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Magnolia mercedesiarum (subsect. *Talauma*, Magnoliaceae): a new Andean species from northern Ecuador, with insights into its potential distribution

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Abstract

Magnolia mercedesiarum, a new species from the eastern slopes of the Andes in northern Ecuador, is described and illustrated, and a key to Ecuadorian *Magnolia* (subsect. *Talauma*) is provided. This species differs from *M. vargasiana* in having broadly elliptic leaves that have an obtuse base vs. suborbicular and subcordate to cordate, glabrous stipular scars, more numerous lateral veins per side and fewer stamens. It also differs from *M. llanganatensis* in having leaf blades broadly elliptic vs. elliptic, longer petioles, less numerous lateral leaf veins per side, larger fruits and more numerous petals and carpels. Using MaxEnt species distribution models and IUCN threat criteria, *M. mercedesiarum* has a potential distribution area of less than 3307 km² and is assessed as Endangered (EN): B1 ab (i, ii, iii). The relevance of systematic vegetation sampling in the discovery of rare species is highlighted.

Resumen

Magnolia mercedesiarum es descrita e ilustrada como especie nueva nueva de la vertiente oriental de los Andes en el norte de Ecuador. Se incluye una clave para las especies ecuatorianas de *Magnolia*. Esta especie se diferencia de *M. vargasiana* por tener hojas elípticas a ampliamente elípticas de base obtusa vs. suborbiculares (rara vez anchamente elípticas) de base subcordada a cordada, cicatriz de estipular glabra, mayor número de nervios laterales por lado de la hoja y menor número de estambres. Esta especie se diferencia de *Magnolia llanganatensis* por tener láminas foliares ampliamente elípticas vs. elípticas a angóstamente elípticas, pecíolos más largos, menos venas foliares por lado; frutos más grandes y pétalos y carpelos más numerosos. Mediante el uso de los modelos de distribución de especies MaxEnt y los criterios de amenaza de la IUCN, *M. mercedesiarum* tuvo una área de distribución potencial menor de 3307 km² y fue diagnosticada como En Peligro (EN): B1 ab (i, ii, iii). Se resalta la relevancia de levantamientos sistemáticos de vegetación en el descubrimiento de especies raras.

Keywords: Ecuadorean flora, Guacamayos, Antisana, Sumaco-Galeras, Napo, Orellana, Sucumbíos

Introduction

New World Magnoliaceae consist of evergreen or deciduous trees that inhabit temperate and tropical mesic habitats from the ancient tepuis of the Guiana Shield to the recent highlands of the Mexican Trans-Volcanic Belt and the Andes, from its northernmost record in Vermont, USA to its southern limit in the Mata Atlántica of Serra do Mar, Paraná, Brazil, with several diversity peaks between the equator and the Tropic of Cancer and from near sea level to an upper elevation record at 3400 m on Cerro de la Muerte, Costa Rica (Vázquez-García *et al.* 2014, 2015, 2016a).

Here we treat New World Magnoliaceae as consisting of a single genus, *Magnolia* Linnaeus (1753: 535) including ca. 158 species in three sections: 1) sect. *Macrophylla* Figlar & Noteboom (2004: 92) (seven species: four in temperate areas of southeastern USA and northeastern México; and three south of the Tropic of Cancer in the Mexican Sierra

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Madre Oriental); 2) sect. *Magnolia* (27 species, usually at intermediate elevations in tropical mountains of Mexico and Central America, two temperate species in North America, one of these two recently reported from Cuba; and 3) sect. *Talauma* Jussieu (1789: 281) Baillon (1866: 66), the last including 124 species included in four subsections: 1) subsect. *Cubenses* Imchanickaja (1991: 60) (ten species in Antillean mountains), 2) subsect. *Dugandiodendron* Lozano (1975: 33) Figlar & Nooteboom (2004: 90) (18 species mostly at intermediate elevations in the Andes and the Guiana Shield), 3) subsect. *Talauma* (90 species, largely in continental and Caribbean Neotropical lowlands to premontane areas; Vázquez-García *et al.* 2014), and 4) subsect. *Chocotalauma* Vázquez, Pérez & Arroyo in Pérez *et al.* (2016: 270), consisting of six species from the Chocó biogeographic region of western Colombia and Ecuador. The family throughout the Neotropics displays a remarkable pattern of allopatric speciation (Howard 1948, Vázquez-García 1990, 1994; Lozano 1994; Vázquez-García *et al*. 2002, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c, 20013d, 2014, 2015a, 2015b, 2016a, 2016b, 2016c, 2017; Jiménez & Cruz 2005, Jiménez *et al*. 2007, Cruz *et al*. 2008, Arroyo & Pérez 2013, García-Morales 2017).

TABLE 1. Species of *Magnolia* sect. *Talauma* and occurrences in the provinces of Ecuador

Subsect. *Chocotalauma*	
M. chiguila Arroyo, Pérez & Vázquez in Pérez *et al.* (2016: 272).	Pichincha, Imbabura
M. mashpi Pérez, Arroyo & Vázquez in Pérez *et al.* (2016: 272).	Pichincha
M. stritaifolia Little (1969: 198).	Esmeraldas
Subsect. *Duganidodendron*	
M. bankardiourum Dillon & Sánchez-Vega (2009: 7).	Zamora-Chinchipe
M. jaenensis Marcelo-Peña in Marcelo & Arroyo (2013: 107).	Zamora-Chinchipe
M. lozanoi Vázquez & Castro-Arce in Vázquez-García *et al*. (2012c: 114).	Morona-Santiago
M. shuariorum Arroyo & Vázquez in Arroyo *et al*. (2013: 505).	Morona-Santiago
M. yantzazana Arroyo in Arroyo & Pérez (2013: 5).	Zamora-Chinchipe
Subsect. *Talauma*	
M. arroyoana Molinari (2016: 200).	Zamora Chinchipe
M. canandeana Arroyo, in Arroyo *et al*. (2013: 498).	Esmeraldas
M. dixonii (Little 1969: 457) Govaerts in Frodin & Govaerts (1996: 70).	Esmeraldas
M. equatorialis Vázquez in Vázquez-García *et al*. (2012c: 100).	Orellana, Pastaza
M. kichuana Vázquez, Arroyo & Pérez in Arroyo *et al*. (2013: 501).	Napo, Pastaza, Morona-Santiago
M. llanganatensis Vázquez & Neill in Vázquez-García *et al*. (2016c: 597).	Tungurahua
M. mercedesiarum Neill, Vázquez & Arroyo (this paper).	Napo, Sucumbíos
M. mindoensis Vázquez, Neill & Dahua in Vázquez *et al*. (2017: 202).	Carchi, Cotopaxi, Pichincha
M. neillii (Lozano 1994: 71) Govaerts in Frodin & Govaerts (1996: 71).	Sucumbíos
M. palandana Arroyo in Arroyo & Pérez (2013: 1).	Zamora-Chinchipe
M. pastazaensis Arroyo & Pérez (2013: 4).	Napo, Pastaza
M. rimachii (Lozano 1994: 105) Govaerts in Frodin & Govaerts (1996: 71).	Orellana, Morona-Santiago
M. "*napoensis*" *ined*. (Vázquez-García *et al*. 2016a).	Napo, Pastaza
M. vargasiana Vázquez & Neill in Vázquez *et al.* (2015b: 27).	Tungurahua, Morona-Santiago
M. zamorana Arroyo in Arroyo *et al*. (2013: 507).	Zamora-Chinchipe

A close look of *Magnolia* species patterns in Ecuador reveals 23 species of *Magnolia* (Table 1) in three subsections of sect. *Talauma*, including the one here proposed as new (Vázquez-Garcia *et al.* 2016a; author citations of all *Magnolia* species names from Ecuador are provided in Table 1). Ecuadorian *Magnolia* species cover most of the wet mountainous and lowland tropical forest throughout the country, displaying highly concentrated, mostly allopatric speciation (Vázquez-García *et al.* 2016a; Fig. 1, Pérez *et al.* 2016), but species co-occurrence at a local level and niche differentiation are also evident to a lesser extent; e.g. a) in Yasuní National Park in lowland Amazonia, the emergent tree *M. equatorialis* shares habitat with the understory shrubby *M. rimachii*; b) in the Rio Zuñac watershed of the Llanganates region the broad and subcordate-leaved *M. vargasiana* shares habitat with the narrowly leaved *M. llanganatensis*; c) in the montane forest of the San Francisco Reserve of Zamora-Chinchipe *M. palandana* with hairy leaves shares habitat with *M. zamorana*, a glabrous species; and d) in the Cordillera del Cóndor, the pubescent and broad leaved *Magnolia yantzazana* shares habitat with the glabrous and elliptic-leaved *M. bankardiourum*. Of the 23 species of *Magnolia* in Ecuador, five species correspond to subsect. *Dugandiodendron* (Table 1), endemic to the Cordillera del Cóndor with costate-ellipsoid fruits, stipules free from the petiole and long staminal appendages (connectives); three species belong to subsect. *Chocotalauma* (Table 1) in the biogeographical Chocó region, with globose and thick-walled fruits and stipules free from the petioles and; 15 species of subsect. *Talauma* (Table 1), all with stipules adnate to the petiole, six of these in Amazonia (with either globose or costate ellipsoid fruits), five in the Andes (with costate-ellipsoid fruits), three confined to the biogeographical Chocó (with thick walled globose fruits,) and one in the Cordillera del Cóndor (with unknown fruits). As predicted by previous occurrence of species in the Andes, the species here proposed as new fits the expected morphology of costate-ellipsoid fruits with stipules adnate to the petiole. The observed morphological and geographical speciation patterns observed in Ecuador for three subsections of sect. *Talauma* can only be explained through a combination of vicariance, dispersal and niche differentiation.

The aim of this work is to describe and illustrate another new species of *Magnolia* from the eastern slopes of the Andes in northern Ecuador, estimate its potential distribution, assess its conservation status and provide a key to the species of *Magnolia* of Ecuador.

Materials and Methods

The newly proposed taxon was first collected in sterile condition in 1990 from the Río Due area, Sucumbíos Province by Carlos E. Cerón and J. Ayala (*Cerón & Ayala 9896*) and subsequently, in flower bud, by Jürgen Homeier from Volcán Sumaco in May 2005. Both of these early collections were obtained during systematic vegetation sampling of tree plots or transects (Table 3). Frank Arroyo suspected first that the specimen from the Río Due with stipular scars covering the entire length of the petiole could be an undescribed species of sect. *Talauma,* but had no luck finding fertile material in a 2013 visit. Antonio Vázquez also suspected that the material of *Homeier et al. 1737* and *3135,* obtained during vegetation sampling (Table 3)*,* from the Antisana Ecological Reserve, Napo Province (Cordillera Guacamayos) with long, thin petioles could be a new species. In November 2014, after obtaining precise directions and coordinates from Jürgen Homeier´s permanent plots, David Neill, Antonio Vázquez, Mercedes Mamallacta and Alex Rosillo visited the Cordillera Guacamayos locality and collected a few flower buds, two immature gynoecia, a single petal and a decayed fruit, adding evidence for a possible new taxon. Three additional visits in 2014–2015, two of those at the Guacamayos site led by Efrén Merino-Santi (a native Kichwa student at the Universidad Estatal Amazónica, tree climber and illustrator of this species) and one by John L. Clark at the private Alto Coca Reserve, yielded flowering (a mature flower bud, about to open, which was forced to open) and fruiting material and confirmed that we were dealing with a taxonomic novelty, here described as new. Morphological description and illustrations were based on fresh and herbarium material. Leaf descriptions and general shapes of reproductive structures follow Lozano (1994). Nomenclature of Magnoliaceae follows Figlar and Nooteboom (2004). The herbarium acronyms follow Thiers (2017). For accepted names we used POWO (2017). Authors and names of plants follow the International Plant Name Index, IPNI (2017). Conservation status was assessed based on the criteria of the IUCN (2012). Many references were made accessible by Tropicos (http://www.tropicos.org/) and the Biodiversity Heritage Library (http://biodiversitylibrary.org).

TABLE 2. Differences between *Magnolia mercedesiarum*, *M. llanganatensis* and *M. vargasiana*

Characters	*M. mercedesiarum*	*M. vargasiana*	*M. llanganatensis*
Terminal internodes			
Length (cm)	1.0–2.0	0.4–1.0	0.2–1.0
Pubescence	glabrescent	glabrous	pubescent
Petiole			
Length (cm)	(2.0–)4.0–8.5	4.0–6.5	1.0–1.5
Pubescence	glabrous	short hairs along stipular scar	hairs on petiole and midvein sides
Leaf blade			
Shape		suborbicular, rarely broadly elliptic	elliptic to narrowly elliptic
		subcordate to cordate	obtuse
Base		7.5–11.0	
		6–7	3.5–5.0
Width (cm)			16–17
No. lateral veins per side			
No. of stamens	23–29	50–54	20–25(–30)
No. of petals	8	8	6

Species distribution modelling:—The initial estimation of extent of occurrence of *Magnolia mercedesiarum* was performed in accordance with recommendations of IUCN (2012). The species presence points were obtained by georeferencing of cited specimens following the MaPSTeDI protocol (Murphey *et al.* 2004) with locality confidence level from 4 to 5, which corresponds to bias from 1–5 km. Presence points and extent of occurrence served as a starting point for further development of species distribution modelling (SDM). The probability of presence of *M. mercedesiarum* was estimated with spatial resolution of approximately 250 m using MaxEnt 3.4.1 (Phillips *et al.* 2006, 2017) in R 'dismo' 1.1-4 environment (Hijmans et al. 2017). In accordance with presumed narrow distribution range of the species under consideration, we performed two separate SDM analyses: the exploratory analysis in northwestern South America defined as a rectangular zone in the interval of latitude from 10°N to 10°S and longitude from 70°W to 82°W, and detailed analysis with 20 cross-validation replications in a rectangular envelope area of 500 km distance from the observation points. To account for the effect of collecting bias, we used the target-group background sampling technique to provide background points to the MaxEnt algorithm, as well as during construction of bias-corrected null-models for SDM (Raes and ter Steege 2007). The dataset selected as the target-group is the specimen-based georeferenced record for flowering plants available through Global Biodiversity Information Facility (GBIF 2017a, 2017b) and consistent with *Magnolia* in collecting techniques and collector effort distribution. The stack of raster variables for SDM includes 19 bioclimatic variables (Nix 1986, O'Donnell & Ignizio 2012) and median elevation above sea level in 7.5" grid cells. The set of monthly minimum and maximum temperatures publicly available with angular resolution of 30" was statistically downscaled to 7.5" using GMTED2010 (Danielson and Gesch 2011) median elevation data as the high-resolution predictor variable. The sensitivity-specificity combined approach was used to produce thresholds for transformation of probability of species occurrence to probable presence area following Liu *et al.* (2005), the more conservative estimation was made by minimising the difference between training specificity and sensitivity (ETSS) and less conservative by maximizing both parameters (MTSS). For model evaluation we estimated AUC as the only useful indicator of model accuracy for low-prevalence species (van Proosdij et al. 2016) and tested it against a set of 99 null-models with a significance level of 0.05, expecting that the actual AUC rank exceeds 95. The full description of SDM can be found in Vázquez-García *et al.* (2018).

TABLE 3. Ecuadorian *Magnolia* species discovered or located during systematic forest sampling.

Year found	Species of *Magnolia* discovered or located.	Forest Plots or Transects by	Place of plots	Species Published
1986	*M. "napoensis"*	David Neill	Jatun Sacha Biological Station	Ined.
1988	*M. "napoensis"*	Carlos Cerón	Jatún Sacha Biological Station	Ined.
1990	*M. neilli*	Carlos Cerón	Reserva Faunística Cuyabeno	1994
1990	*M. mindoensis*	Alwyn Gentry	Reserva Maquipucuna	2017
1990	***M*. mercedesiarum**	Carlos Cerón	Río Due, Sucimíos	This paper
1992	*M. mindoensis*	Grady Webster	Reserva Maquipucuna	2017
1993	*M. lozanoi*	Alwyn Gentry	Morona Santiago, Cordillera del Cóndor	2012
1994	*M. striatifolia*	M. Tirado	Reserva Ecoógica Cotacachi	1969
2000	*M. zamorana*	Jürgen Homeier	San Francisco Biological Station	2013
2000	*M. palandana*	Jürgen Homeier	San Francisco Biological Station	2013
2005	***M*. mercedesiarum**	Jürgen Homeier	Antisana Ecological Reserve	This paper
2005	*M*. **mercedesiarum**	Jürgen Homeier	Sumaco-Galeras National Park	This paper
2007	M. *pastazaensis*	Jürgen Homeier	Jatun Sacha,	2013
2007	*M.* sp.	Jürgen Homeier	Podocarpus National Park	Ined.
2008	*M. yantzazana*	D. Neill & W. Quizhpe	Los Encuentros, Río Machinaza plots	2013
2008	*M. napoensis*	David Neill	Taisha, Río Cangaime	Ined.
2009	*M. rimachii*	Alvaro Pérez	50 ha plot at Yasuni Bilogogical Station	1994
2009	M. *bankardiorum*	David Neill	Área de Conservación Los Tepuies,	2009
2012	M. *equatrorialis*	Alvaro Pérez	50 ha plot at Yasuni Biological l Station	2012
2014	*M. vargasiana*	David Neill	Plot Zuñac 2, Tungurague	2015
2014	*M. llanganatensis*	David Neill	Plot Zuñac 1, Tungurague	2016

Taxonomic treament

Magnolia mercedesiarum D.A.Neill, A.Vázquez & F.Arroyo, *sp. nov.* (Figs. 1, 2)

Type:—ECUADOR. Napo: Cosanga, Cordillera de Guacamayos, Reserva Ecológica Antisana, ca. 6 km SE of Cosanga, along trail below parking lot at viewpoint; after reaching the pipeline 50 m west on the right side of the trail, wet montane tropical forest, 00°38'S, 77°50'W, 1940 m, 3 January 2015 (fl bud, fr), *Efrén Merino-Santi 1,* with Alex Dahua-Machoa, D. Yajaira Malucín-Andrade & Alex Rosillo (holotype: ECUAMZ!; isotypes: IBUG!, K!).

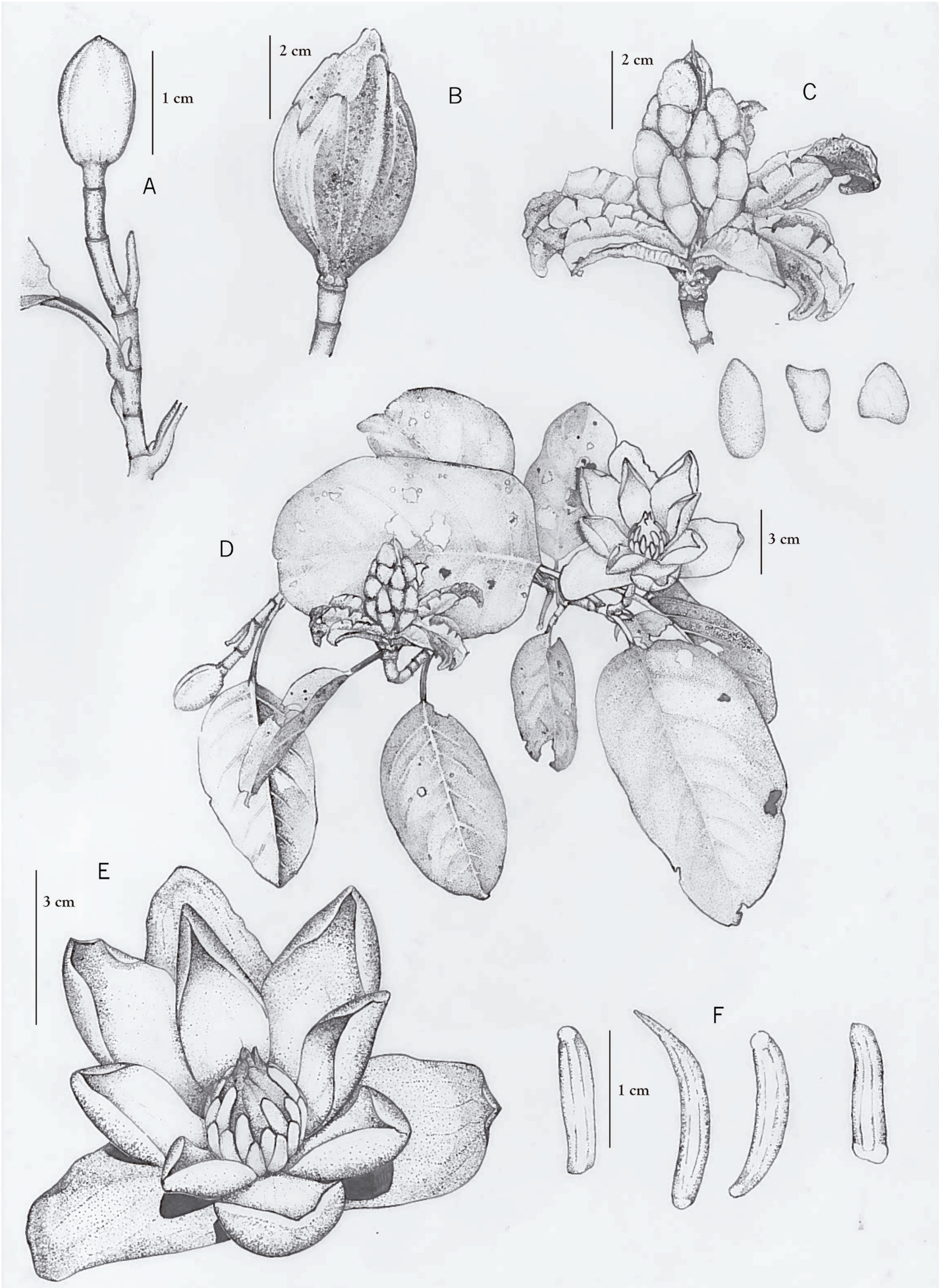

FIGURE 1. *Magnolia mercedesiarum*. A. Flower bud. B-C. Fruit before and during dehiscence. D. Flowering and fruiting branch. E. Flower (forced to open from mature flowerbud). F. Stamens. All from the type material. Drawing by Efrén Merino Santi.

FIGURE 2. *Magnolia mercedesiarum*. A. Tree. B. Flower (forced to open from mature flowerbud). C. Leaf and lateral veins. D. Flower bud. E. Fruit before dehiscence. Photographs A and E by Efren Merino-Santi. B, C and D. by Antonio Vázquez. A tree. B and E from the holotype. C and D from *Vázquez et al. 10126*.

FIGURE 3. *Magnolia mercedesiarum*. A.-B. Open small fruit with eight carpels. C and D. Open fruit of nine carpels. E.-F. Open fruit of ten carpels. Illustration by R. Efren Merino- Santi, all based on the type material.

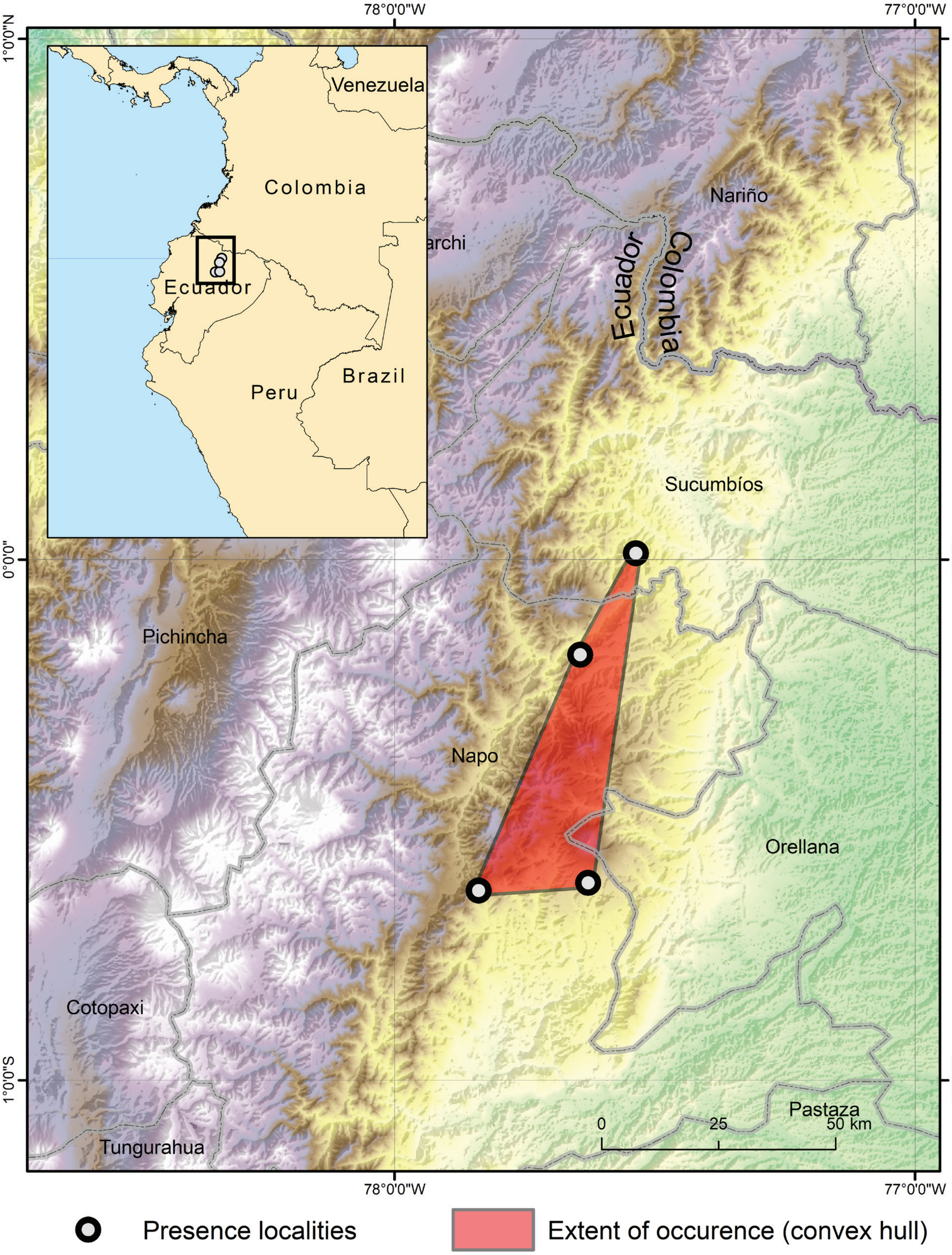

FIGURE 4. Localities of *M. mercedesiarum* and minimal convex polygon. Basemap from GMTED2010 digital elevation model (Danielson and Gesch 2011) and ESRI World administrative divisions (ESRI 2017). Colour gradient represents elevation. Extent of occurrence as defined by the IUCN (2012) is 901 km².

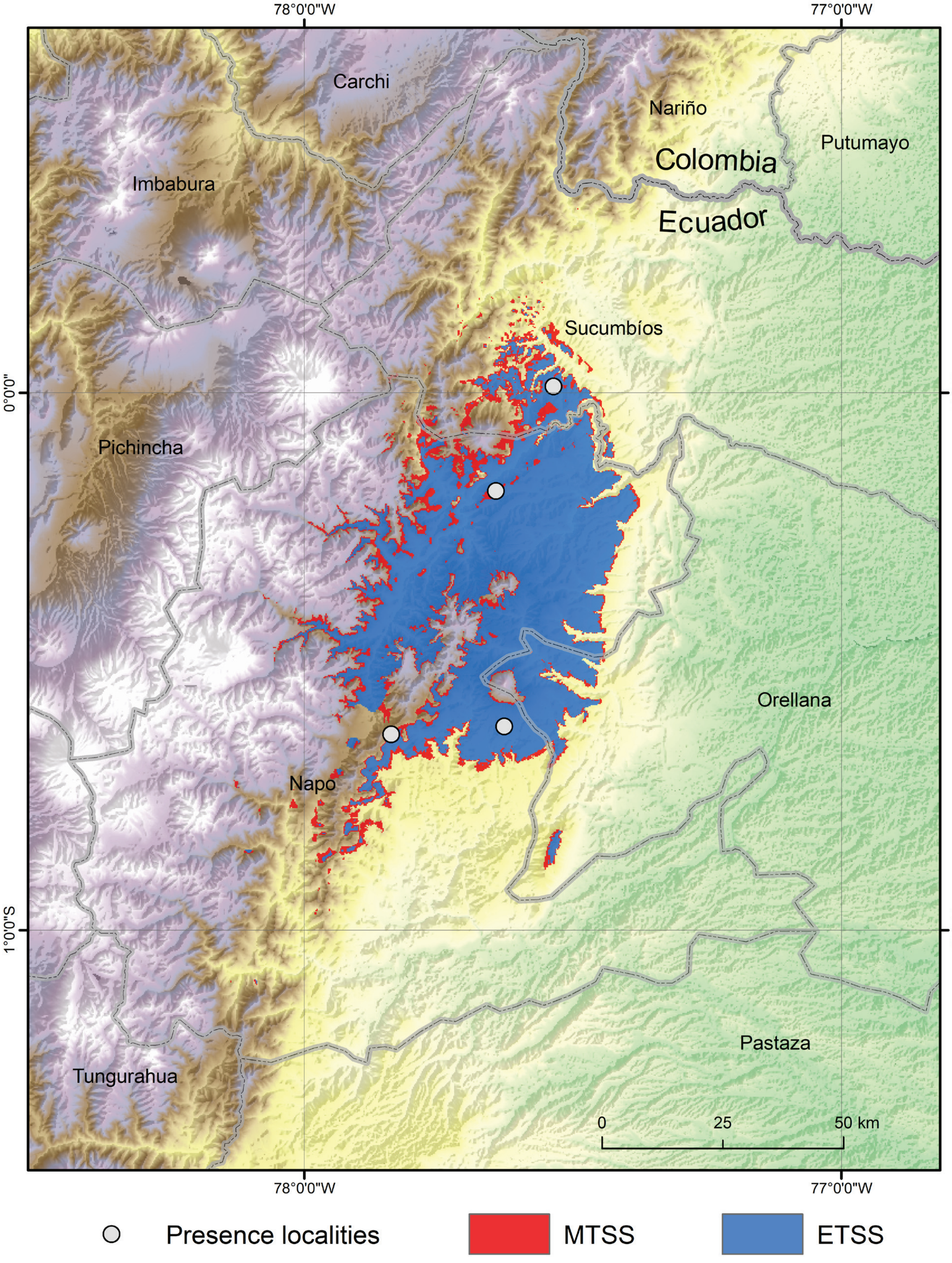

FIGURE 5. Potential distribution area of *Magnolia mercedesiarum* after threshold application. Both conservative (equal training sensitivity and specificity, ETSS) and less conservative (maximum sum of training specificity and sensitivity, MTSS) thresholds included. Colour indication for MTSS is the additional area included in potential distribution around the edges of the coverage with the MTSS threshold. Base map is the same as in Figure 4.

Magnolia mercedesiarum is similar to *M. vargasiana* but differs in having broadly elliptic leaves that area obtuse at the base vs. suborbicular and subcordate to cordate, glabrous stipular scars, more numerous lateral veins per side and fewer stamens. It is also similar to *M. llanganatensis* in having similar size of flowers and glabrous leaves; however, it differs from the latter in having leaf blades broadly elliptic vs. elliptic, longer petioles (2.0–) 4.0–8.5 vs. 1.0–1.5 cm, fewer lateral veins per side 9–10 vs. 16–17, more numerous petals (8 vs. 6) and carpels (8–10 vs. 4–6) and larger fruits (3.8–5.0 × 2.7–3.6 cm vs. 3.0 × 2.0 cm; Table 2).

Trees 15–20 m tall, with trunk 8–24 cm in diameter at breast height, first branch at 9 m; bark creamy white to pale brown. Twig internodes 1.0–2.0 × 0.3–0.5 cm, glabrous. Petioles (2.0–)4.0–8.5 × 0.1–0.2 cm, glabrous, with the stipular scar along its length; leaf blades broadly elliptic, 10.0–16.0 × 4.5–9.0(–10.0) cm, glabrous; 9–10 lateral veins per side. Hypsophylls 2–3, pubescent. Flower buds 1.8–2.7 × 1.3–2.0 cm, ellipsoid; open flowers 7 cm in diameter, fragrance smelling of ketone solvents. Sepals 3, greenish white, turning brownish purplish. Petals 8, obovate, 3.0–4.0 × 1.0–2.0 cm, cochleate, creamy white, but soon oxidizing to brownish, the outer three, larger, widely obovate and subequal, the next three subequal and the inner two narrower and spathulate; stamens 23–29, linear, acute at the apex, pale yellowish. Gynoecium ellipsoid, carpels 8–10, 2.7–3.5 × 1.0–1.3 cm. Fruit asymmetrical, ovoid, costate, 3.8–6.0 cm × 2.7–4.0 cm, nearly half of the fruit green the other half reddish, where lenticels become more evident, fragrance like *Annona cherimola*. Seeds 1.0–2.0 × 0.5–0.7 cm, covered with a red aril when mature.

Distribution habitat, and phytogeography:—The species is confined to four localities, three of them in Napo Province: 1) the Cordillera Guacamayos in the eastern Andean slopes of northern Ecuador, near the Urcu Siki creek, a tributary of the Upper Jondachi watershed; 2) on the southern slopes of Volcán Sumaco in Sumaco Napo-Galeras National Park, 3) the private Alto Coca Reserve; and 4) Sucumbíos Province in the upper Río Due watershed, Parroquia Reventador. It grows in dense, wet, tropical cloud forest at 1800–2000 m. At the type locality in the Cordillera de Guacamayos, the common tree species that occur in association with *M. mercedesiarum* include *Erythrina edulis* Triana ex Micheli (1892: 145; Fabaceae), *Morus insignis* Bureau (1873: 247; Moraceae), *Weinmannia pinnata* Linnaeus (1759: 1005; Cunoniaceae), *Endlicheria griseosericea* Chanderbali (2004: 100-102; Lauraceae), *Calatola costaricensis* Standley (1926: 416–418; Metteniusaceae), *Schefflera minutiflora* Harms (1908: 153; Araliaceae), *Elaeagia mariae* Weddell (1849: 94) and *Joosia ulei* Steyermark (1975: 255; both Rubiaceae).

Species distribution modelling:**—**The distribution of *Magnolia mercedesiarum* as currently known is restricted to four localities in Napo and Sucumbíos provinces. The extent of occurrence (IUCN, 2012), i.e., the minimum convex polygon containing all points of occurrence (Fig. 4) is 901 km². The probable presence area of *M. mercedesiarum* was estimated as restricted to wet habitats in eastern slopes of the Ecuadorian Andes, using the species distribution model of MaxEnt, and measures 3307 km² considering MTSS (maximum sum of training specificity with sensitivity) or 2701 km² considering ETSS (equal training sensitivity and specificity; Fig. 5).

Phenology:**—**Unpredictable because the species has been found sterile in May, September and October, in bud in January, May and November and fruiting in January and April. It has not been found with open flowers.

Eponymy:—The species is named in honour of two Ecuadorian women named Mercedes who have contributed to botanical science and conservation in their native country: Mercedes Asanza, professor at the Universidad Estatal Amazónica, administrative curator of the ECUAMZ herbarium at that university, and specialist in taxonomy and ecology of ferns; and Mercedes Mamallacta, a Kichwa ethnobotanist from Archidona, Napo Province, gardener, native plant propagator and inheritor and guardian of millennia of Kichwa plant lore.

Ethnobotany:—No uses are recorded for the species in the type locality. However, according to informant Antonio Naranjo (*Cerón & Ayala 9896,* from Río Due*)*, the plant is known as "orejas de burro" (donkey ears). It is aromatic, and leaves mixed with urine and salt are used to clean sick animals.

Conservation status:—Following IUCN (2012) Red List threat criteria *Magnolia mercedesiarum* was assessed as endangered (EN): B1 ab (i, ii, iii); an extremely rare tree, only known from four locations and endemic to the Napo and Sucumbíos Provinces of Ecuador, with a potential distribution area of less than 3307 km² on the eastern slopes of the Andes. Only two adult trees and one juvenile (3 m tall) were observed in the type locality. A fallen fruit showed signs of predation, most likely by rodents, leaving only the empty torus without any seed. No seeds or seedlings were observed below or near the adult tree. Efforts to propagate the tree from seeds and cuttings have failed. Fortunately, it is protected within the Antisana Ecological Reserve, Sumaco Napo-Galeras National Park and the private Alto Coca Reserve.

Additional specimens examined:—ECUADOR. Sucumbíos: Gonzalo Pizarro, Parroquia Reventador, PreCooperativa García Moreno, Tercera Línea al N de la carretera, cerca al Río Dué [transecto 5 (50 × 2 m), 70], 00°03'N 77°35'W, 1800 m, 23 May 1990 (sterile), *Cerón & Ayala 9896* (MO). Napo: Cordillera de Guacamayos. ca. 6 km SE of Cosanga (plot 7, tree label 171), 00°38.551'S, 77°50.214'W, 1940 m, 28 Sep 2005 (sterile), *Homeier, Chicaiza*

& Moreno 1737, (GOET, MO, QCA, QCNE); Cordillera de Guacamayos, ca. 6 km SE of Cosanga (plot 54, tree label 1613), 00°38.196'S, 77°50.384'W, 2000 m, 24 Octr 2007 (sterile) *Homeier, Chinchero, Jaramillo & Guachamin 3135* (GOET, MO, QCA, QCNE); Quijos, Cosanga, Cordillera de Guacamayos, ca. 6 km SE of Cosanga, 1.5 horas de distancia caminando (ca. 4 km) al sur por Sendero Jumandy, wet montane tropical forest, 00°38'S 077°50'W, 1940 m, 13 Nov 2014 (fl bud), *Vázquez-García, Neill, Mamallacta & Rosillo 10126* (ECUAMZ, IBUG); Cosanga, Cordillera de Guacamayos, ca. 6 km SE of Cosanga, 1.5 horas de distancia caminado (ca. 4 km) al sur por Sendero Jumandy, 00°38'S, 77°50'W, 1940 m, 3 Jan 2015 (fl bud, fr), *Vázquez et al. 10128* (ECUAMZ, IBUG); Reserva Alto Coca, 0°10'58"S, 77°38'36"W, ca. 1800 m, 8 Apr 2015 (fr), *Clark s.n.* (four images by JLC); Parque Nacional Sumaco Napo-Galeras, pendiente sur del Volcán Sumaco, 1780 m, 15 May 2005 (fl bud), *Homeier & Chinchero 1869* (GOET, QCNE).

Notes:—*Magnolia mercedesiarum* is the first species of *Magnolia* described from the eastern slopes of the Andes in northern Ecuador; it is the third confirmed species of *Magnolia* in Napo Province after *Magnolia pastazaensis* and *M. "napoensis"* ined. (Vázquez-García *et al*. 2016a), the last two at lower elevation and sympatric at Jatun Sacha Biological Station. Its occurrence in the Due River area represents the second species of *Magnolia* recorded from Sucumbíos Province after *M. neillii* in the Amazon lowlands of northeastern Ecuador (Vázquez-García *et al*. 2016a).

Magnolia discoveries in Ecuador and the Neotropics:—Including *Magnolia mercedesiarum,* there are now 18 (82%) species of *Magnolia* from Ecuador published in the last decade, representing a third of all Neotropical species of *Magnolia* published in the last decade. It is noteworthy that over half of all magnolias from Ecuador were first discovered or at least located during systematic vegetation sampling of permanent plots in selected natural protected areas (Table 3). Most Ecuadorian species of *Magnolia* are rare canopy or subcanopy trees, inconspicuous in dense forest and easily overlooked, especially when they are not in flower; many have been discovered only because the tree plot inventories require careful sampling of all trees within the plot boundaries. As a result of the more numerous discoveries of magnolias from Neotropical areas in the last decade, the proportion between Old World vs. New World species has shifted from 2:1 to 1:1 (ca. 350 *Magnolia* species presently known worldwide; Vázquez *et al*. 2016a). Insufficient flowering and fruiting material have prevented understanding of the family in Ecuador for decades, and intensive, systematic fieldwork has proven to be fundamental. We are just beginning an era of finding the rarest and least accessible species in the most remote and often risky areas of the world.

Conservation status:—The conservation status of *M. mercedesiarum* using IUCN (2012) criteria resulted as endangered, not vulnerable as reported previously by Vázquez-García *et al*. (2016a). The great number of recent discoveries of Neotropical magnolias has made necessary the update of the IUCN Red List of Magnoliaceae (Rivers *et al*. 2016), a substantial increase of from the previous version (Cicuzza *et al*. 2007). The majority (3/4) of the magnolia species in Ecuador including the species described here are threatened with extinction, and a quarter of all magnolias of Ecuador are critically endangered (CR; Vázquez-García *et al*. 2016a); local, national and international authorities should act immediately before the species and their habitats are lost forever.

Species distribution modelling and conservation status:—The comparatively sparse distribution of this new species and its estimated potential distribution extend the distribution of *Magnolia* to the eastern Andes of northern Ecuador, where no other species have been recorded (Vázquez *et al.* 2016a). The two new hypotheses on potential distribution areas for *M. mercedesiarum* are 28% (ETSS) and 12% (MTSS), more conservative than the area of "potential habitat" (3742 km²) estimated in the monograph of magnolias of Ecuador (Vázquez-García *et al*. 2016), the latter based on the ecosystem map of the Ministerio del Ambiente of Ecuador (MAE) and taking into account forested cover, elevation, and natural boundaries (including rivers of third and fourth order). The advantage of the modelling approach in this paper compared to that of Vazquez *et al*. (2016a) consists of producing reproducible hypotheses of species distribution based on available presence data and individual response of species to complex environmental gradients without arbitrary presumptions of relationships between drainage basins, elevation ranges and species boundaries. The two models used, as well as the IUCN (2012) method, predict that the species could be found in Orellana Province, in addition to Napo and Sucumbíos. In contrast, the model does not predict a probable presence in the neighbouring area of Nariño, Colombia.

Key to species of sect. *Talauma* in Ecuador

1. Stipules free from the petiole, stomata group number 2–3 2
- Stipules adnate to the petiole, stomata group number 5, subsect. *Talauma* 9
2. Fruit globose, rarely pyriform; stamens without a long connective appendage embedded in the gynoecium, subsect. *Chocotalauma* .... 3.
- Fruit elipsoidal; stamens with a long connective appendage embedded in gynoecium, subsect. *Dugandiodendron* .... 5.

3.	Leaf blade elliptic	*M. striatifolium*
-.	Leaf blades broadly elliptic to obovate	4.
4.	Fruit 5.0–5.5 × 5.0 cm, stamens 115–135	*M. mashpi*
-	Fruit 15.9–16.4 × 10.0–10.6 cm, stamens 195–205	*M. chiguila*
5.	Number of stamens 106–171	*M. jaenensis*
-	Number of stamens 40–100	6.
6.	Trees 13–35 m tall, number of stamens 58–98	11. *M. yantzazana*
-	Trees 3–11.5 m tall, number of stamens 40–55	7.
7.	Carpels 10–15, lateral veins per side 10–16, petiole 2.0–2.8 cm long	*M. bankardiorum*
-	Carpels 7–9, lateral veins per side 17–18, petiole 0.9–1.2 cm long	8.
8.	Trees 10 m tall, leaves 15.9 × 9.9 cm	*M. shuariorum*
-	Trees 3 m tall, leaves 8.5 × 4.1 cm	*M. lozanoi*
9.	Flower buds oblong (flowers and fruits unknown)	*M. arroyoana*
-	Flower buds ovoid ellipsoid to subglobose	10
10.	Carpels 5–20, stamens 20–90	11
-	Carpels 35–165, stamens 105–175	19
11.	Leaves suborbicular, cordate, broadly ovate, rarely broadly elliptic	12
-	Leaves elliptic to lanceolate or broadly elliptic	14
12.	Outer petals narrowly oblanceolate and barely concave	*M. kichuana*
-	Outer petals obovate–spathulate and strongly concave	13
13.	Leaves usually suborbicular, stamens 50–54	*M. vargasiana*
-	Leaves elliptic to broadly elliptic, stamens 23–29	*M. mercedesiarum*
14.	Carpels 4–8, stamens 20–42, narrowly ellipsoid, Minuticarpae group	15
-	Carpels 10–19, stamens >59–89, broadly ellipsoid	17
15.	Leaf blades mostly glabrous or glabrescent on both sides	*M. llanganatensis*
-	Leaf blades at least abaxially pubescent	16
16.	Fruit 4.5 long, carpels 8; stamens 27–28	*M. palanadana*
-	Fruit 2.5–3.0 cm long, carpels 7; stamens 38–42	*M. zamorana*
17.	Leaf blades at least abaxially pubescent	*M. mindoensis*
-	Leaf blades mostly glabrous or glabrescent on both sides	18
18.	Hypsophylls 2, lateral veins per side 16–20	*M. rimachii*
-	Hypsophylls 7–10, lateral veins per side 10–16	*M.* "*napoensis*" ined.
19.	Carpels unbeaked, dorsal wall 2.5 cm thick or more, Pachyacarpae group	20
-	Carpels strongly beaked at the tip, dorsal wall <2.0 cm thick, Echinaticarpae group	21
20.	Carpels 125–130; stipular scar covering 100% of petiole	*M. dixonii*
-	Carpels 98–102; stipular scar covering 30% of petiole	*M. canandeana*
21.	Petioles and internodes pubescent, carpels 35–40	*M. neillii*
-	Petioles and internodes glabrous or glabrescent, carpels 98–165	22
22.	Fruit ellipsoid, leaves 28–70 × 12—37 cm; lateral leaf veins per side 10–22	*M. equatorialis*
-	Fruit broadly ovoid to subglobose, leaves 16–26 × 6–17 cm, lateral leaf veins per side 6–9	*M. pastazaensis*

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