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A new orange-fruited species of *Monstera* (Araceae: Monsteroideae) from Panama

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Abstract. *Monstera alcirana*, endemic to Panamá, is described and illustrated using a color plate based on photographs of the vegetative and reproductive structures of living material. This species is the fourth of the very small species of *Monstera* in Central America. It is morphologically similar to *M. obliqua*, *M. minima* and *M. gambensis* but differs by has short internodes, thickly coriaceous blade and peduncle longer than the length of the leaf.

Keywords: Aroids, Central America, *Monstera obliqua*, Panamanian flora.

INTRODUCTION

Monstera, a climbing aroid genus best known for its often perforated leaf blades, remains rather poorly understood in the Neotropics as a whole, though progress has recently been made for Mexico and Central America (Grayum 2003; Cedeño-Fonseca 2019; Cedeño-Fonseca et al. 2018, 2020a, 2020b), including the recent publication of several new species in the region: *Monstera anomala* Zuluaga & Croat, *M. integrifolia* Zuluaga & Croat, *M. limitaris* M. Cedeño, *M. guzmanjacobiae* Díaz Jim., M. Cedeño, Zuluaga & Aguilar-Rodr., *M. croatii* M. Cedeño & A. Hay and *M. gambensis* M. Cedeño & M.A. Blanco (Cedeño-Fonseca et al. 2018; Zuluaga & Cameron 2018; Cedeño et al. 2020b; Díaz-Jiménez et al. 2020). Costa Rica and Panama are the centre of diversity of the genus, principally in the Talamanca mountain range below 2300 m elevation (Madison 1977; Cedeño-Fonseca et al. 2020a), and particularly the Caribbean slope.

Hitherto, *Monstera obliqua* Miq., was the only known species in Costa Rica and Panama with an orange fruiting spadix (Madison 1977; Grayum 2003; Cedeño-Fonseca 2019). This species is most common from the south of Panama, mainly in the Chocó biogeographic region, and throughout the

Amazon basin, where orange spadix is more frequent in the genus (Madison 1977). Other species with orange fruiting spadix are *Monstera praetermissa* E.G. Gonç. & Temponi, endemic to Bahia, Brazil (Gonçalves & Temponi 2004), and *Monstera xanthospatha* Madison endemic to the Cordillera Occidental and the Cordillera Central of the Andes in Colombia (Madison 1977). *Monstera obliqua* itself appears to be a large and variable species complex with orange fruiting spadices. Most probably some populations of *M. obliqua* in the Amazonian basin might be resolved as separate species with further research.

Here we describe and illustrate a new species endemic from Panama with an orange fruiting spadix, and we include an extensive documentation of the populations of *M. obliqua* in Costa Rica and Panama.

TAXONOMIC TREATMENT

Monstera alcirana Croat, M. Cedeño, Zuluaga & O. Ortiz **sp. nov.**

Type: Panamá. Coclé: along ridge of Cerro Gaital, N slopes of mountains near La Mesa, N of El Valle; 28 April 1982, 8°40'N, 80°7'W, 800–900 m, *Knapp & Dressler 4880* (holotype, MO; isotypes, K, PMA, US).

Diagnosis

Monstera alcirana is recognised by its small, entire, thickly coriaceous leaves lacking fenestrations, petioles with deciduous sheath, primary lateral veins arising from the midrib at 35–45°, peduncle longer than the leaf, spathe creamy yellow on both surfaces, and the orange spadix when the fruits are ripe.

Description

Nomadic vine with appressed-climbing habit. Seedlings: foliose. Juvenile plants: **stems** smooth, terete, dark-green; **internodes** 1.5–2.5 cm long, 4–6 mm diam.; **petiole** conspicuous, light green, smooth, 4–9 cm long, sheathing to the base of the blade; **petiole sheath** slightly persistent or completely deciduous; **blades** oblong-elliptic to lanceolate, attenuate at the base, coriaceous, 3–6 × 3–4 cm, not appressed to the phorophyte; **fenestrations** absent. Adult plants: **stems** dark green, smooth, terete or slightly flattened; **internodes** 0.5–3 cm long, 5–10 mm diam.; **anchor roots** black and corky, with black root hairs; **feeder roots** black and corky, with black root hairs; **petiole** light green, smooth, 5–15 cm long, sheathing to the base of the geniculum; **petiolar sheath** deciduous; geniculum bulky, 0.5–1 cm long; **blades** nar-

row, lanceolate, oblong-elliptic or ovate, attenuate at the base, obtuse or short-acuminate at apex, thickly coriaceous, drying yellowish, 7.5–25 × 3–10 cm, 2.4–3.5 times longer than wide, with the base slightly decurrent on the geniculum; **midrib** sunken adaxially, convex abaxially; **primary lateral veins** 4–7 per side, departing from midrib at 35–45°, strongly sunken adaxially, raised abaxially; **tertiary veins** inconspicuous; **collective veins** not visible; **fenestrations** absent; **margins** entire. Inflorescences on ascending stems; **peduncle** smooth, 10–38 cm long, 2–4 mm diam.; **spathe** light-green during development, cream on both surfaces at the anthesis; **spadix** white during development, cream at the anthesis, 3–5.2 cm long, 0.7–1 cm diam.; **flowers** 3–4 mm long; stamens with laminar filaments, 1.5–4 mm long; anthers 0.5–1 mm long; ovary quadrangular and ribbed, 1.5–2.5 × 1.5–2 mm; style hexagonal, 1–2 × 2–2.5 mm; stigma linear; basal sterile flowers 1.5–3 mm long; **berries** with orange-green styler cap, greenish during development; pulp white; **seeds** green or black, spherical, 2–4 mm long.

Etymology

The species is named in honor of Alcira Pérez de Gómez a Venezuelan botanist from Barquisimeto who did her Master's thesis under the direction of Tom Croat at St. Louis University in St. Louis.

Distribution and habitat

Monstera alcirana is endemic to Panama to the Comarca Guna Yala and Provinces of Coclé, Panamá, Colón and Veraguas, at 350–1000 m, in *Tropical wet forest* and *Premontane rain forest* life zones (Holdridge 1967).

Conservation status

Monstera alcirana occurs in nine localities of which four are in protected areas (Chagres National Park, Cerro Gaital Natural Monument, General de División Omar Torrijos Herrera National Park and Santa Fe National Park). The principal threat to this species is the habitat loss due to urban expansion and extensive livestock activities, which were observed mainly in those locations devoid of protection. We calculate an Extent of Occurrence of 9236 km² and an Area of Occupancy of 80 km², therefore, we suggest considering *M. alcirana* as a vulnerable species [VU, Blab(i,ii,iii,iv)].

Phenology

Flowering has been recorded in January–April, July, November, and fruiting in January–May, and July.

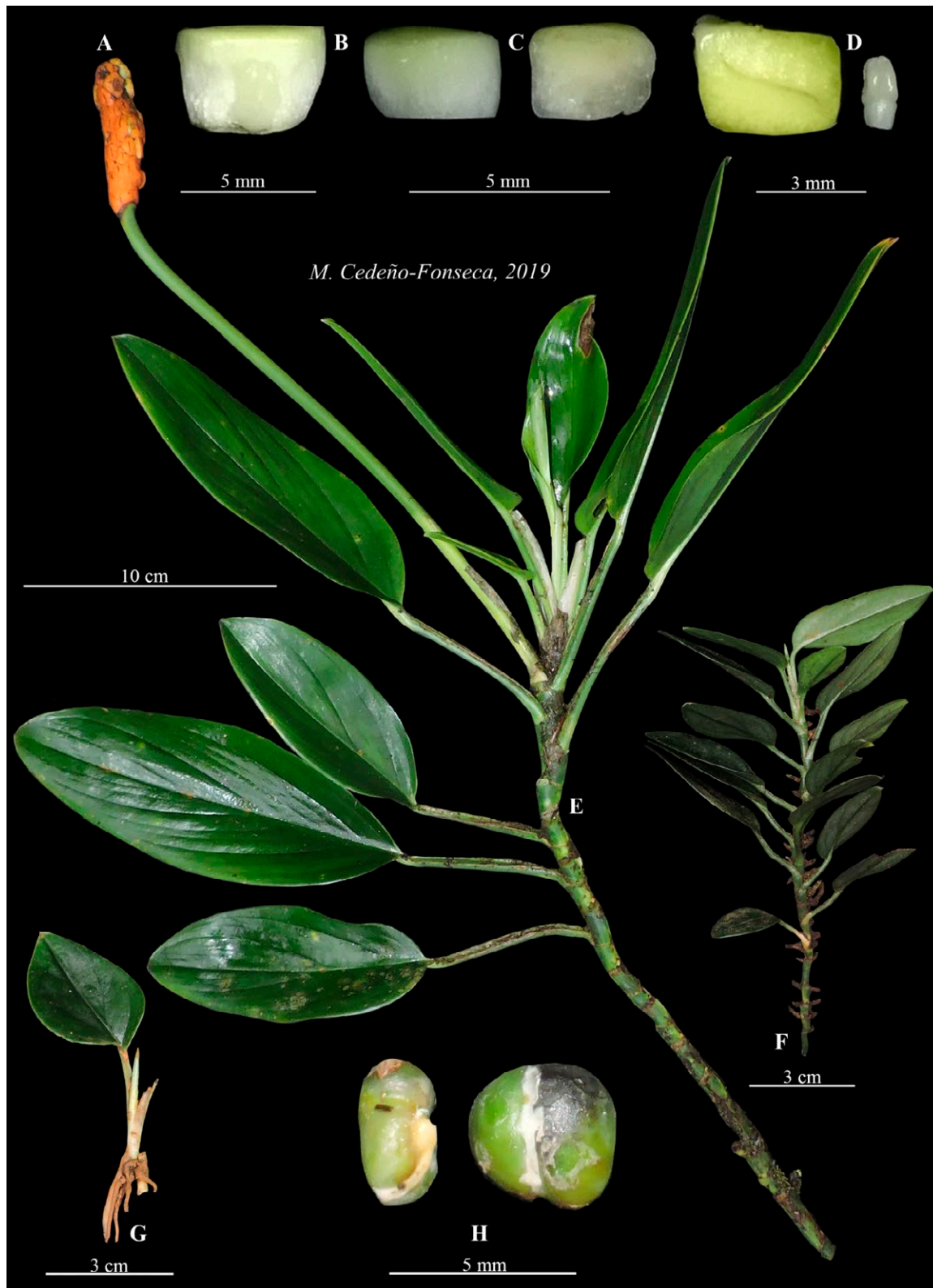


Figure 1. *Monstera alcirana* sp. nov. A. Infructescence. B. Fertile flower. C. Sterile flower in lateral view (left) and in longitudinal section (right). D. Stylar plate, top view (left), and individual stamen (right). E. Adult plant. F. Juvenile plant. G. Seedling. H. Seeds. Images by M. Cedeño-Fonseca.



Figure 2. *Monstera alcirana* sp. nov. A. Juvenile plant. B. Pre-adult plant. C. Adult plant without inflorescence. D. Adult plant with infructescence. Images by M. Cedeño-Fonseca.

Notes

The new species is a member of sect. *Monstera* (*sensu* Madison, 1977), and is unusual in the genus in having leaves that are somewhat like *Stenospermation*, and indeed the species was long confused with that genus (Gómez, 1983).

The species superficially resembles *Stenospermation*, it is impossible to confuse *M. alcirana* with any other species of *Monstera*. It is similar to *M. obliqua* in having the same color of the spathe and spadix, but it differs because *M. alcirana* has short internodes 0.5–3 cm long (vs. 2–10 cm long), thickly coriaceous blade (vs. a thinly coriaceous blade), peduncle 10–38 cm long (vs. 10–17 cm long), and the juvenile with small leaf blade 3–6 × 3–4 cm (vs. 7–13 × 2–4 cm). The pre-adult and adult plants of *M. alcirana* are very similar to the juvenile plant of *M. standleyana* G.S. Bunting.

The other species that can be confused *M. alcirana* is *M. minima* Madison, but *M. minima* is only known from the type locality in the Comarca Guna Yala (formerly San Blas), Panama, and from Colombia. The key differences are that *M. alcirana* has an orange fruiting spadix (vs. an apparently creamy fruiting spadix), and a thickly coriaceous leaf blade, 7.5–25 × 3–10 cm (vs. a thinly coriaceous blade 9–14 × 2.0–4.0 cm), obtuse or short-acuminate at apex (vs. long-acuminate at the apex). *Monstera alcirana* is the fourth diminutive species of *Monstera* in Central America, together with *M. minima* Madison, *M. obliqua* Miq., and the recently published species *M. gambensis* M.Cedeño & M.A.Blanco (Cedeño-Fonseca et al. 2020b). *Monstera alcirana* differs from the latter species in having a smooth petiole (vs. rough petiole), the petiole sheath deciduous (vs. persistent and involute), and the fruiting spadix orange when ripe (vs. yellow when ripe).

Additional specimens studied (paratypes):

PANAMA: **Coclé**, La Mesa above El Valle; in forest on both sides of junction with road to Cerro Pilon, ca. 800 m, 21 Jul 1974, *T.B. Croat* 25390 (MO). Along road between Llano Grande and Coclesito (N of Pintada), 4 mi. N of Llano Grande, 600 m, 28 Jan 1980, *T. Antonio* 3561 (MO). 27 km N of Penonome on road to Coclesito in forest reserve at Continental Divide, ca. 300 m, 20 Feb 1978, *B. Hammel* 1635 (MO). Vicinity el Valle de Antón, at forested flat area near Finca Macarenita at La Mesa, 08°36'N, 80°07'W, 800 m, 6 Jul 1994, *T.B. Croat* & *G.H. Zhu* 76665A (MO). Parque Nacional General de División Omar Torrijos Herrera, Caño Sucio, camino hacia el Alto Tife, bosque húmedo con suelos muy rocosos, 8°42'55"N, 80°38'12"W, 243 m, 18 Jul 2013, *O. Ortiz et al.* 1416 (MO, PMA). **Colón:**

East Santa Rita Ridge, 11 January 1968, *M.D. Correa* & *R.L. Dressler* 595 (MO). Near Agua Clara rainfall station, Santa Rita Ridge, 9°20'N, 79°48'W, 23 Apr 1970, *R.B. Foster* 1752 (PMA). Along ridge of Cerro Gaital, N slopes of mountains near La Mesa, N of El Valle, Premontane rainforest, 08°38'00"N, 80°08'30"W, 800–900 m, 28 Apr 1982, *S. Knapp* & *R. J. Schmalzel* 4880 (MO). Flotation Molly, 8°51'12"N, 80°38'18"W, 139 m, 21 May 2014, *S. Castillo* 402 (PMA). Distrito de Donoso, área de Concesión Minera Panamá, Pipeline Road, 8°53'46"N, 80°38'50"W, 127 m, 6 May 2013, *O. Ortiz et al.* 1310 (MO, PMA). **Panamá**, Between 6–12 km north of El Llano on Cartí road, forest and roadside, 09°15'32"N, 078°57'42"W–09°16'32"N, 078°55'49"W, 365 m, 13 Jan 1978, *B.E. Hammel* 889 (MO). Cerro Jefe, ca. 1000 m, *J.D. Dwyer* 9480 (MO). El Llano-Cartí Road, 17.5 km from Inter-American Highway, wet forest, 09°17'45"N, 78°55'59"W, 350 m, 14 Feb 1975, *S.A. Mori et al.* 4605 (MO). Altos de Pacora, northwest of Cerro Jefe, 09°16'30"N, 79°18'50"W, 650–750 m, 8 Nov 1979, *T. Antonio* 2502 (MO). 16–18 km from Interamerican Highway on the El Llano-Cartí Road, 09°17'50"N, 78°56'03"W, 400 m, 28 Mar 1974, *E. L. Tyson* & *M. H. Nee* 7342 (MO). 8.2 miles from the Pan-American Highway on the El Llano-Cartí Road, 09°14'N, 79°00'W, 6 Jul 1982, *S. Knapp* 5917 (MO). Beyond Goofy Lake along road to Cerro Jefe, 9°14'N, 79°21'W, 4 Jan 1968, *M.D. Correa et al.* 567 (MO, PMA). Campo Tres, 3 miles NE of Altos de Pacora, 500–800 m, 10 Mar 1973, *R.L. Liesner* 523 (MO, PMA). Road to Cartí (San Blas), 15.5 km north of El Llano, 09°21'30"N, 78°58'00"W, ca. 400 m, 13 Feb 1973, *P. Busey* 366 (MO). La Eneida, región of Cerro Jefe, 9°14'N, 79°21'W, 650 m, 15 Jan 1973, *R.L. Dressler* 4253 (PMA). El Llano-Cartí Rd. km. 17.4, Tropical wet forest, 9°19'N, 78°55'W, 350 m, 1 Jul 1985, *G. de Nevers* 5922 (MO, PMA). Altos de Cerro Azul, sendero el Cantar, 500 m, 16 Sept 2015, *O. Ortiz et al.* 2515 (MO, PMA). **Veraguas**, Santa Fe, Río Piedra, bosque secundario maduro, camino cerca del río, 8°44'06"N, 80°46'21"W, 370 m, 16 Dec 2013, *A. Morris* & *L. Martínez* 2062 (PMA). Santa Fe, Parque Nacional Santa Fe, área del Río Veraguas, bosque achaparrado, trocha sobre filo de un cerro, dosel con una altura aproximada de 25 m, con presencia de *Colpotherinax*, 8°41'21"N, 80°50'09"W, 539 m, 8 Feb 2014, *L. Martínez et al.* 1672 (PMA).

Monstera obliqua Miq., *Linnaea* 18: 79. 1844

Type: Surinam, Vredenburger-Zandrits, October 1842, *Focke* 719 (holotype, U; photos: BH, SEL!).

(=) *Monstera falcifolia* Engler, *Bot. Jahrb.* 37: 117. 1905. Type: BRAZIL. Amazonas, Juruá Miry, July 1901, *Ule* 5622 (holotype, B; photos: BH, GH, US; isotypes, K, L, MG; photo: BH).

(=) *Monstera fendleri* Engler, *Bot. Jahrb.* 37: 117. 1905. Type: TRINIDAD. 1877-1880, *Fendler* 736 (holotype, K!; isotypes: NY, P).

(=) *Monstera sagotiana* Engler, *Bot. Jahrb.* 37: 117. 1905. Type: FRENCH GUIANA, Karouany, *Sagot* 609 (holotype, BM; photo: BH).

(=) *Monstera snethlagei* Krause, *Notizbl. Bot. Gart. Berlin-Dahlem* 9: 272. 1925. Type: BRAZIL, Maranhão, Jury-assu, Mta. de Alegria, Ketterpflanze im Igapowald, gelb, Hüllblatt ebenfalls gelb, 14 November 1923, *Snethlage* 327 (holotype, B; photos: BH, GH, US).

Description

Nomadic vine with appressed-climbing habit. Seedlings: foliose. Juvenile plants: **stems** smooth, dark green; **internodes** 3–5 cm long, 2–5 mm diam.; **petiole** conspicuous, dark green, smooth 5–11 cm long, sheathing to the base of the geniculum; **petiole sheath** deciduous; **blades** lanceolate, truncate at the base, acuminate at apex, sub-coriaceous, 7–13 × 2–4 cm, not appressed to the phorophyte; **fenestrations** absent. Adult plants: **stems** smooth, light to dark green; **internodes** 2–10 cm long, 3–5 mm diam.; **cataphylls** light-green, deciduous but leaving dry fragments on peduncles; **anchor roots** black; **feeder roots** black; **petiole** light green, smooth, 5–18 cm long, sheathing to the geniculum, **petiole sheath** deciduous; geniculum smooth, 3–5 mm long; **blades** lanceolate to narrowly elliptical, cuneate at the base, acuminate at apex, membranous to sub-coriaceous, drying blackish, reddish, light brown or greyish, 12–23 × 3–10 cm, not decurrent on geniculum; **midrib** ribbed adaxially, convex abaxially; **primary lateral veins** 4–8, obscure adaxially, prominent abaxially, departing midrib at 35–50°; **tertiary veins** inconspicuous; **collective veins** not visible; **fenestrations** absent or scarcely developed (in Central America); **margins** entire. INFLORESCENCES on ascending stems, 1–3 simultaneously at flowering time, arranged in the axils of the leaves or cataphylls; **peduncle** smooth, 10–17 cm long, 5–6 mm diam.; **spathe** acuminate, light-green during development, yellow externally and white internally at anthesis, the margins towards the apex involute, deciduous at the end of the anthesis, up to 4 cm longer than the spadix; **spadix** with green style margins and white at the medial part during development, cream at anthesis, 3–5 × 0.5–1

cm; flowers 4–7 mm long; stamens with laminar filaments, 1–2 mm long; anthers 1–2 mm long; ovary square and ribbed, 1.5–2 × 1.5–2 mm; style square or hexagonal, 1.5–2 × 2.5–3 mm; stigma linear; basal sterile flowers scarce or absent; **berries** with a moss-green styler cap during development, mature styler cap orange; pulp white; **seeds** black, 3–5 mm long.

Distribution and ecology

Monstera obliqua ranges from Costa Rica to Bolivia, Venezuela, the Guianas, Brazil, and Trinidad & Tobago. In Costa Rica it grows at 0–100 m elevation, in *Tropical wet forest* life zones, but in Panama it grows at 0–1410 m, in *Tropical moist forest*, *Tropical lower montane wet forest* and *Montane moist forest* life zones (Holdridge 1967).

Phenology

In Costa Rica and Panama, flowering has been recorded in July and November, and fruiting in January, March, July and November.

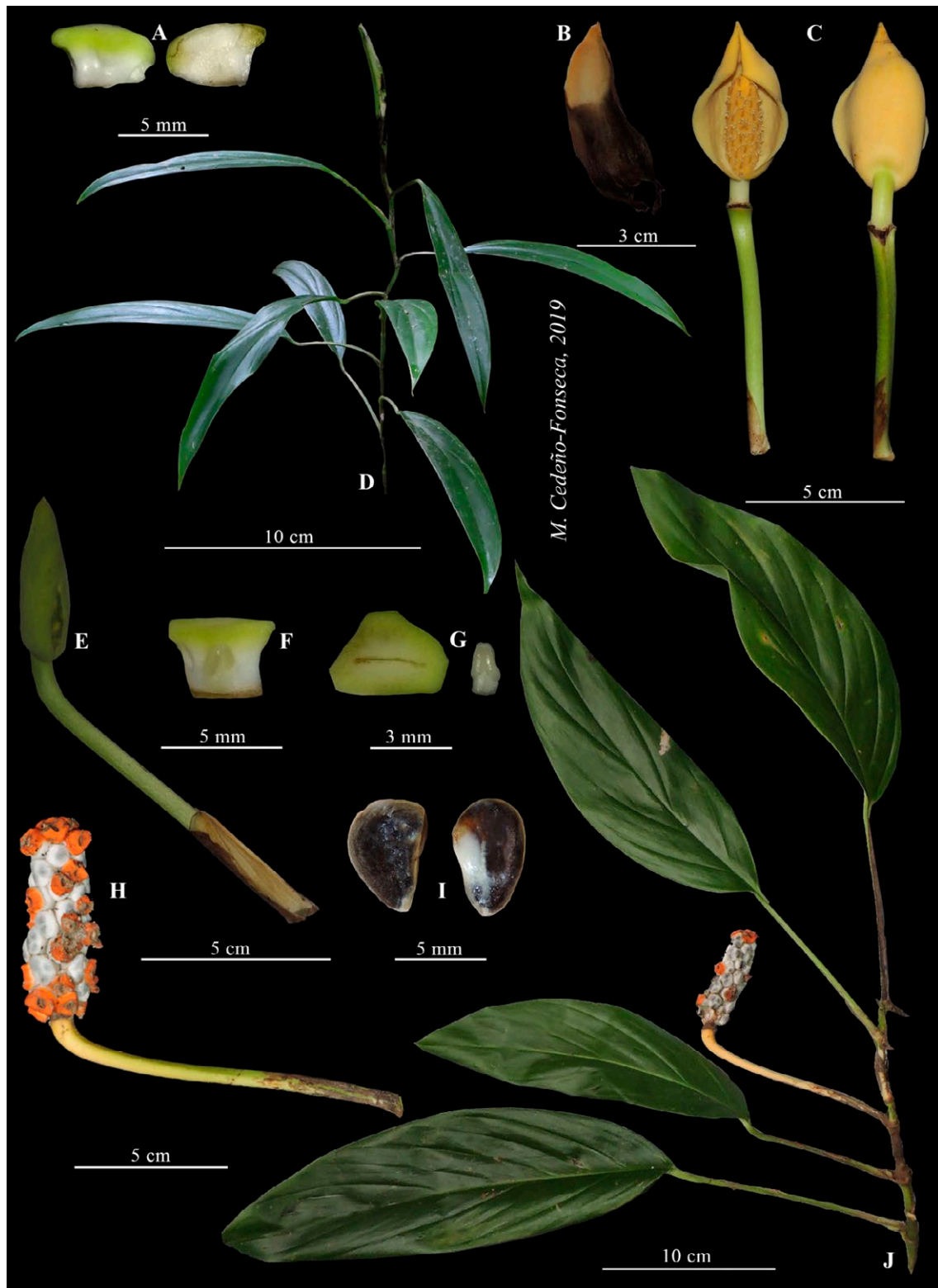
Notes

The species is a member of sect. *Monstera* (*sensu* Madison, 1977), characterized by its small elliptic-lanceolate, inequilateral blades which have entire margins, usually lack perforations, its inflorescences with peduncles that are as long as or longer than petioles (but not the whole leaf) and by its dark orange, small fruiting spadix.

Monstera obliqua in Costa Rica is only known from the southeast Caribbean watershed. It is not common, and possible to find only in primary and secondary forests, at 0–100 m. Most populations have leaf blades without perforations: only the populations in the region of Sixaola have fenestrate blades. This species is the only *Monstera* with orange ripe fruit in Costa Rica, (Figure 3).

However, the situation for Panama is different: *M. obliqua* is very common along to the Caribbean slope, at 0–1410 m, growing in *Tropical wet forest*, *Tropical moist forest*, *Tropical lower montane wet forest*, and *Montane moist forest* life zones (Holdridge 1967). The most common morphotype is one with the leaf blades without perforations similar to the plant from Costa Rica, but the only difference is the much wider altitudinal distribution. (Figure 4–5). *Monstera obliqua* in Panama grows in rocks where it can develop to the adult phase and producing inflorescences. (Figure 4A–B). Some plants from the Cerro Azul in Panamá have coriaceous leaf blades, with the indistinct primary lateral veins in both surfaces and prominently thick geniculum and peduncles (Figure 4F–G, 5).

Monstera obliqua has never been recorded for Costa Rica and Panama with perforated and membranaceous



M. Cedeño-Fonseca, 2019

Figure 3. *Monstera obliqua* from Costa Rica. **A.** Sterile flower in lateral view (left) and in longitudinal section (right). **B.** Spathe anomaly. **C.** Front and back views of open inflorescence. **D.** Juvenile plant. **E.** Developing inflorescence. **F.** Fertile flower. **G.** Styler cap, top view (left), and individual stamen (right). **H.** Mature infructescence, stylar cap detached toward the apical part. **I.** Seeds. **J.** Adult plant. Images by M. Cedeño-Fonseca.

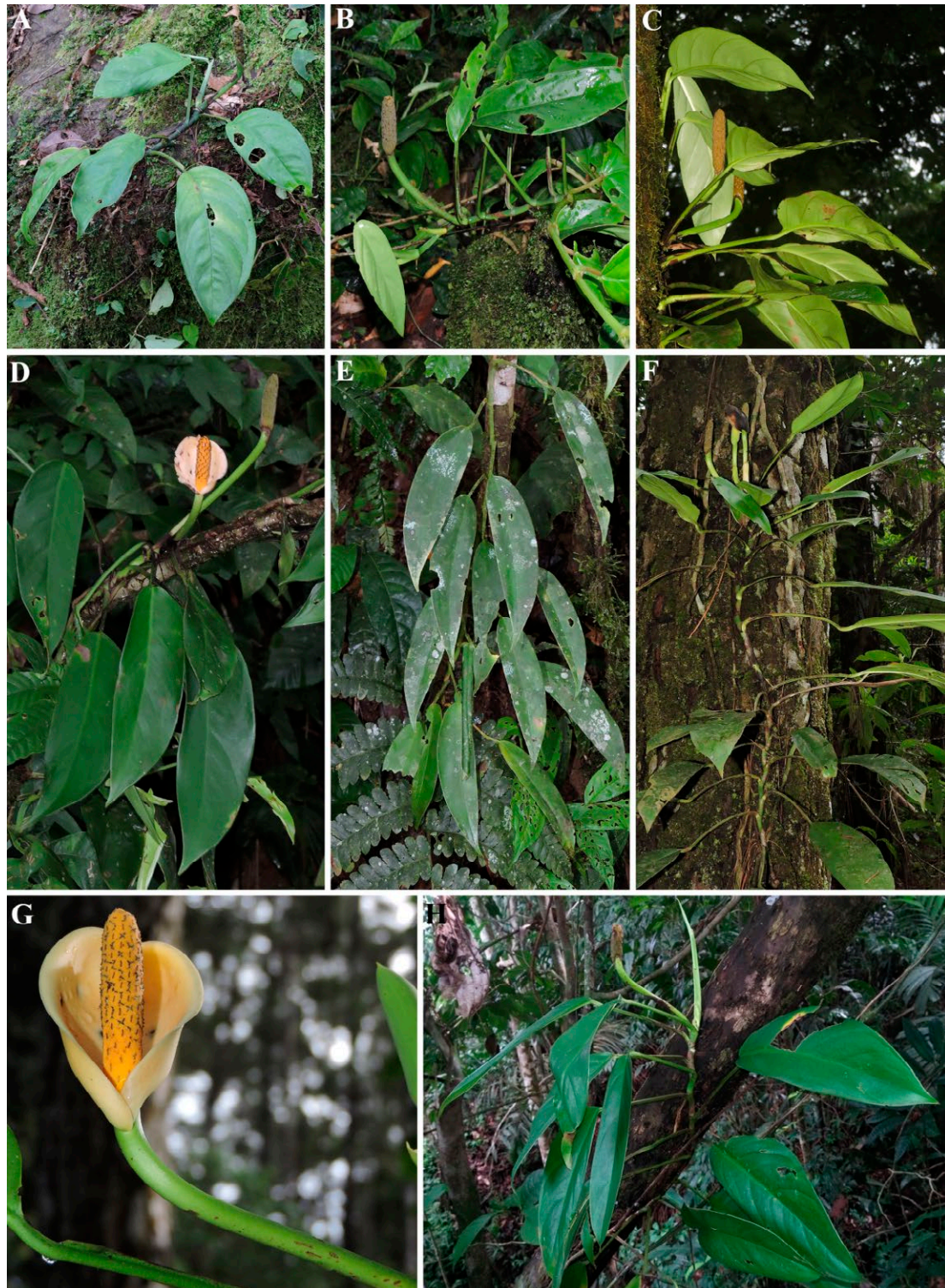


Figure 4. Different morphotypes of *Monstera obliqua* from Panama. **A.** Plant in adult phase with infructescence growing on rocks in the Caribbean in Bocas del Toro. **B.** Plant in adult phase with infructescence growing on rocks in the Pacific in Santa Fe. **C.** Adult plant growing 3 m above the ground on trees in Santa Fe. **D.** Adult plant with a white spathe growing 1 m above the ground on a shrub in the Cope. **E.** Juvenile individual growing in the Cope. **F.** Adult plant with inflorescence and infructescence growing on trees in Cerro Azul. **G.** Inflorescence with creamy spathe in Cerro Azul. **H.** Adult plant with infructescence growing 2 m above the ground in Santa Rita. Images by M. Cedeño-Fonseca.

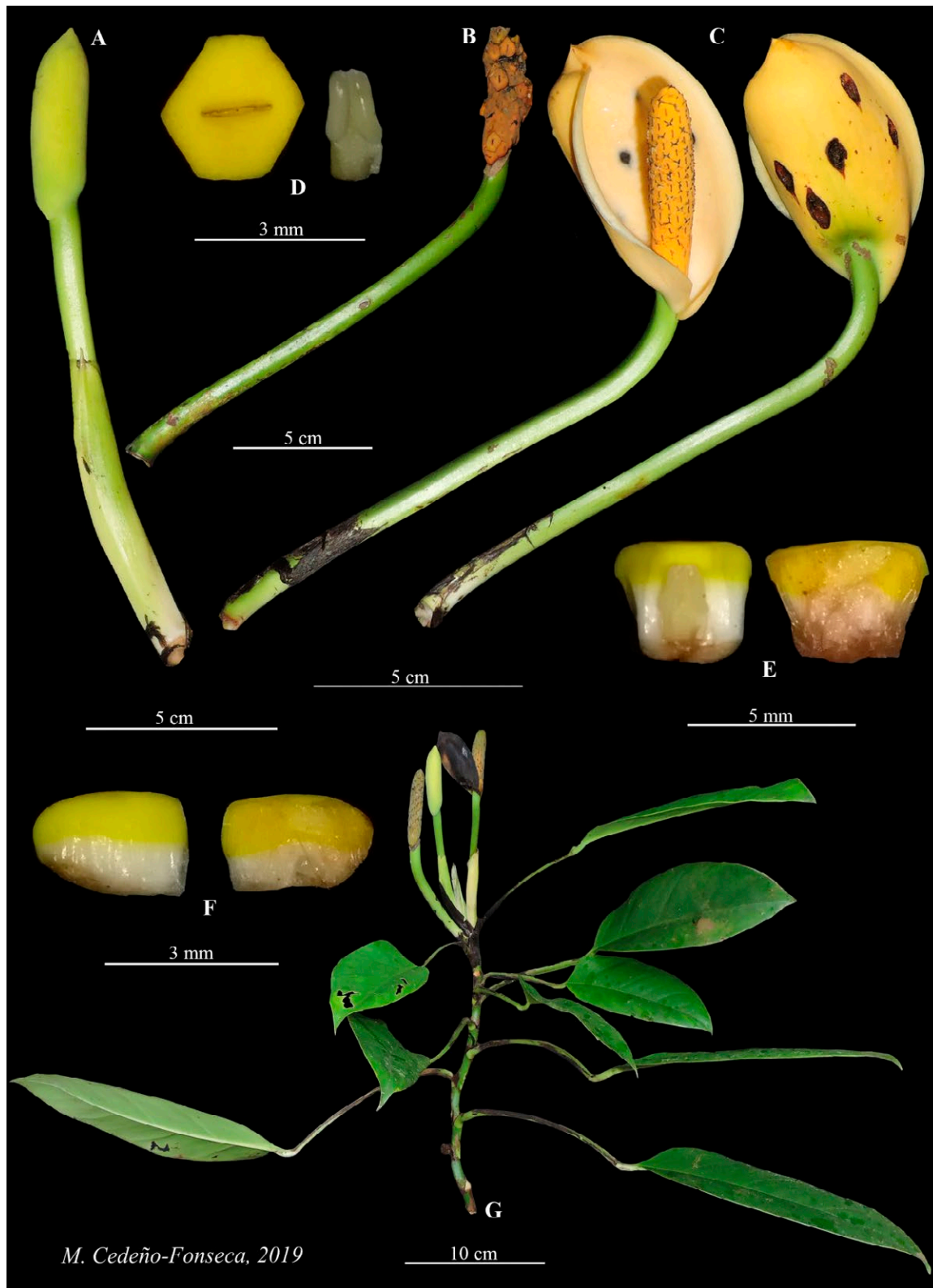


Figure 5. *Monstera obliqua* from Panamá, Cerro Azul. **A.** Developing inflorescence. **B.** Mature infructescence. **C.** Front and back views of open inflorescence. **D.** Stylar cap, top view (left), and individual stamen (right). **E.** Fertile flower in lateral view (left) and in longitudinal section (right). **F.** Sterile flower in lateral view (left) and in longitudinal section (right). **G.** Adult plant. Images by M. Cedeño-Fonseca.

leaf blades. This characteristic is present solely in one morphotype occurring throughout the Amazon basin and which may be a different species since (the type of *M. obliqua* is not of this morphotype). Madison (1977) speculated that the entire leaf morphotype from Panama (which also occurs in Costa Rica) was probably driven by a limited immigrant line from South America with a consequent decline in genetic variability.

Additional specimens studied:

COSTA RICA: Limón, Talamanca, Sixaola, San Miguel de Sixaola, Finca-albergue de ASACODE, 9°34'10"N 82°39'20"W, 35 m, 28 July 1994, (Fr.), *J. Sánchez et al.* 340 (CR). Talamanca, Bratsi, Suretka, Bosques cercanos al sitio de exploración petrolera, 9°35'20"N 82°53'50"W, 200 m, 19 July 1995, (Fl., Fr.), *A. Cascante et al.* 551 (CR). Talamanca, Cahuita, Between Bri Bri and Sixaola, NW of Paraíso, Disturbed forest, 9°39'0"N 82°40'0"W, 50 m, 5 July 1983, (Fr.), *K. Barringer et al.* 3489 (CR, MO). Talamanca, Sixaola, Hills between headwaters of Quebrada Mata de Limón and upper branches of Quebrada Tigre, and lowland forest of Quebrada Tigre drainage, Finca Anai, (Sixaola region), 9°34'0"N 82°40'0"W, 28 m, 18 November 1984, (Fl., Fr.), *M. Grayum et al.* 4458 (CR, MO). Talamanca, Sixaola, Headwaters of quebrada Mata de Limón, westernmost fork, Finca Anai, (Sixaola region), 9°34'0"N 82°39'0"W, 23 m, 17 November 1984, (Fr.), *M. Grayum et al.* 4439 (CR, MO). Talamanca, Cahuita, Gandoca, El Llano entre Fila Manzanillo y Río Creek, Atrás de la playa, 9°37'0"N 82°41'0"W, 80 m, 27 March 1995, (Fr.), *G. Herrera & E. Sandoval* 7600 (CR). Limón, Valle La Estrella, Fila Espavel, 9°39'37.853"N 83°1'11.19"W, 200 m, 3 July 2000, (Fr.), *L. Acosta* 2117 (CR). Talamanca, Sixaola, Sendero Cerillo, 9°36'38.821"N 82°37'24.9"W, 1 m, 3 March 1999, (Fr.), *U. Chavarría* 1920 (CR). Talamanca, Sixaola, San Miguel, senderos en la ruta a Manzanillo, 9°34'30"N 82°40'0"W, 30 m, 16 January 1997, (Fr.), *J. González* 1582 (CR). Camino entre Fila Dimat y Río Uren, 22 October 1985, (Fr.), *L. Gómez* 23765 (MO). 10 miles S of Punta Cahuita, 9°36'0"N 82°48'36"W, 70 m, 11 August 1977, (Infert.), *T.B. Croat* 43199A (MO). Talamanca, Bribri, Proyecto ARA, 9°37'43"N 82°40'31"W, 4 m, 30 September 2018, (Fl., Fr.), *M. Cedeño et al.* 1481 (USJ). Talamanca, Bribri, Proyecto ARA, 9°37'43"N 82°40'31"W, 4 m, 30 September 2018, (Fr.), *M. Cedeño et al.* 1482 (USJ).

PANAMA: Bocas del Toro, Above Chiriquí Grande on side road 10 mi from continental divide; on trail off pipeline trace, 8°55'N, 82°10'W, 300 m, 28 May 1988, *G. McPherson* 12569 (MO). Hill just south of Chiriquí Grande; at end of pipeline access road 2 mi N of 2nd large bridge N (10 mi.) of cont. divide, 8°54'N, 82°10'W,

350–500 m, 10 Mar 1986, *Hammel et al.* 14743 (MO). Vicinity of Chiriquí Lagoon, 8 Oct 1940, *Wedel* 1091 (MO). Milla, 7.5, 26 July 1971, *T.B. Croat & Porter* 16277 (MO). **Chiriquí,** Chiriquí Grande-Fortuna, along Continental Divide from road branching N off main Fortuna-Chiriquí Grande Highway near Continental Divide, 1.1 mi from main highway, 8°44'N, 82°17'W, 1200 m, 11 Mar 1985, *T.B. Croat & M. Grayum* 60347 (MO). **Coclé:** Cerro Pilon near El Valle, 700–900 m, 700–900 m, 10 June 1967, *Duke* 12155 (MO). Between Cerro Pilon and El Valle, 700–900 m, 15 Aug 1967, *Duke* 13993 (MO). El Valle, 1000 m, 24 Dec 1972, *Gentry* 6893 (MO). El Valle; end of road leading to Turstico Hotel, 11 May 1977, *Folsom* 3111 (MO). Trail between the Río Blanco and the Continental Divide N of El Cope and El Potroso sawmill, 400–1700 ft, 14 Dec 1980, *Sytsma et al.* 2580 (MO). Vicinity of El Valle, 600–1000 m, 8 Dec 1938, *Allen* 1227 (MO). Mountains beyond La Pintada, 400–600 m, 16 Feb 1935, *Hunter & Allen* 544 (MO). Cerro Pilón, 2000–2700 ft, 28 Mar 1969, *Dwyer et al.* 4565 (MO). Continental divide N of Penonome on road to Coclesito, 1600 ft, 25–26 July 1978, *Hammel* 4039 (MO). Foot of Cerro Pilón, above El Valle de Antón. Rain forest, 2000 ft, 28 Mar 1969, *Porter et al.* 4612 (MO). El Valle de Anton, La Mesa, 1000 m, 1 Apr 1973, *Helen et al.* 3011 (MO). El Valle site, on the end of the trail from the end of the road to the site, 24 Apr 1968, *Kirkbride* 1082 (MO). Continental divide, 4 mi past Llano Grande on road to Cascajal, NW of Penónome, 500 m, 9 Apr 1981, *Sytsma* 3878 (MO). Road from Penonomé to Coclecito, 9 km N of Llano Grande, tributary on Río Caseaja, 11 Oct 1978, *D'Arcy & Hammel* 12282 (MO). **Colón:** Santa Rita Ridge, Santa Rita (Arriba)-Cerro Azul, 09°20'21"N, 79°46'47"W, 200–260 m, 23 July 1990, *Grayum & Evans* 9922 (MO). Santa Rita Ridge Road, 6.5 mi E of Boyd-Roosevelt Hwy, 09°21'15"N, 79°44'00"W, 370 m, 16 July 1994, *Croat & Zhu* 76941 (GB, MO, SAR). 25–26 kms from Transisthmica Hwy on Santa Rita Ridge, 09°26'N, 079°37'W, 500 m, 21 Oct 1981, *Knapp et al.* 1733 (MO). Santa Rita Ridge, E of Agua Clara rain gauge, 4 March 1973, *Kennedy* 2753 (MO). Santa Rita Ridge. In forest on Tassell's property, 8 Nov 1974, *Mori & Kallunki* 3026 (MO). Santa Rita lumber road, 8.7 km E of Transisthmian Highway, 15 June 1977, *Folsom* 3690 (MO). Santa Rita Ridge Road, 7.8 km from the Boyd-Roosevelt Hwy., ca 25 km W of Colón., 23 Aug 1975, *Mori & Dressler* 7907 (MO). Trail S of Río Guanache, on ridge to Cerro Pan de Azúcar, 200 m, 20 Sept 1974, *Mori & Kallunki* 2031 (MO). 9 km W of Llano Grande just S of Cascajal, 800 ft, 11 Oct 1978, *Hammel & D'Arcy* 5099 (MO). **Darién:** Vicinity Cerro Pirre, along trail from base camp to Rancho Frio on slopes of Cerro Pirre, 07°58'N,

77°43'W, 200–450 m, 27 July 1994, *Croat & Zhu* 77130 (MO). Parque Nacional Darién, subiendo por la trocha limitrofe desde Casa Vieja hacia Cerro Sapo, 07°58'N, 78°23'W, 500–800 m, 25 May 1991, *Herrera et al.* 1000 (MO). Parque Nacional Darién, Serranía de Cerro Sapo, por la trocha limitrofe del PND entre Casa Vieja y Cerro Sapo, 07°58'N, 78°23'W, 20–400 m, 24 Nov 1990, *Herrera & Polanco* 742 (MO). Parque Nacional del Darién. Slopes of Cerro Mali; head waters of S branch of Río Pucuro; ca. 22 km E of Pucuro., 08°04'30"N, 77°14'00"W, 1300–1400 m, 21 Oct 1987, *Cuadros et al.* 3912 (MO). Parque Nacional del Darién. Ridge between Río Topalisa & Río Pucuro ca. 13 km E of Pucuro; Quebrada Pobre to Mi Casita, 8°03'N, 77°20'W, 450–600 m, 14 Oct 1987, *Nevers et al.* 8316 (MO). Parque Nacional del Darién Ridge between N & S Branches of Río Pucuro; in forest N of old village of Tacarcuna; ca. 18 km E of Pucuro, 8°05'N, 77°16'W, 600–800 m, 24 Oct 1987, *Hammel et al.* 16486 (MO). Cerro Tacarcuna Expedition. South slope of Cerro Tacarcuna above Río Pucuro base camp, 700–1000 m, 25 January 1975, *Gentry & Mori* 13899 (MO, PMA). Cerro Tacarcuna Expedition. Trail from Pico Mali to old Tacarcuna village on Río Tacarcuna, premontane wet forest, 700 m, 7 Feb 1975, *Gentry & Mori* 14181 (MO). Cativo Swamp, Río Chucunaque, ca. 1/2 hr below Morti, 18–31 May 1967, *Duke* 11749 (MO). 10 km NE of Jaqué, headwaters of Río Pavarandó, 1400 ft, 30 Jan 1981, *Sytsma & D'Arcy* 3352 (MO). 10 km NE of Jaqué, ridge between Río Tabuelita and Río Pavarandó., 1400–1600 ft, 1 Feb 1981, *D'Arcy & Sytsma* 14551 (MO). Near Jacque at Enseñada del Guayabo, Apr 1980, *Garwood* 1024 (MO). Cerro Mali: Cerro Tacarcuna Expedition. Trail from Tacarcuna village on Río Tacarcuna to Cerro Mali, 800–1300 m, 16 Jan 1975, *Gentry & Mori* 13601 (MO). Parque Nacional Darién: S of Garachine near Pacific coast above Casa Vieja along boundary trail, W flank of Serranía Sapo, 7°58'N, 78°23'W, 150–300 m, 22 May 1991, *Hensold* 1083 (MO, PMA). Punta Guayabo Grande: N of Punta Guayabo Grande, trail to ridge top, 200–600 ft, 21 Apr 1980, *Antonio & Hahn* 4346 (MO, PMA). **Panamá**, Along trail to Cerro Brewster from Río Pacora Valley, 9°20'N, 79°15'W. Forested slopes c. 650 m, 9°20'N, 79°15'W, 650 m, 21 Nov 1985, *G. McPherson* 7558 (MO). 1 mi N Cerro Azul, 2300 ft, 27 May 1966, *Tyson & Blum* 4088 (FSU, MO); El Llano-Carti Road, 10 km from Interamerican Hwy., 5 Oct 1974, *Mori & Kallunki* 2326 (MO). Campo Tres, 3 mi NE of Altos de Pacora, 500–800 m, 10 Mar 1973, *Liesner* 578 (MO). Cerro Azul, 23 June 1972, *T.B Croat* 17304 (MO). El Llano-Carti Road, 09°16'N, 078°58'W, 1000 ft, 6 Sep 1980, *Sytsma* 996 (MO). El Llano-Carti road, 12 km N of Pan. Am. Hwy at El Llano, 400 m, 11 Mar 1974, *Nee* 10450 (MO). Cerro Azul, 24 Mar 1969, *Porter et al.* 4070 (MO). *Porter et al.* 4098 (MO). 2–3 mi S of Goofy Lake, road to Cerro Jefe, 2000–2200 ft, 10 Dec 1966, *Lewis et al.* 264 (MO). Near foot of Loma Larga, east of Cerro Azul (Goofy Lake), 5 Apr 1973, *Dressler* 4319 (MO, PMA). vicinity of Finca Neptuno, 3.5 km NE of Lago Cerro Azul on road to Cerro Jefe., 600–800 m, 11 May 1974, *Nee* 11524 (MO). El Llano-Carti Road, 9.6 km from Inter-American Highway, 350 m, 26 May 1975, *Mori & Kallunki* 6402 (MO). **Comarca Guna Yala**, Nusagandí, 30 May 1993, *Marrienne* 25 (MO). Trail from mouth of Río Irgandí to a tributary of Río Cartí Senni. Two hours through second growth, one hour through forest. 9°25'N, 78°51'W., 9°25'N, 78°51'W, 20 Dec. 1985, *Nevers & Herrera* 6580 (MO). Cangandi, 9°24'N, 79°24'W. 9°24'N, 79°24'W, 30 m, 10 Feb 1986, *Nevers & Herrera* 7041 (MO). Cangandi, hills around village. Assoc: *Cespedizia macrophylla*, 9°24'N, 79°24'W., 9°24'N, 79°24'W, 50 m, 13 Dec. 1985, *Nevers et al.* 6487 (MO, PMA). El Llano-Carti Road, 19.1 km from Interamerican Hwy; elev. 350 m. 9°19'N, 78°55'W, 9°19'N, 78°55'W, 350 m, 4 Mar 1985, *Nevers et al.* 4951 (MO). Campamanto Nusagandi, en ELC a 19.1 km de la vía Panamericana, Sendero Wedar Igar, 9°11'N, 78°15'W, 200–350 m, 31 Oct 1992, *Herrera et al.* 1265 (MO, PMA). Nusagandí; El Llano-Carti Road, 9 mi N of main highway; Nergan Igar (Nergan Trail), 09°20'N, 79°00'W, 350 m, 2 July 1994, *Croat & Zhu* 76563 (CM, MO). Trail east of Cangandi-Mandinga airport road, 2–5 mi S of Mandinga airport. 27 Oct 1967, *Duke* 14813 (MO). Cerro Habú, trail from Río Sidro, primary wet forest, 09°23'N, 078°49'W, 800–1400 ft, 18 Dec 1980, *Sytsma et al.* 2635 (MO). On trail to inland village of Armila, 3 to 8 km SW of Puerto Obaldía, 21 June 1975, *Mori et al.* 6798 (MO). Puerto Obaldía and trail to Colombian Frontier, 0–500 m, 28 Apr 1980, *D'Arcy* 13624 (MO). 3–4 hours up Río Mulatupu, 17 Aug 1967, *Kirkbride* 229 (MO). El Llano-Carti road, 10.5 mi from Interamerican Hwy., 09°18'N, 079°58'W, 550 m, 14 Mar 1985, *Croat* 60487 (MO). Nusagandi: Sendero Wedar, 9°18'N, 78°58'W, 300–400 m, 19 July 1986, *McDonagh et al.* 174 (BM). **Veraguas**, Slopes of Cerro Tute, along trail from between first and second creeks N of height above Alto de Piedra; forest, 08°30'N, 81°07'W, 600–750 m, 21 March 1987, *McPherson* 10730 (MO). Trail on ridge to summit of Cerro Tuté, Cordillera de Tute. 1 km past Escuela Agricola Altos de Piedra, just W of Santa Fe, upper montane and elfin forest, 08°36'N, 081°06'W, 1250–1410 m, 15 December 1981, *Knapp & Sytsma* 2532 (MO). Vicinity of Escuela Agricola Alto Piedra near Santa Fe, 0.3 mi beyond the fork in the road near the agricultural school toward Atlantic coast, along trail to top of Cerro Tute, 1050–1150 m, 29 November

1979, *Croat 48887* (MO, PMA). Carribbean slope above Río Primero Brazo 5 mi NW of Santa Fe, 700–1200 m, 18–19 Mar 1973, *Liesner 801* (MO). Along trail to summit of Cerro Tute, ca. 3 km above Escuela Agricultura Alto Piedra near Santa Fé, 2600–2800 ft, 4 Jan 1981, *Sytsma & Antonio 2987* (MO). Vicinity of Escuela Agricultura Alto Piedra, near Santa Fé along trail to top of Cerro Tute, 2800 ft, 3 Apr 1980, *Antonio 3978* (MO). Along road from Santa Fé to Río Calovebora 0.6 mile beyond Escuela Agricola Alto Piedra, 735 m, 4 Apr 1976, *Croat & Folsom 34133* (MO). 0.6 mi beyond Escuela Agricola Alto Piedra, 730 m, 4 Apr 1976, *Croat & Folsom 34000* (MO). Caribbean slope above Río Primero Brazo 5 mi NW of Santa Fé, 700–1200 m, 18–19 Mar 1973, *Croat 23146* (MO). Road beyond Escuela Agricola Alto Piedra, above Santa Fé, Atlantic watershed., 800–1000 m, 1 Jan 1975, *James et al. 4566* (DUKE); 1 km past Agricultural School, forested slope to the rear. Road from Santa Fe, 1000–1200 m, 5 Feb 1977, *Folsom & Collins 1610* (MO).

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