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A new species of *Helietta* (Pilocarpinae, Zanthoxyloideae, Rutaceae) from Colombia and notes on the morphology and circumscription of *H. glaziovii*

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Abstract

Helietta magna, a new species from the Magdalena River Valley in Colombia is described and illustrated, with notes on its geographical distribution, phenology, conservation status and taxonomic affinities. The new species shares the character of leaflets with an involute margin apically only with *H. apiculata* and *H. glaziovii* and can be distinguished from these two species mainly by its larger leaflets, which are acuminate with involute margin only over the acumen and its ovary puberulous apically. Being the first recorded species from very humid forest, it expands the ecological spectrum of the genus, heretofore known only from mesic to dry habitats. Novel morphological information observed in the type specimens of *H. glaziovii* is also presented, along with notes on its current circumscription.

Key words: Endangered species, Inter Andean Valleys, Magdalena River, Sapindales

Introduction

The genus *Helietta* Tulasne (1847: 280) comprises nine species exclusively distributed in the neotropical and adjacent subtropical regions (Pirani 1998, Kubitzki *et al.* 2011, Cuadros 2023). The species belonging to this genus are recognizable by their shrubby or arboreal habit, trifoliolate and (sub-) opposite leaves; actinomorphic, haplostemonous and bisexual flowers, syncarpic gynoeceum and fruits in a samarium (see Spjut 1994) composed of (3–)4–5 samaroid mericarps separating at maturity, each bearing one distal wing (Pirani 1998).

Recent phylogenetic studies based on molecular data placed *Helietta* in the subfamily Zanthoxyloideae and subtribe Pilocarpinae, the latter an exclusively American clade (Gropo *et al.* 2017, 2022, Appelhans *et al.* 2021). Gropo *et al.* (2017, 2021) recently referred to Pilocarpinae as the sister group of the species-rich neotropical subtribe Galipeinae, while Appelhans *et al.* (2021) found the relationship between the Polyaster Alliance—also exclusively American—, Pilocarpinae and Galipeinae as unresolved in the more robust and recent phylogenetical analyses for Rutaceae. Subsequently, Joyce *et al.* (2023) supported to Pilocarpinae and Galipeinae as both monophyletic and sister groups in a broad phylogenomic study of Sapindales.

Helietta is disjunctively distributed between two main areas: one extending from southern North America (Texas to Mexico), Cuba and northern South America (Venezuela and Colombia), and another area that comprises eastern Paraguay, northern Argentina, and southeastern Brazil, with an isolated record for the eastern Andes slopes of Peru (Pirani 1998, Kubitzki *et al.* 2011). Most of species occur in mesic to dry habitats, *i.e.* in Mexico, northern Colombian-Venezuelan and the dry Cerrado-Chaco-Caatinga region of the Brazilian shield, while the records for the Amazon, Andes and Brazilian Atlantic Coast regions are scanty or lacking (Pirani 1998).

Current studies in taxonomy and systematics of neotropical Rutaceae by the authors detected an undescribed species of *Helietta* from the Magdalena River Valley in Colombia. The new species is here described and illustrated, followed by comments about its geographical distribution, phenology, conservation status and taxonomic affinities. We also provided novel information on the morphology of *Helietta glaziovii* (Engler 1896: 27) Pirani (1998: 369).

Materials and methods

The taxonomic delimitation at the genus and species levels follow treatments and keys by Pirani (1998) and Kubitzki *et al.* (2011). Types and representative specimens of published names within *Helietta* were studied from digital images through the Global Plants project (<http://plants.jstor.org>), respective virtual herbaria, and publications. Herbaria CAUP, COAH, COL, CUVC, F (Digital images), FMB, HUA, HUQ, ICESI, JAUM, MEDEL, TOLI, TULV, UDBC (Digital images) were consulted (acronyms according to Thiers 2023), the herbaria FAUC and UIS were not consulted and are cited below because some cited specimens were on loan for this study or were donated to these herbaria.

For the newly described species, six specimens were analyzed using a stereomicroscope for the taxonomic description and illustration; the flowers and fruits were described and illustrated from material preserved in 70% ethanol, rehydrated material, and photographs of fresh structures. Morphological terminology was mainly taken from Pirani (1998); terms for venation and shape of laminar structures follow Ellis *et al.* (2009). In the description of leaflets, the term “Drip tip” refers to an acuminate apex with the acumen abruptly narrows (Ellis *et al.* 2009: 34). Two types of trichomes are present in *Helietta* (Pirani 1998: 349–351): multicellular, nearly sessile and glandular trichomes or unicellular, simple and cylindric trichomes. The former is here described as “glandular reddish trichomes”. The latter is here described according to terminology by Hewson (2019).

The distribution map was made using Arcgis 10.5. Climatic characterization followed Kottek *et al.* (2006). The conservation status was evaluated according to the criteria of IUCN (2012) in conjunction with the R package “ConR” (Dauby, 2019). The term “subpopulation” is according to the definition by IUCN (2012: 10): “geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange”.

All specimens cited from the department of Antioquia correspond to the same tree within a permanent plot. However, the variations in the writing of the locality and coordinates taken by each collector are kept in the citation of each specimen to avoid confusion about the specimens examined.

Taxonomy

Helietta magna Londoño-Ech., A.M.Trujillo, Pirani & Pérez-Zab., *sp. nov.* (Figs. 1, 2, 3)

Type:—COLOMBIA. Caldas. Mun. La Dorada: Margen del río La Miel, Vereda La Atarraya, Finca Los Achiles, relictos de bosque al margen trasero de la Finca, 214 m, 5°40'44.6"N, 74°44'16.2"W, 3 August 2021 (fl & fr), *D. Sanín* & *D. Jaramillo* 7973 (holotype: FAUC!; isotypes: COL!, FMB!, HUA!, MEDEL!).

Diagnosis:—*Helietta magna* shares the character of leaflets with involute margin at apex only with *H. apiculata* Benth in Hooker (1882: 67) and *H. glaziovii*. From both, *H. magna* can be differentiated by its leaflets mainly acuminate without a drip tip and with the involute margin only over the acumen of apex (*versus* leaflets apiculate with drip tip, margin involute along entire length of apiculum and adjacent margins in *H. apiculata*, or leaflets rounded to blunt at apex and occasionally with involute margin only laterally at very apex in *H. glaziovii*), by its larger leaflets blade (4–)5–12(–17.3) × (1.1–)2.1–5.6(–7) cm [*vs.* (3–)5–8.5(–9.5) × 0.5–1.7(–2.5) cm in *H. apiculata* or 3–8(–9) × 1.4–3.4(–4.2) cm in *H. glaziovii*] and its ovary puberulous apically (*vs.* glabrous in *H. apiculata* and *H. glaziovii*).

Shrub or tree 2–25 m tall, the branches striate, velvety, glabrescent. *Leaves* 3-foliolate, (sub-) opposite, commonly 1–2 leaflets aborting, the petiole (0.4–)1–4 cm long, canaliculate, shortly winged distally, striate, puberulous, glabrescent; petiolules ca. 0.5 mm long, puberulous, glabrescent; leaflet blade (4–)5–12(–17.3) × (1.1–)2.1–5.6(–7) cm, obovate to elliptic, occasionally oblong (very rarely orbicular in stunted leaflets); basally acute (slightly obtuse) and decurrent, symmetrical or asymmetrical (in lateral leaflets), apically acute to obtuse and acuminate without drip tip (very rarely retuse to emarginate in stunted leaflets), glabrous to sparsely puberulous toward the midvein on both surfaces, the

glandular reddish trichomes sparsely in both surfaces; pellucid-punctate, glands visible as dark dots on both surfaces, the margin entire, slightly revolute for almost all length, but noticeably involute only over the acumen of apex; the midvein raised abaxially, slightly raised to flattened adaxially, striate on both surfaces; secondary veins slightly raised on both surfaces, (8–)12–20 pairs, brochidodromous, intersecondaries present, tertiary veins irregularly reticulate. *Inflorescence* a terminal diplothyrs, 5.4–12.8 cm long including peduncle, shorter or longer than the subjacent leaves, puberulous to velvety, peduncle 0.4–1 cm long; bracts ca. 0.5 × 0.7 mm, ovate, present in all nodes of inflorescence, puberulous abaxially, glabrous adaxially, ciliolate; pedicels ca. 0.5 mm long, puberulous to velvety; bractlets 2 per pedicel, ca. 0.5 × 0.5 mm, opposite, in the middle of the pedicel, ovate, puberulous abaxially, glabrous adaxially, ciliolate. *Flowers* 5-merous; calyx quincuncial; sepals 0.6–0.9 × 0.7–0.9 mm, semiorbicular to ovate, apically obtuse and rounded to cuneate, puberulous in both surfaces, the margin erose, ciliolate; petals 2.5–2.9 × 1–1.3 mm, obovate, basally acute and cuneate to unguiculate, apically obtuse and rounded, white *in vivo*, glabrous, recurved in anthesis, the margin erose; the filaments 1.5–1.6 × 0.1–0.3 mm, glabrous, the anthers 0.4–0.5 × 0.3–0.4 mm, dorsifixed, bilobate at apex by extension of the thecae over the connective, thecae ovoid to ellipsoid; disk 0.4–0.6 mm high, plicate, equal to or slightly enclosing the ovary, glabrous, the margin sinuate; ovary 0.4–0.5 mm high, 5-carpellate, puberulous apically, the style 0.4–0.6 mm long, glabrous, the stigma ca. 0.1 × 0.3 mm, glabrous. *Fruit* a samarium of 5 samaroid mericarps, each free at maturity, glandular reddish trichomes scattered on the entire surface, occasionally with very few and isolated simple trichomes; each mericarp with seed locule 0.8–1.3 cm long, ellipsoid, the wing (1.7–)2.1–3 × (0.8–)1–1.3 cm, obovate to elliptic. Seed 1 per mericarp, ca. 9.1 mm long, ellipsoid, the testa slightly rugose without, dark brown to black in rehydrated material, glabrous, the radicle ca. 1 mm long, fleshy, smooth, the cotyledons ca. 6 × 1.3 mm, fleshy, smooth.

Distribution and habitat:—*Helietta magna* is endemic to Colombia, where it has been recorded so far only for the eastern slopes of the Cordillera Central (Central Mountain Range) in the municipalities of Puerto Berrío and La Dorada, in the departments of Antioquia and Caldas respectively (Fig. 4). It is found at an elevation of near 220 m, which corresponds to the biogeographic region of the Magdalena Valley (*sensu* Bernal 2016), under equatorial rainforest climate (Af climate type). Mature individuals, *i.e.* flowering or fruiting, have been observed as emergent trees over the forest canopy, where individuals reach to 18–25 m tall; less frequently as shrubs on disturbed areas in early ecological succession up to 5 m canopy, where individuals were recorded from 2 m tall.

Phenology:—*Helietta magna* has been recorded blooming in August and fruiting in August, November and December.

Etymology:—The epithet from the Latin “Magna”, referencing the great height that individuals reach and also to the size of leaflets, which are the largest within the genus.

Preliminary conservation status:—*Helietta magna* is only known by two isolated subpopulations with an AOO=8 km² and EOO=16 km², none of these occur inside official protected areas. Its range of distribution comprises small and very fragmented forest patches (<50 km²) due to the expansion of the agricultural and livestock frontier; in fact, the Magdalena River Valley is currently considered one of the hotspots of deforestation in Colombia by Sánchez-Cuervo & Aide (2013). Both subpopulations are located less than 10 km from populated centers and are immersed in mining and oils licenses areas. The subpopulation on the department of Caldas is inside the Jardín Botánico del Magdalena (Magdalena Botanical Garden), a recent private initiative for the support and encouragement of the biological research and conservation. Here the proposed category for *Helietta magna* is “Endangered” EN according to the criteria B: B1ab(iii)+2ab(iii) of IUCN (2012), based on its small and restricted geographical distribution, the poor conditions of its habitat, proximity to population centers, as well as the null ecological connectivity of its subpopulations with other forest matrix.

Additional specimens examined:—COLOMBIA. Antioquia. Mun. Puerto Berrío: Hacienda La Suiza, cerca a la escuela La Espiga, 240 m, 6°17'28.8"N, 74°34'52.4"W, 23 January 2001 (st), *A. Idárraga et al.* 1944 (HUA!, JAUM!); vereda La Cristalina, predios de la hacienda bufalera La Suiza, escuela La Espiga (parcela), 250 m, 6°17'27.8"N, 74°34'52.4"W, 15 November 1999 (st), *E. Riascos & A. Duque* 1 (JAUM!); hacienda La Suiza, cerca de la exescuela La Espiga, 216 m, 6°17'30.97"N, 74°34'36.88"W, 30 November 2018 (im fr & fr), *Y. Londoño et al.* 287 (COL!, CUVC!, FAUC!, HUA!, ICESI!, JAUM!, MEDEL!, SPFR!); *ibid.*, 30 November 2018 (im fr & fr), *A.M. Trujillo et al.* 68 (FAUC!, HUA!, JAUM!, MEDEL!, SPF!). Caldas. Mun. La Dorada: vereda La Atrarraya, finca Los Achiles, predios del Jardín Botánico del Magdalena, entrando por un caño al margen de la vía, 224 m, 5°40'0.5"N, 74°44'12.9"W, 5 December 2021 (fr), *D. Sanín et al.* 8005 (COL!, FMB!, FAUC!, HUA!, JAUM!, MEDEL!, UDBC!, UIS!).



FIGURE 1. Isotype of *Helietta magna* at HUA (Sanin & Jaramillo 7973).

Notes:—*Helietta magna* is a unique species within the genus, because of its larger leaflets and as it inhabits very humid forest, *i.e.* under equatorial rainforest climate (vs. mesic to dry habitats where all other species are found, Pirani 1998), which expands the ecological spectrum of the genus. Table 1 presents the main features that are useful

for the recognition between the species of *Helietta* that exhibit leaflets with margin involute at apex, besides some morphological data not previously reported for *Helietta glaziovii* (see the comments for *H. glaziovii* below).

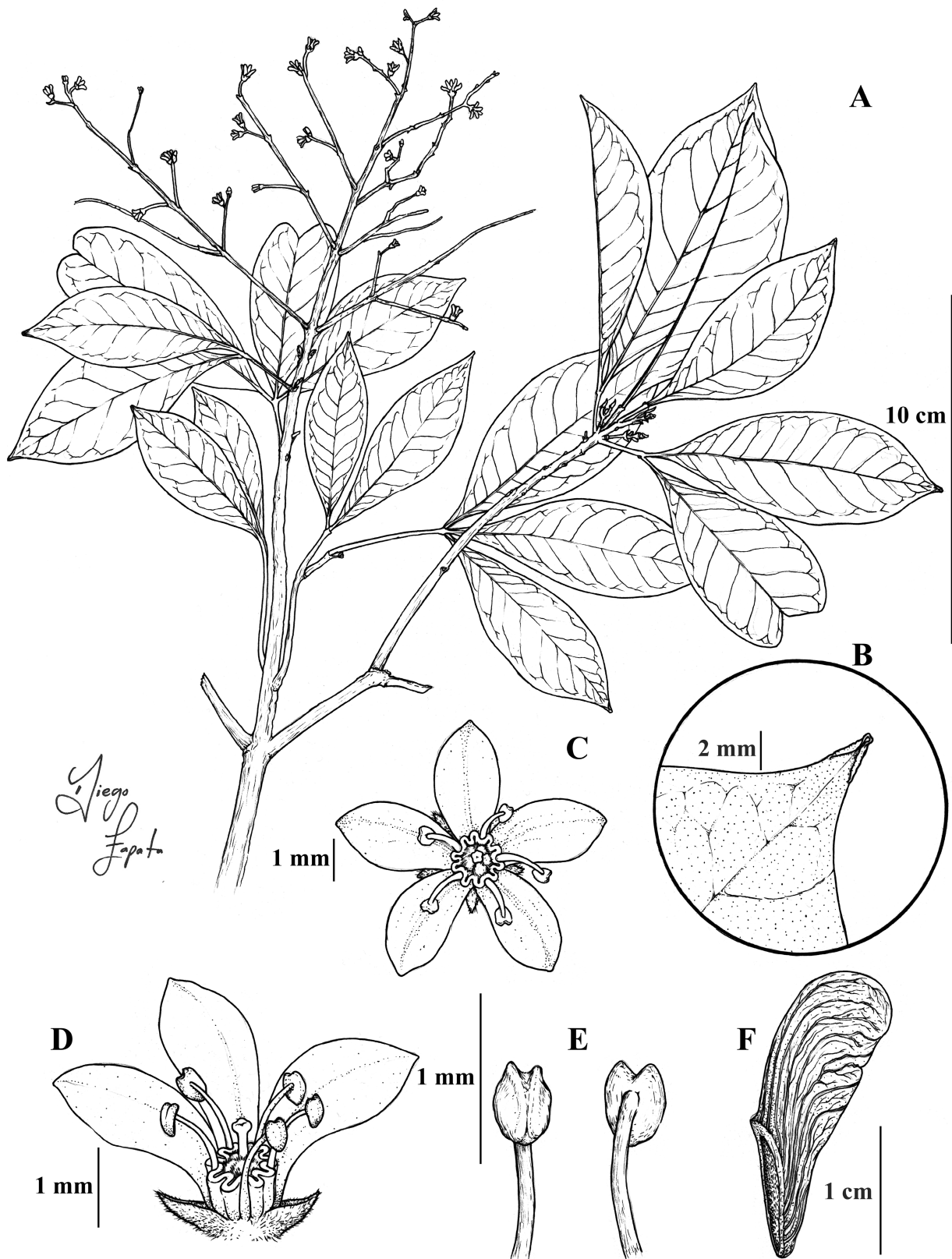


FIGURE 2. Illustration of *Helietta magna*: **A.** Distal portion of flowering branch, **B.** Apex of leaflet with involute margin over the acumen, **C.** Flower, upper view, showing the ovary puberulous apically **D.** Flower without two petals and one sepal, lateral view, showing the ovary puberulous apically **E.** Distal portion of stamen, adaxial and abaxial view, **F.** Mericarp. (A from the isotype at FMB, B–E from the holotype, F from *Y. Londoño et al.* 287. Illustration by Diego Armando Zapata, HUA illustrator).

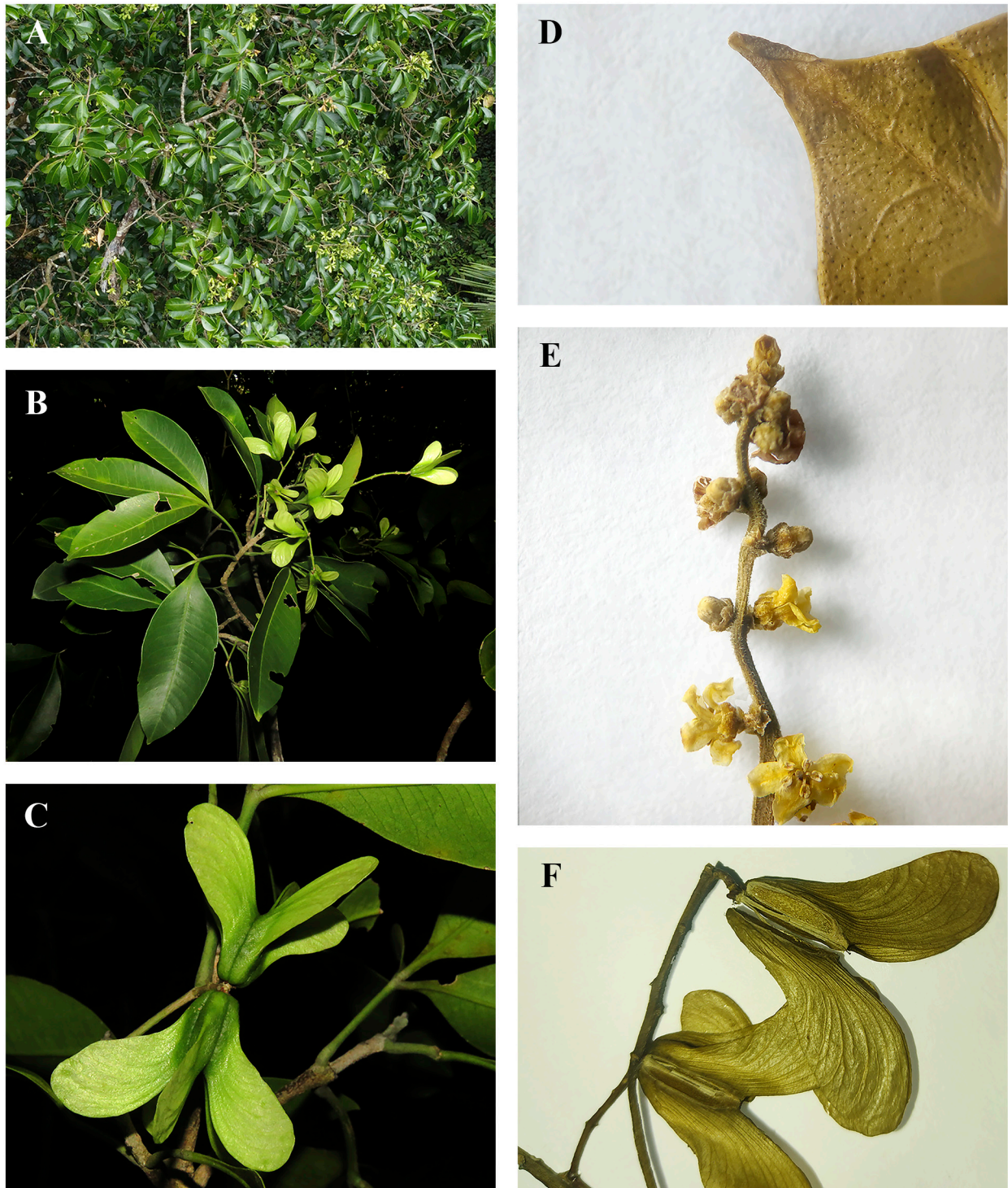


FIGURE 3. Photographs of *Helietta magna*: **A.** Tree top view from drone, **B.** Fruiting branchlet *in vivo*, **C.** Samarium *in vivo*, **D.** Leaflets apex in dried specimen, **E.** Distal portion of inflorescence in dried specimen, **F.** Samarium in dried specimen. (A from *D. Sanin et al. 8005*, B–D, F from *Y. Londoño et al. 287*, E from the holotype. Composed by Ana Cristina Pareja, HUA illustrator. A by Miguel Uribe, B–F by Y. Londoño).

Helietta glaziovii (Engl.) Pirani. *Esenbeckia glaziovii* Engl.

Type:—BRAZIL. Rio de Janeiro: Alto Macahé [Macaé], 2 June 1891 (fl), *A. Glaziou 18171* (Lectotype designated by Pirani 1998: P-2440994 [digital image!]; Isolectotypes: C-10018445 [digital image!], C-10018446 [digital image!], F-936483 [digital image!], K-531280 [digital image!], LE-2719 [digital image!], P-6679885 [digital image!], P-6679886 [digital image!]; photos of destroyed B holotype at F, MO, NY, SPF).

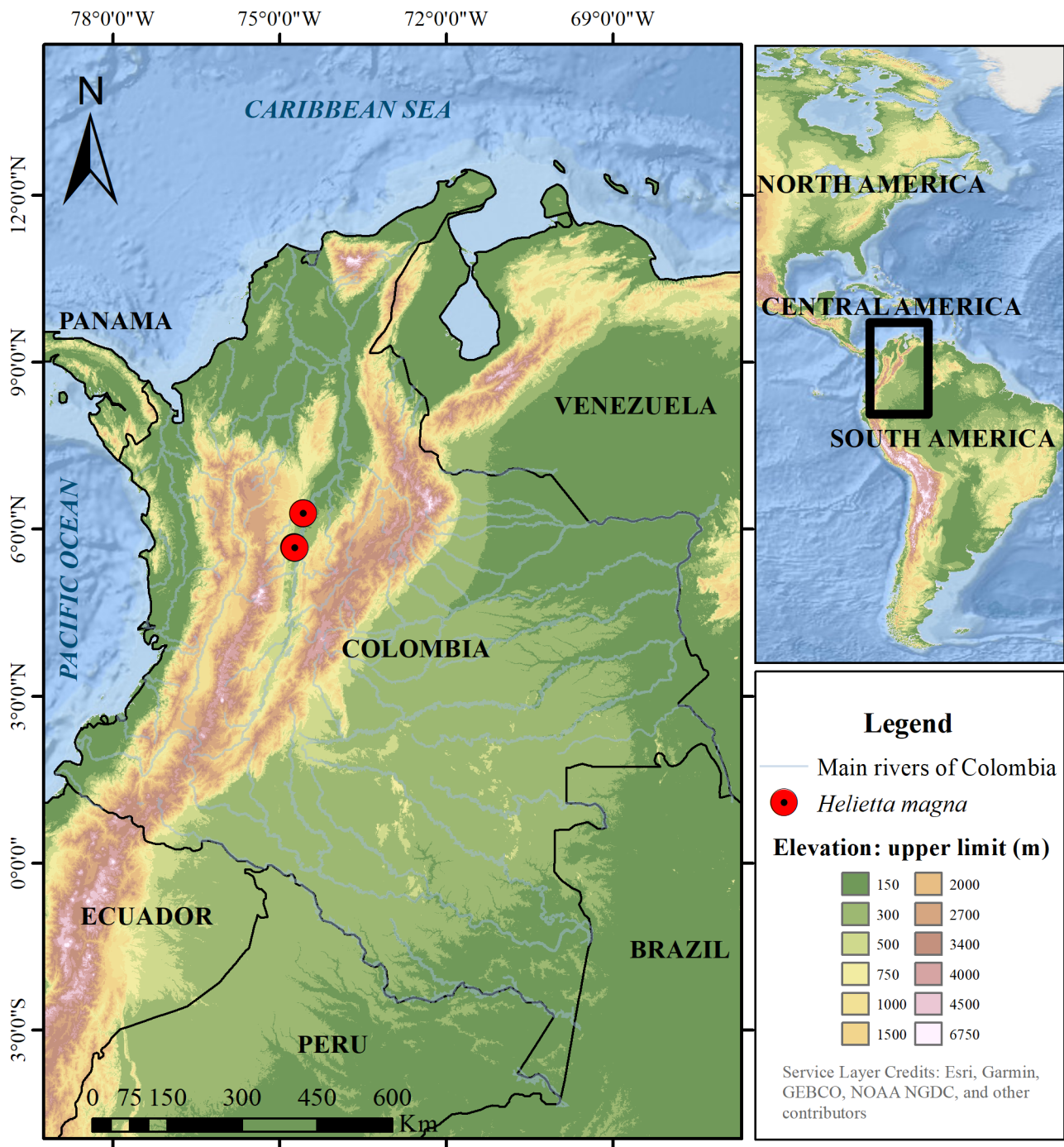


FIGURE 4. Geographical distribution of *Helietta magna*.

The morphological limits of *Helietta glaziovii* were reviewed during this study. Two additional features not previously recorded by Pirani (1998) were detected in the type specimens: Its leaflets with margin involute laterally at the very apex and its petals being glabrous, not ciliate. The current circumscription of *H. glaziovii* by Pirani (1998) and Pirani & Groppo (2023) is based on several additional specimens from the Espinhaço Range and other areas in the states of Bahia, Minas Gerais and Goiás, in Central and eastern Brazil. However, none of these specimens exhibit leaflets with margin involute at apex and a few of them have petals that are glabrous. These features are taxonomically important for the species circumscription within the genus and could suggest the possibility of recognition of two taxa. However, this is prevented by the absence of additional specimens exhibiting the morphological combination present in the type of *H. glaziovii*, as well as by the doubt about the precise type locality, since the annotation by Glaziou on the labels are undoubtedly inaccurate (see Pirani 1998: 369–371). It is very unlikely that the type specimen could have been collected around Macaé in Rio de Janeiro state, a region included within the moist Atlantic Forest Dominion. Previous

analyses of specimens of other families collected by Glaziou also lead to the conclusion that he probably provided erroneous data about the locality of some collections (cf. Rudd 1965: 367, Wurdack 1970, Kaastra 1982: 115, Pirani 1998: 369–371).

TABLE 1. Comparative characters of *Helietta apiculata*, *H. glaziovii*, and *H. magna*.

Character	Species		
	<i>H. apiculata</i>	<i>H. glaziovii</i>	<i>H. magna</i>
Length of leaflets (cm)	(3–)5–8.5(–9.5)	3–8(–9)	(4–)5–12(–17.3)
Width of leaflets (cm)	0.5–1.7(–2.5)	1.4–3.4(–4.2)	(1.1–)2.1–5.6(–7)
Apex of leaflets	Apiculate with drip tip, margin involute along entire length of apiculum and adjacent margins	Rounded to blunt or retuse to emarginate, margin involute laterally at very apex or not involute	Acuminate without drip tip, margin involute only over the acumen
Merosity of flowers	(4–)5-merous	(4–)5-merous	5-merous
Indumentum of petals	Glabrous	Glabrous or ciliolate	Glabrous
Indumentum of ovary	Glabrous	Glabrous	Puberulous apically
Shape of wing of mericarps	Oblong	Oblong	Obovate to elliptic
Width of wing of mericarps (mm)	5–9	9–11	(8–)10–13
Distribution	Eastern Paraguay, southern Brazil and in northeastern Argentina*	Central and eastern Brazil	Central Colombia

*The previous record of *Helietta apiculata* from Peru is excluded here. This record was based on *Gentry & Smith 45084* (MO-n.v., U-1578709 [digital image!]), which only have young inflorescences and the leaf morphology does not completely match *H. apiculata*. In addition, leaflets with involute margin at the apex have been detected in some species of *Esenbeckia* Kunth (1825: 246), e.g. in *E. cornuta* Engler (1874: 146), and occasionally in *Balfourodendron* Corr. Méllö ex Oliver (in Hooker 1877: 3–4). It is considered here that assign a precise identity to the specimen *Gentry & Smith 45084* is not possible while fruiting specimens from that population have not seen.

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