MORE AMERICAN BLACK SAPOTES: NEW *DIOSPYROS* (EBENACEAE) FOR MEXICO AND CENTRAL AMERICA

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ABSTRACT

During the preparation of a monograph of the *Ebenaceae* for Mexico, numerous collections previously determined to be *Diospyros conzattii* Standley and *Diospyros riojae* Gomez-Pompa could not be reconciled with their original descriptions, type specimens and illustrations. It was determined that collections of putative *D. conzattii* from Costa Rica represent a new species, *D. costaricensis*, described here. All but one collection of putative *D. riojae* from the Mexican states of Queretaro, Hidalgo, Tamaulipas, and San Luis Potosi, represent a new species, *D. gomeziorum*, described here. Putative collections of *D. riojae* from Veracruz additionally include specimens of *D. conzattii*, a species previously unreported for the state, and a new species from the Sierra de Los Tuxtlas, *D. tuxtlensis*, described here. We provide emended descriptions of *D. riojae* and *D. conzattii*, and describe three new species of *Diospyros* for Tropical America. We also provide comments on distribution, ecology, conservation, ethnobotany, and provide illustrations for each of these taxa.

KEYWORDS: black sapote, Costa Rica, *Diospyros gomeziorum*, *D. conzattii*, *D. costaricensis*, *D. pergamentacea*, *D. riojae*, *Diospyros rosei* Complex, *D. tuxtlensis*, Ebenaceae, granadilla, guacalillo, Mexico, new species, persimmon, zapote negro silvestre, zapotillo

RESUMEN

Durante la preparación de la monografía de *Ebenaceae* para México, numerosas colecciones previamente determinadas como *Diospyros conzattii* Standley y *Diospyros riojae* Gomez-Pompa no pudieron ser reconciliadas con las descripciones originales, el espécimen tipo y las ilustraciones. Se determinó que la colección putativa *D. conzattii* de Costa Rica, representa una especie nueva, *D. costaricensis* descrita aquí. Todas, excepto una de las colecciones putativas de *D. riojae* de los estados mexicanos de Querétaro, Hidalgo, Tamaulipas y San Luis Potosí representan una especie nueva de *D. gomeziorum*, descrita aquí. Adicionalmente, las colecciones putativas de *D. riojae* de Veracruz, incluyen especimenes de *D. conzattii*, una especie no citada previamente para ese estado y de una especie nueva de la Sierra de los Tuxtlas *D. tuxtlensis*, descrita aquí. Proveemos descripciones corregidas de *D. riojae* y *D. conzattii* y describimos tres especies nuevas de *Diospyros* para América tropical. También hacemos comentarios sobre la distribución, ecología, conservación, etnobotánica y aportamos ilustraciones de todos los taxa.

PALABRAS CLAVE: Complejo de *Diospyros rosei*, Costa Rica, *Diospyros gomeziorum*, *D. conzattii*, *D. costaricensis*, *D. pergamentacea*, *D. riojae*, *D. tuxtlensis*, Ebenaceae, especie nueva, granadilla, guacalillo, México, persimo, zapote negro, zapote negro silvestre, zapotillo

INTRODUCTION

The pantropical genus *Diospyros* (Ebenaceae) consists of about 500 species of trees, shrubs, and suffrutices (White 1983). A treatment of the Mexican species of *Diospyros* in full has not appeared since Standley (1924). Modern treatments have dealt with smaller areas, such as Veracruz (Pacheco 1981), northeastern Michoacan, Guanajuato, and Queretaro (Carranza 2000), the Yucatan Peninsula (Lundell 1942), and the Tehuacán-Cuicatlán Valley, Oaxaca (Kelly 2001), or covered portions of southern Mexico within a larger flora (Whitefoord & Knapp 2001). Circumscription of the Mexican and Central America taxa is not entirely agreed upon. However, based on our preliminary work, a reasonable estimate of the number of native species occurring in Mexico is around 25.

In 1918, C. Conzatti collected a new black zapote from the coastal mountains northeast of San Pedro Pochutla, Oaxaca. He recorded some characteristics of the tree, especially those pertaining to the edible fruit, the taste of which he enjoyed. He believed that the fruit of the 'zapote negro silvestre' (*Conzatti 3167*) had potential as a new tree crop (Standley 1922). This zapote was formally described a few years later as *Diospyros conzattii* Standl. (Standley 1922). According to Trabut (1926), *D. conzattii* was introduced to California and Florida. However, he did not provide any specific details, and we are unaware of any other information that might corroborate the putative introduction of this species to the United States.

Diospyros riojae Gomez-Pompa was described from one fruiting collection made in the Misantla region of central Veracruz, Mexico (Gomez-Pompa 1964). Since then, collections of putative *D. riojae* have been made in several more locations in Veracruz, Tamaulipas, San Luis Potosi, Hidalgo, and numerous places in northeastern Queretaro. *Diospyros riojae* is considered an endangered species (Sánchez-Coello 2002).

During the preparation of a monograph of the Ebenaceae for Mexico, we noticed a large amount of morphological variation among collections of putative *D. riojae* and *D. conzattii*. While we had intended to examine the taxonomy of both species at a later time, in view of the endangered status of *D. riojae*, and a sense of some urgency regarding its protection (e.g., Sosa et al. 1998), we thought it would be prudent to proceed with the treatment of the following taxa now, lest the designation of protected areas, or expensive and time-consuming ecological research, be confounded by the unrecognized presence of similar looking taxa.

About eighty-five specimens from seventeen herbaria were examined for this study. With the exception of one collection from San Luis Potosi, specimens of putative *D. riojae* collected outside of Veracruz represent a new species, *D. gomeziorum*, described here. Much of the material collected in Veracruz and attributed to *D. riojae* has been found to represent *D. conzattii*, and a species

new to science, *D. tuxtlensis*, described here. Costa Rican material, previously ascribed to *D. conzattii*, clearly represents a third new species, *D. costaricensis*, which is described here. These species are best considered members of what we have informally recognized as the 'Diospyros rosei Complex' (Provance & Sanders 2005), a group that additionally includes: *Diospyros rosei* Standl., *Diospyros oaxacana* Standl., *Diospyros palmeri* Eastwood, *Diospyros californica* I.M. Johnston, *Diospyros sonorae* Standl., *Diospyros texana* Scheele, *Diospyros riojae* Gomez-Pompa, *Diospyros conzattii* Standl., *Diospyros rekoi* Standl., *Diospyros torresii* M.C. Provance & A.C. Sanders, *Diospyros morenoi* A. Pool and *Diospyros xolocotzii* Madrigal & Rzedowski. Previously (Provance & Sanders 2005), we called into question the distinctness of *D. morenoi*. At that time, we only had the holotype to examine. Very recent collections from Chiapas, Mexico, have inclined us to reevaluate our position on the status of this species. We now believe that it is a valid taxon, and we plan to address this issue further in the near future.

In this treatment we use 'lanceolate' in the sense of Jackson (1916), being broadest near the lower third of the leaf, not at mid-leaf in the sense of Stearn (2000). 'Scintillant' refers to the sparkling appearance of the epidermis of some plant structures when viewed under a dissecting microscope using bright light. Lengths for winged petioles are unavoidably approximate. Female inflorescences are inferred from fruiting specimens and persistent pedicels, where they are otherwise unknown for these taxa. The leaf venation for most taxa is 'arcolanguid,' defined here as an intermediate state between eucamptodromous and brochidodromous, in which major lateral veins nearly form distinct loops with superadjacent lateral veins, but tardily wane, becoming difficult to distinguish as loops. The term is coined for efficiency and out of necessity, since the term 'eucamptodromous-brochidodromous' of Todzia and Keating (1991) refers to a different type of intermediacy. Geographical coordinates, elevations, and similar estimations when made by us are presented in brackets.

TAXONOMIC TREATMENT

1. Diospyros riojae Gomez-Pompa, J. Arnold Arbor. 45:465. 1964. (**Fig. 1**). TYPE: MÉXICO. VERACRUZ: between Chiconquiaco and Misantla, in *Liquidambar-Quercus* forest, with *Magnolia*, *Meliosma*, *Juglans*, and *Turpinia*, 1350 m, 13 Aug 1962 (fr), *A. Gómez-Pompa 789* (HOLOTYPE: A; ISOTYPES: MEXU, US on fiche from UCSB!). Original material examined: (TYP. IC.: *A. Gómez-Pompa 789*!, J. Arnold Arbor. 45:467. 1964.).

Trees, rarely shrubs, probably facultatively deciduous, to 25 m tall, and to 2.5 m in diameter. (Pacheco 1981); **trunk** channeled, rimose, *bark* dark-brown (Pacheco 1981); **aged stems** subterete to terete, *bark* shallow-fissured with dark ridges, gray and black, *stemwood* pale yellow; **2nd–3rd year stems** short-fissured, glabrous to furfuraceous-pulverulent, puncticulate, lenticellate, half-netted, gray above, tawny below; **current year's stems** angular, smooth to sulcate, glabrous

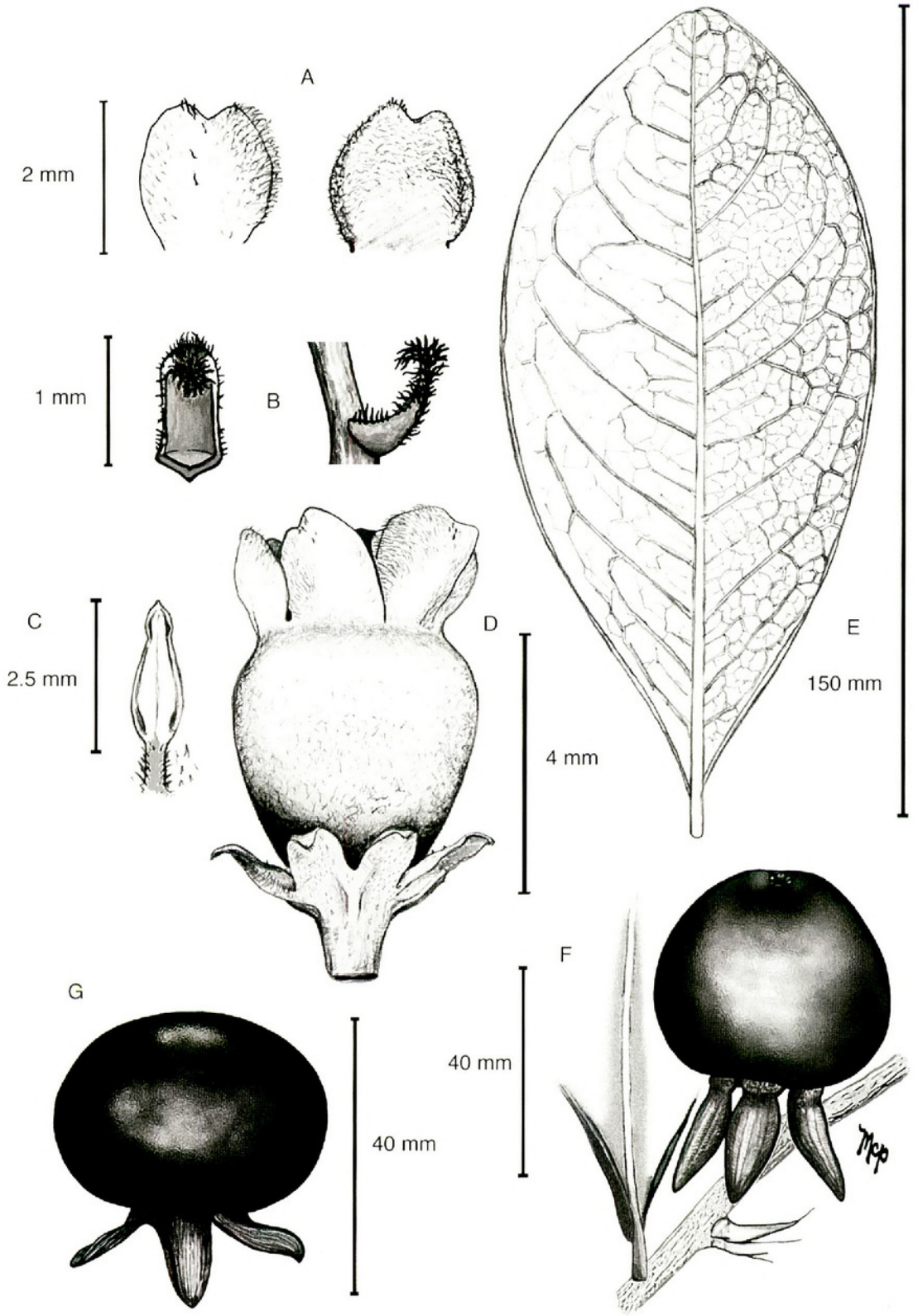

Fig. 1. **A–G.** *Diospyros riojae* Gomez-Pompa. **A.** Abaxial surface (left) and adaxial surface (right) surface of staminate petal lobe. **B.** Adaxial (left) and lateral (right) views of staminate inflorescence bract. **C.** Typical anther. **D.** Staminate flower. E. Abaxial surface of mature leaf showing detail of several degrees of venation. **F.** Fruiting stem. **G.** Fruit. A–D. Based on *F. Ventura A. 15078*. E–F. Based on *J. Becerra Z. 83*. G. Based on *L. Pacheco & J.I. Calzada 18*.

to sparingly subappressed puberulent, hirtellous at the base and near the apex, tan to reddish-brown, glandular. **Petioles** stout, thicker than width, (2–)4–6(–7) mm long, winged, rugose below, slightly pruinose, deeply concave to V-grooved above, ciliolate, glandular. **Leaves** alternate, simple, entire, subcoriaceous to coriaceous, (5–)7–13(–14.2) cm long, (2.5–)3–6(–7.5) cm wide, elliptic, widely elliptic, oblong, widely obovate, sub-oval, *apex* acutely to obtusely rounded, or short-acuminate to a rounded point, *margin* slightly recurved, ± thickened, sometimes ciliolate, *base* obtusely rounded, cuneate, or short-acuminate; **lower leaf surface** glabrous, puncticulate, sometimes slightly pruinose or scintillant, shiny, olive to bronze to brown; **upper leaf surface** glabrous, shiny, pale light-green to gray-green or copper-green, epidermal cells enlarged, the anticlinal walls thickened. **Venation** arcolanguid; **midrib** prominent below, chartreuse to reddish-brown, shallowly concave above, smooth to clavate glandular hairy, shiny, olive to yellow-green; **2°–3° veins** reticulated, raised below, fine with sharp relief, sometimes pruinose-scintillant, granular-papillose, shiny, usually prominent above, *lateral veins* 8–12 pairs. **Laminar extrafloral nectaries** abaxial, near base and midrib, round to narrowly elliptic, sometimes on lateral veins. **Male inflorescence** fascicle, 1–4 flowers from leaf axils of the previous year's growth, or from the base of new stems, sometimes a pair of solitary flowers from the new stem just above the fascicle; **pedicels** 4–7(–10) mm long, sparingly brown to claret velutinous, epidermis green; **pedicel bracteoles** 2, 1 mm long, oblong, ± flat to slightly concave, ascending wavy hairy below, the hairs thick, glistening. **Male flowers** 5-merous; **calyx** infundibuliform; **calyx tube** 1.5 mm long, glabrous or scantly minute subulate hairy; **sepals** triangular to ovate, 1.3–1.8 mm long, 0.7–0.9 mm wide, ciliolate, scantly minute appressed subulate hairy basally, becoming dark glandular wavy hairy apically; **corolla** urceolate-campanulate, tan to brown, reportedly white in living material; **corolla tube** constricted below the lobes, 4 mm long, 3 mm wide, interior grading from glabrous distally to minutely deltoid scaly at mid-tube, again becoming glabrous near the base, except near filament bases, exterior puberulent with hairs erratically directed, some glandular; **corolla lobes** oblong-squarish, emarginate, 2 mm long, 2 mm wide, interior pubescent, exterior minutely sericeous-puberulent, exmedially appressed, several black hairs present near the apex. **Stamens** 18, subexserted, adnate to corolla at mid-tube or lower, some inserted on the receptacle, some lower stamens extrorse, abruptly geniculate, and connected to introrse upper stamens by a superdermal vascular trace; **filaments** 1 mm long, hirtellous, especially on margin; **anthers** basifixed, lance-ovate, ± 2.5 mm long, laterally concave, apically constricted, opening by short apical slits; **pistillode** ± wheel-shaped, lobes 5, bifurcate, glabrous, dark gray. **Female inflorescence** flowers solitary, from caducous bract scar axils near the base of young stems. **Fruiting pedicels** 7–12 mm long, stout, very minutely hirtellous. **Fruiting calyx** 5-lobed; **fruiting calyx tube** 3.5–4 mm long, explanate to reflexed; **fruiting sepals** accrescent, coriaceous,

arcuate-reflexed to spreading, 7–25 mm long, 7–13 mm wide, oblong, narrowly triangular or ovate, apex usually ascending to incurved, sometimes glaucous-pruinose to scintillant. **Fruit** berry, 3–5.5 cm long, up to 4.7 cm wide, subglobose, *locules* 8–10; **mesocarp** fleshy, yellow-orange in dried specimens; **hypodermis** thick and stony; **epidermis** smooth to bullate, shiny in living material, green to brown or black, herbarium material reddish-brown to dark-brown, immature fruits sometimes atropurpureous. **Seeds** not seen in available material (seeds orangish in photograph in Sánchez-Coello 2002 from Conde 2000), described by Pacheco (1981) as brownish to grayish, shiny, very rugose, and with a prominent raphe.

Additional specimens examined. **MÉXICO. San Luis Potosi. Mpio. Tamazunchale:** Tamazunchale, [21° 16'N, 98° 47'W, 153 m], 24 Jul 1937, *M.T. Edwards 670* (MO, US). **Veracruz. Mpio. Alto Lucero:** Cruz Blanca, 19° 46'N, 96° 40'W, 900 m, 30 Apr 1980, *L. Pacheco & J.I. Calzada 23 & 24* (XAL); same locality, 19 Sep 1979, *L. Pacheco & J.I. Calzada 18* (XAL); Cruz Blanca, 19° 40'N, 96° 50'W, [900 m], 25 May 1998, *Tono Vázquez 98-045* (UCR). **Mpio. Chiconquiaco:** Cañada del Huerfano, 19° 49'N, 96° 48'W, [900–1200 m], 10 Jul 1966, *A. Gomez-Pompa 1602* (XAL). **Mpio. Martinez de la Torre:** Malaupan [Santa Ana Maloapan, 20° 04'N, 97° 04'W], 100 m, 15 Mar 1978, *F. Ventura A. 15078* (IEB, XAL). **Mpio. Tantima:** Sierra de Tantima, 21° 17'N, 97° 51'W, 740 m, 23 Aug 1979, *J.I. Calzada 5550* (XAL). **Mpio. Tepetzintla:** Sierra de la Peña Blanca, Sierra de Tantima, [21° 13'N, 97° 55'W, ± 700 m], 21 Sep 1989, *P. Zamora C. et al. 1217* (XAL); San José de Copaltitla al NE de Tepetzintla, 21° 12'N, 97° 52'W, 350 m, 28 Aug 1981, *G. Castillo C. & A. Benavides M. 2265* (XAL); Cerro de Mixtepec, Sierra de Tantima, 21° 18'N, 97° 50'W, 1000 m, 17 May 1988, *J. Becerra Z. 83* (XAL).

Distribution and Ecology.—The only known collection of this taxon made outside of the state of Veracruz is from Tamazunchale, San Luis Potosi. This 1937 collection (*M.T. Edwards 670*) is the earliest one of the species known to us. Tamazunchale is at 153 m, a low elevation based on the literature (e.g. Pacheco 1981). In northern Veracruz, this species occurs in the Sierra de Tantima. In central Veracruz, occurrences are in the Sierra de Chiconquiaco, the lowlands of its northern base, and the Misantla region. Populations in northern Veracruz are in isolated cloud forest patches. In central Veracruz, collection sites have been characterized as forested escarpments near pasture (Sosa et al. 1998), cloud forest, and deciduous forest (Pacheco 1981) at 750–1000 m. It seems not to be widely realized that this taxon also occurs at lower elevations at 100–300 m. Low elevation occurrences are associated with tropical evergreen forest with *Quercus*. In this community, they are known to flower during March. This species is considered to be in danger of extinction (Sánchez-Coello 2002).

Ethnobotany.—The tree is called 'granadilla' in the Sierra de Tantima region of northern Veracruz where it is considered edible (*G. Castillo C. & A. Benavides M. 2265*). The name 'sapote prieto', is indicated on the collection from Tamazunchale, San Luis Potosi.

2. Diospyros gomeziorum M.C. Provance & A.C. Sanders, sp. nov. **(Fig. 2e)**. TYPE: MÉXICO. QUERETARO: Mpio. Jalpan de Serra, 5–6 km al NW de San Juan de los Dúran, El Arroyo, 21.48°N, 99.12°W, escaso, bosque de pino-encino, cedro blanco, orilla de arroyo, cañada, 1500–1600 m, 21 Aug 1991 (fr), *Benito Servín 1274* (HOLOTYPE: IEB-150586).

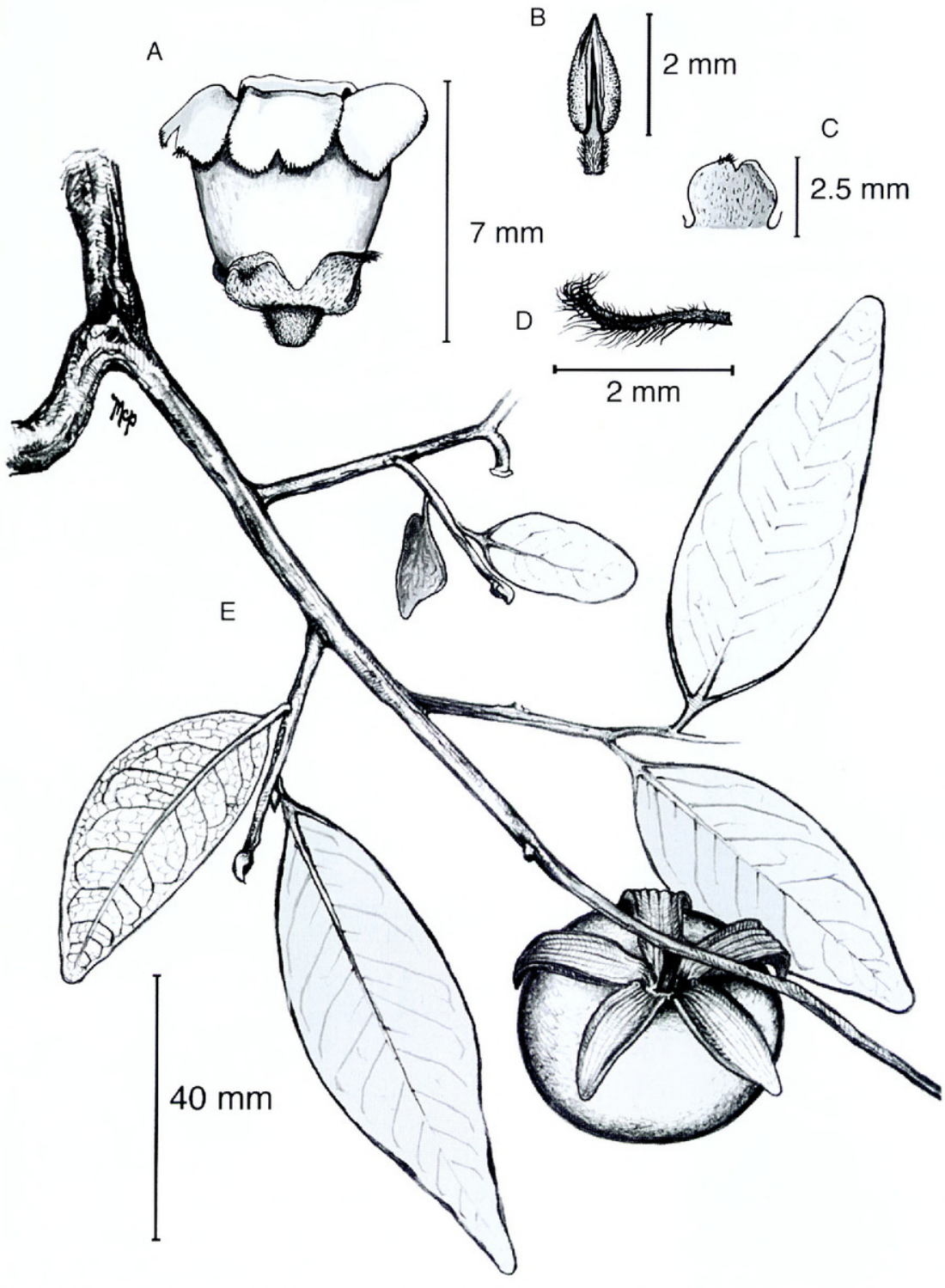

FIG. 2. **A–E.** *Diospyros gomeziorum* M.C. Provance & A.C. Sanders, sp. nov. **A.** Staminate flower. **B.** Typical anther. **C.** Adaxial surface of staminate petal lobe. **D.** Lateral view of staminate inflorescence bract. **E.** Fruiting branch. A–C. Based on *R. Fernández N. 2829*. D. Based on *Hiram Rubio 1520*. E. Based on *Benito Servín 1274*.

Arbor frutexve usque ad 20 m altus, *D. riojae* Gómez-Pompa similis sed differt margine folii a pagina adaxiali usque ad paginam abaxialem exter obliquantibus; cellulis epidermalibus paginae laminae adaxialis non amplificatis, sine conspicue incrassatis parietibus cellularum anticlinalibus; foliis saepe copiose glaucipruinosis; calyce fructifero effuso et cum apicibus sepalorum ascendentibus; pedicellis fructiferis non crassis.

Trees or shrubs to 20 m tall, facultatively deciduous; **trunk** reported to 12 cm diameter for a 5-6 m tree (*Servín 1274*) and 20 cm in diameter for a 4 m tree (*R. Fernández N. 2459*), erect, longitudinally fissured, *bark* gray, reportedly shiny; **aged stems** angular, *bark* verrucose, scarred, short-fissured, cinereous, *stem wood* yellow to yellow-orange; **2nd–3rd year stems** angular to subterete, sometimes hirtellous, ± half-netted, the outer epidermal layer gray, tawny or reddish-brown, the lower layer cream to orangish; lenticels protruding, sometimes 2–3 mm long; **current year's stems** subterete, smooth to striate, densely hirtellous, reddish-brown, puncticulate. **Petioles** stout, often thicker than wide, 2–5(–8) mm long, glabrous to minutely erect hairy to deltoid scaly, rounded to ruminate below, usually glistening, dark brown to olive green, narrowly channeled, flat or barely raised, furfuraceous-glandular, ascending ciliolate on margin, yellow-green to olive above. **Leaves** alternate, simple, entire, pergamentaceous to chartaceous, sometimes subcoriaceous, lanceolate to ovate to elliptic, 6–11(–11.5) cm long, 2–4.8 cm wide, *apex* acute, obtuse or acuminate to a rounded point, *margin* beveled outward from upper surface at ± 45° to the lower surface, somewhat sharp, shiny, sparsely to moderately ciliolate, *base* acute to obtuse, decurrent onto petiole; **lower leaf surface** glabrous to sparsely subappressed pubescent, hairs black or reddish, most common near the base, midrib, and apex, surface shiny, green to olive, puncticulate; **upper leaf surface** glabrous, glaucous to pruinose-scintillant, localized or covering most of surface, but not on the beveled margin, granular-papillose, olive or pale blue-olive to dark-olive or dark blue-green, usually darker above than below, young leaves tend to be lighter above. **Venation** arcolanguid, granular-papillose, glaucous to pruinose-scintillant; **midrib** prominent below, glabrous to subappressed pubescent, hairs black, reddish-brown, or white, narrowly canaliculate above, sparsely to densely hirtellous to deltoid scaly, rarely glabrous, yellow-green; **2° venation** subprominent below, *lateral veins* (8–)11–13(–14) pairs; **3° venation** reticulate, obscure to prominent below, usually prominent above. **Laminar extrafloral nectaries** abaxial, minute, circular. **Male inflorescence** fascicles of 1–3(–5) flowers in leaf scar axils of previous year's growth, or one to several flowers at the base of new growth in scar axils of caducous bracts; **pedicels** 1–3 mm long, densely straight hairy, the hairs reddish, black, and white; **pedicel bracts** 2, 2–2.5 mm long, ± linear. **Male flowers** (4–)5(–6)-merous; **calyx** infundibuliform-campanulate, deeply lobed, interior glabrate or scantily minute white hairy, exterior sparsely minute deltoid scaly; **calyx tube** 1.5–2 mm long, 2.5–3 mm wide, sparsely subappressed puberulent; **sepals** lance-ovate to triangular, 2–7 mm long, 1–4

mm wide, exterior glabrous to pubescent basally, subappressed pubescent apically, the hairs glossy, black to reddish, simple and glandular, epidermis viscous; **corolla** urceolate-campanulate, white in living material; **corolla tube** 3–5.5 mm long, 3–6 mm wide, exterior densely pubescent, most hairs distally oriented, some hairs irregular, interior sparingly hirtellous, hairs sometimes erratically directed; **corolla lobes** (4–)5, spreading, oblate to squarish or widely obovate, often emarginate, 2–4 mm long, 2–3.5 mm wide, several short black hairs near the apex, interior sericeous. **Stamens** 20, equal to, or barely surpassing tube, most adnate to corolla, some inserted on the receptacle; **filaments** 0.3–0.8 mm long, ascending puberulent; **anthers** basifixed, oblong-ovate to ovate, 2 mm long, opening by short slits near apex, rarely by complete lateral slits, granuliferous, apex acute or rounded and mucronulate; **pistillode** conspicuously wheel-shaped, short, wide, corrugate. **Female inflorescence** flowers solitary, cauline near the base of current season's growth, rarely from leaf scar axil of old growth (e.g. *Ferguson 15*), sometimes two opposite inflorescences, but two mature opposite fruit not seen. **Female flowers** not seen, but **styles** (4–)5 as remnants on mature fruit, appressed white puberulent. **Fruiting pedicels** (4–)5–8(–11) mm long, densely hirtellous. **Fruiting calyx** 5–6-lobed. **Fruiting calyx tube** 3–4 mm long; **fruiting sepals** accrescent, ± spreading, 19–20 mm long, 8–11 mm wide, lanceolate to narrowly elliptic or obovate, glabrous to sparsely appressed hairy, apices rounded, sometimes ascending, surfaces often bluish-white glaucous, non-glaucous areas tawny, puncticulate. **Fruit** berry, subglobose to slightly obovoid, 3 cm long, 3–4.5 cm in diameter, green when immature, turning black (and then presumably ripe), atropurpureous in dried specimens, *locules* 10; **mesocarp** orange when dry; **hypodermis** thin, not very stony, often broadly rippled in specimens; **epidermis** orange-peel-textured, scintillant, glaucous-pruinose. **Seeds** 16–19 mm long, 9–10 mm wide, rugose, shiny, light brown.

PARATYPES: **MÉXICO. Hidalgo. Mpio. Meztitlán:** Barranca de Meztitlán, 9 km al NE de Mesquititlán a lo largo de una cañada, 20.74°N, 98.98°W, 2200 m, 3 May 1975, *F.G. Medrano et al. 7932* (SD, US, XAL). **Queretaro. Mpio Arroyo Seco:** 2 km al W de El Jardín, 21° 25' 24"N, 99° 41' 42"W, 1380 m, 4 Jul 1989, *E. Carranza 1852* (IEB). **Mpio. Jalpan de Serra:** 2–3 km al Poniente de San Isidrio, La Parada, 21° 30.5'N, 99° 10'W, 1300 m, 14 May 1990, *Benito Servín 206* (CIIDIR, IEB); 2–3 km al S de La Parada, 21° 32.3'N, 99° 10'W, 1200 m, 26 Mar 1990, *Benito Servín 58* (IEB); 6–7 km al Oriente de La Parada, 21° 30.5'N, 99° 6.8'W, 1400 m, 5 Apr 1990, *Benito Servín 96* (IEB); 2–3 km al N de La Parada, 21° 32.3'N, 99° 10'W, 1100 m, 13 Aug 1990, *Benito Servín 412* (IEB); ± 2 km al W de La Parada, Cuesta de los Lirios, 21° 30.5'N, 99° 11.2'W, 1180–1250 m, 13 Mar 1990, *E. Carranza 2392* (CAS, IEB). **Mpio. Colón:** cerca vado río Colón, 20° 48'N, 100° 03'W, 1900 m, 2 Apr 1982, *Elizabeth Arqüelles 1761* (DES). **Mpio. Pinal de Amoles:** 1 km S de Escanelilla, sobre la carretera a Pinal de Amoles, 21° 9'N, 99° 33'W, 1250 m, 18 May 1987, *J. Rzedowski 43398* (HUAA, IEB); ± 4 km al SE de Santa Agueda, 21° 14' 30"N, 99° 37' 54"W, 1190 m, 18 Apr 1989, *E. Carranza 1635* (IEB); 3 km al S de Escanelilla, 21° 10.2'N, 99° 34'W, 1100 m, 19 Mar 1985, *R. Fernández N. 2829* (US); same location, 30 Jul 1984, *R. Fernández N. 2459* (IEB). **Mpio. Landa de Matamoros:** 1.5 km al SW de El Naranjo, 21° 01' 18"N, 99° 27' 42"W, 900 m, 10 Mar 1990, *Hiram Rubio 1542* (IEB); 1 km al Poniente de El Cerro de La Palma, 21° 12' 28"N, 99° 04' 32"W, 1500 m, 2 Mar 1990, *Hiram Rubio 1520* (IEB); cerca de Tres Lagunas, 21° 19' 36"N, 99° 12' 12"W, 1700 m, 22 Jun 1988, *J.*

Rzedowski 46695 (IEB); 2 km al Norte de Neblinas, 21° 13' 58"N, 99° 06' 18"W, 1060 m, 29 Sep 1988, *Hiram Rubio 185* (IEB); El Humo, 2 km a l'Ouest d'El Humo, 21° 18'N, 99° 05'W, 1320 m, 1 Oct 1994, *J.N. Labat & E. Carranza 2562* (IEB); 2 km al SE de El Humo, 21° 13' 55"N, 99° 06' 15"W, 1100 m, 7 Jun 1989, *Hiram Rubio 775* (HUAA, IEB); 2.5 km NE de El Humo, [21° 18'N, 99° 05'W], 1000 m, 11 Aug 1990, *Hiram Rubio 1865* (IEB); 1.5 km SE de El Naranjo, 21° 01' 18"N, 99° 27' 42"W, 1000 m, 25 Jun 1990, *Hiram Rubio 1746* (IEB); 4–5 km al S de Tres Lagunas, 21° 19' 33"N, 99° 12' 12"W, 1820 m, 3 Mar 1990, *E. Carranza 2359* (HUAA, IEB); El Calvario, 1 km al Poniente de El Aguacate, 21° 16' 06", 99° 14' 42", 1620 m, 26 Jun 1989, *Hiram Rubio 838* (IEB); ± 8 km de desviación, camino Tres Lagunas, 21° 19' 35"N, 99° 06' 15"W, 1900 m, 7 Nov 1988, *E. Carranza 1144* (IEB); 2 km al SE de Neblinas, 21° 15'N, 99° 03' 12"W, 900 m, 23 Jun 1989, *Hiram Rubio 826* (IEB). **San Luis Potosi. Mpio. Rayon:** 3.5 mi by road S of km 81.5 on hwy 70 W of Valles at microwave tower, [± 21° 53'N, 99° 30'W], 1340 m, 23 May 1981, *George Ferguson 15* (UTEP). **Tamaulipas. Mpio. Gómez Farias:** Rancho del Cielo, a 11 km de Gómez Farias, [23° 04'N, 99° 12'W], 1110 m, 22 Sep 1974, *F.G. Medrano 7416* (ARIZ); Rancho del Cielo, La Sierra de Gómez Farias, 1100 m, 1 May 1982, *H. Narave F. & T. Dent 134* (XAL); Rancho El Cielo, F. Harrison's place, E ridge of the Sierra Cucharas, 1200 m, 23 Aug 1950, *E. Hernández X. & F. Harrison X-5861* (CHAPA).

Distribution and Ecology.—This species occurs in the Sierra Madre Oriental, including the Sierra Cucharas, just north of Gomez Farias in southwest Tamaulipas, mountainous regions southwest of Tamasopo in southeast San Luis Potosi, northeast Queretaro, and Barranca de Meztitlán in eastern Hidalgo. Collections are from a variety of vegetation types at elevations between 900 and 2200 m. More material, by far, has been collected in the state of Queretaro than any other state. In Queretaro, it has been described as abundant in pine-oak forest, oak forest, oak forest with *Liquidambar*, and *Tilia* forests. Other settings in which it has been reported but described as scarce include gallery forests with *Platanus*, and canyons with *bosque mesofilo de montaña* (± cloud forest). An unusual association occurs in Hidalgo, where it was described as very abundant in a canyon with *matorral espinoso* and *matorral crasicaule* at 2200 m (*F.G. Medrano et al. 7932*). The five male flowering collections we examined were all taken in March. Some of these specimens were just leafing out at the time. The fruits ripen between September and early November.

Ethnobotany.—Queretaro: 'zapote prieto' (*Rubio 1746*), 'zapote del monte' (*Servín 206*), zapotillo (Carranza 2000).

Etymology.—The epithet is intended to honor both Arturo Gomez-Pompa, who discovered and described *Diospyros riojae*, and has also been a great inspiration to our work on Latin American *Diospyros*, and also the late J. 'Carmelo' Gomez, who assisted the first author in the field on many occasions, and was very knowledgeable on local plant use in the Sierra Tlachichila, Zacatecas.

Collections of *D. gomeziorum* have often been confused with *D. riojae*. A conspicuous feature that differentiates *D. gomeziorum* from *D. riojae* is the leaf margin, which is beveled outward from the upper to the lower surface at about 45° in *D. gomeziorum*. The margin formed tends to be sharp, shinier, and greener, while that in *D. riojae* is thick, not as shiny, and a paler green. Other differences include the upper leaf surface, which is often copiously glaucous-pruinose in *D. gomeziorum*, while typically only the abaxial leaf surface is slightly prui-

nose-scintillant in *D. riojae*. The epidermal cells of the upper leaf surface in *D. riojae* are large, with thickened anticlinal walls, a feature absent in *D. gomeziorum*. Leaf shape in *D. gomeziorum* ranges from elliptical to lance-ovate or ovate, while the leaves of *D. riojae* often tend to be oblong or obovate. However, this character overlaps, since both taxa may have elliptical leaves. In fruiting collections, the shorter, less stout, fruiting pedicels, the thinner, less sclerenchymatous fruit wall, and the glaucous-pruinose to scintillant fruit distinguish *D. gomeziorum*. The pedicel bracteoles of the male inflorescence in *D. gomeziorum* are twice as long as those in *D. riojae*, and are nearly folded lengthwise (navicular). The anthers in *D. gomeziorum* are minutely granular, lacking the apical constriction and smooth texture seen in *D. riojae*.

Carranza (2000) described male flowers of this species (as *D. riojae*) as cymose. We did not find cymes in material referable to either species. Developmentally, the inflorescences may be related to cymes, but, they appear to be fascicles. Some flowers may appear to be in dense terminal clusters (e.g., *H. Rubio 1542*). However, this appearance is superficial, since small terminal shoot apices can be found, although sometimes only with difficulty.

3. Diospyros conzattii Standl., J. Wash. Acad. Sci. 12(17):399. 1922. **(Fig. 3)**. TYPE: MEXICO. OAXACA: Distrito de Pochutla, Cerro Espino, Cafetal San Rafael, 24 Apr 1917 (fr), *C. Conzatti 3167* (HOLOTYPE: US-1014759 not seen; ISOTYPES: MO-879066! (in sched. 1100 m, with *Reko & Makrinus*), MO-1039787!, fragment US-892600! (in sched. 900 m, with *Reko & Makrinus*).

Trees or shrubs, 8–10 m tall, probably facultatively deciduous, trunk not reported; **aged stems** subterete to angular, *bark* verrucose, fissured, gray, *stemwood* off-white to yellowish or pale orange; **2nd–3rd year stems** angular to subterete, *bark* rimose, epidermis glabrous to sparsely hirtellous, sometimes pulverulent, sparingly clavate glandular hairy, densely lenticellate, puncticulate, chestnut to tawny, becoming silvery gray; **current year's stems** quadrangular, finely sulcate, glabrate to hirtellous, sometimes sparsely strigillose, the hairs off-white to brown, the epidermis shiny, viscous, olive to nearly black. **Petioles** usually thin, sometimes flexuous, 5–8 mm long, pale green to green-brown, rounded below, glabrous to appressed puberulent, conspicuously winged part way above, the wings becoming vertically oriented and narrow along the petiole, petiole slightly convex and minutely V-grooved above, to widely flat-channeled, to 3-channeled (main channel raised and skirted by side channels formed by vertical wings), glabrous to erect puberulent, sometimes clavate glandular hairy, especially in young leaves. **Leaves** alternate, simple, entire, pergamentaceous to chartaceous, lanceolate to elliptic to ovate, 5–14(–14.7) cm long, (2.5–)3–5(–6) cm wide, immature leaves membranaceous, *apex* acuminate to an acutely or obtusely rounded point, *margins* flat to subrevolute, curved downward near the base of the leaf, thickened intramarginal zone seen when viewed abaxially, hyaline and minutely ciliolate in immature leaves, base acutely or obtusely

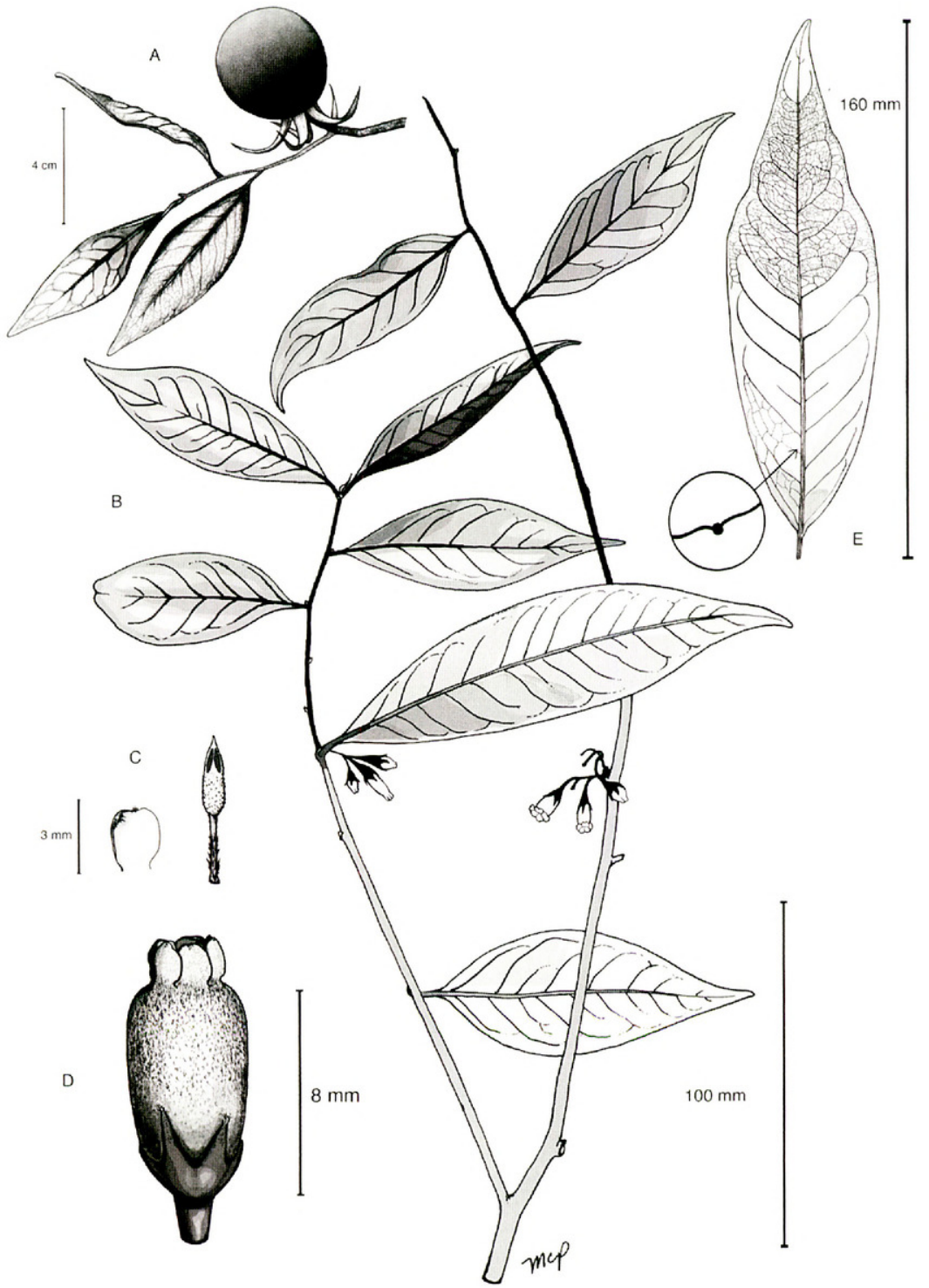

FIG. 3. **A–E.** *Diospyros conzattii* Standl. **A.** Fruiting branchlet. **B.** Staminate flowering branch. **C.** Adaxial surface of staminate petal lobe (left) and typical anther (right). **D.** Staminate flower. **E.** Adaxial surface of mature leaf (apex extrapolated) showing detail of several degrees of venation, and a lateral cross section of the leaf (outset detail). A. Based on *J.L. Martinez & A. Hernandez 1302*. B–E. Based on *F. Ventura A. 7131*.

rounded, sometimes cuneate, decurrent onto petiole, sometimes loosely recurved near the petiole; **lower leaf surface** usually glabrous, very rarely minutely white glandular hairy, puncticulate, dull, olive; **upper leaf surface** glabrous, glaucous, densely puncticulate, dull, olive. **Venation** arcolanguid; **midrib** very prominent below, slightly undercut, terete, glabrous, straw to light-green, weakly raised above, and then caniculate within the raised midrib, very sparsely minute erect hairy; **2°–3° venation** reticulate, veins narrow, raised below and above, *lateral veins* 9–14 pairs, 2° arches formed with superadjacent lateral veins typically obscure. **Laminar extrafloral nectaries** abaxial, conspicuous, round to oval, dark-red to black, often evenly spaced and near the midrib. **Male inflorescences** cymes, 1(–2) near the base of current year's stems, or (1–)2 leaf scar axils of the previous year's growth, 1–3-flowered, black to umber velutinous, sparsely covered with minute clavate glandular hairs; **peduncles** 4–6 mm long, velutinous, umber to dark brown; **pedicels** slender, 5–7 mm long, vestiture as in peduncles; **pedicel bracts** 1–2, alternate or opposite, narrowly oblong, 1 mm long, 0.8 mm wide, umber. **Male flowers** 5(–6)-merous; **male flowering calyx** funnelform, drying very dark-brown to black, glabrate to appressed-pubescent, coterminous with pedicel and uninterrupted; **male flowering calyx tube** 2–3 mm long, 1.5–2 mm wide; **sepals** 5, acute-triangular, 2–4 mm long, ciliolate, apically vermiform glandular hairy, sinuses rounded; **corolla** 5–6-lobed, long-urceolate, drying very dark-brown to black, reportedly whitish in life; **corolla tube** widest above middle, 7–8.5 mm long, 4–5 mm wide, abruptly constricted distally, exterior densely minute white puberulent, hair density ± increasing distally, interior sparsely white puberulent, the hairs concentrated in regions of filament attachment; **corolla lobes** quadrate to oval, 2–2.5 mm long, 1.5–2 mm wide, asymmetrical, apex obtuse-rounded, truncate, emarginate, or trifid, often with several short dark hairs, exterior densely minute white puberulent, interior inflexed at the distal right margin, left margin slightly involute, pubescent. **Stamens** 30, sometimes attached in pairs, adnate to corolla from midpoint to bottom of tube, sometimes inserted on the receptacle; **filaments** 3 mm long, minutely hairy; **anthers** basifixed, lanceo-apiculate, 3–3.5 mm long, opening by terminal pores or short lateral slits, connective minutely deltoid-scaly, *pistillode* minute, obturbinate, smooth, nearly unlobed, having a few smooth very small basal lobes, glabrous. **Female inflorescence** flowers solitary, cauline, at the junction of current and previous year's growth. **Fruiting pedicels** stout, (7–)12–15 mm long, glabrous to sparingly minute hirtellous. **Fruiting calyx** 5-lobed; **fruiting calyx tube** 3 mm long, explanate to campanulate, usually with a conspicuous enlarged basal region encircling the pedicel joint; **fruiting sepals** accrescent spreading to reflexed slightly, apices straight, coriaceous, narrowly to linearly triangular, 24–31 mm long, 5–8 mm wide, margins sometimes sharp edged, sometimes glaucous, glabrous, puncticulate. **Fruit** berry, depressed-globose slightly obovoid, up to 4 cm long, 4.5 cm in diameter, reportedly reddish (*Chazaro 3969*) or green (Standley

1922) when ripe, mostly atropurpureous in herbarium material. *Locules* 10–12; **mesocarp** reportedly black when ripe, usually orange in dried specimens; **hypodermis** 0.2–0.5 mm thick, stony; **epidermis** bullate, glaucous-scintillant, usually wrinkled when dry. **Seeds** 15–16 mm long, 11–12 mm wide, 5.5–9.5 mm thick, sculpture cerebriform, chestnut.

Additional material examined: **MÉXICO. Veracruz. Mpio. Calcahualco:** 4.2 km W of Escola, 19° 10'N, 97° 10'W, 2200 m, 12 Jan 1981 (fr), *M. Nee & G. Schatz 19777* (XAL). **Mpio. Chiconquiaco:** abajo de Vaqueria dirección Arroyo Colorado, 19° 46'N, 96° 45'W, 1650 m, 25 Oct 1988 (fr), *C. Gutierrez B. 3292* (XAL) & *3293* (XAL). **Mpio Coscomatepec:** 3 km al SE de la antigua Xicola, Cima del Cerro La Magdalena, 19° 06'N, 97° 04'W, 1900 m, 29 Apr 1987 (fr), *J.L. Martinez & A. Hernandez 1302* (XAL). **Mpio. Jalacingo:** El Cuizalín, ca. 19° 50'N, 97° 16'W[1], 1500[2] m, 22 May 1982 (pist. fl), *F. Ventura A. 7131* (IEB, MO, XAL). **Mpio. Tatatila:** camino de herradura de Tatatila a Escalone (o Puente Caballos), [± 19° 42'N, 97° 6'W, 1500 m], 14 Jan 1986 (fr), *M. Chazaro & Roberto Acosta 3969* (WIS, XAL). **Mpio. Tlacolulan:** Abajo del Saucal, dirección Agustin Melgar, 19° 45'N, 96° 57'W, 1180 m, 14 Aug 1990 (fr), *C. Gutierrez B. 4056* (XAL).

Distribution and Ecology.—The type locality is in the Pacific coastal ranges of the Sierra Madre del Sur, Oaxaca. It occurs there in dry tropical forest on coastal slopes (Anonymous 1927). According to Conzatti (in Standley 1922), the fruit is ripe in April. In Veracruz, occurrences are near Pico de Orizaba, the Sierra de Tezuitalan, and the Sierra de Chiconquiaco, between 920 and 2200 m altitude. It occurs on slopes with pine-oak woodland and Alnus, oak forests, and deciduous forests.

Ethnobotany.—Veracruz: 'zapotillo' (*C. Gutierrez B. 3292*). Oaxaca: 'zapote negro montés' (Standley 1922 [quoting Conzatti], and on US-892600), 'zapote negro silvestre' (*Conzatti 3167* [in his own handwriting]). The wood is considered valuable (Anonymous 1927 [paraphrasing Conzatti]).

Only one of the isotypes we examined, MO-879066, included a fruit. Unfortunately, the large atropurpureous fruit is in rather poor condition. However, upon close examination it was clear that the epidermis is bullate, glaucous, although tending towards brown in some areas. The fruit wall is thick and quite stony. A fragment packet attached to another type, MO-1039787, contains a spreading fruiting calyx tube bearing the basal 5 mm of one sepal, and much less of the base of another. The sepals appear to have been quite narrow, ca. 4–5 mm wide at the base and further narrowed distally. Characteristics seen in the fruit of *D. conzattii* collections from Veracruz are consistent with the characteristics found in the isotype. An enlarged region below the fruiting calyx encircling the pedicel joint is only seen in the Veracruz material, but not the isotype. At this point, we are unsure of its significance.

[1]Coordinates based on F. Ventura A. collection of *Rhamnus capreaefolia* var. *capreaefolia* from Cuizalín, 22 June 1970 (LL) accessed through REMIB. www.conabio.gob.mx/remib_ingles/doctos/ remib_ing.html.

[2]The label indicates the collection was made at 150 m. This seems to be a typographical error. The coordinates for Cuizalín are compatible with an elevation estimate of 1500 m.

4. Diospyros costaricensis M.C. Provance & A.C. Sanders, sp. nov. (**Fig. 4b, e**). TYPE: COSTA RICA. GUANACASTE. Cantón de Liberia: Parque Nacional de Guanacaste, Cordillera de Guanacaste, Cerro Cacao, Estación Cacao, 10° 55' 45"N, 85° 28' 15"W, 1100 m, 14 Jul 1991 (fr), *Carlos Chávez 569* (HOLOTYPE: MO-5316680!; ISOTYPES: "4 duplicates" indicated on label, but not seen by us).

Arbor *D. conzattii* Standl. similis sed anterides-faciente, usque ad 35 m alta et 1.5 m diametro; petiolis adaxiale fere negris; zona intermarginali laminae neque incrassata neque elevata in pagina abaxiali; costa glabra ad aurohirtella adaxiale, vadose (saepe late) concava, aut ab lateribus contiguis laminae longistrorsum crispanti in speciminibus exsiccatis.

Trees, probably facultatively deciduous, reportedly colonial, reportedly up to 35 m tall, and 1.5 m in diameter (*Espinoza 54*); **trunk** buttress-forming, channeled, smooth, greenish-black to greenish-brown, *slash* yellow and aromatic; **aged stems** somewhat angular, half-netted, black to gray above, lower layer beige to golden-brown, sometimes ± mottled, sometimes shallow-fissured, lenticellate; **2nd–3rd year stems** irregularly half-netted, beige beneath, black and grey above, hirtellous, pubescence sometimes persisting on three year old stems, lenticellate; **current year's stems** quadrangular, sulcate to minutely ridged, sparsely subappressed golden hairy, the hairs fine and ± straight, sparingly to very densely erect puberulent, dark-green to black, somewhat glandular, becoming lenticellate. **Petioles** usually thin, somewhat flexuous, 3–6.5 mm long, wings tapering gradually from the decurrent lamina, and twisting abruptly into a vertical orientation along the margin, glabrous to hirtellous below, rugose to invaginate, light olive to very dark brown, concave above, often minutely V-grooved, usually golden hirtellous, often glandular, epidermis often nearly black. **Leaves** alternate, simple, entire, chartaceous to subcoriaceous, cartilaginous, ovate to elliptic, rarely widely-obovate, 6.5–9.5(–10.2) cm long, 2.8–4(–5) cm wide, very often tattered around the margins, wrinkled, *apex* usually asymmetric, tapering to an obtusely rounded tip, *margin* curved under near the base of the leaf, *base* mostly obtuse and tardily abrupt-acuminate, sometimes acute, long decurrent onto the petiole; **lower leaf surface** sparsely appressed puberulent, puncticulate, sometimes clavate glandular hairy near base, dull, brown to brown-green; **upper leaf surface** glabrous, very rarely glaucous-scintillant, papillose, puncticulate, brown-green. **Venation** brochidodromous; **midrib** prominent below, glabrous to sparsely appressed puberulent or hirtellous, epidermis green to brown-green, shallowly concave above, glabrous to golden hirtellous, sometimes partly shrouded by the lamina, then canaliculate and hairs crisscrossing, epidermis of basal half often black, otherwise greenish; **2° venation** fine below, usually prominent, *lateral veins* 9–12 pairs, forming definite 2° arches with superadjacent lateral veins, arch apices 3 or more mm from the margin, venation tending to be obscure above, but variable; **3°–4° venation** reticulated below, fine, usually apparent, but varying from obscure to prominent. **Laminar extrafloral nectaries** often up to 30, sometimes more, scattered on the abaxial side of the lamina, minute, peripherally rimmed with a narrow band

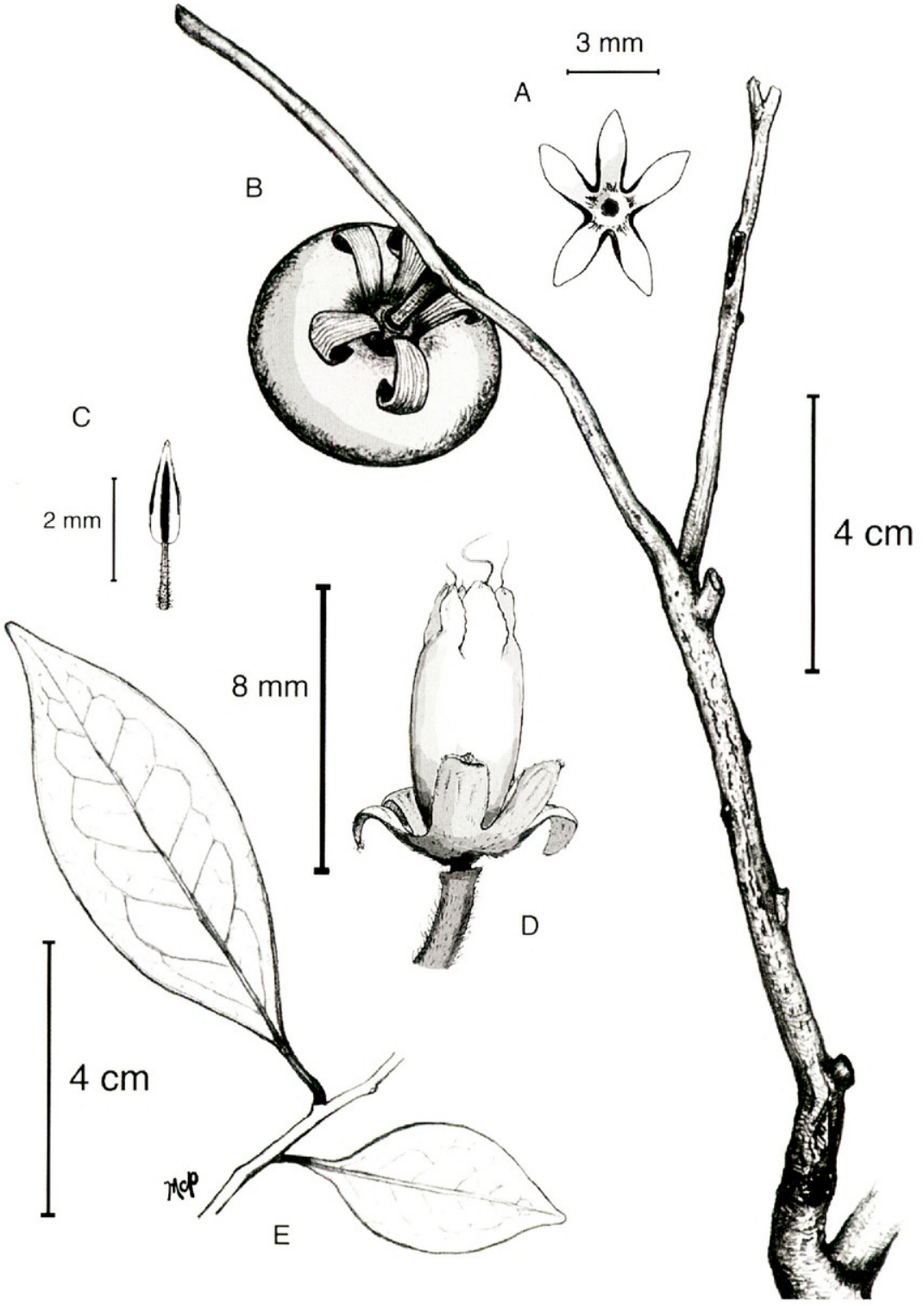

FIG. 4. **A–E.** *Diospyros costaricensis* M.C. Provance & A.C. Sanders, sp. nov. **A.** Adaxial view of staminate male calyx with corolla removed. **B.** Fruiting branch. **C.** Typical stamen. **D.** Staminate flower. **E.** Stem with leaves. A, C, and D. Based on *Zobeida Fuentes, N. Zamora & Eduardo Lépiz 248*. B and E. Based on *Carlos Chávez 569*.

of raised tissue. **Male inflorescence** cymes, 2–3-flowered, 1–2 cymes per axil, from growth of the previous year, or from the base of new growth, densely subulate puberulent; **peduncles** up to 4 mm long, sparsely to densely pubescent to strigose with light brown to black hairs, epidermis dark brown; **pedicels** 0.5–3.5 mm long, vestiture and epidermis as in peduncles, *pedicel bracts* rarely persisting in herbarium material, 0.3–1 mm long, deltoid, densely hairy, the hairs dark-brown and straight. **Male flowers** 5-merous; **calyx** infundibuliform, exterior short-appressed gold to white puberulent, sometimes with clavate glandular hairs, epidermis dark brown; **calyx tube** 0.8–1.3 mm long, interior with ring of straight appressed white hairs; **sepals** usually erect, rarely slightly recurved, 2–3.5 mm long, 0.8–1.5 mm wide, interior glabrous to glandular setulose, exterior pubescent, often densely so at the apex, the hairs wavy and amber, appearing glandular; **corolla** long-urceolate; **corolla tube** 3.5–7.5 mm long, 3 mm wide, interior lower-third of tube short golden pubescent, hairs ± erratically directed, exterior evenly and densely short appressed to ascending golden hairy, also clavate glandular hairy; **corolla lobes** 5, quadrate to oval, 2–2.8 mm long, 1.2–2.5 mm wide; *apex* sometimes bearing a long flagellate trichome, interior right margins involute, interior glabrous, exterior appressed to ascending white puberulent, the left side of lobe densely appressed fine puberulent, sometimes with several minute black hairs near the apex. **Stamens** 17–19, adnate at various levels at and below the basal third of the corolla; **filaments** 1–1.5 mm long, narrowed distally, glabrous to densely erect hispidulous; **anthers** basifixed, 2.3–2.5 mm long, several minute hairs at the apex, surface light-yellow apically, opening by short lateral slits confined to the distal half to two-thirds of the anther, sometimes opening by a complete lateral slit, *pistillode* ± sub-conical, slightly wavy peripherally, ± 8 long straight hairs originating from the central apex, otherwise glabrous. **Female inflorescence** flowers solitary in leaf scar axils of 2nd year stems, or cauline at junction of previous and current growth. **Fruiting pedicels** stout, 3–18 mm long, sparsely hirtellous, reddish-gold, and gray, lenticellate. **Fruiting calyx** 5-lobed, sinuses acute; **fruiting calyx tube** explanate, sparsely appressed puberulent, scintillant, ± 3.5 mm long; **fruiting sepals** accrescent, coriaceous, lorate to lanceolate, (16–)22 mm long, (5–)6–8(–9) mm wide, spreading to moderately reflexed, apex straight to quite incurved, puncticulate, shiny, golden brown, sparingly scintillant basally. **Fruit** berry, sometimes pendulant, depressed-globose, 2.5 cm tall, 4 cm wide, reportedly green in living material, dull, atropurpureus to dark-brown in herbarium material, *locules* 10; **mesocarp** reportedly yellow in living immature fruits, dark orange in herbarium material; **hypodermis** ± 0.5 mm thick, stony, not wrinkling in herbarium material; **epidermis** bullate, glaucous to pruinose-scintillant, either locally or over most of the fruit. **Seeds** not seen.

PARATYPES: **Costa Rica. Guanacaste. Cantón de Liberia:** Parque Nacional de Guanacaste, Estación Cacao, 10° 55' 45"N, 85° 28' 15"W, 1100 m, 24 Nov 1990, *R. Espinoza 54* (K, MO); Cordillera de Guanacaste,

Estación Cacao, sendero a Estación Maritza, 10° 55' 43"N, 85° 28' 10"W, 1100 m, 15 Jul 1996, *José González et al. 1108* (K). **Cantón de La Cruz:** Parque Nacional de Guanacaste, Cordillera de Guanacaste, V. Orosí, Sector Orosí (antes Maritza), sendero Casa Fram. 10° 57' 40"N, 85° 29' 45"W, 600 m, 13 Jul 1994, *José González et al. 301* (MO [2 accessions]). **Puntarenas. Cantón de Puntarenas:** Reserva Biológica, Monteverde, Cordillera de Tilarán, Altos de San Luis, Los Leitones, 10° 17' 25"N, 84° 48' 10"W, 1200 m, 4 Sep 1991, *E. Bello 4014* (MO); sendero a la Catarata, por el río, sendero Miguel Leitón, 10° 16' 20"N, 84° 49' 30"W, 1100 m, 11 Mar 1993, *Zobeida Fuentes 248* (K, MO).

Distribution and Ecology.—As far as known, this tree is endemic to northwestern Costa Rica, where it occurs in the Cordillera de Tilarán and the Cordillera de Guanacaste, between 600 and 1200 m in elevation. Details concerning associated vegetation are mostly lacking on the collections from the Cordillera de Guanacaste, a drier and more seasonal mountain range than the Cordillera de Tilarán (Hammel et al. 2004). This species could be associated with deciduous forests of the region. The collections from Puntarenas come from the Pacific side of the Cordillera de Tilarán. Label data from one of the collections, *Bello 4014*, indicates that the tree was growing in *charral*, or young secondary forest (Kleinn et al. 2002). The other collection does not provide details about the associated vegetation. In a broad sense, the region of the occurrences in Puntarenas has been mapped as Costa Rican seasonal moist forests. These are deciduous forests that obtain 90% of their annual precipitation, (± 1500 mm total), during the months of April through October (World Wildlife Fund 2001). The formation of new leaves and male flowers apparently occur during March (only one flowering collection was examined).

Ethnobotany.—Known by the common name 'guacalillo' in Puntarenas, Costa Rica (*Fuentes 248*).

Etymology.—The epithet refers to the only country in which the species is currently known to occur.

This species is different from *D. conzattii* in several respects. First, it is a buttress-forming tree attaining 35 m in height; this is quite exceptional among *Diospyros* from Central America and Mexico. *Diospyros conzattii* is not known to reach over 10 m in height. The abaxial leaf venation is conspicuously brochidodromous, the lateral veins forming well defined secondary arches with the superadjacent lateral veins. Another interesting difference involves the distance from the outer-perimeter of secondary arches to the leaf margin, which is usually around 3–6 mm at about mid-leaf. This distance is 1–3 mm in *D. conzattii*. The marginal loops of *D. conzattii* often become difficult, but not impossible, to discern, hence the aforementioned distance is measurable. Some other vegetative differences useful for separating these species include yellowish to orange hairs on the adaxial midrib, and the converging adaxial lamina along the depressed midrib in *D. costaricensis*. The inflorescences of *D. conzattii* and *D. costaricensis* are clearly cymes, with peduncles around 6 mm and 4 mm long respectively.

5. Diospyros tuxtlensis M.C. Provance & A.C. Sanders, sp. nov. (**Fig. 5**). TYPE: MEXICO. VERACRUZ: Mpio. San Andrés Tuxtla, borde de la cima del Cerro Mastagaga, al N del Ejido Ruíz Cortinez, Sierra de los Tuxlas, 30 May 1985, *J.I. Calzada 11855* (HOLOTYPE: IEB-48870; ISOTYPE: XAL).

Arbor usque ad 10 m alta, *D. riojae* Gómez-Pompa similis sed differt foliis ellipticis et non glauciis, marginibus non crassis et inter paginas oppositas rotundatis; pedicellis abaxiale atropurpureis; sepalis fructiferis 26–40 mm longis, reflexissimis et com apicibus rectis; pedicellis fructiferis 14 mm longis.

Trees 8-10 m tall, probably facultatively deciduous; **aged stems** terete to subterete, ± glabrous, half-netted to squamose, dark-brown to grey-brown with beige, short-fissured *stem wood* yellowish to orange-brown; **2nd–3rd year stems** angular to subterete, glabrous, sulcate to shallow-fissured or half-netted, in combinations of dark-brown, gray, and orange-brown; **current year's stems** angular, smooth to finely sulcate, very cream to grey, shiny, lenticellate, glabrous to densely minute hirtellous, appressed off-white puberulent near apex, puncticulate. **Petioles** 4–7 mm long, glabrous, flat to slightly concave above, golden-brown, below widely rounded, glaucous-scintillant, dark-purple. **Leaves** alternate, simple, entire, pergamentaceous to chartaceous, ± elliptic, 8–15 cm long, 3–5(–5.8) cm wide, widest at or just above the middle, both sides very sparsely scintillant, but leaf surface dull golden-brown to bronze between individual scintillae, *apex* usually acuminate, the acumen long, narrow, obtusely rounded at the tip, *margin* flat with slight intramarginal thickening, *base* acuminate to attenuate, decurrent onto petiole; **lower leaf surface** sometimes sparingly appressed puberulent near base and midrib, conspicuously puncticulate; **upper leaf surface** glabrous, papillose. **Venation** arcolanguid to brochidodromous; **midrib** conspicuously flat and wide below, sulcate, purplish basally, becoming orange-red to golden-brown and somewhat keeled apically, sometimes sparsely appressed puberulent, glaucous, shallowly concave above, glabrous, not darkened; **2° venation** raised above, obscure, *lateral veins* 8–9 pairs, shiny, chartreuse to golden-brown and conspicuous; **3° venation** obscure below, granular-papillose, apparent above. **Laminar extrafloral nectaries** abaxial, common, sometimes along 2° veins, rimmed with the same bright color seen in 2° veins **Male inflorescence** unknown. **Female inflorescence** flowers solitary, emerging at the junction of old and new growth. **Fruiting pedicels** stout, 14 mm long, 3 mm wide, wavy-rugose, minutely fissured, lenticellate, black and tan mottled. **Fruiting calyx** with lobes and distal portion of tube strongly reflexed, sinuses rounded; **fruiting calyx tube** exterior sparsely appressed puberulent; **fruiting sepals** 5, very accrescent, 26–40 mm long, 7.5–11 mm wide, ovate to widely lanceolate, narrowed basally, apex acutely pointed, sometimes rounded, sepals glabrous, golden-brown, sepal nerves distinct. **Fruit** berry, depressed-globose, up to 4 cm tall, 4.5 cm in wide, atropurpureous, number of locules indiscernible; **mesocarp** dark-brown in live material and in immature fruits of herbarium material; **hypodermis** ± 0.5 mm thick, sclereidic; **epidermis**

Fig. 5. *Diospyros tuxtlensis* M.C. Provance & A.C. Sanders, sp. nov. Fruiting branch. Based on *J.I. Calzada 11855*.

glaucous-scintillant, wrinkled. **Seeds** immature, sizes indiscernible (broken seeds only), dark reddish brown, granulate to minutely ruminate (sensu Stearn 2000, fig. 38).

Paratypes: **Mexico. Veracruz. Mpio. San Andrés Tuxtla:** senda para el Cerro Baxin, al N de San Andrés Tuxtla, Sierra de Los Tuxtlas, 6 Mar 1985, *J.I. Calzada 11929* (IEB, XAL). **Mpio. Soteapan:** Ejido Santa Marta camino a la Ventana, 18° 22'N, 94° 54'W, 920 m, 19 Sep 1986, *R. Acosta P. & C. González R. 1312* (LSU, XAL).

Distribution and Ecology.—Apparently endemic to the Sierra de Los Tuxtlas,

Veracruz, Mexico. Only one elevation recorded, 920 m (*R. Acosta P. & C. González R. 1312*). The associated vegetation types for the known collections have included primary selva mediana perennifolia, selva baja perennifolia, and deciduous forest. It was considered common in selva baja perennifolia with elements of deciduous forest (*Calzada 11855*).

Ethnobotany.—A common name has not been reported, but since the fruits are likely to be edible, the species may be well-known to local residents. The species may eventually be found as a conserved tree near homes or pastures.

Etymology.—The epithet refers to Sierra de Los Tuxlas, Veracruz, Mexico, from where the only collections of this species have been made.

SPECIES OF UNCERTAIN STATUS

Diospyros pergamentacea Lundell, Contr. Univ. Michigan Herb. 7:44. 1942. TYPE. MEXICO. CHIAPAS: Pico de Loro, near Escuintla, in advanced forest, 2200 m, 25 Jun 1941, *Eizi Matuda 4278* (HOLOTYPE: MICH not seen; ISOTYPES: photo A!, photo CAS! (sterile), photo F!, IT not seen, photo LL-372460!, MO-1213673!, US-1849013!).

A redescription of this taxon did not seem appropriate, given that there are no new specimens. We do not think we can add much to the work of Lundell. Overall, this species looks quite similar to *D. conzattii*, with which some authors have considered it conspecific[3]. This species is known only from the type specimen, collected on Pico de Loro, near Escuintla, Chiapas. The petioles are very long and flexuous, reported to be up to 15 mm long by Lundell (1942). There also seem to be differences in the sepals, they being strongly reflexed, and having a shape that is suggestive of some populations of *D. rosei* sensu lato. In fact, these differences are significant enough that we are not entirely convinced that it is synonymous with *D. conzattii*. The leaves of the isotypes we examined had a thin coating of clear glue on much of their surface, which may obscure some characters. We recommend re-evaluating the taxonomic status of this taxon when additional material from the Chiapas-Guatemala borderland becomes available. For the time being, we do not recommend reduction to synonymy with *D. conzattii*.

DISCUSSION

Neither the holotype nor the two isotypes of *D. riojae* were available for a first-hand examination. Unfortunately, there are no paratypes for *D. riojae*, *D. conzattii*, or *D. pergamentacea*. Microfiche of an isotype and the detailed description of *D. riojae* by Gomez-Pompa (1964) were valuable in completing this paper. The original description made use of tables and text in contrasting differences between *D. riojae* and *D. conzattii*. Additionally, it was supplemented

[3]For example: A. Gomez-Pompa (1964); F. White in 1968 and C. Whitefoord & S. Knapp in 1996, in both cases by annotation of the isotypes.

with an illustration prepared from the original collection (Gomez-Pompa, pers. comm.). The illustration is consistent with the type description, and the isotype at US, and in accordance with the *Code*, Article 9.2: Note 2 (Greuter et al. 2000), the illustration in the protologue represents original material.

Because fruiting *D. riojae* material keys to *D. conzattii* in Standley's treatment of *Diospyros* of Mexico (1924), Gomez-Pompa (1964) provided a table of leaf and fruit characters that could be used to separate these taxa. Admittedly, some of these characters overlap to some degree. When it is considered that Gomez-Pompa had one fruiting collection of *D. riojae*, one fruiting collection of *D. pergamentacea*, and probably only one collection of *D. conzattii* to examine, it is to his credit that the characters he emphasized are often still useful for separating these taxa. We have provided an updated character table (Table 1) that should be helpful in the differentiation of the three new species described here.

Redetermination of the available material resulted in roughly a 70% reduction in the number of documented occurrences of *D. riojae* from what might have been reported based on an uncritical review of locations based on herbarium material. At the least, this constitutes a reaffirmation of the rarity of this species. The realization that *D. conzattii* is an element of the Veracruz flora is very interesting. As far as we can tell, these are the first reports of the species for Veracruz. Material from the Cordillera de Guanacaste, and the Cordillera de Tilarán, Costa Rica, represents a distinct new species, *D. costaricensis*. The discovery of a new species, *Diospyros tuxtlensis*, from the Sierra de Los Tuxtlas does not come as a shock, since this region is renowned for having numerous endemic species of plants and animals. The distributions of the closely allied taxa, *D. tuxtlensis* and *D. costaricensis*, are notable in light of some recent interest in Los Tuxtlas-Costa Rica disjunctions (Hammel 1997). In addition to occurring in native stands of vegetation, individuals of this taxon should be sought as conserved trees in local gardens and pastures. This taxon seems to be a rare endemic of the Sierra de Los Tuxtlas, and could be in need of formal protection.

We have not seen female flowers of any of these species. The only description of a female flower that we have seen in the literature is by Carranza (2000) and refers to material from Queretaro (*D. gomeziorum*). The lack of flowering Ebenaceae material in herbaria, as pointed out by Gomez-Pompa (1964) and Wallnöfer (2001), and clearly demonstrated by our sample, makes searching for taxonomically informative vegetative characters a particularly attractive proposal (Gomez-Pompa 1964). Below we provide a key to the species described in this paper that emphasizes vegetative characters. Male flower and inflorescence characters (Table 2) can be used to supplement the following key if desired. It should be noted that *D. tuxtlensis* is not treated in Table 2, since flowering material is not currently known.

TABLE 1. Vegetative and fruiting morphology across the described taxa.

	gomeziorum	costaricensis	conzattii	riojae	tuxtlensis
Life form and size	Trees or shrubs to 20 m tall	Buttressed trees to 35 m tall	Trees or shrubs, 8–10 m tall	Trees, rarely shrubs, to 25 m tall	Trees, 8–10 m tall
Leaf shape	lanceolate to ovate to elliptic	ovate to elliptic, rarely widely-obovate	lanceolate to elliptic to ovate	elliptic, oblong, obovate, or nearly oval	elliptic
Leaf margin	beveled, sometimes ciliolate, not thickened	curved under near base, not thickened	curved under near base, intramarginal thickening	slightly recurved, thickened, sometimes ciliolate	flat, slight intramarginal thickening
Leaf luster (both sides)	shiny	dull	dull	shiny	dull
Leaf vestiture below	glabrous to sparsely subappressed hairy	sparsely appressed hairy, sometimes glandular	usually glabrous, very rarely glandular	glabrous	glabrous to sparingly appressed puberulent
Leaf bloom above	glaucous to pruinose-scintillant	very rarely glaucous-scintillant	glaucous	sometimes slightly pruinose or scintillant	slightly scintillant
Epidermal cells of lamina above	not large and not thickened	not large and not thickened	not large and not thickened	large and thickened	somewhat large and thickened
Epidermal cells of lamina below	puncticulate	puncticulate	puncticulate	puncticulate	conspicuously puncticulate
Midrib vestiture above	sparsely to densely hirtellous to deltoid scaly	glabrous to golden hirtellous	very sparsely hirtellous	glabrous, sometimes sparingly glandular	glabrous
Midrib topography above	narrowly caniculate	shallowly concave	caniculate, sometimes raised	shallowly concave	shallowly concave
Number of major lateral veins	(8–)11–13(–14)	9–12	9–14	8–12	8–9
Emergences on venation above	2°–3° granular papillose	none	none	2°–3° granular papillose	3° granular papillose
Petiole color above	yellow-green to olive-green	nearly black	pale green to green-brown	light green to chartreuse to amber	golden-brown

TABLE 1. continued

	gomeziorum	costaricensis	conzattii	riojae	tuxtlensis
Petiole color below	olive-green to dark brown, glistening	light olive-green to very dark brown	pale green to green-brown	light green to chartreuse to amber	dark purple
Fruiting calyx posture	spreading	spreading to moderately reflexed	spreading to slightly reflexed	arcuate-reflexed to spreading	strongly reflexed
Fruiting sepal apices	apices ascending	apices straight to quite incurved	apices straight	apices incurved to ascending	apices straight
Fruiting sepal length	19–20 mm long	(16–)22 mm long	24–31 mm long	7–25 mm long	26–40 mm long
Fruiting sepal shape	lanceolate to narrowly elliptic or obovate	lorate to lanceolate	narrow to linear triangular	oblong, narrowly deltoid or ovate	ovate to widely lanceolate
Fruiting pedicels	(4)5–8(–11) mm long, not stout	3–18 mm long, stout	(7–)12–15 mm long, stout	7–12 mm long, stout	14 mm long, stout
Fruit hypodermis	thin	thick	intermediate	thick	thick

TABLE 2. Reproductive morphology of four similar taxa from Mexico and Costa Rica.

	Diospyros gomeziorum	Diospyros costaricensis	Diospyros conzattii	Diospyros riojae
Male inflorescence	fascicles on previous year's growth, solitary on new growth	cymes from previous year's growth, cymes from new growth	cymes from previous year's growth, cymes from new growth	fascicles from previous year's growth, fascicles from new growth
Male corolla tube shape	urceolate-campanulate	long-urceolate	long-urceolate	urceolate-campanulate
Male corolla tube interior vestiture	sparingly hirtellous, hairs sometime erratic	lower-third of tube short golden pubescent, hair direction erratic	sparsely puberulent, densest from mid-tube to tube bottom	deltoid scaly at mid-tube
Stamens	20	17–19	30	18
Anthers	2 mm long, oblong-ovate to ovate, minutely granular, short slits near apex	2.3–2.5 mm long, several minute hairs at apex, short lateral slits in distal 2/3 to 1/2	3–3.5 mm long, lanceolate, apiculate, short lateral slits near apex	± 2.5 mm long, lance-ovate, constricted near the apex
Filaments	0.3–0.8 mm long, ascending-puberulent	1–1.5 mm long, glabrous to densely erect hispidulous	3 mm long, minutely hairy	1 mm long, hirtellous, especially along margin

A KEY TO *DIOSPYROS RIOJAE*, *DIOSPYROS CONZATTII* AND SOME ALLIED BLACK ZAPOTES

1. Leaves dull, laxly revolute (loosely rolled under) near the base of the leaf; neither the 2° nor the 3° upper leaf surface venation granular papillose.
   2. Buttressed trees up to 35 m tall and 1.5 m in diameter; petiole color above nearly black; leaf margin or intramarginal zone not thickened (viewing bottom surface); midrib above shallowly, and often widely, concave, or crimped lengthwise by the adjacent sides of the lamina (boxed in); midrib glabrous to golden hirtellous; currently known only from Costa Rica _____ **4. Diospyros costaricensis**
   2. Trees or shrubs, 8–10 m tall, lacking buttresses as far as known; petiole color above pale green to green-brown; leaf margin or intramarginal zone thickened (on bottom surface); midrib above narrowly caniculate, the canal(s) raised or ± even with the lamina; midrib very sparsely hirtellous; currently known only from Veracruz, Oaxaca, and possibly from Chiapas _____ **3. Diospyros conzattii**
1. Leaves shiny or dull, margins flat or sometimes subrevolute, but never loosely rolled under near the base; 2° or 3° venation, or both, usually granular papillose on upper leaf surface.
   3. Leaf margin beveled outward from the upper leaf surface, down to the lower leaf surface; epidermal cells of the upper lamina surface not large and conspicuous with thickened anticlinal cell walls; leaves often copiously glaucous-pruinose; fruiting calyx spreading, fruiting sepals with ascending apices; fruiting pedicels generally slender _____ **2. Diospyros gomeziorum**
   3. Leaf margin never beveled; epidermal cells of the upper lamina surface large and conspicuous, having thickened anticlinal cell walls; leaves sometimes somewhat pruinose or scintillant, but never with copious bloom; fruiting calyx spreading to strongly reflexed, apices various; fruiting pedicels very stout
      4. Leaves shiny, often tending towards oblong, oval or obovate, but may also be elliptic; leaf margins thickened, rounded from the top leaf surface to the bottom; petiole color below light green to chartreuse or amber; fruiting sepals 7–25 mm long, spreading to arcuate-reflexed, the apices incurved to ascending; fruiting pedicels 7–12 mm long _____ **1. Diospyros riojae**
      4. Leaves dull, elliptic; leaf margins flat or with a slight intramarginal thickening visible on the bottom surface; petiole dark purple below; fruiting sepals 26–40 mm long, strongly reflexed, the apices straight; fruiting pedicels 14 mm long _____ **5. Diospyros tuxtlensis**

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