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Two new species of *Graffenrieda* (Melastomataceae: Merianieae) from Colombia and Panama

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Abstract

Two new species of *Graffenrieda* (Melastomataceae: Merianieae) are described from Colombia and Panama. ***Graffenrieda jefensis***, a Panamanian endemic from Cerro Jefe, is characterized by a calyptrate calyx that falls away as a unit at anthesis, 5-merous flowers, 3-locular ovary, and conspicuous persistent calyx teeth. ***Graffenrieda maklenkensis***, a Colombian endemic from the Cordillera Oriental in the northern Andes of Colombia, has a calyx that is fused in bud but ruptures into four (rarely three) lobes at anthesis that lack external calyx teeth, 4–(5)-merous flowers, a 3–(4)-locular ovary, and hypanthial indumentum (at anthesis) that is minutely lepidote intermixed with glandlike or resinous scurfy trichomes. Each species is illustrated, compared with presumed relatives, and provided with a conservation assessment using IUCN guidelines.

Resumen

Se describen dos nuevas especies de *Graffenrieda* (Melastomataceae: Merianieae) de Colombia y Panamá. *Graffenrieda jefensis*, endémica de Panamá de Cerro Jefe, se caracteriza por el cáliz caliptrado que es dehiscente como una unidad en antesis, flores 5-meras, ovario 3-locular, y dientes del cáliz persistentes y conspicuos. *Graffenrieda maklenkensis*, endémica de Colombia de la Cordillera Oriental en los Andes del norte, se caracteriza por tener el cáliz fusionado en botón, pero que es dehiscente en cuatro (raramente tres) lóbulos en antesis sin dientes externos, flores 4–(5)-meras, ovario 3–(4)-locular, indumento del hipanto (en antesis) diminutamente lepidoto entremezclado con tricomas glandulares o escamas resinosas. Para cada especie se incluye la ilustración, comparación con las presuntas especies cercanas, y una evaluación del estado de conservación utilizando criterios de la UICN.

Introduction

Graffenrieda Candolle (1828: 105), a neotropical genus of shrubs and trees (rarely woody climbers), is distributed from southern Mexico, Central America, and the West Indies to Andean South America (Venezuela south to Bolivia), east to the Guianas and Venezuelan tepuis, and south to southeastern Brazil between sea level and 3200 m (Wurdack 1973, 1980, Almeda 2009, Mendoza-Cifuentes & Fernández-Alonso 2010). Like other woody members of the neotropical tribe Merianieae, it is characterized by capsular fruits, narrow seeds that lack conspicuous sculpturing, and appendiculate anther connectives. In many ways it is a streamlined member of the Merianieae clade with small to medium sized white flowers (petals mostly 0.5–1.5 cm long), isomorphic yellow anthers, anther connectives modified dorso-basally into small deflexed toothlike appendages, dorsally arcuate anthers with mostly ventrally inclined pores, and cuneiform, filiform, or linear-pyramidate seeds with straight embryos (Almeda 1984, Mendoza-Cifuentes & Fernández-Alonso 2011).

Graffenrieda is the second largest genus in the tribe Merianieae. A majority of its species is centered in two main regions of South America: the Andes and the Guayana Highlands. Venezuela and Colombia, with 31 and 25 species respectively (Almeda *et al.* submitted, Michelangeli & Cotton 2008), collectively harbor about 70% (44) of the known species and also have a larger number of endemic species (17) than any other area of the neotropics.

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We describe here two new species of *Graffenrieda,* each endemic to Panama and Colombia respectively. These and three other recently described taxa (Goldenberg & Meirelles 2011, Michelangeli & Goldenberg 2013, Michelangeli & Ulloa Ulloa 122013) tentatively bring the number of currently recognized species in the genus to 65. One of the new species described here was discovered during recent collecting expeditions to Colombia for the Miconieae Planetary Biodiversity Inventory project (http://sweetgum.nybg.org/melastomataceae/). Flowering material of the other species came to light in the course of studying Panamanian collections sent to CAS for routine identification. Because only fruiting material of this species was known when the treatment of Melastomataceae for Flora Mesoamericana (Almeda 2009) was being prepared this species was set aside in hopes that flowering material would eventually come to light.

Graffenrieda jefensis Almeda, Alvear & Humberto Mend. *sp. nov.* (Fig. 1)

Graffenrieda jefensis is distinguished by its consistently 5-merous flowers, linear-oblong anther thecae with notched or emarginate apices, leaf bases with two revolute lobes on each side of the blade, costate hypanthia, calyptrate calyx, 3-locular ovary and persistent erect calyx teeth. Closely related species with a calyptrate calyx, 5-merous flowers, and 3-locular ovaries differ in having acuminate or caudate-acuminate leaf apices, anther thecae that are subulate, petals that are basally attenuate or clawed, and calyx teeth that are reduced to small inconspicuous tubercles.

Type:—PANAMA. Panama province: Cerro Jefe, 1000 m, 11 June 1975 (mature buds), *S. Mori 6524* (holotype: CAS!; isotypes: MEXU, MO!, PMA).

Tree 8–9 m tall. Young branches, petioles, and inflorescence branches densely to moderately rufescent, lepidote becoming glabrescent. *Internodes* 1–6.5 cm long, the uppermost quadrangular to subquadrangular and irregularly sulcate when dry but becoming terete with somewhat enlarged nodes with age. Petioles canaliculate, 2–4 cm long. *Leaves* opposite and isophyllous, 7.5–14 × 4.5–7.5 cm, elliptic, apex blunt-cuspidate, base obtuse, slightly decurrent, with two triangular revolute lobes or flaps ca. 1.5–3 mm long on each side of the blade ca. 1.5–3 mm above the petiole/laminar junction, both surfaces densely lepidote on young leaves but the adaxial surface typically glabrescent with age. Venation acrodromous, the primary nerve somewhat elevated on the adaxial surface, very prominent on the abaxial surface, with two pairs of secondary nerves but only the innermost pair extending to the blade apex and converging with the primary nerve. The secondaries basal to shortly supra-basal, diverging from the primary nerve up to 2 mm from the base, secondary nerves impressed on the adaxial and prominent on the abaxial surface, tertiaries (transversals) impressed on the adaxial surface, flat to slightly prominent on the abaxial surface. *Inflorescence* a terminal, open and multiflorous panicle, 5–14.5 cm long (including the peduncle, which is 2.5–5.5 cm long), with up to 4 nodes, typically with 4 branches on the proximal node and 2 branches on the upper nodes; paracladia 4.5–6 cm long, with 2–3 levels of branching; ultimate units of each paraclade with clusters of 3–11 flowers. Bracts 2 × 0.8 cm, similar to the leaves in shape and vestiture. Bracteoles apparently early caducous and not seen. *Flowers* 5-merous, on pedicels 0.5–1 mm, lengthening to 2–3 mm on fruiting hypanthia. *Hypanthium* 2–2.5 × 2 mm, suburceolate, externally costate and moderately to densely rufescent lepidote (the scales 0.1 mm in diameter). *Calyx* fused into a hyaline attenuate-apiculate conic calyptra 2.8–3.2 mm long while in bud, sparsely lepidote, dehiscing and falling away as a unit at anthesis; the 5 external deltoid teeth callose-thickened, erect, 1–1.5 mm long (from torus to apex on flowers) and persistent on mature hypanthia, calyx tube less than 0.2 mm long. *Petals* 2.5–3 × 1.5 mm, ovate-lanceolate, apex acute, base rounded-truncate, white, entire and glabrous. *Stamens* 10, isomorphic; filaments 0.5–0.8 mm long, pale yellow, ligulate; anther thecae 1.8–2.3 × 0.5 mm, yellow, linear-oblong, notched or emarginate apically, the solitary apical pore 0.2 mm wide and somewhat ventrally inclined; connective not prolonged but modified into a deflexed dorso-basal acute, glabrous spur (appendage) 0.2–0.3 mm long. *Ovary* 1–1.5 × 0.75 mm, ovoid, the apex moderately lepidote with a lobulate collar 0.2–0.3 mm long, (2) 3-locular, basally 1/2–1/3 inferior; style 2.8–3.3 mm long, linear, glabrous; stigma punctiform. *Capsules* 3 × 3 mm; the enveloping hypanthium 3.5 × 3 mm, conspicuously costate externally and moderately to densely rufescent lepidote (the scales 0.1 mm diameter). *Seeds* 1–1.3 × 0.2–0.3 mm, cuneiform to narrowly pyramidate, brown, lateral symmetrical plane oblong-arcuate, the chalazal end typically flattened vertically and sometimes tapered to an acute projection on the raphal side that is confluent with the raphal ridge, antiraphal symmetrical plane angulate or rounded, the raphal zone narrow, oblong, and mostly forming a thin carinate ridge extending the entire length of the seed, testa ± granulate and inconspicuously papillate especially on the antiraphal side.

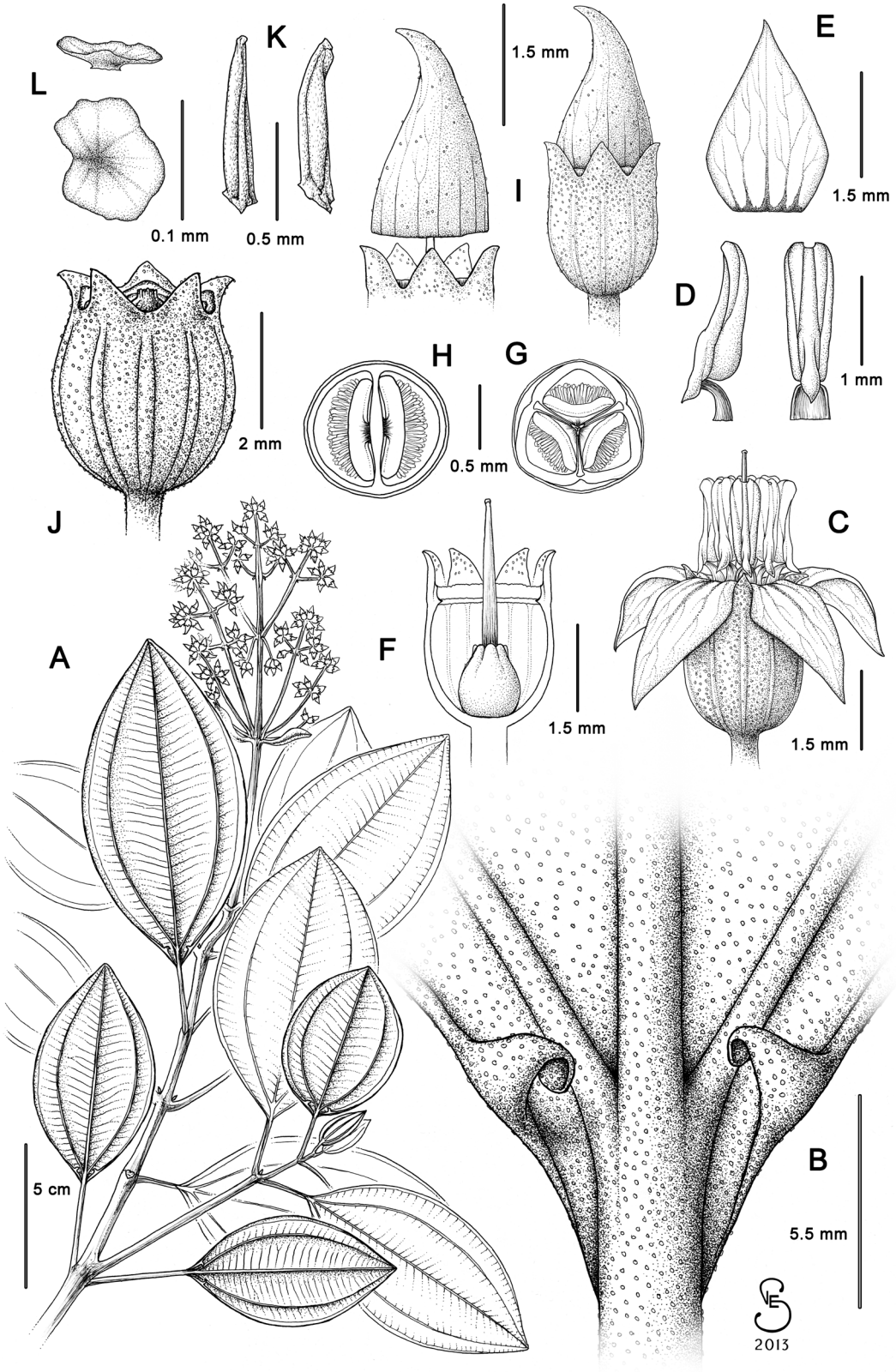

FIGURE 1. ***Graffenrieda jefensis***. **A.** Flowering branch. **B.** Leaf base showing revolute lobes on abaxial surface. **C.** Flower. **D.** Stamen, lateral view (left) and dorsal view (right). **E.** Petal (adaxial surface). **F.** Hypanthium (at anthesis) in longitudinal section. **G.** Ovary in cross section (3-locular). **H.** Ovary in cross section (2-locular). **I.** Flower bud showing hypanthium and fused calyx (right) and cleanly rupturing calyptrate calyx (left). **J.** Fruiting hypanthium. **K.** Seeds. **L.** Enlargement of lepidote indumentum scale from abaxial foliar surface. (A-I from *Mori 6542,* CAS; J-L from *McPherson 9797,* CAS).

Distribution and habitat:—Endemic to the upper slopes of Cerro Jefe east of the Canal Area in Panama where it grows in wet cloud forests with species of *Clusia* (Linnaeus 1753: 509) and *Colpothrinax cookii* (Read 1969: 13) at 850–1000 m. Cerro Jefe was an important island refugium from the middle of the Miocene until the land bridge between North America and South America was established ca. 3.5–2.4 million years ago (Graham 1985, Carrasquilla 1997, Almeda 2000a). The high incidence of vascular plant endemism on Cerro Jefe and adjacent Cerro Azul is a reflection of this geologic history (Lewis 1971). Of the 1230 + species of plants thought to be endemic to Panama (Carrasquilla 1997), over 150 are restricted to the Cerro Jefe region, including the following six locally endemic species of Melastomataceae: *Adelobotrys jefensis* (Almeda 1981: 210), *Blakea hexandra* (Almeda 1990: 320) Penneys & Almeda in Penneys & Judd (2013: 26), *Miconia jefensis* (Almeda 2000b: 43), *Miconia morii* (Almeda 2000b: 46), *Miconia peltata* (Almeda 1989a: 218), and *Tessmannianthus carinatus* (Almeda 1989b: 2).

Phenology:—This species has been collected with mature flower buds in early June, and in fruit in early and late July.

Conservation status:—This species is known only from the summit forest of Cerro Jefe which has protected status since it is within Chagres National Park (1290 km²). This park was created in 1984 to protect all lands that contribute to water production and sustainability of the Chagres watershed which in turn protects the Panama Canal and Lake Alajuela (Carrasquilla 1997). Based on IUCN guidelines and criteria (IUCN 2001, 2011) and our current knowledge of its limited distribution, this species is assigned a provisional IUCN conservation status of Endangered (EN).

Etymology:—The specific epithet is derived from Cerro Jefe, the type and only known locality for this species.

Additional specimens examined (paratypes):—PANAMA. Panama province: Cerro Jefe, NE of Panama City, 850–900 m, c. 9°15' N, 79°30' W, 12 July 1986 (fr), *G. McPherson 9736* (CAS!, MO, PMA, US); vicinity of Cerro Jefe, 850 m, c. 9°15' N, 79°30' W, 24 July 1986 (fr), *G. McPherson 9797* (CAS!, CR, MO, PMA).

Discussion:—*Graffenrieda jefensis* is distinguished by its 5-merous, pedicellate flowers, oblong anther thecae with notched apices, leaf bases that are slightly decurrent with two triangular revolute lobes on each side of the blade, externally costate hypanthia, calyptrate calyx that falls away as a unit following anthesis, (2) 3-locular ovary, and external deltoid calyx teeth that are callose thickened, erect, and persistent on fruiting hypanthia. The calyx teeth are so prominent that they superficially resemble true calyx lobes.

In the key to species of *Graffenrieda* with a calyptrate calyx (Goldenberg & Meirelles 2011), *G. jefensis* keys to the couplet that includes *G. bella* (Almeda 1984: 275) and *G. micrantha* (Gleason 1950: 346) L. O. Williams (1963: 564). These three Panamanian species share a calyptrate calyx, 5-merous flowers, and a 3-locular ovary but they are otherwise distinct and readily separated from one another. In *G. bella,* which also has leaf bases with revolute lobes on each side of the blade abaxially, the leaves are smaller (4.7–8 ×2.1–4 cm) with an acuminate apex, the hypanthium (at anthesis) is narrowly subcylindric, the calyx teeth are poorly developed and evident as blunt tuberculiform projections 0.25–0.5 mm long, the petals are cuneate to distinctly clawed at the base, the anther thecae are distinctly subulate, and the ovary is copiously lepidote distally. *Graffenrieda bella* is also allopatric with a distribution restricted to Chiriquí and Veraguas provinces west of the Canal Area. *Graffenrieda micrantha,* which is only known from the type (Fish Creek mountains in Bocas del Toro province in western Panama), differs by its terete uppermost branches. It also has large leaf blades (8–20.5 × 4.5–9 cm) like *G. jefensis* but the apices are caudate-acuminate and the base is not decurrent and has divergent auriculate lobes at the petiole/laminar junction, small hypanthia at anthesis (ca. 1.25 mm long to the torus), inconspicuous calyx teeth (0.25 mm long) evident as mere tubercles, small narrowly oblong-lanceolate petals (3 × 0.5 mm), and minute anther thecae (2–2.25 mm).

The floral measurements given in the above description for *G. jefensis* were taken from mature hydrated buds so dimensions may increase somewhat when specimens are collected with fully open flowers.

Graffenrieda maklenkensis Humberto Mend., Alvear & Almeda *sp. nov.* (Figs. 2, 3)

Graffenrieda maklenkensis is characterized by its modally elliptic leaves with acute to obtuse base, long inflorescence (15–27 cm, including peduncle) with divaricate branching, short pedicellate flowers at anthesis, lepidote hypanthial indumentum mixed with translucent glandlike or resinous scurfy trichomes, and a calyx that is fused in bud but ruptures into four (rarely three) persistent lobes with apiculate apices that are evident at anthesis but caducous on fruiting hypanthia. Its closest relative is *G. harlingii* (Wurdack 1976: 7) which differs in having smaller leaves with a rounded base and non-divaricate

inflorescence branching, sessile flowers at anthesis, hypanthia (at anthesis) with a uniformly amorphous furfuraceous chocolate brown indumentum, and apically rounded, non-apiculate calyx lobes.

Type:—COLOMBIA. Santander: Municipio of Floridablanca, vereda La Judía, Cerro La Judía, Reserva Natural Campesina Los Maklenkes, Sendero Mario Mejía, 1900 m, 7°4.80' N, 73°2.70' W, 9 March 2012 (fl), *F. Almeda, M. Alvear, H. Mendoza, G. Saavedra & D. Alvear 10643* (holotype: COL!; isotypes: CAS!, FMB!, HECASA!, NY!, UIS!)

Tree 3–12 m tall. Young branches, petioles and inflorescence branches sparsely rufescent lepidote becoming glabrescent. *Internodes* 1–3 cm long, the uppermost rounded-quadrangular becoming terete with age. Petioles canaliculate, 2.1–4 cm long. *Leaves* opposite and isophyllous, 11–16 × 6–8 cm, modally elliptic to oblong-elliptic; apex obtuse, sometimes short-cuspidate, base acute to obtuse and slightly revolute and decurrent, margin entire; adaxial surface glabrescent to glabrous at maturity, abaxial surface densely covered with a mixture of minute rufescent scales and whitish scales 0.1 mm in diameter; venation acrodromous, the primary nerve flat on the adaxial surface, prominent on the abaxial surface, with two pairs of secondary nerves, but only the innermost pair extending to the blade apex and converging with the primary nerve, the secondaries basal to very shortly supra-basal, diverging from the primary nerve up to 2 mm form the base, impressed on the adaxial surface and prominent on the abaxial surface, tertiaries (transversals) impressed on the adaxial surface, flat to slightly prominent on the abaxial surface. *Inflorescence* a terminal, open and multiflorous panicle, 15–27 cm long (excluding the peduncle, which is 5.5–8 cm long), with up to 4 nodes and 2 branches at the proximal and upper nodes; paracladia 7–14 cm long, with 3–4 levels of branching, the ultimate units of each paraclade with clusters of 3–9 flowers. Bracts and bracetoles not seen, apparently early caducous. *Flowers* 4–(5)-merous, morphologically protogynous, on pedicels 0.5–0.7 mm long. *Hypanthium* 3.6–4 × 2–2.5 mm, subcylindric to narrowly campanulate, externally slightly costellate, sparsely and caducously covered with rufescent scales and translucent glandlike scurfy trichomes (0.3 mm diameter); calyx tube less than 0.2 mm long, the exterior calyx teeth obsolete, calyx fused in bud then rupturing into four (sometimes three) mostly regular or irregular (if three in number) triangular-rounded lobes, 1–1.3 mm long (from torus to apex), short-apiculate at the apex, with an indumentum like that of the hypanthium. *Petals* 4–5 × 2.5–3.5 mm, obovate, apically rounded to emarginate, white, entire and glabrous. *Stamens* 8–(10), isomorphic; filaments 2.5–3.8 mm long, pale yellow, ligulate; anther thecae 3.8–4.2 mm long, yellow, oblong-subulate, dorsally arcuate, the solitary pore 0.17–0.23 mm wide and ventrally inclined; connective prolonged 0.1 mm below the thecae and modified into a deflexed tooth-like appendage 0.2 mm long. *Ovary* ca. 2.3–2.5 mm long, elliptic to globose, apex lobulate, minutely granulose and sparsely glandular-puberulent, (3)–4-locular, basally 1/3 to 1/2 inferior; style 7–11 mm long, linear, straight to sometimes slightly curved apically, glabrous, stigma punctiform. Post-mature capsules 3 × 3 mm, globose; the enveloping hypanthium 4.5–5 mm long to the torus, bluntly costellate and glabrous externally. *Seeds* 0.7–1.1 × 0.4–0.5 mm, pyramidate, brown, lateral symmetrical plane oblong-arcuate to pyramidate, the chalazal end flattened horizontally, antiraphal symmetrical plane angulate to somewhat rounded, the raphal zone oblong and extending the entire length of the seed, testa smooth and shiny.

Distribution and habitat:—Endemic to the Cordillera Oriental in the Northern Andes of Colombia, in the departments of Santander and Norte de Santander. This species grows in Andean and High Andean forests at 1900–3000 m. It has only been collected in areas with well preserved forest.

Phenology:—The type from Santander, which was collected in early January, has flowers. Other material collected in October was in flower and fruit.

Conservation status:—This species is known from two localities. One of the localities is currently protected in the Reserva Natural Campesina Los Maklenkes (0.12 km^2), that is adjacent to the Parque Regional Natural Cerro La Judía (35.21 km^2). These two areas are included within the Important Bird Area of Cerro La Judia (IBA CO171). The Area of Occupancy (AOO) based on this IBA area is 86 km^2 (Franco et al. 2009, CDMB 2012, Birdlife International 2013). The population in Norte de Santander is not in a protected area and we have no information on its size. However, ongoing deforestation is a major environmental threat in the region. Based on our current knowledge and the IUCN guidelines and criteria (IUCN 2001, 2011), this species is assigned a provisional IUCN conservation status of Endangered (EN).

Etymology:—The specific epithet is taken from the name of the protected area where we collected the type specimens, "Reserva Natural Campesina Los Maklenkes".

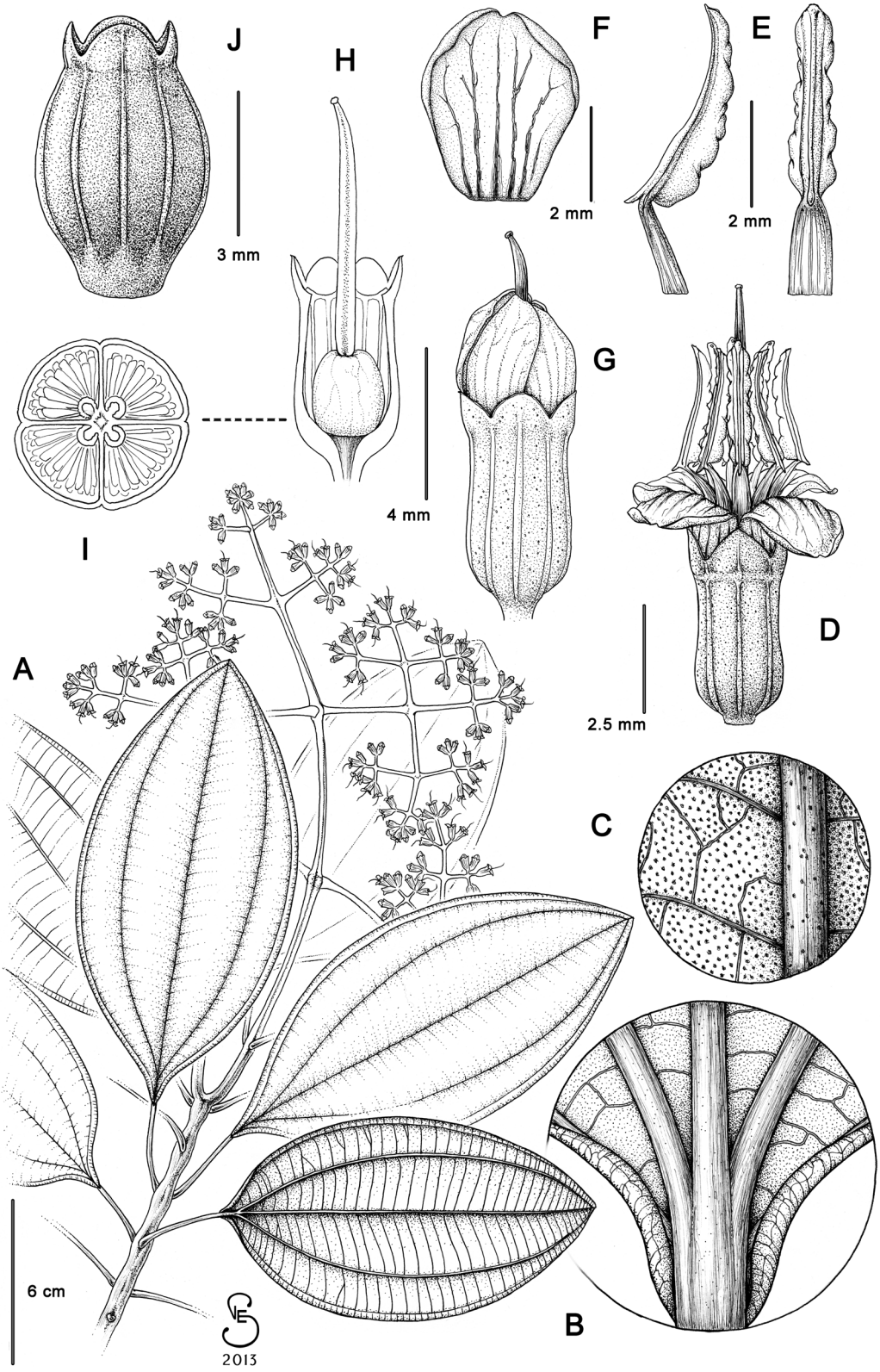

FIGURE 2. ***Graffenrieda maklenkensis***. **A.** Flowering branch. **B.** Leaf base detail (abaxial surface). **C.** Indumentum detail on abaxial leaf surface. **D.** Flower. **E.** Stamen, lateral view (left) and dorsal view (right). **F.** Petal (adaxial surface). **G.** Flower bud showing morphologic protogyny. **H.** Hypanthium (at anthesis) in longitudinal section. **I.** Ovary cross section. **J.** Fruiting hypanthium. (A–J from *Almeda et al. 10643,* CAS).

Additional specimens examined (paratypes):—COLOMBIA. Santander: Municipio de Floridablanca, La Judía, Cerro La Judía, 2049 m, 7°05'28"N, 73°02'40"W, 11 October 2005 (fr), *L. L. Roa-Fuentes 403* (COL!); Norte de Santander: Municipio Villa Caro, Vereda al páramo de Guerrero, en laderas de fuertes pendientes en franja de bosque, 3000 m, 10 October 2009 (fl), *R. Sánchez 12706* (HECASA!).

Discussion:—*Graffenrieda maklenkensis* can be recognized by its appressed lepidote rufescent indument on branches and inflorescence, the conspicuous tertiary and quaternary venation, 2 pairs of secondary nerves, the open divaricately branched inflorescence with 4–5-merous, short pedicellate (at anthesis) flowers, hypanthia with a mixture of rufescent scales and whitish glandlike scales, calyx lobes with a caducous apiculate apex, and obovate apically rounded-emarginate petals. Among described species, *Graffenrieda maklenkensis* is most similar to *G. harlingii*, a species centered in southern Ecuador with one known population in Colombia (Antioquia), but the latter has smaller leaves (5–10 × 3.5–6 cm) with a rounded base, quaternary venation that is not conspicuous on abaxial foliar surfaces, smaller inflorescences with poorly developed and unbranched paracladia, sessile flowers at anthesis, hypanthial indumentum that is dark chocolate brown and amorphous furfuraceous at anthesis, calyx lobes that lack a caducous apiculate apex, petals that are obovate with a rounded-obtuse apex, anther connective prolonged 0.4 mm below the thecae, and dorso-basal anther appendages 0.4–0.7 mm long.

Another vegetatively similar species with 4-merous flowers is *G. reticulata* Wurdack (in Maguire & Wurdack 1958: 110), endemic to Cerro de La Neblina in Venezuela, which has a consistently 3-locular ovary, smaller leaves (6–12 × 3–6 cm) with only one pair of secondary veins, shorter petioles (1–2 cm), and abaxial leaf surfaces that are glabrous (Gröger 2001). *Graffenrieda tristis* Triana (1871: 72) L.O. Williams (1963: 564), another species with 4-merous flowers from Peru, is also similar vegetatively but differs by its smaller leaves with only one pair of secondary veins, pedicellate flowers (pedicels 2–3 mm long), and calyptrate calyx.

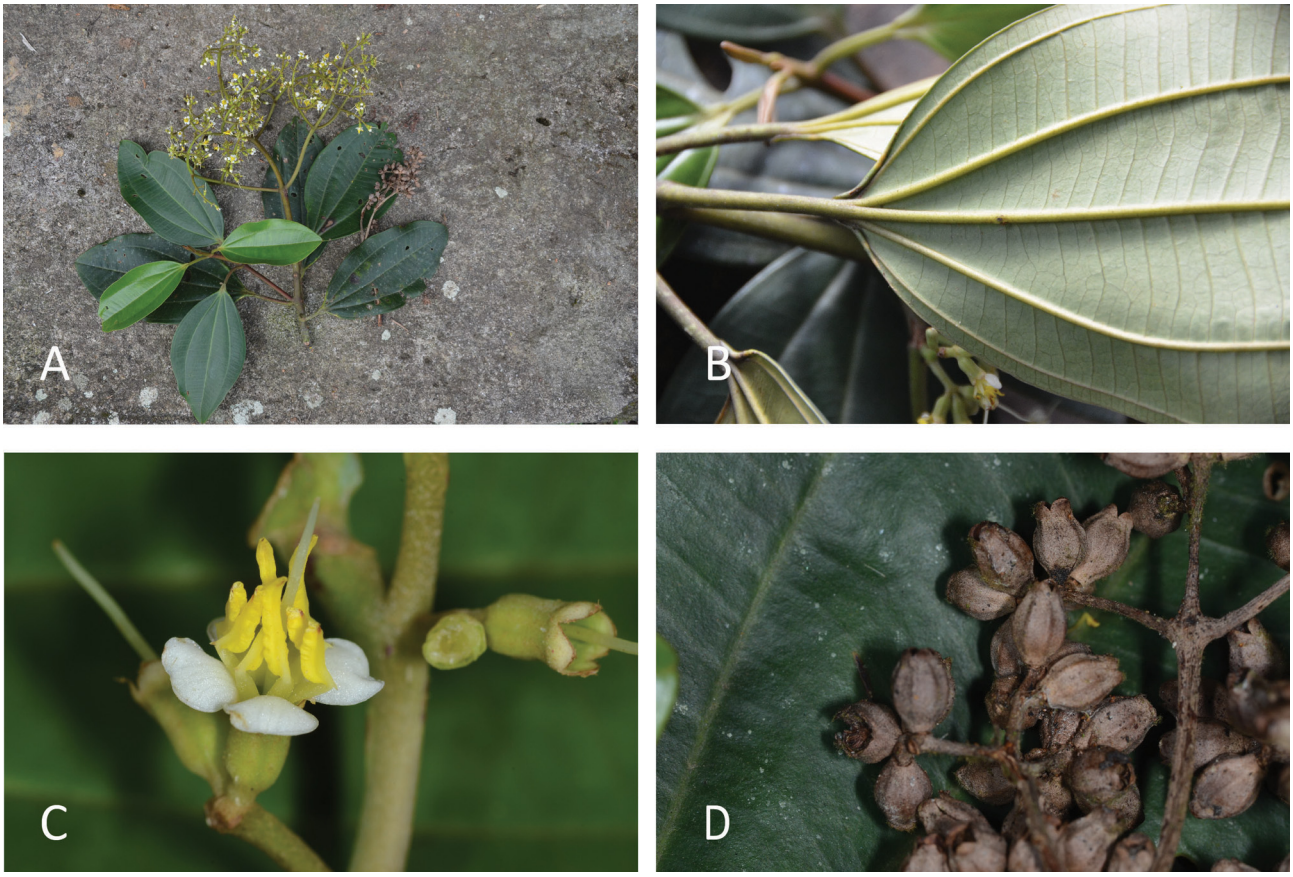

FIGURE 3. ***Graffenrieda maklenkensis***. **A**. Branch showing leaves (adaxial surfaces) and inflorescence.**B.** Leaf showing primary and secondary nerves and revolute base (abaxial surface). **C.** Flower and young fruiting hypanthia. **D.** Hypanthia in post-mature fruit. (all photos from the type collection by F. Almeda).

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