Hammel, B.E. 2015. Three new species of *Pentagonia* (Rubiaceae) from southern Central America, one foreseen, two surprising. Phytoneuron 2015-46: 1–13. Published 11 August 2015. ISSN 2153 733X

THREE NEW SPECIES OF *PENTAGONIA* (RUBIACEAE) FROM SOUTHERN CENTRAL AMERICA, ONE FORESEEN, TWO SURPRISING

BARRY E. HAMMEL
Missouri Botanical Garden
P. O. Box 299
St. Louis, Missouri 63166-0299
barry.hammel@mobot.org

ABSTRACT

The species presented as "*Pentagonia* sp. A" in the recently published Vol. VII of *Manual de Plantas de Costa Rica* is here described as **Pentagonia gomez-lauritoi** Hammel, **sp. nov.** Two additional new species, also from Costa Rica, discovered and fully characterized too recently for inclusion in that volume, are described as well. The latter two are surprising not only for their untimely discovery but also for their unusual leaf morphology. Simple, entire leaves are the rule in Rubiaceae, with *Pentagonia* the one genus where species with pinnately lobed leaves have been described. Until now just 2 out of the 10 species known from Costa Rica (4 out of 15 in *Flora Mesoamericana*) had lobed leaves; **Pentagonia gambagam** Hammel & Aguilar, **sp. nov.**, adds a third. The other new species, **Pentagonia osapinnata** Aguilar, N. Zamora, & Hammel, **sp. nov.**, was at the time of its discovery little short of astounding, as it has pinnately compound leaves, which had not been described for the family.

RESUMEN

La especie presentada como "*Pentagonia* sp. A" en el recientemente publicado Vol. VII del *Manual de Plantas de Costa Rica* se describe aquí como *P. gomez-lauritoi*. Se describe dos especies adicionales, también de Costa Rica, descubiertas y caracterizadas tarde para incluirlas en dicho volumen. Estas dos últimas sorprenden, no solo por su reciente descubrimiento, sino también por la morfología inusual de sus hojas. Las hojas simples y enteras son la regla general en Rubiaceae, *Pentagonia* siendo el único género donde se ha descrito especies con hojas pinnadamente lobuladas. Hasta el momento se conocía solo dos especies (de las diez conocidas) con hojas lobuladas en Costa Rica (cuatro de 15 en *Flora Mesoaméricana*); *P. gambaga*m figura como la tercera. La otra especie nueva, *P. osapinnata*, en el momento de su descubrimiento fue simplemente asomobrosa, ya que tiene hojas pinnadamente compuestas, lo cual no se había descrito para la familia.

Pentagonia Benth. has not been revised in 100 years, during which time the number of recognized species has more than tripled; Standley (1914a) described five new species and recognized a total of eleven in his revision (as *Watsonamra*). Including *Nothophlebia costaricensis* Standl., described in the same volume (Standley 1914b) and subsequently transferred to *Pentagonia*, a total of 12 species were known at the time. Including the three described here, approximately 40 species (12 in Costa Rica, 18 in Mesoamerica) are currently recognized and the genus is in dire need of a thorough revision with careful field work (Rova & Andersson 1995; Taylor 2012). The genus is easily recognized vegetatively by virtue of its frequently unbranched, subshrub to arborescent growth form with the leaves clustered towards the stem apex, its large, entire and strongly carinate, interpetiolar stipules, its usually rather large leaf blades (10 up to at least 200 cm long), and especially by the leaf surfaces distinctly and closely striate with fine epidermal fibers. The calyx tube usually has adaxial patches or lines of glands at or below the sinuses of the lobes. See also Rova and Andersson (1995) and Taylor (2002). It is the only genus of Rubiaceae with any species whose normal, mature leaves are pinnately lobed to deeply pinnatifid. In the New World, occasional individuals of some species of *Simira* may have pinnatifid leaves (Taylor 2002) and a few species of *Cruckshanksia* have leaves deeply and digitately 2 or 3 lobed (see Taylor 1996).

Contrary to what has sometimes been suggested elsewhere [cf. notes under *Pentagonia donnell-smithii* (Standl.) Standl. in Taylor 2012; Taylor & Hammel 2014] field work at La Selva research station and throughout Costa Rica demonstrates habit type to be quite constant within species of *Pentagonia* (see also Taylor 2002). Just three [*P. costaricensis* (Standl.) W.C. Burger & C.M. Taylor, *P. nuciformis* Dwyer, and *P. osaensis* C.M. Taylor] of the 12 species now known from Costa Rica are typically much-branched trees up to 18 meters tall. All the others are treelets mostly less than 8 meters tall and usually monopodial. Of these latter, an occasional small plant may be somewhat branched from near the base, but otherwise in my experience any indicated habit outside these norms has been due to incorrect identification to species or a probable label mix-up.

PENTAGONIA GAMBAGAM Hammel & Aguilar, **sp. nov. TYPE: COSTA RICA. Puntarenas.** Cantón de Golfito, Corredor Biológico la Gamba, Santuario Gambagam, 8°41' N, 83°11' W, 110 m, 28 Apr 2014 (fl, fr), *B. Hammel, R. Aguilar,* and *I. Pérez 26730* (holotype: CR; isotypes: MO, GB). Figure 1.

Similar to *Pentagonia macrophylla* by its reddish and bracteate inflorescence, its petiolate leaves, and its narrowly funnelform, trumpet-shaped corolla but differing markedly by its lobed leaf blades, more shallowly lobed calyx, and often greenish, totally glabrous corolla. It is also similar to the locally sympatric *P. wendlandii*, which has sessile or subsessile and entire leaves as well as a tubular and densely tomentulose corolla. The new species has leaves that are much more shallowly lobed than those of all other *Pentagonia* species in the region with lobed leaves.

Shrub or small tree 4–8 m, unbranched; stems blackish brown, matte. **Stipules** reddish, 5–9 × 1.5–4.5 cm, ± ovate to deltate, acute to acuminate, coriaceous, abaxially and densely strigulose, adaxially glabrous. **Leaves** simple; petiole reddish green at the very base, to ca. 10 cm; blade 78–96 × 66–74 cm, spatulate to pandurate, basally truncate to more often shallowly cordate, rarely obtuse (often bullate between the basal secondary nerves), ± coriaceous, dull on both surfaces, densely and minutely strigulose on the main nerves abaxially, glabrous adaxially, pinnately lobed (1/3–2/3 the way to the midrib), and with 15–18 principal secondary veins per side (the ones feeding the lobes somewhat thicker than the rest), the lobes 4 or 5(–7) per side, 8–27 × 11–16 cm [the sinus ca. (4–)8–12 cm from the midrib]. **Inflorescences** subsessile, glomerate; **bracts** reddish, to at least 30 × 16 mm, ovate, sparsely strigulose to glabrescent; flowers to at least 20, sessile or with pedicel to ca. 2 mm; hypanthium 5–7 mm, ± funnelform, densely strigulose; **calyx** limb reddish, 15–20 mm, coriaceous, basally and sparsely strigulose, apically glabrous, somewhat irregularly 5-lobed, the lobes imbricate, 5–7 mm, ± ovate to obovate, apically obtuse to rounded, the **glands** in lines 4–5 mm, from ca. mid tube downward; **corolla** green or greenish yellow to cream colored, 35–40[–55] mm, narrowly funnelform, trumpet-shaped, the tube basally 2–4[7] mm wide, apically 4–6[11] mm wide, straight to sometimes slightly curved at the base, internally pilosulose at the insertion of the filaments and pilosulose to strigulose upward to ca. 6 mm, otherwise glabrous inside and out, 5-lobed, the lobes 4–5[5–8] mm, triangular, marginally granulose puberulent except pilosulose at the very tip; stamens with the filament ca. 13 [15] mm, inserted at ca. 10 mm above the base of the tube, apically curved just below the anther (in life), basally pilosulose, the anthers ca. 3 mm, in life held perpendicular to the major portion of the filament and held at the same level or slightly above the stigma; style ca. 23 mm. **Fruits** reddish, 2.5–3.5 cm subglobose to ellipsoid, densely to sparsely strigulose and markedly pustulose-warty. Measurements in square brackets [ ] are from fresh or EtOH preserved material.

Flowering Apr, Jun; fruiting Apr. At edge and in clearings of wet forest, 110 m elev.; Costa Rica (Prov. Puntarenas), Fila Gamba.

Additional material examined. **COSTA RICA. Puntarenas:** Cantón de Golfito, Corredor Biológico la Gamba, Santuario Gambagam, 8°41' N, 83°11' W, 110 m, 2 Jun 2013 (fl), *Aguilar 14395* (photos; see <https://www.flickr.com/search/?q=RA%2314395>).

Etymology. This species is named (by a noun in apposition) for the Santuario Gambagam, its type and only known locality.

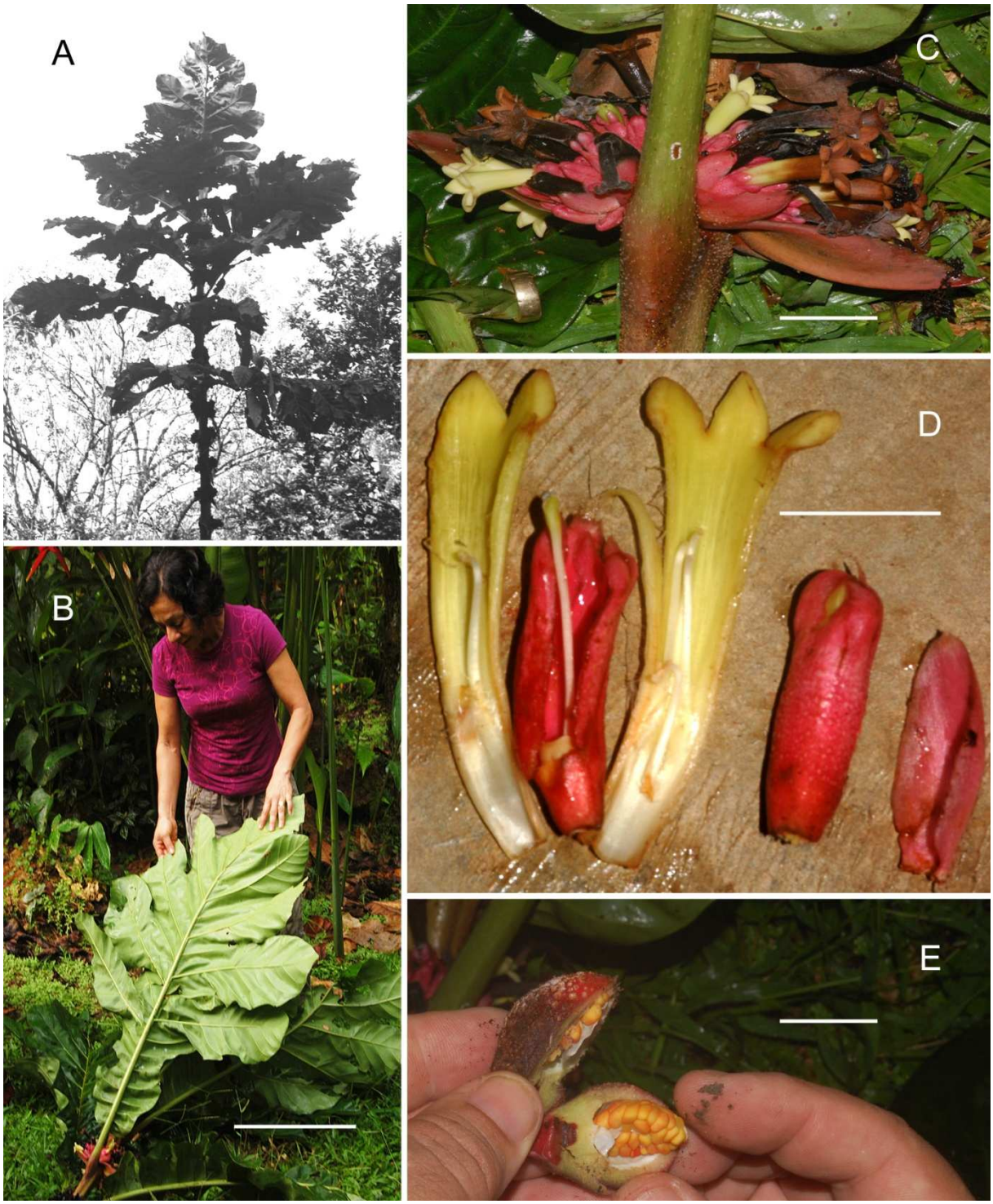

Figure 1. *Pentagonia gambagam.* A. habit. B. Specimen before pressing, with leaf (showing lower surface), stem and inflorescence. C. Inflorescence; D. Flower showing corolla split (on each side of the flower from which removed), flower bud, and associated bract. E. fruit split open. Scale bars: B=20 cm, C=4 cm, D & E=2 cm. All from *Hammel et al. 26730*.

Figure 2. *Pentagonia macrophylla*. Inflorescence from *Hammel et al. 26294* (MO).

Figure 3. *Pentagonia wendlandii.* Inflorescence from *Hammel et al. 26733* (CR).

Figure 4. *Pentagonia lobata*. Inflorescence from *Hammel et al. 26114* (CR).

Because of its monopodial habit, large, petiolate leaves, reddish inflorescence with reddish, relatively large bracts, and funnelform, trumpet-shaped flowers, this species on first impression seemed to be an odd version of *Pentagonia macrophylla* Benth. with lobed leaves. However, closer examination prevented us from leaving it lie as that. In any case, the taxonomy we follow here, that of Taylor 1995, 2002, 2012 and Taylor & Hammel 2014) gives considerable weight to lobate vs. entire leaves as an indicator of speciation. Armed with that consideration, we find that the more shallowly lobed calyx (ca. 1/3 vs. 3/4 to completely), the often greenish and externally glabrous (vs. white to cream-colored and densely strigose-tomentulose) corolla along with the lobate leaves clearly distinguish *P. gambagam* from *P. macrophylla*. We should note that while the corolla of *P. macrophylla* flowers has sometimes been described as simply "tubular" (e.g., Taylor 2012), examination of live material and photos of that species demonstrate that it is narrowly funnelform with patent lobes (see Fig. 2), very much as that of *P. gambagam*. The total population we found of *P. gambagam* (ca. ten individuals) occurs only in and at the edges of the clearing surrounding the Gambagam station and its dwellings. Several hours of hiking in forest close-by, revealed only *P. lobata* C.M. Taylor and *P. wendlandii* Hook. as locally sympatric. The latter was also flowering at the time, and was found along streams as well as in the same clearing. We note that the corollas of *P. wendlandii* in this area are cream-colored and more decidedly tubular, with the tube little or not at all expanded towards the apex, and the lobes erect or only slightly spreading (see Fig. 3). In material of *P. wendlandii* from Panama the corollas—usually described on labels simply as yellow—may be externally nearly glabrous to sparsely strigulose or subtomentulose, with the trichomes becoming denser towards the apex, whereas in this population we found them to be densely tomentulose throughout. The flowers of *P. lobata*, on the other hand, have a greenish corolla that is broadly funnelform and glabrous externally, with suberect to ± patent lobes (Fig. 4). The same is true for *P. gymnopoda* (Standl.) Standl. and *P. tinajita* Seem., two other lobate-leaved species from Mesoamerica. The fourth species (*P. pinnatifida* Seem.) with lobed leaves known from the region is

very distinctive for its basally auriculate leaves and flowers with a red corolla. *Pentagonia gambagam* differs from all four of those by its much more shallowly lobed leaves (the sinus no less than 8–12 vs. no more than 4 cm from the midrib). We have also examined material or images and/or protologues of all the other species of *Pentagonia* with lobed leaves and found none a good match to this material.

Due to its highly restricted distribution in disturbed habitat and also because of certain morphological characters, *Pentagonia gambagam* might be speculated to be of hybrid origin, with the two-mentioned sympatric species as parents. It does produce fruits with what appear to be viable seeds. In common *with P. lobata*, *P. gambagam* has lobed leaves (though less-deeply so and with wider lobes) and a greenish, externally glabrous corolla. With *P. wendlandii* it shares the reddish stipules and petiole bases, a relatively short petiole (compared to *P. lobata*), basally bullate leaf blades, reddish inflorescences, and a non-spatulate, 5-lobed calyx (although some of the flowers do appear to have the calyx limb ± deeply split along one of the sinuses). All three species have a monopodial habit. Numerous other species of *Pentagonia* also appear to have highly restricted ranges (see e.g., *P. osapinnata* below).

PENTAGONIA GOMEZ-LAURITOI Hammel, **sp. nov. TYPE: COSTA RICA. Limón.** Cantón de Talamanca, 3 km Oeste de Volio (Uatsi), 09°37.7' N, 82°54' W, 100 m, 6 May 1990 (fl) *J. Gómez-Laurito & G. Vargas 11958* (holotype: CR). Figure 5.

Differing from all other species of *Pentagonia* known to me by its ferrugineous and often matted, fibrillose indument, very large leaves that are glossy on the upper surface, ebracteate inflorescences, and especially by the yellowish claviform trichomes on the exterior of its densely tomentulose corrolla.

Shrub or treelet, 2–6 m, unbranched or rarely with several main branches (from low down); stems brownish to slightly copper-colored, often somewhat pustulose. **Stipules** (3.5–)5–7 cm. **Leaves** sessile or with a petiole 1–4 cm; blades (37–)71–127(–140?) × (19–)28–56 cm, obovate or (more often) oblanceolate, acute to narrowly rounded or auriculate at the base, entire, sparsely to densely ferrugineous fibrillose to soon glabrescent abaxially, glabrous and sometimes described on labels as glossy adaxially with 15–20 secondary veins per side. **Inflorescences** sessile or with a peduncle to ca. 2 cm, subcapitate to congested–cymose, 1–8 cm; **bracts** apparently lacking (but sometimes with abortive inflorescence branches or flowers 3–11 mm that may resemble bracts). Flowers to ca. 25, with a pedicel to ca. 1–8 mm; hypanthium 3--8 mm, ± cylindrical, densely fibrillose and pilosulose; **calyx** limb reddish to red, 12–20 mm, coriaceous, densely fibrillose basally to glabrescent apically (externally), ± regularly 5–lobed, the lobes imbricate, 3–12 mm, elliptic or ligulate, rounded at the apex, the **glands** sparsely clustered in patches starting ca. mid tube; **corolla** white to cream colored or yellow, the tube 27–35 mm, trumpet-shaped, densely tomentulose externally (with claviform trichomes), the lobes (4–)6–8 mm. **Fruits** red, reddish green or brownish red, 2.5–4 × 2–3.5 cm, ellipsoide or ovoid to rarely subglobose.

Flowering Apr–Jun, Nov; fruiting Jan, Mar, May–Aug, Oct, Nov. Moist or wet primary forest, and stream edges, 0–250(–500+) m; Caribbean slope of Costa Rica and Panama.

Additional material examined. **COSTA RICA. Limón:** Cantón de Limón, propiedad de Selva Bananito Lodge, 09°49' N, 83°04' W, 23 Mar 2010 (bud, label says fruits) *Monro et al. 6579* (CR); 50–100 m, 24 Mar 2001 (bud) *Morales 7733* (CR); 12 Apr 2011 (bud) *Sánchez et al. 2296* (CR); R.B. Hitoy Cerere, 09°40' N, 83°01.5' W, 27 Jun 2000 (fl) *Acosta 1888* (CR); 24 Jun 1996 (fl) *Rodríguez & González 3562* (CR); 12 May 1999 (fl) *Rodríguez et al. 4904* (CR); 17 Jun 1997 (fr) *Soto & Rodríguez 45* (CR); Hitoy Cerere, Quebrada Cunabrí, Jul 1984 (fr) *Gómez 24065* (MO); Cantón de Talamanca, P.N. Cahuita, 09°43' N, 82°49' W, 7 May 2009 (bud, fr) *Vargas et al. 3741*

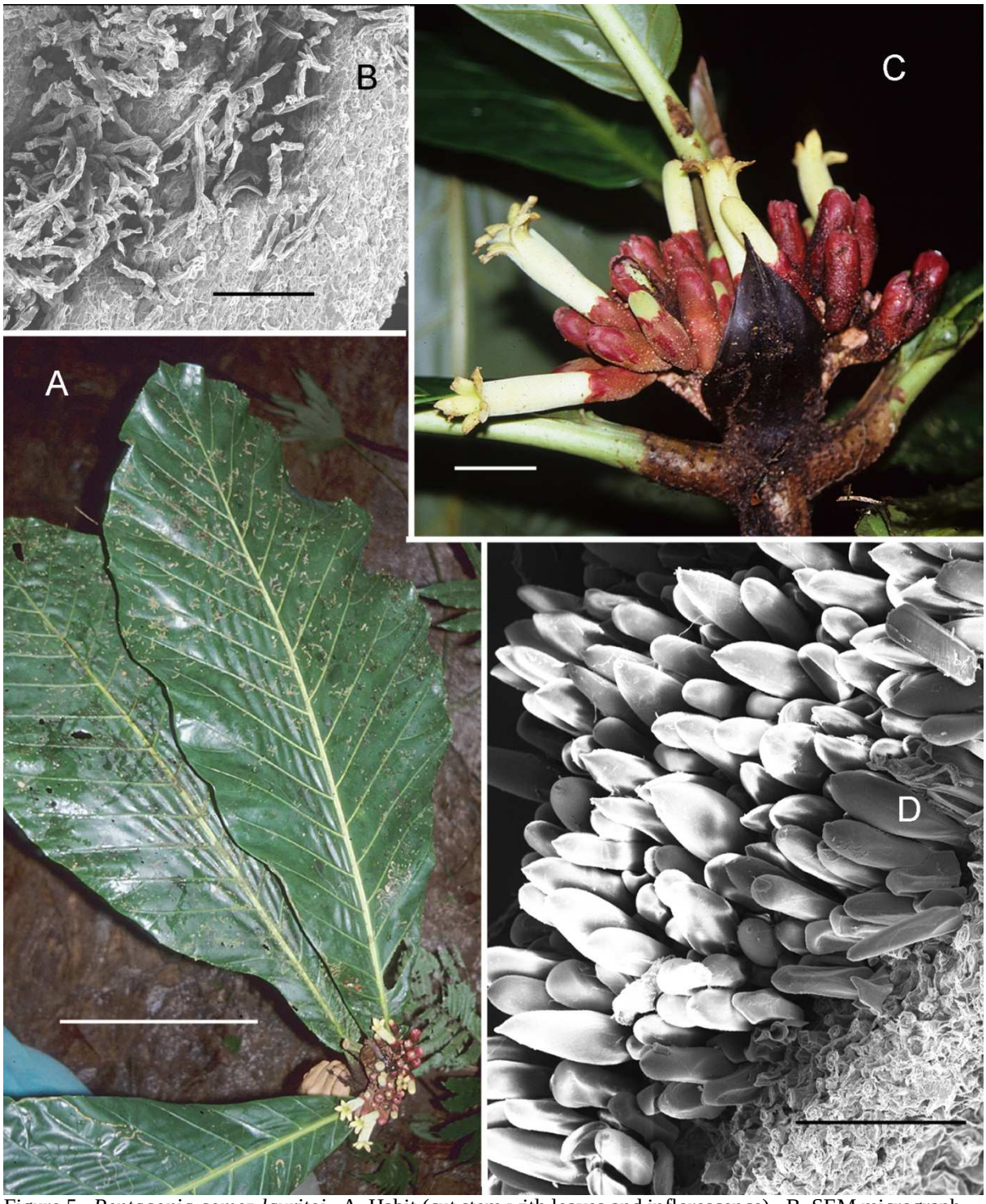

Figure 5. *Pentagonia gomez-lauritoi*. A. Habit (cut stem with leaves and inflorescence). B. SEM micrograph of fibrillose indument (calyx). C. Inflorescence. D. SEM micrograph of clavate trichomes on outside of corolla. Scale bars: A=20 cm, B & D=0.2 mm, C=2 cm. A & C from *Rodríguez & González 3527*, B & D from *Stapf & Toribio 614*.

(CR); R.V.S. Gandoca-Manzanillo, 09°36' N, 82°36.3' W, 5 Oct 2000 (fr) *Acosta et al. 2872* (CR×2); San Miguel, ASACODE, 9°34' N, 82°40' W, 23 Jan 1997 (fr) *González et al. 1744* (CR); hills between headwaters of Quebrada Mata de Limón and upper branches of Quebrada Tigre, Finca Anai,

09°34' N, 82°40' W, 18 Nov 1984 (fr), *Grayum et al. 4475*, (MO); 12 Mar 1999 (bud, fr) *Hammel 21930* (CR×2, MO); catarrata del Río Sand Box, 29 Nov 1978 (fl) *Gómez-Laurito 4261* (USJ); aguas arriba del Río Sand Box, 17 Jul 1982 (fr) *Gómez-Laurito 8779* (CR); 23 Apr 1983 (fl fide label, but specimen has leaves only), *Gómez-Laurito 9321* (CR); Amubri, camino entre Amubri y Soki, 09°30' N, 82°59' W, 30 Jun 1989 (fl) *Herrera 3092* (CR); 4.5 km Fahrkilomerter Sudostlich vo Shiroles an der linken Seite des Río Telire, 2 May 1992 (fl), *Döbbeler 5132*, USJ; along Río Sixaola, 0.9 mi SW of Bambu [Bratsi], 5.5 mi SW of Bribrí, 12 Aug 1977 (fr) *Croat 43294* (MO). **PANAMÁ. Bocas del Toro**: Boca de Drago, finca Rosemary, 15 km de STRI., 09°25.5´ N, 82°13.3' W, 22 Apr 2009 (fl), *Stapf & Toribio 614*, (MO, SCZ); Forest above RR stop at Milla 7.5, 26 Jul 1971 (fr), *Croat & Porter 16254* (MO).

Etymology. This species is named in memory of Costa Rican botanist, friend and colleague Jorge Gomez-Laurito (see Hammel et al. 2015), who because of his numerous trips to the Baja Talamanca region, has made more collections of the species than anyone else. Gomez-Laurito made many important collections of plants in many families from out-of-the way sites and unusual habitats throughout Costa Rica.

Pentagonia gomez-lauritoi is distinctive for its sparsely to densely ferrugineous fibrillose but soon glabrescent stems and leaves, sometimes enormous and usually oblanceolate leaf blades that are apparently glossy on the adaxial surface, ebracteate and congested inflorescences, and corollas with the tube densely tomentulose on the outside with unusual yellowish and claviform trichomes. The trichomes on corollas of all other species of *Pentagonia* from Central America are acicular. The calyx limb is notably persistent in fruit, with the lobes about as long as the tube. Because of its sessile to shortly petiolate leaves the material described here has been mistaken for *P. wendlandii*, however it lacks the large [(10–20)–30 mm], reddish inflorescence bracts that help to characterize the latter species. Also, the young leaves and branches, the stipules and the inflorescence are beset with a distinctive reddish brown, often tightly matted, fibrillose indument, not seen in any other species. The indument on vegetative parts of *P. wendlandii* is of whitish to yellowish ± appressed to suberect (not fibrillose) trichomes and those of the corola tube are acicular, not club-shaped. In describing *P. wendlandii* Hooker (1861) considered the position of the glands of the calyx tube significant; basal in his new species, compared to the only other species known at the time *P. macrophylla*, where they are apical on the calyx tube, in patches at the sinus of the lobes. This character has not subsequently been given much attention, and may or may not be of taxonomic significance. Curiously, in all the material of *P. wendlandii* I have examined for this character, the glands are in the same postion as those of *P. macrophylla* (in patches at or just below the sinuses of the lobes), as they are in *P. donnell-smithii* and *P. nuciformis*. In the present new species they are clustered in patches at the middle of the tube. In the remaining Costa Rican species I have found glands distributed as follows: *P. costaricensis* (just above middle of tube), *P. hirsuta* Standl. (very sparse, ephemeral, below middle of tube, best or only seen in flower bud), *P. lobata* (in lines ca. middle of tube), *P. tinajita* (in patches or lines about middle of tube, sometimes beginning near sinuses). In no case did I find glands restricted to the very base of the calyx tube as described and illustrated for *P. wendlandii*.

For its (usually) monopodial growth habit, congested inflorescence and lack of inflorescence bracts this new species is comparable to the sympatric *P. donnell-smithii* [with green inflorescence bracts to only ca. 3(–8) mm], which differs—in addition to lacking fibrillose indument of stems, leaves and inflorescences as well as claviform corolla trichomes—by its often much longer petioles [(1.5–)3–15 cm] and by its strigulose pubescence present throughout the plant, present only, if at all, in the inflorescences of the new species. *Pentagonia gomez-lauritoi* can also be compared to the eastern Panamania *P. sanblasensis* C.M. Taylor with congested and ebracteate or minutely bracteate inflorescences. It differs from that species most obviously by its glabrous (vs. conspicuously pilosulose on the lower surface) mature leaves, by virtue of its red (vs. green) and less deeply (1/4 to ca. 1/2 vs. 3/4 to completely) lobed calyx with the lobes rounded instead of acute, by the claviform

(vs. acicular) trichomes external on the corolla, and by its reddish or reddish brown to greenish red (vs yellow) fruits. The new species is distinct from the enigmatic *P. bocataurensis* Dwyer (as per the protologue; no type, nor any other authoritatively identified material, has been located—cf. Taylor & Hammel 2014) at least by virtue of its red fibrillose (vs golden puberulent) calyx with longer lobes (3–12, vs 0.4–0.8 mm) and by its shorter corolla tube (27–35, vs 35–50 mm).

PENTAGONIA OSAPINNATA Aguilar, N. Zamora, & Hammel, **sp. nov. TYPE: COSTA RICA. Puntarenas.** Cantón de Osa, Reserva Forestal Golfo Dulce, Bahia Chal, 8°45' N, 83°28' W, 280 m, 11 Apr 2014 (fr), *N. Zamora et al. 6669* (holotype: CR; isotypes: GB, KRIB, MO) Figures 6–8.

Differing from nearly all other species of *Pentagonia* by its pinnately compound leaves with 8–10(–11) leaflets per side, from the otherwise similar *P. tinajita* and the likewise pinnately leaved (but with just ca. 8 leaflets per side) *P. imparipinnata* by its ebracteate inflorescence.

Shrub or small tree 4–6 m, unbranched (rarely branched); stems with pale copper-colored, slightly exfoliating epidermis (in dried material). **Stipules** reddish green, 2.5–5 × 1–3.3 cm, ± ovate, acute to acuminate, coriaceous, glabrous except marginally (and often inconspicuously) cilliate. **Leaves** (odd-)pinnately compound (sometimes distally subpinnatifid with the ultimate 1-3 pairs of leaflets sessile or rarely laminate across the rachis, but the terminal leaflet usually petiolulate); petiole basally reddish green, 10–18(–23) cm; rachis 27–36(–46) cm, the leaflets 8–10(–11) per side, alternate to subopposite, sessile or with petioluoles to 1.5 cm, the blades (6–)8–26 × (1.5–)2–6[–7] cm, elliptic, basally cuneate (often inequilaterally), apically acuminate, membranaceous, dull abaxially, ± lustrous adaxially, glabrous throughout, the venation brochidromous with 6–11 lateral nerves per side (adaxially impressed in fresh material). **Inflorescences** glomerate, apparently ebracteate; flowers to ca. 15, sessile or with pedicel to ca. 3 mm, glabrous throughout (except as indicated); hypanthium ca. 9[14] mm, ± funnelform; **calyx** limb green, 18–22[20–26] mm, 5-lobed, the lobes 10–14 mm, narrowly ovate or elliptic, rounded at the apex, the **glands** in lines starting at or very near the sinuses and reaching nearly to the base of the tube; **corolla** green, 40–55[–70] mm, funnelform, the tube basally ca. 3[7] mm wide, apically 9–12[15–20] mm wide, curved (60–90°) at ca. 1/3 from base of tube, internally pilosulose at the insertion of the filaments and upward for ca. 7[8] mm, 5-lobed, the lobes 3.5–5[5–8] mm, triangular, marginally granulose puberulent; stamens with the filament 14–20[15–25] mm, inserted at ca. 15 mm above the base of the tube, apically curved just below the anther, basally pilosulose, the anthers 2.5–2.8[3–3.7] mm, held perpendicular to the major portion of the filament (and in the opposite direction to the curve of the corolla) and held 7-12 mm above the stigma; style ca. 22[25] mm. **Fruits** copper-colored, 1.5–3 cm subglobose to ellipsoid, glabrous but markedly pustulose-warty. Measurements in square brackets [ ] are from fresh or EtOH preserved material.

Flowering Jun.; fruiting Apr. In deep primary wet forest, on slopes and along ridges, sometimes at edge of small ravines, 200–280 m; Costa Rica (Prov. Puntarenas), Osa Peninsula, Bahía Chal.

Additional specimens examined. **COSTA RICA. Puntarenas:** Cantón de Osa, Reserva Forestal Golfo Dulce, carretera entre Bahía Chal y Los Mogos, bajando hasta cabeceras de Quebrada Taboga, 25 Dec 1991, (st), *Herrera 5009* (CR); 13 Apr 2014; (fr.) *Aguilar 14910;* 27 Apr 2014 (st), *Hammel, Aguilar & Pérez 26720, 26721, 26722* (CR); 18 Jun 2014 (fl), *Aguilar & Poveda 14927* (MO).

Etymology. The epithet is a combined toponym and descriptive: “osa” for the cantón from which it has been collected, and “pinnata” for its pinnate compound leaves.

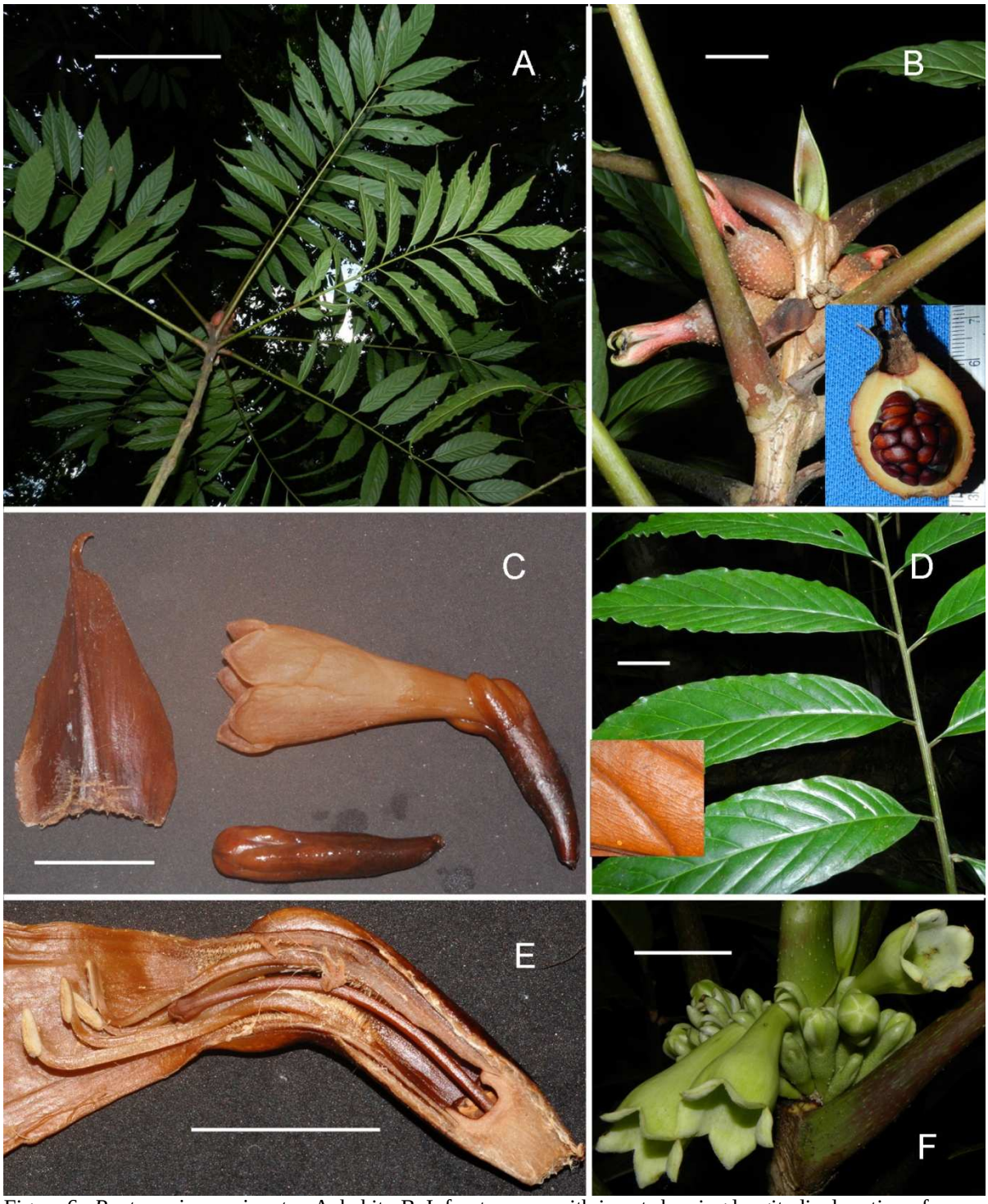

Figure 6. *Pentagonia osapinnata*. A. habit. B. Infructesence, with insert showing longitudinal section of mature fruit showing seeds. C. Stipule, open flower, bud (conserved in EtOH). D. Close-up of leaflets, with insert of leaf surface. E. Longitudinal cross section of flower (conserved in EtOH). F. Inflorescence with open flower. Scale bars: A=20 cm, B--F= 2 cm. A, B, D from *Zamora et al 6669*; C, E, F from *Aguilar & Poveda 14927*.

This astounding new species was actually first collected from the type and only known locality over 20 years ago by legendary Costa Rican collector Gerardo Herrera. However, being a unicate and sterile, the specimen lay virtually unstudied (tentatively identified as *Pentagonia* cf. *lobata*); unusual morphologies, especially of leaves can easily be passed over as oddities of sucker shoots. In fact in retrospect, the rather small leaves on the Herrera specimen most probably were from a rather young individual, "2 m" tall and with leaf rachises measuring only up to ca. 18 cm. Excuses — for not having explored the area more carefully on the basis of Gerardo's problematic specimen — aside, the recent and serendipitous rediscovery of plants of this species in fertile condition inspired immediate reaction, the first being to cry "A compound-leaved Rubiaceae? Impossible!"

Figure 7. *Pentagonia osapinnata.* Bud leaves of mature plant.

Pentagonia osapinnata differs from nearly all other congeners by its pinnately compound leaves. It is similar to two locally sympatric species, *P. lobata* and *P. tinajita*, with pinnately lobed leaves. Both of these are similar to the new species in their greenish white, funnelform corollas but differ principally for their leaves that are only lobed. In addition, this new species differs from *P. lobata* for its 5-lobed (vs. spathaceous) calyx and from *P. tinajita* for its curved flowers. It differs from both for its apparent lack of inflorescence bracts and especially for its glabrous, pinnate leaves with 8–10(–11) leaflets per side, vs. estrigulose or puberulent to glabrescent, lobed leaves (with 4–6 or 3 or 4 principal lobes per side in *P. lobata* and *P. tinajita*, respectively). It is also clearly distinct from the recently described Colombian species *P. imparipinnata* Cornejo, which has fewer (ca. 8) leaflets per side and large, persistent inflorescence bracts (Cornejo 2014).

While we have not done any microtomic studies of leaf ontogeny of this species, simple microscopic and photographic observation of bud leaves (see Fig. 7) demonstrate that the leaflets of mature leaves of *P. osapinnata* surely must "arise from separate leaflet primordia" (Foster & Gifford 1996; p. 491). While these observations apply to mature leaves, the situation with the leaves of immature plants—as is often the case with compound-leaved species (cf. Foster & Gifford 1996)—is quite the opposite; the leaves of very small plantlets of *P. osapinnata* may be completely entire, those of somewhat larger plants pinnately-lobed, and these with relatively few lateral lobes, much-resembling the mature leaves of *P. tinajita* (see Fig. 8). This latter-mentioned species we presume to be closely related to *P. osapinnata* because of their very similar floral morphology (rather large, funnelform and greenish white flowers) and thus while the occurrence of compound leaves in

Figure 8. *Pentagonia osapinnata*. Mature leaves of juvenile plants.

Rubiaceae disrupts the norm of standard characters for the family, it most certainly has no far-reaching phylogenetic implication, i.e. that *Pentagonia* and therefore Rubiaceae should have close relatives with compound leaves. Even though pinnately divided and now pinnately compound leaves are apparently unique to *Pentagonia* for Rubiaceae, examples of similar cases of species with compound leaves within families of mostly simple-leaved species are not hard to find [eg. various species of *Solanum* (Solanaceae)]. Plants with very deeply pinnatifid leaves, where very little blade tissue follows along the midrib between the lobes (cf. Taylor 2002, 2012) have long been known for *P. gymnopoda*, a poorly distinguished Panamanian species apparently closely related to if not synonymous with *P. tinajita* (see Taylor & Hammel 2014). Detailed phylogenetic and molecular studies will surely confirm the compound leaves of *P. osapinnata* to have evolved by way of relatives with simple, pinnatifid-lobed leaves. With this new compound-leaved species, *Pentagonia* establishes yet another character to the long list of exceptions for the standard Rubiaceae description (Taylor pers. comm.).

One of the new species described here, *Pentagonia gomez-lauritoi*, is already incorporated (as *P.* sp. A.) into the Costa Rican *Manual* key to species (Taylor & Hammel 2014). The other two can easily be added to that key by the following modification (new couplet 4 equals old couplet 2, new 2' equals old 1' and so on)

1. Láminas foliares compuestas, con 8–10(–11) pinna por lado, glabras en todo ..... **P. osapinnata**
1' Láminas foliares simples, a veces pinnada a bipinnadamente lobuladas (con 3–7 lóbulos principales por lado), variadamente pubescentes a glabrescentes.

2. Láminas foliares lobuladas.

3. Láminas foliares someramente lobuladas, el seno no menos de (4–)8–12 cm del nervio medio; brácteas de la infl. rojizas, hasta al menos 30 mm; cáliz rojiza ..... **P. gambagam**
3' Láminas foliares profundamente lobuladas, el seno no más de 1–4 cm del nervio medio; brácteas de la infl. verdes, 8–25 mm; cáliz rosado o (más a menudo) verde.

ACKNOWLEDGEMENTS

Many thanks to Sara Edwards of Kew for providing high-resolution images of type material of *Pentagonia wendlandii*, helping to confirm that it lacks fibrillose indumentum as well as claviform trichomes. Colleague John Pruski kindly helped as hands-on tutor in the use of the SEM at MO. The second author of *Pentagonia osapinnata* thanks the project INBio-KRIBB for support of field work. Thanks also to Museo Nacional colleague Alexander Rodríguez for providing photos of *Pentagonia gomez-lauritoi.*

LITERATURE CITED

Cornejo, X. 2014. *Pentagonia chocoensis* y *P. imparipinnata* (Rubiaceae, Condamineeae): Dos nuevas especies para Colombia, y el primer registro de hojas compuestas para la familia Rubiaceae. Rev. Cient. Cien. Nat. Ambien. 8: 4–7.

Foster, E. and A. Gifford. 1996. Morphology and Evolution of Vascular Plants (ed. 3). W.H. Freeman & Co., New York.

Hammel, B.E, M.H. Grayum, C. Herrera, and N. Zamora (eds.). 2015. Dedication. Manual de Plantas de Costa Rica. Vol. VIII. Dicotiledóneas (Sabiaceae-Zygophyllaceae). Monogr. Syst. Bot. Missouri Bot. Gard. 131: 1–657.

Hooker, W.J. 1861. *Pentagonia Wendlandi*. Wendland's Pentagonia. Bot. Mag. 87: t. 5230 et seq. 2 pp. text.

Rova, J.H.E. and L. Andersson. 1995. A reevaluation of the tribes Hippotideae and Tammsieae (Rubiaceae). Nord. J. Bot. 15: 269–284.

Standley, P.C. 1914a. A revision of the genus *Watsonamra*. Contr. U.S. Natl. Herb. 17: 439–444.

Standley, P.C. 1914b. *Nothophlebia*, a new genus of Rubiaceae from Costa Rica. Contr. U.S. Natl. Herb. 17: 437–438.

Taylor, C.M. 1995. New species and combinations in Rubiaceae from Costa Rica and Panama. Novon 5: 201–207.

Taylor, C.M. 1996. Taxonomic revision of *Cruckshanksia* and *Oreopolus* (Rubiaceae: Hedyotideae). Ann. Missouri Bot. Gard. 83: 461–479.

Taylor, C.M. 2002. Rubiacearum Americanarum Magna Hama Pars IX. New species and a new combination in *Hippotis* and *Pentagonia* (Hippotideae) from central and western South America. Novon 12: 555–562.

Taylor, C.M. 2012. *Pentagonia*. Pp. 355–365, in G. Davidse, M. Sousa S., S. Knapp, F. Chiang, & C. Ulloa U. (eds.), Flora Mesoamericana 4(2): 1–552.

Taylor, C.M. and B.E. Hammel. 2014. *Pentagonia*. Pp. 663–671, in B.E. Hammel, M.H. Grayum, C. Herrera, and N. Zamora (eds.). Manual de Plantas de Costa Rica. Vol. VII. Dicotiledóneas (Picraminaceae-Rutaceae). Monogr. Syst. Bot. Missouri Bot. Gard. 129: 1–840.