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## *Coccoloba efigeniana* and *C. ibarrae*, two new species of *Coccoloba* sect. *Paniculatae* Meisn. (Polygonaceae)

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### Abstract

Two new species of *Coccoloba* sect. *Paniculatae* are described and illustrated from Mexico, Central and South America. *Coccoloba efigeniana* is described for Costa Rica, Panama, and The Guianas and can be distinguished from the similar *C. mollis* and *C. latifolia* by having obpyramidal and pilosulose fruits. *C. ibarrae* is described for the Mexican states of Oaxaca and Veracruz and it is similar to *C. belizensis* from which is distinguished by having larger, ribbed, and crowned fruits.

**Keywords:** Brazil, *Coccoloba hirsuta*, *C. mollis*, *C. standleyana*, South America

### Introduction

*Coccoloba* P.Browne (1756: 209) is the richest genus of tropical trees and shrubs within the family Polygonaceae Juss. (Howard 1959a, 1961, Melo 2004, Burke & Sanchez 2011, Ortiz-Díaz 2016). The presence of an ochrea, small flowers with 5–6 tepals, 10 stamens, the achene trigone embedded between the tepals, and/or the expanded hypanthium are the diagnostic characteristics of *Coccoloba* (Melo 2004, Burke *et al.* 2010, Ortiz-Díaz 2023). This genus is native and widely distributed in the Neotropics, including four regions with high species richness and endemism (Koenemann & Burke 2020): Mesoamerica, Antilles, Amazonia, and Southeast of Brazil.

The only monographic study of the genus, carried out by Lindau (1890), includes 125 species, but more recent studies estimate the number of species from 120 (Hernández-Ledesma *et al.* 2015) to 150 (Howard 1961, Brandbyge 1990, Melo 2004, Acevedo-Rodríguez & Strong 2012, Koenemann & Burke 2020). Recent phylogenetic analyzes of *Coccoloba* subfam. Eriogonoideae Arn. have shown the monophyly of the genus and *Neomillspaughia* Blake (1921: 84) (sister to *Coccoloba*), and together with *Podopterus* Humboldt and Bonpland (1809: 89) they form the tribe Coccolobeae (Burke *et al.* 2010, 2011, Koenemann & Burke 2020).

The classification and phylogenetic relationships within the genus *Coccoloba* remain elusive due to the poor sampling of phylogenetic studies and the lack of a full taxonomic treatment of the genus. In the most complete treatment of *Coccoloba*, Lindau (1891) recognized four sections, two of which are his own: sect. *Eucoccoloba* Lindau (1891: 134), sect. *Campderia* Lindau (1891: 209), sect. *Rhigia* Grisebach (1866: 62), and sect. *Paniculatae* Meisner (1855: 43). This last section comprises the species with racemiform and spiciform paniculate inflorescences. For the flora of Mesoamerica, Ortiz-Díaz (2023) reports 46 *Coccoloba* species, of which 6 display inflorescences in panicles.

The objectives of this work are 1) to describe and illustrate two new species of *Coccoloba* belonging to the sect. *Paniculatae* from Mexico, Central and South America, and 2) to provide a dichotomous key for the identification of the Mexican and Central American species of the sect. *Paniculatae*.

## Materials and methods

The work is based on a morphological analyzes carried out on specimens preserved in the herbaria BM, MEXU, NY, MO, UADY, and US (acronyms according to Thiers 2023 [continuously updated]). Morphological characters were measured using a digital caliper Absolute Digimatic Mitutoyo (Japan). In total, 31 specimens were measured and compared: 13 of *Coccoloba efigeniana* *sp. nov.* and 18 of *C. ibarrae* *sp. nov.* The distribution map was created in SimpleMapper (Shorthouse 2010) using the geographic coordinates of the herbarium labels.

## Taxonomy

*Coccoloba efigeniana* J.J.Ortiz-Díaz & J.J.Ancona *sp. nov.* (Fig. 1).

**Type:**—COSTA RICA, Puntarenas: Cantón de Osa, Finca Eloy Cubero, 08°41'05"N 83°33'50"W, 230 m a.s.l., 8 August 1991, *Marin 112* (holotype MO!, isotype CR!).

**Diagnosis:**—*Coccoloba efigeniana* is morphologically similar to *C. latifolia* Lamarck (1804: 61) and *C. mollis* Casaretto (1844: 72), but differs in leaf blades papery and densely hirsutulous abaxially, panicle spicate and densely hirsutulous, fruit obpyramidal, 8.0–8.5 mm long, pilosulous with base truncate, and tepals free at the apex of the achene.

**Description:**—Tree 10–20 m tall; branch internodes 1–8 × 4–8 mm. Ochrea 1.4–3.7 cm long, densely pubescent to woolly, yellow-brown to dark brown trichomes, breaking irregularly. Leaves simple, alternate, petiole 1.7–3.0 × 3–7 mm, striated, pubescent, with yellow brown trichomes, inserted at base of the ochrea; leaf blade obovate to oblong-elliptical (15.4–)17.0–25.8 × 9.0–16.0(–19.2) cm, chartaceous, densely hirsutulous abaxially, glabrous to hirsutulous adaxially, with yellow–brown trichomes, margin entire, apex obtuse to slightly acuminate, base cordate, venation pinnate, reticulate, (9–)10–14 pairs of primary nerves, prominent, pubescent to hirsutulous, with yellow–brown trichomes. Inflorescence panicle, spiked, terminal, 9.5–17.6(–20.0) cm long, densely hirtellous; rachis striate, pulverulent; ochreolae 0.6–0.8 mm long, membranous, pulverulent, apex rounded; flowers 1(2–3) per fascicle, 2.2–3.0 mm long, tepals 5, 0.8–1.4 mm long, whitish. Fruit 8.0–8.5 mm long × 5–6 mm in diameter, obpyramidal, base truncate, brown, pilosulose. Achene, light brown; embedded in the accrecent hypanthium, almost completely covering the achene; tepals, covering the apex of the achene.

**Eponymy:**—The specific epithet is in honor of Dr. Efigenia Melo an expert botanist in South American Cocolobas.

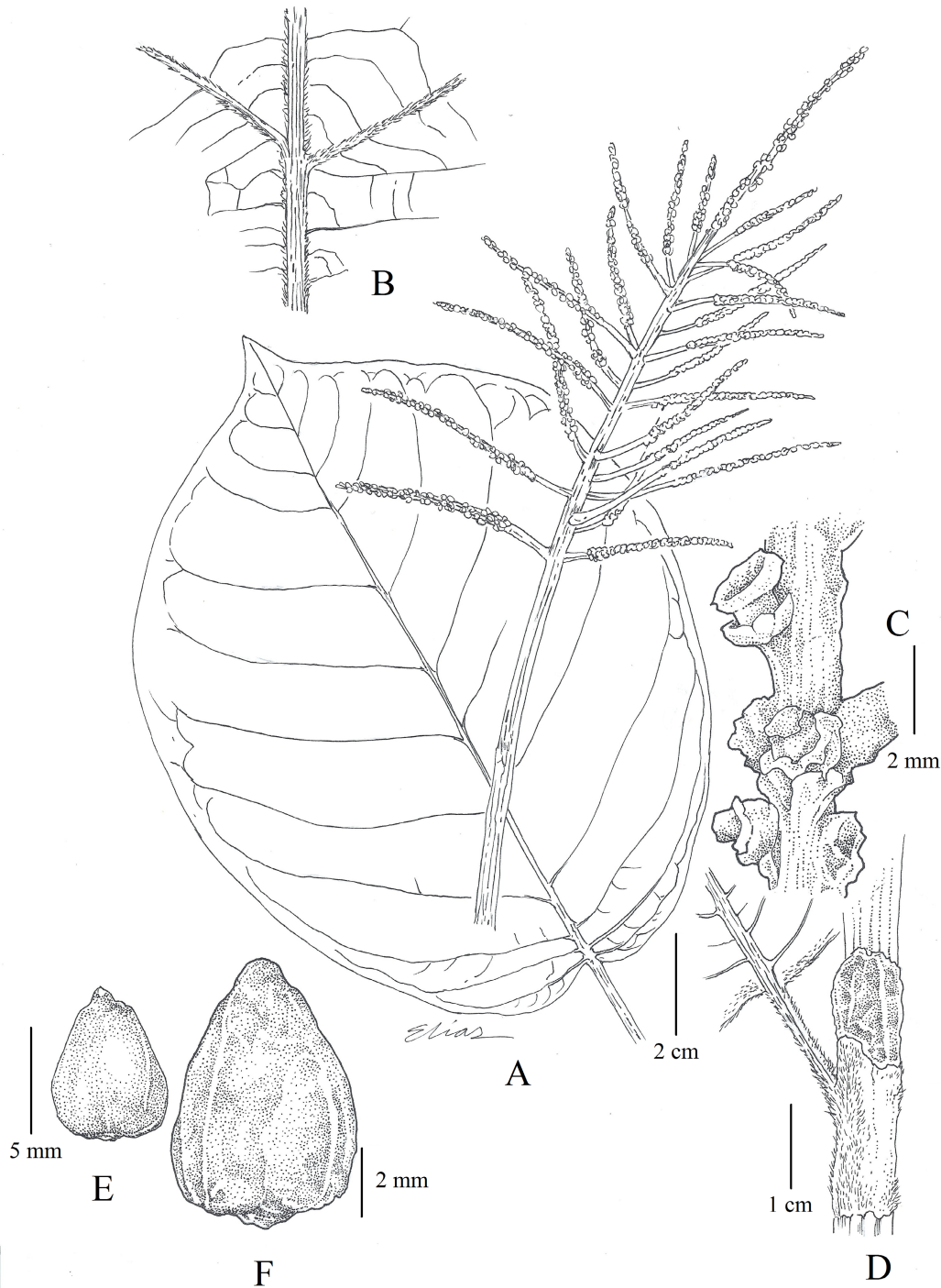
**Distribution and habitat:**—*Coccoloba efigeniana* is distributed from Costa Rica and Panama to the Guianas in South America (Fig. 4), inhabiting tropical forests at 100–350 m a.s.l.

**Phenology:**—Flowering time March–July (sporadic blooms in September); fruiting times August–October.

**Notes:**—*Coccoloba efigeniana* was poorly determined in herbarium specimens. The collections of this species for Costa Rica were identified as *C. standleyana* Allen (1956: 409), whereas the collections from Panama as *C. mollis*. The description of *C. standleyana* was based on sterile specimens (adventitious shoots) which are identical to the sterile specimens that were served to describe *C. hirsuta* Standley (1929: 303). Later, Howard (1959b) considered *C. hirsuta* as a synonym of *C. belizensis* Standley (1928: 38). In addition, we confirmed that the adventitious shoots of *C. belizensis* collected by Howard (specimen *Howard et al. 451* at BM) was indicated as the holotype of *C. standleyana*. Therefore, we have considered *C. standleyana* to be a synonym of *C. belizensis*.

*Coccoloba mollis* and *C. latifolia* are two species morphologically very similar to *C. efigeniana*, but the fruit morphology allows us to discriminate the species. Table 1 compares the morphological characters that are important to delimit and identify these three similar species. *C. mollis* is widely distributed in South America; *C. latifolia* is endemic to the Guianas where it grows in sympatry with *C. efigeniana* and *C. mollis*.

**Conservation status:**—*Coccoloba efigeniana* is widely distributed from Central America to the South American Guianas. According to the red list criteria (IUCN 2021), this new species does not seem to fall into any of the risk categories, so it is considered a species of minor concern (LC).



**FIGURE 1.** *Coccoloba efigeniana*. **A.** Leaf blade and paniculate inflorescence; **B.** Indumentum of the primary and secondary veins; **C.** Details of the pedicels and ochreoles; **D.** Petiole and ochrea; **E.** Achene; **F.** Achene embedded in the expanded hypanthium and tepals. Illustration by J.E. García.

**Additional Specimens Examined:**—COSTA RICA, Puntarenas: Osa, R.F. Golfo Dulce, península de Osa, entre Quebrada Banegas y Rancho Quemado, 08°41'00"N 8°32'30"W, 100–200 m, 14 July 1998, *Aguilar 5457* (MO, INB); Cantón de Osa, R.F. Golfo Dulce, península de Osa (cuello de la península) Los Mongos, 8 km de Chacarita, 08°45'38"N 83°17'45"W, 250 m, 14 November 1933, *Hammel et al., 19117* (MO); Parque Nacional Corcovado, Sirena Woods, 08°28'N 83°35'W, 50 m, 2 July 1989, *Kernan 1208* (MO); Parque Nacional Corcovado, Pavo Forest, poorly drained lowland, 08°27'30"N 83°33'38"W, 100 m, 14 July 1988, *Kernan 700* (MO). GUYANE FRANCAISE. Pisté de Saint-Elié 05°19'N 53°02'W, 18 March 1984, *Foresta 550* (US); Godebert wachenheim legit, 13 July 1921, *s.c. s.n.*; entre 2 et 3 km á l'Est de la Crique Sparouine: plateau Bastin, 05°15'50"N 54°13'40"W, 140 m, 23 September 2003,

*Bardenave et al. 7294* (US). PANAMA—Province of Colón: Santa Rita Ridge, 1 March 1971, *Croat 13866* (MO). Province of Panama, along newly cut road from El Llano to Carti-Tupile, 12 mi. above Pan-Am Hwy. 200 to 500 m, 13 March 1973, *Croat 22887* (BM, MEXU); 10 km above Pan-Am highway on road from El Llano to Carti-Tupile, 150 to 350 m, 23 March 1973, *Kennedy & Dressler 2947* (MO). Province of San Blas, comarca de San Blas, El Llano-Cartí Rd. Km 19.1, 09°19'N 78°55'W, 350 m, 11 February 1985, *de Nevers & Cavagnaro 4805* (MO); Comarca de San Blas, vecindad del río Nargandi, tierra firme de Norgana caminando hacia la costa, 09°26'N 78°35'W, 11 August 1994, *Herrera et al. 1750* (MEXU, MO); comarca de San Blas, El Llano-Cartí Rd. Km 19.1, 9°19'N 78°55'W, 350 m, 11 February 1985, *de Nevers & Cavagnaro 4810* (MO); along newly cut road from El Llano to Carti-Tupile, Continental divide to 1 mi. from dive, 300-500 m, 30 March 1973, *Liesner 1313* (BM, MEXU, MO); comarca de San Blas, El Llano-Cartí road. 13.8 km to 19 km from interamerican Hwy. 09°19'N 78°55'W, 350 m. 3 September 1984, *de Nevers & Porras 3818* (MO); comarca de San Blas, El Llano-Cartí road. 13.8 km to 19 km from interamerican Hwy. 09°19'N 78°55'W, 350 m. 1 July 1985, *de Nevers 5945*(MO). SURINAME. *Zanderij*, 16 December 1916, *s.c. s.n.* (US03223476). VENEZUELA. Bolívar: Río coroní Valley, guayana. 400 m, November 1947, *Cardona 2207* (US); Río coroní Valley, guayana. 400 m, November 1947, *Cardona 2209* (US).

**TABLE 1.** Morphological comparison between *Coccoloba efigeniana*, *C. mollis*, and *C. latifolia*.

	<i>Coccoloba efigeniana</i>	<i>Coccoloba mollis</i>	<i>Coccoloba latifolia</i>
<b>Ochrea</b>	Densely pubescent	Densely pubescent	Glabrous
<b>Petiole</b>	Densely hirsute	Densely hirsute	Glabrous
<b>Leaf</b>	Obovate to oblong-elliptical, densely hirsute on both surfaces	Oval-elliptical, glabrous on both surfaces	Obovate, glabrous on both surfaces
<b>Panicle</b>	Spicate	Spicate	Racemose
<b>Fruit</b>	Obpyramidal, dense to sparsely pilose, apex acuminate; tepals fused at the apex	Globose to subglobose, glabrous, apex rounded, tepals crowned	Ovoid to subglobose, glabrous; apex rounded to acuminate; tepals fused at the apex almost appressed

*Coccoloba ibarrae* J.J.Ancona & J.J.Ortiz-Díaz *sp. nov.* (Figs. 2 and 3)

**Type:**—MEXICO. Oaxaca: municipio San Felipe Usila, Cerro Verde 7 km al NNE de San Felipe Usila, 17°56' N, 96°30' W, 1050 m a.s.l., 30 September 1992, *Ibarra Manríquez, Meave del Castillo & Vargas 3719* (holotype MEXU!, isotype MO!).

**Diagnosis:**—*Coccoloba ibarrae* is morphologically similar to *C. belizensis* from which can be distinguished by leaves chartaceous, glabrous, 20–35(–40) × 14–21(–25) cm, panicles racemose, fruit ovoid, 13–13.75 × 8.6–9.4 mm, glabrous, with prominent ribs, acuminate apex, abruptly contracted base, accrescent hypanthium almost completely covering achene, and tepals free at apex of achene, crowned.

**Description:**—Trees 10–25 m tall; branch internodes solid, glabrous, striated. Ochrea 1–1.5 cm long, chartaceous, cylindrical, glabrous to scabrid, dark brown trichomes. Leaves simple, alternate; petiole 2.5–3.5 × 4–7 mm, striated, glabrous to scabrid, dark brown trichomes, inserted at base of the ochrea; leaf-blade elliptical oblong to obovate-elliptical, 20–31(–35) × 14–21(–25) cm, coriaceous to chartaceous, abaxially scabrid, adaxially glabrous, margin entire, apex acute to slightly rounded, base cordate; venation pinnate and reticulate, prominent, scabrid, (9–)10–14 pairs of primary nerves. Inflorescence terminal, panicle, racemiform, 17–22(–25) cm long, raquis striated, glabrous to sparsely acabrid; ochreolae 0.6–0.8 mm long, membranaceous, glabrous, rounded in the apex, yellowish. Flowers solitary or two per fascicle, 1.5–2.0 mm long, short pedicelled, 0.5–1.0 mm long, pedicel on the fruit 2.5–3.5 mm; hypanthium 0.8–1 mm long, green to whitish; tepals 5, 1.0–1.2 mm long, whitish. Fruit ovoid, 13.00–13.75 × 8.6–9.4 mm, with prominent ribs, apex acuminate, base rounded, abruptly contracted at junction with pedicel, glabrous. Achene included, black; hypanthium accrescent, almost completely covering the achene; perianth lobes free, cover the apex of the achene, crowned.

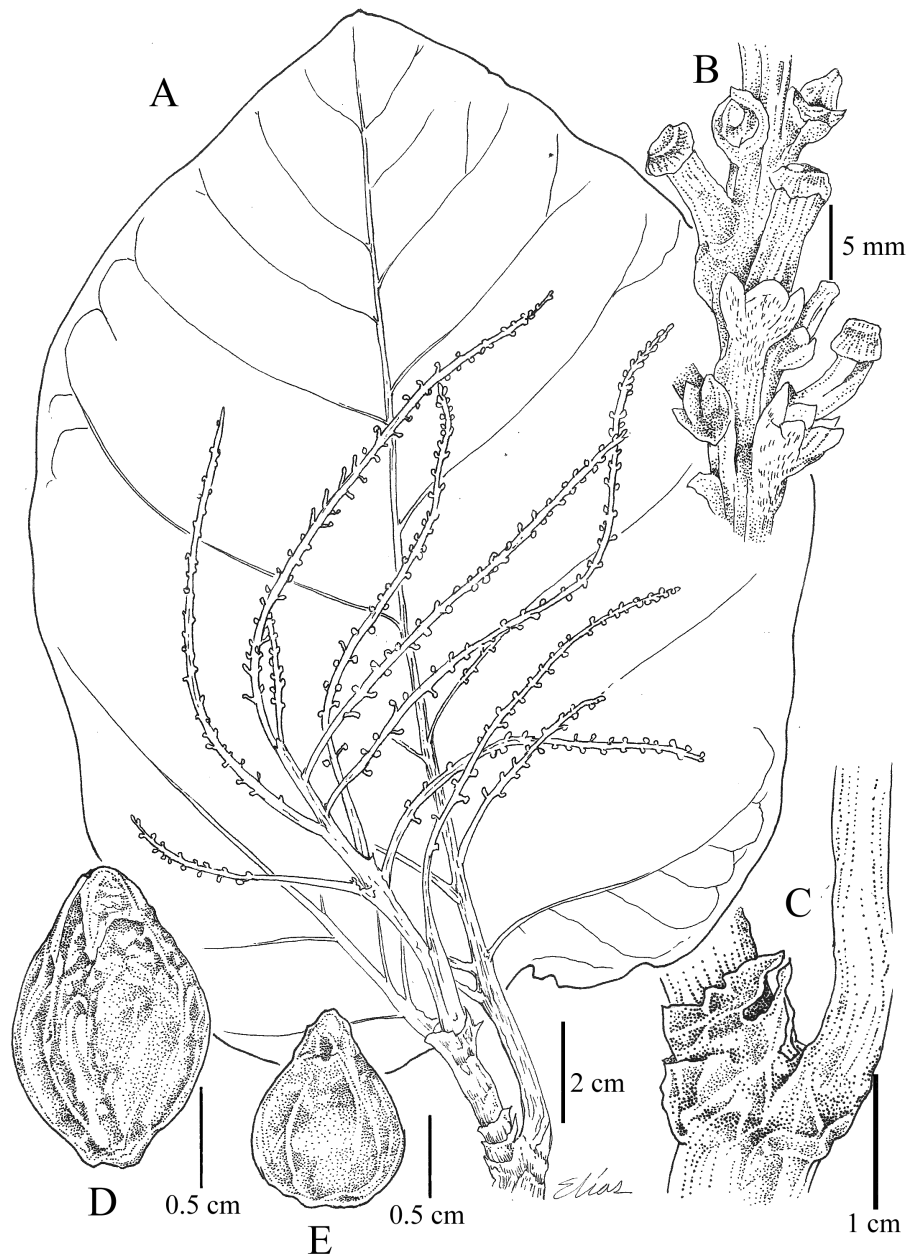
**Eponymy:**—The specific epithet is dedicated to Dr. Guillermo Ibarra Manríquez, collector of the type specimen, and for his dedication to the study of the tropical forests of Veracruz, where the new species is distributed.

**Distribution and habitat:**—*Coccoloba ibarrae* is endemic to Mexico. This species is distributed in the states of Oaxaca and Veracruz (Fig. 4). It inhabits the tropical rain forests and montane cloud forests at 1100–1500 m a.s.l.

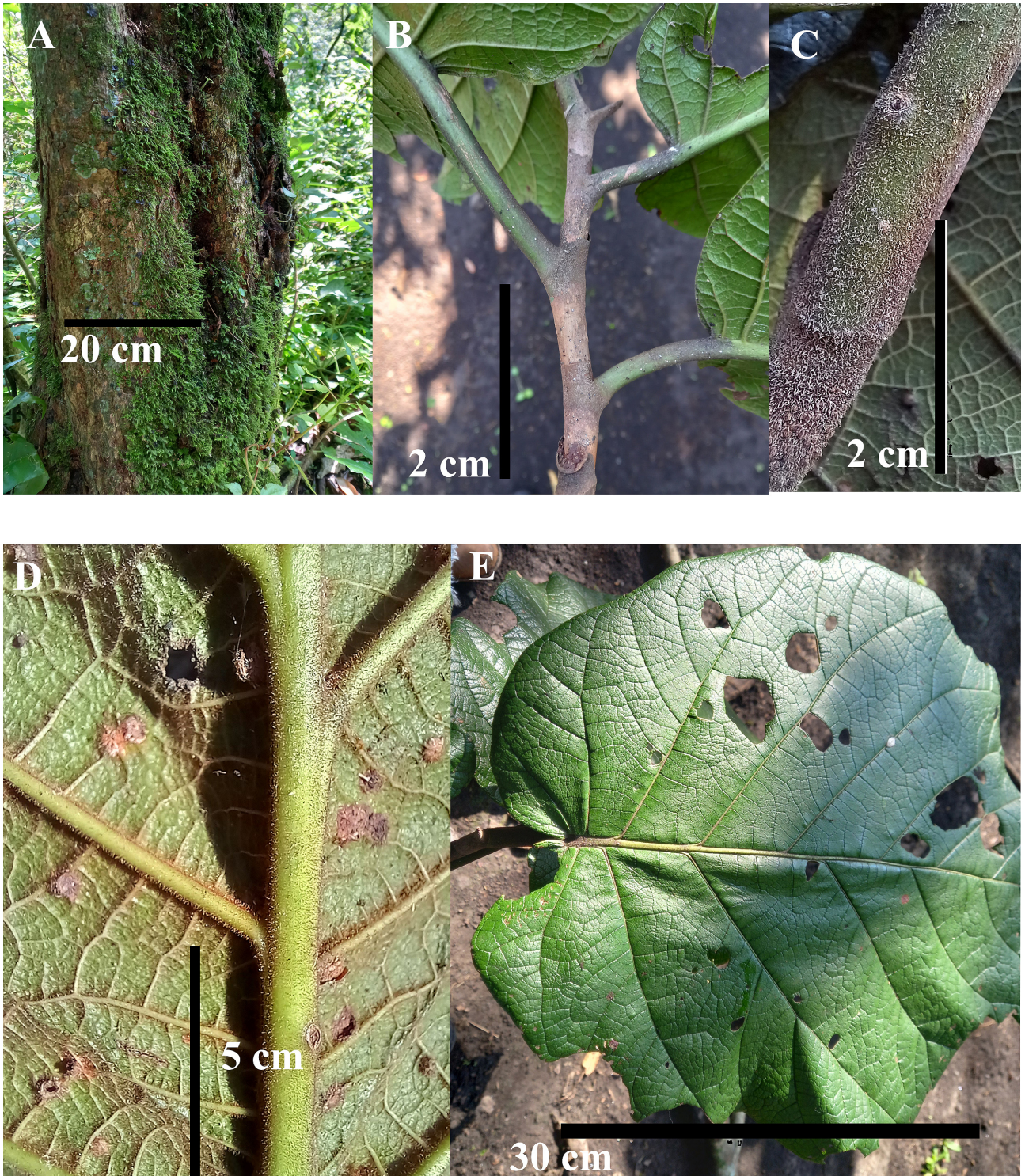
**Phenology:**—Flowering time March–June; fruiting time September–October.

**Notes:**—*Coccoloba ibarrae* is similar to *C. belizensis*, a species distributed in the lowlands of Mesoamerica. *C. belizensis* inhabits the humid forests of Belize, Guatemala, Honduras. In Mexico it is located in the states of Quintana Roo and Chiapas.

**Conservation status:**—*Coccoloba ibarrae* is found mainly in the montane cloud forests of the states of Oaxaca and Veracruz in southern Mexico (Fig. 3). This new species can be classified as vulnerable (VU) in accordance with criteria B1 and B2 of the Red List (IUCN 2021).



**FIGURE 2.** *Coccoloba ibarrae*. **A.** Leaf and panicle inflorescence; **B.** Details of the pedicels and ochreoles; **C.** Petiole and ochrea; **D.** Achene embedded in the expanded hypanthium and tepals; **E.** Achene. Illustration by J.E. García.



**FIGURE 3.** *Cocoloba ibarrae* tree in the wild: **A.** Trunk; **B.** Petiole and ochrea; **C.** detail of the indumentum of the petiole and ochrea; **D.** detail of the indumentum underneath the leaf blade; **E.** Leaf blade. Photographs by J.J. Ancona.

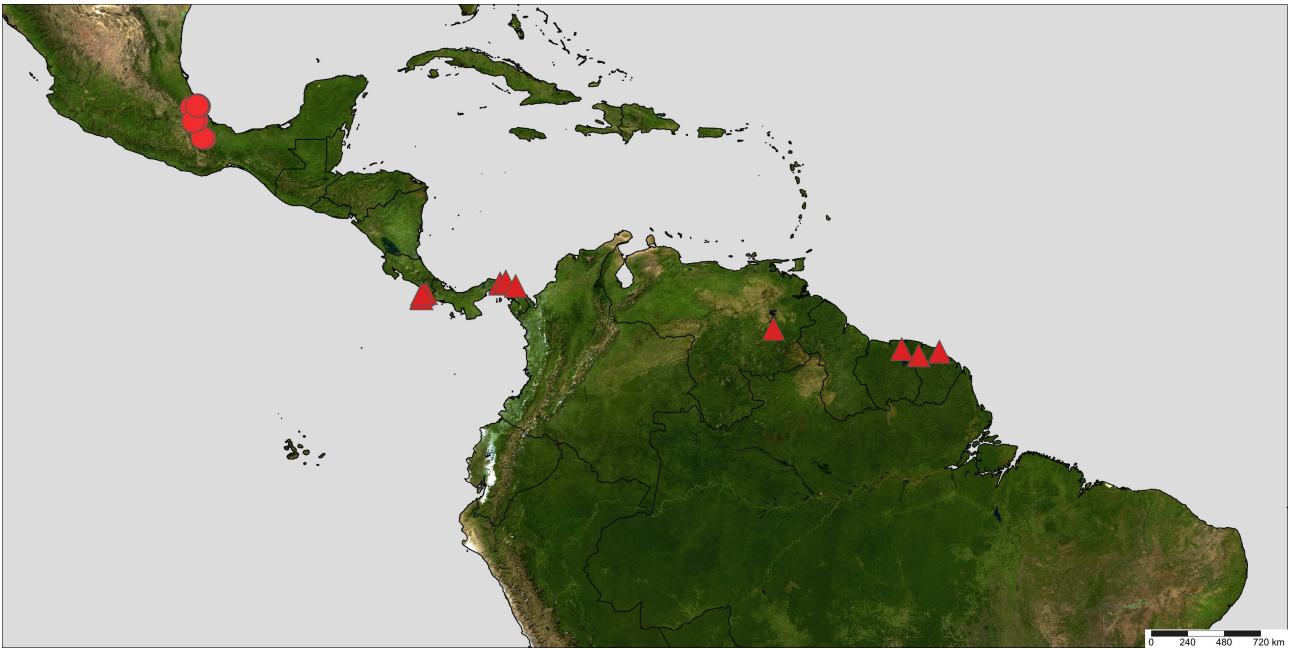


FIGURE 4. Geographical distribution of *Coccoloba efigeniana* (red triangle) and *C. ibarrae* (red circle).

**Additional Specimens Examined:**—MEXICO, Oaxaca: municipality San Pedro Teutila, El Faro, region La Cañada, 14°59'10.4"N 96°39'8"W, 1463 m, 14 January 2005, *Cruz Espinosa & Juárez G. 2293* (MEXU); municipality Valle Nacional, 3 km al SW de Cerro Mirador, camino a San Juan Palantla, 17°53'N 96°22'W, 1200 m, 29 April 1993, *Ibarra et al. 3850* (MEXU); municipality Valle Nacional, Cerro Mirador 15 km NNW de Valle Nacional, 17°93'N 96°22'W, 1200 m, 16 October 1992, *Meave del Castillo et al. 1535* (MEXU); municipality Valle Nacional, Cerro Mirador, 15 km NNW de Valle Nacional, 17°53'N 96°22'W, 1200 m, 27 April 1993, *Ibarra et al. 3008* (MEXU). Veracruz: municipality Tenochtitlán, 2 km en línea recta al SE (140°) de Tenochtitlán faldas del cerro Gigante o Cipresal, 19°47'99"N 96°54'00"W, 1200 m, 06 November 2000, *Rincón G. & Durán E. 2158* (MEXU); municipality Tenochtitlan, Colorado, camino de terracería, Misantla-Tenochtitlan, 920 m, 27 April 1976, *Hernández 190* (MEXU); municipality Yacuatla, 1 km al su de Progreso de Juárez, dirección Barranca de Maíz, 19°48'N 96°48'W, 1200, 15 January 1990, *Gutiérrez-Baez 3807* (MEXU; XAL); municipality Yacuatla, entre Nueva Reforma y El Cedral, 19°50'N 96°46'W, 1000 m, 06 March 1990, *Gutiérrez-Baez 3946* (MEXU); municipality Ixtaczoquitlan, Cerro Buena Vista, 18°53'40"N 97°21'5"W, 1230 m, 27 September 1995, *Juárez L. 750* (MEXU; XAL); municipality Chiconquiaco, Arroyo Colorado, 19°48'N 96°47'W, 1300 m, 06 March 1990, *Gutiérrez-Baez 3940* (MEXU). Municipality Atoyac, Miraflores 9 km al NW de Atoyac, 18°57'N 96°49'W, 1000, 18 May 1985, *Acevedo & Acosta 172* (MEXU, XAL); municipality Juchique de Ferrer, La Cima, Plan de Hayas, 1500 m, 26 June 1976, *Hernández 1606* (MEXU); municipality Juchique de Ferrer, Cerro de la Botella, 19°46'09.4"N 96°41'36.8"W, 847 m, 24 July 2008, *Vázquez MVT8643* (MEXU, UV); Santa Ana Atzacan al N. de Orizaba, 51-B-2, 03 December 1967, 1300, *Rosas 888* (MEXU); Carta Blanca, entre Orizaba y Cordoba (Tajitos), 1020 m, 28 May 1967, *Rosas 397* (MEXU); municipality Coatepec, en el km 6(en Zoncuanntla) carretera vieja Jalapa-Coatepec, 19°27'N 96°57'W, 1200 m, 7 March 1978, *Calzada 4263* (MEXU); municipiaplity Coatepec, en Zoncuanntla, 4 December 1975, *Jiménez A. 107* (MEXU, XAL); municipality La Mina, Las Minas hacia Molinillo, 19°42'N 97°08'W, Elv. 1300 m, 25 May 1989, *Durán E. & Becerra 802* (MEXU, XAL).

**Key for the identification of the species of *Coccoloba* sect. *Paniculatae* occurring in Mexico and Central America**

- 1 Panicles small, 2–3(–4) branches .....2
- Panicles large, > 5 branches .....5
- 2 Petiole pubescent to puberulent, nerves dense to sparsely puberulent, fruit 9.8–10.3 × 8.8–9.14 mm..... *Coccoloba hirtella*
- Petiole glabrous, nerves glabrous, fruit ≤ 8 mm long, ≤ 7.6 mm wide .....3
- 3 Leaf blade chartaceous, base asymmetric, apex long acuminate .....*Coccoloba montana*
- Leaf blade coriaceous, base symmetrical, apex rounded to slightly acute .....4
- 4 Leaf blade obovate to oblanceolate-obovate, base cuneate, petiole ≤ 1cm long.....*Coccoloba lasseri*

-	Leaf blade elliptic-oblong, base subcordatae, petiole 1.0–1.5 cm long .....	<i>Coccoloba matudae</i>
5	Panicle spiciform .....	6
-	Panicle racemose .....	7
6	Ochrea, petioles and leaf blades hirsutulous when mature, fruit obpyramidal, pilosulose .....	<i>Coccoloba efigeniana</i>
-	Ochrea, petioles and leaf blades glabrous when mature, fruit ovoid, glabrous.....	<i>Coccoloba belizensis</i>
7	Leaf-blades obovate to broadly elliptic oblong, glabrous or with few trichomes along the axils beneath, panicle branches glabrous, fruit ovoid without prominent ribs, tepals not crowned .....	<i>Coccoloba tuerckheimii</i>
-	Leaf blades oblong-elliptic to obovate-elliptic, puberulent beneath, with short trichomes on veins, panicle branches puberulent, fruit ovoid with prominent ribs, tepals crowned .....	<i>Coccoloba ibarrae</i>

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