Original Research Article

New and noteworthy records of Angiosperms from Pacific Biogeographical Region at department of Chocó in Colombia, including four new records for the country

ABSTRACT

Six new or noteworthy records of Angiosperms from Colombia are presented based in herbarium specimens from the Chocó department. Four represent the first record for the country, one the first record for the Chocó department and one is the most recent record after 28 years of an endemic species to the Chocó Biogeographical region in Colombia. *Cynometra dwyerii* (Fabaceae), *Pouteria fossicola* (Sapotaceae) and *Tachigali panamensis* (Fabaceae) were heretofore restricted to Central America; *Mosquitoxylum jamaicense* (Anacardiaceae) was previously known from Central America, Caribbean and Ecuador, but there were still no records for Colombia; *Casearia thamnia* (Salicaceae) was recorded from Colombia by a specimen of the year 1916 from the Bolivar department, here its first record from the Chocó department is presented, besides it collected nearly a century after for the country; *Cremastosperma chococola* (Annonaceae) is a endemic species to the biogeographic Chocó in Colombia, only known through three specimens and not collected since the year 1990, here a new record after 28 years is presented. For each record information about protologue, type nomenclatural, distinctive morphology, current geographical distribution, common names, and uses are provided, besides notes about the relevance of the record here presented. A geographical distribution map for these species in Colombia is presented, as well as digital plates composed of herbarium vouchers and morphological diagnostic details for each species. Continue with the biodiversity inventory in the biogeographic Chocó as one of the global biodiversity hotspots is imperative, these records presented here provide useful information for future biological research and conservation actions for their respective species.

Keywords: Caesalpinioideae, Laetia, Leguminoseae, lowland rainforest, Neotropical trees diversity, New chorological records

1. INTRODUCTION

The Chocó Biogeographical Region extending in general terms from Southern Nicaragua to Northwestern Ecuador is Earth's ninth most biodiverse hotspot [1], in Colombia is mainly named Pacific Biogeographical Region being mainly defined as the area comprising lowlands adjacent to the Pacific Ocean coast at west to the Andes [2]. One of the particularities for this region is its high rates of precipitation reaching to ca. 11,700 mm per year in some places, giving the category of the second Earth's rainiest place [1]. The northern portion of this region besides comprises the geographical junction between Central and South America, a geological event considered as one of the main factors for the high diversity in Neotropics [3] and by extension in Colombia. About plants diversity, this area is considered as the most biodiverse in the Earth, while only the species richness for some forest near to Iquitos (Peru) and in the Southeastern Asiatic Forest reach to similar but lesser diversity [4]. Besides, other studies indicate that the plants species endemism for this area reach to ca. 25 % [5], a proportion relatively high among the Earth's hotspot endemism [6, 7]. The region was also considered as the most unknown for botanist and has high proportion of undescribed plant species [5].

The department of Chocó under its political limits, comprises the most of area for the Pacific Biogeographical Region in Colombia. Even though its biological importance, it is one of the focus areas of environmental disturbs such mining and selective logging, which are known as the main economic activities of the people who inhabit there [8, 9], furthermore represents one of the more inaccessible areas for biological researchers mainly by consequence of a long-term armed conflict [10], thus many species still unknown or scarcely recorded [5]. The species account for this department and the Pacific region is permanently increasing in the last decades, by means of new species descriptions or new records derived mainly from taxonomical reviews based in herbarium vouchers [e.g., 11, 12, 13].

The biodiversity inventory is one of the main steps for any conservation action or ecological study, being a basic tool for biodiversity management [14, 15]. This study aims give novelty information about four Angiosperms species previously unknown for Colombia and expand the information about two species previously reported for the country, but scarcely recorded and little known, thus, made wide accessible the information about these species for further biological studies or conservation planning, as well as contribute to the floristic checklist for Colombia, department of Chocó and Chocó biogeographical region. All records are based in herbarium vouchers collected in the Chocó department in Colombia. Each record is presented along to the protologue information, nomenclatural type and comments about its geographical distribution, main diagnostic morphological features, common names, uses and relevance of their record. A geographical distribution map, digital plates composed of herbarium vouchers and distinctive morphology, and live photographs when available are presented.

2. MATERIAL AND METHODS

Herbarium specimens coming from the Chocó department were consulted in the herbarium HUA, along to review of digital images of representative specimens from the herbaria COL, F, MEXU, MO, NY, U, UDBC and US, acronyms according to Thiers [16]. For each species, the taxonomy at genus and species level follows their respective taxonomic literature [17, 18, 19, 20, 21, 22, 23], along to review of their heterotypic synonyms and similar species through the Tropicos Data Base (tropicos.org), type specimens and protologues in Jstor Global Plants Project, original publications, and respective virtual herbaria when available. For the first records here presented were checked their absence of records for the country in the aforementioned herbaria, as well as in the ongoing checklist of Bernal et al. [24].

The morphological descriptions were based in the most recent or actualized literature of each species. For the biogeographical regions of Colombia followed the definition by Bernal [2], the climate types are according to the classification of Kottek et al. [25], the composite digital plates were made using GIMP 2.10.32. The geographical distribution maps were made using ArcGIS 10.5. Data on locality or georeferencing not included in the specimen labels and thus deduced in this study, are placed in square brackets in the specimen citation.

3. RESULTS AND DISCUSSION

3.1 First records for flora of Colombia

3.1.1 Anacardiaceae

***Mosquitoxylum jamaicense* Krug & Urb., Notizbl. Königl. Bot. Gart. Berlin 1: 79. 1895. Figs. 1, 2.**

Type:—JAMAICA. District of Hanover: 1886 (fr), *J. H. Hart 1287* (C barcode 10005504 [digital image!]; US accession 1364996 [digital image!]).

Distinctive morphology: *Trees* up to 30 m tall, exudate whitish. *Leaves* odd-pinnate, 11 to more foliolate, glabrous to puberulous, rhachis unwinged, leaftets petiolulate, without a distinctive marginal secondary vein (e.g., present in the

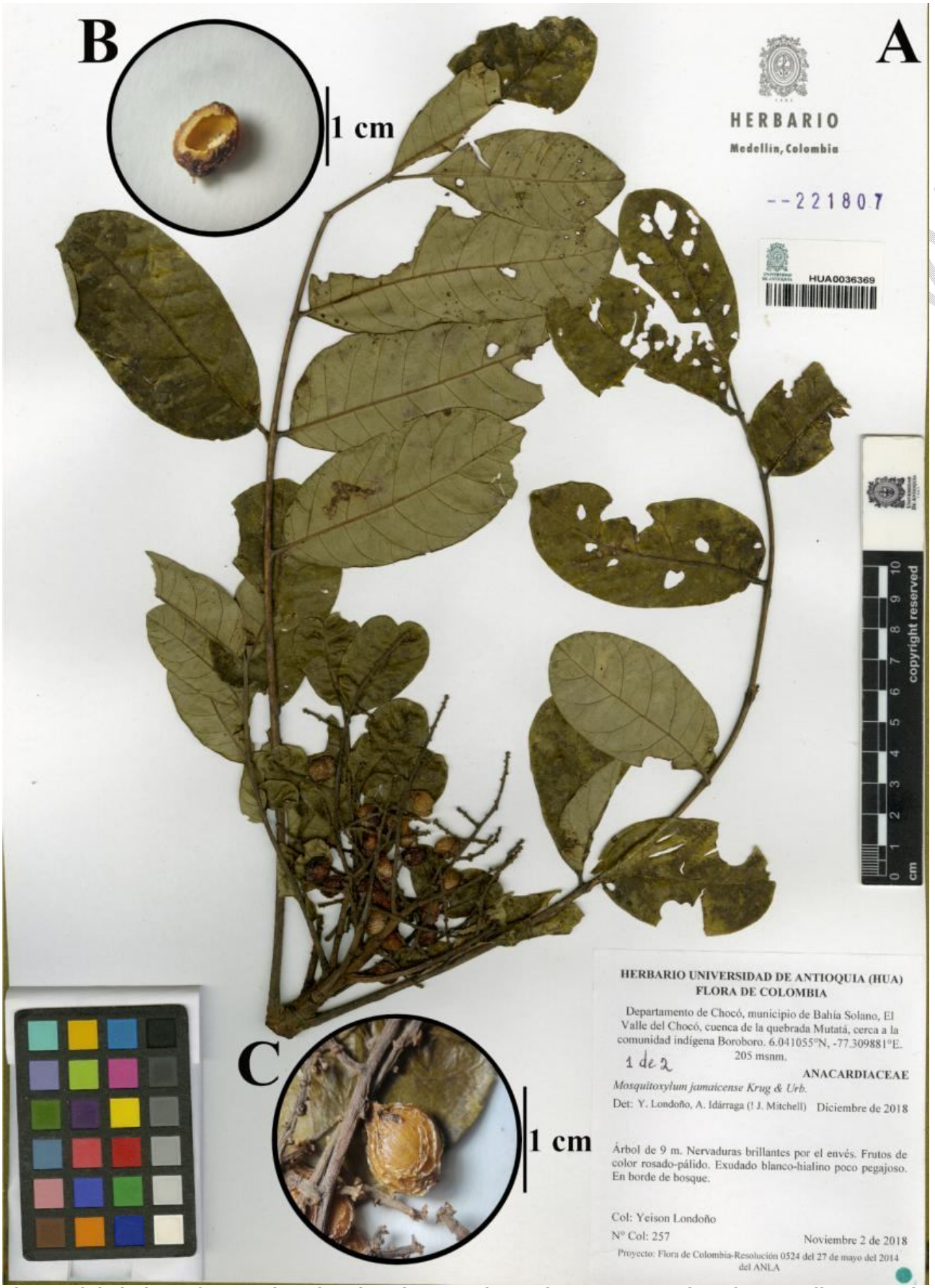

Fig. 1. Digital plate of *Mosquitoxylum jamaicense*. A) Specimen at HUA. B) Fruit manually open, showing locule

mainly empty. C) Fruit, showing outer surface. A-C from *Y. Londoño 257* (HUA accession 221807 [!]). Digital plate by Y. Londoño.

genus *Spondias* L.), margin entire. *Flowers* sessile, hypogynous, haplostemonous, petals present, carpels 3. *Fruits* as drupes, 1-locular, reddish in vivo, glabrous, the seeds occupying a little portion of the locule, locule otherwise empty [17].

Distribution and habitat: Southern Mexico and Jamaica to western Ecuador [17]. In Colombia its occurrence is here documented for first time, where it was recorded from the western slopes of the Baudó Mountain Range (Serranía de Baudó), in the municipality of Bahía Solano (Fig. 3). *Mosquitoxylum jamaicense* in Colombia, occurs in lowland rainforest, at an elevation nearly to 205 m, under equatorial rainforest climate type (Af).

Notes: *Mosquitoxylum* Krug & Urb is a monotypic genus. The unique species, *Mosquitoxylum jamaicense* is widely distributed from Caribbean basin in Mesoamerica to Pacific basin in Northern South America. Although its occurrence in Panama and Ecuador suggested potentially its presence in Colombia, any field record or specimen were known heretofore from the country [26]. The specimen *Y. Londoño 257* is the unique and first documented record from Colombia.

Common names and uses: Mosquito wood (Jamaica) [from the protologue]; Jobillo, Carbonero (Panamá) [27]; Chichemeca (Nicaragua) [28]; Aceituno negro, Cedro negro, Cirrí blanco, Cirrí colorado (Costa Rica) [29]. Used as medicinal in Mexico for menstrual problems, hemorrhages, and gonorrhea [30]; reported as valuable for building in “Flora of Panama” [31]. No common names or uses are reported by indigenous people from Colombia.

Additional specimens examined:—COLOMBIA. Chocó: Mun. Bahía Solano, el Valle del Chocó, cuenca de la quebrada Mutatá, cerca a la comunidad indígena Boroboro, 205 m, 6°2'27.80”N, 77°18’35.57”W, 2 November 2018 (fr), *Y. Londoño 257* (HUA accession 221807 [!], HUA accession 221808 [!]).

Fig. 2. Live photograph of *Mosquitoxylum jamaicense* from the Chocó department in Colombia, showing a fruiting branchlet. Photograph from *Y. Londoño 257* (HUA accession 221807 [!]). Photographed by Y. Londoño.

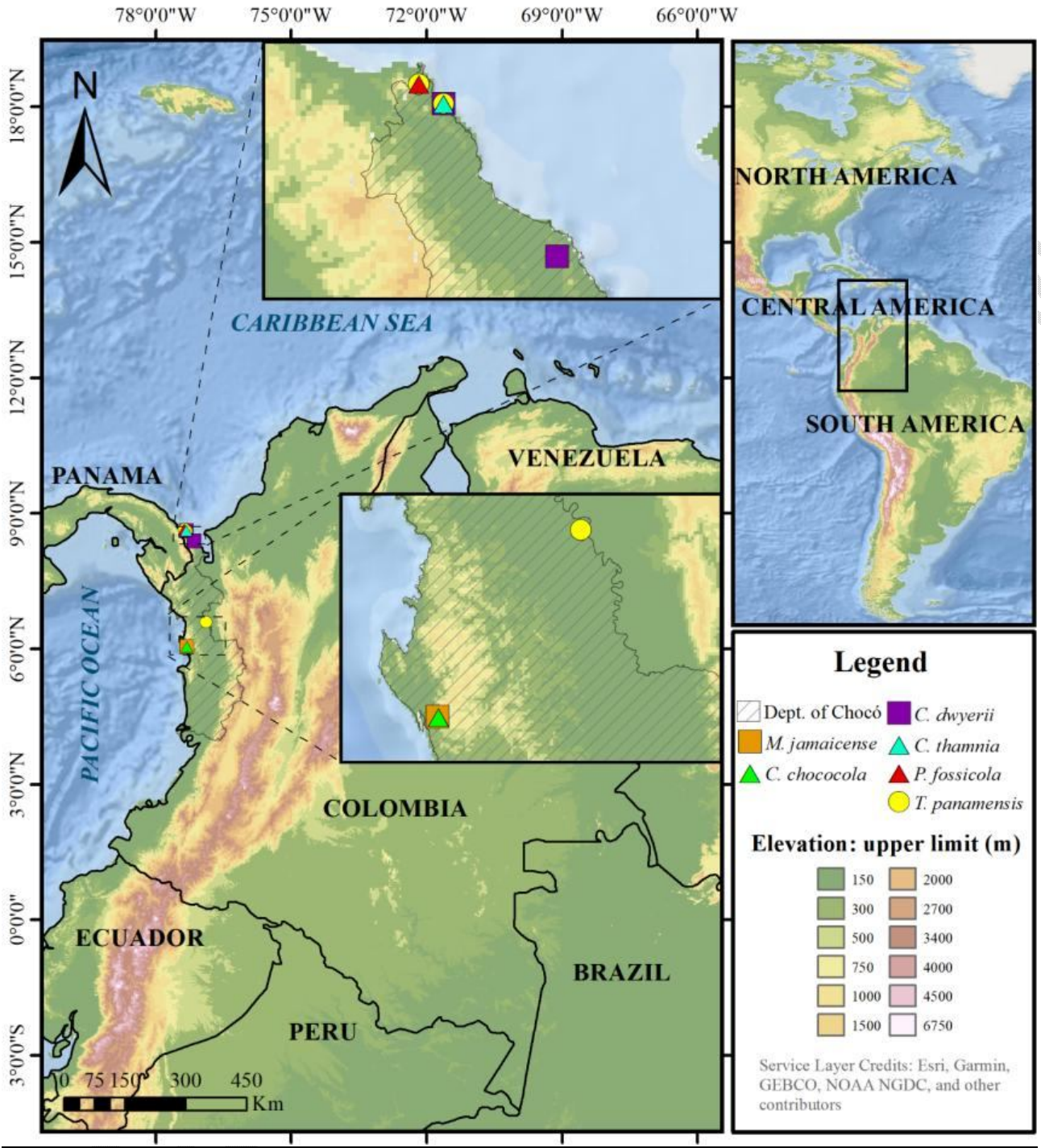

Fig. 3. Geographical distribution map inside Colombia of *Mosquitoxylum jamaicense*, *Cynometra dwyerii*, *Tachigali panamensis*, *Pouteria fossicola*; and georeferenced records of *Cremastosperma chococola* and *Casearia thamnia*.

3.1.2 Fabaceae (Leguminosae)

***Cynometra dwyerii* Rados., PhytoKeys 127: 21, f. 6, 7. 2019. Fig. 4.**

Type:—PANAMA. Darién: [now Comarca Emberá-Wounaan], vicinity of Campamento Buena Vista, Río Chucunaque above confluence with Río Tuquesa, [08°23'N, 77°47'W] 5 July 1959 (fr), *W. L. Stern 941* (holotype: US accession 2396799 [digital image!]; isotype: MO accession 1759925 [n.v.]).

Distinctive morphology: *Trees* up to 30 m tall; leaves alternate, bifoliate, leaflets blade 3.1-3.9 × 1.4-1.9 cm, pubescent toward the midvein and secondary veins abaxially, pubescent toward midvein adaxially, blade isolate pubescent,

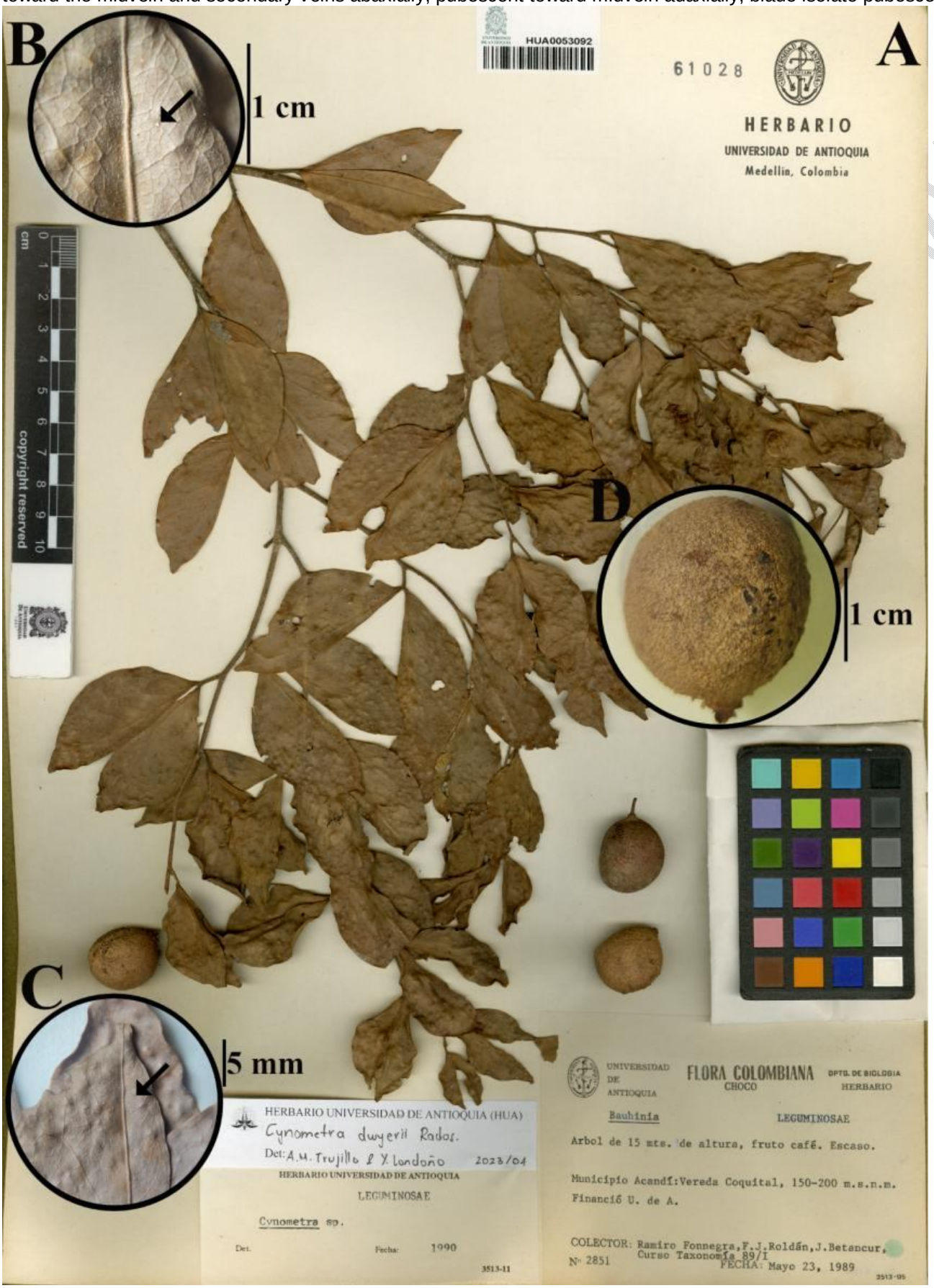

Fig. 4. Digital plate of *Cynometra dwyerii*. A) Specimen at HUA. B) Detail of leaflet at abaxial surface, showing laminar glands and indumentum, arrow indicating a gland. C) Detail of leaflet at abaxial surface, showing distribution of laminar glands on the leaflet upper half, arrow indicating a gland. D) Fruit, outer surface. A-D from *R. Fonnegra et al. 2851* (HUA accession 61028 [!]). Digital plate by Y. Londoño.

acroscopic side with 3-6 glands between the margin and midvein; midvein and secondary veins raised abaxially, slightly less so adaxially. *Racemes* axillary or ramiflorous. *Flowers* unknown. *Fruits* up to 4.7 cm diam., surface of valves rugulose, globose, indehiscent, 1-seeded [18].

Distribution and habitat: Panamá in the Darién region [18]. In Colombia record from the Darién region, in the municipality of Acandí (Fig. 3), inhabits lowland rainforest nearly to the sea level, under equatorial rainforest climate type (Af).

Common names and uses: No common names or uses were reported.

Notes: *Cynometra dwyerii* was known only from the type collection, near to frontier between Colombia and Panama. The specimen *R. Fonnegra et al. 2851* is the second record of the species after of type, and the first record for Colombia. The geographical range of *C. dwyerii* stills nearly equal because the Colombian record locality is very near to the frontier with Panama.
Cynometra dwyerii is easily recognized vegetatively by its leaflet small with numerous glands between the margin and midvein in the acroscopic side and its indumentum in the blade [18].

Additional specimens examined:—COLOMBIA. Chocó. Mun. Acandí: Vereda Coquital, 150-200 m, [8°22’53.39”N, 77° 9’7.13”W], 23 May 1989 (fr), *R. Fonnegra et al. 2851* (HUA accession 61028 [!], MO accession 4593241; [n.v.]). Corregimiento de Capurganá, Bahía El Aguacate-Reserva Natural El Aguacate, Parcela Permanente, 200-250 m, 8°36’58”N, 77°19’41.6”W, 23 July 2008 (st), *S.E. Hoyos-Gómez et al. 808* (HUA accession 167747 [!]); ibid., 6 September 2008 (st), *S.E. Hoyos-Gómez et al. 877* (HUA accession 167756 [!]).

***Tachigali panamensis* van der Werff & N. Zamora, Harv Pap Bot 15(1): 150, f. 1. 2010. Fig. 5.**

Type:—PANAMA, Canal Zone, Barro Colorado Island, 22 August 1978 (fl), *R. Foster & C. Philips 2905* (holotype: PMA accession 14378 [n.v.]; isotype: F accession 1845721 [digital image!], MO accession 2667143 [n.v.]).

Distinctive morphology: *Trees* up to 30 m tall, stipules pinnately divided, leaves alternate, 8-11 pairs of opposite leaflets, paripinnate, leaflet blade 6-13 × 2-4 cm, glabrous adaxially, sparsely appressed abaxially. *Inflorescences* as panicles terminals up to 20 cm long. *Flowers* with hypanthium cupular, asymmetrical, stamens 10, actinomorphic, monomorphic. *Fruits* samara 14-16 × 4.5-5.5 cm, laterally compressed [19].

Distribution and habitat: Panamá, only known from Canal Zone and Barro Colorado Island [19]. In Colombia record from the Darién region, in the municipality of Acandí (Fig. 3), inhabits lowland rainforest nearly to the sea level, under equatorial rainforest climate type (Af).

Common names and uses: “Mierda de cachaco” from *E. Correa et al. 40* (Colombia); Alazano, Reseco (Panamá) [27]. Used in construction in general and the manufacture of furniture and fence post [27].

Notes: *Tachigali panamensis* was known only from Panamá, being this the first record from Colombia. *T. panamensis* has been included under *Tachigali versicolor* Standl. & L.O. Williams distributed in Costa Rica, from which it differs mainly by its pinnate stipules (vs. entire in *T. versicolor*) [19]. *Tachigali panamensis* has been reported as monocarpic, dying after its first flowering [32].

Additional specimens examined:—COLOMBIA. Antioquia. Mun. Vigia del Fuerte: Comunidad indig. de Jarapeto, Río Jarapeto, 18 m, 6°35’33”N 76°53’12”W, 22 May 1993 (st), *José A. Gómez 637* (HUA accession 100595 [!]). Chocó. Mun. Acandí: Reserva Agua Viva, 100m, 8 March 2000 (st), *E. Correa et al. 40* (HUA accession 151958 [!], JAUM [n.v.]); Corregimiento Capurganá, bahía El Aguacate, reserva Natural El Aguacate, parcela permanente, 200-250 m, 8°36’58.60”N, 77°19’41.60”W, 6 September 2008 (st), *S. E. Hoyos-Gómez et al. 868* (HUA accession 167754 [!]).

3.1.3 Sapotaceae

***Pouteria fossicola* Cronquist, Lloydia 9 (4): 289-290. 1946. Fig. 6.**

Type:—PANAMA. Canal Zone: Barro Colorado Island, north shore near Pearson terminal, 7 September 1929 (fl & fr), *F. M. Salvoza 999* (holotype: A barcode 00075804 [digital image!]; isotype: A barcode 00075805 [digital image!]).

Fig. 5. Digital plate of *Tachigali panamensis*. A) Specimen at HUA. B) Detail of stipule. A-B from *E. Correa et al. 40* (HUA accession 151958 [!]). Digital plate by Y. Londoño.

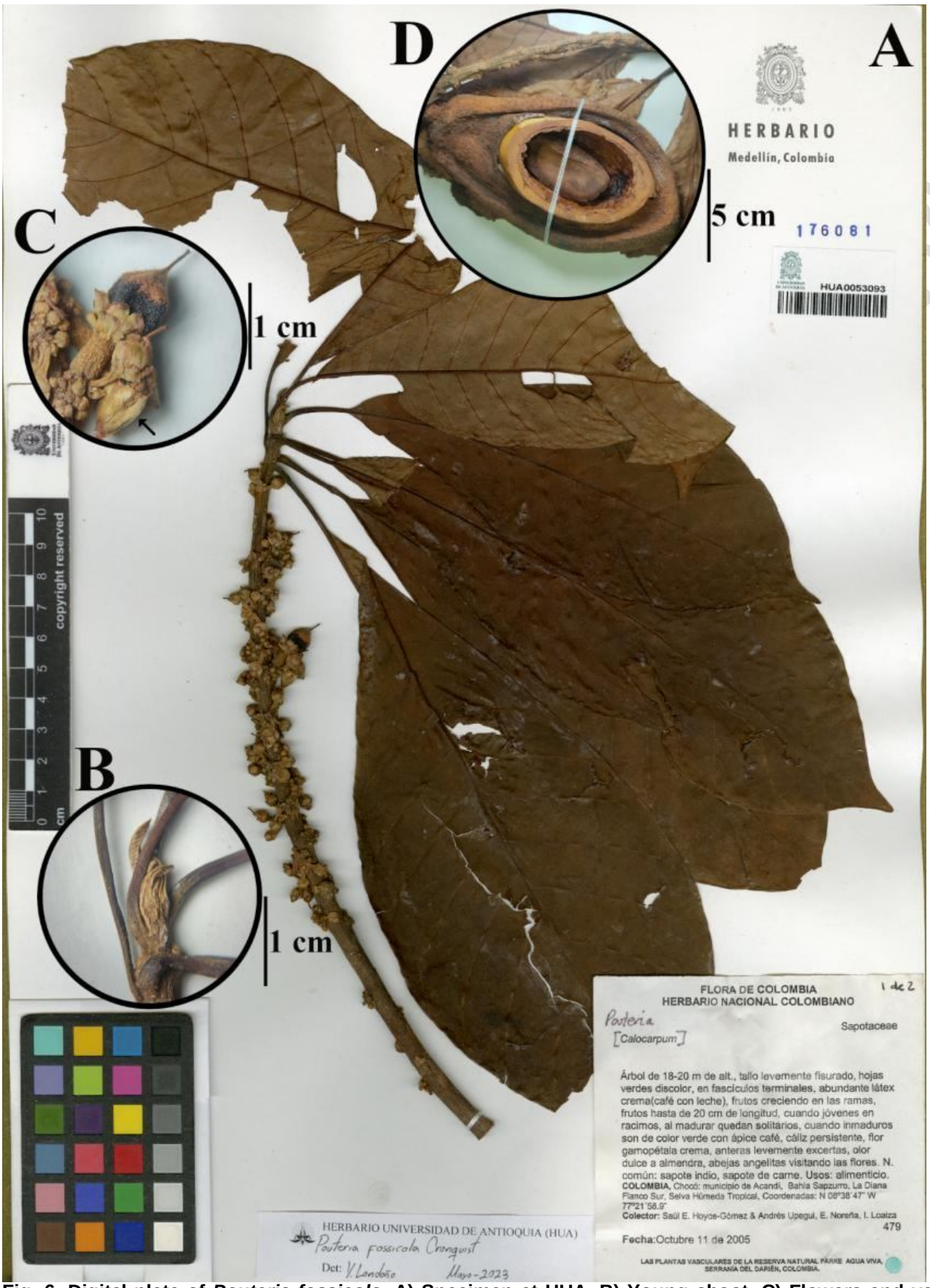

Fig. 6. Digital plate of *Pouteria fossicola*. A) Specimen at HUA. B) Young shoot. C) Flowers and very immature

fruit, arrow indicating the outer surface of corolla. D) Mature fruit, longitudinally and manually open. A-C from *S. E. Hoyos-Gómez et al. 479* (HUA accession 176081 [!]); D from *S. E. Hoyos-Gómez et al. 479* (HUA accession 176106 [!]). Digital plate by Y. Londoño.

Distinctive morphology: *Trees* up to 30 m tall, young shoots finely white puberulous, stipules absent. *Leaves* spirally arranged, chartaceous, base acute to narrowly attenuate, mainly glabrous abaxially, secondary veins 13-20 in each side, tertiary veins oblique, quaternary veins finely areolate. *Flowers* with 7-8 sepals, spirally arranged, each appressed puberulous outside but glabrous toward margin, corolla tubular, 5-merous, sericeous outside, lobes entire, stamens included, staminodes present, ovary 5-locular. *Fruits* broadly ellipsoid to broadly ovoid, 10-25 cm long, surface densely lenticelate, seed with cotyledons plano-convex, without endosperm [20].

Distribution and habitat: Nicaragua to Panama [20, 33]. First documented from Colombia herein, through a record from the Darién region, in the municipality of Acandí (Fig. 3). *Pouteria fossicola* in Colombia, inhabits lowland rainforest nearly to the sea level, under equatorial rainforest climate type (Af).

Common names and uses: Mamey, Mamey de injerto, Mamey verde (Panama); Zapote (Costa Rica) [20]; Zapote de montaña (Nicaragua) [33]; Sapote indio, Sapote de carne (Colombia) from S. E. Hoyos-Gómez et al. 479. Used as alimentary by its edible fruits (fide *S. E. Hoyos-Gómez et al. 479*) and T.D. Pennington [20].

Notes: *Pouteria fossicola* has an edible fruit like to the fruit of *P. sapota* (Jacq.) H.E. Moore & Stearn, a species apparently closely related to it and widely used in Central and South America. This is the first record for Colombia, although the geographical range stills nearly equal because the record locality is very near to the frontier between Colombia and Panama. Previous record of *Pouteria fossicola* from Colombia are based in misidentified specimens from the Amazon biogeographic region (*D. Cárdenas et al. 42282* [NY!]), due fact, a duplicate of this specimen at the herbarium COAH was identified as *Pouteria baehniana* Monach. by T.D. Pennington in the year 2017. *Pouteria fossicola* is clearly recognizable from the specimen *Cárdenas et al. 42282* by its leaves chartaceous (vs. coriaceous in *Cárdenas et al. 42282*), its leave quaternary veins finely areolate (vs. perpendicular to the tertiaries, not finely areolate), its sepals indumented but glabrous toward margins (vs. indumented throughout) and its corolla sericeous outside (vs. glabrous).

Additional specimens examined:—COLOMBIA. Chocó: Mun. Acandí, Bahía Sapzurro, La Diana Flanco Sur, selva humeda tropical, 8°38’47”N, 77°21’58.9”W, 11 October 2005 (fl & fr), *S. E. Hoyos-Gómez et al. 479* (COL [n.v.], HUA accession 176081 [!], HUA accession 176106 [!]).

3.2 Noteworthy records for flora of Chocó department

3.2.1 Annonaceae

***Cremastosperma chococola* Pirie, Blumea 50: 47, f. 3. 2005. Fig. 7.**

Type:—COLOMBIA, Chocó: Alto de Buey, tropical wet forest, 500-1200 m, 8 January 1973 (fr), *A. H. Gentry & E. Forero 7286* (holotype: MO accession 2130033 [digital image!]; isotype: COL accession 192558 [digital image!]).

Distinctive morphology: *Trees* ca. 5 m tall. *Leaves* blades narrowly elliptic, symmetrical, base acute to cuneate, apex acuminate, glabrous, concolorous, primary vein raised and grooved adaxially, secondary veins 8-10 in each side, marginal vein absent (e.g., present in the genus *Pseudoxandra* R.E. Fr.). *Inflorescences* cauliflorous, 1-flowered, pedicels 3.8-4.2 cm, glabrous. *Fruits* apocarpous, glabrous throughout, monocarps 10-13 per fruit, each 1.3-1.4 × 1-1.1 cm, indehiscent, ellipsoid and strongly asymmetrical, shorter than the stipes, each stipe 1.5-1.8 cm [21].

Distribution and habitat: Endemic to Colombia, where is recorded only for the Chocó department, at surroundings of the Baudó Mountain Range in the municipality of Bahía Solano [21] (Fig. 3). *Cremastosperma chococola* inhabits the understory of lowland rainforest, at elevations between 0 to 1200 m, under equatorial rainforest climate type (Af).

Common names and uses: No common names and uses were reported.

Notes: *Cremastosperma chococola* was only known by three specimens in the last review of the genus, of which the most recent one comes from the year 1990 [21]. The specimen *Y. Londoño 264* is the first record after 28 years, representing the southernmost and more precisely georeferenced known population for this species.

Additional specimens examined:—COLOMBIA. Chocó: Mun. Bahía Solano, el Valle del Chocó, cuenca de la quebrada Mutatá, cerca a la comunidad indígena Boroboro, 307 m, 6°2’26.16”N, 77°18’26.34”W, 2 November 2018 (fr), *Y. Londoño 264* (HUA accession 221719 [!], HUA accession 221720 [!]).

Fig. 7. Digital plate of *Cremastosperma chococola*. A) Specimen at HUA. B) Monocarps and seed surfaces. A from

Y. Londoño 264 **(HUA accession 221719 [!]); B from** ***Y. Londoño 264*** **(HUA accession 221720 [!]). Digital plate by Y. Londoño.**

Fig. 8. Digital plate of *Casearia thamnia*. A) Specimen at HUA. B) Fruit, outer surface. C) Fruit, longitudinally and manually open. A-C from *S. E. Hoyos-Gómez et al. 344* (HUA accession 159705 [!]). Digital plate by Y. Londoño.

3.2.2 Salicaceae

***Casearia thamnia* (L.) T. Samar. & M.H. Alford, Novon 27 (1): 69. 2019. ≡ *Laetia thamnia* L., Plantarum Jamaicensium Pugillus 31. 1759. Fig. 8.**

Type:—JAMAICA. Red hills above the Angels, *P. Browne s.n.* (LINN Cat. 680.1 [digital image!]).

Distinctive morphology: *Shrubs or trees* up to 12 m tall. *Leaves* alternate, oblong to oblanceolate-oblong, apex acuminate, margin slightly crenulate, not revolute, persistent. *Inflorescences* as corymbiform cymes, pedunculate. *Flowers* with receptacle unappendaged or unlobed, sepals 4, free, imbricate, petals absent, stamens perigynous, 60-80 per flower, filaments densely pubescent, ovary superior. *Fruits* as capsules.

Distribution and habitat: Mexico and West Indies to Panama and Colombia [22, 34]. In Colombia only reported for Bolivar department through the specimen *M.H. Curran s.n.* (F accession 576264 [digital image!]; US accession 537578 [digital image!]) identified by H.O. Sleumer in the year 1978. Here, it is firs time recorded from the Chocó department, basing in a record from the Darién region, in the municipality of Acandí (Fig. 3). *Casearia thamnia* in Colombia inhabits lowlands dry or rainforest habitat nearly to sea level, under equatorial climate types at several scales of precipitation (Aw and Af climate types).

Common names and uses: Wattlewood (Jamaica) [22]; Cafecillo, Quitacalzón (Costa Rica) [35]; Conejo, Conejo colorado, Palo blanco, Sarguia (Panama) [36, 23]; Chauché, Ixiim Che, Zapote amarillo (México); Bakelac, Hueso de tortuga, Ixbakelac (Guatemala); Bullyhob, Night perfume, Perfume de la noche (Belice) [23]. Its wood is reported as creamish and hard, but any use is specifically reported by Sleumer [22]. More recently was reported as medicinal for the indigenous people of Panama and also as resource of wood for building [23].

Notes: *Casearia thamnia* stand as a widely distributed species, mainly at the Caribbean basin, including both continental and insular areas. The previous record from Colombia comes from the year 1916, in which M.H. Curran collected the specimens. The specimen *S. E. Hoyos-Gómez et al. 344* represents the second record for Colombia, 89 years after the Curran fieldwork; besides, it is the first record for the Chocó department. In the synopses of the genus *Laetia* Loefl. ex L. for Mesoamerica, *Casearia thamnia* (under *L. thamnia*) was recognized as a polymorphic species that perhaps include more than one taxonomic entities, even after the segregation of *Casearia povedae* (N. Zamora, Aguilar & D. Santam.) T. Samar. & M.H. Alford, a species previously confused and remarkably similar to *C. thamnia* [23]. The specimens here analyzed can be recognized from *C. povedae* by its leaves with margin slightly crenulate, the main useful feature for recognize these species indicated by the authors of *C. povedae*, which has leaves with margin entire in both juvenile and mature individuals.

Additional specimens examined:—COLOMBIA. Chocó. Mun. Acandí: corregimiento Capurganá, El Aguacate, Serranía del Darién, colecciones realizadas en el sendero de la toma de agua del Aguacate, cercanías quebrada la Esperanza y el filo de la montaña respectiva, 250-350 m, 8°37'N, 77°18'W, 24-25 July 2006 (fr), *Julio Betancur et al. 12295* (COL accession 563430 [digital image!], HUA accession 187760 [!]); Bahía El Aguacate, camino hacia la quebrada La Mora, [200-250 m], [8°36'58"N, 77°19'41.6"W], 30 June 2005 (fr), *S. E. Hoyos-Gómez et al. 344* (COL accession 544791 [digital image!], HUA accession 159705 [!]).

4. CONCLUSION

These records make up a small part of the diversity of plants in the biogeographic Chocó, however they allow us to confirm that knowledge about them still requires extensive work. Being the biogeographical Chocó one of the global biodiversity hotspots, these records may be useful for future ecological studies or conservation plans for these species; In addition, they draw attention to the importance of continue to carry out scientific expeditions that increase knowledge of the Chocó flora through biological collections. This study also makes possible to highlight the importance of herbariums and biological collections as essential documentation and study centers in biodiversity research.

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