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Artículo

Macrolobium floridum H. Karst. (Fabaceae, Detarioideae), a Venezuelan Coastal Cordillera endemic species not collected since 1844

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Abstract. *Macrolobium floridum*, an endemic species to the Coastal Cordillera of Venezuela, was collected in 1844 by Hermann Karsten, and described by himself in 1861. This taxon had not been recollected until the new reports presented here. A full description based on recent collections, which for the first time includes the fruit, and an updated key to the 35 species of *Macrolobium* reported from Venezuela are provided. The presence of this and other endemic plant species along the Coastal Cordillera demonstrates the important role that protected areas have played in preserving the high plant diversity found along the Coastal Cordillera in the midst of the most populated and industrialized area of Venezuela. The rediscovery of this rare species also suggests that the plant diversity of this cordillera has not been thoroughly sampled.

Keywords: Legumes; conservation; endemism; Cordillera de la Costa; Venezuela

***Macrolobium floridum* H. Karst. (Fabaceae, Detarioideae), una especie endémica de la Cordillera de la Costa de Venezuela no recolectada desde 1844**

Resumen. *Macrolobium floridum*, es una especie endémica de la Cordillera de la Costa de Venezuela, fue colectada en el año 1844 por Herman Karsten y descrita por el mismo en 1861, desde esa fecha la especie no había sido documentada hasta las nuevas colecciones citadas en la presente contribución. Se presenta una descripción completa, basada en colecciones recientes, por vez primera se incluyen frutos; así mismo, se presenta una clave para las 35 especies de *Macrolobium* registradas para Venezuela. La presencia de *M. floridum*, y otras especies de plantas endémicas, a lo largo de la Cordillera de la Costa demuestra el importante papel de las áreas protegidas en la preservación de la alta diversidad de plantas en esta zona, aun estando en el centro de una de las zonas más pobladas e industrializadas de Venezuela. El redescubrimiento de esta rara especie, sugiere que la diversidad de plantas de la Cordillera de la Costa, todavía no está completamente estudiada.

Palabras clave: Leguminosas; conservación; endemismo; Cordillera de La Costa; Venezuela

Introduction

The Coastal Cordillera (Cordillera de la Costa) is the third largest mountain system in Venezuela, extending approximately 800 km from its western extreme in the Turbio-Yaracuy depression (Figure 1), where it is separated from the Venezuelan Andes, to its eastern end at the tip of the Peninsula de Paria in the state of Sucre (Steyermark 1974). Because of their proximity, the Coastal Cordillera and the Venezuelan Andes or Cordillera de Mérida (a name applied to the end spur of East of the Andes Cordillera which trends northeast through the states of Táchira, Mérida, and Trujillo, in Venezuela, see: Engleman 1935) have sometimes been considered a continuous mountain chain. However, these two cordilleras do not share a common geologic history; the Coastal Cordillera is ca. 65 mya (González de Juana *et al*. 1980), whereas the northern Andes complex are only ca. 23.7 mya (Urbani 2011). In addition, the paleobotanical and geomorphological data indicate that final uplift of the northern Andes was completed around 4–3 mya (Kroonenberg *et al.* 1990, Gregory-Wodzicki 2000, Hooghiemstra and van der Hammen 2004, Hooghiemstra *et al.* 2006).

The highest elevations of the Coastal Cordillera are Pico Oriental (2,660 m), Pico Naiguatá (2,765 m), both just north of the country's capital, Caracas, and Cerro Turimiquire (2,630 m) in Anzoátegui state. The Coastal Cordillera also includes the central portion of Serranía del Interior (Aragua, Guárico and Miranda states), and Sierra de San Luís (Falcón state), isolated, low elevation mountain ranges, as well as all mountains system located in Venezuelan islands (Margarita island being the main one). The coastline of the Caribbean Sea forms the northern limit of the Coastal Cordillera, and to the south, it is bordered by the plains known as the "Llanos del Orinoco" (Huber 1997).

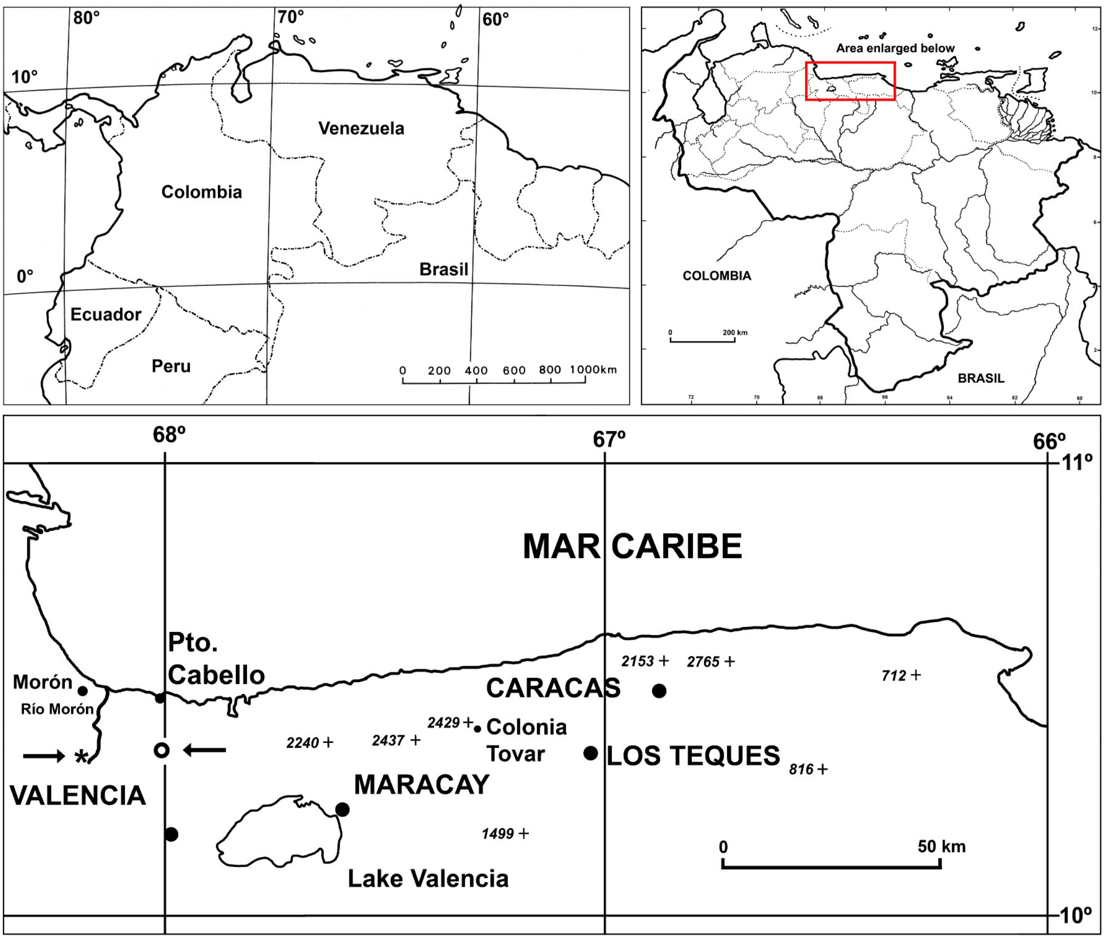

Figure 1. Map showing the central Coastal Cordillera of Venezuela (collection localities indicated with arrows). Symbols: ● [solid circle], main cities; +, highest elevation points; * [asterisk], approximate new locality; ○ [open circle], approximate type locality.

The five most densely populated and industrialized dependencies of Venezuela are found along the central portion of the Coastal Cordillera, including the "Distrito Capital", the seat of the country's capital, and the states of Aragua (Capital: Maracay), Carabobo (Valencia), Miranda (Los Teques), and La Guaira (La Guaira). Furthermore, a relatively high percentage of this area is currently protected in national parks and national monuments than the average for the entire country (Table 1).

Table 1. Comparison of population indices in different regions of Venezuela in the year 2000[1].

Region	Nº. dependencies[2]	% Total surface	% Total population	Population density[3]	% Rural population
Venezuela	24	100	100	26.42	12.91
N of the Orinoco	21	50.29	93.35	95.49	17.44
S of the Orinoco	3	49.71	6.65	2.71	43.47
Central Coastal Cordillera[4]	5	2.15	25.67	305.1	3

[1] Data from Machado-Allison and Rivas, 2004, population from page 51.
[2] States or districts.
[3] In number of inhabitants per square kilometer.
[4] Includes the Capital District and the states of Aragua, Carabobo, Miranda, and Vargas.

The summits and uppermost slopes of the Coastal Cordillera are mostly covered by humid montane forest, which extends between 600–2,000 m. Deciduous, humid low forest and "subpáramo" formation dominated by *Espeletia* (*Libanothamnus*) *neriifolia* (Bonpl. ex Humb.) Sch. Bip. ex Wedd. (Asteraceae) also are found in this region. Scrubs and low forests are present in the arid coastal region, and savannas and herbaceous formations occur on lower slopes, mainly in the interior valleys (Huber and Frame 1988). Steyermark (1974, 1979, 1982) and Manara (1996) studied the Coastal Cordillera flora and concluded that in addition to endemic taxa, the vegetation of this region was a blend of Central American, Caribbean, Andean, and several Guayana-Amazonian elements. According to Huber *et al.* (1998) and Duno de Stefano *et al.* (2009) the region holds between 3,000-3,500 species of vascular plants, of which about 278 are endemic. Meier (1998) cited 31 endemic species from the Cerro del Ávila region alone.

Amongst the several phytogeographical elements found in the Coastal Cordillera, those from the Guayano-Amazonian region are "... highly significant to the slopes of cloud forest" (Steyermark 1974). Of the genera predominantly from the Guayano-Amazonian region found in the Coastal Cordillera, we can cite: *Froesia* Pires (Ochnaceae: *F. venezuelensis* Steyerm. & G. S. Bunting), *Macrocentrum* Hook. f. (Melastomataceae: *M. yaracuyense* Wurdack), and *Roucheria* Planch. (Hugoniaceae: *R. laxiflora* H. Winkl.). Amongst the latter, the following examples are worth mentioning: *Dicranostyles costanensis* Steyerm. & D. F. Austin (Convolvulaceae), and three endemic species of the genus *Macrolobium* Schreb. (Fabaceae, Detarioideae): *M. floridum* H. Karst., *M. obtusum* R. S. Cowan and *M. steyermarkii* R. S. Cowan.

Macrolobium floridum was collected by [Gustav Karl Wilhelm] Hermann Karsten (1817–1908) in March 1844, during his first trip to the Coastal Cordillera, and posteriorly described by him (Karsten 1859–1869). No additional specimens of this species were available for examination until the senior author identified two additional collections gathered in 1991 close to the type locality by a team of botanists from Herbarium PORT, UNELLEZ-Guanare, Venezuela (Figure 1).

Here we present a brief historical account of Karsten's work in Venezuela, a concise overview of *Macrolobium*, and a complete description of *M. floridum*. We argue that the current Venezuelan system of Areas Bajo Régimen Administrativo Especial (ABRAE; which includes national parks and 15 other categories of protected areas) established along the Coastal Cordillera has over the years provided refuge to many rare plant species, as demonstrated by the re-discovery of *M. floridum* and the recent finding of many other species in the most densely populated and industrialized part of the country. We also argue that, despite intense pressure from diverse interest groups in Venezuela to develop areas currently occupied by ABRAE, it is critical that these areas be maintained under protection in order to maintain this rich biodiversity for future generations. Furthermore, the re-discovery of this species and the additional reports cited here suggest that the Coastal Cordillera of Venezuela has not been thoroughly sampled.

Material and Methods

This work is based on morphological (using a dissecting stereomicroscope) and herbarium studies in GH, MO, NY, PORT, VEN and W (herbarium codes after Thiers 2019). In addition, historical and current taxonomic literature on *Macrolobium* was examined, in particular the protologue and delightfully plate (Figure 2) in Karsten (1859–1869), and the specimen citation is here quoted verbatim. Karsten`s collections at W were consulted and those elsewhere were mostly examined at the Herbarium of the Natural History Museum in Vienna website (https://www.nhm-wien.ac.at/en/research/botany)

A monograph of the genus (Cowan 1953), and the treatment of *Macrolobium* in the Flora of the Venezuelan Guayana (Cowan and Berry 1998) were consulted. In addition, Tropicos (http://legacy.tropicos.org/Home.aspx) provided nomenclatural data and links to the Biodiversity Heritage Library (http://www.biodiversitylibrary.org/), which offered free access to botanical literature published during the last three centuries. To determine the conservation status of *M. floridum* (according to the IUCN categories and criteria; IUCN, 2017), 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), constantly updated through the https://www.kew.org/science/our-science/projects/geocat-geospatial-conservation-assessment-tool

Results

History

The life, the academic and scientific legacy of Hermann Karsten has been well documented by Röhl (1944, 1948), Tryon (1963), Alert (1999) and lately by Carrillo-Briceño *et al.* (2016). Nonetheless, it is important to emphasize that he was one of the most prodigious and tireless European naturalists (e.g., Richard Spruce, Alfred R. Wallace) who came to the New World in the nineteenth century inspired by Alexander von Humboldt and Aime Bonpland's travels.

Figure 2. Plate of *Macrolobium floridum* H. Karst. from *Flora Columbiae* (Karsten 1861: I, tab. 75, 1861).

Karsten earned a Doctor of Philosophy degree at Trendelenburg in 1843, and soon after received an offer to travel to Venezuela and stay with his friend Carl Ruehs, who had a hat factory at Puerto Cabello, the most important port city of the new Republic of Venezuela. He readily accepted the offer and soon after his arrival, he explored and collected plant specimens in the humid forest located in La Fila de San Esteban south of Puerto Cabello. Subsequently, in the vicinity of Colonia Tovar and Caracas, and north of Guárico state, thus conducting the first intensive botanical survey in the Coastal Cordillera. After returning to Stralsund, Prussia, Karsten published a gorgeously illustrated summary of his trip in Venezuela entitled *Auswahl Neuer Und Schon Bluhender Gewachse Venezuela's* (Selection of new plants with showy flowers from Venezuela, see Karsten 1848). He returned to America in 1848, and for the next eight years explored the eastern and western portions of Venezuela, as well as parts of Colombia and Ecuador, collecting and studying in the field hundreds of species of plants, especially palms, tree ferns, and species of *Cinchona*, the source of quinine. In addition, he made an extensive collection of fossils and geological samples, including an interesting example of Ammonites, collected close to Río Chabasquén (currently Portuguesa state, Venezuela; see Alvarado 1911).

Based on his botanical collections, Karsten later described more than 600 taxa in *Flora Columbiae*, published in two folio volumes between 1859 and 1869 (Karsten 1856–1857) and also Karsten (1859–1869). The color plates of *Flora Columbiae* are extremely beautifully, detailed and botanically accurate (Fig. 2), but unfortunately they are seldom cited in the botanical literature (Aymard 2019).

Systematics, nomenclature, and description

Macrolobium Schreb. (1789: 30) is a neotropical genus with ca. 80 species (Lewis *et al.* 2005; Estrella *et al.* 2012; Féliz-Da-Silva *et al*. 2016), it is represented by trees or shrubs ranging from 0.6 to 4 m (i.e., *M. longipes* R S. Cowan) to 40 m tall (i.e., *M. acaciifolium* (Benth.) Benth.). Marked floral zygomorphy and a reduced number of petals and/or stamens, are the characters that distinguish this genus (Cowan 1953; Tucker 2002). According to Cowan and Polhill (1981), *Macrolobium* was assigned to tribe Amherstieae, group *Macrolobium*, as pointed out by Bruneau *et al.* (2000, 2001) and Herendeen *et al*. (2003) as genus morphologically diverse and doubtfully monophyletic. However, recent phylogenetic analyses based in molecular and morphological data placed this genus into the order Fabales, family Fabaceae, subfamily Detarioideae (LPWG 2017). This new classification separated the Leguminosae (or Fabaceae) in six subfamilies and showed that these subfamilies originated nearly simultaneously (Koenen *et al.* 2020). The classification used the most comprehensive phylogenetic analyses of legumes to date, based on plastid matK gene sequences, and including near complete sampling of genera (698 of the currently recognized 765 genera) and ca. 20% (3,696) of known species (LPWG 2017).

As currently circumscribed, the genus can be distinguished from other neotropical genera of Detarioideae by the following features: racemose inflorescences, one auriculate petal, large, with 1-4 reduced, minute petalodes, fertile stamens 3, with or without reduced staminodes, all stamens free and in one whorl, and an exserted stipitate gynoecium.

The Amazon river basin (mainly the Rio Negro basin), and the Guayana Shield (i.e., *M. acrothamnos* R. S. Cowan) are the regions with the highest species richness and morphological diversity for *Macrolobium*, containing 60% the former and 14% the latter region of the currently known species. In addition, the genus is found in the Llanos of Colombia and Venezuela, the northwestern Andes and Coastal Cordillera of Venezuela, one species in Trinidad and Tobago (*M. trinitense* Urban) and two taxa in Bahia-Minas Gerais region (eastern Brazil). Additionally, four species are found in the western slopes of the Andes: Chocó bioregion of Colombia and Ecuador, and four (*M. costaricense* W. C. Burger, *M. herrerae* Zarucchi, *M. modicopelatum* Schery, and *M. pittieri* (Rose) Schery) in Mesoamerica (Zarucchi 2001). Lately, a new species had been described from Serra da Aracá, Amazonas, Brazil (see: Farronay *et al*. 2018). African species formerly referred to *Macrolobium* have been transferred to other genera (Cowan 1953, Léonard 1954, 1955).

Most species of *Macrolobium* throughout its distribution occur in lowland rainforest (terra firme in Amazonia) and periodically flooded forests located in the Amazon and Orinoco rivers. However, some species are common in savannas and shrublands over sandy soils (i.e., *M. discolor* Benth; *M. savannarum* R. S. Cowan), Rio Negro caatinga forests (i.e., *M. limbatum* Spruce ex Benth.), Guayana Shield shrublands on granite outcrops (i.e., *M. campestre* Huber), and igapó forests (i.e., *M. taxifolium* Spruce ex Benth.).

Pittier *et al*. (1945) were the first to provide a formal account of *Macrolobium* in Venezuela, reporting five species with common names and localities. Cowan (1953) registered 14 species in Venezuela in his monograph of the genus, and Cowan and Berry (1998) reported 31 species for Venezuela. Currently, 35 taxa of *Macrolobium* are recognized in the flora of Venezuela (Stergios *et al*. 2008), which can be separated using the key in appendix 1.

Taxonomic treatment

Generic name. *Macrolobium* Schreb. 1 (30: 1789). Type species: *Macrolobium vuapa* J.F. Gmel.

Macrolobium floridum H. Karst., Fl. Columb. 1: 151, t. 75. 1861. TYPE (Typified by Cowan 1953): VENEZUELA. Carabobo [currently]: "Cordillera littorali Venezuelae prope Puerto Cabello in silva humida, umbrosa montis, 'Cumbre chiquita' appelati, altitudine 200 metr.,' March 1844, H. G. W. K. Karsten s.n. (HOLOTYPE: presumably at LE, not seen; Isotype, W; note: this specimen is labeled with the following information: Campanero, Pto. Cabello). Figures 2–4.

Here we follow Cowan (1953) in the designation of types. However, According to Stafleu and Cowan (1979), 'Alphonse de Candolle... cites Leningrad (LE) as the herbarium with a large set (2,000) of Columbian plants collected by H. G. W. K. Karsten. Another important set is at Wien herbarium - W (3,594). It is not known whether this was the first set, and whether it really contains Karsten's types....".

The two folio volumes of *Flora Columbiae* are rare books. We provide in appendix 2 a verbatim transcription of Karsten's original Latin description of *Macrolobium floridum*, which may otherwise be difficult to obtain.

The following updated description is largely based on Cowan (1953), supplemented by a description of the immature fruit that hitherto had not been examined:

tree, 20–25 m tall, branches and branchlets glabrous. Petioles 4–6 mm long. Leaflets 15–30 cm long, 8–11 cm wide, sessile, lanceolate-elliptic, the base inequilateral, the longer side rotund-subcordate, the shorter acute, the apex bluntly acute; costa salient, the primary veins prominulous above, prominently salient beneath, the venules prominulous. Inflorescence about 5–15 cm long, peduncle ca. 3.5 mm long, the axis minutely puberulous; bracts 2–3 mm long and wide, ovate, acute, glabrous within, puberulous externally. Hypanthium 9–12 mm long, on a stipe ca. 2 mm long. Sepals 10–13 mm x 3–7 mm, elliptic-oblong, obtuse apically, glabrous within, puberulous externally. Petal blade 27–35 mm long, 15–18 mm wide, elliptic-oblong, the claw ca. 3 mm long, pilosulose basally on the costa. Filaments 40–45 mm long, glabrous, the anthers ca. 5 mm long, ca. 2 mm wide. Stigma subcapitate. Style ca. 35 mm long, short-pilosulose. Ovary ca. 3 mm long, ca. 1 mm wide, oblong, short-pilosulose to hairy marginally (Figure 3), laterally puberulous, 5-ovulate; free portion of the gynophore ca. 2 mm long, pilosulose. Fruit (immature) oblong, glabrous 10–11 cm x 2.5–3 cm, wider toward the apex, apically rostrate.

Additional specimens examined: VENEZUELA. Carabobo: Municipio Mora, sector La Justa, río Morón, bosques de galería, 200-650 m, 10º 17’ N - 68º 10’ W, 22–23 Julio 1991, W. Díaz & W. Jiménez 353 (PORT); same locality and date, W. Díaz & W. Jiménez 412 (NY, PORT: Figure 4).

Common name: “Cacaito” (Díaz and Ortega 2006), from the Spanish diminutive of "cacao", in reference to the fruit of *Theobroma cacao* L. - Malvaceae. In addition, “Cacaito” is a common name for a number of plants in Venezuela, mainly those of

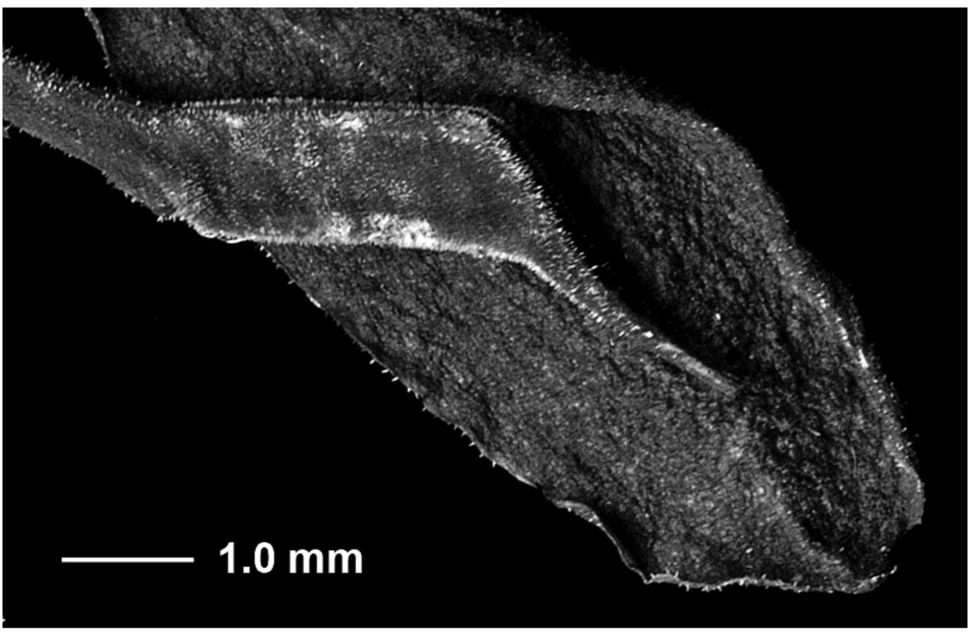

Figure 3. Ovary of *Macrolobium floridum* H. Karst., the integument of which the author described as hirtum (from the Latin hirtus, hairy), a character that distinguishes this species from its closest relatives: *M. limbatum* Spruce ex Benth. and *M. obtusum* Pittier. Notice petalode in the background (from Díaz & Jiménez 412, PORT).

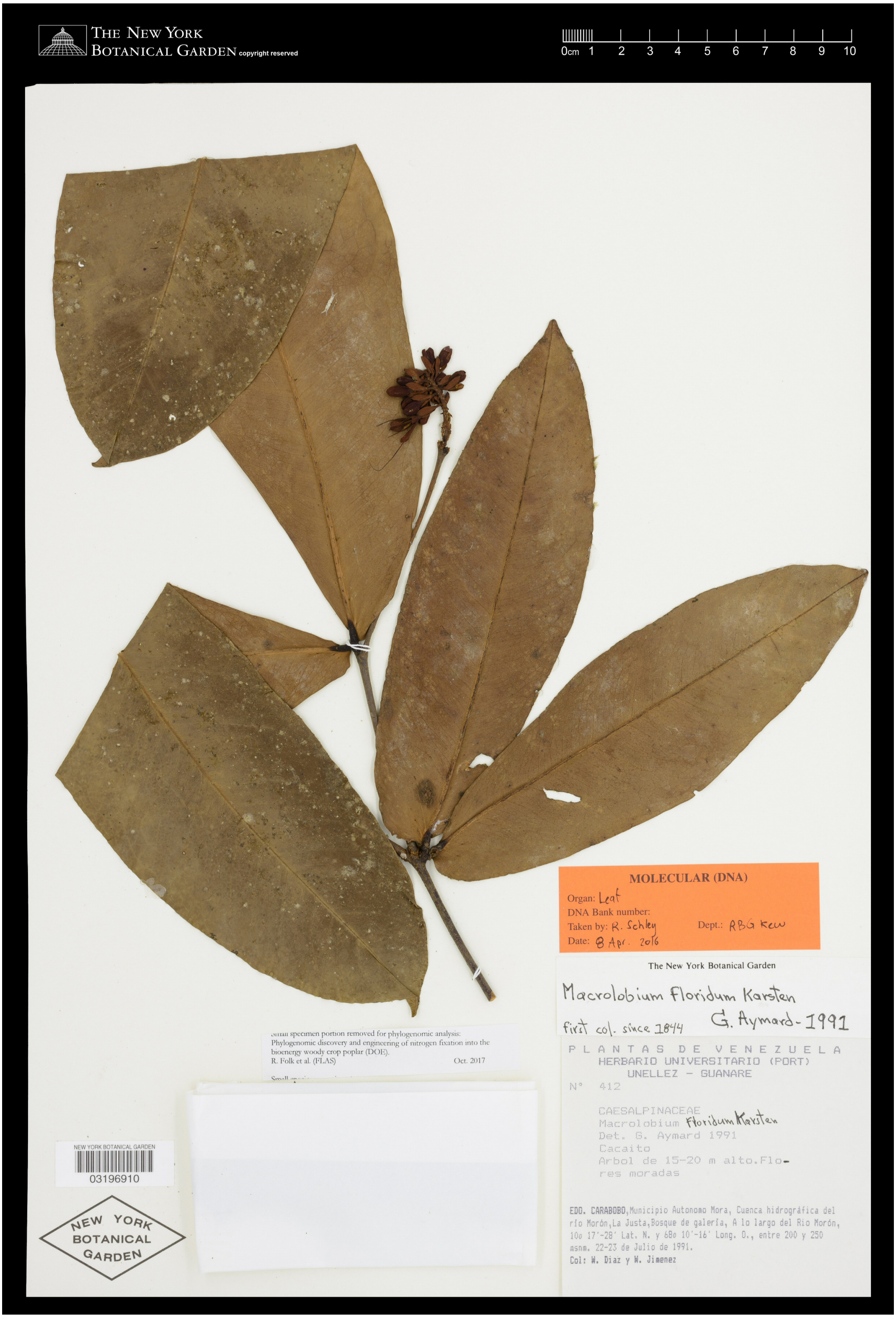

Figure 4. Specimen of *Macrolobium floridum* H. Karst. from sector La Justa, río Morón, Carabobo state, Venezuela (from Díaz & Jiménez 412, NY 03196910).

species of *Herrania* Goudot - Malvaceae (Pittier 1926, 1939, Schnee, 1973; Rondón y Cumana 2005). Also, several species of *Eschweilera* Mart. ex DC. (i.e., *E. parviflora* (Aubl.) Miers; *E. pedicellata* (Rich.) S.A. Mori) - Lecythidaceae found on the lowland humid forests located in Amazon and Guayana Shield areas in Venezuela (Mori 1999).

Ecology and habitat: Known only from humid lowland to midland forest in Carabobo state, Venezuela, at 200-650 m (Figure 1).

Identification: According to Cowan (1953), because of its cylindric hypanthium, bracteoles opening completely on the abaxial side (but only partially on the adaxial side of the flower), four sepals equal in size and shape, and the petal sessile or with a claw much shorter than the blade, *M. floridum* was referred to section *Stenosolen*. The leaves with a single pair of relatively long leaflets place this species close to *M. limbatum* Spruce ex Benth. and *M. obtusum* Pittier. Nevertheless, *M. floridum* is further distinguished by its ovary densely short-pilosule on the margins, puberulous on the lateral surfaces (Figure. 3). In contrast, the ovary in *M. limbatum* and *M. obtusum* is puberulous on the margins and glabrous on the lateral surfaces.

Pittier (1917) published a description of *M. floridum* based on one of his collections from Panama. Later, Rose (1930) based *Vouapa pittieri* Rose on this collection; later, Schery (1951) transferred this species to *Macrolobium.* Britton and Killip (1936) reported *M. floridum* from pluvial forests located in the Chocó area in western Colombia, based in material collected by W. A. Archer in 1931. However, after studying Archer`s material, Cowan (1953) described a new species (*M. archeri* Cowan), the latter currently is also known of Ecuador and Perú. Based on the basally asymmetrical leaflets and petal blade between 27–42 mm long, both *M. pittieri* and *M. archeri* appear to be similar to *M. floridum*, but the latter can be distinguished by its inflorescence 5–15 m long, sepals 10–13 mm, long, hypanthium minutely puberulous, and ovary ca 3 mm long, laterally puberulous (vs inflorescence ca 3.5 cm long, sepals 17–22 mm long; hypanthium glabrous, and ovary 3–7 mm long, laterally glabrous).

Conservation status: In the second edition of red book of Venezuelan plants (Huérfano *et al*. 2020), *M. floridum* was simply mentioned as a taxon with insufficient data. Currently, this species is only known from the type and one additional collection, and it is reported here as rare species. However, under IUCN (2017) guidelines two localities constitute deficient data (DD) to determine its conservation status. Nevertheless, it should be regarded as Critically Endangered [CR, B2ab(ii)] due to it lower estimated Area of Occupancy, with just 8,000 km^2, an estimated Extent of Occurrence of 0.089 km^2, and the continuous deforestation and degradation of the ecosystems of the Coastal Cordillera in the last five decades.

Although conservation status assessments can still be carried out for species with such low numbers of collections (Rivers *et al*. 2011), it may be hard to determine whether an appearance of rarity in a species is due to the lack of data or to its actual rarity. Also, it is important to note that a species with such limited data actually can be endangered, and thus a reassessment will be needed when more data become available (Maas *et al*., 2019). In addition, the region where *M. floridum* was found, La Reserva Hidraúlica del Río Morón, is "apparently" well protected by Palmichal, a subsidiary of the Venezuelan Oil Company (Petróleos de Venezuela, PDVSA). Furthermore, the type locality (presumably included in La Fila de San Esteban) is being protected by the Venezuelan National Park service (Instituto Nacional de Parques, INPARQUES).

Discussion

The re-discovery of a showy tree such as *M. floridum* after almost 150 years is remarkable, especially when one considers that it was re-collected along the central Coastal Cordillera of Venezuela. This region, constituted by the Distrito Capital and (from east to west) the states of Miranda, La Guaira, Aragua, and Carabobo, represents only 2.2 % of the territory of Venezuela. The latter region houses 31.9 % of the country's total population, representing by far the highest population density in the country (ca. 465 versus ca. 34 inhabitants per square kilometer for the entire country (data from Instituto Nacional de Estadística de Venezuela 2021). The value is higher than the population density of France (ca. 106 inhabitants per square kilometer), Germany (224), or England (275); the latter three calculated from land area and population (Central Intelligence Agency 2021). The central Coastal Cordillera is likewise the most heavily industrialized region of Venezuela. Despite being highly developed, 18% of this area is currently protected in national parks and national monuments, compared to 15% for the entire country. This percentage is barely surpassed by the protected areas found south of the Orinoco River, which account for 19% of this region. The latter, however, has a population density of only 1.6 inhabitants per square kilometer (Instituto Nacional de Estadística de Venezuela 2021). Although heavily populated and industrialized, the central Coastal Cordillera of Venezuela has large, protected areas, but the high population density no doubt threatens much more the protected areas of this region than those in the scarce populated portion of Venezuela found south of the Orinoco river.

Elevational and topographic gradients have a determinant influence on biodiversity patterns, additionally, high-elevation habitats are among the most diverse in the world (Rahbek *et al*. 2019a,b). Mountain range uplift creates significant topographic heterogeneity, providing a huge variety of microclimatic niche space in which plants and other organisms can become established (Körner 2004), as well as chances for isolation and allopatric speciation, which can promote diversity and high levels of endemism (Antonelli *et al*. 2009). However, *M. floridum* is only one example of the present day endemic plant diversity that harbor the mountain ecosystems in the Coastal Cordillera. Huber (1997) estimated that 10% of the flora of the Coastal Cordillera of Venezuela is endemic. Noteworthy examples of this endemism are: *Dacryodes costanensis* Steyerm. (Burseraceae), *Trigonia costanensis* Steyerm. & V. M. Badillo (Trigoniaceae) and *Cremastosperma venezuelanum* Pirie (Annonaceae). This species (Chatrou and Pirie 2005) is the second representative in Venezuela of this remarkable genus, the first being *C. macrocarpum* Maas from Falcón and Yaracuy states (Maas *et al*. 1996). Other significant endemic species include *Juglans venezuelensis* W. E. Manning

(Juglandaceae), *Cinnamodendron venezuelense* Steyerm. (Canellaceae), *Rhodostemonodaphne avilensis* Madriñan (Lauraceae), *Billbergia manarae* Steyerm. (Bromeliaceae), *Gyranthera caribensis* Pittier (Malvaceae), *Xylosma avilae* Sleumer (Salicaceae), *Guettarda frondosa* Moritz ex Standl. (Rubiaceae), *Besleria steyermarkiorum* Wiehler ex L. E. Skog (Gesneriaceae), *Chionanthus avilensis* (Steyerm.) P.S. Green (Oleaceae), *Klarobelia subglobosa* Chatrou (Annonaceae), *Habenaria galipanensis* Kraenzl. (Orchidaceae), *Pogonia nana* Schltr. (Orchidaceae, known only from the type, destroyed in B), *Niedenzuella caracasana* W. R. Anderson (Malpighiaceae, see Anderson 2006), *Dichapetalum steyermarkii* Prance (Dichapetalaceae), *Stephanopodium venezuelanum* Prance (Dichapetalaceae) and lately *Palicourea winfriedii* C. M. Taylor (Rubiaceae, see Taylor 2021) and six new endemic species of the genus *Anthurium* Schott (Araceae, see Croat and Hanson 2021). An outstanding finding in this area is *Selaginella gigantea* Steyerm. & A. R. Sm. (Selaginellaceae), described in 1986 and only known from the type collected in Borburata, Carabobo state. Plants of this species certainly have the thickest stems in the genus; they are climbing/scandent, not self-supporting, and they lean on other vegetation forming a "compact cover' (A. C. Smith, pers. com. 2016). In addition, the authors found a new species of *Caryodaphnopsis* Airy-Shaw (Lauraceae) among collections made in 1984 by Andy Field in forests dominated by *Gyranthera caribensis* Pittier (Malvaceae) in the "Henri Pittier" National Park (Aymard and Romero 2009). *Caryodaphnopsis*, a genus previously known only from southeastern Asia (Kostermans 1974) is currently known to occur in wet lowlands areas in the Neotropics (Costa Rica, Panama, Colombia, Ecuador, Peru and Brazil; van der Werff and Richter 1985, van der Werff 1991), and it is here reported for the flora of Venezuela.

These examples demonstrate the important role that national parks and other protected areas (ABRAE) have played in preserving the native plant diversity of the Coastal Cordillera. National parks, natural monuments, and wildlife refuges constitute ca 20% of the country's total area, "... making Venezuela one of the world's leading conservation nations" (UN- Forum on Forests 2021). A sad example of the destruction of a pristine non-protected forest is "Cerro La Chapa", ca 6 km from Nirgua, Yaracuy state. This mountain area was covered by cloud forests with many endemic species (e.g., *Asterogyne yaracuyense* Steyerm. & Henderson (Arecaceae); *Psychotria yaracuyensis* Steyerm. (Rubiaceae); and *Aegiphila arcta* Moldenke (Verbenaceae), of which currently only a small patch remains (Stauffer and Duno de Stefano 1998, Meier 1999).

The re-discovery of *M. floridum*, and the recent finding of new, unique plant species underscore not only the need for the maintenance of the current system of ABRAE but also for more systematic botanical sampling in the Coastal Cordillera. The collection of *Guarea carinata* Ducke (Meliaceae) in the Coastal Cordillera (W. Díaz 81: K, PORT) also supports this view. This species, never collected before in Venezuela, was found with the most recent collection of *M. floridum*. *Guarea carinata* is a common species in terra firme forests in the Amazonian Ecuador, Peru and Brazil, Guyana, Surinam, not yet recorded from Amazonian Colombia, but almost certainly present there (Pennington and Clarkson 2013).

The Coastal Cordillera flora has long been eclipsed by that of the Venezuelan Guayana region, of which a nine-volume, comprehensive flora has been published

(Steyermark *et al*. 1995–2005). Several other publications on the Venezuelan Guayana have appeared, including reports on new vegetation communities (Aymard *et al*. 1997, 1998, 2006), overviews of diversity of vegetation types and a phytogeographical analysis of the vegetation of tepuis (Riina *et al*. 2019). Aside from local floras, florulas and checklist (Steyermark 1966, 1975, Steyermark and Agostini 1966; Steyermark and Huber 1978; Berry and Steyermark 1983, Steyermark and Delascio 1985, Hoyos 1985, Badillo *et al*. 1984) and several publications on the structure, floristic composition, and regeneration of forests (Huber 1986, Monedero and González 1995, Meier 1998, González 1999, Smith and Field 2001, Howorth and Colonnello 2005), no other major publications on the flora of the Coastal Cordillera have been published recently. Clearly, a new concerted effort is need to systematically sample and study the plant diversity of the Coastal Cordillera.

Today, more than ever, Venezuela's ABRAE need to be preserved. These protected areas are under tremendous pressure from special interest groups to be occupied and developed, especially in regions with high population densities and industrial and touristic developments, such as the Central Coastal Cordillera. The World Conservation Union (IUCN) has adopted a new paradigm of protected areas, incorporating "Culturally modified landscapes" and "managed resource areas" that allow resource extraction (Locke and Dearden 2005, Büscher and Fletcher 2020). However, it is essential that existing and future ABRAE in this area be kept within the first four categories of Area Management (IUCN 2008), namely, I (Strict Nature Reserves and Wilderness Areas), II (National Parks), III (National Monuments), and IV (Habitat/Species Management Areas). Only the highest levels of protection can warranty the preservation of the rich biodiversity of the central Coastal Cordillera for future generations.

The protection and maintenance of biodiversity is a global priority. Otherwise, many life forms currently found in the tropics will be eliminated by human activities. Ideally, humanity should be able to accommodate other species without formal protected areas (Locke and Dearden 2005, Büscher and Fletcher 2020). However, global experience clearly shows that this is not the case. Protected areas are needed and, at least in the case of ABRAE along the Coastal Cordillera of Venezuela, they apparently have been highly successful in slowing down biodiversity degradation.

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Appendix 1. Key to species of *Macrolobium* found in Venezuela (based in Cowan and Berry 1998). Endemic species indicated with the symbol "♦".

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1. Leaves with a single pair of leaflets, or a single leaflet ... 2
1. Leaves with 2–45 pairs of leaflets ... 18

2. Leaves with a single leaflet ... *M. unifoliolatum* Cowan var. *unifoliolatum* (Amazonas)
2. Leaves with a single pair of leaflets ... 3

3. Apex of leaflets rounded to emarginate ... 4
3. Apex of leaflets truncate acute, acute to acuminate ... 7

4. Leaflets over half as wide as long ... *M. acrothamnos* Cowan (Bolívar)♦
4. Leaflets less than half as wide as long ... 5

5. Leaflets sessile; inflorescences ramiflorous; petal ca 5 mm long ... *M. exfoliatum* Cowan (Amazonas)♦
5. Leaflets with petiolules 1–10 mm long; inflorescences axillary or terminal; petal 13–20 cm long 6

6. Petiole 6–11 mm long, strongly canaliculate; bracteole ca 10 mm long, petal 13–15 mm long ... *M. canaliculatum* Spruce (Amazonas)
6. Petiole 3–5 mm long, not canaliculate; bracteole 1–1.5 mm long, petal ca, 20 mm long... ... *M. obtusum* Pittier (Aragua, Carabobo)♦

7. Leaflets 15–40 × 6–15 cm ... 8
7. Leaflets usually smaller than above ... 10

8. Leaflets 30–40 long cm, inflorescences always ramiflorous ... *M. wurdackii* Cowan (Amazonas)♦
8. Leaflets 15–30 cm long, inflorescences axillary to ramiflorous ... 9

9. Leaflets with a well-developed marginal vein, punctate on the lower surface; ovary puberulous on the margins, glabrous on the lateral surfaces ... *M. limbatum* Spruce ex Benth. (Amazonas)
9. Leaflets without a well-developed marginal vein, epunctate; ovary densely short pilosule on the margins, puberulous on the lateral surfaces ... *M. floridum* H. Karst. (Carabobo)♦

10. Ovary glabrous or minutely puberulous... 11
10. Ovary pubescent along the margins or over the entire surface ... 15

11. Leaflets with petiolules 2–6 mm long, coriaceous, rigid ... 12
11. Leaflets sessile, thinner and less rigid than above ... 16

12. Bracteole 12–15 mm long; claw of petal ca. 10 mm long, petal red ... *M. rubrum* Cowan (Amazonas)
12. Bracteole 3.5–13.5 mm long; claw of petal absent or 4–5.5 mm long; petal white ... 13

13. Tree to 40 m tall: leaflets arcuate, oblong-elliptic; sepals 3–4 mm long; petal orbicular ... *M. amplexans* (Amshoff) R.S.Cowan (Bolívar)
13. Shrub or small tree to 10 m tall; leaflets falcate, elliptic or lanceolate; sepals 4–9.5 mm long; petal oval, suborbicular or spatulate … 14

14. Shrub or small tree to 10 m tall; petioles 9–20 mm long; inflorescence 4–7.5 cm long; petal oval or suborbicular ... *M. punctatum* Spruce ex Benth. (Amazonas)
14. Slender shrub 1.5–3 m tall; petioles 3–6 mm long; inflorescence 3–5.5 cm long; petal spatulate …. *M. stenopetalum* Amshoff (Amazonas)

15. Leaflets 2–3(4) cm long, apex obtuse to acute; sepals 4, uniform; subshrubs 0.1–0.2–m tall ... *M. savannarum* Cowan (Amazonas)
15. Leaflets 4–12 cm long, apex acute to acuminate; sepals 5, dimorphic; shrub (0.5–)1–3(–10) m tall ... *M. suaveolens* Spruce ex Benth. *senso latu* (Amazonas)

16. Ovary pubescent on all surfaces ... *M. bifolium* (Aubl.) Pers. (Amazonas, Apure, Bolívar, Delta Amacuro)
16. Ovary pubescent only on the margins ... 17

17. Bracts ca. 5 x 3 mm, never triangular; bracteoles strigulose within, densely puberulent to pilosulous externally; ovary pilosulous on the margins ... *M. angustifolium* (Benth.) Cowan (Amazonas, Bolívar)
17. Bracts 1–1.5 x 1–1.5 mm, triangular; bracteoles glabrous or minutely puberulent externally; ovary minutely puberulent on the margin ... *M. suaveolens* Spruce ex Benth. *sensu lato* (Amazonas, Bolívar)

18. Leaflets mostly 2–4 pairs, petiolules 2–4 or 10–12 mm long; bract 5.5–17 mm long ... 19
18. Leaflets 2–45 pairs, sessile or 0.5–1 mm long; bract 1–5 mm long ... 20

19. Leaflets 3 or 4 pairs, petiolules 6–8 x 3–4 cm, spaced 2–3 cm apart, not conspicuously veined; petiolules 10–12 mm long; sepals 5; bract less than 12.5 x 4 mm ... *M. campestre* Huber (Bolívar)
19. Leaflets 2 or 3 pairs, 7–10 x 4–6 cm, spaced (2 cm apart, conspicuously veined; petiolules 2–4 mm long; sepals 4; bract 14–17 x 4–7 mm ... *M. spectabile* Cowan (Amazonas)♦

20. Leaflets 10–45 pairs ... 21
20. Leaflets 2–9 pairs ... 29

21. Leaflets 35–45 pairs, the upper surface strongly convex and shiny; ovary glabrous... ... *M. taxifolium* Spruce ex Benth. (Amazonas)♦
21. Leaflets 10–35 pairs, or if to 40 pairs, then leaflets not strongly convex and shiny and ovary densely pilosulose on margins ... 22

22. Filaments glabrous ... 23
22. Filaments pubescent or villous, sometimes only at the base ... 24

23. Costa on upper surface of leaflets impressed; leaflets concolorous on upper and lower surfaces; bracteoles and pedicels pilosulous; fruits suborbicular…. *M. acaciifolium* (Benth.) Benth. (Amazonas, Apure, Bolívar, Delta Amacuro, Monagas)
23. Costa of leaflets distinctly raised on both surfaces; leaflets much paler on the lower surface; bracteoles and pedicels lanulose-puberulent; fruits narrowly oblong ... *M. longeracemosum* Amshoff (Bolívar)

24. Inflorescence < 2 cm long ... *M. gracile* Spruce ex Benth. var. gracile (Amazonas)
24. Inflorescence > 2 cm long ... 25

25. Leaflets with secondary veins not evident; bracts elliptic-lanceolate ... *M. evenulosum* Cowan (Amazonas)♦
25. Leaflets with secondary veins prominent or at least faintly evident; bracts triangular-ovate, elliptic or oblanceolate or obovate ... 26

26. Leaflets 22–40 pairs, 12–15(20) x 3–4 mm; fruits 2–3 times longer than wide ... *M. gracile* var. *confertum* (Gleason) Cowan (Amazonas)
26. Leaflets 10–16 pairs, 15–45 x 5–15 mm; fruits ca. 4 times longer than wide ... 27

27. Leaflets 0.9–7.2 cm wide; bracteoles oblanceolate or obovate, ca. 2 mm long, glabrous inside; petals sessile; filaments 12–35 mm long … *M. colombianum* (Britton & Killip) Killip ex Uribe *sensu lato* (Carabobo, Lara, Miranda, Sucre, Yaracuy)
27. Leaflets 3–15 mm wide, bracteoles elliptic or triangular-ovate, 5–7 mm long, sparsely pilose or villous inside; petals claw 3.5–7.5 mm long; filaments ca. 10 mm long ... 28

28. Leaflets 3–7 mm wide; bracteoles elliptic, sparsely pilose inside; petals claw ca. 3.5 mm long ... *M. venulosum* Benth. (Amazonas, Bolívar)
28. Leaflets 5–15 mm wide; bracteoles triangular-ovate, villous inside; petals claw 4–7.5 mm long ... *M. flexuosum* Spruce ex Benth. (Amazonas)

29. Upper surface of leaflets pilosulous-velvety, lower surface pilose; inflorescence pilosulous ... ...*M. molle* (Benth.) Cowan (Amazonas)
29. Upper surfaces of leaflets glabrous, lower surfaces glabrous or sparsely puberulent at base; inflorescence glabrous or minutely puberulent ... 30

30. Ovary villose or dense puberulous on all surfaces ... 31
30. Ovary glabrous or pubescent only on margins ... 32

31. Leaflets 15–45 x 7–25 mm, oval to oblong to oblong-obovate; sepals 5; petal blade 25–70 x 4–5 mm; ovary villose ... *M. microcalyx* Ducke (Amazonas)
31. Leaflets 40–50 x 20–30 mm, elliptic or oblanceolate; sepals 4; petal blade 25–30 x 12–15 mm; ovary dense puberulous …. *M. steyermarkii* Cowan (Aragua, Distrito Capital)♦

32. Ovary glabrous ... 33
32. Ovary pubescent on margins ... 35

33. Leaflets 3–4 x 0.8–1 cm, epunctate, in 3–6 pairs; bracteole 8.5–9 mm long ... *M. schinifolium* Cowan (Amazonas)♦
33. Leaflets 4–8 x 1.5–3 cm, punctate or epunctate on lower surface, in 1–6 pairs; bracteole 12–17 mm long... 34

34. Leaflets 1–3 pairs, 4–8 x 1.5–3 cm, punctate on lower surface; shrubs to 4 m tall; fruits elongate ... *M. longipes* Cowan (Amazonas)
34. Leaflets 4–6 pairs, 4–6 x 2.5–3 cm, epunctate on lower surface; big trees; fruits (orbicular ... ...*M. multijugum* (DC.) Benth. var. *multijugum* (Amazonas, Apure, Bolívar, Guárico)

35. Leaflets linear, 2.5–3.5 mm wide ... *M. cataractarum* Cowan (Amazonas)♦
35. Leaflets elliptic to oblong, lanceolate-oblong, oblong-oval, to oblong-obovate, 4–35 mm wide ... 36

36. Leaflets not glaucous or wax-producing on lower surface ... 37
36. Leaflets glaucous to wax-producing on lower surface ...38

37. Shrub to tree to 15 m tall; bracteoles ca. 2 mm long, lanceolate; hypanthium 5–6 mm long, glabrous to sparsely puberulous ... *M. colombianum* (Britton & Killip) Killip ex Uribe *sensu lato* (Carabobo, Lara, Miranda, Sucre, Yaracuy)
37. Shrub to 3 m tall; bracteoles 5–7 mm long, ovate; hypanthium 1–1.5 mm long, puberulous ... ...*M. discolor* Benth. var. *egranulosum* Cowan (Amazonas)

38. Leaflets oblong, 12–23 x 5–8 mm; pedicel 1–1.5 mm long ... *M. anomalum* Cowan (Amazonas, Bolívar)♦
38. Leaflets usually oblong-oval to oblong-obovate, 45–70 x 10–35 mm; pedicel usually 2–5 mm long ... *M. discolor* Benth. var. *discolor* (Amazonas, Bolívar)

Appendix 2 Original, Latin description of *Macrolobium flori*dum H. Karst. (Karsten, H. 1859–1869. *Flora Colombiae* [Terrarunque Adicentium Specimina Selecta in Peregrinatione Duodecim Annorum Observata Delineavit et Descripsit] I–II. Ferdinandi Duemmlerum Succesores, Berlin, Germany.)

Character differentialis

M. foliolis sessilibus obovato-lanceolatis, acutis, basi obliquis, inaequilateris, glabris, subcoriaceis; bracteolis ovalibus, coriaceis, latere altero semiconnatis; inflorescentia folio duplo vel triplo breviore; ovario quinque-ovulato.

Character naturalis

Arbor magna, ramosa et frondosa, rauiis ramulisque teretibus, cortice cinereo, sublaevi. Folia sparsa subdisticha, coriacea, glabra, unijuga; foliola in petiolo communi, brevissimo, tereti, calloso, 4–6 mm. longo sessilia, obovato-lanceolata, acuta, basi obliqua latere exteriore producto rotundata, 25–50 cm longa, 8–11 cm lata; penninervia, reticulato -venosa, nervis validioribus et longioribus ante marginem incurvatis et anastomosantibus, brevioribus inter illos ramosis et reticulatis. Inflorescentia terminalis, pedunculata, racemosa, folio duplo vel triplo brevior, Flores approximati, completi, irregulares, hermaphroditi, breve pedicellati; bractea minuta, triangularis, acuta; pedicelli 0,5 centim. longi, sub apice bibracteolati; bracteae oppositae, ovales, subacutae, subcoria-ceae, latere altero ad medium usque connatee, intus glabrae, extus parce pilosulae. osepalus extus, praesertim superne, pilosulus; tubo cylindrico centimetrum longo; fauce calloso et pilosulo; limbo quadrisecto, segmenta aequalia, oblonga, membranacea, decussato-imbricata. Petalum unicum fauci calloso insertum, sepalo supremo oppositum et subtriplo longior, basi pilosulum, unguiculatum; lamina alba, roseo-carinata, oblonga, margine eroso undulata, aestivatione galeato-incurva. Stamina tria sepalis lateralibus et inferiore opposita cum petalo iis breviore inserta, fertilia; filamenta subulata in alabastro duplicata; antherae oblongae versatiles, biloculares, superne minute-papillosae; thecae basi discretae, dorso connectivo lato, apiculato adnatae, rima longitudinali dehiscentes. Pollen ovale longitudinaliter tririmosum, triocellatum. Ovarium unicum, stipitatum, stipite calycis tubo pariete postico adnato, hirtum; ovulis anatropis quinque, sutura ventrali uniseriatim inserta; stylo longo, tereti, piloso, in alabastro involuto-reflexo; stigma obtusum, capitatum. Fructus ignotus.

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