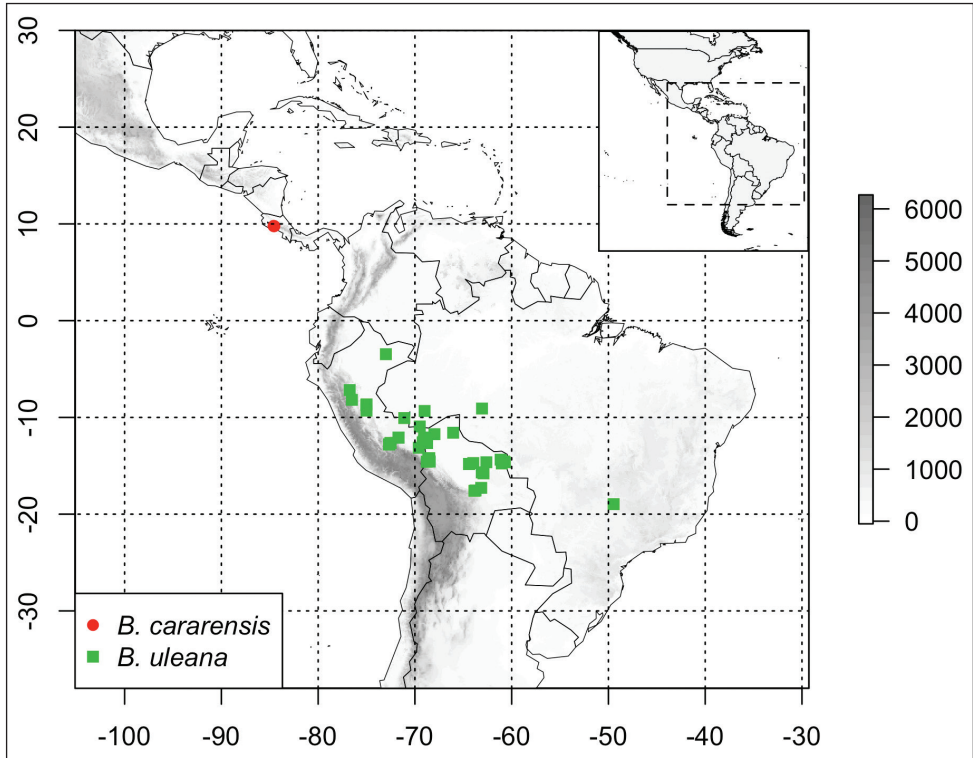


Figure 2. Distribution of *Bignonia cararensis* (red circles) and *B. uleana* (green squares). Elevation in meters, following the scale on the right.

Phenology. Three fertile collections are documented for *Bignonia cararensis*: a single flowering specimen was collected in February and two fruiting specimens were collected in February and October.

Etymology. The name is a reference to the type locality.

Conservation status. The collections from the main herbaria of Costa Rica (CR, INB and USJ) were consulted, but so far this species is only documented from Parque Nacional Carara. Since *B. cararensis* is known exclusively from the type locality, its full distribution cannot be accurately assessed and is here listed as Data Deficient (DD). Additional fieldwork is necessary to estimate the number of mature individuals and to assess the full extend of the species' distribution.

Discussion. This species is similar to *B. uleana*, a species from Bolivia, central western Brazil and Peru. *Bignonia cararensis* can be recognized by the absence of interpetiolar ridges (vs. present in *B. uleana*), the inflorescences in lateral compound dichasia (vs. lateral simple dichasia in *B. uleana*), and the fruit up to 14 cm and with cylindrical delicate spines (vs. longer than 16 cm with triangular rough spines in *B. uleana*) (Table 1).

The flowering collection *Zuñiga 90* was previously identified as *Cydista lilacina* A.H.Gentry [\equiv *B. lilacina* (A.H.Gentry) L.G.Lohmann] (Burger and Gentry 2000,

Table 1. Contrasting characters of *Bignonia cararensis* and *B. uleana*.

Character	<i>B. cararensis</i>	<i>B. uleana</i>
Interpetiolar ridge	Absent	Present
Inflorescence lateral structure	Compound dichasia	Simple dichasia
Fruit length (cm)	11.2–14.5	16.8–26.0
Fruit spines	Cylindrical, moderately distributed	Triangular, sparsely distributed
Distribution	Costa Rica	Bolivia, Brazil and Peru

Hauk 1997, *in sched.* at CR, INB and MO), and so was the sterile specimen *Acosta Vargas* 826 (*in sched.* at INB and MO). *Bignonia lilacina* is similar to *Bignonia cararensis*, with which it shares cylindrical stems, large leaflets, and inflorescences in thyrses with compound lateral dichasia. However, *Bignonia cararensis* differs from *B. lilacina*, an Amazonian species, by its glabrous and verrucose ovary (vs. densely lepidote and smooth in *B. lilacina*), sparsely lepidote stems, inflorescences and flowers (all of these structures are densely lepidote in *B. lilacina*), gland clusters borne on the adaxial surface of leaflet apices (vs. basal gland clusters on the abaxial leaflet surface in *B. lilacina*) and buds with straight apices (vs. curved apices in *B. lilacina*).

In contrast, the fruiting collection *Jiménez* 2042 was previously identified as *Clytostoma pterocalyx* Sprague ex Urb. [\equiv *B. pterocalyx* (Sprague ex Urb.) L.G.Lohmann] (*in sched.* at INB), and as *Clytostoma sciuripabulum* Bureau & K.Schum. [\equiv *B. sciuripabulum* (Bureau & K.Schum.) L.G.Lohmann] (*in sched.* at CR and INB). The other fruiting material of this new species (*Weinberg* s.n.) was also identified as *C. sciuripabulum* (*in sched.* at MO). However, *Bignonia cararensis* differs from *B. pterocalyx* by its puberulous stems and inflorescences (vs. pilose in *B. pterocalyx*), 2-foliolate leaves (vs. 1-foliolate in *B. pterocalyx*) and moderately echinate fruit (vs. densely echinate in *B. pterocalyx*). *Bignonia cararensis* differs from *B. sciuripabulum* by the cylindrical stems (vs. quadrangular in *B. sciuripabulum*) and apical gland clusters borne on the adaxial leaflet surface (vs. no apical clusters in *B. sciuripabulum*).

Clytostoma pterocalyx and *Cydista lilacina* were reported as new records for Costa Rica (Burger and Gentry 2000, Hauk 1997, Jiménez and Grayum 2002) based on the specimens studied here, but with the re-identification of these specimens both of these species are now known only from South America. *Bignonia pterocalyx* is found in Venezuela and Colombia, and *B. lilacina* is distributed throughout Amazonia.

The Carara National Park is located in the northern portion of the Tárcoles-Térraba floristic region, which extends through the central portion of Pacific coastal Costa Rica (Hammel et al. 2004). This region has a combination of dry and moist forests, and includes elements from Nicoya and Osa Peninsulas, where *B. cararensis* might also be found.

Additional examined specimens. COSTA RICA. Puntarenas: Carara Biological Reserve, 2.6 km del portón de la entrada del sendero Laguna Meandrica. Primer desviación a mano izquierda entrando, 9°48.0'N, 84°35.16'W, 100 m, 6 Apr 2000, *L.G. Acosta Vargas* 826 (INB, MO); Camino a Coopecarara, 9°47.16'N, 84°36.16'W, 100

m, 11 Oct 1995, *Q. Jiménez 2042* (CR, INB); Carara Biological Reserve. 15 minute walk from entrance of Carara taking trail winding right (counter-clockwise), 9°46'N, 84°31'W, 18 Feb 1991, *R. Weinberg s.n.* (MO-3842040).

***Bignonia sanctae-crucis* Zuntini, sp. nov.**

urn:lsid:ipni.org:names:77149638-1

Type. Bolivia. Santa Cruz: Prov. Ichilo. El Carmen (8 km al SSW de Buena Vista), tramo de 2km al W de la comunidad por el camino al Campamento del Río Saguayo, 17°31.98'S, 63°41.85'W, 400 m, 5 October 1996, *I.G. Vargas C. 5382* & *S. Hurtado P.* (holotype: MO-5878679!; isotypes: K, NY!). Figure 3.

Diagnosis. This new species is similar to *Bignonia potosina* (K.Schum. & Loes.) L.G.Lohmann, but is distinguished by its membranous leaflets with mixed opposite-alternate percurrent tertiary venation (vs. chartaceous with alternate percurrent tertiary venation in *B. potosina*), membranous calyx (vs. chartaceous calyx in *B. potosina*) and fruits shorter than 6.8 cm long (vs. fruits longer than 15 cm in *B. potosina*). Table 2.

Description. Lianas. **Stems** solid, tetragonal, winged or ribbed, with lenticels, without interpetiolar gland field, with interpetiolar ridge, puberulous to pilose at least at nodes, sparsely lepidote; foliaceous prophylls caducous, falcate (subulate), ascending, stipitate, asymmetrical, 0.9–2.3 mm × 0.5–1.5 mm, without simple trichomes, sparsely lepidote, with a few glands on abaxial surface (no glands); bromeliad-like prophylls present. **Leaves** 2-foliolate; petiole semi-cylindrical, (6.1–)15.1–38.9 mm, pubescent, puberulous or pilose, sparsely lepidote; petiolules semi-cylindrical, 9.7–29.8 mm, pilose, sparsely lepidote; blades slightly discoloured, membranous, matte, slightly asymmetrical to asymmetrical, elliptic to widely ovate, acuminate to long acuminate apically, rounded basally (short attenuate), 8.3–13.3(–18.9) × 5.1–8.5(–12.3) cm, on adaxial surface without simple trichomes, densely lepidote, without glands, on abaxial surface pilose along midvein and secondary veins, sparsely lepidote, with a few scattered glands; venation pinnate, with tertiary venations mixed opposite-alternate percurrent; tendrils rarely present, simple, without simple trichomes, sparsely lepidote, with simple apex. **Inflorescences** racemes, terminal, 2–4-flowered, without simple trichomes or puberulent, sparsely lepidote, primary axis 8.3–13.8 mm long; bracts caducous, not observed; pedicels 5.5–10.0 mm, without simple trichomes, moderately lepidote. **Flowers** with calyx cupular, 5-toothed, membranous, 4.5–6.0 × 4.3–5.1 mm wide at apex, ciliate, moderately lepidote, with glands clustered in columns, teeth 0.6–1.5 mm; corolla creamish outside, yellowish inside, infundibuliform, dorso-ventrally flattened, membranous, 30.6–52.8 mm, externally pubescent at lobes, moderately lepidote, without glands, internally with pubescent lobes, not lepidote, with shortly stipitate glandular trichomes at base, tube 19.8–40.0 × 2.1–5.0 mm wide at base and 9.2–16.3 mm wide at apex, lobes rounded or oblong, 9.7–15.4 × 8.8–15.2 mm; androecium didynamous, with stamens included, the largest 10.7–18.0 mm, the shortest 6.4–11.7 mm, without simple trichomes, not lepidote, with shortly stipitate glandular

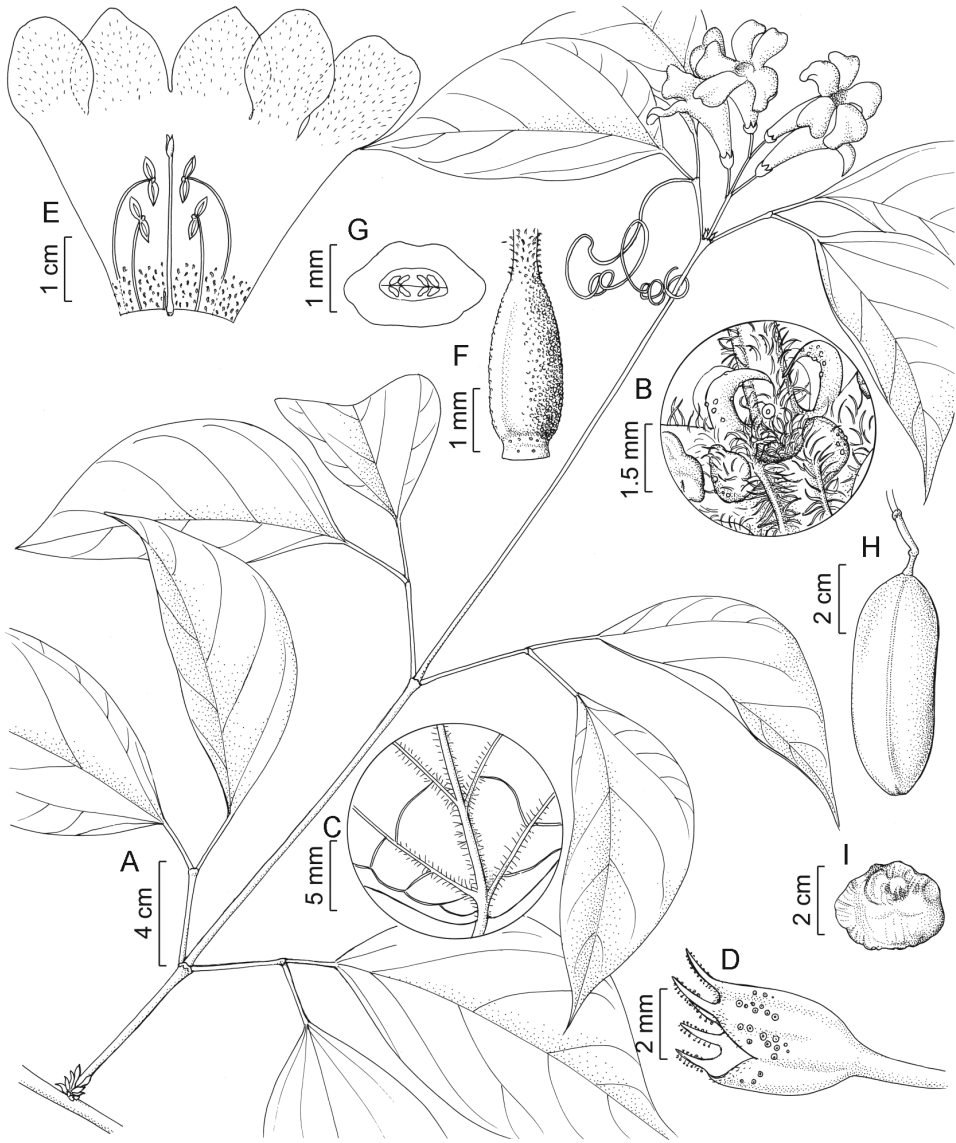


Figure 3. *Bignonia sanctae-crucis* Zuntini. **A** Flowering branch **B** Stem node with prophylls of the axillary buds **C** Detail of the abaxial leaflet surface **D** Calyx **E** Opened flower **F** Ovary side-view **G** Ovary cross-section **H** Fruit **I** Seed. Illustrated from *Vargas* 5382 (NY) [**A,D**], *Saldias* 4775 (NY) [**E–G**] and *Nee* 52361 (NY) [**B, C, H, I**].

trichomes at base, thecae 1.7–3.6 mm, staminode 0.9–2.5 mm; gynoecium 21.5–29.2 mm, ovary ovoid to cylindrical, smooth, without simple trichomes (pilose at apex), densely lepidote, ovules in 4 series per locule, style sparsely lepidote at base; nectariferous disk reduced. **Fruits** inflated, oblong, ca. 6.8 × 2.8 wide × 0.8 cm thick, valves

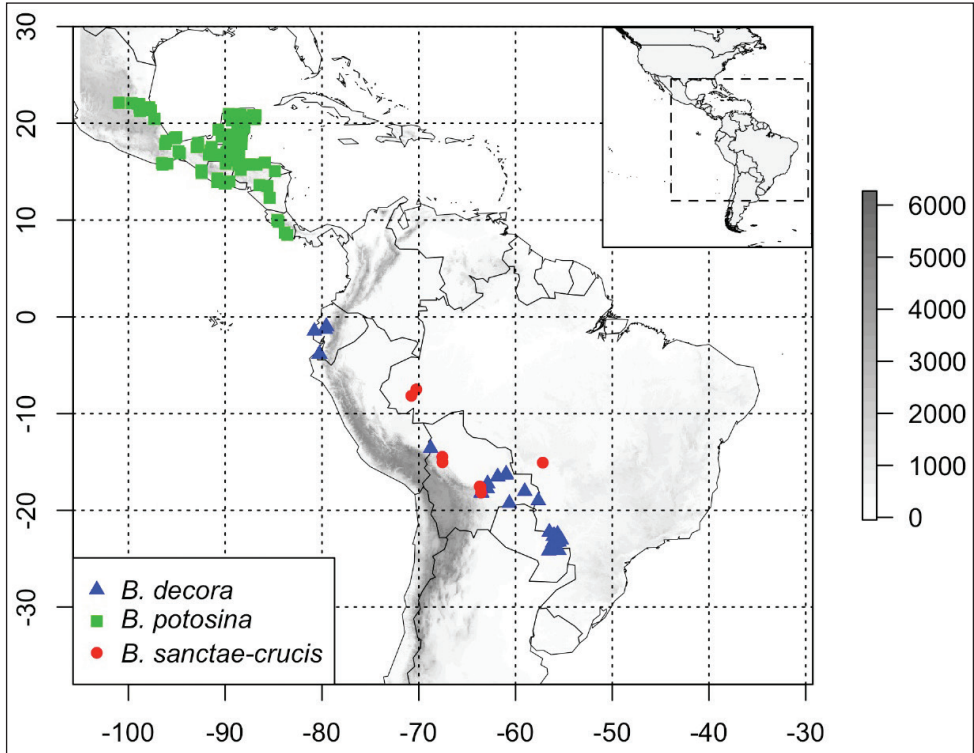


Figure 4. Distribution of *Bignonia sanctae-crucis* (red circles), *B. decora* (blue triangles), and *B. potosina* (green squares). Elevation in meters, following the scale on the right.

woody, without ridges, smooth, without simple trichomes, sparsely lepidote, without glands. **Seeds** beige, thin, transversally elliptic to narrowly transversally oblong, symmetrical, 13.7–24.3 × 28.5–39.4 mm, with two opaque wings; seed body flattened, 0.8–1.2 mm thick.

Distribution. This species is found in evergreen or semideciduous forests in Western Amazonia, occurring in Bolivia (Beni, La Paz and Santa Cruz) and Brazil (Acre, Amazonas and Mato Grosso), between 160 to 700 m alt. (Fig. 4).

Phenology. This species was collected with flowers in June, September, October and November. A single fruiting specimen was collected in July.

Conservation status. *Bignonia sanctae-crucis* is known from only seven locations but is considered Least Concern (LC) given its wide extent of occurrence (over 600.000 km²) and the different physiognomies where it occurs, including secondary formations. The number of locations where this species is known to occur is likely underestimated because *Bignonia* species are usually not densely distributed and because this entire region is not well documented floristically. Additional fieldwork is needed in order to fully document the extent of distribution of this species.

Etymology. The epithet refers to the type locality, the Department of Santa Cruz (Bolivia), where most specimens were collected.

Table 2. Contrasting characters of *Bignonia decora*, *B. potosina* and *B. sanctae-crucis*.

Character	<i>B. decora</i>	<i>B. potosina</i>	<i>B. sanctae-crucis</i>
Prophylls of axillary buds	Foliaceous, persistent and spreading	Falcate, caducous and ascending	Falcate, caducous and ascending
Leaf texture	Sub-chartaceous to chartaceous	Chartaceous to sub-coriaceous	Membranous
Leaf tertiary venation	Alternate percurrent	Alternate percurrent	Mixed opposite-alternate percurrent
Inflorescence	Thyrse	Raceme	Raceme
Calyx texture	Chartaceous	Chartaceous	Membranous
Fruit length (cm)	14.7–37.7	12.0–24.0	Ca. 6.8
Distribution	Bolivia, Brazil, Ecuador and Peru	Central America	Bolivia and Brazil

Discussion. *Bignonia sanctae-crucis* and *B. potosina* share quadrangular and ribbed (winged) stems, prominent interpetiolar ridges, falcate and caducous prophylls, and few-flowered racemes. Apart from being morphologically similar, these species are also closely related and can be confused. However, *Bignonia sanctae-crucis* can be distinguished from *B. potosina* by the membranous calyx (vs. chartaceous in *B. potosina*) and fruits shorter than 6.8 cm long (vs. fruits longer than 15 cm in *B. potosina*) (Table 2). These two species are also geographically widely separated, with *B. sanctae-crucis* found in Bolivia and central to western Brazil while *B. potosina* is widely found in Mexico and Central America but not in South America. *Bignonia sanctae-crucis* can also be confused with the sympatric species *B. decora* (S.Moore) L.G.Lohmann due to the quadrangular stems shared by both species. However, *B. sanctae-crucis* can be recognized by its falcate and caducous prophylls (vs. foliaceous and persistent in *B. decora*), few-flowered racemes (vs. multi-flowered thyrses in *B. decora*) and fruit without ridges (vs. three longitudinal ridges in *B. decora*) (Table 2). Quadrangular stems are also characteristic of *B. sciuripabulum* (Bureau & K.Schum.) L.G.Lohmann, a distantly related species (Zuntini and Lohmann, in prep.) that has a verrucose and glabrous ovary (vs. smooth and lepidote in *B. sanctae-crucis*) and echinate fruits (vs. smooth in *B. sanctae-crucis*); *B. sciuripabulum* is found in Amazonia and the Atlantic forest of Brazil.

The only fruiting material of this new species (*Nee* 52361) was previously identified as *Cydista* cf. *decora* (S.Moore) A.H.Gentry [\equiv *B. decora*] (*in sched.* at NY), a closely related species. The flowering specimens of *B. sanctae-crucis*, however, were identified as *Clytostoma sciuripabulum* Bureau & K.Schum. [\equiv *B. sciuripabulum*], *Clytostoma uleanum* Kraenzl. [\equiv *Bignonia uleana*], and some other *Clytostoma* species (*in sched.* at MO and NY). The thin-textured corolla probably confused the generic identification, given that most *Cydista*, as previously circumscribed, were characterized by thicker corollas whereas such thin corollas were characteristic of the previously recognized *Clytostoma*. Despite its corolla texture, *B. sanctae-crucis* is not closely related to the species that were included in *Clytostoma*, and does not have the verrucose glabrous ovary that is characteristic of that group.

Additional examined specimens. BOLIVIA. Beni: Rurrenabaque, Rurrenabaque, 14°28'S, 67°34'W, 333 m, 8 Oct 1921, *White 874* (NY). La Paz: Alto Beni, Concesión de San Jose de Papay, 15°02'S, 67°33'W, 500 m, 23 Oct 1987, *E. Vargas 2022* (LPB, MO); San Buena Ventura, 500 m, 29 Nov 1901, *R.S. Williams 363* (NY). Santa Cruz: Cercado, Lomas del Río Cúcha, 450 m, 28 Oct 1925, *J. Steinbach G. 7307* (F, MO); Ibáñez, Gorge of Río Bermejo, 6.5km (by road) W of the checkpoint at Angostura, 18°10'S, 63°33'W, 690 m, 25 Jul 2003, *M.H. Nee 52361* (LPB, NY, USZ). Ichilo, 2 km W of Center of San Carlos, older secondary growth along highway from Buena Vista to Villa Tunari, 17°24.5'S, 63°45'W, 310 m, 31 Oct 1999, *M.H. Nee 50398* (NY); Ichilo, Estância San Rafaél (propiedad de la Universidad NUR), 16 km SW de Buena Vista, 17°36'S, 63°36'W, 432 m, 1 Oct 1996, *M. Saldias P. 4775* (NY, USZ). BRAZIL. Acre: Tarauacá, 1–3 km east of Rio Tarauacá, 24 Sep 1968, *G.T. Prance 7513* (K, INPA, MG, MO, NY). Amazonas: Envira, Rio Juruá, Basin of Rio Juruá, near mouth of Rio Embira, 7°30'S, 70°15'W, 160 m, 28 Jun 1933, *B.A. Krukoff 5046* (MICH, MO, NY, US). Mato Grosso: Barra do Bugres, Fazenda Ochsenfeld, 23 Oct 1995, *G. Hatschbach 63777* (MBM, SPF).

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