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Forestiera veracruzana (Oleaceae), a new species from the riparian forests of central Veracruz, Mexico

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Abstract

The new species *Forestiera veracruzana* is described and illustrated. This newly described plant is part of the tree and shrub strata of riparian forests in the lowlands and hills of the Mexican states of Veracruz and Tabasco. *Forestiera veracruzana* is morphologically similar to *F. corollata*, and *F. isabeliae* by the presence of petals, and possibly to *F. rhamnifolia,* which also grow in similar environments, but it can be readily distinguished from these by its polygamodioecious condition, the length of peduncle, and the length and shape of pistil at anthesis.

Resumen

Se describe e ilustra a la nueva especie *Forestiera veracruzana*. Este nuevo taxón forma parte de los estratos arbóreo y arbustivo de los bosques riparios en las planicies y colinas de los estados de Veracruz y Tabasco, México. *Forestiera veracruzana* es morfológicamente similar a *F. corollata* y *F. isabeliae* por la presencia de pétalos, y posiblemente con *F. rhamnifolia,* las cuales habitan en ambientes similares, pero se distingue de éstas por su condición poligamodioica, la longitud del pedúnculo y la longitud y forma del pistilo en antesis.

Introduction

The genus *Forestiera* Poiret (1810: 312) (Oleaceae) comprises some 14 species of trees and shrubs widely distributed from the United States of America and Central America to Ecuador in northwestern South America, and the Caribbean (Cornejo & Bonifaz 2006, Cornejo & Wallander 2007, Hammel & Cornejo 2009). Eleven taxa had been previously recorded in Mexico (Villaseñor 2016), but Cornejo & Wallander (2007) reported and described an additional species, *Forestiera corollata* Cornejo & Wallander (2007: 13–16), for the State of Tabasco, which is also present in Guatemala and Belize. Species most recently described for this genus include *Forestiera corollata*, *Forestiera ecuadorensis* Cornejo & Bonifaz (2006: 78–82), and *Forestiera isabeliae* Hammel & Cornejo (2009: 52–55).

However, the genus has been little studied due to the scarce availability of voucher specimens (Green 2016); its short flowering period; the similarity of fruits, leaves, and other morphological traits; as well as the inconsistent presence and density of pubescence, all of which have led to the split of several species into subspecies and varieties based on these characters. Moreover, the dioecious condition of these plants makes their identification difficult, and several species have been described solely based on either female or male specimens, or on fruits.

While reviewing the genus *Forestiera* for the *Flora of Veracruz*, we found some specimens that had been identified as *Forestiera rhamnifolia* Grisebach (1866: 169) or *Neea psychotrioides* Smith (1891: 199) but whose characteristics did not seem to match those described for these species. Such specimens more closely resemble *F. corollata*, and *F. isabeliae* in the presence of petals in the flowers but differ in various other floral characters. Upon collecting additional material in the field to better examine their characteristics when fresh, significant differences were found relative to *F. corollata* and *F. isabeliae.* Thus, we hereby describe such specimens as belonging to a species new to science.

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The distribution of *Forestiera veracruzana sp. nov.* is restricted to riparian and dry forests in flooded areas in the Mexican states of Veracruz and Tabasco (Fig. 1). Adding this new species to those previously known makes a total of 13 taxa in the genus *Forestiera* reported for Mexico.

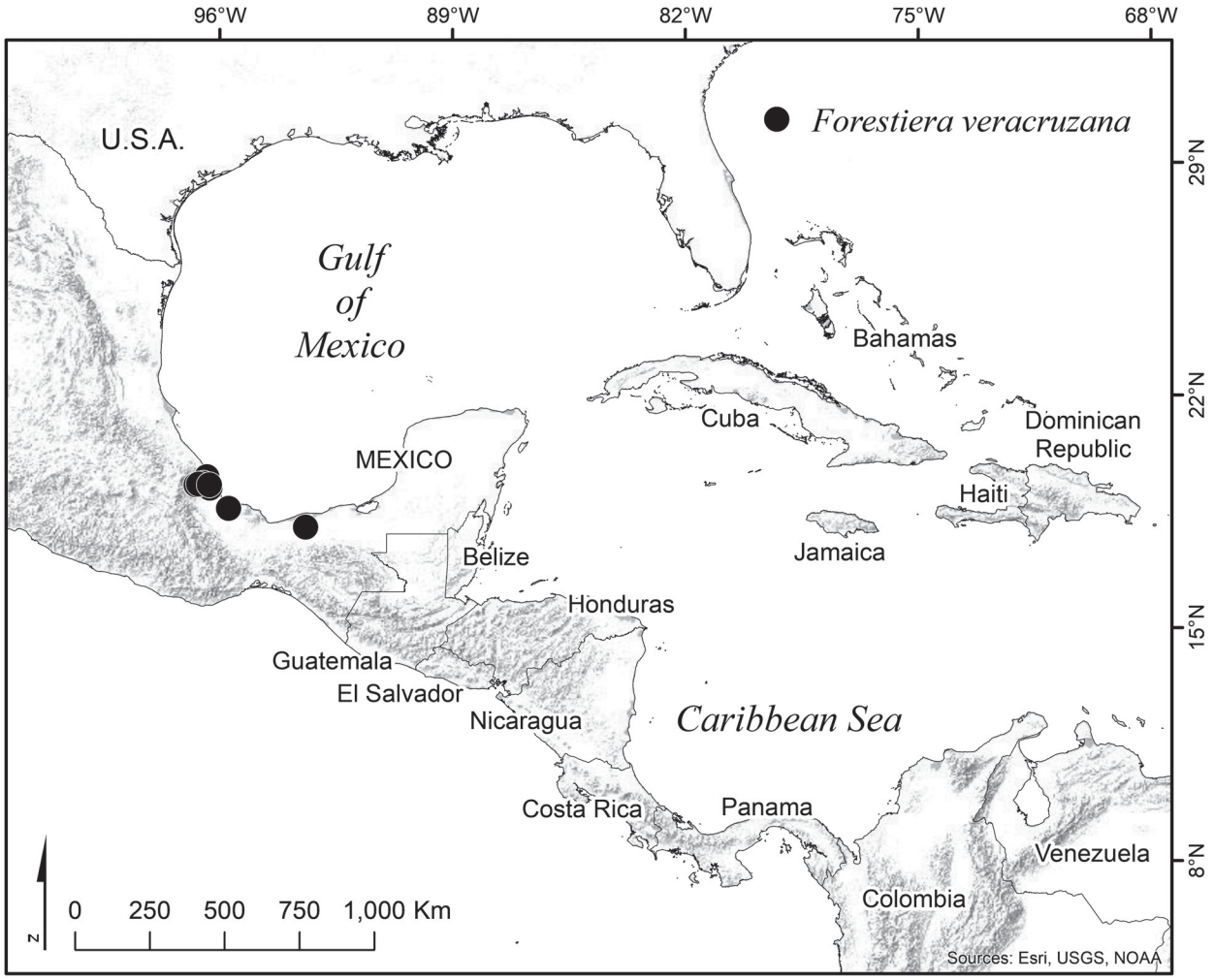

FIGURE 1. Collection localities of *Forestiera veracruzana sp. nov*.

Material and methods

While reviewing voucher specimens of the genus *Forestiera* (Oleaceae) deposited in major Mexican herbaria, as well as fresh samples collected in patches of riparian vegetation in the central region of the State of Veracruz, some specimens were found whose characteristics did not match those of previously described *Forestiera* species. Based on such differences, we concluded that the specimens recently collected correspond to a new taxon, *Forestiera veracruzana* (Figs. 2 and 3).

Analysis of the original descriptions of *Forestiera* species, supported by examination of voucher specimens deposited in major Mexican herbaria (ENCB, MEXU, and XAL), and images of type specimens available at JSTOR Global Plants website (JSTOR 2021) showed that *F. corollata* and *F. isabeliae* are the two species morphologically closest to the new taxon, also growing in similar ecological conditions. The specimens were also compared with *F. rhamnifolia* since they were previously identified as this species—although some authors have pointed out that the distribution of *F. rhamnifolia* is likely restricted to the Caribbean islands (Cornejo & Wallander 2007). The differential characteristics of the new taxon and those of its closest species (*F. corollata*, *F. isabeliae* and *F. rhamnifolia*) are summarized in table 1. The morphological traits of all specimens studied were examined under a Carl Zeiss microscope (Stemi 2000-C, Barrington, US).

Female and male-hermaphrodite specimens were collected in the field, from separate individuals; the specimens bore flowers and fruits in various stages of development. This allowed making a thorough description, something that

had seldom been possible for other species in this genus because of the difficulty in finding voucher specimens of both sexes.

The provisional conservation status of the new species was assessed using the IUCN Red List categories and criteria (IUCN 2012; IUCN 2017).

Taxonomy

Forestiera veracruzana Cast.-Campos & Pal.-Wass., *sp. nov*. (Fig. 2)

Type: MEXICO. Veracruz: Municipality of Actopan, Caño Gallego, 19°32'12.92"N, 96°23'22.40"W, 12 m, 19 January 2021, *O. Palacios-Wassenaar, G. Castillo-Campos, & I. Acosta R. 965* (holotype XAL!; isotypes ENCB!, MEXU!).

This taxon shows similarities with *F. corollata*, *F. isabeliae* and *F. rhamnifolia* and grows under similar ecological conditions in some municipalities of the Mexican states of Veracruz and Tabasco. However, *F. veracruzana* differs from the other two species in its polygamodioecious condition, the longer peduncle, the length and shape of pistil at anthesis, the presence of 1–2 styles, and its generally bilobed stigma (Table 1).

TABLE 1. Comparison of morphological characters of *Forestiera veracruzana sp. nov.* and the three species morphologically closest to it, *F. corollata*, *F. isabeliae* and *F. rhamnifolia*.

Character	*F. veracruzana*	*F. corollata*	*F. isabeliae*	*F. rhamnifolia*
Breeding system	polygamo-dioecious	dioecious	polygamo-dioecious	dioecious
Number of primary veins (pairs)	(5–)7–11	8–12	8–14	4–6
Petiole length (mm)	(7–)9–13	5–10	4–12	4–7
Number of flowers per inflorescence	7–15	5–11	5–13	3–7
Peduncle length (mm)	0.7–1.5(–3.5)	3–7	1.5	0.5–1.5
Pistil length (mm)	2–2.5	1.5	1.2–1.5	0.6–1
Petal length × width (mm)	1.5–3 × 0.2–0.4	1.2–2.3 × 0.1–0.2	1.5–3.5 × 0.2	petals absent
Number of styles	1–2	1	1	1
Stigma shape	bilobed, rarely claviform	undifferentiated stigma, widened since post-flowering	capitate	capitate
Infructescence length (cm)	2–3	1–2.5	2–2.5	1–1.6
Fruit length × width (mm)	8–15 × 4.5–6	8–10 × 3–4.5	15–20	7–9

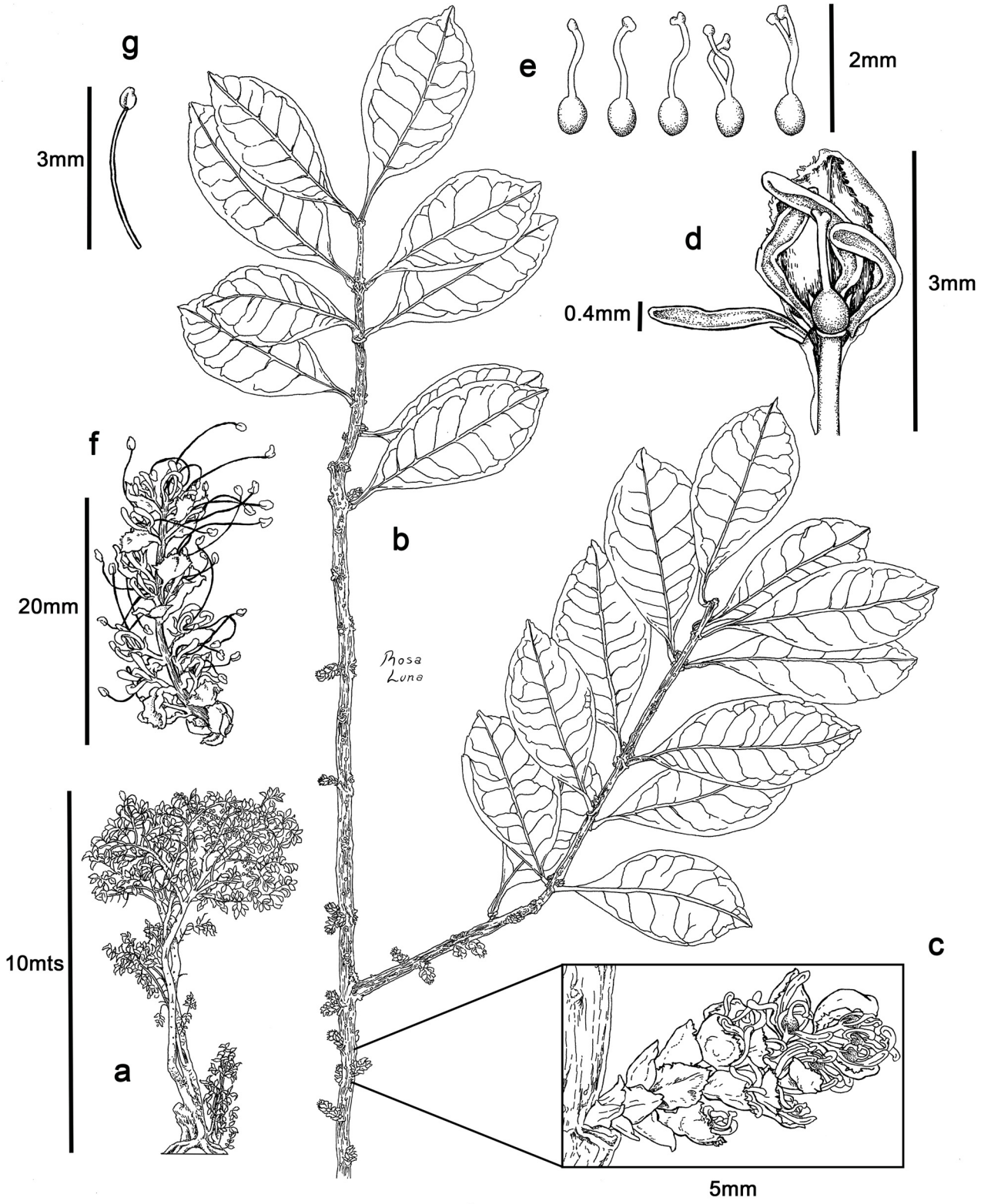

FIGURE 2. Illustration of *Forestiera veracruzana* Cast.-Campos & Pal.-Wass. *sp. nov.*: a, tree; b, branch with pistillate inflorescences; c, pistillate inflorescence; d, detail of pistillate flower; e, style types; f, staminate inflorescence; g, detail of stamen. Illustration by Rosa Pérez based on the type specimen *O. Palacios-Wassenaar et al. 965* and *969* (XAL).

Geographic distribution and ecology:—*Forestiera veracruzana* is part of the tree and shrub strata of riparian forests (*sensu* Rzedowski, 2006); and is sometimes present in seasonally flooded evergreen tropical forests, deciduous tropical forests, semi-evergreen tropical forests, palm tree forests (*sensu* Miranda & Hernández-X, 1963), and shrublands, both primary and disturbed. It generally grows on sandy soils at elevations between 5 and 350 m.

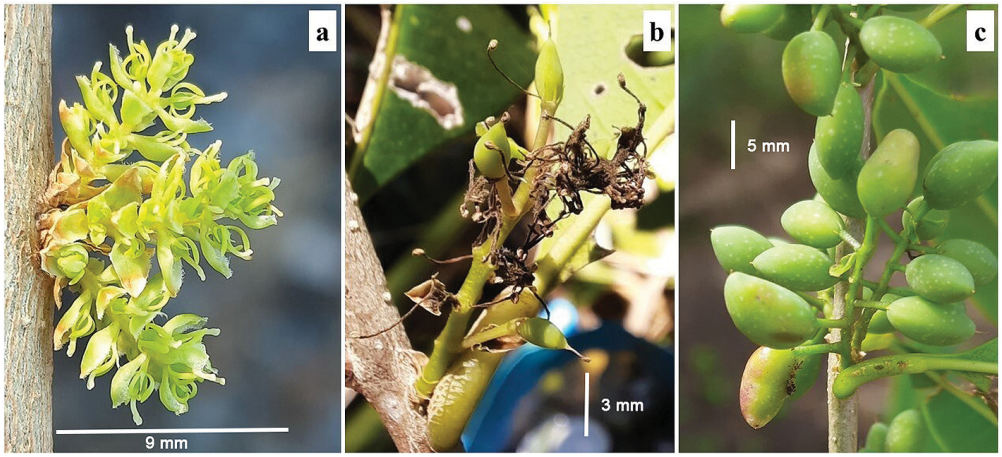

FIGURE 3. Inflorescences and fruits of *Forestiera veracruzana sp. nov.*: a, pistillate inflorescence; b, staminate-hermaphroditic inflorescence; c, almost mature fruits (Photographs by O. Palacios-Wassenaar).

Trees or shrubs up to 12 m in height; polygamodioecious. Trunk subcylindrical, with whitish brown, verrucose, scaly bark; trunks and main branches with thorny-like branchlets, up to 30 cm long, usually leafless; branches with whitish orbicular lenticels, 0.2–0.5 mm in diameter; young branches decussate, striate, with reddish-brown lines; recent basal shoots greenish brown, with multiple lenticels; terminal branches short and sparsely puberulent, glabrescent; non-reproductive terminal branches bear 1 or 2 yellowish, scaly buds, 2–3 mm long in leaf axils. Leaves opposite, simple, elliptical to slightly obovate, (5–)6–13 × (2–)3–5(–6.5) cm; margin subrevolute, sparsely dentate to crenate in the distal half or third, conspicuously serrate in leaves of recent sprouts; apex acute to shortly acuminate, occasionally obcordate, acumen up to 5 mm; base cuneate to slightly attenuate, decurrent; blade smooth, glabrous adaxially, with scattered white crystals abaxially; midrib scarcely canaliculate adaxially, prominent abaxially, greenish yellow, sparsely puberulent on recent leaves; primary venation brochidodromous, yellowish green, (5–)7–11 pairs, conspicuous and slightly canaliculate adaxially, inconspicuous abaxially; tertiary venation reticulated, inconspicuous adaxially, dark green abaxially; petioles (7–)9–13 mm long, canaliculate, occasionally semi-terete, glabrous, articulate. **Inflorescences** racemose, axillary, supraxillary, with (2–)3–6 pairs of basal bracts, sessile, imbricate, decussate, carinate, adaxially convex, deltoid, 1–2.5 × (0.8–)1–2 mm; margin sparsely ciliate, erose, sometimes entire; apex acute; with 7–15 flowers in decussate pairs, the terminal section with three flowers, the central bractless, the others subtended by a foliaceous bract, obovate, adaxially concave, 2–3.5 × 1.4–2.5 mm; margin generally ciliate, sometimes erose; apex rounded, occasionally acute; base pericladial or clasping; deciduous; peduncle, rachis, and pedicels cylindrical, glabrous; pedicels articulate at the base. **Female inflorescences** in groups of 1 to 3, lemon green to yellowish green, (5–)6–11 mm long, with 7–15 flowers; peduncle 0.7–1.5(–3.5) mm long; pedicels 0.5–1 mm long, frequently with a linear bracteole 0.5–1.3 mm long in the middle of the pedicel; sepals 4, free, subulate, markedly uneven, 0.4–1.2 × 0.1–0.2 mm, margin entire, apex acute, glabrous; petals 4, alternisepalous, free, oblanceolate, 1.5–3 × 0.2–0.4 mm, moderately involute, margin entire, apex rounded, glabrous, deciduous; staminodes absent; pistil 2–2.5 mm long; ovary sessile, bilocular, green, spheroid, 0.6–1 × 0.5–1 mm, glabrous, apical placentation; ovules 2 per locule, obovoid, compressed, 0.3 × 0.2 mm, styles 1–2, occasionally bifurcate from mid-length, 1–1.5 mm long, glabrous; stigma slightly or conspicuously bilobed, rarely claviform, 0.3–0.5 mm long. **Male inflorescences** solitary or in pairs, (8–)14–20 mm long, with (10–)15 flowers; peduncle 1.5–2 mm long; pedicels 0.5–1.5 mm long; sepals 4–5, free, subulate, moderately unequal, 0.5–1.5 × 0.1–0.2 mm, margin entire, apex acute, glabrous; petals 4, alternisepalous, free, oblanceolate to linear, (2.5–)3–5.5 × 0.2–0.4 mm, moderately involute, margin entire, apex rounded, glabrous, deciduous; stamens 4–6, filaments 3.5–6 mm long; anthers basifixed, dithecal, with longitudinal dehiscence, elliptical to ovate, 0.5–0.8 mm long. **Inflorescences** with functionally hermaphroditic and staminate flowers, solitary, 15–20 mm long, with 11–13 flowers either hermaphroditic or hermaphroditic and staminate alternating along the rachis; peduncle 2.5–3 mm long; pedicels 3–3.5 mm long; sepals 4, 0.6–1.5 mm long; petals deciduous, style 1–1.2 mm long; stigma bilobed, 0.5 mm long. Infructescences 1–2 per axil, 2–3 cm long; pedicels 2.5–5 mm long; rachis subtetragonal, sparsely puberulent, with 2–10(–12) drupes, green when immature, purple at maturity, white dotted, ellipsoid, sometimes slightly falcate, 8–15 × 4.5–6 mm; apex acute, rarely rounded; base acute; style persistent, 1.2–1.8 mm long; mesocarp 1–2.5 mm thick; putamen striated. Seeds 1, rarely 2, ellipsoid, 6–7 × 3–3.5 mm.

The prevalent climate in such forests is Aw (tropical with summer rains) (Koeppen 1948, Rzedowski 2006), with mean annual precipitation between 300 and 1800 mm, five to eight dry months over the year, and mean annual temperature of 20–29°C (Rzedowski 2006).

Adult individuals of this newly described taxon are up to 12 m in height, forming part of the upper tree stratum (15–35 m) together with *Attalea butyracea* (Mutis ex L. f.) Wess. Boer (Arecaceae), *Bambusa amplexifolia* (J. Presl) Schult. f. (Poaceae), *Bumelia celastrina* Kunth (Sapotaceae), *Ficus insipida* Willd. (Moraceae), *Ginoria nudiflora* (Hemsl.) Koehne (Lythraceae), *Inga vera* Willd. (Fabaceae), and *Tabebuia rosea* (Bertol.) DC. (Bignoniaceae). They share the middle tree stratum (5–15 m) with *Bursera simaruba* (L.) Sarg. (Burseraceae), *Coccoloba humboldtii* Meisn. (Polygonaceae), *Cupania dentata* DC. (Sapindaceae), *Guazuma ulmifolia* Lam. (Malvaceae), *Sabal mexicana* Mart. (Arecaceae), *Salix humboldtiana* Willd. (Salicaceae), *Tabernaemontana alba* Mill. (Apocynaceae), and *Trichilia havanensis* Jacq. (Meliaceae). The dominant species of the shrub stratum (2–5 m) of these forests are *Acacia cornigera* (L.) Willd. (Fabaceae), and *Pluchea odorata* (L.) Cass. (Asteraceae). Various species of lianas and vines also occur, including *Agdestis clematidea* Moc. & Sessé ex DC. (Phytolaccaceae), *Callicarpa acuminata* Kunth (Lamiaceae), *Melothria pendula* L. (Cucurbitaceae), *Pisonia aculeata* L. (Nyctaginaceae), *Serjania triquetra* Radlk. (Sapindaceae), and *Tetracera volubilis* L. (Dilleniaceae). *Heliconia latispatha* Benth. (Heliconiaceae) and *Syngonium podophyllum* Schott (Araceae) predominate in the herbaceous stratum.

Etymology:—The name assigned to the new species refers to the State of Veracruz, where the type specimen was collected.

Phenology:—*Forestiera veracruzana* blooms between January and February, and bears fruit from February to May.

Additional specimens examined:—**MEXICO. Veracruz:** Mpio. Actopan, Caño Gallego, 3 km al N de Paso del Cedro, 25 May 1985, *R. Acosta P. & N. Acosta B. 394* (MEXU, XAL); Mpio. Actopan, Caño Gallego, 2 km de Paso del Cedro, 27 April 1985, *R. Acosta P. 544* (MEXU, XAL); Mpio. Tlacotalpan, 2 km al W de Pérez y Jiménez, 8 km al SW de Tlacotalpan, 1 February 1984, *M. Nee & K. Taylor 29180* (F, XAL); Mpio. Veracruz, 3 km by air SW of Santa Fe, junction of road to Tenenexpan and old free Hwy 140 from Veracruz to Xalapa, 23 February 1984, *M. Nee & K. Taylor 29666* (F, MO, NY, XAL); Mpio. Actopan, Caño Gallego, entrando por desvío de terracería, unos 3 km después de Paso del Cedro, 19 January 2021; 2, 10 and 23 February 2021, *O. Palacios-Wassenaar, G. Castillo-Campos & I. Acosta R. 965, 969, 970, 971, 972, 973, 974, 978, 980* (XAL); Mpio. Tlaltetela, Monte Rey, ejido Coetzala, 6 March 1983, *L. Robles H. 68* (XAL); Mpio. Puente Nacional, Tamarindo, 16 April 1973, *F. Ventura A. 8179* (ENCB, MEXU, XAL); Mpio. Apazapan, Los Baños Termales, 12 April 1978, *F. Ventura A. 15188* (ENCB, XAL); Mpio. La Antigua, 1 km de La Pureza, 26 March 1987, *P. Zamora C. 321* (XAL). **Tabasco:** Mpio. Cárdenas, 2ª sección de Arroyo Hondo, 19 March 1983, *F. Ventura A. 20057* (ENCB, XAL).

Notes:—*Forestiera veracruzana* grows in locations with conditions similar to those where *F. corollata*, *F. isabeliae* and *F. rhamnifolia*, occur. Specimens of the newly described taxon have frequently been misidentified as *F. rhamnifolia* and even as *Neea psychotrioides*. More recently, some specimens were identified as *F. corollata* when this new species was described by Cornejo & Wallander (2007). The authors of *F. corollata* pointed out that *F. rhamnifolia* is likely restricted to the region where it was first described (Cuba). On the other hand, the authors of *F. isabeliae* reported this species as endemic to Costa Rica (Hammel & Cornejo 2009).

Conservation status:—*Forestiera veracruzana* is usually found in remnants of riparian forests in heavily disturbed areas, surrounded by sugar cane plantations where they are continually threatened by deforestation and fragmentation for agricultural and livestock activities expansion. Riparian forests are one of the vegetation types with the smallest area in Mexico, less than 30,000 ha. In the state of Veracruz, more than 77% of the state's surface has been transformed to agricultural and livestock activities, while in Tabasco, the estimated surface use change is 64% (SEMARNAT 2016). Given the restricted distribution, low abundance, and potential threats to the habitat of this species, it is crucial to conserve and protect its remaining habitats, as well as promoting its inclusion as a species subject to special protection in the Official Mexican Standard for species at risk (NOM-59-SEMARNAT 2010) (SEMARNAT 2010) and the Red List of threatened species of the International Union for Conservation of Nature (IUCN 2017). Based on the facts mentioned above and our field experiences, there is a suspected population size reduction of ≥50% over the last 10 years caused by factors that have not stopped and whose effects are practically irreversible (IUCN criteria A2), and the quality of the habitat (section c) is strongly reduced by human activities in the eight localities where the species has been collected. Therefore, according to the IUCN Red List Categories and Criteria (IUCN 2012), the species should be assessed as Endangered (EN A2c).

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