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Brownea jaramilloi (Leguminosae: Caesalpinioideae), a new, over-looked species endemic to the Ecuadorian Amazon

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Summary. *Brownea jaramilloi*, a new species, endemic to the northeastern Ecuadorian Amazon, is described and illustrated, and its placement in the genus discussed. It is unique in the genus *Brownea* in being characterised by yellow flowers. In a 25-ha plot in Yasuni National Park, this new species averaged 20 individuals (with dbh≥1 cm) per hectare.

Resumen. *Brownea jaramilloi*, una nueva especie, endémica de la Amazonía del noreste de Ecuador se describe e ilustra y se discute su ubicación en el género. Esta es la única especie en el género *Brownea* que se caracteriza por tener flores amarillas. En una parcela de 25-ha en el Parque Nacional Yasuni se ha registrado un promedio de 20 individuos (con DAP≥1 cm) por hectárea.

Key Words. DNA, endemism, Fabaceae, IUCN, *matK*, taxonomy, Yasuni National Park.

Introduction

Brownea Jacq. is a neotropical legume genus (belonging to subfamily Caesalpinioideae) and consists of 12 – 15 species of understory shrubs and trees (Klitgård 1991a; Mackinder 2005). The species occur from humid tropical lowland to premontane forests, from sea level to 1300 m, and range from Costa Rica south to Peru and Brazil (Klitgård 1991a; Velásquez & Agostini 1981). In recent years a few new species of *Brownea* have been described from Colombia by Quiñones (1995, 1997) (*B. enricii* Quiñones, *B. santanderensis* Quiñones, *B. chocoana* Quiñones) and Venezuela by Velásquez & Agostini (1981) (*B. gladysrojasiae* D. Velásquez & G. Agostini, *B. tillettiana* D. Velásquez & G. Agostini), but this is the first new species from Ecuador since 1948 when Little published *B. angustiflora* Little (1948) and *B. puberula* Little. Both these species were described from the coastal rain forest of Esmeraldas and both were later synonymised under *B. coccinea* Jacq. (Klitgård 1991a). Until now four species of *Brownea* were reported from Ecuador, two of which are native to the coastal rainforest (*B. coccinea* Jacq. and *B. multijuga* Britton & Killip), and two native to the Amazonian rainforests (*B. grandiceps* Jacq. and *B. macrophylla* Hort. ex Mast.). On both sides of Andean Ecuador the species reach about 1000 m above sea level. All the Ecuadorian species are either used medicinally and/or as ornamentals (Klitgård 1991b; Neill *et al.* 1999; Rios *et al.* 2007; Torre *et al.* 2008).

As a result of intensive survey work and studies of *Brownea* specimens collected around the Yasuni Scientific Station and in the large plot of the Yasuni Forest Dynamics Project (Valencia *et al.* 2004) we conclude that this species is new to science, and easily distinguishable from *Brownea grandiceps* Jacq., also recorded from YFDP plot. Its yellow flowers are unique in the genus; all other species except one (*B. leucantha* Jacq. with cream flowers) are characterised by bright scarlet to orange hummingbird-pollinated globose inflorescences. The species is herein described and illustrated, and its biology, phenology and position in the genus *Brownea* discussed.

Materials and Methods

This study is based on: (1) collection and monitoring of all the individuals and species of *Brownea* present at the 25-ha plot in the Yasuni National Park; (2) revision of all relevant literature; (3) examination of collections available at QCA, QCNE and K (all specimens cited have been seen by the authors); (4) extraction of DNA and sequencing of the *matK* gene; (5) phylogenetic analysis of the molecular data using

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standard molecular methods and phylogenetic analysis of the molecular data using the Maximum Likelihood algorithm (GTR+I+Γ model) as implemented in RAxML (Stamatakis *et al.* 2008). Conservation status category and assessment criteria are based on IUCN (2001).

Taxonomy

Brownea jaramilloi *A. J. Pérez & Klitg.* **sp. nov.** The new species resembles *Brownea grandiceps* Jacq. but it differs in leaf, inflorescence, flower, and fruit morphology (Table 1), and its striking, yellow flowers makes it unique in the genus *Brownea*. Type: Ecuador, Orellana, Estación Científica Yasuni, *Villa & Alvia* 1606 (holotype QCA!; isotype K!).

http://www.ipni.org/urn:lsid:ipni.org:names:77123562-1

Tree to 15 m tall, 8 – 18 cm in diam. (dbh). *Bark* and branches with corky lenticels. *Branchlets* with 4 longitudinal furrows (cross-shaped in cross-section), mature parts ± terete (if cross-sectioned still with central cross-shape). *Leaves* with (2 –) 6 – 9 (– 11) pairs of leaflets; rachis subterete near the petiole and terete at the distal part; rachis and petiole (10 –) 25 – 50 (– 65) cm long; petiole glabrous, swollen, 0.5 – 2 cm; petiolules 0.5 – 1 mm; leaflets subopposite to alternate, leathery, midvein ± tomentose, soon glabrous, glossy green above, paler below, proximal leaflets ovate, 7 – 15 (– 22) × 2 – 5 cm, distal ones oblanceolate, (13 –) 18 – 28 × 4 – 8 cm, base of proximal leaflets cordate, distal ones asymmetrical, apex acuminate to long-acuminate. *Inflorescence* an erect, dense, monopodial capitulum, axillary to ramiflorous, 5 – 11 cm in diam.; peduncle ± tomentose, 5 – 12 cm long; bracts normally caducous before anthesis, spirally arranged, imbricate, the outer ovate, forming an involucre enclosing the young inflorescence in bud, the inner filamentous ones supporting a single flower. *Flowers* (20 –) 30 – 60 (– 70) per inflorescence; pedicel ± tomentose, 5 – 8 mm long; bracteoles fused into a bi-lobed tube, initially green, turning brown at maturity, ± tomentose, 20 – 33 mm long; hypanthium outer surface ± tomentose, inner surface villous, 20 – 30 mm long; sepals 4, unequal, outer surface ± tomentose, two 18 – 23 × 10 – 14 mm, two 20 – 25 × 5 – 9 mm; petals 5, equal, yellow turning orange with age, 25 – 40 × 5 – 12 mm, clawed; stamens 11, exserted, stamen tube + filaments 25 – 40 mm long; anthers monomorphic, 4 – 6 mm long; tomentose ovary and glabrous style 35 – 45 mm long. *Mature pods* tough and woody, stipitate, 20 – 25 × 4.5 – 5.5 cm, laterally flattened with a pronounced lower suture, dark brown due to the velvety indumentum; seeds 5 – 10 per pod, 1.5 – 2.5 × 3.5 – 4 cm, without endosperm, orbicular to rectangular in outline, and laterally compressed. Figs 1 and 2.

SPECIMENS EXAMINED. ECUADOR. Orellana: Yasuni National Park. Scientific Station (YSS), 50-ha plot, Tag # 6032, 00°38'S, 76°30'W, 200 – 300 m, 23 Nov. 2002, fl., *Villa & Alvia* 1606 (holotype QCA; isotype K); YSS, Tag # 480588, 8 Dec. 2000 fl., *Villa & Alvia* 767 (QCA); YSS, Botanical trail 300 m at right side, 17 June 2002, fl., *Villa, Alvia, Moscoso & Santiana* 1539 (K, QCA); YSS, 50-ha plot, Tag # 55158, 23 Nov. 2002, fl., *Villa & Alvia* 1609 (K, QCA); YSS, 700 m along the river, 6 Dec. 2002, fl., *Villa, Alvia & Sandoya* 1645 (QCA); YSS, Napo Trail, 1500 m on left side, 18 Nov. 2002, fl., *Villa & Alvia* 1867 (QCA); YNP, km 46 – 47 of the Maxus/YPF pipeline road, in primate plot, 00°42'S, 76°28'W, 250 m, Jan. – Feb. 1999, fl., *Pitman* 5173 (MO, QCA, QCNE); YSS, 50-ha plot, 14 June 2007, fl., *Pérez & Alvia* 3485 (K, QCA); *loc. cit.*, 12 Feb. 2009, fl., fr., *Pérez & Alvia* 3485 (K, QCA); YSS, Chorongo Trail at 550 m, 15 Nov. 2009, fl., *Pérez & Santillán* 4394 (K, QCA). Napo: Archidona. Cultivated on Finca Amiruca, 525 m, 23 Nov. 2010, fl., *Cornejo, Montenegro & Grefa* 8370 (GUAY, K, NY).

DISTRIBUTION. *Brownea jaramilloi* is endemic to the Yasuni National Park in the Orellana province of northeastern Ecuador (Map 1). To date it is only recorded from the 25-ha plot, the forests surrounding

Table 1. Morphological differences between *Brownea jaramilloi* and *B. grandiceps* compared.

Character	*B. jaramilloi*	*B. grandiceps*
Pairs of leaflets per leaf	(2 –) 6 – 9 (– 11)	(4 –) 7 – 12 (– 15)
Shape and size — proximal leaflets	ovate, 7 – 15 (– 22) × 2 – 5 cm	widely ovate, 5 – 9 (– 14) × 2 – 5 cm
Shape and size — distal leaflets	oblanceolate, (13 –) 18 – 28 × 4 – 8 cm	lanceolate or narrowly oblanceolate, (9 –) 11 – 17 × 2 – 6 cm
Inflorescence	erect, axillary to ramiflorous, 5 – 11 cm in diam., (20 –) 30 – 60 (– 70) flowers per inflorescence	pendent, terminal on branches, 11 – 20 cm in diam., (22 –) 40 – 90 (– 102) flowers per inflorescence
Shape and size of sepals	spathulate, two: 18 – 23 × 10 – 14 mm, two: 20 – 25 × 5 – 9 mm	spathulate, two: 25 – 35 × 9 – 16 mm, two: 21 – 41 × 9 – 14 mm
Shape and size of petals	bright yellow, clawed, blade spathulate, petal 25 – 40 × 5 – 12 mm	bright red, clawed, blade orbicular, petal 50 – 67 × 17 – 24 mm
Pod size	20 – 25 × 4.5 – 5.5 cm	21 – 40 × 6 – 8 cm

Fig. 1. *Brownea jaramilloi*. **A** ramiflorous inflorescence with acropetal aestivation, few flowers open, most still in bud; **B** paripinnate leaves; **C** open flower; **D** mature, woody pod with nine seeds. PHOTOS **A** – **C** BY XAVIER CORNEJO, **D** BY ÁLVARO J. PÉREZ.

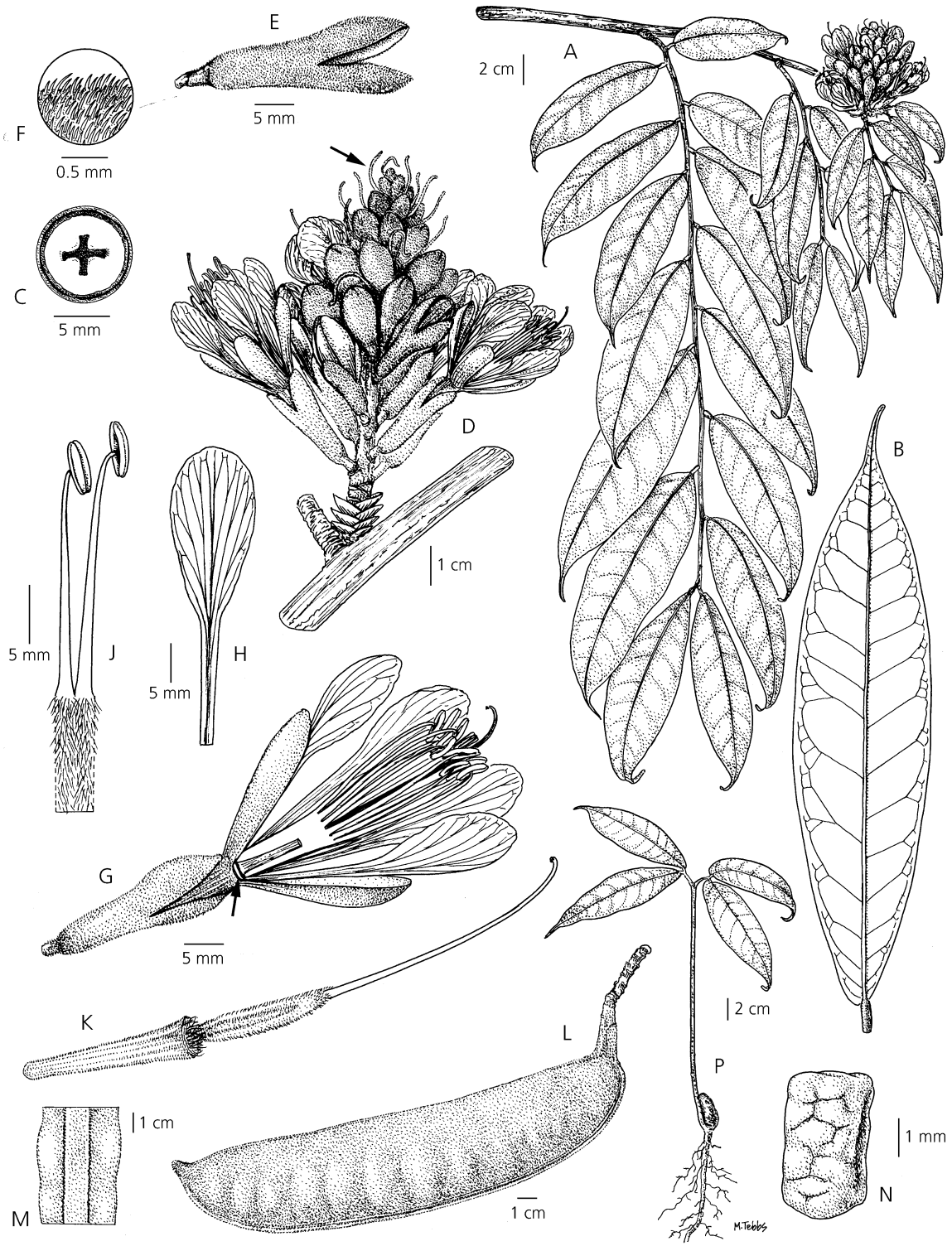
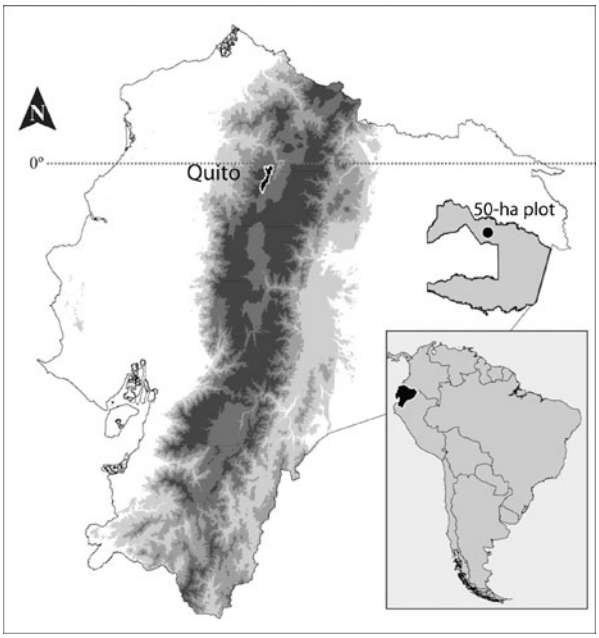
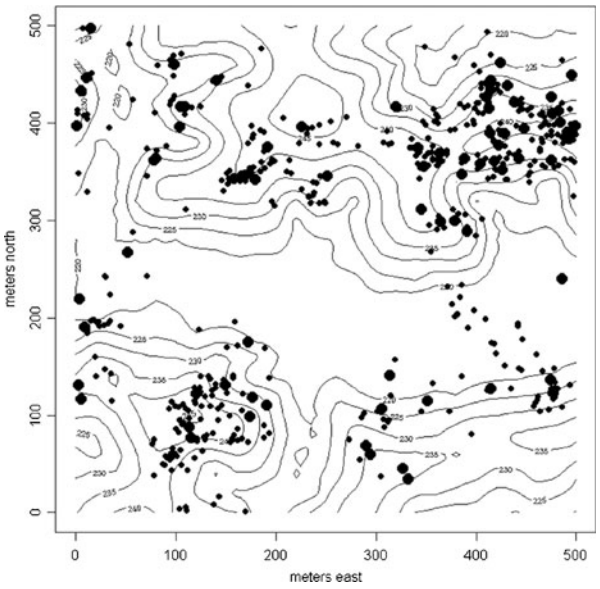


Fig. 2. *Brownea jaramilloi*. **A** paripinnate leaf with seven alternate pairs of leaflets, plus smaller leaves and inflorescences; **B** under side of distal leaflet; **C** cross-section of mature branch showing a cross; **D** inflorescences with scale-like involucral bracts, a few open flowers, most in bud, and filamentous floral bracts (at arrow); **E** fused bracteoles; **F** indumentum of bracteoles; **G** open flower with fused bracteoles, two free sepals (one removed at arrow), four equal petals (one removed at arrow), and staminal tube; **H** single petal; **J** two stamens, inner side of stamen tube densely villous; **K** hypanthium and ovary hairy, style and stigma glabrous; **L** densely velvety, woody pod; **M** ridged lower suture of pod; **N** seed; **P** seedling with remnant seed attached. **A**, **C** from *Perez & Alvia* 4085 (K), **B** from *Perez & Alvia* 3412 (K), **D** from *Villa* 1609 (K), **E** – **K** *Pitman* 5271 (K), **L** – **P** from photos by ÁLVARO J. PÉREZ. DRAWN BY MARGARET TEBBS.



Map 1. Position of the 25-ha plot at Yasuni National Park, Ecuador.



Map 2. Distribution of *Brownea jaramilloi* with dbh≥1 cm in a 25-ha plot at Yasuni National Park, Ecuador. Map overline on 5 m contours. Distribution points come in two sizes: the large dots indicate trees with dbh≥10 cm (78 individuals) and the small dots indicate dbh<10 cm (430 individuals). The total number of stems is 508.

the Yasuni Scientific Station (Valencia *et al.* 2004; Valencia *et al.* 2009), and at km 46 – 47 along the Maxus/YPF pipeline road (00°42'S, 76°28'W), at alt. 200 – 300 m.

HABITAT AND DEMOGRAPHY. In a 25-ha plot of Amazonian rain forest located in Yasuni National Park at alt. 200 – 300 m, there were 508 individuals of *Brownea jaramilloi* with dbh ≥ 1 cm. In this plot between 1995 and 2002 annual mortality rate was 0.42%, recruitment rate was 1.7 individuals per year, and average growth rate was 0.48 mm per year. Both juveniles and adults are more abundant on ridges, but some individuals can be found in depressions. Map 2.

CONSERVATION STATUS. Judging from the population at the 25-ha plot and the few additional records the species merits a 'Vulnerable' status according to IUCN (2001).

PHENOLOGY. Flowers and fruits are most abundant from Oct. – Dec., but throughout the year individual trees were observed to be fertile at different times.

ETYMOLOGY. The species is named in honour of Prof. Jaime Jaramillo, lecturer in botany at the Catholic University in Quito since 1976, who died in 2010. Over the years, Prof. Jaramillo mentored many students and most of the Ecuadorian botanists who are now leaders in their field.

VERNACULAR NAME. The Waorani ethnic species name for *Brownea jaramilloi* is *Gadetawe* (*wao tededo*).

USES. Throughout their range *Brownea* species are used as ornamental garden or street trees. The new species is no exception in this respect, as it has already been reported as an ornamental garden tree in Archidona (*Cornejo, Montenegro & Grefa* 8370, Cornejo pers. comm.).

PHYLOGENETIC NOTES. The molecular analysis based on *matK* sequences resolves *Brownea jaramilloi* with 96% BS support in a clade containing five *Brownea* and *Browneopsis* sequences (Saslis-Lagoudakis, pers. obs.). Currently only a subset of five of the 19 – 22 *Brownea* and *Browneopsis* species have been sequenced, making the exact placement of this species in *Brownea* or its sister *Browneopsis* difficult based on molecular evidence alone. Flower morphological characters, such as the presence of well-developed bracteoles (absent in all *Browneopsis* species) and five well-developed petals (petals a mixture of rudimentary and well-developed in *Browneopsis*), however, places the species firmly in *Brownea*.

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