Rodriguésia 72: e01762019. 2021
http://rodriguesia.jbrj.gov.br
DOI: http://dx.doi.org/10.1590/2175-7860202172044

Original Paper

Olacaceae and Schoepfiaceae in eastern Northeast Brazil

Danielly da Silva Lucena[1,4,6], *Edlley Pessoa*[2,3] & *Marccus Alves*[1,5]

Abstract

This study provides descriptions, identification key and illustrations of diagnostic characters, as well as comments on the distribution and habitat of species of Olacaceae and Schoepficeae occurring in the eastern portion of northeastern Brazil, this area includes the states of Alagoas, Ceará, Paraíba, Pernambuco and Rio Grande do Norte. The morphological descriptions are based on samples collected during field expeditions (2017-2019) and analysis of herbarium specimens. Were recorded five species in four genera belonging to the family Olacaceae (*Cathedra rubricaulis*, *Dulacia gardneriana*, *Heisteria ovata*, *H. perianthomega* and *Ximenia americana*) and one of Schoepfiaceae (*Schoepfia brasiliensis*), these species occur mainly in Atlantic Forest domain (Lowland and Montane Forests) are also registered in Caatinga and Cerrado domains. The distribution of *D. gardneriana* and *H. perianthomega* was expanded, to the states of Rio Grande do Norte and Paraíba, respectively. The main vegetative characters useful for specific delimitation are presence/absence of armed branches, petiole dorso-ventrally flattened or cylindrical and nerves impressed or flat on the adaxial surface. The presence/absence of staminodes, of a pubescent ovary and hypogynous disc, as well as floral pedicel size and diameter of accrescent calyx in fruits, are the most important reproductive characters for species determination.

Key words: Atlantic Forest, Caatinga, flora, Santalales, taxonomy.

Resumo

Este estudo fornece descrições, chave de identificação e ilustrações dos caracteres diagnósticos, bem como, comentários sobre distribuição e habitat, para espécies de Olacaceae e Schoepfiaceae que ocorrem na porção oriental do Nordeste do Brasil, essa área inclui os estados de Alagoas, Ceará, Paraíba, Pernambuco e Rio Grande do Norte. As descrições morfológicas foram baseadas em amostras coletadas durante expedições de campo (2017-2019), e análise de espécimes de herbário. Foram registradas cinco espécies em quatro gêneros pertencentes à família Olacaceae (*Cathedra rubricaulis*, *Dulacia gardneriana*, *Heisteria ovata*, *H. perianthomega* e *Ximenia americana*), e uma Schoepfiaceae (*Schoepfia brasiliensis*), essas espécies ocorrem principalmente no domínio da Floresta Atlântica (montanas e de terras baixas), sendo registradas também nos domínios da Caatinga e Cerrado. A distribuição de *D. gardneriana* e *H. perianthomega* foi ampliada para os estados do Rio Grande do Norte e Paraíba, respectivamente. Os principais caracteres vegetativos úteis à delimitação específica são, presença/ausência de ramos armados, pecíolo achatado dorso-ventralmente ou cilíndrico e nervura principal impressa ou plana na face adaxial. A presença/ausência de estaminódios, de ovário pubescente e disco hipógino, assim como, tamanho do pedicelo floral e diâmetro do cálice acrescente nos frutos, são os caracteres reprodutivos mais importantes para a determinação das espécies.

Palavras-chave: Floresta Atlântica, Caatinga, flora, Santalales, taxonomia.

[1] Universidade Federal de Pernambuco, Depto. Botânica, Prog. Pós-graduação em Biologia Vegetal, Recife, PE, Brazil.

[2] Universidade Federal de Mato Grosso, Depto. Botânica e Ecologia, Inst. Biociências, Cuiabá, MT, Brazil. ORCID: <https://orcid.org/ 0000-0003-3800-8684>.

[3] Universidade Estadual do Maranhão, Prog. Pós-graduação em Biodiversidade, Ambiente e Saúde, Morro do Alecrim, Caxias, MA, Brazil.

[4] ORCID: <https://orcid.org/0000-0001-7028-174X>.

[5] ORCID: <https://orcid.org/0000-0001-9281-2257>.

[6] Author for correspondence: botanicadane@gmail.com

Introduction

Based on molecular data, the phylogenetic relationship among the genera of Olacaceae *s.l.* has been changed (Malécot & Nickrent 2008). In APG III (2009), *Schoepfia* Schreb, traditionally placed in Olacaceae, was recognized as a separate family, Schoepfiaceae, also included in the order Santalales. Subsequent phylogenetic studies have indicated Olacaceae *s.l.* as polyphyletic group, from which about seven families could be recognized (Malecot & Nickrent 2008; Nickrent *et al.* 2010). However, changes in Santalales were avoided by APG IV (2016) and Christenhusz *et al.* (2015, 2017), that maintained the traditional classification for family, followed also in this study.

Olacaceae and Schoepficeae (Santalales *sensu* APG IV 2016) are fairly variable in life forms, being recorded as trees, shrubs, lianas and perennial herbs, autotrophic or often hemiparasites of roots (Malécot *et al.* 2004; Christenhusz *et al.* 2017). Olacaceae includes 29 genera and 170 species distributed mainly in the tropical region of Africa, Asia and America, growing especially in Lowland Forests (Heywood 1993; Christenhusz *et al.* 2017). Schoepfiaceae comprises three genera and 58 species distributed in America and Asia (Nickrent *et al.* 2010; Christenhusz *et al.* 2017). The Neotropics are cited as the center of diversity for these families with around 50% of their genera and species occurring in this region (Sleumer 1984).

In Brazil, 12 genera and 53 species are recorded to Olacaceae, and the family is widespread in the country with the Amazonian domain as the richest area (38 spp.) (BFG 2018). Schoepfiaceae is represented by four species of *Schoepfia*, one of them distributed mainly along the Brazilian coast (*S. brasiliensis* A.DC), two restricted to the state of Mato Grosso (*S. lucida* Pulle and *S. velutina* Sandwith) and one restricted to the state of Amazonas (*S. clarkii* Steyerm), in addition to *Schoepfia*, the genus *Arjona* Cav. is also recorded in the southern country, represented by one species (Farroñay *et al.* 2019; BFG 2018).

The species of both families are characterized by simple and alternate leaves without stipules, mainly bisexual flowers, and drupaceous fruits which can have a persistent, expanded and showy calyx in some genera of Olacaceae, such as *Heisteria*, *Chaunochiton* and *Aptandra* (Sleumer 1984; Heywood 1993; Malécot *et al.* 2004; Nickrent *et al.* 2010). The ovary is inferior in Schoepfiaceae but superior in Olacaceae (Sleumer 1984; Barroso *et al.* 2002).

The taxonomic data for Brazilian species of Olacaceae and Schoepfiaceae are limited to Sleumer (1984), and local floras (Guimarães *et al.* 1971; Cabral & Agra 1999; Ribeiro *et al.* 1999; Rodrigues & Rossi 2002; Assis 2004; Meirelles & Fernandes Júnior 2017). Northeastern Brazil is often underestimated in terms of species richness and distribution of several families; the number of species and their distribution in this region have been expanded relative to what had previously been reported (Maciel *et al.* 2009; Amorim & Alves 2012; Alves-Araújo & Alves 2013; Melo & Alves 2013; Santos & Alves 2013; Costa-Lima & Alves 2015; Maciel *et al.* 2015; Pessoa & Alves 2015; Gomes-Costa & Alves 2016). Similar results could also be expected for Olacaceae and Schoepficeae.

Thus, this study aims to update knowledge on the taxonomy, phenology, geographic distribution, and indication of occurrence in Conservation Units for species of Olacaceae and Schoepfiaceae in the eastern portion of northeastern Brazil, as well as to provide an identification key and useful illustrations of diagnostic characters to distinguish species.

Material and Methods

Study area

The eastern portion of northeastern Brazil includes the states of Alagoas, Ceará, Paraíba, Pernambuco and Rio Grande do Norte (Lima *et al.* 2002). The region is located to the north of the São Francisco River and has an area of approximately 385,000 km^2, including portions of two phytogeographic domains, the Caatinga and Atlantic Forest (Rizzini 1997; Tabarelli *et al.* 2006).

In the area, the Atlantic Forest extends from the states of Alagoas to Rio Grande do Norte, with enclaves at higher altitudes (> 600 m alt.) in the northern portion of Ceará (Veloso *et al.* 1991; Tabarelli *et al.* 2006). It is mainly distributed along the coast, at elevations ranging from 50 to 800 m (Tabarelli *et al.* 2006; Melo & Alves 2013). The Atlantic Forest is classified into Lowland Forest (< 100 m altitude), which includes the "*tabuleiros*" and the "*restingas*",

Submontane Forest (100–600 m alt.), found to the east of the Serra da Borborema along the foothills, and Montane Forest (> 600 m alt.), which includes the "*brejos de altitude*" (Veloso *et al.* 1991; Tabarelli *et al.* 2006; Thomas & Barbosa 2008).

The Caatinga domain covers most of the study area with annual rainfall below 1,000 mm, where the vegetation presents xeromorphic features such as small, deciduous leaves thorns, succulent habit and therophytic life form (Prado 2003; Fernandes & Queiroz 2018). According to geomorphological variations, two main floristic units are found in this phytogeographical domain: crystalline caatinga, mainly located in the "*depressão sertaneja*", where the soils are shallow, clayey and stony, and sedimentary Caatinga, common in the sedimentary basin of the São Francisco River, where the soils are deeper and sandy (Queiroz 2009; Silva *et al.* 2009; Moro *et al.* 2014).

Taxonomic treatment

The morphological descriptions were produced based on samples collected during field expeditions, carried out in 2017–2019, as well as on samples from collections of the herbaria ALCB, CEN, EAN, EAC, HB, HST, HUEFS, HUCPE, IPA, JPB, MAC, MUFAL, PEUFR, R, RB, UFP, UFRN, UPCB and images from NY (acronyms according to Thiers, continuously updated). The morphological terminology follows Radford *et al.* (1974) and Harris & Harris (2000). Protologues, floras and taxonomic revisions (Guimarães *et al.* 1971; Sleumer 1984; Cabral & Agra 1999; Ribeiro *et al.* 1999; Rodrigues & Rossi 2002; Assis 2004; Meirelles & Fernandes Júnior 2017) were also consulted.

In the cases of only a few samples from the study area, additional materials from other Brazilian states were used. Information of habitat, phenology and geographic distribution, were retrieved from specimen labels and are presented for all species from the area. Maps with the geographical distribution of the species were elaborated using the software QGIS v.2.18.6 (QGIS Team 2015).

Results and Discussion

Five species of Olacaceae were recorded from the area, distributed in four genera: *Cathedra rubricaulis* Miers, *Dulacia gardneriana* (Benth.) Kuntze, *Heisteria ovata* Benth., *H. perianthomega* (Vell.) Sleumer and *Ximenia americana* L.; and one species of Schoepfiaceae: *Schoepfia brasiliensis* A.DC.

The richest states in number of species are Alagoas, Pernambuco and Paraíba (four spp. each), followed by Ceará and Rio Grande do Norte (three spp. each). Those three states (Alagoas, Pernambuco and Paraíba) are often the richest in plant diversity in the study area (Melo & Alves 2013; Santos & Alves 2013; Gomes-Costa & Alves 2016).

Regarding geographic distribution, *Cathedra rubricaulis*, *D. gardneriana* and *H. perianthomega* are endemic to Brazil (BFG 2018). *Heisteria ovata* and *S. brasiliensis* are widely distributed in South America, while *X. americana* has a pantropical distribution (Sleumer 1984; MacDougal 2003; Christenhusz *et al.* 2017; BFG 2018).

The number of species in Olacaceae and Schoepfiaceae for eastern northeastern Brazil has not changed with this study, however, the distribution of some species was updated (Figs. 1-2). The first record of *D. gardneriana* for Rio Grande do Norte, and of *H. perianthomega* for Paraíba was identified. This latter species has been cited to Ceará (BFG 2018), however, its distribution is confirmed only for Alagoas, Paraíba and Pernambuco. *Heisteria blanchetiana* (Engl.) Sleumer was mentioned to Alagoas by Nusbaumer *et al.* (2015) but no voucher was located in this study to confirm that information.

Based on the records of species occurrence some taxa have a restricted local distribution, in general growing only in relatively well preserved sites. *Cathedra rubricaulis*, for example, is known from only four samples collected more than 50 years ago and not collected recently despite several visits to the same sites. Nevertheless, none of the taxa studied are cited in the Brazilian Red List of Threatened Species (Martinelli & Moraes 2013), many probably due to their larger extent of occurrence, or due to lack of evaluation regarding Conservation Status. However, at least one sample of each species registered here was collected in Conservation Units, evidencing the importance of these areas for the maintenance of local biodiversity (Tab. 1).

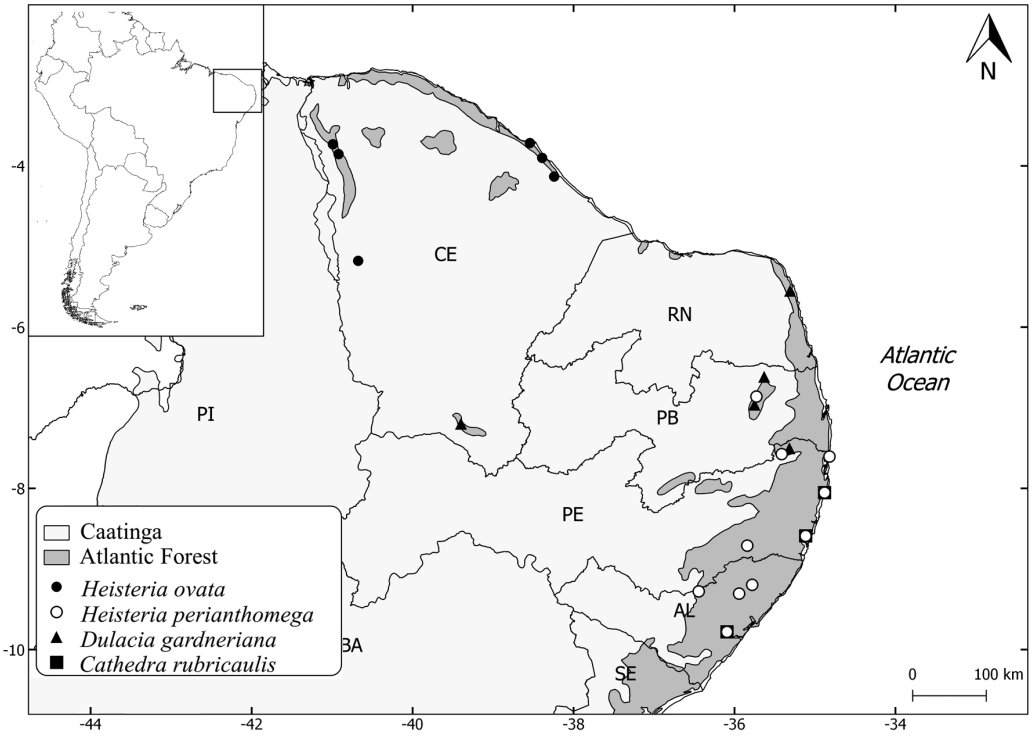

Figure 1 – Geographical distribution of *Cathedra rubricaulis*, *Dulacia gardneriana*, *Heisteria ovata* and *Heisteria perianthomega* in the eastern portion of Northeastern Brazil.

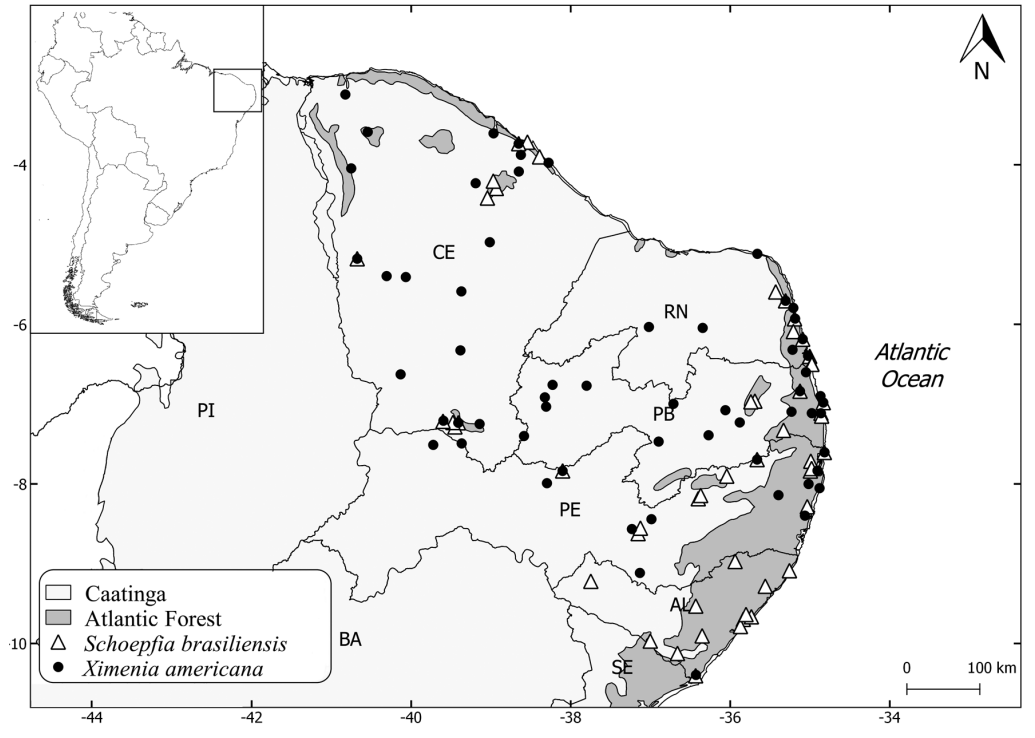

Figure 2 – Geographical distribution of *Schoepfia brasiliensis* and *Ximenia americana* in the eastern portion of Northeastern Brazil.

Table 1 – Species of Olacaceae and Schoepfiaceae registered in eastern northeastern Brazil (Alagoas - AL, Ceará - CE, Paraíba - PB, Pernambuco - PE and Rio Grande do Norte - RN) that occur in Conservation Units (UCs) federal and state, full protection (Ecological Station, National Park, State Park, Biological Reserve, Wildlife Refuge) or sustainable use (Environmental Protection area, National forest, Private Reserve of Natural Patrimony).

Espécies	**UCs**
Cathedra rubricaulis Miers	PE: State Park of Dois Irmãos
Dulacia gardneriana (Benth.) Kuntze	PB: State Park Mata do Pau Ferro
Heisteria ovata Benth.	CE: National Park Ubajara
Heisteria perianthomega (Vell.) Sleumer	AL: Ecological Station Murici, Biological Reserve Pedra Talhada. PE: Private Reserve of Natural Patrimony Fazenda Tabatinga, Private Reserve of Natural Patrimony Frei Caneca, State Park of Dois Irmãos.
Ximenia americana L.	CE: Environmental Protection area Dunas of Lagoinha, Environmental Protection area Chapada do Araripe, Environmental Protection area cachoeira da Missão Velha, Ecological Station Aiuaba, National forest of Araripe, Wildlife Refuge Pedra da Andorinha. PB: Private Reserve of Natural Patrimony fazenda almas. PE: National Park of Catimbau, State Park Dois irmãos, Wildlife Refuge mata Tapacurá, Private Reserve of Natural Patrimony fazenda tabatinga, Private Reserve of Natural Patrimony Nossa senhora do outeiro de Maracaípe. RN: Private Reserve of Natural Patrimony Garabu, Private Reserve of Natural Patrimony Stoessel de Britto, Private Reserve of Natural Patrimony Mata estrela, State Park Dunas de Natal.
Schoepfia brasiliensis A.DC.	AL: Private Reserve of Natural Patrimony Reserva Gulandim. CE: Private Reserve of Natural Patrimony Serra das Almas. PB: State Park Mata do Pau Ferro, National forest restinga de Cabedelo (known to the local population as amém), Biological Reserve Guaribas. RN: Environmental Protection area do Jenipabu.

Identification key to the species of Olacaceae and Schoepfiaceae in eastern northeastern Brazil

1. Branchs often armed; leaf apex apiculate; calyx or hypogynous disk not accrescent in fruits.....6. *Ximenia americana*
1'. Branchlets without thorns; leaf apex acute to/or acuminate; calyx or hypogynous disk accrescent in fruits.....2
    2. Petiole dorso-ventrally flattened; staminodes present; ovary pubescent; fruit apex tomentose .....2. *Dulacia gardneriana*
    2'. Petiole cylindrical; staminodes absent; ovary glabrous; fruit completely glabrous.....3
        3. Main nerve strongly impressed on the adaxial surface; stamens ca. 0.4 mm long; hypogynous disk accrescent, enveloping 1/2 of the fruit .....1. *Cathedra rubricaulis*
        3'. Main nerve slightly impressed on adaxial surface; stamens 1.5–5.5 mm long; hypogynous disk absent.....4
            4. Petals fused forming a tube; stamens 4–5; ovary inferior; calyx involving 11/12 of the fruit when mature .....5. *Schoepfia brasiliensis*
            4'. Petals free; stamens 10; ovary superior; calyx patent to fruits when mature.....5
                5. Pedicel 2–3 mm long; calyx in fruits 7–8 mm long and 10–15 mm diameter.....3. *Heisteria ovata*
                5'. Pedicel 0.5–1 mm long; calyx in fruits ca. 20 mm long and 27–40 mm diameter..4. *Heisteria perianthomega*

1. *Cathedra rubricaulis* Miers, Ann. Mag. Nat. Hist., ser. 2, 7:458. 1851. Fig. 3a-e

Trees, 6–8 m tall. Bark scaly; branches glabrous, no thorns. Petiole 5–11 mm long, cylindrical, slightly canaliculate, not winged, glabrous, longitudinally striate; blades (8–)9.5–14 × 3.5–5 cm, glabrous, narrow-elliptic to oblong, margin entire, apex acute to acuminate, base rounded to obtuse, main nerve strongly impressed on the adaxial and prominent on the abaxial, secondary nerves 8–11, broquidodromous venation. Inflorescences in axillary fascicles, sessile, glabrous, 3–13 flowers, bisexuals, bracts ca. 0.5 mm long, sessile; calyx inconspicuously pentamerous or hexamerous, gamosepal, 1 mm long; corolla 5–6-mera, dialipetal, petals 1.1–1.2 × 0.7–0.8 mm, triangulars to lanceolate, concaves, apex adaxially sericeous; stamens 5–6, ca. 0.4 mm long, staminodes absent, filaments free, anthers basifixed, poricidal; gynoecium 1 mm long, ovary superior, umbonate, glabrous, 2-locular, 2-ovulate, hypogynous disk present, accrescent in fruit. Drupe 12–25 × 14–20 mm, subgloboid, hypogynous disk involved 1/2 of the fruit, apex free, glabrous; calyx accrescent, ca. 4 mm long; bracts at the base of the calyx 1 mm long; pedicel ca. 5 mm long.

Materials examined: ALAGOAS: São Miguel dos Campos, 26.X.1968, fl., *M.T. Monteiro 22823* (PEUFR, RB). PERNAMBUCO: Recife, Areias, 6.X.1949, fl., *D. Andrade-Lima 49-334* (IPA); Parque Estadual de Dois Irmãos, 11.X.1968, fl., *D. Andrade-Lima 68-5444* (IPA). Sirinhaém, Engenho Lage, 1.XI.1968, fl., *D.P. Lira 12618* (HST, IPA).

Additional material: BRAZIL. BAHIA: Ilhéus/Una, Reserva Biológica de Una, 1.II.2009, fr., *J.G. Jardim 5456* (CEPEC).

Cathedra bahiensis Sleumer, cited to Bahia and Espirito Santo (BFG 2018), is the species most similar to *C. rubricaulis*, however, these two species are distinguished by the pedicel length in the flowers (1.5 mm *vs.* sessile) and shape of the drupe (oblongoid to rarely obovoid *vs.* subgloboid).

The genus *Cathedra* it is recognized morphologically mainly by the calyx and hypogynous disk accrescent in the fruits. The proportion of the hypogynous disk to the fruit and its shape are also important in the delimitation of the species (MacDougal 2003). Comprises five species endemics to South America (Sleumer 1984; Christenhusz *et al.* 2017). *Cathedra rubricaulis* is restricted to the Brazilian Atlantic Forest (Sleumer 1984), and in the study area only a few individuals were recorded to Lowland Forests of Alagoas and Pernambuco (Fig. 1). The small number of samples and absence of recent collections may be related to the severe forest fragmentation that has occurred over recent decades, mainly caused by sugarcane monoculture and urban growth (Tabarelli *et al*. 2005). It is possible that *C. rubricaulis* no longer exist in the study area.

The flowering and fruiting period from October to February.

2. *Dulacia gardneriana* Kuntze, Revis. Gen. Pl. 1: 111. 1891. Fig. 3f-k

Trees, 8–10 m tall. Bark longitudinally striate; branches glabrous, no thorns. Petiole 2–3 mm long, dorso-ventrally flattened, not canaliculate, slightly winged, glabrous, smooth; blades 3.8–7.5 × 1.8–4 cm, glabrous, ovate to lanceolate, margin entire, apex acute, base rounded, attenuate to the petiole, main nerve flat on the adaxial and prominent on the abaxial, secondary nerves 4–7, broquidodromous venation. Inflorescences in axillary racemes, peduncle 3–4 mm long, glabrous, 3–7 flowers, bisexuals, bracts absent, pedicel ca. 3 mm long; calyx incospicuously pentamerous, gamosepal, ca. 0.2 mm long; corolla 5-mera, dialipetal, petals 5.5–6 × ca. 1.5 mm, oblong, base adaxially pubescent; stamens 3, 2–2.5 mm long, staminodes 6, both filaments adnates at the corolla, anthers dorsifixed, rimose; gynoecium ca. 3 mm long, ovary superior, conical, pubescent, 1-locular at apex and 3-locular at base, 1-ovulate at apex and 3-ovulate at base, hypogynous disk absent. Drupe 13–17 × 11–12 mm, oblongoid, apex free, tomentose, apiculate, hypogynous disk absent; calyx accrescent, involving 9/10 the fruit; bracts at the base of the calyx absent; pedicel ca. 5 mm long.

Materials examined: CEARÁ: Serra do Araripe, 1957, fl., *G. Gardner* (IPA 39199); fl., *F. Allemão & M. Cysneiros 170* (R). PARAÍBA: Areia, 17.V.1953, fr., *J.C.M. Vasconcelos* (EAN 1055); 9.XII.2011, fl., *E. Melo 10746* (UFRN); Parque Estadual da Mata do Pau Ferro, 7.VI.2001, fr., *E. Cunha* (JPB 27466); 8.II.2001, fr., *I.S. Nascimento* (JPB 26471); 20.XII.1953, fr., *G.S.B. Pickel* (EAN 1063). Dona Inês, Mata do Caboclo, 20.V.2008, fr., *R.R.F. Xavier 104* (EAN). PERNAMBUCO: Timbaúba, Engenho Bela Vista, 4.XII.1957, fl., *D. Andrade-Lima 57-2840* (IPA). RIO GRANDE DO NORTE: Ceará Mirim, Fazenda Diamante, 14.III.2012, fr., *A.A. Roque 1288* (UFRN).

Besides *Dulacia gardneriana*, four other species are recorded from northeastern Brazil: *D. candida* (Poepp.) Kuntze and *D. guianensis* (Engl.) Kuntze from Maranhão; *D. papillosa* (Bastos) Sleumer and *D. pauciflora* (Benth) Kuntze from Bahia (BFG 2018). *Dulacia candida*

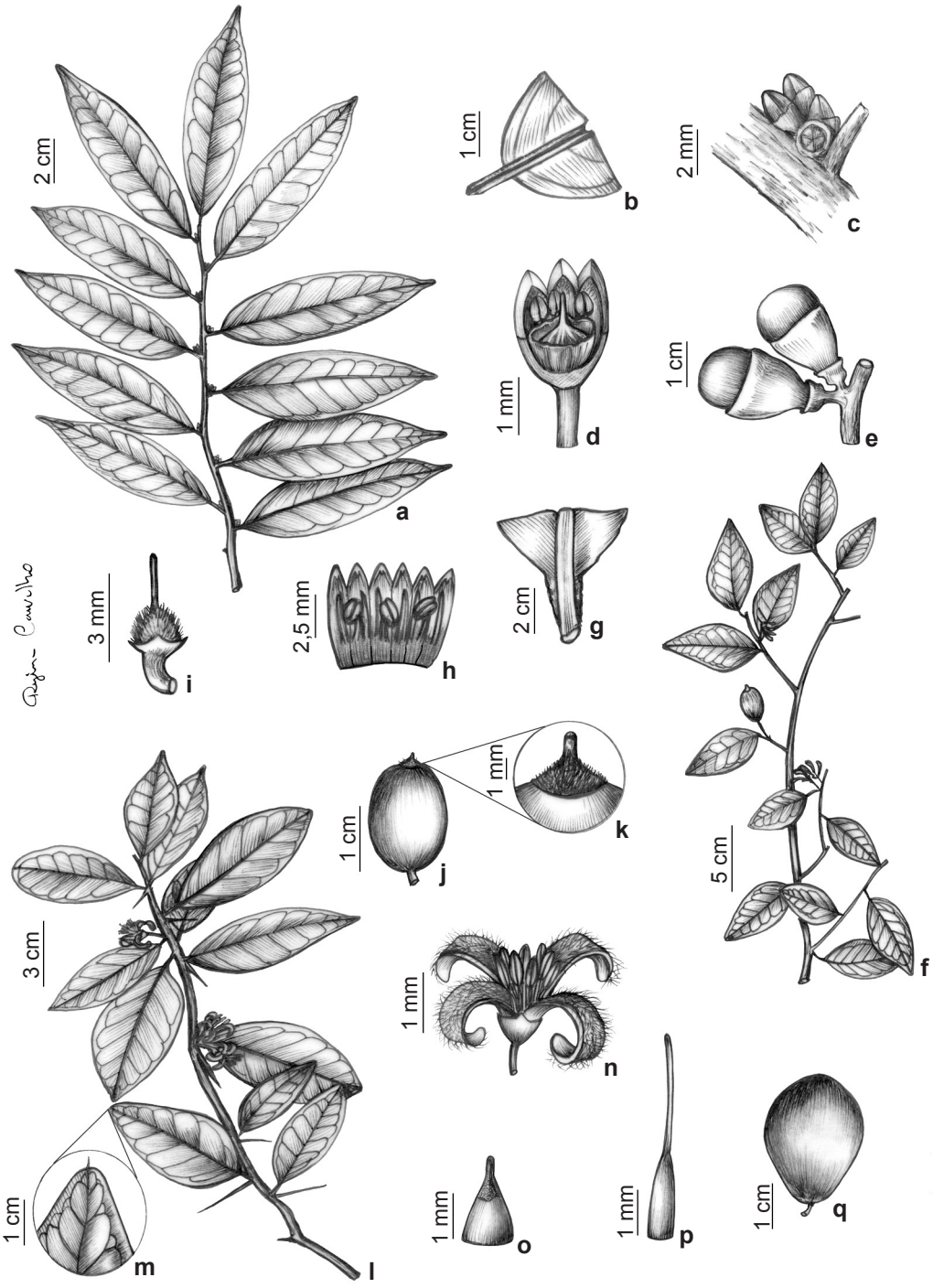

Figure 3 – a-e. *Cathedra rubricaulis* – a. branch with flowers; b. detail of the midvein on the adaxial surface; c. inflorescence; d. longitudinal view of the flower, evidencing the sepals, petals, sessile stamens, hypogynous disk and gynoecium; e. fruit. f-k. *Dulacia gardneriana* – f. branch with flowers and fruits; g. detail of the petiole; h. corolla, evidencing stamens and staminodes; i. gynoecium; j. fruit; k. detail of the tomentose apex. l-q. *Ximenia americana* – l. branch with flowers; m. detail of apiculate leaf apex; n. flower; o. gynoecium of a functionally pistillate flower; p. gynoecium of a functionally staminate flower; q. fruit. (a-e. *D. Andrade-lima* 68-5444, *J.G. Jardim* 5456; f-k. *D. Andrade-lima* 57-2840, *R.R.F. Xavier* 104; l-q. *I. Meunier et al*. (HST 16079), *P.Y. Ojima* 112).

is distinguished from *D. gardneriana* by the apex of the leaves acuminate to long acuminate (*vs*. acute) and *D. guianensis* differs by the shape and size of the fruits, (ellipsoid, 20–27 × 15–24 mm *vs*. oblongoid, 13–17 × 11–12 mm). *Dulacia papillosa* and *D. pauciflora* have papillose or pubescent trichomes on the branches, while in *D. gardneriana* the branches are glabrous or rarely with sparse indument (Sleumer 1984).

The genus is morphologically recognized mainly by its six staminodes and the accrescent calyx that almost completely covers the fruits, just the free apex (MacDougal 2003). *Dulacia* comprises 13 species restricted to South America (MacDougal 2003; Christenhusz *et al*. 2017). *Dulacia gardneriana* is endemic to northeastern Brazil (BFG 2018), and in the study area it is found in Atlantic Forest in Paraíba, Pernambuco and Rio Grande do Norte, mainly in "*tabuleiros"* and "*brejos de altitude*" (Fig. 1). It is also recorded from Ceará, in moist forest phytophysiognomies in Chapada do Araripe (Moro *et al.* 2015). It is popularly known as "*pimenta de cotia*".

The flowering and fruiting period from December to June.

3. *Heisteria ovata* Benth., Hooker's J. Bot. Kew Gard. Misc. 3: 366. 1851. Fig. 4a-d

Shrubs or trees, 3–6 m tall. Bark longitudinally striate, round lenticels; branches glabrous, no thorns. Petiole 6–10 mm long, cylindrical, canaliculate, not winged, glabrous, rugose; blades 7.7–10.2 × 2–4.7 cm, glabrous, elliptic, oblong, margin entire, revolute, apex acute to acuminate, base rounded or cuneate, attenuate to the petiole, main nerve flat to slightly impressed on adaxial and prominent on abaxial, secondary nerves 7–10, broquidodromous venation. Inflorescences in axillary fascicles, sessile, glabrous, 12–15 flowers, bisexuals, bracts ca. 0.2 mm long, pedicel 2–3 mm long; calyx pentamerous, gamosepal up to 0.5 mm long, lobus 0.5 mm long, ca. 1 mm long, triangular, apex acuminate; corolla 5-mera, dialipetal, petals 2.5–3 × ca. 1 mm, elliptic, adaxially pubescent; stamens 10, 1.5–2 mm long, staminodes absent, filaments free, anthers basifixed, rimose; gynoecium ca. 1.5 mm long, ovary superior, depressed-globose, glabrous, 3-locular, 3-ovulate, hypogynous disk absent. Drupe 8.5–10 × 5–7 mm, oblongoid, apex apiculate, hypogynous disk absent; calyx accrescent, involving the fruits when immature and patent when mature, 7–8 mm long, diameter 10–15 mm, 5-lobed, coned at base up to ca. 3.2 mm, lobes free ca. 2 × 4.2–7 mm, apex rounded to acute; bracts at the base of the calyx absent; pedicel 5–8 mm long.

Materials examined: CEARÁ: Aquiráz, Serrote da Preaoca, 4.VII.1999, fl., *A.S.F. Castro* (EAC 28354). Cascavel, Serra de Mataquiri, 12.VIII.2001, fr., *A.S.F. Castro 1017* (EAC). Crateús, Reserva Particular do Patrimonio Natural Serra das Almas, 19.VIII.2003, fr., *R.C. Costa 285* (EAC); *R.C. Costa 310* (EAC). Fortaleza, 21.X.1960, fr., *L.Z. Almeida* (EAC 2027). Tianguá, 22.VIII.2004, fr., *L.W. Lima-Verde 2961* (EAC). Ubajara, Parque Nacional de Ubajara, 23.IX.1978, fr., *A. Fernandes* (EAC 5025).

It differs from *H. perianthomega*, which also occurs in the study area (Fig. 1), by its longer floral pedicel, 2–3 mm long (*vs*. 0.5–1 mm long) and fruit with a smaller diameter calyx, 10–15 mm (*vs*. 27–40 mm). For both it is also important to emphasize that the size of the pedicel is taxonomically important when in flower because it expands during frutification and becomes similar in size.

Heisteria can be recognized by inflorescences in axillary fascicles, persistent and accrescent calyx in the fruits, often patent when mature (Sleumer 1984). The genus is composed of 33 species, which occur almost exclusively in the Neotropical region, except for three African species (MacDougal 2003; Nickrent *et al*. 2010; Christenhusz *et al.* 2017). It *Heisteria ovata* is widely distributed in South America, with records from Bolivia, Brazil, Colombia, Guyana, Peru and Venezuela (Sleumer 1984; MacDougal 2003). In Brazil, it is cited from phytogeographics domains Amazon, Caatinga, Cerrado and Atlantic Forest (BFG 2018). However, in the study area, it is found only in Ceará, in areas of Lowland Atlantic Forest such as "*tabuleiros*" and "*restingas*", Submontane and Montane Forest, and in areas of crystalline Caatinga (Fig. 1).

The flowering and fruiting period is from April to October.

4. *Heisteria perianthomega* (Vell.) Sleumer, Fl. Neotrop. Monogr. no. 38: 76. 1984. Fig. 4e-h

Trees, 8–20 m tall. Bark longitudinally striate; branches glabrous, no thorns. Petiole 5–11 mm long, cylindrical, canaliculate, not winged, glabrous, rugose; blades 6.5–16 × 2.5–6.5 cm, glabrous, elliptic to oblong, margin entire, revolute, apex acuminate, occasionally subfalcate, base obtuse to rounded, attenuate to the petiole, main nerve flat to slightly impressed on adaxial and prominent on abaxial, secondary nerves 7–12, broquidodromous venation. Inflorescences in

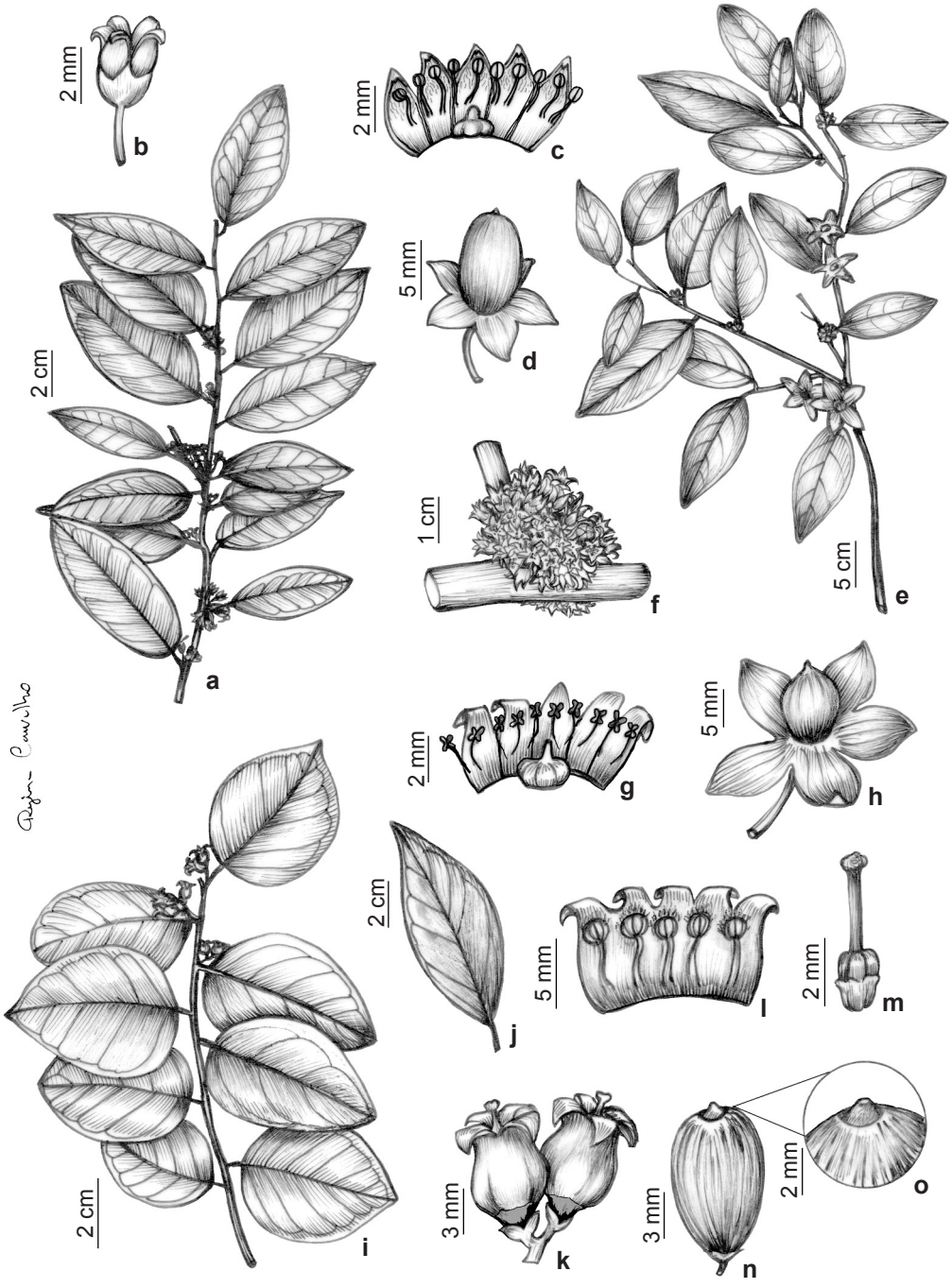

Figura 4 – a-d. *Heisteria ovata* – a. flowering branch; b. flower; c. internal view of the flower, showing the androecium and gynoecium; d. fruit. e-h. *Heisteria perianthomega* – e. branch with flowers and fruits; f. inflorescences; g. internal view of the flower, showing the androecium and gynoecium; h. fruit. i-o. *Schoepfia brasiliensis* – i. flowering branch; j. leaf; k. inflorescence; l. internal view of the flower, showing the androecium; m. gynoecium; n. fruit; o. detail of the fruit apex. (a-d. *L.Z. Almeida* (EAC 2027), *A.S.F. Castro* (EAC 28354); e-h. *D. Cavalcanti* 619, *M.T. Monteiro* 22704; i-o. *A.S.F. Castro 629* (EAC), *R.C. Costa* 312).

axillary fascicles, sessile, glabrous, 7–9 flowers, bisexuals, bracts ca. 0.2 mm long, pedicel 0.5–1 mm long; calyx pentamerous, gamossepal up to 0.3 mm long, lobus ca. 1.5 mm long, ca. 1.8 mm long, lanceolate to ovad, apex acuminate; corolla 5-mera, dialipetal, petals ca. 2 × ca. 0.7 mm, elliptic, adaxially pubescent; stamens 10, 1.5–2 mm long, staminodes absent, filaments free, anthers basifixed, rimose; gynoecium ca. 1 mm long, ovary superior, depressed-globose, glabrous, 3-locular, 3-ovulate, hypogynous disk absent. Drupe 7–11 × 5.5–8.5 mm, ovoid to oblongoid, apex apiculate, hypogynous disk absent; calyx accrescent, involving the fruits when immature and patent when mature, ca. 20 mm long, diameter 27–40 mm, 5-lobed, coned at base up to 4–11 mm, lobes free 11–15 × 11–13 mm, apex rounded to acute; bracts at the base of the calyx absent; pedicel 4–7 mm long.
Materials examined: ALAGOAS: Flexeiras, Fazenda Triunfo, 9.II.2011, fr., *R.C. Pinto 112* (MAC); 16.VIII.1968, fr., *M.T. Monteiro 22704* (HST). Murici, Estação Ecológica de Murici, 20.XI.2012, fr., *M.C.S. Mota & E.C.O. Chagas 11791* (MAC). Quebrangulo, Reserva Biológica de Pedra Talhada, 9.XII.1994, fr., *A. Cervi et al.* 7280 (NY). São Miguel dos Campos, Fazenda Sinimbú, 17.IX.1968, fr., *M.T. Monteiro 22765* (HST, IPA). PARAÍBA: Areia, 9.XII.2011, fr., *E. Melo et al. 10767* (HUEFS). PERNAMBUCO: Goiana, Reserva Particular do Patrimônio Natural Fazenda Tabatinga, 14.X.2011, fr., *D. Cavalcanti et al. 619* (UFP). Jaqueira, Reserva Particular do Patrimônio Natural Frei Caneca, Mata do Ageró, 20.IX.2011, fl., *B.S. Amorim 1079* (JPB, UFP). Recife, Parque Estadual de Dois Irmãos, 13.X.1967, fr., *O.C.Lira 83-67* (UFP). São Vicente Férrer, Mata do Estado, 2.XII.2017, fr., *D.S. Lucena et al. 835* (HUEFS, JPB, MBML, RB, UFP). Sirinhaém, Engenho Lage, 30.X.1968, fr., *D.P. Lima 12613* (HST, IPA).

Among *Heisteria* recorded in northeastern Brazil, *H. blanchetiana*, from Bahia, is morphologically similar to *H. perianthomega*. However, its floral pedicel ranges from 4–6 mm long (*vs.* 0.5–1 mm long) and fruit with a larger calyx 45–70 mm (*vs.* 27–40 mm diam.).

Heisteria perianthomega is endemic to Brazil and distributed in the Northeast and Southeast regions (Sleumer 1984; BFG 2018). In the study area, it is found in Alagoas, Paraíba and Pernambuco, from Lowland to Montane Forests including "*brejos de altitude*" (Fig. 1). The species is often found along perennial or temporary rivers. It is popularly known as "*canelinha*".

The flowering and fruiting period from August to February.

5. *Schoepfia brasiliensis* A.DC., Prodr. [A.P. de Candolle] 14(2): 622. 1857. Fig. 4i-o

Shrubs or trees, 1–6 m tall. Bark longitudinally striate, round lenticels; branches glabrous, no thorns. Petiole 2–5 mm long, cylindrical, canaliculate, not winged, glabrous; blades 4.5–14 × 2.5–4.6 cm, glabrous, lanceolate, elliptic or ovate, margin entire, apex acute to acuminate, base cuneate to rounded, main nerve flat on adaxial and prominent on abaxial, secondary nerves 5–8, broquidodromous. Inflorescences in axillary monocasios, peduncle 1–3 mm long, glabrous or rarely with indument puberulent, 2–4 flowers, bisexuals, distylous, bracts ca. 1 mm long, sessile; epicalyx 2-lobate, 0.8–1 mm long; calyx inconspicuous; corolla 4–5-mera, gamopetal, 5–8 mm long, slightly urceolate, lobus reflexes or rarely erect, tuft of trichomes inserted behind each anther; stamens 4–5, 4–5.5 mm long, staminodes absent, filaments adnate to corolla tube, anthers basifixed, rimose; ovary inferior, 1–1.5 × 1.2–1.7 mm, obconic, glabrous, epigynous disc ca. 1 × 1–2 mm, 1-locular at apex e 3–4-locular at base, 1-ovulate at apex e 3–4-ovulate at base, hypogynous disk absent; longistylous form: stigma 2.5–4 mm long; brevistylous form: stigma ca. 1 mm long. Drupe 7–14 × 4–10 mm, obovoid, apex free, glabrous, hypogynous disk absent; calyx involving 11/12 the fruit; subtended by persistent epicalyx; pedicel ca. 5 mm long.
Materials selected examined: ALAGOAS: Coqueiro Seco, 31.IX.2011, fr., *O.J. Pereira et al. 7916* (MAC). Ibateguara, Coimbra, 27.X.2003, fr., *M. Oliveira et al. 1438* (MAC). Igreja Nova, Usina Marituba, X.2007, *A. Costa 257* (MAC). Inhapi, Serra do Grude, 23.IV.2009, fl., *M.C.S. Mota & E.C.O. Chagas et al. 2922* (MAC). Japaratinga, 16.X.2009, fl., *A.M. Bastos et al. 110* (MAC). Maceió, Serra da Saudinha, 5.II.2009, fl., *M.C.S. Mota & E.C.O. Chagas 1928* (MAC). Marechal Deodoro, Restinga do Leprosário, 13.VII.2007, fl., *W.S.R. Ferreira Júnior* (MUFAL 3979). São Luís do Quintude, Reserva Particular do Patrimonio Natural Garabu, 21.VIII.2004, fl., *R. Lemos et al. 8448* (MAC). Tanque D'Arca, Reserva Particular do Patrimonio Natural Cachoeira, 20.XI.2010, fr., *M.C.S. Mota & E.C.O. Chagas 9532* (MAC). Teotônio Vilela, Reserva Particular do Patrimonio Natural Gulandim, 20.VII.2012, fr., *I.A. Bayma et al. 2366* (MAC). Traipu, Serra das Mãos, 22.VIII.2010, fr., *R.P. Lyra-Lemos et al. 13242* (MAC). CEARÁ: Aquiráz, Preaoca, 22.XII.1998, fr., *A.S.F. Castro 629* (EAC). Aratuba, Pico do Mussum, 30.VI.2017, fl., *E.C. Tomaz et al. 130* (UFRN). Caucáia, 16.VIII.2009, fl., *A.S.F. Castro 2211* (EAC). Crateús, Reserva Particular do Patrimonio Natural Serra das Almas, 20.VIII.2003, fl., *R.C. Costa 312* (EAC). Crato, subida de Belomonte,

21.VII.2014, fl., *F.C.L. Pinto & E.R. Silveira 51* (ALCB). Fortaleza, BNB do Passaré, 23.VIII.2002, fl., *A.S.F. Castro* (EAC 32264). Guaramiranga, Sítio Sinimbu, 8.VII.2004, fr., *V. Gomes & A. Xavier 8071* (EAC). Pacoti, Serra de Baturité, 12.VIII.2009, fl., *F.S. Gomes et al. 980* (ALCB, EAC). Santana do Cariri, estrada para Crato, 24.V.2011, fl., *E. Melo et al. 9848* (HUEFS). PARAÍBA: Areia, Parque Estadual da Mata do Pau Ferro, 5.X.1999, fl., *M.R. Barbosa 1823* (JPB). Cabedelo, Mata da Amém 17.IX.1999, fr., *A.F. Pontes 141* (JPB). Itabaiana, fazenda de Aguinaldo Velozo, 9.VIII.1952, fl., *F. Melo* (JPB 1999). João Pessoa, Estação da Prata, 27.VII.1989, fl., *A.O. Dias* (JPB 15777). Mamanguape, Reserva Biológica Guaribas, Área II-Cabeça de boi, 27.XI.2002, fr., *A.C. Sevilha & G. Pereira-Silva 2579* (CEN). Mataraca, Milennium Inorganic Chemicals Mineração LTDA, 4.X.2007, fl., *P.C. Gadelha Neto et al. 1844* (JPB). Umbuzeiro, 22.VIII.1952, *L. Xavier* (JPB 1616). PERNAMBUCO: Brejo da Madre de Deus, Mata da Rita, 4.IX.1999, fr., *A.G. Silva & I.M. Nascimento 161* (HUEFS). Buíque, 19.X.2007, fl. and fr., *R. Pereira et al. 1066* (HUEFS). Cabo de Santo Agostinho, Área do Projeto Suape, 9.XI.1977, fl., *D. Andrade-Lima et al. 80* (IPA). Igarassu, Usina São José, 4.IX.2007, fl., *A. Alves-Araújo 545* (UFP, UPCB). Garanhuns, Alto do Magano, 27.V.2011, fl., *E. Pessoa* (UFP 60605). São Vicente Férrer, Mata do Triunfo, 6.V.2006, fl., *C.G. Lopes 656* (PEUFR). Taquaritinga do Norte, 11.XI.1983, fl., *V.C. Lima et al.* (IPA 32337). Triunfo, Sítio Lagoa Nova, 18.VI.1992, fl., *E.M.N. Ferraz 176* (IPA). RIO GRANDE DO NORTE: Baía Formosa, Mata Estrela, 10.IX.2011, fl., *J.L. Costa-Lima & W.M.B São-Mateus 562* (UFRN). Ceará-Mirim, Fazenda Diamante, 8.II.2014, fl., *J. Jardim et al. 6718* (UFRN). Extremoz, Área de Preservação Ambiental Jenipapu, 7.V.2011, fl., *J.G. Jardim 5966* (UFRN). Natal, 29.VIII.1992, fr., *L.P. Félix 5199* (EAN). Nísia Floresta, 26.VIII.2012, fl., *W.M.B. São-Mateus et al. 206* (UFRN). Parnamirim, Fazenda EMPARN, Mata Jiqui, 25.V.2015, fr., *P.P.A.C. Mello* (JPB 62557). Tibau do Sul, praia de Pipa, 6.II.1984, fl., *R. Pereira et al. 233* (UFRN).

Besides *Schoepfia brasiliensis*, three other species occur in Brazil. *Schoepfia velutina* Sandwith differs from the others by its branches and leaves with velutinous indument (*vs.* glabrous in *S. clarkii* Steyerm, *S. lucida* Pulle and *S. brasiliensis*), while *S. clarkii* Steyerm, *S. lucida* Pulle and *S. brasiliensis* are distinguished from each other by corolla size, being 1.8–2 mm, 4–4.5 mm and 5.5–8 mm long, respectively (Sleumer 1984; Farroñay *et al.* 2019).

Most species in the genus are hemiparasites of roots, characterized morphologically by the presence of an epicalyx with 2–3 lobes on the pedicel of the flowers and fruits, stamens adnate to the corolla tube and calyx almost completely enveloping the fruits (MacDougal 2003). *Schoepfia* comprises 25 species distributed in Asia (six spp.) and America (19 spp.) (Nickrent *et al*. 2010; Christenhusz *et al.* 2017). *Schoepfia brasiliensis* occurs in Argentina, Brazil and Venezuela. In Brazil, it grows in the phytogeographics domains Amazon, Caatinga, Cerrado and Atlantic Forests (BFG 2018). In the study area it is widespread and found in crystalline and sedimentary Caatinga, as well as, in Atlantic Forest (Lowland to Montane Forests, "*restingas*", "*tabuleiros*" and "*brejos de altitude*") and Cerrado in Ceará (Fig. 2). Considerable variation in leaf size and shape was observed, which could be the result of plasticity related to its wide range of habitats.

The flowering and fruiting periods are throughout the year.

6. *Ximenia americana* L., Sp. Pl. 2: 1193. 1753. Fig. 3l-q

Trees to shrubs, 2–5 m tall. Bark with lenticels round and spaced; branches glabrous, often armed, thorn 0.5–3.5 cm long. Petiole 3–9 mm long, cylindrical, slightly canaliculate, not winged, glabrous or rarely with simple and spaced trichomes along the canal; blades 2.5–7 (7.5–9) × 1.7–4.1 cm, glabrous, elliptic, oval or ovate, margin entire, apex apiculate, base cuneate to obtuse, main nerve flat to slightly impressed on adaxial and prominent on abaxial, secondary nerves 3–6, broquidodromous venation. Inflorescences in axillary racemes umbellate, peduncle 5–12 mm long, glabrous, 3–7 flowers, functionally unissexuals, bracts absent, pedicel 4–9 mm long; calyx inconspicuously tetramer, gamosepal, ca. 0.5 mm long; corolla 4-mera, dialipetal, petals 7–12 × 1.5–2.5 mm, linear, adaxially villous; stamens 8, 3–10 mm long, staminodes absent, filaments free, anthers basifixed, longitudinal; gynoecium 2–7 mm long, ovary superior, oblongoid, glabrous, 4-locular, 4-ovulate, hypogynous disk absent. Drupe 15–40 × 10–30 mm, subglobose, hypogynous disk absent; no persistent calyx; bracts at the base of the calyx absent; pedicel 5–10 mm long.

Materials selected examined: ALAGOAS: Piaçabuçu, próximo a Potengi, 17.III.1982, fr., *R.F. Almeida 187* (MAC). Umbuzeiro, 26.XI.1971, *D. Andrade-Lima et al.* (MAC 1714). CEARÁ: Aiuaba, Estação Ecológica de Aiuaba, 14.V.1998, *N.M. Gerda* (EAC 27042). Aquiraz, Trilha das Sucurujubas, 15.I.2016, fl., *A.P. Negreiros et al. 23* (EAC). Caridade, Fazenda Feijão, 18.XI.1990, fl., *B. Freitas* (EAC 22905). Caucaia, Parque Botânico do Ceará, 26.IV.1997, fl., *A. Fernandes et al.* (UFC 25726). Crato, Chapada do Araripe, 20.XI.2001, fl., *F.S. Cavalcante*

(EAC 31008). Graça, 19.XII.2007, fr., *P.M. Teixeira et al.* 31 (HUEFS). Granja, Fazenda Recanto, 13.X.1989, fr., *F. Cavalcante & E. Nunes* (EAC 16242). Guaiúba, Fazenda da UECE, 5.II.2017, fl. and fr., *O. Mesquita* (EAC 39619). Horizonte, estrada Coluna-Cascavel, 13.XI.2008, fl., *J.E. Alves* (EAC 43881). Iguatu, 4.III.2013, fr., *L.R. Pereira Júnior* (EAN 22712); 16.IV.2014, *L.P. Félix 14883* (EAN). Independência, estrada para Quiterianópolis, 10.IV.1998, *E.B. Sousa* (EAN 26394). Maracanaú, Aldeia indígena Pitaguary, 13.X.2011, fr., *P. Pantoja* (EAC 50435). Missão Velha, 4.I.2009, fr., *M.F. Moro et al. 698* (EAC). Pacujá, 20.XII.2007, fr., *I.M. Andrade 3111* (HUEFS). Paraipaba, Área de Preservação Ambiental Dunas de Lagoinha, 19.X.2003, fl., *D.V. Azevedo* (EAC 33020). Pentecoste, Fazenda Experimental, 9.XI.2016, fl., *N.C. Rebouças et al. 06* (UFC). Pombal, 15.IX.1953, *J. Carneiro* (JPB 1654 A). Poranga, 19.IV.2014, *E.M. Almeida et al. 1112* (EAN). Quixadá, comunidade São João, 4.II.2010, fr., *V. Gomes et al. 1373* (EAC). Senador Pompeu, Serrote do Patu, 18.I.1995, *E.B. Sousa et al.* (EAC 21906). São Gonçalo do Amarante, Estação Ecológica do Pecém, 12.X.2011, fl., *R.G. Ferreira* (EAC 49904). Tauá, Bacia do Riacho Carrapateira, 10.XII.2014, fl., *A.C. Gomes* (57387). Venturoza, Serra da Meruoca, 8.X.2002, fl., *A. Fernandes* (EAC 32193). PARAÍBA: Cabaçeiras, Sítio Bravo, 18.II.1992, fr., *V.L. Nascimento et al. 23* (JBP). Cabedelo, 15.XII.1999, fr., *A.F. Pontes 346* (JPB). Campina Grande, 29.IX.1986, fr., *A. Fernandes* (EAC 14779). Caturité, 20.XII.2012, fl., *L.P. Félix 14218* (EAN). Itaporanga, Serra Água Branca, 7.I.1994, fr., *M.F. Agra 2512* (EAN). João Pessoa, Falésia de Cabo Branco, 12.XI.1986, fl., *C.A.B. Miranda 202* (JPB). Junco do Seridó, 20.XII.2012, *L.P. Félix 14220* (EAN). Lucena, 2.XII.1997, fl., *R. Pereira et al. 1307* (JPB, IPA). Mamanguape, Tarana, Sema II, 22.XI.1991, fl., *L.P. Félix et al. 4572* (EAN). Mataraca, Millennium Inorganic Chemicals Mineração, 4.X.2007, fl., *P.C. Gadelha Neto et al. 1861* (JBP). Nazarezinho, Serra do Pico, 9.I.2000, fr., *P.C. Gadelha Neto et al. 503* (JPB). Pocinhos, 31.X.2007, fl., *P.C. Gadelha Neto et al. 1939* (JPB). Sapé, Inhana, 10.VIII.1991, fl., *O.T. Moura 626* (JPB). São José dos Cordeiros, Reserva Particular do Patrimonio Natural Fazenda Almas, 24.I.2008, fr., *M.C. Pessoa et al. 267* (JPB). São Sebastião de Lagoa de Roça, 29.III.2013, *L.P. Félix 14230* (EAN). Sousa, Sítio Lamarão, 13.VI.1996, *H.M. Moreira 36* (JPB). PERNAMBUCO: Águas Belas, Mata do Paredão, 13.II.2008, *G.T. Soldati et al. 160* (IPA). Arcoverde, Serra das Varas, 22.II.2006, fr., *R. Pereira et al. 2658* (IPA). Buíque, Parque Nacional Serra do Catimbaú, 26.VI.2007, *R.M. Santos et al. 1630* (HUEFS). Exu, Serra do Araripe, 30.IX.2013, fl., *M.E. Saraiva 194* (EAC); Fazenda Taboquinha, 19.I.2006, fr., *I. Meunier et al.* (HST 16079). Goiana, Reserva Particular do Patrimonio Natural Fazenda Tabatinga, 28.XII.2010, fl., *A. Melo et al. 717* (IPA, UFP). Igarassu, Usina São José, 26.XII.2008, fl., *A. Alves-Araújo & B. Amorim 1086* (UFP); 10.XII.2007, fl., *P.Y. Ojima 112* (UFP). Ipojuca, Área do Projeto Suape, 23.XI.1977, fl., *A. Lima et al. 100* (IPA). Itamaracá, 31.V.1994, *P. Coelho* (IPA 55547). Moreilândia, 19.I.2006, fr., *F.S. Cavalcanti* (EAC 38605). Pombos, Assentamento Cervo Mendes, 1.II.2008, fr., *L.R. Silva 181* (HST). Recife, 23.XI.1963, fl., *S. Tavares 869* (HST). Serra Talhada, Serra da Carnaubeira, 22.V.1971, *E.P. Heringer* (IPA 19707). São Lourenço da Mata, Refúgio de Vida Silvestre Mata Tapacurá, 11.XII.2013, fl., *M.S. Sobrinho 443* (UFP). Vitória de Santo Antão, Engenho Pombal, 25.XI.1997, fl., *A. Laurênio 678* (UFRN). RIO GRANDE DO NORTE: Alto dos Rodrigues, Comunidade Barrocas, 30.V.2010, *D.F. Torres et al. 34* (UFRN). Baía Formosa, Reserva Particular do Patrimonio Natural Mata da Estrela, 26.IV.2015, fl., *P.P.A.C. Melo* (JPB 62574). Ceará-Mirim, Dunas de Mariú, 11.II.2016, fr., *E.O. Moura et al.* (UFRN 20388). Cerro Corá, Conglomerado RN 76 4-7-2, 10.IX.2014, fl., *A.F. Silva et al. 103* (UFRN). Extremoz, 28.XI.2013, fl., *O.J. Pereira 8001* (UFRN). Goianinha, Fazenda Nossa Senhora do Carmo, 12.II.2011, *J.L. Costa-Lima et al. 383* (EAN, UFRN). Jucurutú, Reserva Particular do Patrimonio Natural Stoessel de Brito, 22.XII.2017, fl., *A.A. Roque 340* (JPB). Maxaranguape, Maracajaú, 22.XII.2016, fr., *D.S. Lucena & M. Alves 861* (UFP). Natal, 31.X.1992, fl., *L.P. Félix 5447* (EAN). Parnamirim, Riacho Águas Vermelhas, 21.IX.2005, *A. Ribeiro et al. 166* (UFRN). São Miguel do Gostoso, Novo Horizonte, 14.V.2007, *M.I.B. Loiola et al. 1191* (UFRN).

Besides *Ximenia Americana*, two other species occur in Brazil. *Ximenia coriacea* Engl. differs from the others by presenting flowers solitary or in axillary fascicles (*vs.* racemes or cymes in *X. americana,* subumbel in *X. intermedia* (Chodat & Hassl.) De Filipps (Sleumer 1984).

The genus is characterized morphologically mainly by the presence of armed branches, apiculate leaf apex and petals with long trichomes on the adaxial surface (MacDougal 2003). *Ximenia* is composed of 10 species of roots hemiparasites with a pantropical distribution (Nickrent *et al*. 2010; Christenhusz *et al*. 2017). *Ximenia americana* is widely distributed in Brazil (BFG 2018). In the study area it grows in all states, in areas of crystalline and sedimentary Caatinga, as well as in Atlantic Forest but it is most common in Lowland Forests such as "*restingas*", "*tabuleiros*", "*brejos de altitude*" and Cerrado enclaves (Fig. 2). It is popularly known as "*ameixa-da-caatinga*", "*ameixa-brava*" ou "*ameixa-de-espinho*". The species differs from the other species of Olacaceae in the study area by its armed branches, and absence of a calyx or hypogynous disk accrescent in the fleshy fruits.

The flowering and fruiting periods are throughout the year, but most fertile specimens were collected from April to October.

Because of its history of use in traditional communities, *X. americana* is the most widely known species of Olacaceae. It has anti-inflammatory and antimicrobial uses, with proven efficacy against bacteria (*Escherichia coli* (Migula) Castellani and Chalmers) and *Pseudomonas aeruginosa* (Schroeter) Migula) and fungus (*Candida albicans* (C.P. Robin) Berkhout) (Ogunleye & Ibitoye 2003). It is traditionally prepared as teas and infusions of the bark (Brasileiro *et al.* 2008).

Acknowledgments

To the Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq, for the grant awarded to the first author. To the curators and technicians of the visited herbaria, for the space given for the consultation of the botanical collections.

References

Alves-Araújo A & Alves M (2013) Checklist of Sapotaceae in Northeastern Brazil. Check List 9: 59-62.

Amorim BS & Alves M (2012) Myrtaceae from lowland Atlantic Forest areas in the State of Pernambuco, Northeastern Brasil. Phytotaxa 40: 33-54.

APG III - The Angiosperm Phylogeny Group (2009) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 161: 105-121.

APG IV - The Angiosperm Phylogeny Group (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 181: 1-20.

Assis MC (2004) Flora de Grão-Mogol, Minas Gerais: Olacaceae. Boletim Botânica 22: 349-351.

Barroso GM, Peixoto AL, Ichaso CLF, Guimarães EF & Costa CG (2002) Sistemática de angiospermas do Brasil. 2nd ed. UFV, Viçosa. 309p.

BFG - The Brazil Flora Group (2018) Brazilian Flora 2020: innovation and collaboration to meet Target 1 of the Global Strategy for Plant Conservation (GSPC). Rodriguésia 69: 1513-1527.

Brasileiro MT, Egito AA, Lima JR, Randau KP, Pereira GC & Rolim Neto PJ (2008) *Ximenia americana* L.: botânica, química e farmacologia no interesse da tecnologia farmacêutica. Revista brasileira de farmacologia 89: 164-167.

Cabral S & Agra MFA (1999) Flora paraibana: Olacaceae Mirb. *ex* dcDC. Revista Nordestina de Biologia 13: 1-11.

Christenhusz MJM, Vorontsova MS, Fay MF & Chase MW (2015) Results from na online survey of Family delimitationin angiosperms and ferns: recommendations to the Angiosperm Phylogeny Group for thorny problems in plant classification. Botanical Jounal of the Linnean Society 178: 501-528.

Christenhusz MJ, Fay MF & Chase MW (2017). Plants of the world: an illustrated encyclopedia of vascular plants. Royal Botanic Gardens, Kew. 672p.

Costa-Lima J & Alves M (2015) Flora da Usina São José, Igarassu, Pernambuco: Erythoxylaceae. Rodriguésia 66: 285-295.

Farroñay F, Perdiz RO, Costa FM, Prata BEM & Vicentini A (2019) A new record and emended description of a rare Amazonian White-sand species: *Schoepfia clarkii* (Schoepfiaceae). Brittonia 2019: 1-6.

Fernandes MF & Queiroz LP (2018) Vegetação e Flora da Caatinga. Ciência e Cultura 70: 51-56.

Gomes-Costa GA & Alves M (2016) Cucurbitaceae Juss. na Floresta Atlântica de terras baixas ao norte do Rio São Francisco, Brasil. Iheringia 71: 62-71.

Guimarães EF, Barroso GM, Ichaso CLF & Bastos AR (1971) Flora da Guanabara Flacourtiaceae - Olacaceae - Boraginaceae. Rodriguésia 38: 143-252.

Harris JG & Harris MW (2000) Plant identification terminology, an illustrated glossary. Spring Lake Publishing, Spring Lake. 197p.

Heywood VH (1993) Flowering plants of the world. Oxford University Press, New York. 336p.

Lima MHP, Rodrigues CM, Silva JKT, Martins PC, Terron SL & Silva RLS (2002) Divisão Territorial do Brasil - 2002. Instituto Brasileiro de Geografia e Estatística. Mapa 8. Available at <http://www.ipeadata.gov.br/doc/DivisaoTerritorialBrasileira_IBGE.pdf>. Access on 10 August 2019.

Macdougal JM (2003) Olacaceae. *In:* Steyermark JA, Berry PE, Yatskievych K & Holst BK (eds.) Flora of the Venezuelan Guayana. Missouri Botanical Garden, St. Louis. Pp. 162-186.

Maciel JR, Oliveira RC & Alves M (2009) *Paspalum* L. (Poaceae: Panicoideae: Paniceae) no estado de Pernambuco, Brasil. Acta Botânica Brasílica 23: 1145-1161.

Maciel JR, Louzada R & Alves M (2015) *Aechmea* Ruiz & Pavón from the northern portion of the Atlantic Forest. Rodriguésia 66: 477-492.

Malécot V, Nickrent DL, Baas P, Oever LVD & Callen DL (2004) A morfological cladistic analysis of olacaceae. Systematic Botany 29: 569-586.

Malécot V & Nickrent DL (2008) Molecular phylogenetic relationships of Olacaceae and related santalales. Systematic Botany 33: 97-106.

Martinelli G & Moraes MA (2013) Livro Vermelho da Flora do Brasil. Andrea Jakobsson: Instituto de Pesquisas do Jardim Botânico do Rio de Janeiro. Rio de Janeiro. 1102p.

Meirelles J & Fernandes Júnior AJ (2017) Flora of the Cangas of Serra dos Carajás, Pará, Brazil: Olacaceae. Rodriguesia 68: 1053-1057.

Melo A & Alves M (2013) Sinopse das ervas aclorofiladas ocorrentes no norte da Floresta Atlântica, Brasil. Revista Brasileira de Biociências 11: 29-38.

Moro MF, Lughadha EM, Filer DL, Araújo FS & Martins FR (2014) A catalogue of the vascular plants of the Caatinga Phytogeographical Domain: a synthesis of floristic and phytosociological surveys. Phytotaxa 160: 001-118.

Moro MF, Macedo MB, Moura-Fé MM, Castro ASF & Costa RC (2015) Vegetação, unidades fitoecológicas e diversidade paisagística do estado do Ceará. Rodriguesia 63: 717-743.

Nickrent DL, Malécot V, Vidal-Russel R & Der JP (2010) A revised classification of Santalales. Taxon 59: 538-558.

Nusbaumer L, Barbosa MRV, Thomas WW, Alves M, Amorim BS, Pessoa E, Melo A, Loizeau PA & Spichiger R (2015) Inventário da Reserva biológica de Pedra Talhada. *In*: Studer A, Nusbaumer L & Spichiger R (eds.) Biodiversidade da Reserva Biológica de Pedra Talhada, Alagoas, Pernambuco - Brasil. Editions des cConservatoire & Jardin botaniques, Geneva. Pp. 439-547.

Ogunleye DS & Ibitoye SF (2003) Studies of antimicrobial activity and chemical constituents of *Ximenia americana*. Tropical Jounal Pharmaceutical Research 2: 239-241.

Pessoa E & Alves M (2015) Synopsis of Orchidaceae from Serra of Urubu: an area of montana forest, Pernambuco State, Brazil. Hoehnea 42: 109-133.

Prado DE (2003) As caatingas da América do Sul. *In*: Leal IR, Tabarelli M & Silva JMC (eds.) Ecologia e conservação da Caatinga. Universidade Federal de Pernambuco, Recife. Pp. 3-74.

QGIS Development Team (2015) QGIS Geographic Information System. Open Source Geospatial Foundation Project. Available at <http://qgis.osgeo.org>. Access on 8 June 2019.

Queiroz LP (2009) Leguminosas da Caatinga. Editora da Universidade Estadual de Feira de Santana, Feira de Santana. 443p.

Radford AE, Dickson WC, Massey JR & Bell CR (1974) Vascular Plant Systematics. Harper & Row Publ., New York. 891p.

Ribeiro JELS, Hopkins MJG, Vicentini A, Sothers CA, Costa MAS, Brito JM, Souza MAD, Martins LHP, Lohmann LG, Assunção PACL, Pereira EC, Silva CP, Mesquita MR & Procópio LC (1999) Flora da reserva Ducke: guia de identificação das plantas vasculares de uma floresta de terra firme na Amazônia central. INPA, Manaus. 799p.

Rizzini CT (1997) Tratado de fitogeografia do Brasil: aspectos ecológicos, sociológicos e florísticos. 2nd ed. Âmbito Cultural Edições Ltda, Rio de Janeiro. 747p.

Rodrigues EA & Rossi L (2002) Olacaceae. *In*: Wanderley MGL, Shepherd GJ & Giulietti AM (eds.) Flora fanerogâmica do estado de São Paulo. 2nd ed. Instituto de Botânica, São Paulo. Vol. 2, pp. 213-218.

Santos SO & Alves M (2013) Sinopse taxonômica da família Lauraceae na porção norte da Floresta Atlântica brasileira. Revista Brasileira de Biociências 11: 14-28.

Silva KA, Araújo EL & Ferraz EMN (2009) Estudo florístico do componente herbáceo e relação com solos em áreas de caatinga do embasamento cristalino e bacia sedimentar, Petrolândia, PE, Brasil. Acta Botânica Brasílica 23: 100-110.

Sleumer HO (1984) Olacaceae: Flora Neotropica Monograph. Organization for Flora Neotropica. New York Botanical Garden, Bronx. 160p.

Tabarelli M, Pinto LP, Silva JMC, Hirota M & Bedê L (2005) Challenges and Opportunities for Biodiversity Conservation in the Brazilian Atlantic Forest. Conservation Biology 19: 695-700.

Tabarelli M, Siqueira Filho JA & Santos AMM (2006) A Floresta Atlântica ao norte do Rio São Francisco. *In*: Pôrto KC, Cortez JSA & Tabarelli M (eds.) Diversidade biológica e Cconservação da Floresta Atlântica ao norte do rio São Francisco. Ministério do Meio Ambiente, Brasília. Pp. 23-37.

Thiers B [continuously updated] Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at <http://sweetgum.nybg.org/science/ih/>. Access on 29 October 2018.

Thomas W & Barbosa MRV (2008) Natural vegetation types in the Atlantic Coastal Forest of Northeastern Brazil. *In*: Thomas W (ed.) The Atlantic Coastal Forest of Northeastern Brazil. Pp. 6-20.

Veloso HP, Rangel-Filho ALR & Lima JCA (1991) Classificação da vegetação brasileira, adaptada a um sistema universal. IBGE, Rio de Janeiro. 124p.

List of exsicates

A Alves-Araújo 1086 (6), 457 (5), 545 (5), 632 (5). **A Cervi** 7280 (5). **AC Sevilha** 2579 (5). **AJC Aguiar** 37 (6). **AM Bastos** 110 (5). **A Costa** 257, 528 (5). **AG Silva** 161 (HUEFS). **ASF Castro** 1017, EAC 28354, EAC 30078 (3), EAC 32264, 629 (5). **AO Dias** 01 (5). **A Fernandes** EAC 5025 (3), EAC 13965, 14779, 25726, 32193 (6). **AC Gomes** EAC 57387 (6). **A Laurênio** 678 (6). **A Melo** 717 (6). **AP Negreiros** 23 (6). **AF Pontes** 279, 346 (6), 95, 141, 219 (5). **A Ribeiro** 166 (6). **AA Roque** 1288 (2), 340, 1671 (6). **A Silva** IPA 58817 (6). **AF Silva** 10, 103 (6). **AG Silva** 161, 138 (5). **BS Amorim** 1079 (4). **B Freitas** EAC 22905 (6). **B Pickel** 3184, IPA 974, IPA 3685, IPA 3687 (6). **CAB Miranda** 202 (6). **CAM Oliveira** 29 (5). **C Ferreira** IPA 66438 (6). **CEB Nobre** 01 (5). **CG Lopes** 656 (5). **D Andrade-Lima** 49-334, 68-5444 (1), 57-2840 (2), 49-393, 54-1903 (4), MAC 1714, 49-398, 68-5446, 100 (6), 80, 51-938 (5). **D Cavalcanti** 637 (6)**. DF Torres** 34 (6). **DP Lima** 12618 (1), 12613 (4). **DS Lucena** 835 (4), 861 (6). **EB Almeida** 507 (6). **EB Souza** EAC 21906, 26394 (6), 2190 (5). **ECO Chagas** 1928, 2922, 4662, 5900, 9532, 29222 (5). **E Cunha** JPB 27466 (2). **EC Tomaz** 130 (5). **EMN Ferraz** 550 (4), 239, 803 (6), 176, 439, 504 (5). **E Melo** 10746 (2), 10767 (4), 10220 (6), EAC 31879 (5). **EMP Fernando** 720 (5). **EO Moura** 573 (6), 84, 977 (5). **EM Almeida** 1112 (6). **F Cavalcante** EAC 16242 (6). **F Allemão & M Cysneiros** 170 (2). **FCL Pinto** 51 (5). **FF Araújo** 91 (6). **F Melo** JPB 1999 (5). **FS Cavalcante** 929, EAC 33010, 38605 (6). **FS Gomes** 980 (5). **G Gardner** 1957 (2). **GC Pereira** UFP 45322, IPA 73349 (6). **G Teixeira** 2886 (4), 2898, 2964 (6). **GT Soldati** 160 (6). **HM Moreira** 36 (6). **IA Bayama** 2303, 2366, 2383, MAC 57084 (5). **IM Andrade** 3111, 4015, 4028 (6). **I Meunier** HST 16079 (6). **IB Lima** 931, 937, 1178 (6), 1001 (5). **IS Moreira** 168 (5). **JAN Souza** 464 (6). **JCM Vasconcelos** EAC 666, 1055 (2). **JC Sousa Jr** 55 (6). **JE Alves** EAC 43881 (6). **JG Jardim** 5456 (1), 6165 (2), 5603 (6), 5832, 5966, 6092, 6718 (5). **JL Costa-Lima** 383, 1908 (6), 562 (5). **JLH Alves** UFP 7382 (6). **JR Lemos** 509 (5), EAC 38235 (6). **JS Marques** 232 (5). **JS Sobrinho** 354 (6). **J Soares** HST 2016 (4), IPA 75026, IPA 75724, PEUFR 15451 (4). **LZ Almeida** EAC 2027 (3). **LMR Melo** 136 (6). **LA Cestaro** 99-0215 (6), 99-0196 (5). **LA Pereira** 226 (5). **LQ Matias** 210 (6). **LP Félix** 4572, 5447, 14218, 14220, 14230, 14883 (6), 2994, 10593, 15138, EAN 7775 (5). **LR Pereira Júnior** EAN 22712 (6). **LR Silva** 181 (6). **L Xavier** JPB 1412 (2), 1137 (6), 1616, 1739 (5). **LW Lima-Verde** 2961 (3), 1775, 1823, 1879, 3085 (6). **MF Agra** 0401, 2512 (6). **MJG Andrade** 375 (5). **MR Barbosa** 1823, 1854 (5). **MA Figueiredo** EAC 16469, 426 (6). **MOT Menezes** 130 (5). **MT Monteiro** 22704, 22765, 22806, 22823 (4). **MF Moro** 698 (6). **MN Rodrigues** 2849 (5). **ME Saraiva** 194 (6). **MIB Loiola** 854, 1191 (6), 2567 (5). **MS Sobrinho** 443 (6). **MSC Mota** 11791 (4). **M Oliveira** 1438 (5). **MR Oliveira** 20984 (5). **MC Pessoa** 267 (6). **MB Sousa** 162 (6). **NA Albuquerque** 642 (6), 463 (5). **NM Gerda** EAC 27042 (6). **NT Amazonas** 2005 (5). **NT Medonça** 86 (5). **NC Rebouças** 6 (6). **OC Lira** 83-67 (4). **OJ Pereira** 8001 (6), **O Mesquita** EAC 39619 (6). 7916 (5). **OT Moura** 585, 628, 722, 925 (6). **P Coelho** IPA 55547 (6). **PC Gadelha Neto** 244, 985. 1861, 1902, 1939, 2012, 3119 (6), 979, 980, 1229, 1231, 1577, 1578, 1819, 1844 (5). **PM Teixeira** 31 (6). **PPAC Mello** 62574 (6), 62557 (5). **PV Luetzelburg** EAC 25841 (6). **PY Ojima** 112 (6). **P Pantoja** EAC 50435 (6). **R Coelho** 369 (6). **RA Pontes** 679 (6). **RC Costa** 285, 310 (3), 312 (5). **RC Pinto** 112, 243 (5). **RF Almeida** 187, 513 (6). **RM Santos** 1630 (6). **RG Ferreira** EAC 49904 (6). **R Lemos** 8848 (5), **RP Lyra-Lemos** 4636, 9904, 11487, 11525, 11535, 12727, 13242 (5). **R Pereira** 1307, 2658 (6), 233, 1066, (5). **RRF Xavier** 11, 104 (2). **SA Lima** 47 (5). **S Tavares** 869 (6). **VGR Cardoso** 8 (5). **V Gomes** 1373 (6), 807-1, 807-5 (5). **VC Lima** 432 (6), IPA 32337, IPA 32347 (5). **VM Mascena** C69 (6). **VL Nascimento** 23 (6). **WMB São Mateus** 03, 206 (5). **WSR Ferreira Júnior** MUFAL 3979 (5).

Area Editor: Dr. João Iganci
Received in September 17, 2019. Accepted in May 19, 2020.