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Original Paper
Flora of Reserva Ducke, Amazonas, Brazil: Linaceae

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Abstract

This study defines and characterizes the species of Linaceae occurring in Reserva Ducke. We analyzed material collected mainly during the Project Flora of Reserva Ducke. Two genera, each with one species, are recorded: *Hebepetalum humiriifolium* and *Roucheria columbiana*. We present species descriptions, taxonomic comments, illustrations, habitat information, geographic distribution and an identification key to species of Linaceae.
Key words: Amazon, floristics, *Hebepatalum*, *Roucheria*, taxonomy.

Resumo

Este estudo define e caracteriza as espécies de Linaceae que ocorrem na Reserva Ducke. Analisamos materiais coletados principalmente durante o Projeto Flora da Reserva Ducke. Dois gêneros, cada um com uma espécie, são registrados: *Hebepetalum humiriifolium* e *Roucheria columbiana*. Apresentamos descrições das espécies, comentários taxonômicos, ilustrações, informações sobre habitat, distribuição geográfica e uma chave de identificação para as espécies.
Palavras-chave: Amazônia, florística, *Hebepatalum*, *Roucheria*, taxonomia.

Introduction

Linaceae comprises 13 genera and 260 species (McDill & Simpson 2011). The family is widely distributed in the Tropics and along the Neotropical region it is represented by four genera and 19 species (Secco 2012). In Brazil, four genera and 12 species (BFG 2015, 2018; Secco 2015) are known, with two genera and six species occurring in the Brazilian Amazon (Secco 2015).

The project Flora of Reserva Ducke (Hopkins 2005) was developed in the 90s, in the Reserva Ducke, which is a largely well preserved area near the city of Manaus (Amazonas, Brazil), resulting in the production of one of the most important vascular plant identification guides for the Amazonian flora (Ribeiro *et al*. 1999).

The genera *Hebepetalum* Benth. and *Roucheria* Planch are both reported as Hugoniaceae in the Reserva Ducke guide, with each genus containing a single species (Sothers *et al*. 1999). However, recent molecular data indicates that Hugoniaceae forms part of the subfamily Hugonioideae which, together with the subfamily Linoideae, now forms part of the family Linaceae (McDill & Simpson 2011).

The members of the Linaceae found in Reserve Ducke protection area are trees, with simple and alternate leaves and deciduous stipules. The inflorescence is paniculiform, terminal or axillary. Flowers are hermaphrodite, actinomorphic, with 4–5 sepals, these being fused at the base or free, the petals are 5 and free. The androecium consists of 8–10 stamens, the filaments having different lengths and are fused at the base. The anthers have longitudinal dehiscence. The gynoecium has a superior ovary, syncarpic, with 2–5-loci, 1–2 ovules per locule, with 3 free styles and a capitate stigma. The fruits are drupaceous and the seeds solitary or in pairs per locule.

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With the objective of monographing families that occur in the Reserva Ducke protection area, this work presents a taxonomic treatment of Linaceae. We present an identification key, a taxonomic description with comments, illustrations, habitat information and geographic distribution for the species of Linaceae known to occur in Reserva Ducke.

Material and Methods

Material from Reserva Florestal Adolpho Ducke were analyzed from exsiccates in the INPA herbarium (acronyms according to Thiers, continuously updated). The reserve has 100 km² of primary forest with areas of lowland, slope and plateau, including a "campinarana" area (white sand forest). Detailed information on these vegetation types and sampling methodology during the project Flora of Reserva Ducke are described in Hopkins (2005). The botanical terminology follows Ramirez *et al*. (1999) and Secco (2008).

Results

In the Reserva Ducke protection area, we recorded two species of the six species of Linaceae reported for the Amazonas state (BFG 2018; Secco 2015). The same number of species was reported by Sother *et al*. (1999) during the project Flora of Reserva Ducke. We used leaf vein patterns and floral morphology to separate *Hebepetalum* and *Roucheria* species as traditionally used in Secco & Silva (1990). *Roucheria punctata* (Ducke) Ducke was reported in Sother *et al*. (1999) but it is now considered as synonymous with *Roucheria columbiana* Hallier (BFG 2018; Secco 2015).

Identification key for Linaceae species in the Reserva Ducke

1. Leaf blade 9–12.5 × 4.8–6.2 cm, elliptical; secondary veins 19–21 pairs; flowers with petals internally villous.....1. *Hebepetalum humiriifolium*
1'. Leaf blade 12–25 × 4.5–9 cm, obovate; secondary veins 60–70 pairs; flowers with petals internally glabrous.....2. *Roucheria columbiana*

1. *Hebepetalum* Benth.

Trees. Leaves alternate, petiolate, crenulate margins, secondary veins not parallel to each other; stipules present. Inflorescence paniculiform. Flowers yellow, shortly pedicellate; sepals 4, free; petals 5, deciduous, shortly clawed at the base and with a prominent central line. Stamens 10, filaments in different lengths and fused at the base. Ovary globose, 4–5 locular, 1 or 2 ovules per locule; styles 3, stigma capitate. Fruits drupaceous, ovoid, 1–5 locules, endocarp hard. Seeds solitary, rarely paired per locule, elongated.

Hebepetalum is represented by three species and occurs in Bolivia, Brazil, Colombia, Ecuador, Guiana, French Guiana, Suriname, Peru and Venezuela (Ramirez *et al*. 1999; Secco 2008, 2015). In Brazil, all three species are recorded and occur in the Amazon and Cerrado domains (BFG 2015; Secco 2015).

In the Reserva Ducke the genus may be recognized by its tree habit and paniculiform inflorescences, yellow flowers with shortly clawed petals and with a central line. In Reserve Ducke, only *Hebepetalum humiriifolium* (Planch.) Benth. occurs.

1.1. *Hebepetalum humiriifolium* (Planch.) Benth. Gen. Pl. 1: 244. 1862. Fig. 1a-e

Trees up to 17 m; 25 cm dbh; branches puberulent, external and internal bark not recorded. Leaves 9–12.5 × 4.8–6.2 cm, elliptic, acute at apex, margin crenate, acute to decurrent at base, glabrous on both sides, shiny on both sides when dry; secondary veins 19–21 pairs, brochidodromous, central vein prominent adaxially and abaxially, intersecondaries absent, veins of major order reticulate; petioles 2–3 cm long, canaliculate; stipules 1.5–2 × 1 mm, triangular, deciduous. Inflorescence terminal and axillar, axes puberulent, bracts 1–2 × 1 mm, ligulate. Flowers yellow, pedicel 0.5–0.8 mm long; sepals 4–4.3 × 1.3–1.5 mm, ovate, glabrous; petals 4–4.5 × 1–1.5 mm, oblong, internally white-villous. Stamens 10, attached at base and surrounding the ovary, filaments with different sizes, 2–3 mm long (short ones), 4–5 mm long (long ones); anthers ca. 0.5 mm. Ovary 1–1.5 × 1 mm, glabrous; styles 3, free, 2.5–3 mm long; stigma capitate. Fruits drupes, 0.8–1 × 0.4–0.5 cm, ovoid, glabrous; vestiges of calyx and style. Seeds 4–5 × 0.5–1 mm, flattened, smooth.

Examined material: 8.XI.1994, fl., *P.A.C.L. Assunção 60* (G, INPA, K, MBM, MG, MO, NY, R, RB, SP, U, UEC); 17.I.1995, fr., *P.A.C.L. Assunção 148* (IAN, INPA, K, MG, MO, NY, RB, SP, UEC); 22.I.1969, fr., *J. Aluizio 247* (INPA); 20.II.2001, fr., *V.F. Kinupp 1625* (INPA); 6.XII.2002, fr., *E.C. Pereira et al*. 262 (INPA); 23.IX.1963, fr., *W. Rodrigues 7644* (INPA); 26.IX.1964, fl., *W. Rodrigues & Osmarino 6730* (INPA); 17.XII.1963, fr.,*W. Rodrigues, & D. Coêlho 5606* (INPA); 28.IX.1996, fr., *C.A. Sothers et al. 185* (G, HRB, IAN, INPA, K, MG, U, UB).

Hebepetalum humiirifolium is distributed in Bolivia, Ecuador, Guiana, French Guiana, Peru, Suriname and Venezuela (Ramirez *et al*. 1999; Funk *et al*. 2007). In Brazil, it occurs in the Amazon and Cerrado domains and it is recorded in Amazonas, Amapá, Maranhão, Pará, Rondônia

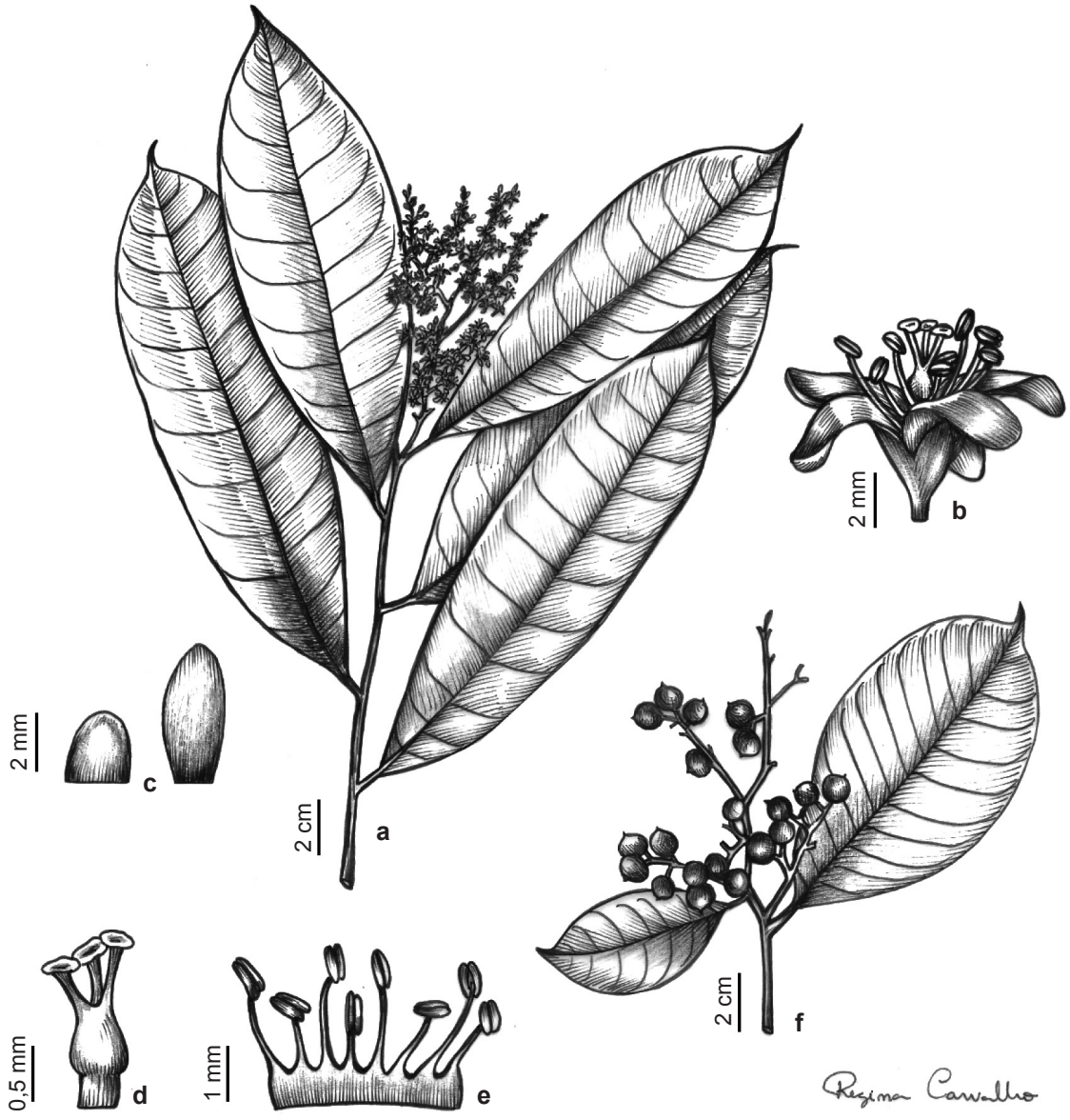

Figure 1 – a-f. Linaceae morphology – a-e. *Roucheria columbiana* – a. floriferous terminal branch; b. flower; c. sepal and petal; d. ovary; e. stamens; f. *Hebepetalum humiriifolium* – terminal branch with fruits. (a-e. *Rodrigues & Coelho 5573*; f. *Assunção 148*). Drawing by Regina Carvalho.

and Roraima states (BFG 2015; Secco 2015). In the Reserva Ducke area it was recorded in *terra-firme* forest (lowland) on clay soil. It was collected with flowers in September and November and with fruits in January to February and September and December.

Hebepetalum humiriifolium is distinguished from *Roucheria columbiana* Hallier, the other species of Linaceae that occurs in Reserva Ducke, by having elliptic leaves with a crenulate margin, with 19–21 pairs of lateral veins, intersecondary veins are absent and flowers have villous inner petals (*vs.* obovate leaves with entire to crenulated margin, 60–70 pairs of lateral veins, conspicuous intersecondary veins and flowers with glabrous inner petals in *Roucheria columbiana*).

2. *Roucheria* Planch.

Trees. Leaves alternate, petiolate, entire to crenulate margins, numerous secondary veins parallel to each other, stipules present. Inflorescence paniculate, terminal or axillar. Flowers pedicellate; sepals 5, imbricated, fused at base; petals 5, free. Stamens 8–10, filament in different lengths, flat, fused at base forming a short tube. Ovary globose, 1–5 locular, 1 or 2 ovules per locule; style (2–)3(–5), filiform, stigma capitate. Fruits drupaceous, sub-globose, 3–5-angulate, endocarp hard. Seeds 1 or 2 per locule, flattened.

The genus comprises seven species (Ramirez *et al*. 1999; Secco 2012), distributed in Brazil, Bolivia, Colombia, Ecuador, Guiana, French Guiana, Suriname, Peru and Venezuela (Ramirez *et al*. 1999). In Brazil, three species are recorded within the Amazonian domain (BFG 2015, 2018). In the Reserva Ducke area *Roucheria* can be recognized by its simple and alternate leaves with entire to crenulate margins, with numerous secondary veins (over 60 pairs) and flowers with petals glabrous on the inner surface. In Reserva Ducke only *Roucheria columbiana* Hallier occurs for the genus.

2.1. *Roucheria columbiana* Hallier, Beiheftezum Botanischen Centralblatt 39(2): 49. 1923. Fig. 1f

Trees up to 15 m.; branches glabrous, lenticels abundant, external bark greenish with fine fissures, inner bark yellow-orange, exudate dark. Leaves 12–25 × 4.5–9 cm, obovate (oblong), caudate at apex, entire to slightly crenate margin, decurrent at base, glabrous on both sides; secondary veins 60–70 pairs, brochidodromous, central vein prominent adaxially and prominent angled abaxially, intersecondary veins conspicuous; petioles 0.7–1.3 cm long; stipules 4 × 3 mm, ligulate, deciduous. Inflorescence terminal or axillar 10–11 × 7–10 cm. Flowers yellow, pedicel ca. 0.5 mm long; sepals 1.5–2 × 1.3–1.5 mm, ovate, glabrous; petals 4 × 1.2 mm, ligulate, glabrous. Stamens 8–10, attached to the base and forming ca. 0.5 mm tube; filament with different sizes, ca. 1 mm long (short ones), ca. 2 mm long (long ones); anther ca. 0.5 mm. Ovary 1–1.5 × 1 mm, glabrous; style ca. 3.1 mm long, stigma capitate. Fruits drupes, 1–1.3 × 0,6–0,7 cm, ovoid, glabrous, black when mature, vestiges of calyx or sometimes pistil at the base of the fruit. Seeds not seen.

Examined material: 9.I.1995, fr., *P.A.C.L. Assunção 131* (IAN, INPA, K, MG, MO, NY, RB, SP, U); 17.I.1995, fr., *P.A.C.L. Assunção 156* (BM,G, INPA, K, MG, R, US, UB); 15.V.1995, fr., *I. Cordeiro et al. 1558* (COL, F, IAN, INPA, K, MBM, MG, UEC,VEN); 6.XII.1963, fl., *W. Rodrigues & D. Coelho 5573* (INPA); 12.I.1965, fr., *W. Rodrigues & O.P. Monteiro 6834* (INPA); 7.XII.1994, fl., *C.A. Sothers & C.F. Silva 279* (IAN, INPA, K, MG, MO, NY, RB, SP, U).

Roucheria colombiana occurs in Brazil, Bolivia, Colombia, Ecuador, Nicaragua and Peru (Ramirez *et al*. 1999). In Brazil, it is recorded in the Amazon and Atlantic Forest, in the states of Acre, Amazonas, Amapá, Bahia and Pará (BFG 2015; Secco 2015). In Reserva Ducke, it occurs in *terra-firme* forest (lowland) with clay and sandy soil. It was collected with flowers in December and fruits in January and May.

This species is recognized by its obovate leaves with entire to crenulate margins, with 60–70 pairs of lateral veins, conspicuous intersecondary veins and flowers with glabrous inner petals. To differentiate from the other species in the area, see *Hebepetalum humiriifolium* comments.

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