

Conchocarpus kallunkiae (Rutaceae: Galipeinae), a new endemic species from the tropical rainforest in the Magdalena River Valley in Colombia

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Abstract. *Conchocarpus kallunkiae* (Rutaceae: Galipeinae), a new species from the Magdalena River Valley region in Colombia, is described and illustrated and comments about its geographical distribution, phenology, conservation status, and taxonomic affinities are provided. The new species differs from any other species in the genus by the combination of remarkably bullate blades, basally appendaged anthers, and a 4-carpellate ovary. Based on inflorescences and flowers, it seems closely related to *Conchocarpus macrophyllus* (type species of the genus) with which it shares foliaceous primary bracts, partial inflorescences developing as scaly short-shoots, zygomorphic flowers, an androecium of two stamens and five staminodes, and a glabrous ovary. Because it is endemic to the inter-Andean valleys of Colombia and exhibits some traits uncommon among the Galipeinae (for example, anthers connate by their basal appendages), including this species in future evolutionary studies may provide insights about the geographical and morphological histories of the genus and the subtribe.

Keywords: Endangered species, neotropical diversity, plant taxonomy, Samaná Norte River, Sapindales.

Resumen: *Conchocarpus kallunkiae* (Rutaceae: Galipeinae), una nueva especie de la región del valle del río Magdalena en Colombia, se describe e ilustra y se proveen comentarios sobre su distribución geográfica, fenología, estado de conservación y afinidades taxonómicas. La nueva especie se diferencia de otras especies del género por la combinación de hojas notablemente buladas, anteras con apéndices basales y ovario con cuatro carpelos. Con base en las inflorescencias y las flores, parece estar estrechamente relacionada con *Conchocarpus macrophyllus* (especie tipo del género), con el cual comparte brácteas primarias foliáceas, inflorescencias parciales que se desarrollan como brotes cortos escamosos, flores zigomorfas, androceo de dos estambres y cinco estaminodios y ovario glabro. Debido a su condición como endémica de los valles interandinos de Colombia y la presencia de algunos caracteres poco comunes en Galipeinae (por ejemplo, anteras connadas por sus apéndices basales), la inclusión de esta especie en futuros estudios evolutivos puede ayudar a aclarar las historias geográfica y morfológica tanto del género como de la subtribu.

Conchocarpus J.C.Mikan is the most diverse (Rutaceae, Galipeaeae). Species belonging to this genus of the Neotropical subtribe Galipeinae genus occur from Nicaragua to northern Bolivia

and southern Brazil (Kallunki & Pirani, 1998; Bruniera et al., 2015). Kallunki and Pirani (1998) recognized 45 species in the synopsis of the genus; subsequently, four new species have been described and one species previously under synonymy was accepted (Pirani et al., 2011; Groppo et al., 2019; Kallunki & Meier, 2019). In addition, five species of *Almeidea* A.St.-Hil were transferred to *Conchocarpus* (Bruniera et al., 2015), and five species previously in *Conchocarpus* are now recognized as belonging to *Dryades* Groppo, Kallunki & Pirani (Groppo et al., 2021), resulting in a current count of 50 species in the genus, two of which are about to be recognized as synonyms (Bruniera et al., [in press](#)).

The species of *Conchocarpus* are generally treelets or shrubs occurring in the understory of forests. These are often recognizable by their usually unbranched or few branched stem, 1-foliolate and alternate leaves, tubular corolla (coherent or connate petals), androecium adherent to the corolla, the presence of staminodes, basally unappendaged anthers and an apocarpous ovary (Kallunki & Pirani, 1998). Recent phylogenetic studies based on molecular data (Bruniera et al., 2015; Groppo et al., 2021) have revealed that *Conchocarpus* is non-monophyletic and comprises a small clade and a much larger clade. Groppo et al. (2021) transferred the five species of the small clade, i.e., his “*Conchocarpus gaudichaudianus* group” to a new genus *Dryades*. The large clade, i.e., “*Conchocarpus sensu stricto*,” comprises the rest of the species, including the type, *Conchocarpus macrophyllus* J.C. Mikan, and the five species previously transferred to *Conchocarpus* from *Almeidea* (Bruniera et al., 2015). This recircumscribed *Conchocarpus* differs from *Dryades* by the combination of calyx lobes not overlapping (vs. overlapping) at anthesis, anthers narrowly (vs. broadly) attached to the filaments, usually a pubescent (vs. glabrous) ovary, and a curved (vs. straight) embryo with plicate-conduplicate and \pm equal (vs. plano-convex and unequal) cotyledons (Kallunki & Pirani, 1998; Bruniera et al., 2015, Groppo et al., 2021). Further anatomical studies of a greater number of species may show that the differences in microstructural floral traits identified by El Ottra et al. (2019) also support the partition of the genus.

The center of species richness of *Conchocarpus* is the Brazilian Atlantic Rainforest, where most of

the species occur and many show a restricted distribution (Pirani et al., 2011; Colli-Silva & Pirani, 2019). In Colombia only five species are reported, from equatorial rainforest and monsoon climates (Af and Am climate types; Kottek et al., 2006) in the Magdalena River Valley and Pacific and Amazon regions (Bernal, 2016), none of them endemic to the country.

As a result of studies of herbarium specimens of Rutaceae from Colombia focused on Galipeinae and several field explorations in the Magdalena River Valley, the authors detected a new species of *Conchocarpus* inhabiting the understory of rainforest associated with calcareous rock outcrops. The new taxon is here described and illustrated. Comments about its geographical distribution, habitat, phenology, and taxonomic affinities are provided, and its conservation status is evaluated.

Materials and methods

Fieldwork was conducted in the municipalities of Caracolí and Puerto Nare in the department of Antioquia, where herbarium specimens were collected and supplemented with photographs (Canon PowerShot SX60 HS), with material preserved in 70% ethanol, and with GPS data (Garmin eTrex Vista HCx).

Herbaria COAH, COL, HUA, JAUM, MEDEL, and UDBC were consulted (acronyms according to Thiers, 2016). Eleven collections from mature individuals were analyzed using a stereomicroscope (Wild Heerbrugg M3) for the taxonomic description and illustration. Flowers and fruits were described and illustrated from material preserved in 70% ethanol, rehydrated material, and photographs of fresh structures. Additionally, the description of seedlings and some in vivo data were based on field observations and photographs. The terminology was mainly taken from the synopses made by Kallunki and Pirani (1998), venation and shape of laminar structures followed Ellis et al. (2009), and indumentum description and colors followed Hewson (2019) and Beentje (2016), respectively. The term capillinection was defined by Weberling (1989).

The distribution map was made using Arcgis 10.5, and the conservation status was evaluated according to criteria of IUCN V 3.1 (IUCN, 2012) and assessed by the R package “ConR” (Dauby,

2019; Protected Planet, 2019; R Core Team, 2019).

Because the specimens collected by the authors come from monopodial individuals (i.e. with unbranched stems), each specimen was assigned a different collection number, so they do not have duplicates. As it is important to cite all the specimens examined and send to other herbaria outside Colombia, here some specimens are cited as deposited in NY and SPFR, but they will only be sent once logistics permit.

Conchocarpus kallunkiae Londoño-E., Ana Trujillo, Pérez Zab. & Groppo, **sp. nov.** Type:—Colombia, Antioquia, Mun. Caracol: hidroeléctrica Argos Nare, camino desde el Río Nare hacia las Cavernas del Nus, 6°17' 41.5"N, 74°41'18.9"W, 246 m, 2 Dec 2018 [bud, fl], *Y. Londoño et al. 288* (holotype: MEDEL). (Figs. 1, 2.)

Diagnosis: *Conchocarpus kallunkiae* differs from all congeners by its blades bullate along the mid, secondary and tertiary veins (vs. not bullate or slightly bullate at the mid and secondary veins), its basally appendaged (vs. unappendaged) anthers, and its 4-carpellate (vs. 5-carpellate) ovary. Within the genus, *C. kallunkiae* shares only with *C. macrophyllus* an androecium of two stamens and five staminodes and also shares, with this and other species, foliaceous primary bracts, partial inflorescences developed as scaly short-shoots, zygomorphic flowers, and a glabrous ovary; however, *C. kallunkiae* differs from it by blades oblanceolate with long-cuneate base (vs. elliptic, oblong, or narrow-oblong with convex to rounded base), calyx with lobes 1.1–1.7 (vs. less than 1) mm long, and anthers exerted (vs. not exerted) from the corolla throat.

Treelet up to 1.4 m tall, unbranched, bearing congested leaves near apex of stem, the internodes not evident; the apical bud villous with reddish brown indument. *Leaves* 1-foliolate, alternate; petiole (2.9–) 3.5–7 cm long, flattened adaxially, swollen at base, swollen and geniculate at apex, villous with reddish brown indument, glabrescent, with 2 adaxial-lateral appendages of 1.5–1.8 × 1 mm subtending the blade like stipels; blade (20.1–) 23.6–34.9 × (5.1–) 6.6–11.4 cm, oblanceolate to narrowly oblanceolate, acute and long-cuneate at the base, obtuse and acuminate at the apex, abaxially villous and adaxially sparsely villous when expanding with reddish brown indument, and glabrescent when fully expanded, shiny in vivo, bullate along the mid, secondary and tertiary veins, pellucid-punctate, the glands visible as dark dots more evident on the abaxial surface, the margin entire, slightly revolute, the

midvein abaxially raised, adaxially impressed, the secondary veins 16–19 (–21) pairs, eucamptodromous becoming brochidodromous distally, abaxially raised, adaxially impressed, the tertiary veins percurrent, abaxially raised, adaxially impressed, a perimarginal vein of 3° gauge present. *Thyrse* (21–) 28.6–36 (–46.2) cm long, long-pedunculate, extra-axillary, more than one borne on a stem, erect, the axes complanate, sparsely villous with reddish brown indument, perennating; peduncle (17.7–) 20.5–28.9 (–36.2) cm long, the floriferous portion (3.3–) 6.3–12.4 cm long, with 2–4 floriferous nodes; primary bracts 2.4–8.5 × 0.5–1.5 mm, elliptic to narrowly elliptic, acute at apex, caducous, sparsely villous with reddish brown indument, glabrescent, with a tuft of trichomes near the apex; partial inflorescences cymules, sessile, congested, generally borne on the distal third of the thyrses, villous with reddish brown indument, long-lived, with 2–9 apparently monochasial branchlets developing with age as scaly short-shoots up to 3.2 cm long, these bearing up to 88 flower scars; secondary bracts 1.2–1.8 × 0.5 mm, ovate, acute at apex, persistent, sparsely villous with reddish brown indument; pedicels 1.7–2.5 mm long, strigose with reddish brown indument. *Calyx* 1.5–2.1 mm long, 5-merous, valvate, abaxially strigose with reddish brown indument, with a tuft of villous indumentum near the apex, adaxially glabrous at base and strigose at apex with reddish brown indument, the lobes 1.1–1.7 × 0.6–1.1 mm, ovate, acute at apex. *Corolla* 5-merous, zygomorphic, cochlear, abaxially white or white but becoming mauve distally, adaxially white, short-tubular, the tube 3.2–3.5 mm long, the innermost petal in upper position; petals 9.3–13.1 × 2.1–3 mm (including the tube), oblanceolate (the innermost occasionally oblong with an extended acute base), obtuse, rounded, or slightly acuminate at apex, with white indumentum, abaxially strigose along the midvein, adaxially tomentose at the corolla throat, minutely on the rest of both surfaces, slightly recurved; cucullate to flat; the innermost coherent by capillinection to adjacent petals along 3.2–3.5 mm from the base, the other four coherent to each other by capillinection along 3.7–4.2 mm from the base. *Androecium* of 2 fertile stamens flanking the innermost petal and 5 staminodes (3 antesepalous and 2 antepetalous); filaments of fertile stamens 3.8–4.7 × c. 0.8 mm, linear to narrowly oblanceolate, acute and acuminate at

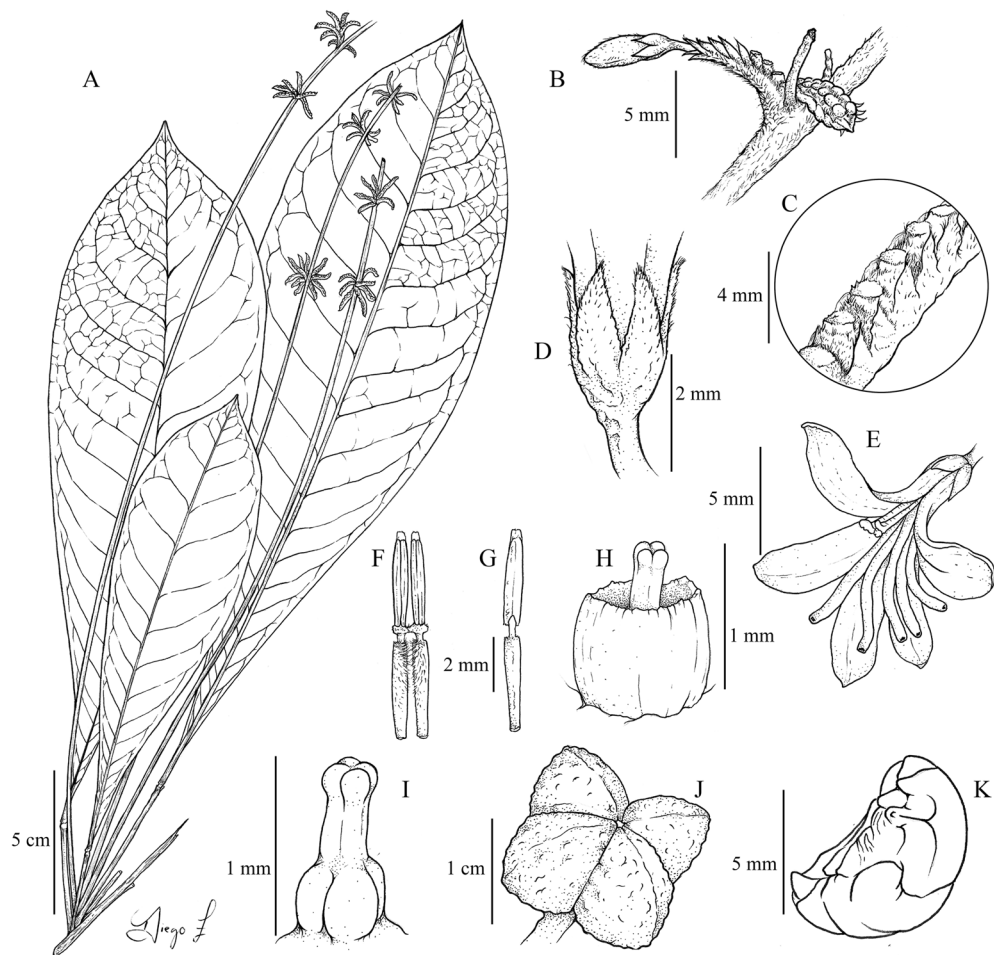


FIG. 1. *Conchocarpus kallunkiae*. A. Distal portion of flowering stem. B. Two primary bracts and two partial inflorescences. C. Short-shoot with secondary bracts, lateral view. D. Calyx. E. Flower. F. Stamens, adaxial view. G. Stamen, abaxial view. H. Disc enclosing ovary. I. Gynoecium. J. Fruit. K. Embryo, lateral view. (A from *Suescún* et al. 1274; B–D from *Trujillo* et al. 86; E from *Trujillo* et al. 102; F–I from *Londoño* et al. 288; J from *Londoño* et al. 289; K from *Londoño* et al. 290. Drawn by Diego A. Zapata, HUA illustrator.)

apex, with white indumentum, abaxially tomentose, adaxially velvety at the corolla throat, glabrous toward the base and apex on both surfaces, barely coherent to each other by capillinection, adherent by capillinection to the corolla throat, free above; staminodes $9.2\text{--}12 \times c. 1$ mm, linear but laterally expanded at the distal half in vivo, evenly linear in dried material, glandular at apex, with white indumentum, abaxially tomentose, adaxially velvety at the corolla throat, glabrous toward the base and apex on both surfaces, the antesepalous staminodes adherent by capillinection to the corolla throat, free above, the antepetalous staminodes adnate to the corolla at the base and adherent by capillinection to the

corolla throat, free above; anthers oblong, narrowly attached to the filament, not obviously glandular on the connective, appendaged at base and apex, connate by their basal appendages, exerted from the corolla throat at anthesis, the thecae $2.9\text{--}3.4 \times 0.4\text{--}0.7$ mm, abaxially sparsely puberulous with white indument to glabrous, adaxially glabrous, the basal appendages $c. 0.3 \times c. 0.6$ mm, transversely oblong, glabrous, membranous, the apical appendages $0.5\text{--}0.8 \times c. 0.5$ mm, rounded at apex, abaxially glabrous, adaxially puberulous with white indument. Disc $c. 0.6$ mm high, slightly shorter or longer than the ovary. Ovary $0.4\text{--}0.9$ mm high, 4-carpellate, glabrous; style $0.6\text{--}2.1$ mm long (including stigma), glabrous; stigma

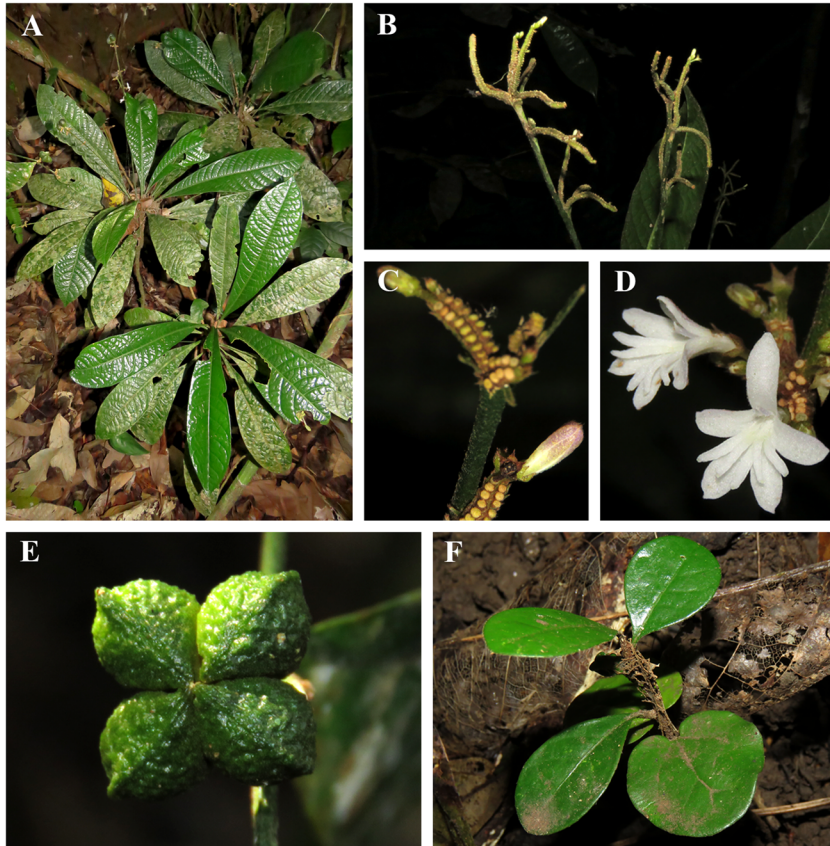


FIG. 2. *Conchocarpus kallunkiae*. A. Habit and typical clumped dispersion pattern. B. Distal part of inflorescences with elongated short-shoots. C. Portion of inflorescence showing short-shoots, a primary bract, and floral buds. D. Flowers. E. Fruit. F. Young plant with two cotyledons and three leaves. (B from Londoño et al. 290; C, E from Londoño et al. 289; D from Trujillo et al. 102. Photos by Y. Londoño, created by Ana C. Pareja, HUA illustrator.)

inserted or slightly exserted from the corolla throat at anthesis. *Fruit* of 1–4 free mericarps, each 9.8–13 × 8.8–9.3 mm, ventrally straight, dorsally slightly carinate, transversely shallowly ridged, glabrous, rugose. *Seed* 9.2–10 × 7.1–9 mm, glabrous, subrugulose, dorsally slightly tuberculate, the testa leathery. *Embryo* curved, the cotyledons plicate-conduplicate. *Seedling* phanerocotylar, the cotyledons orbicular, cordate at base, rounded at apex.

Distribution, habitat and ecology.—*Conchocarpus kallunkiae* is endemic to Colombia, where it has been collected only in the east of the department of Antioquia in the municipalities of Puerto Nare and Caracolí (Fig. 3). The individuals form gregarious populations in the understory of forest patches and notably on outcrops of calcareous rocks in the forests adjacent to the Nare River

near its mouth on the Magdalena River. This area is located in the biogeographic region of the Magdalena Valley (Bernal, 2016) at an elevation between 246 and 352 m, under equatorial rainforest climate (Af climate type; Kottek et al., 2006).

Phenology and perennating inflorescences.—Herbarium vouchers indicate blooming times in April, June, and October–December, and a fruiting time in October–December. However, a specimen cultivated by the authors has been flowering throughout the year over the same inflorescences through gradually lengthening partial inflorescences. The last observation and the fact that the examined specimens have remarkably long partial inflorescences (up to 3.2 cm long) that grow longer with age, hence, suggesting that natural populations bloom and produce fruits throughout the year. Such perennating

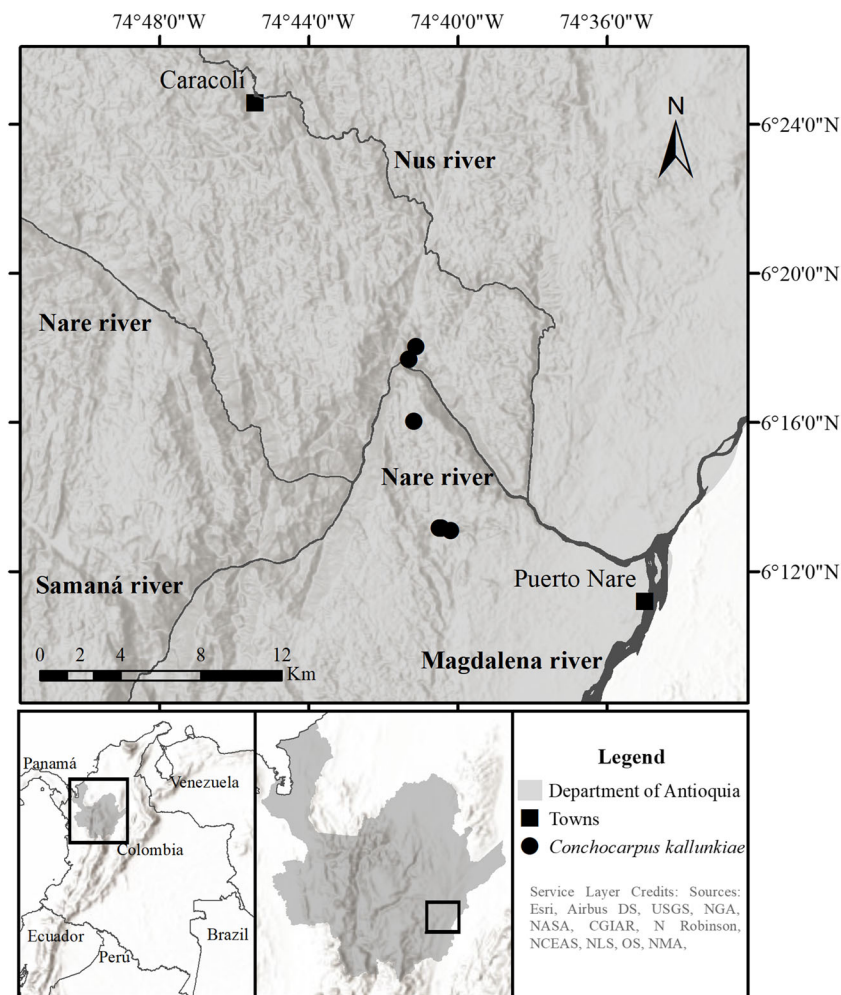


FIG. 3. Distribution of *Conchocarpus kallunkiae*.

inflorescences seem to be an unusual feature in angiosperms and were previously reported in *Conchocarpus* and some species of several genera of Galipeinae by Kallunki (1992), and Kallunki and Pirani (1998).

Etymology.—This species is named in honor of Jacquelyn Ann Kallunki, Curator Emerita of the Herbarium of The New York Botanical Garden and expert in Galipeinae, a group for which she has been making magnificent contributions about its taxonomy and systematics. This is an acknowledgment of her enthusiasm and dedication, which have enabled her to achieve impeccable work, motivating other botanists to work on increasing the knowledge and conservation of tropical plants.

Conservation status.—The species is known only from one population within small forests fragments (<500 km²) immersed in a deforested matrix with cattle raising and mining activities, resulting in moderate soil erosion impacts. A large-scale limestone mining project has partially encroached its occupation area. All known individuals occur outside official protected areas and less than 15 km from a populated center and an oil exploration and production area. These hazards together with the small extent of occurrence and area of occupancy (EOO = 12 km², AOO = 12 km²) places this taxon in the category CR (Critically Endangered), according to the criteria B1ab(iii) of IUCN (2012).

Additional specimens examined.—**COLOMBIA.** **Antioquia:** Mun. Caracolí: hidroeléctrica Argos Nare, camino desde el Río Nare hacia las Cavernas del Nus, 6°17'41.5"N, 74°41'18.9"W, 246 m, 2 Dec 2018 [bud, fr], *Y. Londoño* et al. 289 (JAUM); *ibid.*, 2 Dec 2018 [bud, fl], *A. M. Trujillo* et al. 86 (HUA); *ibid.*, 2 Dec 2018 [bud, fl, fr], *A. M. Trujillo* et al. 87 (SPFR). Mun. Nare [=Mun. Puerto Nare, but the specimen label states Mun. Caracolí]: hidroeléctrica, parte superior de la represa, cerca a las cavernas del Nus, [6°18'1.3"N, 74°41'7.9"W], 500 m [348 m], 13–19 Dec 1995 [bud, fr], *N. Gil* 26 (HUA). Mun. Puerto Nare: vereda Caño Seco, cerca de la desembocadura del Caño Seco en el río del acueducto municipal, 6°13'09.8"N, 74°40'29.7"W, 352 m, 3 Dec 2018 [bud, fl, fr], *Y. Londoño* et al. 290 (HUA); V. Peñaflo, carretera Narices-Nare aprox. 2.5 km después del 2do. cruce de la línea con la carretera, 6°13'06"N, 74°40'12"W, [340 m], 4 Oct 1998 [bud, fl, fr], *W. Rodriguez* et al. 1119 (JAUM); corregimiento La Sierra, Hacienda Casanare, 6°16'01.8"N, 74°41'11.2"W, 350 m, 12 April 2013 [bud, fl], *D. Suescún* et al. 1274 (HUA); vereda Caño Seco, cerca de la desembocadura del Caño Seco en el río del acueducto municipal, 6°13'09.8"N, 74°40'29.7"W, 352 m, 3 Dec 2018 [bud, fl, fr], *A. M. Trujillo* et al. 102 (NY); vereda Caño Seco, bosques sobre las márgenes de la quebrada Caño Seco, 6°13'09.8"N, 74°40'26.8"W, [352 m], 23 Jun 2011 [bud, fl], *D. Tuberkua* et al. 3298, 3299 (HUA).

The new species belongs to *Conchocarpus*, as morphologically defined by Kallunki and Pirani (1998), due to the combination of unbranched stem, 1-foliolate and alternate leaves, simple trichomes, calyx less than 5 mm long, coherent petals, androecium adherent or adnate to the corolla, staminodes present, and free carpels.

Conchocarpus kallunkiae stands now as the only endemic species of the genus known from Colombia. It can be clearly distinguished from the other two species with 1-foliolate leaves recorded for the country, i.e., *C. nicaraguensis* (Standl. & L.O. Williams) Kallunki & Pirani and *C. ucayalinus* (Huber) Kallunki & Pirani, by stems with internodes obscured by congested leaves (vs. evident), partial inflorescences developed as scaly short-shoots (vs. with obvious internodes), calyx lobes not overlapping (vs. overlapping) at anthesis, and anthers connate by their basal appendages (vs. laterally connate by their thecae and lacking basal appendages).

Even though *Conchocarpus kallunkiae* has not yet been included in molecular phylogenetic studies, its morphological affinities—based on non-overlapping calyx lobes, anthers narrowly attached to the filaments, and plicate-conduplicate cotyledons—may be with the *Conchocarpus* sensu stricto clade. Moreover, it shares some traits that are unusual in the genus with a few other species already included in molecular phylogenetic studies

by Bruniera et al. (2015) and Groppo et al. (2017, 2021): with *C. cuneifolius* Nees & Mart., *C. bellus* Kallunki, and *C. macrophyllus* (all from the Brazilian Atlantic Forest) foliaceous primary bracts and partial inflorescences that develop as scaly short-shoots, and also with *C. cuneifolius* anthers exerted from the corolla throat at anthesis and with *C. macrophyllus* an androecium of two stamens and five staminodes (both features heretofore unique within the genus; Kallunki & Pirani, 1998).

Particularly, *Conchocarpus kallunkiae* exhibits two floral features unique in the genus and infrequent in other Galipeinae, namely anthers with basal, connate appendages, as in *Andreodoxa* Kallunki, *Toxosiphon* Baillon, and some species of *Erythrochiton* Nees & C. Martius, *Galipea* Aubl., and *Neoraputia* Emmerich ex Kallunki (Kallunki, 1998a; Kubitzki et al., 2011) and a 4-carpellate ovary, as in *Leptothyrsa* Hook. f. and some flowers of *Apocaulon* Cowan, *Galipea*, *Rauia* Nees & Mart., and *Ticorea* Aubl. (Kallunki, 1998b; Kubitzki et al., 2011; El Ottra et al., 2019). These features are added to the morphological exceptions previously reported for some species of *Conchocarpus* (e.g., the presence of opposite leaves, a staminal tube, or basally connate mericarps (Kallunki & Pirani, 1998; Groppo et al., 2019), as well as to the complex variability in floral traits within and between genera, recently found in morphological and anatomical studies of Galipeinae, e.g. the floral merism in the androecium and the types of the union of petals (Pirani et al., 2010; El Ottra et al., 2013; El Ottra et al., 2016; El Ottra et al., 2019).

Including *Conchocarpus kallunkiae* in future comparative phylogenetic studies in a broader scale could provide insights to understand the complex variation of floral traits and the atypical character states observed in some species of *Conchocarpus* and other Galipeinae, uncover some clues about the biogeographic histories of the genus and the subtribe underlying the current distribution (both with many species in the Atlantic forests in Brazil and few in the inter-Andean valleys), and provide complementary information to help support the conservation efforts of this highly endemic species and many others in Rutaceae known for their narrow distributions and scarce number of collections.

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