New and Noteworthy Records of Angiosperms from Pacific Biogeographical Region at Department of Chocó in Colombia, Including Four New Records for the Country

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Authors’ contributions

This work was carried out in collaboration between both authors. Authors AMTL and YLE developed the conceptualization of this study, work on specimen determinations, review of literature and herbariums, and wrote the manuscript. Author YLE made the geographical distribution map and digital plates. Both authors read and approved the final manuscript.

ABSTRACT

Six new or noteworthy records of Angiosperms from Colombia are presented based in herbarium specimens from the Chocó department in Colombia. Four are first records for the country, one is the first record for the Chocó department and one is the most recent record after 28 years of an
The Chocó Biogeographical Region extending in general terms from Southern Nicaragua to Northwestern Ecuador is Earth’s ninth most biodiverse hotspot [1]. It is mainly named Pacific Biogeographical Region in Colombia being defined as the area comprising lowlands adjacent to the Pacific Ocean coast at west to the Andes [2]. One of its particularities is the high rates of precipitation reaching to ca. 11,700 mm per year in some places, giving the category of the Earth’s second rainiest place [1]. The northern Chocó region besides comprises the Central and South America junction, a geological event considered as one of the main factors for the high Neotropical biodiversity [3]. About plants diversity, this area is considered as the most biodiverse in the Earth, while only some forest near to Iquitos (Peru) and in the Southeastern Asiatic Forest reach to similar but lesser diversity [4]. Other studies indicate that the plants 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 comprises the most 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, this region is one of the more inaccessible areas for biological researchers in Colombia, mainly as consequence of long-term armed conflicts [10], thus many species still unknown or scarcely recorded [5]. The species account for this department and the Pacific region have been continuously increasing in the last decades, by means of new species descriptions or new chorological records derived mainly from taxonomical reviews based in herbarium vouchers [11,12,13].

The biodiversity inventory is one of the main steps for any conservation action or ecological study, it 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, become it accessible 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. The protologue information, type specimens and comments about geographical distribution, diagnostic morphological features, common names, uses and relevance of each record are provided. A geographical distribution map, digital plates composed by photographs of herbarium vouchers are presented, as well as live photographs when available.

2. MATERIALS AND METHODS

Herbarium specimens from the Chocó department were consulted in the herbarium...
HUA, along to review of digital images of representative specimens at 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 [17-23], 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, protologues, and respective virtual herbaria when available. For first records were checked their absence of records for the country in the above mentioned herbaria, as well as in the ongoing checklist of Bernal et al. [24].

The morphological descriptions were based in the most recent literature or the broadest study of each species. For biogeographical regions of Colombia followed the definition by Bernal [2], 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 map was 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


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, rachis unwinged, leaflets petiolulate, without a distinctive marginal secondary vein (e.g., present in the 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 locale, 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 Northwestern South America. Although its occurrence in Panama and Ecuador suggested 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, Cirri blanco, Cirri 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°27′20″N, 77°18′35.57″W, 2 November 2018 (fr), Y. Londoño 257 (HUA accession 221807 [!], HUA accession 221808 [!]).

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 Chucunake above confluence with Río Tuquesa, [08°23′N, 77°47′W] 5 July 1959 (fr), Y. 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. 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
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.

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 it is recorded from the Darién region, in the municipality of Acandí (Fig. 3), inhabiting 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* is nearly equal because the Colombian record locality is very near to the frontier with Panama.

*Cynometra dwyerii* is easily recognized vegetatively by its small leaflets with numerous glands between the margin and midvein in the acroscopic side and its blade indumentum [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 it is recorded from the Darién region, in the municipality of Acandí (Fig. 3), inhabiting lowland rainforest nearly to the sea level, under equatorial rainforest climate type (Af).

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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.
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
Common names and uses: “Mierda de cachaco” from E. Correa et al. 40 (Colombia); Alazano, Reseco (Panamá) [27]. It is used in construction and in 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 indíg. 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. Acandi: 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]).

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]. Herein first documented from Colombia, through a record from the Darién region, in the municipality of Acandi (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. Acandi, 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]).
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 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 [l]), HUA accession 221720 [l]).

3.2.2 Salicaceae


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 Bolívar 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 recorded first time from the Chocó department, basing in a record from the Darién region, in the municipality of Acandi (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, Ixim 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* Loeff. 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.
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 [1]). Digital plate by Y. Londoño
Additional specimens examined: Colombia. Chocó. Mun. Acandí: corregimiento Capuruganá, 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 plant diversity in the biogeographic Chocó, however they allow confirm that knowledge about the Chocó flora still requires extensive work. Being the biogeographical Chocó one of the global biodiversity hotspots, these records could be useful for future ecological studies or conservation plans for these species; in addition, they draw attention to the importance of continue carrying out scientific expeditions that improve the knowledge of Chocó flora through biological collections. This study also makes possible to highlight the importance of herbaria and biological collections as essential documentation and study centers in biodiversity research.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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