

Flora Farallonensis IV: Gentianales from the Pico de Águila Low Montane Forest in Colombia

Flora Farallonensis IV: Gentianales del bosque montano bajo de Pico de Águila en Colombia

Miguel Ángel Gamboa-Gaitan

M.Sc. (Biology) of University of Puerto Rico, USA. Professor Universidad Nacional de Colombia, Colombia
magamboaga@unal.edu.co | <https://orcid.org/0000-0002-8145-8712>

Citation: Gamboa-Gaitan, M. A. (2024). Flora Farallonensis IV: Gentianales from the Pico de Águila Low Montane Forest in Colombia. *Mutis*, 14(2). 1-13.
<https://doi.org/10.21789/22561498.2070>

Recibido: 23 de enero de 2024
Aceptado: 4 de marzo de 2024

Copyright: © 2024 por los autores. Licenciado para *Mutis*. Este artículo es un artículo de acceso abierto distribuido bajo los términos y condiciones de la licencia Creative Commons Attribution (<https://creativecommons.org/licenses/by/4.0/>).

ABSTRACT

This is the fourth article in a series dedicated to the flora from Los Farallones de Cali, a natural region located in the western mountain system of Colombia. The general purpose of the series is to make an inventory of plants, algae, and fungi by studying different locations in Los Farallones. This paper deals with species of the order *Gentianales* (*Asclepiadaceae* and *Rubiaceae* families) from the Pico de Águila low montane forest (in the Valle del Cauca department, in Colombia). Data related to altitudinal and biogeographical distribution in Colombia of species belonging to this order are presented here, along with drawings that facilitate their identification in the field.

Keywords: Neotropical flora; *Asclepiadaceae*; *Rubiaceae*; *Oxypetalum*; *Coccocypselum*; *Ladenbergia*; *Palicourea*; *Psychotria*; *Sabicea*; Natural sciences.

RESUMEN

Este es el cuarto artículo de una serie dedicada a la flora de Los Farallones de Cali. El propósito general de la serie es hacer un inventario de las plantas, algas y hongos estudiando localidades puntuales en Los Farallones. Este artículo está dedicado a las especies del orden *Gentianales*, familias *Asclepiadaceae* y *Rubiaceae* del bosque de Pico de Águila, en el departamento del Valle del Cauca, Colombia. Para hacer este inventario se recolectaron especímenes que fueron secados en el herbario CUVC y enviados a especialistas para su identificación. Se presentan datos sobre la distribución altitudinal y biogeográfica de las especies para Colombia por departamentos y algunas ilustraciones para facilitar su identificación. Varias de las especies halladas tienen potencial para estudios de bioprospección.

Palabras claves: Flora neotropical, *Asclepiadaceae*; *Rubiaceae*; *Oxypetalum*; *Coccocypselum*; *Ladenbergia*; *Palicourea*; *Psychotria*; *Sabicea*; Ciencias naturales.

INTRODUCTION

Gentianales is a monophyletic order of angiosperms composed of five families: Apocynaceae, Gelsemiaceae, Gentianaceae, Loganiaceae, and Rubiaceae. It is distributed worldwide and consists of ca. 14,200 species according to Judd et al. (2008), or over 20,000 species as postulated by APG (2023). They are important to humans because of their ornamental uses (e.g. Gardenia, Gentiana), as a source of medicinal substances (e.g. Catharanthus, Cinchona, Vinca), and as the source of one of the most popular beverages worldwide: coffee (Jones, 1988).

This article is the result of a research project dedicated to study the flora from Los Farallones de Cali (LFC), a natural montane ecosystem located in the western branch of the Colombian Andean mountains. The first paper of this series (Gamboa-Gaitán, 2018) has a broader description of the project Flora of Los Farallones de Cali, including an overview of LFC as a natural environment. In brief, this project has studied the flora from LFC by sampling specific locations, starting with Pico de Águila, a low montane forest situated next to Cali (in the Valle del Cauca department, in Colombia). This paper is the fourth related to this site, and it deals with two families in the order Gentianales found at Pico de Águila: Apocynaceae and Rubiaceae. More information about our research lines, projects and activities, including pictures, can be found at the Laboratorio de Biología Tropical website: <https://labiotrop.weebly.com>

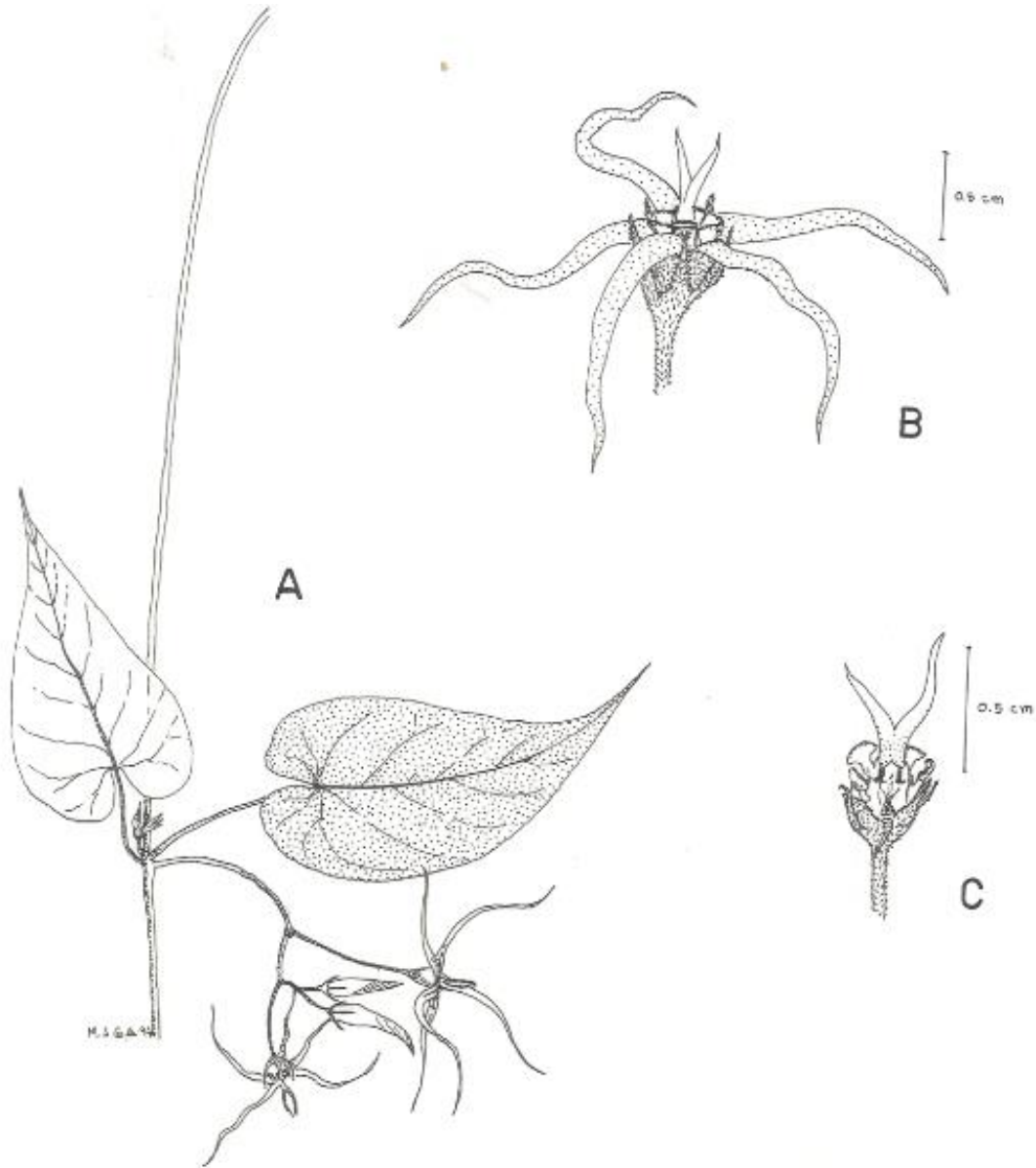
MATERIALS AND METHODS

Los Farallones de Cali (LFC) is a natural region in western Colombia, which includes a diverse array of ecosystems from the sea level to the montane locations at 4000 meters above sea level. Most of its territory is protected as a national park named Los Farallones de Cali Parque Nacional Natural (PNN) (Sarría, 1993). LFC is a highly diverse location, which is also threatened (García, 1986) due to illegal mining and deforestation. Some areas of LFC are not protected but are buffer zones. Such buffer zones are located outside the lands of the national park and are a transition area between the populated cities and the preserved environments. The forest of Pico de Águila is an example of such buffer zones. It is located near Cali – the third largest city in Colombia – and homes a small rural community with less than 100 inhabitants in a suburban location. Pico de Águila is at 1550 meters above sea level in the east slope of LFC, and its vegetation is classified as low montane tropical forest (Espinal, 1968; Gamboa-Gaitán & Ramos, 1995).

This study began in 1994 (Gamboa-Gaitán, 1995). Plants were collected in the field following standard procedures and transported either to the Universidad del Valle Herbarium (CUVC) or to the Laboratory of Tropical Biology at Universidad Nacional de Colombia (Bogotá campus). The biological material collected was pressed and dried in conventional ovens using standardized protocols (70°C for 24 hours). The drawings were made based on living specimens. Dried herbarium specimens were used for identification of species by using keys or by sending vouchers to specialists. The original samples of the plants reported here were deposited at CUVC, at Herbario Nacional Colombiano (COL) or at the herbarium in the Missouri Botanical Garden (MO). The study of Pico de Águila flora continues to

the present by performing more samplings and collecting information about plants used by local people.

Figure 1. *Oxypetalum cordifolium*. A) General view, B) flower, C) stigma, petals and appendixes were removed.



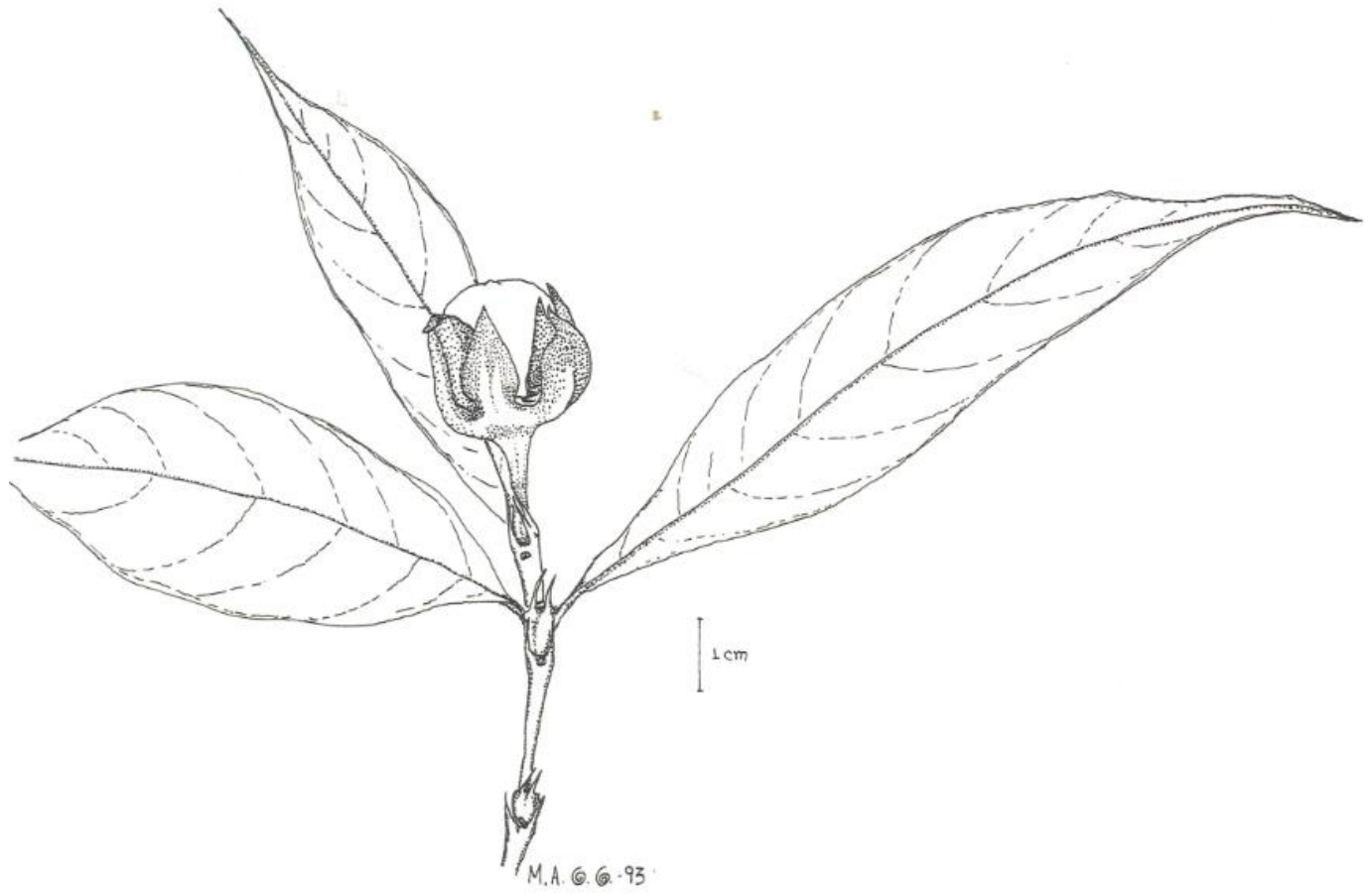
Source: Elaborated by the author.

Figure 2. *Ladenbergia oblongifolia*. Terminal part of branch, with fruits and leaves.



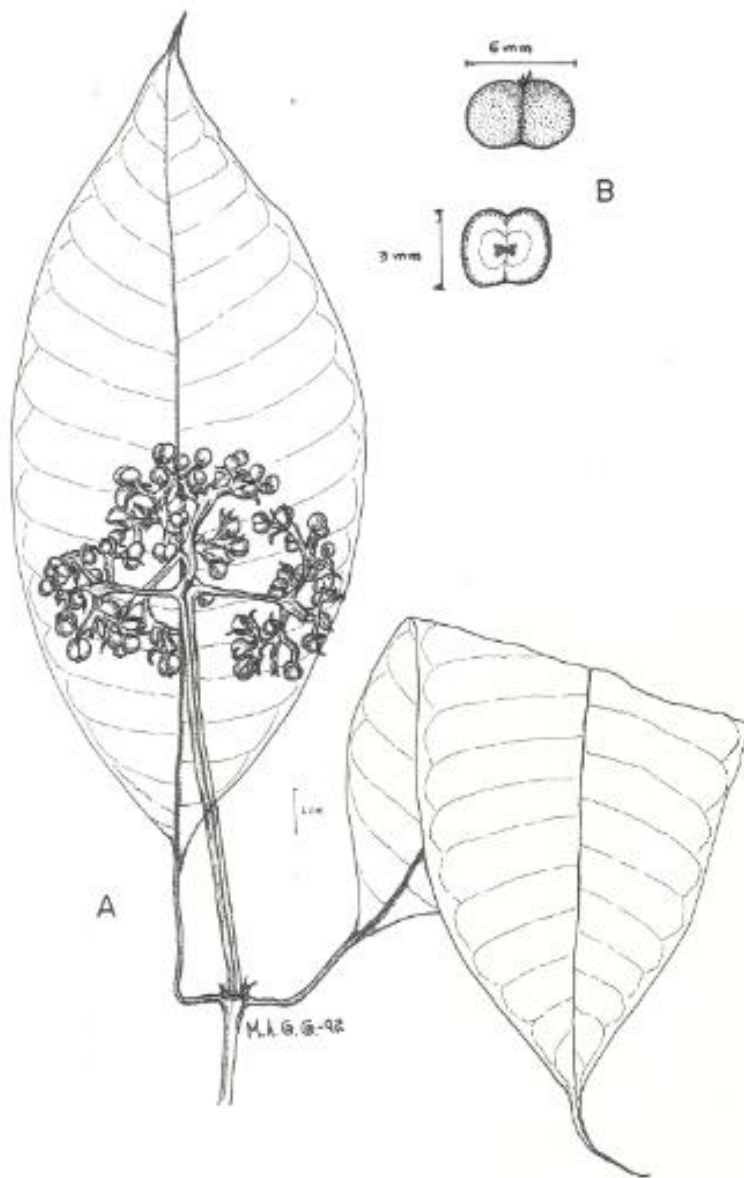
Source: Elaborated by the author.

Figure 3. *Palicourea angustifolia*. Fertile branch, fruit and leaves.



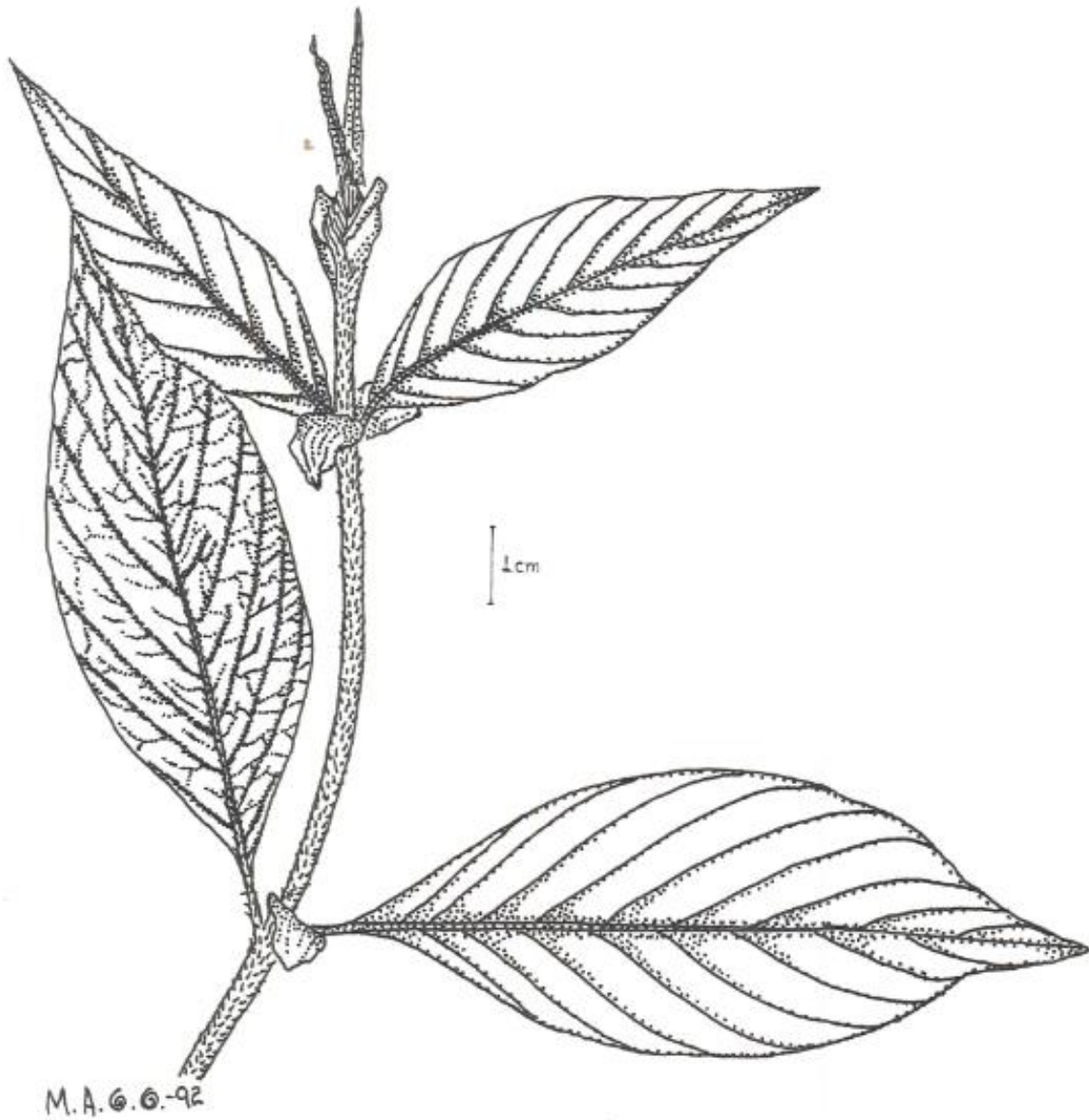
Source: Elaborated by the author.

Figure 4. *Psychotria compta*. A) Terminal apex of fertile branch, with fruits, B) lateral view of fruit and medial section.



Source: Elaborated by the author.

Figure 5. *Sabicea villosa*. Terminal young branch.



Source: Elaborated by the author.

RESULTS

Gentianales are represented at Pico de Águila by nine species in two families: *Apocynaceae* (1) and *Rubiaceae* (8).

***Apocynaceae* A.L. de Jussieu.**

The following is a general description of this family: Trees, lianas, vines, shrubs and herbs, sometimes succulent plants. Laticifers and milky sap, with cardiac glycosides and iridoid alkaloids. Entire simple leaves, sometimes alternate or whorled, stipules reduced or lacking, flowers usually radial, 5 sepals, 5 petals, 5 stamens always adnate to the corolla with highly modified anthers, 2 carpels with apical portion of style expanded and highly modified. Widespread family in tropical and subtropical environments, with a few genera in temperate areas. It contains around 3,700 species in 355 genera, being the most species-rich ones *Asclepias*, *Tabernaemontana*, *Cynanchum*, *Ceropegia*, *Hoya*, *Matelea*, *Rauvolfia*, *Gonolobus*, *Secamone* and *Mandevilla* (Cronquist, 1981; Jones, 1988; Judd et al., 2008).

***Oxypetalum cordifolium* (Vent.) Schltr.**

Slender herbaceous vine, finely velutinous on the leaves, stem, and inflorescences. Leaves simple, opposite, base cordate, acuminate at the apex, dark green above, 4-11 cm long and 1-5 cm wide. Axilar inflorescences, paucifloras, calyx deeply lobed, 5 sepals, corolla yellowish, 5 petals, puberulent, lanceolated, 5 stamens with polinia, one pistil, stigma conspicuously bifid, floral bud contorted. This species is found in secondary forests, and on borders of walking paths. Distribution: Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Huila, Magdalena, Nariño, Quindío, Santander, Tolima and Valle, 200 to 2800 meters above sea level (Gamboa-Gaitán, 1995; Hassler, 2004 – 2023; Tropicós, 2023; UNAL, 2023) (Figure 1).

***Rubiaceae* A. L. Jussieu.**

The following is a general description of this family: Trees and herbs mostly, sometimes herbs and lianas. Simple leaves, opposite, interpetiolar stipules. Flowers monoecious and radial, sepals 4 or 5, connate, petals 4 or 5, connate, corolla Wheel-shaped to funnel-shaped, stamens 4-5, filaments adnate to corolla, carpels 2 (-5), connate, ovary inferior, fruit a capsule, berry or drupe. It is a cosmopolitan family but most diverse in tropical and subtropical regions, some 9000 species in 550 genera. Major ones are *Psychotria*, *Galium*, *Ixora*, *Pavetta*, *Hedyotis*, and *Tarenna*. (Cronquist, 1981; Jones, 1988; Judd et al., 2008). The most economically important products from *Rubiaceae* are coffee from *Coffea arabica*, and quinine, a drug used for treating malaria, obtained from bark of *Cinchona* spp. In Colombia, a popular beverage is made with fruits of *Borojoa patinol*, a species native to Pacific lowlands (Pérez-Arbeláez, 1978). An important contribution to the study of Colombian *Rubiaceae* is a survey of genera found in this country (Mendoza et al., 2004).

***Coccocypselum lanceolatum* (Ruiz & Pavón) Pers.**

Reclined herb 30 cm long. Simple leaves, opposite, elliptic in shape, 5-10 cm long x 2-5 cm wide, with trichomes. Fleshy fruit, blue purple in color, rounded 1.0 x 1.5 cm, conspicuous, axillary, sustained by a peduncle up to 3 cm long. Common herb on the border of pathways and in cattle pasturelands. Distribution: Antioquia, Boyacá, Caquetá, Cauca, Cesar, Chocó, Cundinamarca, Huila, Magdalena, Nariño, Norte de Santander, Quindío, Risaralda, Santander, Tolima and Valle, 100 to 2900 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicos, 2023 ; UNAL, 2023).

***Ladenbergia oblongifolia* (Humb. ex Mutis) L. Andersson**

Tree up to 15 m tall, brittle branches with short trichomes at terminal ends. Simple leaves, opposite, ovate, thick, 21-32 cm long, 10-19 cm wide, petiole and base of leaf veins red in color, conspicuous scars on branches after leaf fall, big stipules, 3 cm long, foliose, acuminate, reddish, deciduous. This species is found both in well conserved forests and on the borders of roads and pathways. Distribution: Antioquia, Bolívar, Boyacá, Caquetá, Cauca, Cesar, Cundinamarca, Guainía, Guaviare, Huila, Nariño, Putumayo, Quindío, Risaralda, Tolima, Valle and Vaupés, 150 to 2340 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicos, 2023; UNAL, 2023) (Figure 2).

***Palicourea angustifolia* Kunth**

Shrub 2 m tall, stem violet in color. Simple leaves, opposite, lanceolate, 7-17 cm long, 2-4 cm wide. Terminal inflorescence, with few flowers, bracts fused in a calyx-like structure, tubular flower 2 cm long, fused sepals, pistil with bifid stigma, violet in color. Shrub commonly found in the understory of preserved zones. Distribution: Antioquia, Boyacá, Caldas, Caquetá, Casanare, Cauca, Cesar, Chocó, Cundinamarca, Huila, Magdalena, Meta, Nariño, Norte de Santander, Putumayo, Quindío, Risaralda, Santander, Tolima and Valle del Cauca, 500 to 3600 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicos, 2023; UNAL, 2023) (Figure 3).

***Palicourea cyanantha* Standl.**

Shrub 1.5 to 3.0 m tall, terminal branches climbing. Simple leaves, opposite, 6-16 cm long, 3-6 cm wide, elliptic, acuminate, with trichomes, especially younger ones, stipules 1 cm long. Inflorescences terminal, blue in color, highly trichomated, tubular flowers, 3 cm long; petals fused, pentamers; 5 epipetal stamens; stigma bifid. Fruit a drupe, fleshy, white pericarp, spongy, two seeds. This species produces flowers for the most part of the year and is found in preserved understory. Distribution: Antioquia, Caldas and Valle del Cauca, 1600 to 2440 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicos, 2023; UNAL, 2023).

***Psychotria compta* Standl.**

Shrubs 2 m tall. Simple leaves, opposite, ovate, subcoriaceous, 5-25 cm long, 3-15 cm wide, acuminate. Terminal inflorescences, capitulum-like, dense, with coarse bracts and short and strong trichomes; 5 petals, white in color, throat of corolla yellow; 5 exerted stamens; pistil single. It is found in parts of the forest with few shadows, sometimes on the borders of pathways. Distribution: Amazonas, Antioquia, Cauca, Chocó, Nariño and Valle del Cauca, 200 to 2600 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicós, 2023; UNAL, 2023) (Figure 4).

***Psychotria lucentifolia* (S.F. Blake) Steyererm.**

Synonym: *Psychotria ostreophora* (Wernham) C.M.Taylor (Delprete & Cortés, 2016). Shrub 0.5 to 2.0 m tall. Simple leaves, opposite, thin, fusiform, 9 to 11 cm long, persistent stipules. Terminal inflorescences, purple bracts; trichomes in throat of corolla; epipetal stamens, white anthers; bifid stigma. Distribution: Amazonas, Antioquia, Boyacá, Caldas, Caquetá, Cauca, Chocó, Córdoba, Cundinamarca, Meta, Putumayo, Valle del Cauca and Vaupés, 20 to 2200 m. (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicós, 2023; UNAL, 2023).

***Psychotria macrophylla* R. & P.**

Synonym: *Notopleura macrophylla* (Ruiz & Pav.) C.M.Taylor. Short shrub, uncommon, found only once in the understory of Pico de Águila. Opposite leaves, simple, elliptic, 10 to 45 cm long, 5 to 10 cm wide. Axillary inflorescences, with few flowers. Young parts of the shoot are succulent-like. Distribution: Amazonas, Antioquia, Caldas, Caquetá, Cauca, Cesar, Chocó, Cundinamarca, Guajira, Huila, Magdalena, Meta, Nariño, Norte de Santander, Putumayo, Risaralda, Santander, Tolima and Valle del Cauca, 0 to 3150 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicós, 2023; UNAL, 2023).

***Sabicea villosa* Schult.**

Vine on shrubs of the understory, stem with short, soft hairs. Simple leaves, trichomated, ovate-elliptic, apex acuminate, 2 to 13 cm long, 1 to 6 cm wide. Axillary inflorescences, inconspicuous, with broad, leafy bracts. Distribution: Amazonas, Antioquia, Caldas, Caquetá, Cauca, Chocó, Cundinamarca, Guaviare, Huila, Meta, Nariño, Putumayo, Santander, Valle del Cauca, Vaupés and Vichada, 0 to 2600 meters above sea level (Gamboa-Gaitán, 1995; Jiménez, 2002; Tropicós, 2023; UNAL, 2023) (Figure 5).

DISCUSSION

The order *Gentianales* is a monophyletic taxon, which is commonly used to produce alkaloids or iridoid compounds or both, treated apart from *Rubiales* by Cronquist (1981), but currently fused together as stated in APG (2023) and Judd et al. (2008). Its medicinal importance is due to the species usefulness in treating malaria since some species in the genus *Cinchona* (*Rubiaceae*) produce quinine. Another family in this group, *Apocynaceae*, have laticifers and glandular tissues that are important to produce cardiac glycosides and alkaloids that are key in biomedical research.

Nearly all taxa in this family are poisonous. Among genera with high potential for becoming a source of medicinal compounds are *Catharanthus*, *Nerium*, *Oxypetalum*, *Rauvolfia*, *Strophanthus* and *Vinca* (Judd et al. 2008).

Oxypetalum cordifolium is a source of alkaloids, sterols and triterpenes, saponins and flavonoids, as recorded by Gaviria et al. (2015). Since it is a common herb and it has been demonstrated that methanol extracts hold useful compounds, this species is a strong candidate for future phytochemical studies.

Ladenbergia oblongifolia is commonly known as “*cascarillo blanco*”, and is a medicinal species broadly used for treating malaria (García-Barriga, 1975). *Ladenbergia* is related to *Cinchona* and species in these genera, as well as in *Remijia*, are referred to as “*cascarillas*”, “*quinas*” or “*pseudoquinas*”. Many of them hold alkaloids and have been traditionally used against malaria and respiratory illnesses (García-Barriga, 1975; López-Medina et al., 2020). A pending task is to conduct phytochemical studies with *L. oblongifolia* individuals from this locality.

Psychotria macrophylla is currently known as *Notopleura macrophylla*, after the traditional section *Notopleura* was separated from *Psychotria* (Taylor, 2001). No medicinal properties are known for species in this genus, but they are important elements of montane floras – along with *Palicourea* –, since they provide flowers and fruits in abundance, contributing to complex ecological interactions. Chemotaxonomy of the *Rubiaceae* family is another very note-worthy issue that has been partially addressed, based on its leaf fatty acid composition, and surprising results have been found about its utility for taxonomical rearrangements (Mongrand et al., 2005).

Rubiaceae has proven to be a very note-worthy family within *Gentianales*, particularly in montane floras, and is quite common in Colombia. The biological composition of this family needs to receive more attention. Studies involving plant reproduction, ecological interactions, phytochemistry, and floristics – at the very least – are urgently needed.

ACKNOWLEDGEMENTS

I wish to thank my former teachers Jorge Eduardo Ramos, the late Philip Silverstone-Sopkin, and Isidoro Cabrera, from the Herbarium of Universidad del Valle (CUVC), for guiding my efforts, helping me identify plants and providing counseling during my botanical studies. I also thank C.M. Taylor from the Missouri Botanical Garden for helping me identify plants and N. Fetcher from Wilkes University for his advice.

REFERENCES

- APG. (2023). *Angiosperm Phylogeny Website*. Version 14, July 2017. <http://www.mobot.org/MOBOT/research/APweb/>.
- Cronquist, A. (1981). *An integrated system of classification of flowering plants*. Columbia University Press. New York, U.S.A.
- Delprete, P. & Cortés, R. (2016). Rubiaceae. 2: 2252–2343. In Bernal-González R, Gradstein SR & Celis M (eds.) *Catálogo de Plantas y líquenes de Colombia*. Colombia. Universidad Nacional de Colombia (Sede Bogotá), Instituto de Ciencias Naturales.

Espinal, L. (1968). *Visión ecológica del Departamento del Valle del Cauca*. Universidad del Valle.

Gamboa-Gaitán, M. & Ramos, J. (1995). Composición florística y diversidad vegetal de un bosque premontano en Los Farallones de Cali. *Memorias del primer congreso nacional sobre biodiversidad* (pp. 71-76). Instituto de Estudios del Pacífico, Universidad del Valle.

Gamboa-Gaitán, M. (1995). *Contribución a la flora de Los Farallones de Cali. I. Vereda Pico de Águila*. [Trabajo de grado, Departamento de Biología, Universidad del Valle].

Gamboa-Gaitán, M. (2018). Flora Farallonensis I: los helechos del bosque premontano de Pico de Águila. *Revista Mutis*, 8(2). 7-24. <https://doi.org/10.21789/22561498.1412>

García-Barriga, H. (1975). *Flora medicinal de Colombia*. Instituto de Ciencias Naturales. Imprenta Nacional.

García, M. (1986). *Biological evaluation of the Chocó biogeographic region in Colombia*. World Wild Fund.

Gaviria, A., Correa, C., Mosquera, O., Niño, J. & Correa Y. (2015). Evaluación de las actividades antioxidante y antitopoisomerasa de extractos de plantas de la ecorregión cafetera colombiana. *Revista Facultad de Ciencias Básicas*, 11(1), 86-101. <https://doi.org/10.18359/rfcb.383>

Hassler, M. (2004 – 2023). *World Plants. Synonymic Checklist and Distribution of the World Flora*. Version 15.3. <https://www.worldplants.de>.

Jiménez, L. (2002). Lista de las colecciones colombianas de Rubiaceae depositadas en el Herbario Nacional Colombiano (COL). *Caldasia*, 24(1), 41-64.

Jones, S. (1988). *Sistemática vegetal*, 2 ed. McGraw-Hill.

Judd, W., Campbell, C., Kellog, E., Stevens, P. & Donoghue, M. (2008). *Plant systematics: A phylogenetic approach*, 3 ed. Sinauer Associates.

López, S., Mostacero, J., Ostilla, N., Gil, A., De La Cruz A. & Villena L. (2020). Cuantificación de alcaloides de *Ladenbergia oblongifolia* (humb. ex mutis) L. Andersson "árbol de la quina". *Revista de Investigación Científica REBIOL*, 40(2), 170–176. <https://doi.org/10.17268/rebiol.2020.40.02.05>

Mendoza, H., Ramírez, B. & Jiménez, L. (2004). *Rubiaceae de Colombia. Guía ilustrada de géneros*. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt.

Mongrand, S., Badoc, A., Patouille, B., Lacomblez, C., Chavent, M. & Bessoule, J. (2005). Chemotaxonomy of the Rubiaceae family based on leaf fatty acid composition. *Phytochemistry*, 66(5), 549-559. <https://doi.org/10.1016/j.phytochem.2004.12.021>

Gamboa-Gaitan, M. A. (2024). <https://doi.org/10.21789/22561498.2070>

Pérez-Arbeláez, E. (1978). *Plantas útiles de Colombia*. 4a ed. Litografía Arco.

Sarria, S. (1993). *Parque Nacional Natural Farallones de Cali*. [Monografía]. Corporación Autónoma Regional del Valle del Cauca CVC, Fundación Protectora de las Cuencas PROCUENCAS.

Taylor, C. (2001). Overview of the neotropical genus *Notopleura* (Rubiaceae, Psychotrieae), with the description of some new species. *Ann. Missouri Bot. Gard.*, 88, 478–515. <https://doi.org/10.2307/3298587>

Tropicos. (2023). Tropicos.org. Missouri Botanical Garden. <https://tropicos.org>.

Universidad Nacional de Colombia UNAL. (2023). *Catálogo Plantas de Colombia*. <http://catalogoplantasdecolombia.unal.edu.co>.