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## Three new species and a new record of *Monstera* Adans. sect. *Marcgraviopsis* Madison (Araceae: Monsteroideae: Monstereae) from the Caribbean watershed in Costa Rica and Panama

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**Abstract.** Three new species from *Monstera* sect. *Marcgraviopsis*, *M. caribaea* M.Cedeño, O.Ortiz & A.Hay, *M. lamersiana* M.Cedeño & A.Hay and *M. panamensis* M.Cedeño & O.Ortiz, are described, and new record of *M. guzmanjacobiae* Díaz Jim. et al. for Costa Rica is reported here. The new species are compared with the most similar described species with shingling juveniles, and illustrated from living plants.

**Keywords:** Araceae, Central America, conservation, *Monstera*, taxonomy.

## INTRODUCTION

The genus *Monstera* has been considered one of the most taxonomically difficult Neotropical groups within the Araceae, despite its relatively small size compared to the giants *Anthurium* and *Philodendron* whose species are estimated to number in the thousands (Grayum 2003; Boyce and Croat, 2011 onwards; Cedeño-Fonseca et al. 2022). It is represented by approximately 52 species in Central America, which are distributed in wet tropical forested regions at low to medium elevations, from 0–2300 m above sea level (Grayum 2003; Cedeño-Fonseca et al. 2021; Croat et al. in progress). Nearly all are

appressed-climbing hemi-epiphytes or nomadic vines (Zotz 2013; Sperotto et al. 2020).

*Monstera* Adans. has been divided into four formal sections (Madison 1977): section *Echinospadix* Madison (1 sp.), section *Marcgraviopsis* Madison (up till now 11 spp.), section *Tornelia* Madison (3 spp.) and section *Monstera* (37 spp.) (Cedeño-Fonseca et al. 2020, 2022). Work on fuller systematic understanding of this genus is now much progressed but still ongoing, and, although a valuable preliminary molecular phylogenetic analysis of the Monstereae has been made (Zuluaga et al. 2019), indicating among other things that Madison's sections in *Monstera* are partly unnatural, a complete molecular phylogenetic analysis is not yet available to provide the appropriate level of certainty for a revised infrageneric classification to be developed (Cedeño-Fonseca et al. 2022). We therefore persist with Madison's sections for now.

Section *Marcgraviopsis* is characterized by the earliest climbing phase having the leaf blades themselves closely appressed to the substrate (often termed 'shingle plants') with petioles that are less than half as long as the blades (Madison 1997). The great majority of the species in this section are Central American, and a mere four of them also occur in South America: the widespread *Monstera spruceana* (Schott) Engl. and *M. dubia* (Kunth) Engl. & K.Krause along the northern Andes and Amazonia, and *M. pittieri* Engl. and *M. filamentosa* Croat & Grayum reaching only into the Department of Chocó in northwestern Colombia close to Panama.

Nevertheless, we note here, in passing, that species of the exclusively South American, almost entirely Amazonian *Monstera subpinnata* Engl.—*M. barrieri* Croat, Moonen & Poncy complex also have appressed shingling juveniles, but of somewhat distinct morphology from the juveniles of sect. *Marcgraviopsis* [the most obvious, but not the sole difference being the shingling blades held obliquely upward, versus the more usual obliquely downward posture of sect. *Marcgraviopsis* shingling blades]. These species have never been placed in sect. *Marcgraviopsis*, we presume because, in spite of their radical and abrupt differentiation from the adult form, the heteroblastic juveniles have not been noted until relatively recently, and appear to be unrepresented in herbarium collections. The infrageneric placement of this complex also awaits fuller resolution of phylogenetic relationships within the genus, and more detailed description of their heteroblastic phases will form part of a forthcoming commentary on morphological diversity in *Monstera* (Cedeño-Fonseca et al., in prep.).

Despite the recent taxonomic revision of *Monstera* for Costa Rica by Cedeño-Fonseca et al. (2022) and for

Central America as a whole by Croat et al. (in progress), new species of the genus are still being documented along the Cordillera Volcanica Central in Costa Rica and the Cordillera de Talamanca between Costa Rica and Panama. High intraspecific variation within populations and the fragmentary nature of herbarium samples hampers the establishment of evident morphological characters needed for the accurate identification of all species (Grayum 2003; Cedeño-Fonseca et al. 2022). Furthermore, populations encountered in the field only in the sterile state have impeded fuller understanding of species limits. Documentation in the natural state of morphological characteristics of seedlings, juveniles, and adult fertile plants has been essential.

Fieldwork conducted between 2015 and 2021 aimed to document *Monstera* in different regions in Mexico, Costa Rica and Panama, as part of the first author's master's thesis (Cedeño-Fonseca 2019). However, some populations of the genus found in the Caribbean of Costa Rica and Panama could not be identified or included within the range of variation of species already described for Central America. With further observations, we consider that three such taxa represent undescribed species from the Caribbean watershed between Costa Rica and Panama, and a fourth is a new record for Costa Rica of a species recently described from Mexico (Díaz-Jiménez et al. 2020).

We therefore describe and illustrate these three new species belonging to the sect. *Marcgraviopsis* based on morphological evidence, and newly record *Monstera guzmanjacobiae* Díaz Jim. et al., from the same section, for Costa Rica.

## MATERIAL AND METHODS

To compare morphological characters, living plants and herbarium specimens were evaluated. Besides the literature analysis from Central and South America, the following herbaria were consulted (acronyms follow Thiers continuously updated): B, CHIP, COL, CR, CUV, HEM, HLDG, HUAZ, JAUM, JVR, LSCR, MA, MEXU, MO, NY, PMA, SEL, SCZ, UCH, UJUA, USJ, XAL, as well as images and type specimens accessible on-line at COL, EAP, MEXU, and JSTOR Global Plants (2022).

Photographs of living plants were taken with a Nikon COOLPIX P530 and also mobile phones with integrated high-resolution cameras, such as Huawei Y7 and Huawei p20. Measurements were made on herbarium specimens and living plants in the nature. Due to the high demand for aroid species as ornamental plants,

and a rapidly growing black market that endangers native populations (even in protected areas), coordinates are here omitted from all specimen citations, and no distribution maps are provided. Stated life zones follow the terminology of Holdridge et al. (1971).

## TAXONOMY

***Monstera caribaea*** M.Cedeño, O.Ortiz & A.Hay, **sp. nov.** (Figure 1).

Type: Costa Rica, Provincia Limón, Cantón Talamanca, distrito Cahuita, alrededores de Puerto Viejo, 20 m, 30 Jan 2019, *M. Cedeño & A. Hay 1615* (holotype USJ!).

### Diagnosis

*Monstera caribaea* has similarities to *M. pittieri*, with which it grows sympatrically, but differs in having larger leaves on adult plants 20–35 × 15–21 cm (vs. 13–18 × 5–10 cm in *M. pittieri*), margins entire or pinnatifid (vs. entire margins never pinnatifid), erect inflorescences on ascending and/or pendulous stems (vs. pendulous inflorescences on pendulous stems), peduncle 4.0–5.0 cm long (vs. 1.0–4.0 cm long), spadix 12–13 × 2.5–3.5 cm (vs. 4.0–9.0 × 1.5–3.5 cm), styles not separated from adjacent ones (vs. the styles slightly separated from adjacent ones), and the style shorter than the ovary (vs. style longer than the ovary).

### Description

Robust nomadic vine, of appressed-climbing and sometimes later also pendent habit. Seedlings: filiform. Juvenile plants: root climbers; stems green, smooth, flattened; internodes 2.0–8.0 cm long, 3.0–6.0 mm diam.; petiole not visible (covered by blade), dark green, smooth, 2.0–4.0 cm long; blades obovate, cordate at base, obtuse at apex, coriaceous, 4.0–11 × 5.0–9.0 cm, appressed to the phorophyte; fenestrations absent. Adult plants: root climbers; stem light or dark green, smooth; internodes 3.0–13 cm long, 1.0–1.5 mm diam.; anchor roots beige; feeder roots brown; petiole dark green, smooth, striated at the base, 20–25 cm long, sheathed to the base of the geniculum; petiole sheath semi-persistent; geniculum smooth or striated, slightly terete, 2.0–3.0 cm long; blades lanceolate, rounded or subcordate at base, apex acuminate, thinly coriaceous, 20–35 × 15–21 cm, midrib grooved above, convex below; primary lateral veins 9.0–11 per side, submerged on upper surface, prominent on lower surface; secondary venation parallel, reticulate towards margin; collecting vein slightly vis-

ible; fenestrations present or absent, when present, only one side of blade and narrow; margins entire or pinnatifid, due to tearing of the fenestrations that extend to the margin, often only one side is pinnatifid. Inflorescences: on both ascending attached and/or free hanging stems; peduncle smooth, 4.0–5.0 cm long; spathe obtuse or mucronate, in developing inflorescences light green, colour at anthesis unknown; spadix white during development, in male anthesis cream, 12–13 × 2.5–3.5 cm, the basal region of sterile flowers narrowed towards the peduncle; basal sterile flowers 1.5–3.0 mm long; fertile flowers 5.0–7.0 mm long; stamens not seen; ovary rectangular in longitudinal section and ribbed, 3.0–4.0 × 1.5–2.0 mm; style compressed and hexagonal, 1.5–2.0 × 1.5–3.0 mm; stigma linear; berries with stylar layer after anthesis yellowish green, mature stylar cap unknown; pulp unknown; seeds unknown.

### Etymology

The species epithet refers to the Caribbean coast, where the new species was first discovered.

### Distribution and habitat

This species is endemic to the southern Caribbean slopes of Costa Rica and western Caribbean slope of Panama, at 20–25 m elevation. It occurs in *Tropical wet forest* life zones, in open areas.

### Phenology

Flowering time is unknown but fruiting was recorded in January and March.

### Notes

The species is a member of sect. *Marcgraviopsis*. It differs from other species of the section by its appressed-climbing and pendent habit, highly variable blades with the presence of lobes and perforations, but sometimes restricted to only one side of the blade, and the erect inflorescence with short peduncle <5 cm long. The hanging stems of *Monstera caribaea* that connect to the ground are similar to the adult individuals of *M. pittieri*, mainly in that some have perforations in only one margin of the blade.

### Additional specimens examined (paratypes).

**PANAMA.** Provincia Veraguas: distrito Santa Fe, corregimiento San Fe, 18 Mar 2021, 25 m, *M. Cedeño, O. Ortiz & J.E. Jiménez 2351* (PMA); Veraguas: carretera hacia Calovebora, cerca del Río Luis, 194 m, 28 Sep 2019, *O. Ortiz & M. Cedeño 3938* (PMA).





**Figure 1.** *Monstera caribaea*. **A.** Adult plant, leaf-blades perforated and with 2–5 lobes per side. **B.** Adult plant, the leaf-blade entire and with 2 or 5 lobes per side. **C.** Hanging stem leaf-blade with 2 or 3 perforations on one side. **D.** Juvenile plant appressed to the host tree. **E.** Hanging stem with erect inflorescence in development. **F.** Climbing stem with infructescence in development. Photos by Marco Cedeño-Fonseca. *M. Cedeño & A. Hay 1615 (USJ).*

***Monstera lamersiana*** M.Cedeño & A.Hay, **sp. nov.** (Figure 2).

Type: Costa Rica, Provincia Alajuela, Cantón San Carlos, distrito Florencia, Reserva del Hotel Talajari, 43 m, 18 Jan 2021, *M. Cedeño & J. Mark Hughes 2206* (holotype USJ!; isotype MO!).

#### Diagnosis

*Monstera lamersiana* is similar to *M. filamentosa*, from which it differs vegetatively (in adult plants) by having a shorter petiole (15–25 cm vs. 25–55 cm in *M. filamentosa*), petiole green, (vs. cream or pink), and smaller leaf blade (34–38 cm × 28–33 cm vs. 35–105 cm × 25–40 cm), and the ripe infructescence on a hanging peduncle (vs. ripe infructescence on an erect peduncle).

#### Description

Nomadic vine, appressed-climbing. Seedlings: filiform. Juvenile plants: root climbers; stems smooth, dark green, flattened; internodes 3.5–9 cm long × 0.5–1 mm diameter; blades appressed to the phorophyte with visible petiole, dark green, smooth, 2–7 cm long, sheathed to blade base, petiole wings persistent or deciduous; blade lanceolate, cordate at the base, apex acuminate, thinly coriaceous, 7–12 × 3.5–7 cm, slightly flattened to the phorophyte, without fenestrations. Adult plants: root climbers; stem brown to light brown or beige, dorsoventrally compressed, smooth, with longitudinal striations; internodes 3–14 cm long × 1.5–2.5 mm in diameter; anchor roots; dark brown; petiole grooved at the base, adaxially flattened, dark green, 15–25 cm long, sheathed to the base of the geniculum; petiole sheath deciduous, with fibrous residues close to the apex; geniculum smooth, slightly terete, 3–4 cm long; blades oblong-ovate, rounded or subcordate at base, apex obtuse, thinly coriaceous, 34–38 × 28–33 cm, midrib flat on upper surface, convex below; primary lateral veins 9–11 per side, submerged on upper surface, prominent on lower surface; secondary veins pinnate and reticulate; collective vein not visible, lamina completely entire with or without fenestrations near midrib, and then perforations oval or triangular, or deeply pinnatifid, with 5–8 lobes per side, 2.5–4 cm broad, with 1–2 veins per lobe, connected by filaments. Inflorescences: on ascending adherent stems, solitary; peduncle smooth, 4–10 cm long; spathe dark green during development, unknown in anthesis; spadix white during development, in anthesis unknown; basal sterile flowers unknown; fertile flowers unknown; anthers unknown; ovary unknown; style compressed and hexagonal, 1–2 × 3–4 mm; stigma linear; infructescence ovoid-cylindric 6.0–8.0 × 3.0–4.0 cm on a pendent

peduncle; berries with a green stylar cap during development and when mature; pulp white; seeds yellowish, 4–5 mm long.

#### Etymology

This species is named in honour of Gijsbertus Lamers, who has generously supported exploration of both *Monstera* and *Philodendron* in Central America.

#### Distribution and habitat

This species is endemic to Costa Rica. It is currently known only in the region of Muelle de San Carlos, at elevations of ca. 40–300 m, in the Caribbean slope. It occurs in *Tropical wet forest* life zones, in primary forests.

#### Phenology

Flowering time is unknown but fruiting was recorded in January.

#### Notes

The species is a member of sect. *Marcgraviopsis*. It differs from the other species of the section by its internodes 3–14 cm long with longitudinal striations, its smooth dark green petiole striated at the base and adaxially flattened; its deciduous petiole sheath, and almost terete geniculum; the lanceolate leaf blade, rounded or subcordate at the base, with the apex obtuse; and the ripe infructescence on a hanging peduncle with the stylar layer green and the pulp white. *Monstera lamersiana* usually has pinnatilobate leaves, with the basal lobes connected to each other by filaments. Another characteristic of *M. lamersiana* is that some individuals have the leaf blade with an entire margin and without perforations. These occur sympatrically with populations of individuals with pinnatilobed and fenestrate blades.

#### Additional specimens examined (paratypes).

**COSTA RICA.** Provincia Alajuela: Cantón San Carlos, distrito Florencia, 31 Jan 2019, 43 m, *M. Cedeño & A. Hay 1615* (USJ); Cantón San Carlos, 9 km north of Ciudad Quesa, on road to La Florencia; in patch of forest along Rio Peje on property of Jose Corrales, 3 Jun 1986, 300 m, *B. Hammel & G. de Nevers 15309* (MO).

***Monstera panamensis*** M.Cedeño & O.Ortiz, **sp. nov.** (Figure 3).

Type: Panama, Coclé: Parque Nacional Omar Torrijos Herrera. El Copé, carretera que va hacia La Rica, 771





**Figure 2.** *Monstera lamersiana*. A. Adult plant, leaf-blades pinnatilobed with 5–8 lobes per side. B. Adult plant, leaf-blades entire without perforations. C. Juvenile plant appressed to the host tree. D. Adult plant, leaf-blades pinnatilobed with 5–8 lobes per side with pendulous infructescence in development. Photos by Marco Cedeño-Fonseca. M. Cedeño & J. Mark Hughes 2206 (USJ).

m, 30 Sep 2019, O.O. Ortiz & M. Cedeño 3950 (holotype PMA!; isotype MO!).

#### Diagnosis

*Monstera panamensis* is most easily confused with *M. molinae* and *M. spruceana*, but it differs from *M. molinae* in having larger leaves on adult plants (20–45 cm to long vs. 10–30 cm long), pinnatilobed and with perfora-

tions (vs. completely pinnatilobed without perforations), and the style hexagonal, distally slender and cylindrical, and strongly projecting, (vs. a distally square, cylindrical or hexagonal projecting style). It differs from *Monstera spruceana* in having inflorescences on free hanging stems (vs. on attached ascending stems), the petiole completely smooth (vs. smooth or warty), the petiole sheath deciduous without fibrous remnants (vs. deciduous with fibrous frag-





**Figure 3.** *Monstera panamensis*. **A.** Adult plant, leaf-blades pinnatilobed with 2–6 lobes per side. **B.** Adult plant with hanging stem, leaf-blades pinnatilobed with 2–6 lobes per side, erect infructescence in development. **C.** Infructescence in development with style strongly projected and distally cylindrical. **D.** Fruit with style strongly projected and distally cylindrical. Photos by Marco Cedeño-Fonseca. O.O. Ortiz & M. Cedeño 3950 (PMA).

ments), and style hexagonal and strongly projecting and cylindrical distally (vs. style hexagonal and not raised).

#### Description

Robust nomadic vine, appressed-climbing and pendent habit. Seedlings: filiform. Juvenile plants: root

climbers; stems dark green, smooth, cylindrical; internodes 2–6 cm long, 0.5–10 mm diam.; petiole not visible, dark green, smooth, 3–5 cm long; blades obovate, subcordate at base, acuminate at apex, coriaceous, 5–12 × 6–10 cm, appressed to the phorophyte; fenestrations present, usually 1 that breaks at the margin. Adult

plants: root climbers with free lateral branches; stems dark-green or brown, cylindrical, smooth; internodes 3–15 cm long, 2–4 cm diam.; anchor roots light brown; feeder roots dark brown; petiole light-green, smooth, 17–30 cm long, sheathed to base of the geniculum or to base of the blade; petiole sheath deciduous; geniculum smooth, sunken adaxially, convex abaxially, 2–4 cm long; blades lanceolate or ovate to sub-orbicular, obtuse or truncate at base, obtuse to slightly acuminate at apex, coriaceous, 20–45 × 17–20 cm, decurrent on the geniculum; midrib ribbed adaxially, convex abaxially; primary lateral veins 7–10 per side, sunken adaxially, prominent abaxially; collective veins not visible; fenestrations present in transition to adult plants and in some adult leaf blades; margins pinnatilobed, 2–6 lobes per side, 1.5–5 cm wide, 1–2 veins per lobe. Inflorescences: in hanging stems, 1 solitary at flowering time, arranged in the axils of the leaves; peduncle smooth, up to 6 cm long; spathe unknown in development and anthesis; spadix unknown during development, unknown at anthesis, 13–15 cm long, 3–4 cm diam.; basal sterile flowers 5–7 mm long; fertile flowers 7–10 mm long; stamens unknown; anthers unknown; ovary rectangular in longitudinal section, ribbed, more slender than style, 4–6 × 2–3 mm; style hexagonal and strongly projected, slender and cylindrical distally, 4–5 × 3–4 mm, stigma linear; berries with a green stylar cap during development, mature stylar cap unknown; pulp unknown; seeds unknown.

#### *Etymology*

The epithet is drawn from the Republic of Panama, and alludes to the species' origin.

#### *Distribution and habitat*

This species is endemic to Panama, at elevations of 0–850 m, on the Caribbean and Pacific slope. It occurs in *Tropical wet forest* and *Premontane rain forest* life zones, in primary forest.

#### *Phenology*

Flowering time is unknown but fruiting was recorded in September and November.

#### *Notes*

The species is a member of section *Marcgraviopsis*. It is distinguished by its lengthy internodes up to 15 cm long, the pinnatilobed adult leaf blade, the smooth petiole, sheathed up to the base of the geniculum, short peduncles (<6 cm), long spadices (14–15 cm), and a hexagonal, strongly projecting, and distally cylindrical style.

*J.P. Folsom 6207* (MO) was long confused with *M. molinae*. However, due to differences that could be observed in the flowers in the herbarium sample, field-work was carried out to examine the populations in their natural state, with the result that this collection is here redetermined as *M. panamensis*. The majority of populations of *M. panamensis* from the Caribbean lowlands have not been seen with reproductive structures.

#### *Additional specimens examined (paratypes)*

**PANAMA.** Provincia Coclé: Area surrounding Rivera Sawmill, 7 km north of El Cope; Forgotten Hill; 5 Nov 1977, 650–850 m, *J.P. Folsom 6207* (MO); Parque Nacional Omar Torrijos Herrera, El Copé, carretera que va hacia La Rica, 771 m, 30 Sep 2019, O. O. Ortiz & M. Cedeño 3949 (PMA). **Provincia Veraguas:** distrito Santa Fe, corregimiento San Fe, Camino al pueblo Calovebora, 18 Mar 2021, 25 m, M. Cedeño, O. Ortiz & J.E. Jimenez 2353 (PMA); corregimiento Calovebora, Camino de regreso al pueblo Cucuyo, 22 Nov 2022, 120 m, M. Cedeño, O. Ortiz & N. Köster & R. Dapena 2802 (PMA).

#### *New record*

*Monstera guzmanjacobiae* Díaz Jim., M.Cedeño, Zuluaga & Aguilar-Rodr., *Phytotaxa* 437(1): 41. 2020.

Type: Mexico, Veracruz: Municipio Catemaco, La Palma, Selva alta perennifolia, 18° 33' 21" N, 95° 03' 35" W, 56 m, 31 May 2014, *Pedro Díaz Jiménez & Valeria Guzmán Jacob 1305* (holotype XAL!; isotypes, MEXU!, UJAT!).

The species is characterized by its habit with appressed-climbing and pendent shoots, terete stems, light-green, smooth, dorsiventrally compressed petioles each with a projecting ligule up to 3.0 cm long, adult leaf blades with 1–4 fenestrations often only on one side, or without perforations, and flowers with a conical pyramidal style (Díaz-Jiménez et al. 2020). *Monstera guzmanjacobiae* was described as endemic from Los Tuxtlas (Veracruz, Mexico) and it has never been collected in other localities apart from the municipality of Catemaco (Díaz-Jiménez et al. 2020). Plants from Mexico and Costa Rica display rather wide ecological amplitude, generally growing on the edge and interior of the forest, as well as in abandoned areas with secondary vegetation. (Fig. 4).

At present, *Monstera guzmanjacobiae* is only known to occur in Mexico and Costa Rica. This disjunct geographic distribution may be related to the relative lack of sampling of the Araceae in general and *Monstera* in par-





**Figure 4.** *Monstera guzmanjacobiae*. **A.** Adult plant ascending on a tree and with hanging stems. **B.** Hanging stem with erect infructescence in development (note: divided upper left leaf is of *M. filamentosa*). **C.** Developing infructescences on ascending stem. **D.** Developing infructescences with pyramidal and conical style. Photos by Marco Cedeño-Fonseca. *M. Cedeño & J.M. Hughes 2205 (USJ)*.

ticular in Belize, El Salvador, Honduras, Guatemala, and Nicaragua. A similar situation is found in *M. tacanaensis* Matuda, which is distributed in the Tacana Volcano, Chiapas Mexico and in Guatemala, and then jumps to Costa Rica and Panama (Cedeño-Fonseca et al. 2020).

#### *Additional specimen examined*

**COSTA RICA.** Provincia Heredia: Cantón Sarapiquí, Distrito Horquetas, Camino sobre bosques aislados en potreros, 202 m, 17 Jan 2021, *M. Cedeño & J. Mark Hughes 2205 (USJ)*.

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