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COLUMNNEA BLANCOI (GESNERIACEAE),
A NEW SPECIES FROM THE CENTRAL PACIFIC REGION OF COSTA RICA

JOSÉ ESTEBAN JIMÉNEZ,^{1,2,5} ISLER F. CHINCHILLA,^{2,3} AND RICARDO KRIEBEL⁴

Abstract. We describe and illustrate a new species of *Columnnea* from the Central Pacific region of Costa Rica. *Columnnea blancoi* sp. nov. is morphologically similar to *Columnnea canarina*, from Panama which it can be distinguished by having stems that are flaky and sericeous distally, ovate bracts, entire, green and shorter calyx lobes, yellow corolla that is glandular-pilose externally, with a marginal purple-red line 1–2 mm wide on all lobes internal and externally, and a shorter ventral corolla lobe and style. A taxonomic description, illustrations, a distribution map, conservation status, and comments on how *C. blancoi* differs from other morphologically related species are provided.

Keywords: *Columnnea canarina*, *Columnnea lariensis*, Endemism, Premontane Forest, Fila Costeña, Zona de Los Santos

Resumen. Describimos e ilustramos una nueva especie de *Columnnea* de la región del Pacífico Central de Costa Rica. *Columnnea blancoi* sp. nov. es morfológicamente similar a *Columnnea canarina*, de Panamá la que se distingue por tener tallos escamosos y sericeos distalmente, brácteas ovadas, los lóbulos del cáliz enteros, verdes y más cortos, la corola amarilla, glandular-pilosa externamente y con una línea rojo-púrpura marginal de 1–2 mm de ancho en todos los lóbulos interna y externamente, y el lóbulo ventral de la corola y el estilo más cortos. Además, se proporciona su descripción taxonómica, ilustración, mapa de distribución, estado de conservación y comentarios de cómo difiere *C. blancoi* de especies morfológicamente relacionadas.

Palabras claves: *Columnnea canarina*, *Columnnea lariensis*, Endemism, Premontane Forest, Fila Costeña, Zona de Los Santos

Gesneriaceae is the third largest family in the order Lamiales with around 3400 species (Stevens, 2001; Weber et al., 2013). It is divided into subfamilies Coronantheroideae, Cyrtandroideae, and Gesnerioideae, the latter of which encompasses most of the New World species (Weber et al., 2013). Gesnerioideae is itself subdivided into five tribes, of which Beslerieae and Gesnerieae account for most of the species. Gesnerieae includes the species rich genus *Columnnea* L., in which new species continue being described, particularly from Colombia and Ecuador (Amaya-Márquez et al., 2015; Clark et al., 2021; Smith et al., 2013b; Tobar et al., 2022).

Columnnea comprises more than 200 species ranging from Mexico through Central and South America, and the Antilles (Clark et al., 2020). Species in the genus have mostly red or yellow flowers that are pollinated exclusively by hummingbirds (Serrano-Serrano et al., 2017). In addition, *Columnnea* can be distinguished by its epiphytic habit and berry fruits and is very diverse in morphology, with variation in whether plants are erect or pendant,

bear isophyllous or anisophyllous leaves with or lacking markings, as well as variation in corolla shape and color. Morphological and molecular phylogenetic studies have started to elucidate the relationships within the genus testing previous sectional classifications (Smith, 1994; Smith and Sytsma, 1994a; 1994b; 1994c; Smith et al., 2013b).

In this study, we propose a new species of *Columnnea* from Costa Rica, another rich country for this genus. The new taxon is known from the Central Pacific slope, in the Zona de Los Santos region (Cordillera de Talamanca), which has high endemism, and in the north of the Fila Costeña. Unfortunately, the Zona de Los Santos has been slowly deforested to cultivate coffee plantations in the last decades (Fig. 1). Despite this, new endemic plant species have recently been found and described in this region, which is now threatened by the expansion of coffee plantations (Estrada and Santamaría, 2010; Jiménez et al., 2016; Morales, 2018a; 2018b; Cedeño et al., 2020; Jiménez and Hidalgo-Mora, 2021; Juárez and Morales, 2021).

MATERIALS AND METHODS

This study was based on fieldwork performed in 2022, and all specimens prepared were deposited at CR and USJ. Measurements were taken from fresh material and one previously collected herbarium specimen. The illustrations were digitized and diagrammed in a composite plate using

Adobe Photoshop CS6[®] and the drawing was digitally delineated and shaded with an Apple Pencil[®] in Procreate application for iPad Pro[®] tablet (Apple Inc.). *Columnnea* specimens of CAS, CR, MO, PMA, and USJ herbaria were examined physically. The type material of the species

The authors thank Rafael Acuña, Jeffrey Flores, and Daniel González for their support during fieldwork, and to Santiago Parra Chacón, owner of Rancho Tinamú, for informing us of the common name of this species. We are grateful to the staff of CR, MO, PMA, SCZ, and USJ for their kind help during visits to their respective collections. We thank Darha Solano who prepared the drawing used here. John L. Clark (SEL) kindly shared photos of some *Columnnea* species and his previous impressions that improved the manuscript.

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FIGURE 1. Habitat at the type locality of *Columnnea blancoi* J.E. Jiménez, Chinchilla & Kriebel in Zona de Los Santos region, showing the alteration of the natural habitat as a result of the human settlements and the expansion of coffee plantations.

of *Columnnea* most morphologically similar to the new taxon were studied through digital images available in the JSTOR repository (<https://www.jstor.org>). Herbarium acronyms follow Thiers (2022). Terminology for vegetative and reproductive structures follows Kriebel (2010) and Tovar et al. (2002). Morphological characters used in Table 1 were extracted from Kriebel (2010).

The locations of the specimens examined were classified according to the Holdridge life zone system (Holdridge, 1967). The phenology was determined from the examination of herbarium specimens and their labels. A map was prepared

using the QGIS 3.8 Zanzibar program (QGIS Development Team, 2019), based on a satellite image of the year 2000 from NASA's Jet Propulsion Laboratory, National Imagery and Mapping Agency of the U.S. The conservation status of each species was assessed according to the methodology of the International Union for Conservation of Nature (IUCN, 2019). The Extent of Occurrence (EOO) and Area of Occupancy (AOO) were estimated based on the studied specimens using geographical data with the Geospatial Conservation Assessment Tool (GeoCAT, Royal Botanic Gardens, Kew: <http://geocat.kew.org>).

TAXONOMY

Columnnea blancoi J.E. Jiménez, Chinchilla and Kriebel, *sp. nov.*

TYPE: COSTA RICA. San José, Tarrazú, San Lorenzo, San Joaquín, bosque secundario, 1250 m, 9°35'28.41"N, 83°59'40.20"W, 22 September 2022 (fl), J. E. Jiménez 6500 (Holotype: USJ, isotype: CR). Fig. 2–3.

Similar to *Columnnea canarina* Wiehler because of its anisophyllous leaves, larger leaf blade with a red to deep purple red or fuchsia red spot abaxially, and pubescent yellow corolla, but differs in having flaky stems, sericeous

distally (vs. not flaky, completely sericeous), ovate floral bracts (vs. lanceolate), entire and green calyx lobes, 1.1–2.3 cm long (vs. serrate, yellow, 2.5–3.6 cm long), with a marginal purple-red line of 1–2 mm wide on all corolla lobes, glandular-pilose externally (vs. without marginal purple-red line, eglandular-pilose), shorter ventral lobe (1.0–1.3 cm vs. 1.9 cm), and shorter style (3.4–5.3 cm vs. 6.2 cm).

Epiphytic *herb* up to 2.0 m tall. *Stems* terete, branched with shoots to 1.5–1.9 m long, 0.7–1.6 cm in diameter, flaky, sericeous distally to glabrescent with age; internodes 1.5–

TABLE 1. Morphological differences between *Columnnea blancoi* and *C. canarina*, and the four most similar species present in Costa Rica.

CHARACTER	<i>C. BLANCOI</i>	<i>C. CANARINA</i>	<i>C. LARIENSIS</i>	<i>C. MACULATA</i>	<i>C. VERECUNDA</i>
Stem	Flaky, sericeous distally	Smooth, sericeous	Not flaky, villous	Flaky, pilose	Flaky, sericeous distally
Large leaf blade shape dimensions (cm)	6.4–16.5 × 1.9–5.0	12–20 × 4.0–5.5	8.5–15 × 1.6–3.0	17–26 × 6.0–9.5	6.0–12.5 × 1.4–3.0
Abaxial surface of the larger leaf blade	Irregular red to deep purple-red or fuchsia red spot covers the apex or up to the apical third	Light green with dark red tips and sometimes additional red spotting below	Irregular red spot in the apex or up to half of the blade	Irregular red spot in the apex or up to the apical third	Irregular red to fuchsia red spot covers the apex, or light purple to green purplish in all its extension
Number of flowers per inflorescence	1–4	1–4	1–3	1–3	1–5
Calyx lobe shape	Ovate to ovate-lanceolate	Lanceolate-elliptic	Oblong to obovate	Lanceolate	Lanceolate to linear-lanceolate
Calyx lobe margin	Entire	Serrate	Denticulate to lobulate	Fimbriate	Entire
Calyx color	Green	Yellow	Unknown	Green to purple greenish	Green with the purple apex to purple
Corolla indument	Glandular-pilose	Eglandular-pilose	Villose	Sericeous	Sericeous
Corolla color	Yellow with a marginal purple-red line of 1–2 mm wide on all lobes	Yellow	Yellow	Yellow with longitudinal purple lines and irregular spots	Usually yellow to red or pinkish
Distribution	720–1500 m, Central Pacific of Cordillera de Talamanca (Zona de Los Santos) and north of Fila Costeña, Costa Rica	1000–1400 m, Caribbean Watershed of Cordillera de Talamanca (Fortuna Dam site, Chiriquí, Panama)	1300–1500 m, Caribbean Slope, Cordillera de Talamanca (cuenca Río Lari), Costa Rica	100–900 m, Caribbean Slope, Cordillera Volcánica Central and Cordillera de Talamanca, Costa Rica, and Panama	550–1650 m, Caribbean and Slope of Cordilleras Guanacaste, Tilarán, Central and E Talamanca, Costa Rica

3.5 cm long near the base, then 0.5–1.3 cm long clustered at branch apex. *Leaves* opposite, strongly anisophyllous with age, isophyllous when seedling and young; petioles terete, 0.2–0.9 mm long, sericeous; larger blade oblong to oblanceolate, 6.4–16.5 × 1.9–5.0 cm, basally obliquely rounded, apically acute to acuminate, coriaceous, adaxially green, slightly sericeous to glabrescent, abaxially light green or whitish green to light purple red with irregular red to deep purple red or fuchsia red spot, that covers the apex or up to the apical third, sericeous; margin entire shallowly and remotely crenate, ciliate; veins adaxially impressed, glabrescent, abaxially raised, sericeous, light-green to pinkish or light purple red, lateral veins 5–7; smaller blade linear, sessile, 0.4–2.7 × 0.2–1.1 cm, sericeous, adpressed to the stem and sometimes deciduous. *Inflorescences* axillary,

reduce cyme of 1–4 flowers; bracts ovate, acuminate, 0.2–1.1 cm, long sericeous, deciduous; pedicels terete, 0.4–1.7 cm long, sericeous. *Calyx* clasping, 5-lobed, erect, green, white-sericeous, with abaxially raised main vein; lobes ovate to lanceolate, obtuse to acuminate, 1.1–2.3 cm long, entire. *Corolla* funnel-shaped, 5.2–6.7 cm long, erect, zygomorphic, gibbous at the base, yellow with a marginal purple-red line of 1–2 mm wide on all lobes, sparsely glandular-pilose internally, densely glandular-pilose externally; tube 2.9 a 4.1 cm long, 0.35–0.60 cm wide proximally, 0.5–0.7 cm wide distally, the mouth of the tube ca. 0.5–0.8 cm in diameter; limb bilabiate, upper limb with two fused dorsal lobes and two lateral lobes, lower limb with an extended ventral lip; dorsal lobes connate, concave, subquadrate with a small rounded apiculum at the

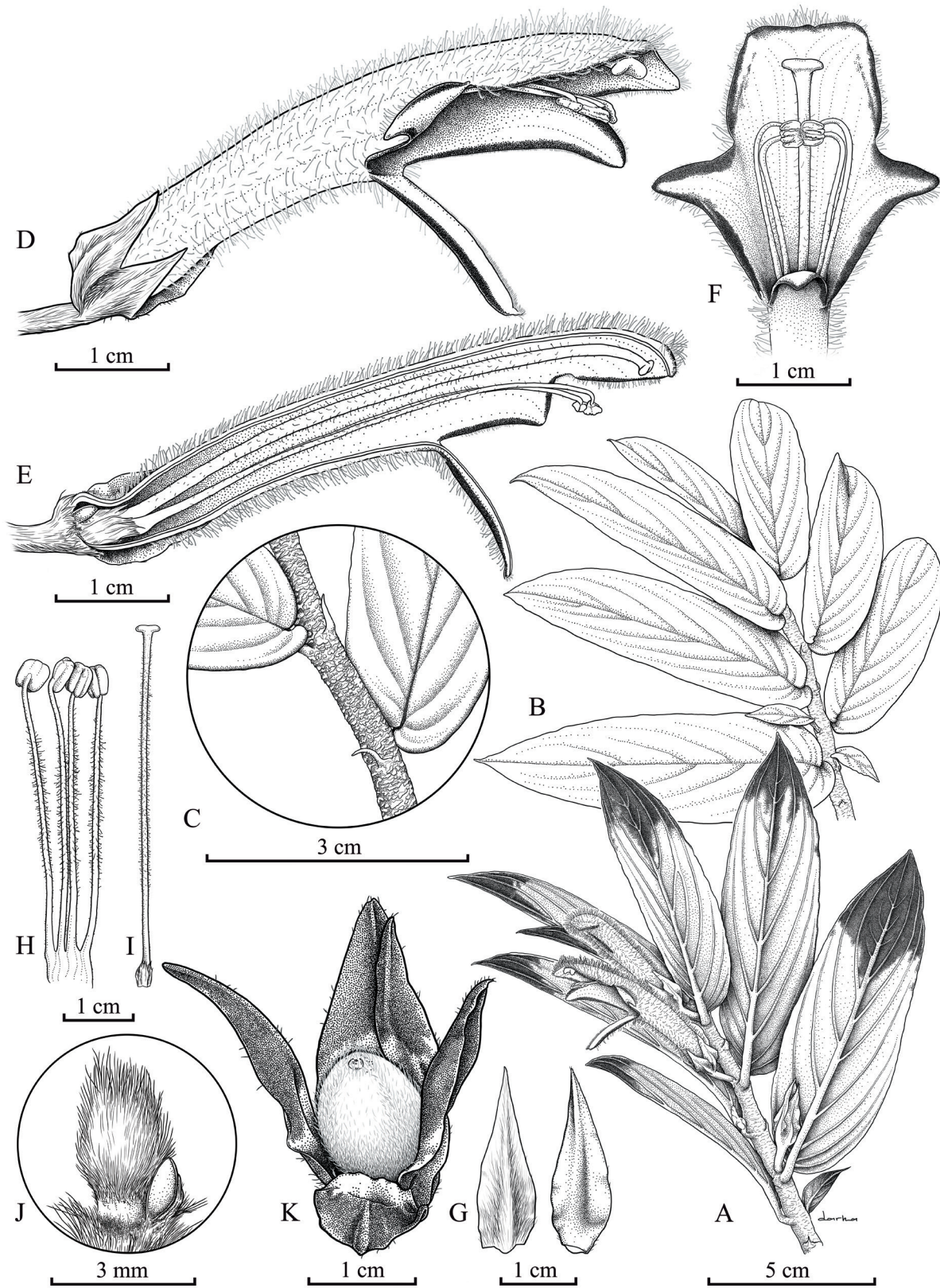


FIGURE 2. *Columnea blancoi* J.E. Jiménez, Chinchilla & Kriebel. A–B, Leaves and flowers in their natural position in abaxial (A) and adaxial (B) surfaces. Note the irregular red to fuchsia red spot on the abaxial surface; C, Close-up of the flaky stems and the linear smaller blade shape; D, Close-up of the flower. Note the glandular-pilose indument externally, and the marginal purple line in all corolla lobes; E, Lateral dissected view of the corolla; F, Ventral view of the flower distally; G, Abaxial (right) and adaxial (left) view of the sepals; H, Stamens; I, Pistil; J, Ovary (left) and nectary gland (right); K, Fruit with the marcescent calyx. Drawing based on live specimens of *J. E. Jiménez* 6500 and *J. E. Jiménez et al.* 6576 (USJ).



FIGURE 3. *Columnnea blancoi* J.E. Jiménez, Chinchilla & Kriebel. **A**, Anisophyllous leaves; **B**, Close-up of the flaky stems and the linear smaller blade shape; **C**, Leaves and flowers in their natural position; **D**, Abaxial surface of the larger leaf blade with the irregular red to fuchsia red spot; **E**, Ventral view of the flower. Note the indument and the marginal purple line in all corolla lobes; **F**, Calyx and the close-up of the glandular-pilose indument on the corolla; **G**, Laterally dissected flower; **H**, Fruit and the marcescent calyx; **I**, A juvenile individual with isophyllous leaves. Photos based on live specimens of *J. E. Jiménez*; 6500 and *J. E. Jiménez et al.* 6576 (USJ).

apex, 1.2–1.5 × 1.0–1.4 cm; lateral lobes triangular, 0.3–0.9 × 0.2–0.7 cm, incurved; ventral lobe narrowly oblong, ca. 1.0–1.3 × 0.2–0.7 cm, recurved. *Stamens* 4; filaments connate at the base, 0.2–0.6 cm long, free ca. 3.8–4.7 cm long, white, pilose-glandular anthers ca. 0.3 × 0.2 cm, not included in the corolla throat, dehiscing by longitudinal slits, fused. *Pistil* 1; ovary ca. 0.3 mm long, conical, densely sericeous; style 3.4–5.3 cm long, white, pilose-glandular stigma bilobed, papillate, green, included in the corolla tube; nectary a bilobed dorsal gland, light green. *Fruits* a berry, subglobose to ovate, 0.9–1.2 cm in diameter, green when immature, pilose to sericeous, with marcescent red calyx. Mature fruit and seeds unknown.

Distribution and habitat: Currently known only from the Central Pacific slope of Costa Rica where it grows at

720–1500 m of elevation. It has been collected in the Zona de Los Santos region (Cordillera de Talamanca), specifically San Lorenzo de Tarrazú, and Sukia de Dota, and north of the Fila Costeña, in Dos Bocas de Quepos, near the border of the provinces of Puntarenas and San José (Fig. 4). It inhabits the primary and secondary forest in the premontane pluvial forest.

Phenology: Plants have been collected flowering in March, April, October to December, and bearing fruits in May.

Eponymy: The specific epithet honors the Costa Rican botanist and professor Mario Alberto Blanco Coto, who is a professor at the University of Costa Rica (UCR). Professor Blanco has contributed to the study of neotropical flora, has taught botany courses at the UCR and the Organization for

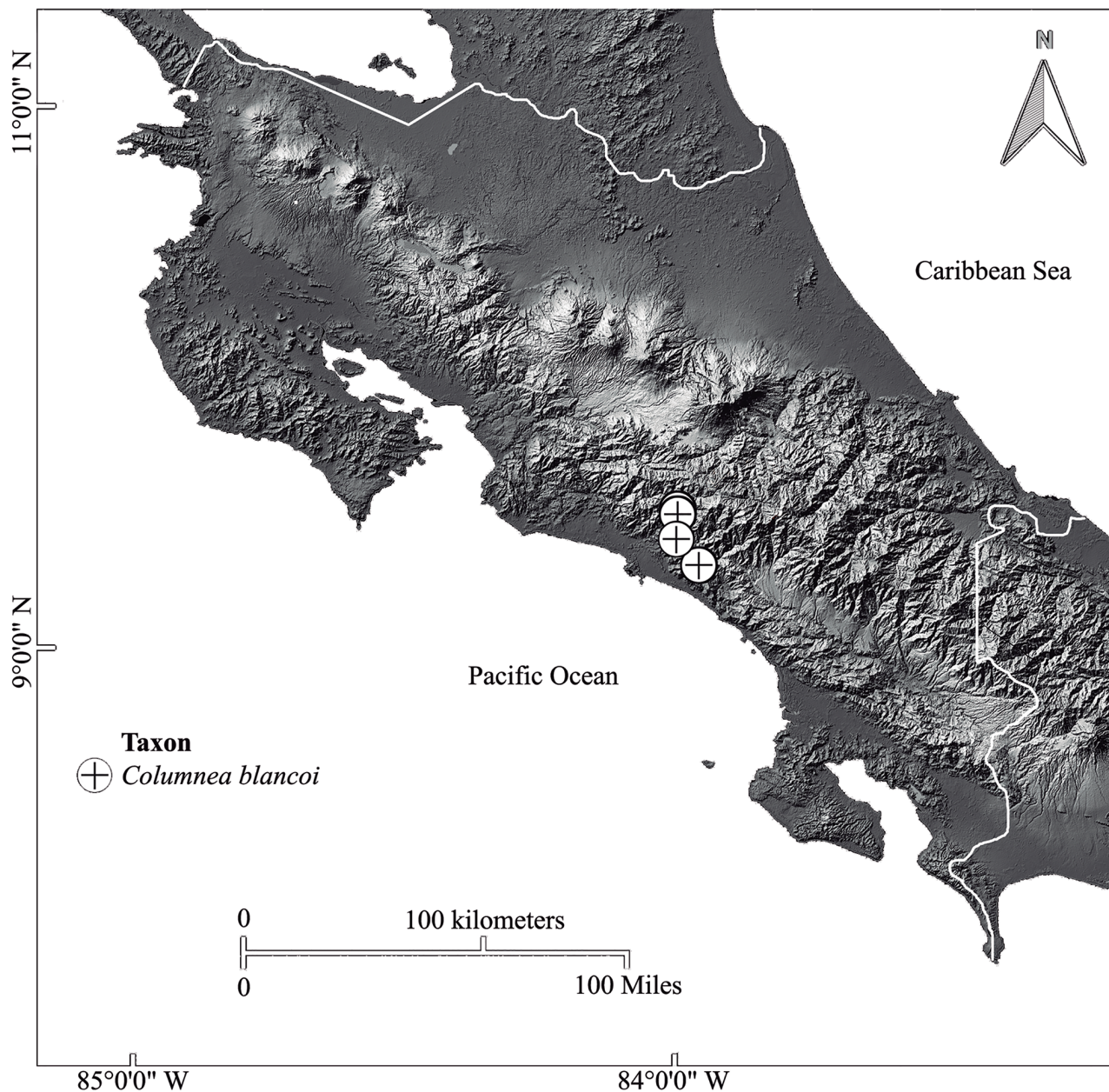


FIGURE 4. Distribution of *Columnea blancoi* J.E. Jiménez, Chinchilla & Kriebel based on herbarium specimens.

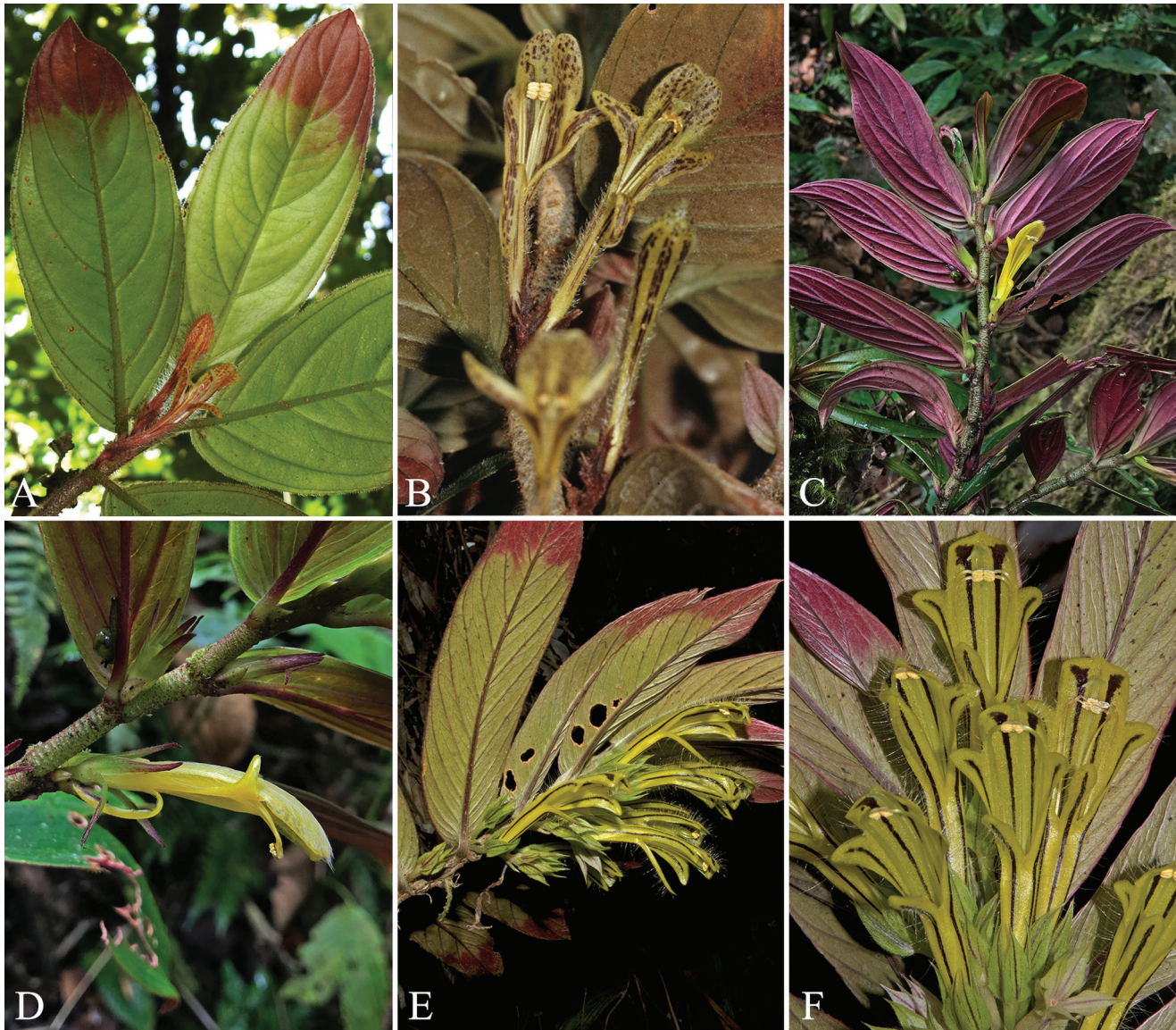


FIGURE 5. Three morphologically similar species of *Columnnea blancoi* J.E. Jiménez, Chinchilla & Kriebel in Central America; **A–B**, *Columnnea maculata* C.V. Morton: **A**, from Costa Rica (J. E. Jiménez 6692, USJ), and **B**, from Panamanian Caribbean (L. E. Skog and S. S. Hodapp 5438, US); **C–D**, *Columnnea verecunda* C.V. Morton (J. E. Jiménez et al. 4357, USJ); **E–F**, *Columnnea zebrina* Raymond (J. L. Clark 12601, US).

Tropical Studies (OTS), and is one of the most influential mentors of the new generations of botany students in the country.

Vernacular name: Known as “panza de mono,” monkey belly.

Conservation status: *Columnnea blancoi* is endemic to Costa Rica, known from three locations in the Central Pacific. Its extent of occurrence (EEO) was estimated at 23.372 km² with an area of occupancy (AOO) of 16 km². The species is known from two disturbed localities by deforestation in the Los Santos Forest Reserve, and the third location at the forest edge in the Fila Costeña outside protected wilderness areas. Currently, its populations are threatened by fragmentation and habitat loss caused by deforestation, and the expansion of human settlements, livestock, and coffee plantations. Further studies on the ecology and population size of this species are required to

promote its long-term conservation. Therefore, the species is listed as Endangered (EN) under criteria B1ab(i, ii)+2ab (i, ii).

Additional Specimens Examined: COSTA RICA. San José: Dota, Santa María, Reserva Forestal Los Santos, Sukia, a la orilla de la calle frente a la Escuela de Sukia, 9°29'37.34"N, 83°58'30.58"W, 720 m, 2 November 2022 (fl), I. Chinchilla 4776 (CR, USJ); Tarrazú, San Lorenzo, 1 km antes de llegar al puente sobre el río Naranjillo, viniendo desde Santa Marta, 9°35'28.36"N, 83°59'40.24"W, 1250 m, 3 April 2022 (fl), J. E. Jiménez and J. Flores 6415 (USJ); Tarrazú, San Lorenzo, San Joaquín, 9°34'45.35"N, 83°59'34.11"W, 1417 m, 22 April 2022 (fl), J. E. Jiménez 6490 (USJ); Tarrazú, San Lorenzo, San Joaquín, 9°35'28.41"N, 83°59'40.20"W, 1250 m, 21 May 2022 (fr), J. E. Jiménez et al. 6576 (USJ); Tarrazú, San Lorenzo, Cerro El Milagro, entrando por San Joaquín de Tarrazú, sobre carretera a mano izquierda antes

de llegar a la escuela, 9°34'45.35"N, 83°59'34.11"W, 1417 m, 26 December 2022 (fl), *J. E. Jiménez and M. F. Cordero 6766* (USJ). Puntarenas: Aguirre [Quepos], Savegre, Dos Bocas, Finca Las Filipinas, propiedad de Adolfo Chinchilla, 9°24'13.54"N, 83°55'7.72"W, 935 m, 18 April 2013 (fl), *I. Chinchilla 283* (CR).

Columnnea blancoi is recognized by its flaky stems that are sericeous distally, anisophyllous leaves, the larger leaf blade with a red to deep purple-red or fuchsia red spot distally abaxially, the calyx lobes ovate, green, and entire, and the corolla yellow with a marginal purple-red line of 1–2 mm wide on all lobes with glandular-pilose indument externally. This new species is similar to *C. canarina*, and apart from the morphological characteristics mentioned in the diagnosis, there is marked allopatry between the two species. *Columnnea blancoi* grows in the Central Pacific slope of Costa Rica in the Cordillera de Talamanca and the north of the Fila Costeña, whereas *C. canarina* is found in the Caribbean Slope of Panama in the Cordillera de Talamanca, specifically in Fortuna Dam site (Table 1).

Columnnea blancoi is also similar to *Columnnea lariensis* Kriebel, but differs from the latter in having flaky stems and sericeous distally (vs. not flaky, villous), the calyx lobes ovate and entire (vs. oblong to obovate and denticulate to lobulate), and the corolla yellow with a marginal purple-red line of 1–2 mm wide in all lobes (vs. yellow without purple-red line), and glandular-pilose externally (vs. glabrous to villose). In addition, the larger leaf blade of *Columnnea blancoi* is oblong to oblanceolate with an irregular red to deep purple-red or fuchsia red spot covers the apex or up to the apical third, while those in *C. lariensis* have elliptic to oblong or oblanceolate with an irregular red spot in the apex or up to half of the blade. There is marked allopatry between the two species. *Columnnea blancoi* grows in the Pacific slope of the Cordillera de Talamanca, whereas *C. lariensis* inhabits in the Caribbean slope of the same range.

Due to the irregular red to deep purple red or fuchsia red spot covering the apex of the abaxial surface of the larger blade and the yellow corolla, *Columnnea blancoi* may also be confused with *Columnnea maculata* C. V. Morton and *C. zebrina* Raymond. It differs from *C. maculata* by having a smaller leaf blade of 6.4–16.5 × 1.9–5.0 cm (vs. 17–26 × 6–9.5), calyx lobes ovate to ovate-lanceolate with an entire margin and green (vs. lanceolate, fimbriate, and green to purple greenish), corolla glandular-pilose with a marginal purple line of 1–2 mm wide in all lobes (vs. sericeous with longitudinal purple lines and irregular spots), and distributed in the Central Pacific of Cordillera de Talamanca (Zona de Los Santos) and north of Fila Costeña between 720–1500 m (vs. Caribbean Slope of Cordillera Volcánica Central and Cordillera de Talamanca between 100–900 m) (Table 1). From the allopatric Panamanian species *C. zebrina* differs notably by having the purple line of the corolla restricted to the margin, whereas *C. zebrina* has four purple lines running longitudinally within the surface and never on the margins (Fig. 5).

Lastly, *Columnnea blancoi* also resembles *C. verecunda* C. V. Morton due to its similar leaf size and number of lateral veins, entire calyx lobes, and the usually yellow corolla (Fig. 5). However, *C. blancoi* differs because of its inflorescence with a solitary flower (vs. 1–5), the ovate to ovate-lanceolate, green calyx lobes (vs. lanceolate to linear-lanceolate, green with the purple apex to purple), the yellow corolla with pilose-glandular trichomes (vs. yellow, red or pinkish and sericeous), the corolla lobes with a marginal purple-red line of 1–2 mm wide in all lobes (vs. without any marginal purple-red line), and being distributed in Central Pacific of Cordillera de Talamanca (Zona de Los Santos) and north of Fila Costeña between 720–1500 m (vs. Caribbean Slope of Cordilleras de Guanacaste, Tilarán, Central and E Talamanca between 550–1650 m) (Table 1).

LITERATURE CITED

- AMAYA-MÁRQUEZ, M., L. CLAVIJO, AND O. H. MARÍN-GÓMEZ. 2015a. *Columnnea longipedicellata* a new species of Gesneriaceae from Colombia. *Phytotaxa* 217: 273–278. DOI: 10.11646/phytotaxa.217.3.4
- AMAYA-MÁRQUEZ, M., L. E. SKOG, AND L. P. KVIST. 2015b. Two new species and two new varieties of *Columnnea* (Gesneriaceae). *Caldasia* 37: 233–250. DOI: 10.15446/caldasia.v37n2.53616
- CEDENO M., M. H. GRAYUM, T. CROAT, AND M. A. BLANCO. 2020. Three new species of *Monstera* (Araceae: Monsteroideae: Monstereae) from the Cordillera de Talamanca in Costa Rica, threatened by the expansion of coffee plantations. *Nordic Journal of Botany* 38(12): 1–13. DOI: 10.1111/njb.02970
- CLARK J. L., L. E. SKOG, J. K. BOGGAN, AND S. GINZBARG. 2020. Index to names of New World members of the Gesneriaceae (Subfamilies Sanangoideae and Gesnerioideae). *Rheedeia* 30: 190–256. DOI: 10.22244/rheedeia.2020.30.01.14
- CLARK J. L., F. TOBAR, L. CLAVIJO, M. PERRET, AND C. H. GRAHAM. 2021. Three new species of *Columnnea* (Gesneriaceae) from the western Andean slopes of Ecuador and Colombia. *PhytoKeys* 182: 67–82. DOI: 10.3897/phytokeys.182.69016
- ESTRADA, A. AND D. SANTAMARÍA. 2010. Una nueva especie de *Fevillea* (Cucurbitaceae, Zanonieae) de Costa Rica. *Journal of the Botanical Research Institute of Texas* 4: 45–49.
- HOLDRIDGE, L. R. 1967. *Life Zone Ecology*. Tropical Science Center, San José.
- IUCN STANDARDS AND PETITIONS COMMITTEE. 2019. Guidelines for Using the IUCN Red List Categories and Criteria, Version 14. Prepared by the Standards and Petitions Committee of the IUCN Species Survival Commission. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed September 22, 2022)
- JIMÉNEZ, J. E., P. JUÁREZ, AND J. M. CHAVES-FALLAS. 2016. *Cupania moralesii* (Sapindaceae), a new endemic tree species from the premontane forest of Costa Rica. *Phytotaxa* 275: 69–74. DOI: 10.11646/phytotaxa.275.1.8
- JIMÉNEZ, J. E. AND J. HIDALGO-MORA. 2021. *Matelea tarrazuana* (Apocynaceae, Asclepiadoideae), a new critically endangered ocellate species from Central Pacific of Costa Rica. *Webbia* 76: 213–220. DOI: 10.36253/jopt-10804
- JUÁREZ P. AND J. F. MORALES. 2021. *Pleurothyrium amissum* (Lauraceae), A New Endemic Tree from the Talamanca Montane Forest in Costa Rica. *Novon* 29: 78–84. DOI: 10.3417/2021655
- KRIEBEL, R. 2010. Gesneriaceae. Pages 841–930 in B. E. HAMMEL, M. H. GRAYUM, C. HERRERA AND N. ZAMORA, EDs., *Manual de plantas de Costa Rica 5. Dicotiledóneas*. Monographs in Systematic Botany from the Missouri Botanical Garden Vol. 119: 1–937. St. Louis: Missouri Botanical Garden Press.

- MORALES, J. F. 2018a. New species and combinations of Apocynaceae, Bignoniaceae, Clethraceae, and Cunoniaceae from the Neotropics. *Anales del Jardín Botánico de Madrid* 75: e071. DOI: 10.3989/ajbm.2499
- . 2018b. Una nueva especie y notas de las Proteaceae en Costa Rica. *Journal of the Botanical Research Institute of Texas* 12: 81–88. DOI: 10.17348/jbrit.v12.i1.915
- QGIS DEVELOPMENT TEAM. 2019. QGIS Geographic Information System. Open Source Geospatial Foundation Project. Retrieved from: <http://qgis.osgeo.org> (accessed September 20, 2022).
- SERRANO-SERRANO M. L., J. ROLLAND, J. L. CLARK, N. SALAMIN, AND M. PERRET. 2017. Hummingbird pollination and the diversification of angiosperms: an old and successful association in Gesneriaceae. *Proceedings of the Royal Society London B* 284: 20162816. DOI: 10.1098/rspb.2016.2816
- SMITH, J. F. 1994. Systematics of *Columnnea* section *Pentadenia* and section *Stygnanthe* (Gesneriaceae). *Systematic Botany Monographs* 44: 1–89.
- . AND K. J. SYTSMA. 1994a. Evolution in the Andean epi-phytic genus *Columnnea* (Gesneriaceae). I. Morphological Variation. *Systematic Botany* 19: 220–235.
- . AND K. J. SYTSMA. 1994b. Evolution in the Andean epiphytic genus *Columnnea* (Gesneriaceae). II. Chloroplast DNA restriction site variation. *Systematic Botany* 19: 317–336.
- . AND K. J. SYTSMA. 1994c. Molecules and morphology: Congruence of data in *Columnnea* (Gesneriaceae). *Plant Systematic and Evolution* 193: 37–52.
- . M. T.-Y. OOI, L. J. SCHULTE, M. AMAYA-MÁRQUEZ, R. PRITCHARD, AND J. L. CLARK. 2013a. Searching for monophyly in the subgeneric classification systems of *Columnnea* (Gesneriaceae). *Selbyana* 31: 126–142.
- . M. AMAYA-MÁRQUEZ, O. H. MARÍN-GÓMEZ, AND J. L. CLARK. 2013b. Four new species of *Columnnea* (Gesneriaceae) with primary distributions in Colombia. *Journal of the Botanical Research Institute of Texas* 7: 667–679.
- . M. T.-Y. OOI, AND J. L. CLARK. 2018. Incipient speciation in a Neotropical Gesneriaceae: *Columnnea kuczyniakii* is nested within *C. strigosa*. *Plant Systematics and Evolution* 304: 511–519. DOI: 10.1007/s00606-018-1502-7
- STEVENS, P. F. 2001 onwards. Angiosperm Phylogeny Website. Version 14, July 2017 (accessed October 22, 2022)
- THIERS, B. 2022 (continuously updated). Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at <http://sweetgum.nybg.org/ih> (accessed October 22, 2022)
- TOBAR, F., J. F. SMITH, AND J. L. CLARK. 2022. Two new pendulous epiphytic *Columnnea* L. (Gesneriaceae) species from the Chocó forests of the Northern Andes. *PhytoKeys* 196: 49–61. DOI: 10.3897/phytokeys.196.79673
- WEBER, A., J. L. CLARK, AND M. MÖLLER. 2013. A new formal classification of Gesneriaceae. *Selbyana* 31: 68–94.