A NEW SPECIES OF *CEDRELA* (MELIACEAE) FROM A COLOMBIAN DRY FOREST AND AN UPDATED KEY FOR THE SPECIES OF THE GENUS

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Abstract. A new species of cedar (*Cedrela gonzalopalominoi)* is described and illustrated, and its morphological relationships with other similar species are discussed. *C. gonzalopalominoi* is found in dry forest remnants in the Western Andean foothills and on the slopes of the Central Cordillera of Colombia. This is a region composed of low hills and plains systems inside inter-Andean valleys in the upper Magdalena River in the Department of Tolima. The new species is a tree up to 20 m tall and shares features with two species, *C. odorata* and *C. weberbaueri*. However, it can be distinguished by the leaflet numbers, pubescence, size and shape, inflorescences, pedicels, calyx, fruit size, and corolla lobes that are short pilose externally and fused to the androgynophore from the middle up. A morphological description, taxonomic comments, an illustration, and information about its current conservation status are presented. An updated key of 21 neotropical species of *Cedrela* is provided.

Keywords: Dry forest, inter-Andean valleys, upper Magdalena River, timber species, CITES, *Cedrela*, Meliaceae

Resumen. Una nueva especie de cedro (*Cedrela gonzalopalominoi*) es descrita, ilustrada y sus relaciones morfológicas con sus especies afines son discutidas. *C. gonzalopalominoi*, se encuentra en remanentes de bosques secos sobre pendientes y pie de monte del sector occidental de la Cordillera central de Colombia. Esta región posee un sistema de lomeríos y planicies situadas en los valles interandinos, en el alto río Magdalena, departamento del Tolima. Esta nueva especie es un árbol de hasta 20 m de altura, que presenta similitudes morfológicas con dos especies (*C. odorata* y *C. weberbaueri*). Sin embargo, se distingue de estas especies en el número, pubescencia, tamaño y forma de los folíolos, en el tamaño de las inflorescencias, pedicelos, calíz y frutos, los lóbulos de la corola son pilosos externamente, los cuales están fusionados al androginóforo arriba de la mitad. Se presenta una descripción morfológica, comentarios taxonómicos, una ilustración e información acerca de su estado actual de conservación. Se incluye una clave de las 21 especies de *Cedrela* presentes en el Neotrópico.

Palabras clave: Bosques secos, valles interandinos, alto río Magdalena, especies maderables, CITES, *Cedrela*, Meliaceae

Cedrela P. Browne (Meliaceae) is a genus endemic to the Neotropics, found from 22 degrees north latitude in Mexico through Central America, Colombia, Venezuela, Guianas, Ecuador, Perú, Brazil, Bolivia, Paraguay, and Argentina (Pennington and Muellner, 2010; Muellner et al., 2010). The genus has 21 species, including the new species described herein. It is an important timber tree genus in Meliaceae, a pantropical family, that comprises trees and shrubs that are widely distributed throughout the tropics and subtropics, and occasionally in temperate zones (Muellner-Riehl and Rojas-Andrés, 2022). This family includes ca. 740 species in 58 genera, of which eight genera and ca. 202 species are present in the Neotropics (Muellner-Riehl and Rojas-Andrés, 2022). A great number of taxa occur in rain forests, with some species extending to seasonally dry forests and mangrove swamps (Pennington et al., 1981). Ten genera (two cultivated: *Azadirachta* A. Juss. and *Melia* L.) and ca. 80 species are found in Colombia (Bernal, 2016).

Recent phylogenetic studies support the monophyly of *Cedrela* and *Toona* (Endl.) M. Roem. Both taxa belong to the tribe *Cedreleae* DC. (also monophyletic), subfamily *Cedreloideae* Arn. (Muellner et al., 2003, 2009; Pennington and Muellner, 2010). Genetic and morphological differences are supported by the geographical disjunction of the genera, with *Cedrela* confined to the Neotropics and *Toona* occuring in Indo-Malasya and Australia (Koenen et al., 2015).

Cedrela is characterized, and differs from the other Meliaceae genera, by its five free stamens adnate to an androgynophore, which is adnate to the petals in its lower half by a central adaxial keel. The genus is also characterized by its alternate and paripinnate leaves, deeply fissured bark on the trunk (except in *C. kuelapensis* T.D. Penn. & Daza),

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fruit a septifragal capsule, lenticelate, loculi multiovulate, and seeds with a thin papery wing below, attached to the distal end of the columella (Pennington and Styles, 1975; Pennington et al., 1981; Mabberley, 2011).

Pennington et al. (1981) published a revision of *Cedrela*, and, subsequently, Pennington and Muellner (2010) presented a full monographic treatment of the genus with extensive morphological and molecular data, accompanied by data from new fieldwork. As a result, the genus was separated into four clades that formed genetically distinct units, and 17 species were recognized, four of which were new to science. Two of the 17 species (*C. odorata* L. and *C. fissilis* Vell.) are very variable lowland species, occurring in both rain forests and dry forests, with local ranges scattered through Central and South America (Pennington and Muellner, 2010; Cárdenas-López et al., 2022).

These results provided evidence indicating that three genetically distinct entitites in *C. odorata* were not separated morphologically. These entities are morphologically cryptic and require a great deal more investigation to delimit their ranges (Muellner et al., 2009). Therefore, the molecular data rejected the *C. odorata* wide species concept, indicating instead that at least three species are "cryptic" under this name (Muellner et al., 2010). In addition, most *Cedrela* species have a localized distribution, which allows for delimitation of their geographical ranges. Since these contributions, three new species have been described (Köcke et al., 2015: Palacios et al., 2019, 2023).

The wood of *Cedrela* and *Swietenia* Jacq. is the most sought after and appreciated lumber in the world, mainly because of excellent properties and relative ease of cultivation in plantations (Morales-Puentes, 1997; López and Cárdenas, 2002; Muellner et al., 2009; Blanco, 2020). The Meliaceae timber species are currently catalogued as some of the most threatened species (Hills et al., 2022; published, 2023). To prevent the decline of population sizes, all *Cedrela* taxa have been incorporated into Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2021; https://cites.org/esp/node/57207). *Cedrela* is subject to overexploitation and excessive logging for domestic and international trade, habitat loss, genetic erosion, and significant illicit cutting and illegal trade (Llerena et al., 2018; Araujo-Murakami et al., 2020; Cotrina-Sánchez et al., 2021).

The present contribution increases to five the number of *Cedrela* species known from Colombia, of which three have been recorded in Colombian dry forests. In Colombia, two species, *C. odorata* (which is found in lowland forests) and *C. montana* Moritz & Turcz. (from highland areas), are the species with the highest number of records in the country's herbaria (Morales-Puentes, 1997). The new species, *C. gonzalopalominoi,* was found during fieldwork supported by the "Universidad de Tolima," while setting up permanent plots and conducting general botanical collections in dry forests located in the upper Magdalena riven basin, Tolima department, Colombia. These studies were conducted in forest remnants in one of the largest dry forest reserves (ca. 150 ha) known as "Bosque Los Limones," a region on the western edge of Magdalena River.

Materials and methods

During field work in 2017, permanent plots were established in the locality of "vereda Salto Nuevo o bosque Los Limones," Venadillo municipality, Tolima department. Specimens were collected, pressed, dried, studied, and deposited in the herbarium TOLI (herbarium codes after Thiers, 2019). The specimens of the new species were compared with the *Cedrela* collections deposited in the following herbaria: Herbario Nacional Colombiano (COL), Jardín Botánico de Bogotá (JBB), Universidad Distrital (UDBC), Instituto SINCHI (COAH), and Universidad de Tolima (TOLI). Additionally, *Cedrela* collections hosted by virtual herbaria, including those maintained by the Field Museum (F; http://emuweb.fieldmuseum.org/botany/taxonomic.php), Missouri Botanical garden (MO; http://https://tropicos.org/home), and the New York Botanical Garden (NY; https://sweetgum.nybg.org/science/vh/) were consulted. Type specimens of *Cedrela* species involved in this study were examined using online images from JSTOR Global Plants (https://plants.jstor.org/).

The new species was described from fresh and dried material. Buds and flowers were rehydrated with liquid soap dissolved in warm water to carry out dissections and measurements. Details of morphological structures were examined using a LEICA Dm750 microscope and a LEICA EZ4 HD stereoscope with Software LAS EZ v3.0 2013. Reproductive structures of the herbarium samples were rehydrated as indicated above. The quantitative characters included in the descriptions were measured using digital calipers. Data concerning the plant habit and the colors of the floral parts were derived from the labels and *in situ* observations.

The specific terminology for vegetative characters, vestiture description, inflorescences, flowers, and fruit morphology follow Font-Quer (2001), Stearn (2004), and Pennington and Muellner (2010). To determine the conservation status (IUCN, 2022), the extent of occurrence (EOO) and area of occupancy (AOO) were calculated using the supporting Red List threat assessments with GeoCAT (Bachman et al., 2011), which is continually updated (https://geocat. kew.org/). GeoCAT is an open source, browser-based tool that performs rapid geospatial analysis for Red List assessment. The EOO is defined by the IUCN (2022) as the minimum convex polygon encompassing all known occurrences of a species. Additionally, AOO is the area within the EOO, which is comprised of 2 × 2 km grid cells containing known occurrence records.

Taxonomy

Cedrela gonzalopalominoi Villanueva & M.E. Morales, *sp. nov*.

TYPE: COLOMBIA. Tolima: Venadillo, vereda Salto Nuevo o bosque Los Limones, vía hacia el Totare por Palmarosa, desvío por Los Limones, 253 m, 4°40'32.93"N; 74°49'17.61"O, 11 Octubre 2017 (fl), *Boris Villanueva Tamayo & Omar Melo 3985* (Holotype: TOLI [018963]). Fig. 1–2.

Cedrela gonzalopalominoii resembles *C. odorata* and *C. weberbaueri* Harms but can be differentiated from these species by having 2–4 pairs of leaflets, 1.6–5.8 × 2.2–10.3 cm, elliptic to ovate, (basal broadly elliptic to broadly ovate), papillate and glabrous on the lower surface, except along the midrib and the secondary veins, where they are covered by scattered yellow trichomes (ca. 0.2 mm long); inflorescences 18.0–18.5 cm long, pedicels 0.7–1.2 mm long; calyx 3.0–3.16 mm long, bell-shaped, puberulous outside, lobes triangular to ovate; corolla lobes short pilose externally, fused to the androgynophore from the middle up; fruit ellipsoid to ovoid, 3.6–3.8 cm long, apex rounded to slightly acute and base acute to rounded.

Tree up to 20 m tall, stem, branches and branchlets strongly fissured, with simple, minute trichomes, scattered to glabrescent when mature. Outer bark rough and fissured, gray to whitish. *Leaves* compound, paripinnate, 10–19 cm long, petioles 2.4–5.0 cm long, rounded, glabrous; rachis rounded to semiterete, 10–15 cm long, glabrous, petiolules ca. 1 mm long, glabrous. *Leaflets* opposite (basal subopposite), 2–4 pairs, elliptic to ovate (basal broadly elliptic to broadly ovate), 3.8–5.8 × 6.9–10.3 cm long (basal 1.6– 3.2 × 2.2–4.0 cm), membranous, yellow-green, apex acute to acuminate, base asymmetric, glabrous on the upper surface, except along the midrib and the secondary veins, where they are covered by very scattered trichomes, along the midrid and secondary veins, glabrescent when mature, weakly glossy, glabrous and papillose on the lower surface, except along the midrib and the secondary veins, where they are covered by scattered yellow trichomes (ca. 0.2 mm long), acarodomatia present on the axils of secondary veins on the lower surface, 0.2 × 0.1 mm, triangular, trichomes unbranched, elongate, hyaline; primary veins eucanthodromous, midrib flat on the upper surface and prominent on the lower surface; secondary veins 9–15 pairs (6–8 pairs in basal leaflets), flat above and prominent below, ascending, parallel; intersecondary veins conspicuous; tertiary veins reticulate. *Inflorescences* terminal, compound panicle, dense, erect, 18.0–18.5 cm long, rhachis with minute, simple trichomes, scattered to glabrous when mature. *Flowers* pentamerous, unisexual, yellow with red glands at the base of the corolla internally, onion-scented; pedicels 0.7–1.2 mm; calyx 5-merous, bell-shaped, 3.0–3.16 × 2.7–3.1 mm, fused to 3/4 of its length, membranous, with marked and irregular veins, puberulous; calyx lobes, 1.10–1.18 mm long, triangular to ovate, with irregular margin, onion-scented; petals 5, free, imbricate to imbricate-quincuncial, linear to elliptic-linear, 6.33–7.50 × 1.4–1.5 mm, white to creamy-white, pilose; trichomes short, lax, simple externally, with a middle vein, and small reticulate veins, fused to the androgynophore from the middle up; stamens 5, attached to base of ovary, free for 2/3 of length, 3.5–4.0 mm; filaments glabrous, attached to form an androgynophore; anthers oblong, 0.80–1.20 × 0.74–0.96 mm, light yellow to brown, glabrous, longitudinally dehisced; ovary elongate, glabrous; style tapered, 1.60–1.72 mm; stigma subglobose, keeled, 0.56–0.60 mm tall, 1.00–1.06 mm wide. *Fruits* septifragal capsules, ellipsoid to ovoid, 3.6–3.8 × 2.5–3.0 cm, apex rounded to slightly acute, base acute to rounded, epicarp olive green to brown with beige, prominent, amorphous, glabrous, with numerous pale lenticels; valves 5, 3.6–3.8 × 2.5–3.0 cm, central column keeled, 5-angled. *Seeds* winged, 2.0–2.2 × 0.7–0.8 cm (includes wing and embryo), wing membranous, reticulate, brown, glabrous, smooth, shiny, embryo dark brown.

Phenology: This new species was collected with flowers in October and November (flowers in different ripening stages), and with fruit in January and June (the capsules had already opened).

Etymology: *Cedrela gonzalopalominoii* is named after professor Gonzalo Palomino Ortíz (1936–2018), a prominent ecologist from the University of Tolima. He was a pioneer of environmentalism in Colombia. Since the 1970s, he led an environmental movement that, among many objectives, envisaged the threat to tropical dry forests. In 1988, he was awarded the Global 500 Prize by the United Nations (UN) in a ceremony held in London, which was attended by "El Comandante," as he was known among his friends and colleagues. In 2011, he was awarded by the newspaper, El Colombiano, with the "El Colombiano Ejemplar," an award in the environment category. These and 13 other distinctions were awarded to him by different entities and organizations (https://es.wikipedia.org/wiki/Gonzalo_Palomino_Ortiz).

Common names: The names "Cedro" and "Cedro cebollo" were recorded during the field work.

Distribution and ecology: *Cedrela gonzalopalominoii* is known to occur in Armero-Guayabal and Venadillo municipalities, Tolima department. This is a region of dry forest on low hills and plains systems inside inter-Andean valleys, located at the western bank of the upper Magdalena river, between 250–300 m elevation. These forests have a maximum slope of 45%, and the hills have an array of intermediate plains areas in the middle of them. They are compact, non-fragmented forests, some of which can be flooded in the rainy season. Besides the new species described here, and despite the larger botanical explorations in the upper and middle Magdalena valley at Cundinamarca and Tolima departments, so far only *C. odorata* has been recorded in this portion of the Madgalena valley (i.e., north of Honda and Mariquita municipalities).

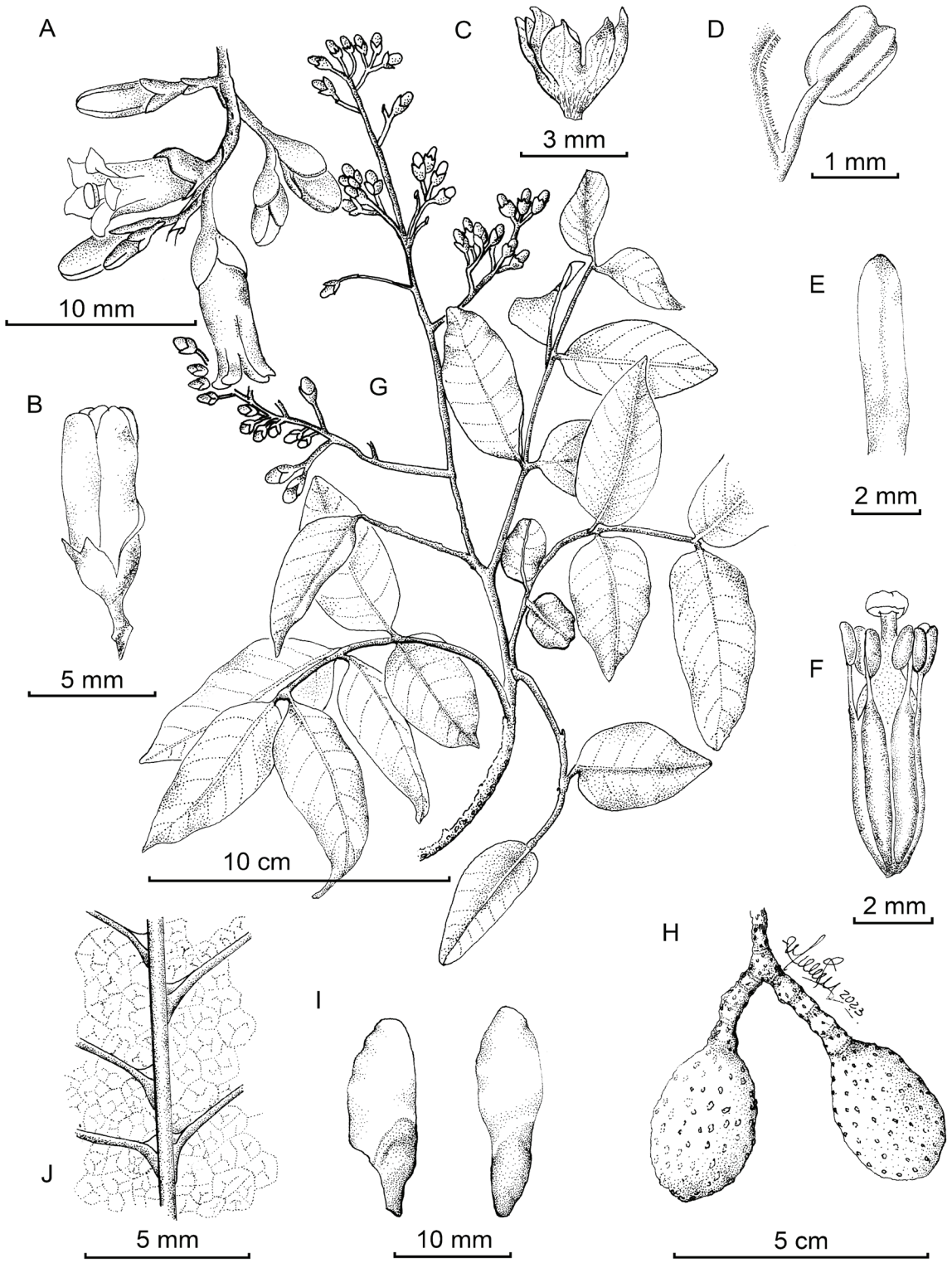

FIGURE 1. *Cedrela gonzalopalominoi* Villanueva & M.E. Morales. **A**, inflorescence branch; **B**, flower in lateral view; **C**, calyx in lateral view; **D**, anther in lateral view showing the connective at the base of the anther; **E**, petal; **F**, flower in cross section showing the staminal tube and gynoecium; **G**, habit showing the floral branch; **H**, immature fruits; **I**, seeds; **J**, leaf abaxial side showing the acarodomatia. A–F based on the holotype; H–I based on *Mendoza-C. 1054* (COL). Drawn by María E. Morales-Puentes.

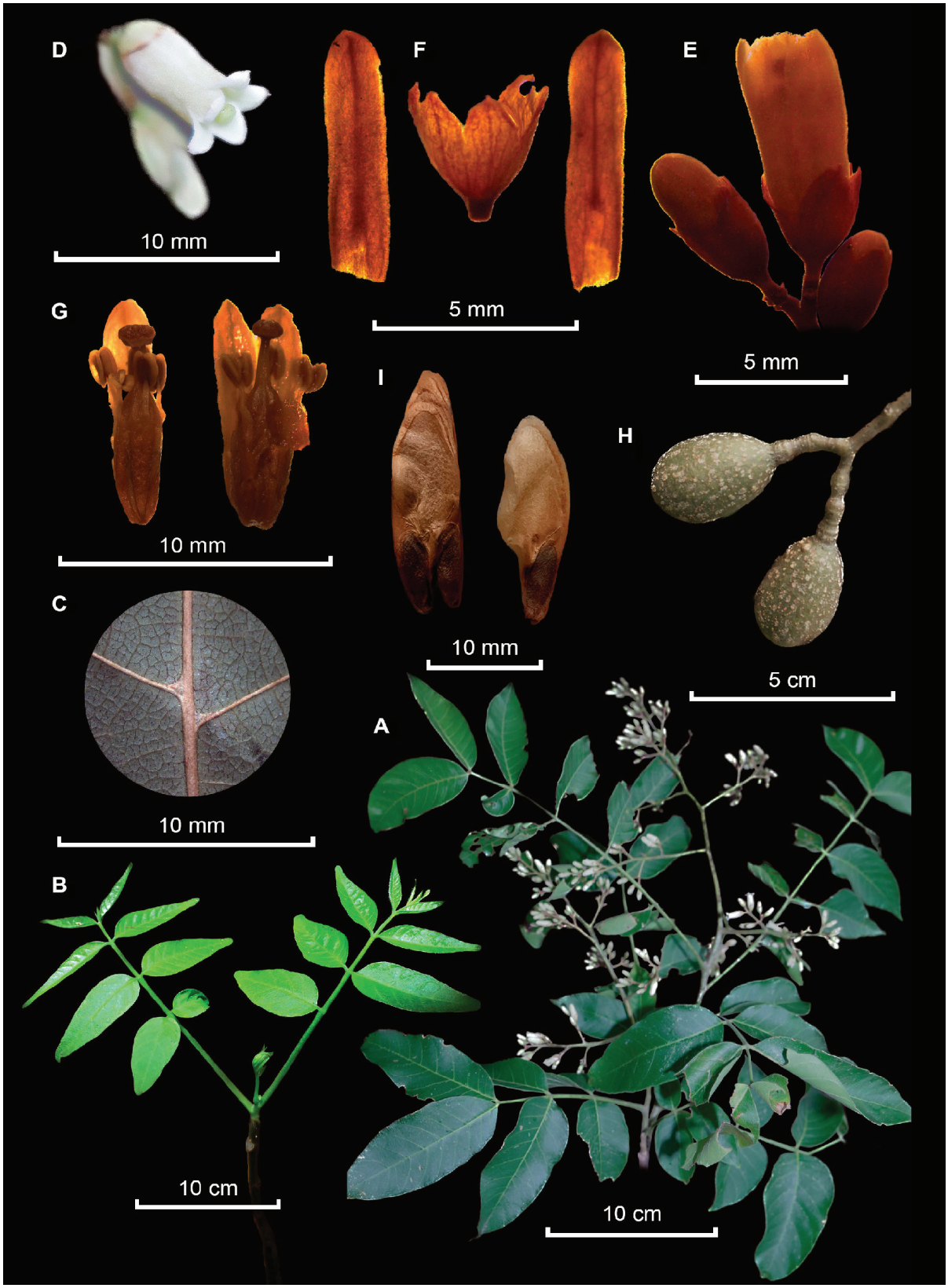

FIGURE 2. *Cedrela gonzalopalominoi* Villanueva & M.E. Morales. **A**, habit showing the floral branch; **B**, leaf branch; **C**, leaf abaxial side showing the acarodomatia; **D, E**, flowers in lateral view; **F,** calyx and petals in lateral view; **G**, flower in cross section showing the staminal tube and gynoecium; **H**, immature fruits; **I**, seeds. A–G based on the holotype; E–G from re-hydrated herbarium material; H–I based on *Mendoza-C. 1054* (COL). Photographs C, E, F, G, and I by Mateo González and Diego Moreno-Gaona; A, B, D, and H by Boris Villanueva Tamayo.

The dry forests from the upper Magdalena valley are characterized by endemic species, such as *Trichilia carinata* M.E. Morales (Meliaceae), *T. oligofoliolata* M.E. Morales (Meliaceae), *Ampelocera* sp. nov. (Ulmaceae), *Bulnesia carrapo* Killip & Dugand (Zygophyllaceae), *Picramnia apetala* Tul. (Picramniaceae), and *Mascagnia violacea* (Triana & Planch.) Nied. (Malpighiaceae), among others.

Additional specimens examined: COLOMBIA. Tolima, Venadillo: Vereda Salto Nuevo, bosque los Limones, 4°40'32.93"N; 74°49'17.61"O, 09 June 2019 (fr), *Boris Villanueva 4957* (TOLI). Armero, 01 January 1941 (fl), *Jesús M. Duque-Jaramillo 3992* (COL, two sheets: 66835, 75175). Armero, Guayabal, 5°05'3.17"N; 74°45'8.12"O, 300 m, 19 November 1995 (fr) *Humberto Mendoza-C. 1054* (COL, TOLI).

Conservation status: At present, *Cedrela gonzalopalominoi* is known from four collections; two from the type locality, and two from ca. 30 km North of the type locality (see the additional specimens). In the type locality, 12 permanent plots, 50 × 50 m (3 ha), were installed, and all individuals with DBH greater than 10 cm were recorded. In this area, with a slope close to 36%., 1305 individuals were measured, but only nine trees belong to the new species. In the same plots, seed rain sampling was done during one year, using a network of 12 fall meshes. The sampling recorded only one C. *gonzalopalominoi* capsule. No seeds were found inside the meshes, indicating lower seed rainfall values under the tallest individuals. Likewise, 25 1 × 1 m plots were created for monitoring seedlings with fortnightly censuses. Seedlings were found on high slopes and were recorded in 20% of the plots.

Under IUCN (2022) guidelines, there are not sufficient data (DD) to accurately determine the conservation status of the new species. However, it should be regarded as Critically Endangered (CR B1a) according to our calculations that estimate its Area of Occupancy (AOO) to be 8.000 km^2 and its Extent of Occurrence (EOO) to be 0.000 km^2 (following guidelines in IUCN, 2022). These guidelines estimate the EOO as the minimum convex polygon that includes all known occurrences of any taxon, and the AOO as the region inside the EOO that is occupied by the species (using a grid of 2 × 2 km). For threatened species, the AOO value recommended by IUCN is above 10,000 km^2 (IUCN, 2022). Although conservation status assessments can be made for species with such small numbers of collections (Rivers et al., 2011), it may be difficult to determine whether the appearance of rarity in a species is due to the lack of, or outdated, data, collection artifact, loss of habitat, or to its actual rarity (Verspagen and Erkens, 2022).

Additionally, the conservation of these dry forests is at

Table 1. Comparison of diagnostic morphological characters of *Cedrela gonzalopalominoi* Villanueva & M.E. Morales and closely related species.

Characters	*C. gonzalopalominoi*	*C. odorata*	*C. weberbaueri*
Leaves	Petiole and rachis: 10–19 cm long	Petiole and rachis: 25–50 cm long	Petiole and rachis: 18–20 cm long
Leaflets	2–4 pairs, 1.6–5.8 × 2.2–10.3 cm, elliptic to ovate, broadly elliptic to broadly ovate, glabrous on the lower surface, or with scattered trichomes, acarodomatia present, secondary veins 6–15 pairs	7–11 pairs, 8 × 2.5–15 × 4.5 cm, somewhat falcate, lanceolate to oblong-lanceolate, glabrous or very rarely puberulous on the lower surface, acarodomatia present, secondary veins 9–14 pairs	4–5 pairs, 7.5–10.8 × 4.5–6.0 cm, ovate, tomentose with pale brown hairs on lower surface, acarodomatia absent, secondaries 12–14 pairs
Inflorescences	18.0–18.5 cm long, flowering when in leaf, pedicel 0.7–1.2 mm long	15–40 cm long flowering when in leaf, pedicel 1–2 (–3) mm long	15–17 cm long, flowering when leafless, pedicel 1–2 mm long
Calyx	3.00–3.16 mm long, bell-shaped, puberulous outside, lobes triangular to ovate	1.5–2.0 (–2.5) mm long, cup-shaped or cupulate, glabrous or, rarely, sparsely puberulous outside, lobes obtuse	1.5–2.0 mm long, cup-shaped, villose outside, lobes shallow triangular acute
Corolla	Short pilose externally, fused to the androgynophore from the middle up	Densely appressed puberulous to sericeous externally, fused to the androgynophore in the lower third or middle	Sericeous externally, fused to the androgynophore in the lower middle
Fruit	Ellipsoid to ovoid, 3.6–3.8 cm long, apex rounded to slightly acute, base acute to rounded	Ellipsoid to oblong, rarely obovoid, 3.0–4.5(–5.0) cm long, apex and base rounded	Obovoid, 8–9 cm long, apex rounded, tapering gradually to an acute base
Distribution	Central Colombia	Mesoamerica, the Caribbean, South America to northern Argentina	Central Peru

risk due the continuous deforestation and degradation of the upper Magdalena valley. The area where *C. gonzalopalominoi* occurs is unprotected by "Sistema de Parques Nacionales Naturales de Colombia". However, the region "Bosque Los Limones," currently is a primary forest (150 ha) and is well protected by regional initiatives.

The plot data and the EOO and the AOO calculations are coherent with the hypothesis raised by Brown et al. (2023). These authors indicated that species with small ranges and/or population sizes are less likely to be encountered in the wild (and thus less likely to be described) and more likely to be threatened (Gaston, 2003).

Because of the size of its fruit and its geographical distribution, *C. gonzalopalominoi* is related to the South American *C. odorata* clade based on sequences from Brazil and Venezuela, according to the cladograms in Muellner et al. (2009) and Pennington and Muellner (2010).

The new species can be recognized by the number of its leaflets (less than five pairs), papilose and glabrous on the lower surface, except along the midrib and the secondary veins, where they are covered by scattered yellow trichomes (ca. 0.2 mm long), the margin ciliate; the flowers with a zygomorphic calyx, the calyx-corolla ratio of 1:4.

Cedrela gonzalopalominoi is morphologically related to two taxa: *C. odorata* and *C. weberbaueri*. It differs from *C. odorata* by its smaller fruit and geographical distribution; it differs from *C. weberbaueri* by the number and size of leaflets (smaller in *C. weberbaueri*), shape of the calyx, and its geographical distribution (see Table 1). Nonetheless, *C. gonzalopalominoi* differs from these two species and others of this genus in the characters discussed in the diagnosis, in Table 1, and in the following key.

Key to the species of Cedrela

The following key is based on Pennington and Muellner (2010), the fruit images available on the Field Museum of Chicago website, and the descriptions of new species published since 2015 (Köcke et al., 2015; Palacios et al., 2019, 2023).

1a. Leaves paripinnately; calyx regularly 5-lobed, lobes often imbricate at base, petal margins free to the base 2

1b. Leaves paripinnate; calyx shallowly or irregularly lobed and often split down one side to the base; petal margins adnate (except some *C. balansae*) 3

2a. Leaflets 3–6 cm wide, usually oblong to oblong-lanceolate, apex acuminate, base rounded, truncate to slightly cordate, pubescent on the lower surface, with brownish hairs to glabrous; calyx lobes sparsely pubescent; petals fused to the androgynophore for one-third to one-half their length; capsule (3–)4–6 cm long . . . . . *C. montana* (Venezuela to northern Peru)

2b. Leaflets 2.0–3.5 cm wide, usually lanceolate, apex caudate, base acute to rounded, glabrous; calyx lobes sparsely appressed puberulous to subglabrous; petals adnate to the androgynophore in the lower one-third; capsule 2.5–4.0 cm long . . . . . *C. angustifolia* (southern Ecuador to Bolivia)

3a. Leaflets 3–6(–7) pairs (usually with fewer than 7) 4

3b. Leaflets (7–)8–20 pairs (sometimes 21–24) 13

4a. Lower leaflet surface essentially glabrous, with scattered trichomes or minutely puberulous on the midrib, secondary veins and the leaf margin 5

4b. Lower leaflet surface uniformly pubescent to tomentose 9

5a. Petiolule 7–13 cm long, leaflet apex caudate, capsule 2.5–4.2 cm long . . . . . *C. dugesii* (central Mexico)

5b. Petiolule 1–5 mm long, leaflet apex acute-acuminate, capsule 3.6–8.0 cm long 6

6a. Lower leaflet surface minutely puberulous on the midrib and secondary veins . . . . . *C. ngobe* (Costa Rica, Panama)

6b. Lower leaflet surface essentially glabrous, or with scattered trichomes on the midrib and secondary veins 7

7a. Lower leaflet surface with scattered trichomes on the veins and the leaf margin; petiolule ca. 1 mm long; capsule 3.6–3.8 cm long . . . . . *C. gonzalopalominoi* (central Colombia)

7b. Lower leaflet surface essentially glabrous; petiolule 2–5 mm long; capsule 6–8 cm long 8

8a. Bark smooth; calyx ± glabrous; corolla pinkish red; capsule 6.0–6.5 cm long . . . . . *C. kuelapensis* (southeastern Ecuador and northwestern Peru)

8b. Bark fissured; calyx puberulous; corolla greenish-cream: capsule 7–8 cm long . . . . . *C. molinensis* (northwestern Peru)

9a. Plant flowering when leafless; inflorescence lateral on old wood 10

9b. Plant flowering when in leaf; inflorescence terminal 11

10a. Leaflets 4–5 pairs, ovate, apex acute; capsule 8–9 cm long . . . . . *C. weberbaueri* (central Peru)

10b. Leaflets 6–7 pairs, broadly oblong, apex rounded or obtuse; capsule 8–14 cm long . . . . . *C. salvadorensis* (Mexico to Costa Rica)

11a. Secondary veins mostly 16–18 pairs; capsule 5–8 cm long . . . . . C. *tonduzii* (Mexico to Panama)

11b. Secondary veins mostly 10–16 pairs; capsule 3–4 cm long 12

12a. Leaflets 5–12 pairs, 11.5–20.0 × 4.5–7.5 cm; capsule pendulous . . . . . *C. saltensis* (southern Peru to northern Argentina)

12b. Leaflets 5–7 pairs, 6–11 × 3–6 cm; capsule erect . . . . . *C. oaxacensis* (southern Mexico)

13a. Leaflets on the lower surface with persistent pubescence, easily visible with the naked eye or a hand lens 14

13b. Leaflets glabrous, or if pubescent on the lower surface, then indumentum confined to midrib and veins, or leaflets discolorous and with minute, white, appressed indumentum visible only with a dissecting scope (30x) 16

Key to the species of Cedrela cont.

14a. Leaflets 10–17 pairs, 2.0–4.5(–5.0) cm wide, 3–4 times as long as broad, oblong-lanceolate or narrowly lanceolate; capsule obovoid with a straight, tapering cuneate base, 5.5–9.0(–11.0) cm long . . . . . *C. fissilis* (Bolivia, Paraguay, southern Brazil to Colombia)

14b. Leaflets (4–) 5–12 pairs, 5–8 cm wide, 2–3 times as long as broad, ovate to broadly lanceolate; capsule ellipsoid, base convex, 3–8 cm long 15

15a. Leaflets oblong-lanceolate, less frequently lanceolate, secondary veins mostly 16–18 pairs; calyx 2–2.5 mm long, ; petals pale tomentose to sericeous outside, scattered coarse pubescence inside; capsule 5–8 cm long . . . . . *C. tonduzii* (Mexico to Panama)

15b. Leaflets broadly lanceolate, ovate, elliptic or oblong-lanceolate, secondary veins mostly 10–15 pairs; calyx 1.5–3 mm long; petals sericeo-tomentose outside; sparse woolly indumentum inside in the lower half; capsule 3–4 cm long . . . . . *C. saltensis* (southern Peru to northern Argentina)

16a. Leaflets discolorous, lower surface with minute, appressed white hairs confined to the interstices of the veins (requires magnification of 30x–40x) 17

16b. Leaflets not discolorous, glabrous, or indumentum, if present, spreading and visible with a 10x hand lens 18

17a. Petiolule 2–4 mm long, leaflet base acute, not, or only slightly, asymmetric, corolla sericeo-tomentose outside . . . . . *C. discolor* (northwestern Mexico)

17b. Petiolule 6–13 mm long, leaflet base strongly asymmetric, acute to obtuse on one side, rounded to truncate on the other, corolla finely sericeous . . . . . *C. longipetiolulata* (Amazonian Peru)

18a. Leaflets with domatial cavities usually present in axils of secondary veins on lower surface 19

18b. Leaflets with domatial cavities absent 21

19a. Leaflets mostly 4–8 cm wide, domatium amorphous and inflated (blister-like); corolla purple-red . . . . . *C. domatifolia* (eastern Ecuador)

19b. Leaflets mostly 2.5–4.5 cm wide, domatium not inflated (flap-like); corolla white or cream 20

20a. Leaflets falcate and glabrous, petal margins adnate, densely appressed puberulous to sericeous outside . . . . . *C. odorata* (Mesoamerica, the Caribbean, South America to northern Argentina)

20b. Leaflets not, or only slightly, falcate, with some pubescence along the midrib and secondary veins below, petal margins often free, finely sericeous outside . . . . . *C. balansae* (Bolivia, Paraguay, southern Brazil, northwestern Argentina)

21a. Corolla puberulent outside; capsule narrowly obovoid, base acute, 1.4–1.8 cm in diameter. . . . . *C. angusticarpa* (northwestern Ecuador)

21b. Corolla sericeous or sericeo-tomentose outside; capsule ellipsoid to slightly obovoid, base obtuse-rounded to rounded; 2.0–2.2 cm in diameter 22

22a. Corolla sericeo-tomentose, capsule valves opening at maturity and slightly reflexed . . . . . *C. nebulosa* (Ecuador and Peru)

22b. Corolla sericeous, capsule valves remaining ± closed at maturity, not reflexed . . . . . *C. monroana* (Guatemala, El Salvador)

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