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DANIELLY DA SILVA LUCENA

ESTUDOS TAXONÔMICOS EM OLACACEAE *S.L.* NO BRASIL, COM ÊNFASE NOS GÊNEROS *CATHEDRA* MIERS. E *HEISTERIA* JACQ.

Recife

2021

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Tese apresentada ao Programa de Pós-Graduação em Biologia Vegetal da Universidade Federal de Pernambuco, como requisito parcial para obtenção do título de Doutor em Biologia Vegetal. Área de concentração: Sistemática e Evolução

Orientador: Marccus Vinícius da Silva Alves

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APROVADA EM 28/04/2021

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RESUMO

Olacaceae R.Br., em sua classificação tradicional (exceto *Schoepfia* Schreb [Schoepfiaceae]) é constituída por 29 gêneros e cerca de 170 espécies, distribuídas nos trópicos e subtrópicos. São árvores, arbustos ou lianas, que se caracterizam pelas folhas simples, alternas, margem inteira, inflorescência axilar, ovário súpero, cálice frequentemente acrescente nos frutos e apenas uma semente. A principal referência para Olacaceae no Brasil é a flora Neotrópica, contudo algumas questões precisam ser melhor elucidadas na família, especialmente em relação às descrições, chaves de identificação, informações acerca da distribuição geográfica, do habitat e conservação das espécies, bem como nomenclaturais. Nesse contexto, o principal objetivo deste trabalho é realizar estudos taxonômicos para a família Olacaceae no Brasil, com ênfase nos gêneros *Cathedra* Miers. e *Heisteria* Jacq.. Para isso, 63 coleções foram analisadas de forma física e/ou virtual e, visitas a 16 áreas para coleta de material botânico foram realizadas nos domínios fitogeográficos do Cerrado (5 áreas) e Mata Atlântica (11 áreas). Os resultados obtidos foram sumarizados em quatro artigos, divididos em três capítulos. O primeiro capítulo traz uma abordagem taxonômica para Olacaceae e Schoepfiaceae, na porção oriental do nordeste brasileiro, com objetivo de elucidar os caracteres morfológicos úteis à delimitação das espécies e gêneros nessas duas famílias e embasar os estudos subsequentes. Olacaceae está representada por cinco espécies em quatro gêneros e Schoepfiaceae por uma espécie, as quais estão distribuídas nos domínios fitogeográficos da Caatinga e Floresta Atlântica, em áreas de Caatinga cristalina e sedimentar e em florestas de terras baixas, montanas e submontanas. Todas as espécies foram registradas em pelo menos uma unidade de conservação da área de estudo. O segundo capítulo é uma revisão taxonômica para o gênero *Cathedra*. Descrições complementares para duas espécies, lectotipicações para dois nomes e uma sinonimização são sugeridas. Ainda nesse estudo, uma nova espécie é descrita (*C. rupestris*), sendo reconhecidas cinco espécies no gênero, três categorizadas Em perigo (*C. bahiensis*, *C. grandiflora*, *C. rubricaulis*), uma Menos preocupante (*C. acuminata*) e uma Criticamente em perigo (*C. rupestris*). O terceiro capítulo é o estudo taxonômico para as espécies extra-amazônicas de *Heisteria*, sendo apresentado em dois manuscritos. O primeiro trata da descrição de uma nova espécie (*Heisteria longipedicellata*) e um novo registro para a Mata Atlântica brasileira (*Heisteria maytenoides*). O segundo é a flora das espécies de *Heisteria* para o Brasil extra-amazônico, onde foram identificadas sete espécies distribuídas nos domínios da Caatinga, Cerrado e Floresta Atlântica. Dentre as espécies identificadas, *Heisteria ovata, H. perianthomega* e *H. silvianii* são amplamente distribuídas na área de estudo e sugeridas no

status de conservação de Menor Preocupação, enquanto *H. blanchetiana, H. citrifolia* e *H. maytenoides* apresentam distribuição restrita e são sugeridas como Em perigo e, por fim, *H. longipedicellata*, representada por um único espécime, não foi avaliada, sendo sugerida como Dados deficientes. A sinonimização de *H. salicifolia* em *H. perianthomega* também é proposta nesse estudo.

Palavras-chave: *Cathedra*; *Heisteria*; morfologia; nordeste oriental; taxonomia.

ABSTRACT

Olacaceae R.Br., in its traditional classification (except *Schoepfia* Schreb [Schoepfiaceae]) is composed of 29 genera and about 170 species, distributed in the tropics and subtropics. They are trees, shrubs, or lianas, which are characterized by simple, alternate leaves, entire margin, inflorescence axillary, superior ovary, calyx often accrescent in fruits and only one seed. The main reference for Olacaceae in Brazil is the Flora Neotropica, however, some issues need to be clarified in the family, especially in relation to descriptions, identification keys, information about geographic distribution, habitat and, conservation of species, as well as nomenclaturals. In this context, the main objective of this work is to realize out taxonomic studies for the Olacaceae family in Brazil, with an emphasis on the genera *Cathedra* Miers. and *Heisteria* Jacq.. For this, 63 collections were analyzed in a physical and/or virtual way and visits to 16 areas for the collection of botanical material were carried out, in the phytogeographic domains of the Cerrado (5 areas) and the Atlantic Forest (11 areas). The results obtained were summarized in four articles, divided into three chapters. The first chapter brings a taxonomic approach to Olacaceae and Schoepfiaceae, in the eastern portion of northeast Brazil, to elucidate the useful morphological characters for the delimitation of species and genera in these two families and, to base the subsequent studies. Olacaceae is represented by five species in four genera and Schoepfiaceae by one species, these species are distributed in the phytogeographic domains of the Caatinga and Atlantic Forest, in areas of crystalline and sedimentary Caatinga and, in lowland, montane and submontane forests. All identified species were registered in at least one conservation unit in the study area. The second chapter is a taxonomic revision for the genus *Cathedra*. Complementary descriptions for two species, lectotyping for two names and a synonymization are suggested. In this study, a new species is described (*C. rupestris*), with five species in the genus being recognized, three categorized as Endangered (*C. bahiensis, C. grandiflora, C. rubricaulis*), one Least concern (*C. acuminata*) and one Critically endangered (*C. rupestris*). The third chapter is the taxonomic study for the extra-Amazonian species of *Heisteria*, being presented in two manuscripts. The first deals with the description of a new species (*Heisteria longipedicellata*) and a new record for the Brazilian Atlantic Forest (*Heisteria maytenoides*). The second is the flora of *Heisteria* species for extra-Amazonian Brazil, where seven species have been identified, distributed in the phytogeographic domains of the Caatinga, Cerrado and Atlantic Forest. Among the identified species *Heisteria ovata*, *H. perianthomega* and *H. silvianii* are widely distributed in the study area and suggested in the conservation status of Least Concern, while *H. blanchetiana*, *H. citrifolia* and *H. maytenoides*

have restricted distribution and are suggested as Endangered, finally, *H. longipedicellata* represented by a single specimen has not been evaluated, being suggested as Deficient data. The synonymization of *H. salicifolia* in *H. perianthomega* is also proposed in this study.

Keywords: *Cathedra*; *Heisteria*; morphology; eastern northeast; taxonomy.

SUMÁRIO

1 INTRODUÇÃO

Olacaceae R.Br., em sua circunscrição mais ampla é constituída por 29 gêneros e cerca de 170 espécies. A região Neotropical é o centro de diversidade para essa família, onde ocorrem aproximadamente 50% das espécies descritas (HEYWOOD, 1993). O Brasil também se destaca em relação à riqueza de táxons da família, com 12 gêneros e 53 espécies distribuídas nos domínios fitogeográficos da Amazônia, Caatinga, Cerrado, Mata Atlântica e Pantanal, onde os gêneros mais representativos em número de espécies são *Heisteria* Jacq. (20 spp.), *Dulacia* Vell. (11 spp.) e *Cathedra* Miers. (5 spp.) (COSTA-LIMA & CHAGAS, 2020).

Buscando contribuir para o conhecimento da família no país, esse trabalho tem como objetivo realizar estudos taxonômicos para Olacaceae *s.l.* no Brasil, com ênfase nos gêneros *Cathedra* e *Heisteria*. Para isso, foram realizadas expedições de campo e análise morfológica de exsicatas (física e/ou virtual) depositadas em diversos herbários do Brasil e do exterior, incluindo os tipos nomenclaturais.

A presente tese está estruturada em três capítulos, precedidos pelo referencial teórico, onde há uma breve explanação sobre o histórico taxonômico, caracterização morfológica, sistemática, distribuição, usos e aspectos ecológicos para a família Olacaceae. Algumas dessas informações também são destacadas para os gêneros *Cathedra* e *Heisteria*.

O primeiro capítulo trata de uma flora local, com as espécies de Olacaceae e Schoepfiaceae ocorrentes no Nordeste Oriental do Brasil. Devido semelhanças morfológicas entre essas famílias, o gênero *Schoepfia* Schreb. já esteve inserido em Olacaceae. Na área de estudo representantes dessas duas famílias têm sua identidade frequentemente confundidas, e esse equívoco, observado nas coleções analisadas, motivou a inclusão da família Schoepfiaceae nesse estudo.

O segundo capítulo traz a revisão taxonômica para as espécies do gênero *Cathedra*. Nesse estudo, uma nova espécie é descrita, atualizações morfológicas, nomenclaturais e na distribuição geográfica das espécies também são propostas. Além das descrições morfológicas, são fornecidas chave de identificação, ilustrações dos caracteres diagnósticos, comentários morfológicos e nomenclaturais, mapas, informações sobre habitat, fenologia, bem como, acerca do status de conservação das espécies.

O terceiro capítulo é composto por dois manuscritos e aborda estudos taxonômicos para o gênero *Heisteria*. Traz atualizações morfológicas, nomenclaturais e na distribuição das espécies, além de informações sobre a conservação. O primeiro manuscrito trata da descrição

de uma nova espécie e um novo registro de *Heisteria* para o Brasil, enquanto o segundo é um estudo taxonômico para as espécies do Brasil extra-amazônico.

Os manuscritos desta tese estão formatados de acordo com as normas das revistas para às quais foram/serão submetidos.

2 FUNDAMENTAÇÃO TEÓRICA

2.1 BREVE HISTÓRICO TAXONÔMICO E SISTEMÁTICA EM OLACACEAE *S.L.*

Olacaceae *s.l.* está posicionada na ordem Santalales, juntamente com Balanophoraceae, Loranthaceae, Misodendraceae, Opiliaceae, Santalaceae, Schoepfiaceae e Viscaceae (APG IV, 2016). Essas famílias compartilham essencialmente presença de lenho, parasitismo, folhas com margem inteira, flores com estames epipétalos, placentação central-livre e semente única, além da presença do ácido ximénico ou santalálico, que são raros ou ausentes em outras Angiospermas (MALÉCOT & NICKRENT, 2008).

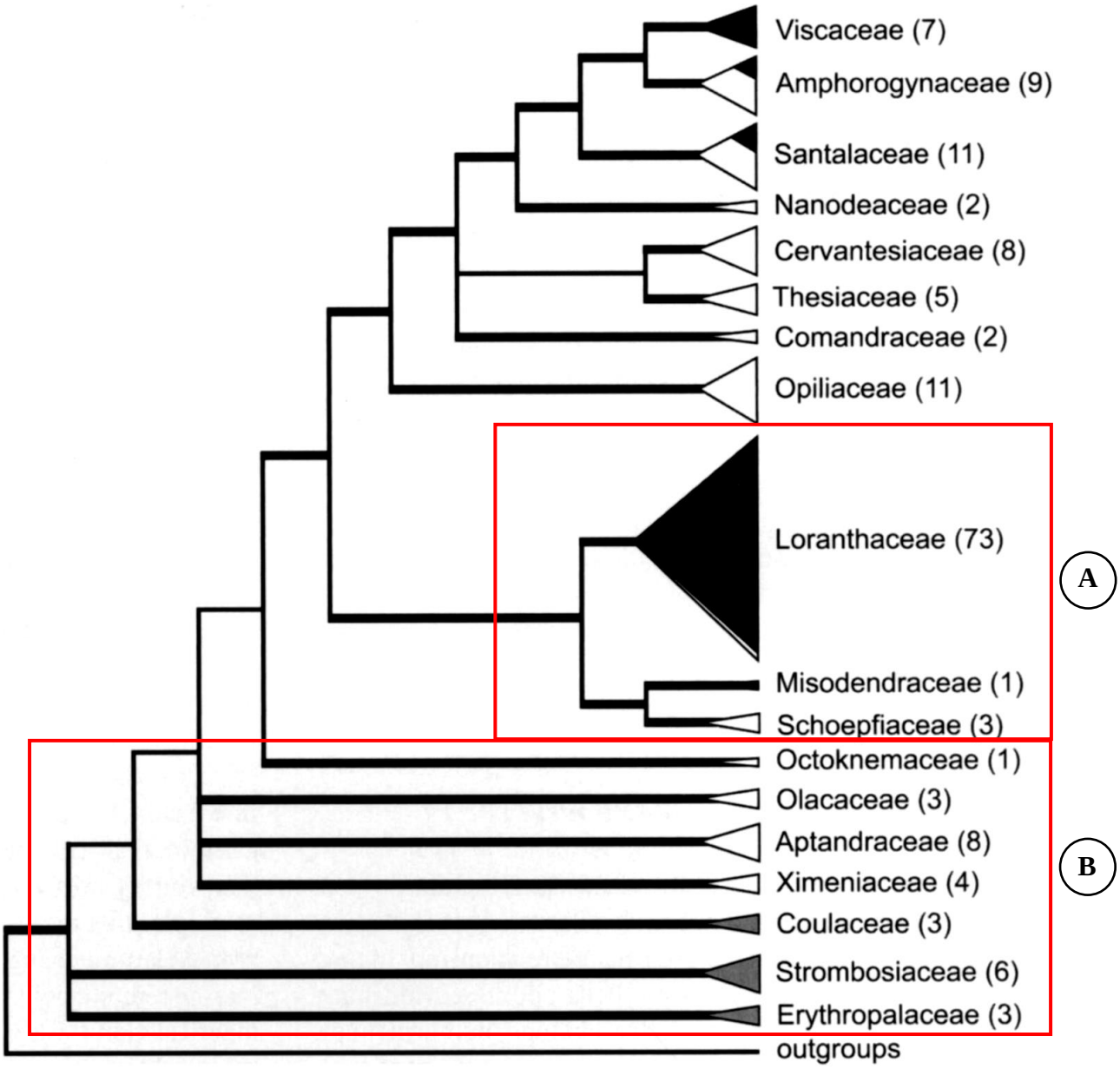
Uma das primeiras referências ao gênero *Olax* L. é feita na Flora Zeylanica (LINNAEUS, 1747). Posteriormente, *Olax zeylanica* é publicada na obra *Species Plantarum* (LINNAEUS, 1753) e, em 1791, Jussieu faz uma resumida descrição para o gênero, baseado somente nessa espécie. Brown, em 1810, descreve três espécies em *Olax* (*O. aphylla*, *O. phyllanthi* e *O. stricta*), detalha melhor a circunscrição do gênero, além de indicar relações com representantes de Santalaceae. Posteriormente, *Olax* é incluído por Brown (1818) em Olacineae. Com base em diferenças morfológicas das inflorescências, ovário, óvulos e sementes, Bentham (1841) subdividiu Olacineae em três tribos: Icacineae, Opilieae e Olaceae, essa última incluindo os gêneros *Olax* L., *Heisteria* Jacq., *Schoepfia* Schreb. e *Ximenia* L., que foi posteriormente denominada como Olacaceae por Miers (1851).

Olacaceae *s.l.*, em sua circunscrição tradicional é composta por gêneros que apresentam grande diversidade morfológica, o que historicamente resultou em diversas classificações na família, propostas com base em dados morfológicos (ENGLER, 1897; ANSELMINO, 1934; SLEUMER, 1935; CRONQUIST, 1981; MALECOT ET AL., 2004; KUIJT & HANSEN, 2015), anatômicos (BAAS, 1982), palinológicos (LOBREAU-CALLEN, 1980) e moleculares (MALECOT & NICKRENT, 2008).

Dados moleculares têm sido uma importante ferramenta para esclarecer as relações entre os gêneros e espécies nessa família. Trabalhos com abordagem filogenética para a ordem Santalales, utilizando *loci* nucleares (SSU rDNA) e plastidiais (*rbcl* e *matk*), mostraram que *Schoepfia*, tradicionalmente inserido em Olacaceae, forma um clado com *Arjona* Comm ex Cav. e *Quinchamalium* Molina antes posicionados em Santalaceae (NICKRENT ET AL., 2010). Com base nesses resultados, esses três gêneros foram reconhecidos como uma família à parte: Shoepfiaceae, que emergiu como grupo irmão de Misodendraceae (DER & NICKRENT, 2008; MALECOT & NICKRENT, 2008; APG III, 2009; SU ET AL., 2015; APG IV, 2016; CHRISTENHUSZ ET AL., 2017) (Figura 1).

Esses estudos confirmaram ainda que Olacaceae *s.l.* não é monofilética (MALECOT & NICKRENT, 2008; NICKRENT ET AL., 2010), e os autores sugeriram que sete clados fossem reconhecidos como famílias distintas (Aptandraceae, Coulaceae, Olacaceae s.s, Octoknemaceae, Strombosiaceae, Erythropalaceae e Ximeniaceae). No entanto, as relações entre esses clados não estão bem resolvidas, emergem em politomias, na base da árvore filogenética para Santalales (Figura 1).

Figura 1 – Filogenia para Santalales baseada em *loci* nucleares (SSU rDNA) e plastidiais (*rbcl* e *matk*). A. Em destaque, as relações filogenéticas entre Schoepfiaceae e Misodendraceae. B. sete clados que compõem a família Olacaceae *s.l.*



Fonte: NICKRENT ET AL. (2010)

Essa proposta de divisão (MALECOT & NICKRENT, 2008; NICKRENT ET AL., 2010) foi aceita por Costa-Lima & Chagas (2020) e, é parcialmente usada por Kuijt & Hansen (2015), que tratam Aptandraceae, Coulaceae, Octoknemaceae e Ximeniceae como famílias distintas, enquanto Olacaceae *s.s*, Strombosiaceae e Erythropalaceae são mantidas numa mesma família (Olacaceae). Christenhusz et al. (2015; 2017) e APG IV (2016) reconhecem que Olacaceae não é um grupo monofilético, mas, até que dados adicionais sejam incluídos nessas filogenias e uma melhor resolução entre esses clados seja obtida, adotam a circunscrição mais ampla (excluindo Schoepfiaceae), buscando manter a estabilidade nomenclatural.

Com base nos grupos evidenciados por Nickrent et al. (2010), Christenhusz et al. (2017) reconheceram seis subfamílias para Olacaceae *s.l.*: **Erythropaloideae** – *Brachynema* Benth. (2 spp.), *Erythropalum* Blume (1 sp.), *Heisteria* Jacq. (33 spp.) e *Maburea* Maas (1 sp.); **Strombosioideae** – *Diogoa* Exell & Mendonça (1 sp.), *Engomegoma* Breteler (1sp.), *Scorodocarpus* Becc (1 sp.), *Strombosia* Blume (10 spp.), *Strombosiopsis* Engl. (3 spp.) e *Tetrastylidium* Engl. (2 spp.); **Couloideae** – *Coula* Baill. (1 sp.), *Minquartia* Aubl. (1 sp.), *Ochanostachys* Mast. (1 sp.) e *Octoknema* Pierre (14 spp.); **Ximenioideae** – *Curupira* Black (1 sp.), *Douradoa* Sleumer (1 sp.), *Malania* Chun & Lee (1 sp.) e *Ximenia* L. (10 spp.); **Aptandroideae** – *Anacolosa* Blume (16 spp.), *Aptandra* Miers (4 spp.), *Cathedra* Miers (5 spp.), *Chaunochiton* Benth. (3 spp.), *Harmandia* Baill (1 sp.), *Hondurodendron* Ulloa (1 sp.), *Ongokea* Pierre (1 sp.) e *Phanerodiscus* Cavaco (3 spp.); **Olacoideae** – *Dulacia* Vell. (13 spp.), *Olax* L. (42 spp.) e *Ptychopetalum* Benth. (5 spp.).

No presente estudo seguiremos a classificação proposta por Christenhusz et al. (2015; 2017) e pelo APG IV (2016), usando Olacaceae *s.l.*

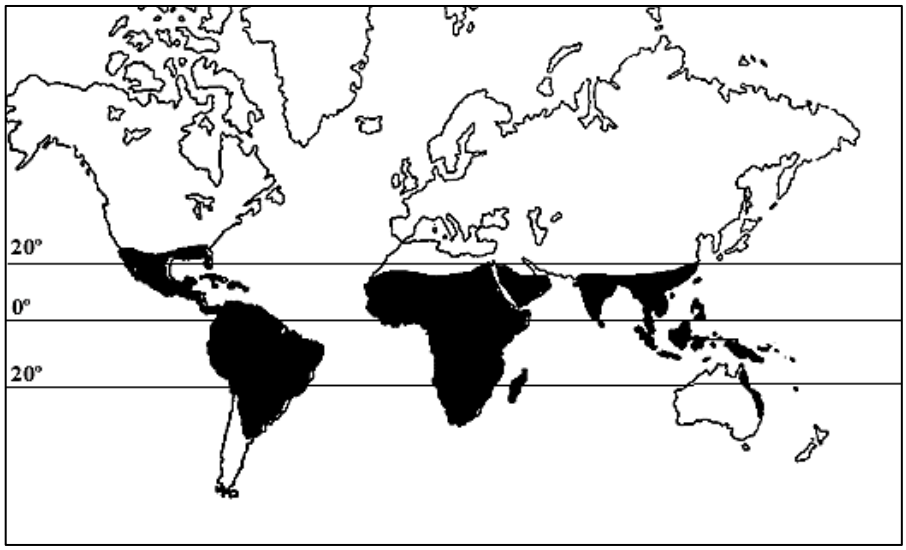
2.2 RIQUEZA, DISTRIBUIÇÃO E CARACTERIZAÇÃO MORFOLÓGICA

Olacaceae *s.l* é constituída por 29 gêneros e cerca de 170 espécies distribuídas nos trópicos e subtrópicos (Figura 2). O centro de diversidade para a família está nos continentes Africano e Americano (SLEUMER, 1984; MACDOUGAL, 2003). Os gêneros com maior riqueza são *Olax* (42 espécies), *Heisteria* (34 spp.), *Anacolosa* (16 spp.), *Octoknema* (14 spp.), *Dulacia* (13 spp.), *Strombosia* (10 spp.) e *Ximenia* (10 spp.), os demais apresentam número de espécies variando de um a cinco (SLEUMER, 1984; CHRISTENHUSZ ET AL., 2017).

No Brasil, Olacaceae *s.l* está representada, até o momento, por 12 gêneros e 53 espécies, sendo 21 endêmicas. As espécies da família estão distribuídas em todas as regiões

brasileiras, nos domínios fitogeográficos da Amazônia (38 espécies), Caatinga (7 spp.), Cerrado e Mata Atlântica (14 spp. cada) e no Pantanal (1 spp.). Os gêneros *Heisteria* (21 spp.), *Dulacia* (10 spp.) e *Cathedra* (5 spp.) destacam-se em número de espécies no país (SLEUMER, 1984; COSTA-LIMA & CHAGAS, 2020).

Figura 2 – Distribuição de Olacaceae *s.l.*



Fonte: HEYWOOD (1993)

Olacaceae *s.l.* é representada por árvores, arbustos ou raramente lianas, autotróficos e alguns gêneros são hemiparasitas de raízes (MALÉCOT ET AL., 2004). Suas espécies são caracterizadas morfologicamente por apresentarem folhas simples, alternas, dísticas ou espiraladas, com margens inteiras, sem estípulas e, raramente com laticíferos ou pontos resiníferos. As inflorescências são do tipo cimeira, racemo ou fascículos axilares, raramente caulifloras e podendo ou não apresentar brácteas. As flores são bissexuadas ou raramente unissexuadas, 3−7-meras, com cálice gamossépalo, frequentemente cupular e, em alguns gêneros acrescente nos frutos, a corola é dialipétala, com estames epipétalos, e o ovário é súpero. Os frutos são do tipo drupa, com uma única semente (BARROSO ET AL., 1999; RIBEIRO ET AL., 1999; MACDOUGAL, 2003; CHRISTENHUSZ ET AL., 2017).

A maioria dos gêneros em Olacaceae *s.l.* apresenta flores diminutas e de cor esverdeada (MACDOUGAL, 2003), essas características tornam a visualização das espécies em campo difícil e, possivelmente explicam a baixa amostragem dessa família na maioria das coleções, somado também a identificações equivocadas, frequentemente espécies de Olacaceae *s.l.* são registradas em Aquifoliaceae, Ebenaceae, Moraceae, Opiliaceae, Salicaceae e

Schoepfiaceae. A baixa amostragem nas coleções e equívocos no reconhecimento da família tornam os estudos taxonômicos com o grupo ainda mais complexos.

2.3 ESTUDOS FLORÍSTICOS E TAXONÔMICOS PARA OLACACEAE *S.L.* NOS NEOTRÓPICOS

Ao longo dos últimos 50 anos, contribuições importantes para o conhecimento taxonômico da família Olacaceae na região Neotropical foram produzidas, dentre as quais se destacam a Flora do Barro Colorado (CROAT, 1978), a Flora Neotropica (SLEUMER, 1984), a Flora das Guianas (HIEPKO, 1993), o Guia de plantas vasculares da Guiana Francesa (HIEPKO, 2002), a Flora da Guiana Venezuelana (MACDOUGAL, 2003) e a Flora Mesoamericana (JIMÉNEZ & KNAPP, 2011). Em geral, incluem chaves de identificação e informações morfológicas que permitem o reconhecimento das espécies. Alguns trazem ainda ilustrações e informações acerca da distribuição geográfica, contudo, com exceção do estudo de Sleumer (1984), os trabalhos citados abrangem somente 2% a 15% da riqueza registrada para a família.

No Brasil, o primeiro tratamento taxonômico para Olacaceae foi elaborado por Engler (1872) na *Flora Brasiliensis*. Posteriormente, a revisão da família na Flora Neotrópica (SLEUMER, 1984) também incluiu as espécies brasileiras. Além disso, informações sobre a morfologia e distribuição dessas espécies foram tratadas em inventários florísticos gerais, nos domínios fitogeográficos da Amazônia (CATTANIO ET AL., 2002; DALY & SILVEIRA, 2008), Caatinga (SAMPAIO ET AL., 2002; BARBOSA ET AL., 2006), Cerrado (SANO ET AL., 1998; MATOS & FELFILI, 2010) e Floresta Atlântica (SAMPAIO ET AL., 2005; BARBOSA ET AL., 2006; ROLIM ET AL., 2006; STEHMANN ET AL., 2009; LEMOS ET AL., 2010), bem como em floras locais, onde se destacam estudos para as regiões Norte (RIBEIRO ET AL., 1999; MEIRELLES & FERNANDES JUNIOR, 2017), Nordeste (STANNARD, 1995; CABRAL & AGRA, 1999) e Sudeste (GUIMARÃES ET AL., 1971; RODRIGUES & ROSSI, 2002; ASSIS, 2004).

Ainda assim, a principal referência para identificação e estudo das espécies de Olacaceae no Brasil é a Flora Neotrópica (SLEUMER, 1984). No entanto, o próprio autor recomenda a continuidade dos estudos com o grupo para que informações morfológicas, nomenclaturais e de distribuição geográfica para algumas espécies sejam complementadas e esclarecidas.

2.4 PARASITISMO EM OLACACEAE *S.L.*

Santalales é a ordem de Angiospermas com maior diversidade de formas de obtenção de nutrientes, incluindo membros autotróficos, endofíticos, parasitas de caules, hemiparasitas e holoparasitas de raízes (HEIDE-JORGESEM, 2008; TESITEL, 2016). Em Olacaceae são registrados representantes autotróficos (*Erythropalum, Heisteria, Ochnostachys, Octoknema, Scorodocarpus* e *Strombosia*) e hemiparasitas de raízes (*Malania, Olax, Ptychopetalum* e *Ximenia*). Porém, para a maioria dos gêneros, a condição trófica ainda é desconhecida (*Anacolosa, Aptandra, Cathedra, Chaunochiton, Coula, Curupira, Dulacia, Diogoa, Douradoa, Engomegoma, Maburea, Minquartia, Ongokea, Phanerodiscus, Tetrastylidium, Strombosiopsis*) (MALECOT ET AL., 2004; HEIDE-JORGESEM, 2008; KUIJT & HANSEN, 2015; TESITEL, 2016; LI ET AL., 2019).

Nesta família, os indivíduos hemiparasitas não apresentam especificidade de hospedeiro, ou seja, podem ligar seus haustórios a sistemas radiculares de diferentes espécies para obter água e nutrientes minerais, principalmente durante períodos secos, sendo capazes de sobreviver com baixa disponibilidade de água (HEIDE-JORGESEM, 2008; CHRISTENHUSZ ET AL., 2017). Ao tempo que a condição parasita pode representar uma vantagem para sobrevivência em condições extremas, a germinação de sementes e o estabelecimento e conexão com o hospedeiro representam pontos críticos no ciclo de vida dessas plantas, podendo ser um fator limitante para o desenvolvimento de algumas espécies, influenciando sua riqueza, abundância e distribuição (TESITEL, 2016; LI ET AL., 2019).

2.5 POLINIZAÇÃO E DISPERSÃO

Estudos florísticos gerais apontam a melitofilia como síndrome de polinização para os gêneros *Heisteria* e *Ximenia* (RODARTE ET AL., 2008; REIS ET AL., 2012). Nessa família, a maioria das espécies apresenta drupa com um pericarpo carnoso e sementes grandes, o que sugere uma dispersão zoocórica (BARROSO ET AL., 1999; RIBEIRO ET AL., 1999; CAMARGO & FERRAZ, 2004). Frutos de *Minquartia guianensis* Aubl., por exemplo, são dispersos por aves, morcegos, macacos e pequenos mamíferos (CAMARGO & FERRAZ, 2004). As espécies de *Olax* apresentam frutos de cor avermelhada, sendo possivelmente dispersas por aves (HEIDE-JORGESEM, 2008). Em *Ximenia americana* L., as síndromes hidrocórica e zoocórica são registradas (SLEUMER, 1894; RIBEIRO ET AL., 1999), enquanto em *Chaunochiton kappleri* (Sagote x Engl.) Ducke, os frutos são pequenos, leves, com cálice

persistente, discoide e membranáceo, apresentando dispersão anemocórica (RIBEIRO ET AL., 1999).

2.6 USOS

Algumas espécies em Olacaceae *s.l.* são amplamente utilizadas para fins madeireiro, medicinal, alimentício e comercial, dentre elas, *Ximenia americana* popularmente conhecida como ameixa-brava ou ameixa da Caatinga (BRASILEIRO, 2008). Existem diversos relatos de usos dessa espécie no Brasil e em países da África, Ásia e América Central (BRASILEIRO, 2008; FEYSSA ET AL., 2012; NUNES ET AL., 2012; CHRISTENHUSZ ET AL., 2017). Estudos com objetivo de avaliar atividade antimicrobiana dessa espécie comprovaram sua eficácia contra bactérias e fungos (OGUNLEYE & IBITOYE, 2003). Sua casca utilizada na forma de chás e infusões é eficiente na inibição de processos inflamatórios, especialmente da pele (BRASILEIRO, 2008; SILVA ET AL., 2018), e a madeira compacta e leve é utilizada na produção de cabos de ferramentas agrícolas (PENNINGTON, 2004; BRASILEIRO, 2008). Além disso, os frutos também são consumidos *in natura* como alimento (FEYSSA ET AL., 2012).

Outra espécie que também se destaca, sobretudo pela importância comercial, é *Ongokea gore* (Hua) Pierre, popularmente conhecida como boleko, uma valiosa oleaginosa empregada como aditivo na fabricação de vernizes e tintas no continente africano. Ainda nesse continente, comunidades tradicionais utilizam as sementes de *Coula edulis* Baill e *Heisteria* como alimento; sementes de *Olax gambecola* Baill. também são utilizadas como condimento. No sudoeste da Ásia, folhas e frutos de *Erythopalum scandens* Blume também são usadas como condimento por apresentarem odor forte e característico (MALAISSE ET AL., 2004; CHRISTENHUSZ ET AL., 2017).

Na região Norte do Brasil, diversas espécies da família são utilizadas. *Minquartia guianensis* Aubl. (acariquara-roxa), por exemplo, possui madeira durável e resistente a cupins e outros organismos do solo. Essa espécie é usada na construção civil e para produzir ferramentas utilizadas na agricultura e pecuária (CAMARGO & FERRAZ, 2004). Ainda nessa região, os frutos de *Dulacia guianensis* (Engl.) Kuntze (cajazinha-de-cotia) e *Curupira tefeensis* G. A. Black (castanha-curupira), ricos em gorduras, são consumidos tanto *in natura*, como na forma de caldos (RIBEIRO ET AL., 1999; PENNINGTON, 2004). As raízes e cascas de *Ptychopetalum olacoides* Benth., popularmente conhecida como Marapuama, são preparadas

em infusão alcoólica para combater doenças relacionadas ao sistema nervoso (SIQUEIRA ET AL., 1998).

2.7 O GÊNERO *HEISTERIA* JACQ.

2.7.1 *BREVE HISTÓRICO, CARACTERIZAÇÃO MORFOLÓGICA E SISTEMÁTICA*

Heisteria foi descrito por Nicolaas Joseph von Jacquin, em 1760, com base em *H. coccinea*, sendo definido nessa obra por poucos caracteres das flores e frutos e sem referência a um material tipo. Em 1763, o mesmo autor fornece uma descrição detalhada da espécie, indicando a procedência do material analisado (Ilha Martinica – Situada no mar do Caribe, departamento da França) e uma ilustração. Posteriormente, nos séculos XIX e XX, diversas espécies foram descritas para *Heisteria* (REES, 1819; POEPPIG, 1843; HOOKER, 1851), ampliando a circunscrição e riqueza do gênero.

Algumas dessas espécies também foram tratadas na *Flora Brasiliensis* (ENGLER, 1872), onde nove espécies são descritas em *Heisteria*, totalizando 19 revisadas nessa obra. Ainda nesse estudo, o gênero foi dividido em duas seções, que se diferenciam principalmente pelo formato da drupa: *H.* sect. *Aulococarpae* que é monoespecífica (*Heisteria kappleri* Sagot ex Engl.) e tem drupa oblongoide com ápice truncado, e *H.* sect. *Leiocarpae* (= *Heisteria* sect. *Heisteria*) que tem drupa globoide ou ovoide, com ápice agudo ou arredondado. Essa divisão infragenérica se manteve até 1922, quando Ducke transferiu *H. kappleri* para o gênero *Chaunochiton* [*C. kappleri* (Sagot ex. Engl) Ducke].

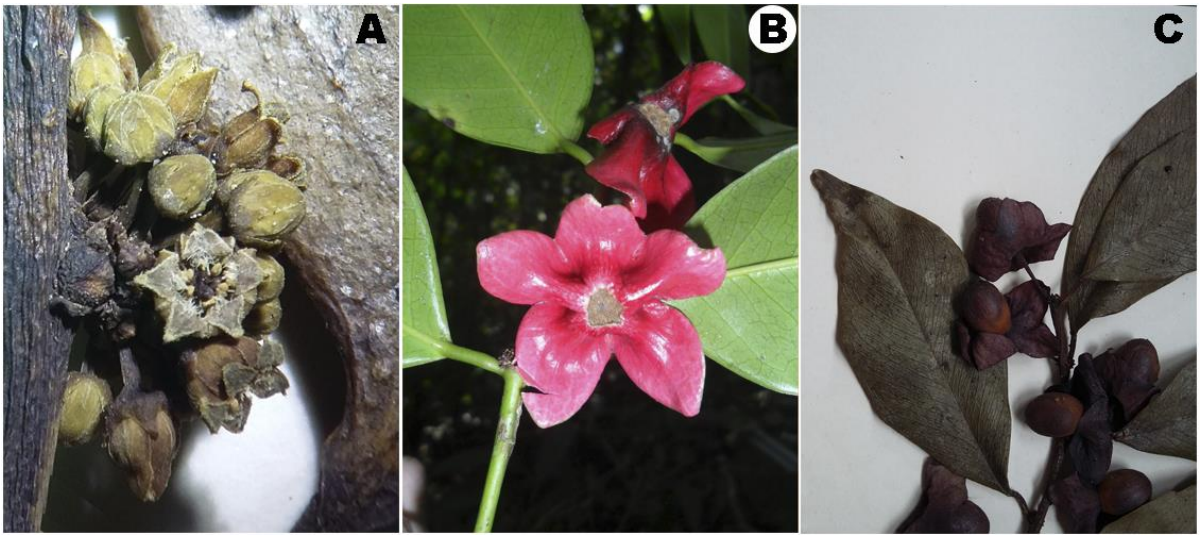
Na revisão taxonômica de *Heisteria* para a Flora Neotrópica (SLEUMER, 1984), nenhuma classificação infragenérica foi sugerida. Nessa obra, três novas espécies foram descritas, tipos nomenclaturais foram indicados, uma chave de identificação e descrições morfológicas para as 30 espécies neotropicais foram elaboradas. Até o momento, essa obra é a principal referência para estudos e identificação dos representantes desse gênero. Ainda assim, o próprio autor destaca a necessidade de mais estudos nesse grupo, mencionando que alguns espécimes em floração ou com frutos imaturos foram identificados provisoriamente, outros permaneceram sem nome e possivelmente representam espécies ainda não descritas.

Engler (1872) enfatiza que as espécies em *Heisteria* são morfologicamente muito semelhantes entre si, fato também destacado por Sleumer (1984). Nesse gênero, as espécies são delimitadas principalmente pela combinação de caracteres das folhas e frutos. Nas folhas, a forma, textura, tamanho e cor quando herborizadas, assim como o número de nervuras laterais

e o padrão de reticulação dessas nervuras são taxonomicamente importantes ao nível específico. Nos frutos, a forma, o diâmetro do cálice acrescente e formato dos lobos, assim como o comprimento do pedicelo são informativos para identificação das espécies (SLEUMER, 1984).

Heisteria é representado por árvores, arbustos ou lianas (somente *H. scandens* Ducke). Morfologicamente é caracterizado por apresentar espécies com pecíolo canaliculado, frequentemente recurvado e latescente. As inflorescências são arranjadas em fascículos axilares, com flores sésseis ou pediceladas, subtendidas por duas ou três brácteas, com 5(−6) sépalas, 5(−6) pétalas e 10(−12) ou raramente 5(−6) estames. Os frutos são do tipo drupa, com apenas uma semente e cálice persistente, acrescente e de coloração vistosa, patente aos frutos quando maduros (SLEUMER, 1984; KUIJT & HANSEN, 2015) (Figura 3).

Figura 3 – Características morfológicas de representantes de *Heisteria* (Olacaceae) A. Inflorescência (*Heisteria ovata* Benth). B. Cálice acrescente (*H. perianthomega* (Vell.) Sleumer). C. Frutos (*H. silvianii* Schwacke).



Fonte: AUTOR (2021)

O gênero é atualmente representado por 34 espécies, distribuídas nos continentes americano (31 spp.) e africano (3 spp.) (CHRISTENHUSZ ET AL., 2017). A região Neotropical é o centro de diversidade para *Heisteria* e o Brasil é o país com maior riqueza, onde 20 espécies são registradas ocorrendo nos domínios fitogeográficos da Caatinga (3 spp.), Cerrado (4 spp.), Mata Atlântica (5 spp.) e Amazônia (16 spp.) em diversos tipos vegetacionais (SLEUMER, 1984; COSTA-LIMA & CHAGAS, 2018). No continente americano, essas espécies ocorrem em florestas montanas e submontanas, sendo mais frequentes em florestas de terras baixas, onde são registradas principalmente no sub-bosque, em áreas sazonalmente inundadas ou ao longo das margens de rios, temporários ou perenes. No Cerrado brasileiro, os representantes do gênero são mais comuns em florestas de galeria (SLEUMER, 1984). No

continente africano, essas espécies também ocorrem preferencialmente em áreas de subosque, próximo a cursos de água, bem como em áreas sazonalmente inundadas ou pantanosas, em solos ácidos e arenosos (MALAISSE ET AL., 2004).

No Brasil, informações morfológicas que auxiliam na delimitação das espécies de *Heisteria*, bem como no entendimento de sua distribuição geográfica estão disponíveis em floras locais, que geralmente incluem menos de cinco espécies (GUIMARÃES ET AL., 1971; CABRAL & AGRA, 1999; RIBEIRO ET AL., 1999; RODRIGUES & ROSSI, 2002; ASSIS, 2004; FERNANDES & QUEIROZ, 2015; MEIRELLES & FERNANDES JUNIOR, 2017). Desviando-se desse padrão, uma recente contribuição para o conhecimento das espécies distribuídas no domínio amazônico brasileiro foi elaborada por Ramos (2020). O autor traz descrições, comentários e uma chave de identificação para 16 espécies registradas nesse domínio, além de comentários ecológicos, uma sinonimização e seis lectotipificações.

No que se refere aos estudos filogenéticos com o grupo, trabalhos com abordagem molecular em Santalales apontam para o monofiletismo de *Heisteria* (MALÉCOT & NICKRENT, 2008) e mostram um gênero americano (*Maburea* Maas), como mais relacionado ao mesmo. Tal proposição foi confirmada por Nickrent et al. (2010) usando os mesmos *loci* do trabalho anterior (SSU rDNA, *rbcl* e *matk*), porém com uma amostragem maior para outros gêneros de Olacaceae. Apesar de evidenciado o monofiletismo de *Heisteria*, as relações infragenéricas ainda permanecem desconhecidas, pois os estudos filogenéticos em Santalales incluíram apenas uma pequena parte (~10%) do gênero, o que impossibilita uma discussão consistente sobre a relação entre as espécies.

2.8 O GÊNERO *CATHEDRA* MIERS.

2.8.1 *BREVE HISTÓRICO, CARACTERIZAÇÃO MORFOLÓGICA E SISTEMÁTICA*

Cathedra foi descrito por John Miers em 1851 com base em espécimes coletados no morro do Corcovado, estado do Rio de Janeiro, Sudeste do Brasil. Nessa obra, além da descrição detalhada para o gênero e *C. rubricaulis*, o autor também descreve *C. gardneriana*. Em 1859, dando continuidade aos estudos, combina *Diplocrater acuminatus* Benth. em *Cathedra* [*Cathedra acuminata* (Benth) Miers.] e na mesma obra descreve *C. crassifolia*. Essas quatro espécies são tratadas por Engler (1872) na *Flora brasiliensis* e delimitadas principalmente pela consistência e forma das folhas, bem como pelo número de flores nas inflorescências. Posteriormente, entre 1889 e 1955, sete espécies foram descritas no gênero, *C.*

grandiflora (LOESENER, 1889), *C. aestuaria, C. inaequilatera, C. oblonga* e *C. paraensis*, todas propostas por Sleumer (1936), além de *C. caurensis* (PITTIER, 1939) e *C. guianensis* (SANDWITH, 1955). Na revisão taxonômica para a Flora Neotrópica, Sleumer (1984) descreve mais uma espécie (*C. bahiensis*), e nessa obra, propõe a sinonimização de *C. gardneriana* Miers à *C. rubricaulis* Miers, e a sinonimização de seis nomes à *C. acuminata* (Benth) Miers.

Cathedra é atualmente representado por cinco espécies endêmicas da América do Sul, todas registradas no Brasil, sendo quatro dessas restritas ao território brasileiro e uma amplamente distribuída na América do Sul ocorrendo no Brasil, Colômbia, Equador, Guiana, Perú e Venezuela. No Brasil essas espécies estão distribuídas nos domínios fitogeográficos da Amazônia (2 spp.), Cerrado (1 spp.) e Floresta Atlântica (3 spp.) (COSTA-LIMA & CHAGAS, 2020). Informações disponíveis para *C. acuminata* (Benth) Miers. mostram que essa espécie ocorre preferencialmente em ambientes sazonalmente inundados, ao longo das margens de rios, em solos arenosos, sendo mais frequentes no sub-bosque das florestas, mas registradas também em áreas antropizadas ou em estágios iniciais de sucessão ecológica (SLEUMER, 1984; MACDOUGAL, 2003), para as demais espécies informações sobre o habitat ainda são escassas.

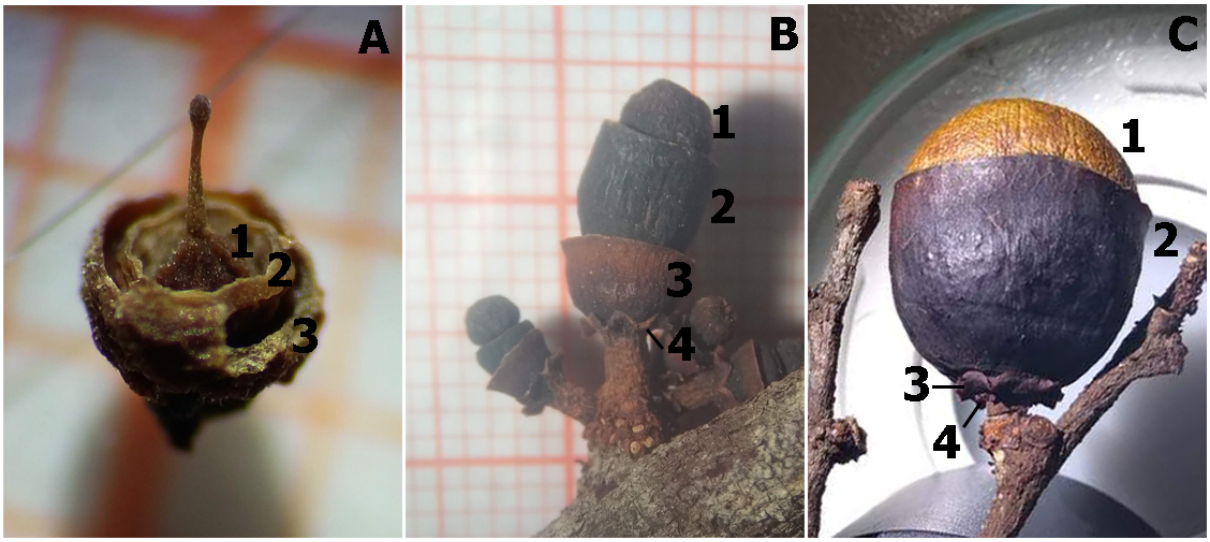
As espécies em *Cathedra* são arbustos ou árvores, morfologicamente caracterizadas por apresentarem o pecíolo canaliculado, as inflorescências axilares, dispostas em fascículos, com flores sésseis ou pediceladas, cálice cupuliforme, 5(−6) denticulado, 5(−6) pétalas, 5(−6) estames, antera alongada com deiscência poricida, ovário envolvido por um disco hipógino, que também se desenvolve durante a formação dos frutos, podendo recobrir parcial ou totalmente os frutos, que são do tipo drupa, com cálice e epicálice também acrescente (SLEUMER, 1984; BARROSO ET AL., 1999; KUIJT & HANSEN, 2015) (Figura 4).

A Flora Neotrópica (SLEUMER, 1984) é a principal referência em estudos taxonômicos para o gênero, contudo algumas atualizações ainda são necessárias, especialmente nas descrições morfológicas, que, apesar de detalhadas, não contam com informações sobre flores ou frutos em algumas espécies, na distribuição geográfica e habitat e, nas indicações de tipos nomenclaturais. No Brasil, poucos trabalhos florísticos (GUIMARÃES ET AL., 1971; RIBEIRO ET AL., 1999; ASSIS, 2004; FERNANDES & QUEIROZ, 2015; MEIRELLES & FERNANDES JUNIOR, 2017) e ecológicos (URAMOTO ET AL., 2008) incluem espécies de *Cathedra*, o que dificulta a compreensão da diversidade morfológica, riqueza, distribuição e status de conservação dessas espécies. Apenas *C. bahiensis* Sleumer é citada na lista vermelha da IUCN (2020) como quase ameaçada.

Em relação à sistemática, estudos com abordagem morfológica e molecular para a ordem Santalales (MALÉCOT ET AL., 2004; MALÉCOT & NICKRENT, 2008; NICKRENT

ET AL., 2010) relacionam *Cathedra* com *Anacolosa* Blume e *Phanerodiscus* Cavaco. Esses gêneros compartilham a presença de células-guarda lignificadas nas folhas, antera alongada e deiscência poricida.

Figura 4 – Características morfológicas de representantes de *Heisteria* (Olacaceae) A. Flor (*Cathedra bahiensis* Sleumer). 1 Ovário. 2 Disco hipógino. 3 Cálice. B. Fruto em desenvolvimento (*C. bahiensis* Sleumer). 1 Drupa. 2 Disco hipógino. 3 Cálice. 4 Epicálice. C. Fruto (*C. rubricaulis* Miers). 1 Drupa. 2 Disco hipógino. 3 Cálice. 4 Epicálice.



Fonte: AUTOR (2021)

Diante do exposto, o principal objetivo desse trabalho é realizar estudos taxonômicos para a família Olacaceae *s.l.* no Brasil, com ênfase nos gêneros *Cathedra* Miers. e *Heisteria* Jacq..

3 RESULTADOS

3.1 ARTIGO 1 – *CATHEDRA* MIERS. (OLACACEAE *S.L.*): A NEW SPECIES AND MORPHOLOGICAL, NOMENCLATURAL AND DISTRIBUTIONAL UPDATES

Manuscrito aceito – Revista Systematic Botany

Cathedra Miers. (Olacaceae s.l.): A New Species and Morphological, Nomenclatural and Distributional Updates

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Abstract—In this study, five species of *Cathedra* (Olacaceae s.l.) were recognized, four of them endemic to Brazil and one widely distributed, occurring in Brazil, Colombia, Ecuador, Guyana, Peru, and Venezuela. ***Cathedra rupestris***, a new species described

here, is endemic to Campus Rupestres (Cerrado) in the state of Bahia, and differentiated from other species of the genus mainly by bark reticulate, length of pedicel in flower (1.5–2.2 mm), length of petals (3–3.5 mm), as well as by the proportion of the hypogynous disk in relation to the fruit, which in this species is limited to the base of the drupe. Regarding conservation status, *C. bahiensis*, *C. grandiflora*, and *C. rubricaulis* are suggested as Endangered, while *C. acuminata* and ***C. rupestris*** are recommend as Least Concern and Critically Endangered, respectively. Here the genus is reviewed, nomenclatural (one synonymization and two typifications) and geographic distributional updates are provided, in addition to an identification key, descriptions and illustrations. Emended descriptions are also provided for two species.

Keywords— Neotropics, nomenclature, Santalales, taxonomy.

Resumo—Nesse estudo, foram reconhecidas cinco espécies de *Cathedra* (Olacaceae s.l.), sendo quatro endêmicas do Brasil e uma amplamente distribuída, ocorrendo no Brasil, Colômbia, Equador, Guiana, Peru e Venezuela. ***Cathedra rupestris,*** uma nova espécie aqui descrita, é endêmica dos Campus Rupestres (Cerrado) do estado da Bahia, e diferenciada das demais espécies do gênero principalmente pelos ramos reticulados, comprimento do pedicelo nas flores (1.5–2.2 mm), comprimento das pétalas (3–3.5 mm), bem como, pela proporção do disco hipógino em relação ao fruto, que nessa espécie é restrito a base da drupa. Em relação ao status de conservação, *C. bahiensis*, *C. grandiflora* e *C. rubricaulis* são sugeridas como Em Perigo, enquanto, *C. acuminata* e ***C. rupestris*** são recomendadas como Menos Preocupante e Criticamente em perigo, respectivamente. Aqui o gênero é revisado, atualizações nomenclaturais (uma sinonimização e duas tipificações) e na distribuição geográfica são fornecidas, além de

uma chave de identificação, descrições e ilustrações. Descrições emendadas também são fornecidas para duas espécies.

Palavras-chave— Neotrópicos, nomenclatura, Santalales, taxonomia

Cathedra Miers. is currently represented by five species restricted to South America (Sleumer 1984; Christenhusz et al. 2017), and almost exclusively to Brazil, where all species are found and four are endemic to the country. These species occur in several vegetation types: Llanos, Cerrado, Amazon and Atlantic Forests (Sleumer 1984; BFG 2018). Genus representatives can be differentiated through the shape and size of fruits, as well as by the proportion of the hypogynous disk in relation to the fruit. Pedicel and petal size are also relevant diagnostic characters at the species level (Sleumer 1984).

The genus was described by Miers (1851) based on a specimen collected in Rio de Janeiro and named *Cathedra rubricaulis* Miers, in this study, the author also published *C. gardneriana*. In 1859 continuing studies, Miers combines *Diplocrater acuminatus* Benth. in *Cathedra* (*Cathedra acuminata* (Benth) Miers.) and in the same work published C*. crassifolia*. Subsequently, between 1889 and 1955, seven species were described in this genus, *C. grandiflora* Loes, *C. aestuaria* Sleumer, *C. inaequilatera* Sleumer, *C. oblonga* Sleumer and *C. paraensis* Sleumer, in addition to *C. caurensis* Pittier and *C. guianensis* Sandwith. In the taxonomic revision for Flora Neotropica, Sleumer (1984) published *C. bahiensis*, and in this work proposes the synonymization of *C. gardneriana* Miers in *C. rubricaulis* Miers, and the synonymization of six names in *C. acuminata* (Benth) Miers, being treated five species in this taxonomic review: *Cathedra acuminata*, *C. bahiensis*, *C. grandiflora*, *C. paraensis* and *C. rubricaulis*.

During taxonomic studies of Olacaceae in Brazil, a new species for the genus

Cathedra was identified and is described here: *C. rupestris*. In this study genus is reviewed, the synonymization of *C. paraensis* in *C. acuminata* and two typifications are proposed, as well as geographic distributional updates, in addition to an identification key, descriptions, illustrations, conservation status for all species, and emended descriptions for two species.

MATERIALS AND METHODS

This study was carried out based on an analysis of almost 200 specimens deposited at ALCB, *ASE, *ASU, *B, *BM, *BR, *C, CEN, CEPEC, *CESJ, *COAH, *CVRD, *E, EAC, EAN, ESA, *F, FURB, FLOR, *G, *GH, *GOET, HB, *HCF, HST, HUEFS, IPA, *INPA, JPB, *K, *L, *LD, *M, MAC, MBML, MBM, *MO, *NY, *P, PEUFR, R, RB, *S, *SAMES, SPSF, SP, SPF, *TCD, *U, UB, UFRN, UFP, UPCB, *US, *VEN and VIES, including an analysis of all types (acronyms according to Thiers 2020). For the herbaria marked with asterisks, only images were seen. Images of types examined online also were consulted on Jstor Global Plants (2020).

Descriptions of morphological characters followed Harris and Harris (2000) and Stearn (1995). Protologues, local floras and taxonomic reviews (Sleumer 1984; Cabral and Agra 1999; Ribeiro et al. 1999; Rodrigues and Rossi 2002; Assis 2004; Meirelles and Fernandes Junior 2017) were also consulted. An identification key and illustrations were constructed, as well as maps of geographic distribution (using the software QGIS v.2.18.6, QGIS Development Team 2015). For each species additional information is provided on distribution, habitat, common names, ecological, nomenclatural, morphological notes, phenology, and conservation status. Some information

(distribution, habitat, phenology) was obtained from labels of herbarium specimens, however for some species these data remain unknown.

Conservation status was proposed for species following the criteria and categories established by the IUCN (2017); the extent of occurrence (EOO) and area of occupancy (AOO) were evaluated by GeoCat software (Bachman et al. 2011), using only occurrence points of samples with confirmed identifications.

TAXONOMIC TREATMENT

CATHEDRA Miers., Ann. Mag. Nat. Hist. ser. 2, 7:452–459. 1851. TYPE: *Cathedra rubricaulis* Miers., Ann. Mag. Nat. Hist., ser. 2, 7:458. 1851.

Shrubs to trees. **Branches** glabrous. **Leaves** alternate; petioles cylindrical, slightly canaliculate, glabrous; blades glabrous, main veins impressed to lightly impressed on the adaxial and prominent on the abaxial surface, venation brochidodromous. **Inflorescences** in axillary fascicles, sessile, bracts triangular to narrowly triangular. **Flowers** bisexual, adaxial surface of calyx and corolla papillose; calyx gamosepalous, cupular, 5–6-dentate; hypogynous disk present, enveloping the ovary, accrescent in fruit; corolla dialypetalous, petals 5–6, apex adaxially lanate, trichomes whitish at the middle portion and yellowish at the apex; anthers basifixed, poricidal; ovary superior, apex sulcate, glabrous, 2- locular, 2-ovulate. **Drupe** with hypogynous disk present, surrounding or not the fruit; calyx accrescent; epicalyx accrescent.

The trophic condition for *Cathedra* is still unknown, however, Santalales, including Olacaceae, is essentially composed of parasitic or root hemiparasitic species (Malécot et

al. 2004).

KEY TO THE SPECIES OF *CATHEDRA*

1. Bark striate, lenticels present and spaced on young parts; flowers with pedicel 3–7 mm long, petals 4–5.5 mm long. 3. *C. grandiflora*

1. Bark scaly or reticulate, not lenticelate; flowers sessile or with pedicel 1.5–2.5 mm long, petals 1.1–3.5 mm long. 2

2. Petals 3–3.5 mm long, gynoecium ca. 4 mm long; hypogynous disk restricted to the base of fruits at maturity. 5. *C. rupestris*

2. Petals 1.1–2 mm long, gynoecium 1–1.5 mm long; hypogynous disk surrounding ½ to ⅔ or ¾ the length of the fruit at maturity, or fully covering the fruit. 3

3. Flowers sessile; hypogynous disk surrounding ½ to ⅔ or rarely almost the length of the fruit at maturity. 4. *C. rubricaulis*

3. Flowers with pedicel, 1.5–2.5 mm long; hypogynous disk surrounding ¾ the length or fully covering the fruit at maturity. 4

4. Stigma truncate to slightly conical, smooth; drupe 13–25 mm long. 1. *C. acuminata*

4. Stigma globoid, papillose; drupe 26–40 mm long. 2. *C. bahiensis*

1. CATHEDRA ACUMINATA (Benth.) Miers, Ann. Mag. Nat. Hist. Ser. III, 4:361 (1859). *Diplocrater acuminatus* Benth., Hooker's J. Bot. Kew Gard. Misc. 3:367 (1851). TYPE: [BRAZIL] In vicinibus Barra [Manaus], Prov. Rio Negro, 1850–1851, *R. Spruce 1410* (lectotype, first step designated by Sleumer (1984: 107) as "holotype", second step designated here: K p.p. [branches on the right side and on the bottom left of the

exsiccate as well as all the leaves] [Barcode K000580922; digital image!], isolectotypes: BM [Barcode BM000839871; digital image!], E [Barcode E00499990; digital image!], GH [Barcode GH00035935; digital image!], K [Barcode K000580921; digital image!], L [Barcode L0038952; fragment; digital image!], LD [Barcode LD1748354; digital image!], MO [No. MO1612857; digital image!], NY [Barcode NY00285457; digital image!]).

Cathedra crassifolia Miers, Ann. Mag. Nat. Hist. Ser. III, 4:361. 1859. TYPE: BRAZIL. Ad. Flum. Guainia vel Rio Negro supra ostium flum. Casiquiare, Aug. 1854. *R. Spruce 3514* (lectotype, first step designated by Sleumer (1984: 107) as "holotype", second step designated here: K [Barcode K000580920; digital image!], isolectotypes: BM [Barcode BM000839872; digital image!], BR [Barcode BR000000528083; digital image!], E [Barcode E00499991; digital image!], GH [Barcode GH00035936; digital image!], GOET [Barcode GOET008318; digital image!], K [Barcode K000580919; digital image], LD [Barcode LD1731713; digital image!], L [Barcode L0038956; fragment; digital image!], MO [No. 1624279; digital image!], NY [Barcode NY00285452; digital image!], RB! [Barcode RB00542397], TCD [Barcode TCD0004118; digital image!]).

Cathedra aestuaria Sleumer., Repert. Spec. Nov. Regni. Veg. 39:279. 1936. TYPE: BRAZIL. Pará, Rio Mucujubinzinho insulis Breves aestuarii amazonici, 17 Nov. 1922, *A. Ducke s.n.* (holotype: B [Barcode B100248317; digital image!], isotypes: K [Barcode K000580923; digital image!], L [Barcode L0038953; fragment; digital image!], RB! [Barcode RB00542396], US [Barcode US00105759; digital image!]).

Cathedra inaequilatera Sleumer. Repert. Spec. Nov. Regni Veg. 39:280. 1936. TYPE: BRAZIL. Amazonas, Parintins, Campo Grande, 9 Sep. 1932. *A. Ducke s.n.* (holotype: B

[Barcode B100248316; digital image!], isotypes: K [Barcode K000580924; digital image!], L [Barcode L0038955; fragment; digital image!], RB! [2 sheets: Barcode RB00542398, RB00557198], U [Barcode U0005292; digital image!], US [Barcode US00105763; digital image!]).

Cathedra oblonga Sleumer., Repert. Spec. Nov. Regni Veg. 39:280. 1936. TYPE: BRAZIL. Amazonas, Manaus, ad ripas rivuli loco, Cachoeira do Mindú, 15 Aug. 1931. *A. Ducke s.n.* (holotype: B [Barcode B100248318; digital image!], isotypes: L [Barcode L0038954; fragment; digital image!], RB! [Barcode RB00542399], S [No. S-R954; digital image!], U [Barcode U0005293; digital image!]).

Cathedra paraensis Sleumer. Repert. Spec. Nov. Regni. Veg. 39:281. 1936. TYPE: BRAZIL. Pará, Rio Trombetas, campinarana [10 Jan. 1927], *A. Ducke s.n.* (holotype: B [Barcode B100248314; digital image!], isotypes: K [Barcode K000580916; digital image!], RB! [Barcode RB00542400]). *syn. nov.*

Cathedra caurensis Pittier., Bol. Soc. Venez. Cienc. Nat. 6:5. 1939. TYPE: VENEZUELA. Bolivar, Bajo Caura, rebalses de Temblador, 03 Apr. 1939. *L. Williams 11687* (holotype: VEN [No. 812; digital image!], isotypes: F [No. 56762, No. 56763; digital image!], L [Barcode L0038957; fragment; digital image!], S [No. S-R951; digital image!], US [Barcode US00105761; digital image!]).

Cathedra guianensis Sandwith., Kew Bull. 10:469. 1955. TYPE: GUYANA. [Nacuyuni-Mazaruni]. Bartica-Portaro Road, 28 Nov. 1947. *D.B. Fanshawe 5590* (holotype: K [Barcode K000580926; digital image!], isotypes: NY [Barcode NY00285453; digital image!], U [Barcode U0005294; digital image!]), US [Barcode US00105762; digital image!]).

Shrubs to trees, 1.5–38 m tall. **Bark** scaly without lenticels. **Leaves** discolorous. Petioles 6–9 mm long; blades 6.5–15 × 2.1–6.7 cm, elliptical, oblong, rarely oval or ovate, margin entire, revolute, apex acute to acuminate, base cuneate, rounded or rarely truncate, secondary veins 5–14. **Flowers** 8–22 (per inflorescence); bracts ca. 0.3 mm long, triangular to narrowly triangular; pedicel 1.5–2.5 mm long, calyx 6-denticulate, 0.5–0.6 × 2–3 mm; hypogynous disk enveloping the ovary, 0.6–1.5 × 1.5–2.2 mm; corolla 6-merous, petals 1.5–2 × 0.5–0.7 mm, lanceolate; stamens 5–6, filaments 0.3–0.7 mm long, anthers 0.3–0.5 mm long; gynoecium 1.2–1.5 mm long, ovary umbonate, stigma truncate to slightly conical, smooth. **Drupe** 13–25 × 10–21 mm, obovoid to globoid, completely surrounded by the hypogynous disk; calyx accrescent, apex slightly revolute, 1.5–2 × 4–5 mm; ca. epicalyx ca. 1 mm long; pedicel 5–10 mm long, striate. Figure 1A–E.

Common Names— Cajuzinho, Cajazinho

Distribution and Habitat—*Cathedra acuminata* occurs in Brazil, Colombia, Ecuador, Guyana, Peru and Venezuela. It is widely distributed in different vegetation types, such as Gallery forest of the Venezuelan Llanos and also occurring in the Amazon in areas of Dense Ombrophilous of Terra Firme Forest, Open Ombrophilous Forest and Campinarana and in the Cerrado domain in Gallery Forests. Here its distribution is expanded to the Atlantic Forest in areas of Dense Ombrophilous Forest State of Espírito Santo. Recorded mainly on riverbanks with sandy soils and a thick layer of decomposing plant material from 100 to 800 m altitude. Figure 2.

Conservation Status and Occurrence in Conservation Units— This species occurs in Conservation Units and was recently collected (CRIA 2020), is recommended

as Least Concern (LC) according IUCN (2017). There is no record in the literature of local uses.

In this study six specimens were recorded in six different Conservation Units, one in Ecuador in the province of Orellana (Parque Nacional Yasuní) and five in Brazil, in the states of Amazonas (Área de Proteção Ambiental Adolpho Ducke), Espírito Santo (Reserva Biológica Augusto Ruschi), Mato Grosso (Parque Estadual do Cristalino and Parque Estadual do Xingu), and Pará (Floresta Nacional do Tapajós).

Notes— *Cathedra acuminata* has wide morphological variability, mainly in the leaves (shape, size and number of the secondary veins) and fruits (shape and size). This may be the reason for the several names that have been proposed for the genus *Cathedra* and later considered by Sleumer (1984) as synonyms of this species. As often found in the genus, *C. paraensis* was described by Sleumer (1936) based on a specimen with immature fruits and young leaves, collected by Adolpho Ducke in the state of Pará, Brazil (*A. Ducke s.n.*). After a careful analysis of the type of this name and of several samples of *C. acuminata* at different stages of fruiting, we suggest here that *C. paraensis* is a new synonym to *C. acuminata*.

The specimens of *C. paraensis* have elliptical blades, 6.5–7.5 × 3.1 cm, 5–6 secondary veins; drupe 15–20 × 15 cm, obovoid, completely surrounded by the hypogynous disk, calyx accrescent with apex slightly revolute, and 2 × 4 mm. All these morphological characteristics are also observed in specimens of *C. acuminata*.

Sleumer (1984) also identified some specimens collected in the municipality of Cruzeiro do Sul (state of Acre, Brazil), such as *GT Prance, BS Pena & JF Ramos 3016*, as *Cathedra paraensis.* However, after morphological analyses of the samples, we conclude that these specimens actually belong to *C. rubricaulis* Miers.

In addition to the synonymization, a second step of lectotypification were designated for *Diplocrater acuminatus* and *C. crassifolia*. *Diplocrater acuminatus* was described by Bentham (1851), based on specimens collected by Richard Spruce in the Amazonian region between December 1850 and March 1851. The protologue made no mention to the collector's number as well as where it was deposited. Subsequently, Sleumer (1984) indicated the exsiccate at K as the holotype [lectotype]. However, two samples with different accession numbers are deposited at K, coming from collections of the Hookerianum and Benthamianum herbaria. The label of the latter collection has handwritten notes by Bentham which corroborate the description in the protologue ("arbor 15–20 pedalis, ramulis foliaceis elongates"), as well as a collection number (1410), while the former has only a printed label with the collector name, place and date of collection.

Sleumer (1984) cited "*Spruce s.n.* ('1410': Mar 1851)", showing that he probably had access to the two samples deposited at K but he did not clearly indicate which one should be the lectotype. Here we elect the sample from the Bentham collection (K000580922) as a lectotype for *Diplocrater acuminatus* (see Turland et al. 2018; Art. 8.3 and Art. 9.17). Despite containing parts belonging to more than one taxon, this sample features well preserved diagnostic characters to the genus as a whole, including flowers.

A similar case is presented by *Cathedra crassifolia*, which was proposed by Bentham, but published by Miers (1859). In the protologue no herbarium is indicated, as was usual practice at that time. Later, Sleumer (1984) indicated the holotype [lectotype] at K but without specifying which specimens. Two exsiccates associated with the name are available at K from the Benthamianum and Hookerianum herbaria. Here, we elect the

sample of the herbarium Benthamianum as a lectotype for that name (K000580920) as it has well preserved inflorescences.

In relation to morphology, *Cathedra acuminata* resembles *C. bahiensis* Sleumer by the size and shape of the calyx and corolla, as well as the shape of the fruit, but differs by the length of the pedicel (1.5–2.5 mm vs. ca. 1.5 mm in *C. bahiensis*), shape of the stigma (truncate to slightly conical vs. globoid), shape of the ovary (umbonate vs. conical) and length of the drupe (13–25 mm vs. 26–40 mm).

Phenology— The species has been collected in flower or fruit throughout the year. It has cream-colored to yellowish flowers and the ripe fruits are green with a yellow, hypogynous disk.

***Additional Specimens Examined*—Brazil**. —ACRE: Bôca do Acre, Rio Purus, 26 Sep. 1966, *G.T. Prance, B.S. Pena, J.F. Ramos & E.R. Videcki Jr. 2574* (L, NY); Cruzeiro do Sul, Rio Juruá, 01 Nov. 1991, *C.A.C. Ferreira 10524* (RB); ibid., Ramal do açude a 5 km da vila Rodrigues Alves, 12 Nov. 1991, *C.A. Cid 10725* (NY); [Goes], caminho entre as colocações Goes e Boa Vista, 28 Oct. 1991, *C.A. Sothers 65* (NY); Manoel Urbano, Seringal Escondido, 27 Nov. 1996, *M. Silveira, D.C. Daly, R.S. Saraiva, A.R.S. Oliveira, L.A. Lima, P.A. Ferraz & J. Ribamar 1619* (INPA); Plácido de Castro, Igarapé Visionário, 05 Feb. 2000, *I.S. Rivero, L. Lima, E.C. Oliveira & P.Mitoso 365* (NY); Sena Madureira, Fazenda Nova Olinda, 29 Oct. 1993, *M. Silveira, D.C. Daly, R.S. Saraiva, F.C. Walthier, D.A.G. Silva & M. Pardo 681* (INPA); [Sena Madureira], Rio Macauhan, 27 Aug. 1933, *B.A. Krukoff 5718* (RB); Xapuri, Rio Acre, 10 Nov. 1991, *D.C. Daly, H. Borges, L.A. Lima, J. Ramos, Y.S. Rivero & R. Saraiva 7278* (NY). —AMAPÁ: Calçoene, between Calçoene and Rio Amapá Grande, 12 Dec. 1984, *S. Mori & R. Cardoso 17364* (F, NY). —AMAZONAS: Humaitá, between Rio Livramento and Rio Ipixuna, 7 Nov. 1934, *B.A. Krukoff 7092* (NY, RB); Japurá, Vila Bittencourt, 16 Nov.

1982, *C.A. Cid & J. Lima 3631* (INPA, L, NY); ibid, 21 Nov. 1982, *C.A. Cid & J. Lima 3737* (INPA, NY); Manaus/Itacotiara, Reserva Florestal Adolpho Ducke, 11 Jul. 1996, *P.A.C.L. Assunção 343* (INPA, NY, RB, U); Manaus, cachoeira do Tarumã, 12 Oct. 1956, *L. Coelho & F. Mello s.n.* (HEPH No. 4708); ibid., Cachoeira baixa do Tarumã, 03 Dec. 1959, *R.L. Coêlho 1449* (INPA); ibid., Cachoeira do Mindu, s.d, *Ducke 16* (NY); ibid., Porto Velho Road, 19 Oct. 1974, *G.T. Prance, T.D. Pennington, M. Leppard, O.P. Monteiro & J.F. Ramos 23040* (INPA, NY, U); ibid., Distrito Agropecuário da SUFRAMA, 11 Dec. 1989, *M.T. Campos & P. Kukle 54* (INPA, MBM, NY, RB); [Manicoré], Rodovia do Estanho, 25 Sep. 1979, *G. Vieira, J. Zarucchi, A.S.L. Silva, C.D.A. Mota & O.P. Monteiro 158* (L, NY, RB); Santa Isabel do Rio Negro, São Tomé, 09 Oct. 1987, *C.A.C. Ferreira 9311* (F, INPA, NY); [São Gabriel da Cachoeira], Ilha das Flôres, 15 Apr. 1947, *J.M. Pires 401* (NY); [São Gabriel da Cachoeira], Alto Rio Negro, Cucuí, 30 Apr. 1975, *P. Cavalcante 3066* (NY); Rio Preto, 29 May. 1964, *W. Rodrigues & D. Coelho 5845* (INPA). —ESPIRITO SANTO: Santa Teresa, Mata Fria, 27 Jan. 1999, *L. Kollmann, E. Bausen & W. Pizziolo 1717* (MBML, UFP); ibid., Cabeceira do Rio Bonito, 13 Jun. 2001, *L. Kollmann, E. Bausen & W. Pizziolo 3959* (MBML, UFP); Nova Lombardia, Reserva Biológica Augusto Ruchi, 19 Dec. 2002, *R.R. Vervloet, E. Bausen & W. Pizziolo 1595* (MBML, UFP). —MATO GROSSO: Alta Floresta, Propriedade particular ambiental delimitada pelo Parque Estadual do Cristalino e pelos rios Teles Pires e Cristalino, 19 Jan. 2007, *D. Sasaki, J. Nascimento, G.S. Henicka, M. Monteiro & J.H. Piva 1315* (INPA); [Castanheira], Rio Juruena, 01 Sep. 1963, *M. Bassett J.M. Pires, C.K. Maguire & N.T. Silva 56519* (L, NYBG); Cocalinho, Fazenda Pinheiral/Ellus, 18 Oct. 2000, *J. Pinheiro Neto JP-103* (UB); [Cocalinho], próximo ao Rio Cristalino, 04 Sep. 1979, *L.A. Dambros 153* (RB); Comodoro, Estrada vicinal à esquerda na BR174, 31 Jul. 1997, *N.M. Ivanauskas, G.F.Árbocz, M.M.R. Silva & J.Zanella 2112* (ESA, MBML, UFP); Gaúcha do Norte, estrada para a Fazenda Pontal, 07 Oct. 2000, *N.M. Ivanauskas 4418* (ESA, MBML,

UFP); Novo Mundo, Parque Estadual Cristalino, 08 Feb. 2008, *D. Zappi, W. Milliken, N. Biggs, G.S. Henicka, E.A. Silveira & J.H. Piva 1091* (NY); Santa Cruz do Xingu, Parque Estadual do Xingu, 05 Mar. 2011, *D.R. Silva, D.C. Zappi, W*. *Milliken, S. Frisby, C.R.A. Soares, A.F. Forte & L.F. Lindolfo 09* (RB). —PARÁ: [Alenquer], Sete Varas airstrip on Rio Curua, 6 Aug. 1981, *J.J. Strudwick, G.L. Sobel, B.W. Nelson, A.N. Pinheiro, C.S. Rosário, N.A. Silva 4268* (L, NY); ibid., 10 Aug. 1981, *J.J. Strudwick, G.L. Sobel, B.W. Nelson, A.N. Pinheiro, C.S. Rosário, N.A. Silva 4494* (L, NY); Altamira, Rio Xingú, 03 Dec. 1986, *S.A.M. Souza, O.C. Nascimento, M.R. Santos & V.C. Nascimento 656* (NY); Itaituba, Parque Nacional do Tapajós, 17 Nov. 1978, *M.G. Silva & C. Rosario 3798* (NY); Macau, Rio Maicuru, 18 Jul. 1981, *J.J. Strudwick, G.L. Sobel, B.W. Nelson, A. N. Pinheiro, C.S. Rosário & N.A. Silva 3101* (INPA, L, NY); ibid., 23 Jul. 1981, *J.J. Strudwick, G.L. Sobel, B.W. Nelson, A. N. Pinheiro, C.S. Rosário & N.A. Silva 3414* (NY); ibid., 24 Jul. 1981, *J.J. Strudwick, G.L. Sobel, B.W. Nelson, A. N. Pinheiro, C.S. Rosário & N.A. Silva 3503* (F, INPA, NY); Melgaço, Estação Científica Ferreira Penna, 12 Nov. 1994, *A.S.L. Silva, C.S. Rosário & A.O. Gomes 3028* (INPA); Pau D'arco, Marajoara, 16 Sep. 1998, *J. Grogan 572* (INPA); Santana do Araguaia, Fazenda Inajaporã between Rio Inajazinho and Rio Inajá, 18 Feb. 1980, *T. Plowman, G. Davidse, N.A. Rosa, C.S. Rosário & R. Santos 8839* (NY); Santarém, 1938, *A.M. Bastos s.n.* (RB [RB00268572]); ibid., Alter do Chão, Dec. 1999, *W.E. Magnuson 5537* (INPA); Vitória do Xingu, Sítio Pimental, 17 Sep. 2012, *L.C. Antonio 725* (RB); Tucuruí, Rio Caraipé, 07–08 Oct. 1983, *F.E. Miranda, J. Ramos, E. Lima & A. Silva 679* (INPA, NY); ibid., Margem direita PA–149, 20 Sep. 1983, *J.Ramos 887* (INPA, NY); ibid., lago 31 de março e arredores, 11 Oct. 1983, *J. Revilla, F.F. Miranda, J. Ramos, E. Lima & A. Silva 8603* (NY); [Tucuruí], approx. 18 Km east of Tucurui and Rio Tocantins, 28 Oct. 1981, *D.C. Daly, R. Callejas, M.G. Silva, E.L. Taylor, C. Rosario & M.R. Santos 959* (INPA, L, NY); *Sine loco acurato,* Rio Tapajóz, 11 Sep. 1916, *A. Ducke 16477* (RB). — RONDÔNIA: Jarú, Jan 1913, *J.G. Khulmann*

308 (RB); Ji-Paraná, estrada Rolim de Moura, 23 Oct. 1979, *M.G. Vieira, J.L. Zarucchi, R.H. Peterson, J.F. Ramos & C.D.A. Mota 581* (INPA); Porto Velho, Canteiro de obras UHE Jirau, 11 Oct. 2012, *M.F. Simon, A.J.B. Santos, G. Pereira-Silva & J.B. Pereira 1713* (CEN, INPA, NY, RB); ibid., Jaci-Paraná, 04 Mar. 2015, *D.M. Torres 421* (RB); ibid.; road Mutum-Paraná top Porto Velho, 24 Nov. 1968, *G.T. Prance, W.A. Rodrigues, J.F. Ramos & L.G. Farias 8824* (INPA, L, NY); [Vilhena], Rodovia RO 399, a 13 km de Vilhena, 03 Nov. 1979, *M.G. Vieira, R.H. Peterson, B.W. Nelson, J.F. Ramos & C.D.A. Mota 875* (INPA, L, NY, R, U); ibid., 28 km Sw of Vilhena on road to Colorado, 26 Oct. 1979, *B.W. Nelson 305* (L, INPA, R). **—** TOCANTINS: Darcinópolis, Fazenda Bragança, 08 Jul. 1993, *J.A. Ratter, S. Bridgewater, E. Cardoso & V.P. Lima 6782* (INPA, NY). **—Colombia.** —CAQUETÁ: Rio Japurá, Cachoeiras de Cupaty, 02 Dec. 1912, *A. Ducke 12361* (RB). —VAUPÉS: Rio Apapuris, 20 Jun. 1952, *R.E. Schultes & I. Cabrera 16834* (U). **—Ecuador.** —NAPO: Orellana, Estacíon Científica Yasuní, Rio Tuputini, 4 Nov. 1995, *K. Romoleroux & R. Foster 1939* (F). **—Guyana.** — NACUYUNI-MAZARUNI: Bartica-Portaro Road, 24 Nov. 1947. *D.B. Fanshawe 5580* (K). **—Peru.** — LORETO, Nauta, Rio Amazonas, 23 Mar. 1979, *M. Rimachi 4358* (RB); Maynas, Rio Chambira, 31 May 1990, *C. Grández, G. Criollo & A. Sarmiente 1544* (F).**—Venezuela.** — AMAZONAS: San Carlos de Rio Negro, 14 May 1980, *H.L. Clark 7568* (INPA); Tama Tama, 8 May 1942, *L. Williams 15256* (F) **—**APURE: Distrito San Fernando, banks of the Rio Arauca, 16–17 May 1977, *G. Davidse & A.C. Gonzalez 13287* (U); ibid., banks of the Rio Meta, 9–11 Feb. 1978, *G. Davidse & A.C. Gonzalez 13821* (L); Distrito Muñoz, Caño caicara, 3 Mar. 1978, *G. Davidse & A. González 14768* (L). **—**BOLIVAR: Ciudad Bolívar, Rio Nichare, Apr. 1995, *C. Knab-Vispo 402* (INPA). **—**GUARICO: Calabozo, Llanos, 15 Feb. 1979, *A. Gentry & R.G. Troth 24806* (L).

2.CATHEDRA BAHIENSIS Sleumer, Fl. Neotrop. Monogr. 38:111. 1984. TYPE: BRAZIL. Bahia, Coastal zone between Alcobaça and Caravelos on the BA highway, ca. 23 km S of Alcobaça, 17 Jan. 1977, *R.M. Harley, S.J. Mayo, R.M. Storr, T.S. Santos & R. S. Pinheiro 18031* (holotype: K [Barcode K000580915; digital image!], isotypes: CEPEC! [No. 18978], MO [Barcode MO4043653; digital image!], NY [Barcode NY00285450, NY00285451; digital image!], US [Barcode US00105760; digital image!]).

Trees, 2–30 m tall. **Bark** scaly without lenticels. **Leaves** discolorous or concolorous. Petioles 4–13 mm long; blades 7–15 × 1.8–5.5 cm, elliptical to narrow elliptical, rarely oblong, oval or ovate, margin entire, slightly revolute, apex acute to acuminate, base cuneate, secondary veins 4–8. **Flowers** 8–13 (per inflorescence); bracts ca. 0.3 mm long, triangular; pedicel ca. 1.5 mm long, calyx 5-denticulate, 0.5–0.6 × 1.2–1.5 mm; hypogynous disk enveloping the ovary, ca. 0.3 × 1 mm; corolla 5-merous, petals 1.3–1.5 × 0.6–0.8 mm, lanceolate; stamens 5, filaments ca. 0.2 mm long, anthers 0.2–0.4 mm long; gynoecium ca. 1.2 mm long, ovary conical, stigma globoid, papillose. **Drupe** 26–40 × 14–25 mm, oblongoid to rarely obovoid, completely or ¾ surrounded by the hypogynous disk; calyx accrescent, apex revolute, 4–5 × 5–9 mm; epicalyx ca. 1 mm long; pedicel ca. 2 mm long, striate. Figure 1F–J.

***Common Names*—**Baleira, Baleira-preta

***Distribution and Habitat*—**Occurring from southern Bahia to southern Espírito Santo. It is endemic to the Atlantic Forest in areas of Tropical Moist Forest, Restinga and Tabuleiros. Figure 2.

Conservation status and occurrence in Conservation Units— It is known mainly from the Restingas of Bahia and Espírito Santo states (Sleumer 1984; CRIA 2020), with an area of occupancy less than 500 Km^2 (Bachman et al. 2011); most of its known populations occur outside protected areas and are threatened by urban development in coastal regions (Mantovani 2003). The species suffers from the continuing decline in habitat area and quality, being recommended as Endangered (EN) [B2ab(ii, iii)].

In this study only two specimens were recorded in Conservation Units in the state of Espírito Santo (Reserva Natural da Vale - CVRD, Parque Estadual de Itaúnas).

Notes—*Cathedra bahiensis* was described by Sleumer (1984) based in specimens in fruit and collected in the state of Bahia. The original description of this species is here complemented with morphological information about the flowers, such as size of pedicel, size and shape of calyx, corolla, hypogynous disc and gynoecium, and stigma surface. The expanding the number of specimens analyzed, providing a better understand of its morphological variability.

Cathedra bahiensis resembles *C. rubricaulis*, especially when the fruits are immature, by the drupe completely surrounded by the hypogynous disc present in *C. bahiensis* and in some specimens of *C. rubricaulis*, as well as by the shape and size of the blades, but they are distinguished by the pedicel length in the flowers (ca. 1.5 mm vs. sessile in *C. rubricaulis*) and shape of the drupe (oblongoid to rarely obovoid vs. globoid).

Phenology— The species was collected in flower from September to November and in fruit from November to January. Flowers are cream-colored and fruits have a

yellow hypogynous disk that is slightly fleshy and with a pleasant smell. All these in fruits characteristics possibly represent adaptations for seed dispersal by small animals.

***Specimens examined*—Brazil. —**BAHIA: Caravelas, Ponta de Areia-Barra de Caravelas, 10 Dec. 2011, *E. Matos, U. Machado & U. Vidal 920* (MBM, HUEFS); Maraú, Mata Costeira, 12 Jan. 1967, *R.P. Belém & R.S. Pinheiro 3055* (CEPEC); Porto Seguro, 25 Oct. 1988, *D.A. Folli 799* (CEN); Una, Fazenda Bolandeira, 02 Nov. 2001, *W.W. Thomas, A.M. Carvalho & Sant'Ana 12731* (MBML, NY). **—**ESPIRITO SANTO: Aracruz, Reserva da Santur, 16 Jan. 1992, *R.N. Oliveira 68* (VIES); ibid., Barra do Sahy, 12 Fev. 1992, *O.J. Pereira, J.M.L. Gomes & M.L.L. Martins 2632* (VIES); Conceição da Barra, Área 157 da Aracruz Celulose, 09 Sep. 1992, *O.J. Pereira, J.M.L. Gomes & J.M.Simões 3849* (VIES); ibid., Área 135 da Aracruz Celulose, 14 Out. 1992, *O.J. Pereira, J.M.L. Gomes & M.L.L. Martins 3905* (VIES); ibid., Área 126 da Aracruz Celulose, 02 Dec. 1992, *O.J. Pereira, J.M.L. Gomes & S.J. Pereira 4272* (VIES); ibid., 25 Dec. 1993, *O.J. Pereira, J.M.L. Gomes & I. Weiler Junior 5136* (VIES); ibid., Parque Estadual de Itaúnas, 25 Nov. 2011, *A.G. Oliveira & L. Marcarini 1059* (VIES); ibid., 05 Jan. 2012, *R.C. Cipriano* & *A.M. Assis 19* (RB, VIES); Linhares, Regência, 2 Dec. 1996, *A.S. Pereira s.n.* (VIES No. 015638); ibid., Reserva Natural da CVRD, 10 Out. 2001, *D.A. Folli 4090* (CVRD); ibid., 25 Nov. 2002, *D.A. Folli 4426* (CVRD); Piuma, ca. 3 km do Morro do Aghá, 08 Dec. 1994, *J.R. Pirani, M.A.G. Magenta & A.A. Conceição 3503* (NY, SPF); Presidente Kennedy, Praia do Marobá, 25 Sep. 2016, *K.S. Valdemarin, T.B. Flores, G.D. Colletta, F.S. Scaravelli, R.L.G. Coelho & C. Toledo 71* (RB); ibid., Praia das Neves, 13 Dec. 2013, *J.P.F. Zorzanelli, A.E. Silva, S.F. Conceição & R.S. Moraes 616* (RB); Santa Teresa, Várzea Alegre, 19 Jan. 2000, *V. Demuner* & *E. Bausen 562* (MBML, UFP); São Matheus, Guriri, 10 oct. 2012, *A. Giaretta 1306* (RB); Serra, Nova Almeida, 30 Oct. 1999, *I.D. Rodrigues 160* (VIES).

3.CATHEDRA GRANDIFLORA Loes., Flora 72 (n.s. 47): 75. 1889. TYPE: BRAZIL. Rio de Janeiro, Alto Macahé [Macaé], 20 Dec. 1887–1888, *Glaziou 16712* (lectotype, designated by Sleumer (1984: 106) as "holotype": B [Barcode B100248315; digital image!], isolectotypes: BR [Barcode BR00000528114; digital image!], C [Barcode C10016048, C10016049; digital image!], F [No. F869097; fragment; digital image!], K [Barcode K000580928; digital image!], L [Barcode L0038958; fragment; digital image!], LIL [Barcode LIL002155; fragment; digital image!], P [Barcode P05349937, P05349938, P05349939, P05349941, P05349942; digital image!], R! [Barcode R000008109).

Trees, 7–18 m tall. **Bark** striate and with spaced lenticels on young parts. **Leaves** discolorous or concolorous. Petioles 5–14 mm long; blades 5–17.5 × 2.4–6.3 cm, elliptical, oval to obovate, margin entire, not revolute, apex acute to rounded, base cuneate, secondary veins 6–10. **Flowers** 16–24 (per inflorescence); bracts ca. 0.3 mm long, triangular to narrowly triangular; pedicel 3–7 mm long, calyx 6-denticulate, 1–1.8 × 2.6–3 mm; hypogynous disk enveloping the ovary, 1.2–2.5 × 2–4 mm; corolla 6-merous, petals 4–5.5 × 1 mm, lanceolate; stamens 6, filaments 1–2 mm long, anthers ca. 1 mm long; gynoecium 4–5.5 mm long, ovary conical, stigma truncate to slightly conical, smooth. **Drupe** 16–21 × 14–18 mm, globoid, rarely obovoid, completely surrounded by the hypogynous disk; calyx accrescent, apex revolute, ca. 4 × 7 mm; epicalyx ca.1 mm long; pedicel 3–8 mm long, striate. Figure 3A–D.

Distribution and Habitat—*Cathedra grandiflora* had its distribution expanded to the state of Bahia and Espírito Santo in this study, occurring from southern Bahia to Rio

de Janeiro. It is endemic to the Atlantic Forest, registered in areas of Dense Tropical Montane Moist Forest, at altitudes ranging from 750 to 1000 m. Figure 4.

Conservation Status and Occurrence in Conservation Units — This species has an area of occupancy of less than 500 km^2 (Bachman et al. 2011), with a known distribution in a few protected areas (Jabot 2020; CRIA 2020). The occurrence area of *Cathedra grandiflora* is highly fragmented, being suggested as Endangered (EN) [B2ab (ii, iii, iv)].

A few specimens have been recorded from Conservation Units in the state of Espirito Santo (Estação Biológica de Santa Lúcia, Estação Biológica de São Lourenço, and Reserva Biológica Augusto Ruschi).

Notes— *Cathedra grandiflora* was described by Loesener (1889) based on specimens in flower and collected in the state of Rio de Janeiro. More than a century later, it was redescribed by Sleumer (1984), but only two specimens were analyzed and no information about the fruits was reported. Sleumer (1984) pointed out that it could be extinct, possibly due to the absence of available specimens at herbaria at that time. We complement here the description of this species after more samples having been located, adding new morphological information about the fruit, such as the shape, size, proportion of the hypogynous disc, as well as the size of the calyx accrescent, epicalyx and pedicel, expanding the number of specimens analyzed, providing an overall understanding of the morphological variability of this species.

Cathedra grandiflora can be confused with *C. rupestris,* by the shape and size of the blades, however they differ in the length of pedicel in flower (3–7 vs. 1.5–2.2 mm in *C. rupestris*) and petals (4–5.5 vs. 3–3.5 mm), as well as the proportion of the hypogynous

disk in relation to the fruit (completely surrounded by the hypogynous disk vs. hypogynous disk restricted to the base of drupe).

This species has great variability in the shape and size of the leaves. Some specimens have secondary veins clearly visible on both surfaces or only on the abaxial surface, while in others they are inconspicuous on both surfaces. The flowers and fruits do not show strong variability in morphology.

Phenology— The species was collected in flower from December to April and in fruit in August, December and January. Flowers are yellow to green with a pleasant fragrance.

***Specimens examined*—Brazil**. —BAHIA: Arataca, Serra Peito de Moça, 19 Jan. 2006, *W.W. Thomas, J.L. Paixão, S. Sant'Ana, M.M.M. Lopes & R. Riina 14587* (CEPEC); ibid., 20 Jan. 2007, *A.M. Amorim, R. Borges, A. Fontana, R. Perdiz, L. Gomes, S. Sant'Ana 6741* (CEPEC) —ESPIRITO SANTO: Santa Teresa, São Lourenço Country Club, 22 Feb. 1999, *L. Kollmann, E. Bausen & W. Pizziolo 1965* (MBML, UFP); ibid., São Lourenço Country Club, 16 Dec. 1999, *V. Demuner, E. Bausen & W. Pizziolo 348* (MBML, UFP); ibid., Reserva Biológica de São Lourenço, 03 Feb. 1999, *L. Kollmann, E. Bausen & W. Pizziolo 1796* (MBML, UFP); ibid., Valsugana Velha, Estação Biológica de Santa Lúcia, 23 Mar. 1999, *L. Kollmann, E. Bausen & W. Pizziolo 2250* (MBML, UFP); ibid., Estação Biológica de Santa Lúcia, 24. Mar. 1999, *L. Kollmann, E. Bausen & W. Pizziolo 2266* (MBML, UFP); ibid., Reserva Biológica Augusto Ruschi, 24. Apr. 2002, *R.R. Vervloet* & *E. Bausen 188* (MBML, UFP); ibid., Reserva Biológica Augusto Ruschi, 28 Aug. 2002, *R.R. Vervloet, E. Bausen & W. Pizziolo 763* (MBML, UFP); ibid., Trilha da divisa, saída para Goipaboaçu, 20 Fev. 2003, *R.R. Vervloet, E. Bausen, W. Pizziolo & J. Rossini 1879* (MBML, UFP). —RIO DE JANEIRO: [Macaé], Alto Macahé, 20 Nov.

1888, *Glaziou 17474* (P); Rio de Janeiro, Santa Maria Madalena, 22 Apr. 2014, *C.R. Mendonça s.n.* (RB [RB01376048]).

4.CATHEDRA RUBRICAULIS Miers, Ann. Mag. Nat. Hist., ser. 2, 7:458. 1851. TYPE: BRAZIL. Rio de Janeiro, Corcovado, Agoas Novas, Jul. 1837, (designated by Sleumer (1984: 109) as "Miers 3840"; corrected here), *Miers 3870* (lectotype, designated by Sleumer (1984: 109) as "holotype": BM (not seen), isolectotypes: G [Barcode G00390257, G-DC 00390258; digital image!]).

Cathedra gardneriana Miers, Ann. Mag. Nat. Hist., ser. 2, 7:459. 1851. TYPE: BRAZIL. Rio de Janeiro, Tejuca [Tijuca], Dec. 1840, *Gardner 5380* (lectotype, designated by Sleumer (1984: 109) as "holotype": BM [Barcode BM000839870; digital image!], isolectotype: K [Barcode K000580917, K000580918; digital image!]).

Shrubs to trees, 1–16 m tall. **Bark** scaly without lenticels. **Leaves** discolorous or concolorous. Petioles 4–11 mm long; blades 8–14 × 3.5–5 cm, elliptical to oblong, margin entire, not revolute, apex acute to acuminate, base rounded to obtuse, secondary veins 8–11. **Flowers** 3–40 (per inflorescence); bracts ca. 0.5 mm long, triangular; sessile, calyx inconspicuously 5–6-denticulate, ca. 0.4 × 1.3 mm; hypogynous disk enveloping the ovary, 1.2–2.5 × 2–4 mm; corolla 5–6-merous, petals 1.1–1.2 × 0.7–0.8 mm, triangular to lanceolate; stamens 5–6, filaments ca. 0.3 mm long, anthers ca. 0.2 mm long; gynoecium ca. 1 mm long, ovary umbonate, stigma slightly globoid to conical, smooth. **Drupe** 12–30 × 14–21 mm, globoid, ½ to ⅔ or rarely almost the length of the fruits surrounded by the hypogynous disk; calyx accrescent, apex revolute, 2–4 × 7–10 mm; epicalyx ca. 1 mm long; pedicel 2–5 mm long, striate. Figure 3E–H.

Distribution and Habitat— Endemic to Brazil and here expanded to the Amazon Rainforest, in areas of Terra Firme forest on sandy soils, in the state of Acre. This species still occurs along the Brazilian East Coast, from the state of Pernambuco to Rio de Janeiro, in this study new occurrences were identified for the states of Minas Gerais and Sergipe. *Cathedra rubricaulis* is registered in areas of Seasonal Semideciduous Forest, Restinga and Tabuleiros, occurring in the interior of vegetation and also along forest borders. Figure 4.

The disjunct distribution pattern observed for this species corroborates the hypothesis of connections between Amazon and Atlantic Forests during periods of Pleistocene climate change (Andrade-Lima 1982; Prance 1982), which has also been suggested for other plant families such as Combretaceae, Chrysobalanaceae, Fabaceae, Lecythidaceae, Melastomataceae, Moraceae and Sapotaceae (Cavalcanti and Tabarelli 2004; Fiaschi and Pirani 2009; Turchetto-Zolet et al. 2012).

Conservation Status and Occurrence in Conservation Units— In the Amazon Forests it is found in two localities with large-scale native timber extraction and agriculture (Bernade et al. 2013; IBGE 2020a). Although the species is registered in several localities of the Atlantic Forest (CRIA 2020), this is a strongly fragmented ecosystem and threatened by poor soil management, development and urban and agricultural expansion (Trindade et al. 2008; Ribeiro et al. 2009). With an area of occupancy of less than 500 km^2 (Bachman *et al.* 2011), the species suffers with the continuing decline in habitat area and quality, and is therefore is recommend as Endangered (EN) [B2ab (ii, iii, iv)].

It is recorded in several Conservation Units in the states of Espírito Santo (Reserva Biológica de Comboios, Reserva Biológica de Córrego Grande, Reserva Natural da Vale - CVRD, and Parque Estadual Paulo Cezar Vinha), Pernambuco (Parque Estadual de Dois

Irmãos), Rio de Janeiro (Reserva Biológica de Poço das Antas and Parque Nacional da Tijuca) and Sergipe (Reserva Particular do Patrimônio Natural Mata do Crasto).

Notes— *Cathedra rubricaulis* was described and illustrated by Miers (1851) based on specimens from the state of Rio de Janeiro. In the protologue, the location is indicated (Agoas Novas, on the ascent to Corcovado) and the date of collection (July 1837), but without a collector's number. The author also explains that the illustration of this taxon would be published later ("This species, with ample generic details, will be shown in the 'contributes to Botany', &c., plate 2"). Sleumer (1984) made the necessary lectotypification, indicating holotype [lectotype] and isotype [isolectotype] respectively deposited at BM (The Natural History Museum) and G (Conservatoire et Jardin Botanique de la Ville de Genève) herbaria, and adding a collector number ("3840") for this type. However, at G two specimens were located, one of them from the Augustin de Candolle collection which was incorporated into the Genavense herbarium. On both, the collection site (Corcovado, Rio de Janeiro), collector number (3870) and indication for the illustrations (Miers 1861, Contrib. Bot. p. 14, Tab.2) are handwritten by Miers. This publication is a compilation of species and their illustrations described for South America (Miers 1861). On page 14, the description of C*. rubricaulis* is republished, with an illustration on plate 2, as indicated on the labels at G. Based on this information, we believe the number of collectors were unintentionally confused by Sleumer (1984), and here it is corrected (see Turland et al. 2018; Art.9.2).

Morphologically, *Cathedra rubricaulis* can be confused with *C. bahiensis*, the similarities and morphological differences between these two species are commented on in the description of *C. bahiensis.*

***Phenology*—** The species was collected in flower from August to December and in fruit in January, February, April and from October to December. It has cream-colored flowers, greenish fruits with a yellow hypogynous disk and a pleasantly sweet fragrance and taste, these characteristics in the fruits suggest it is possibly used in the diet of small animals.

***Additional Specimens Examined*—Brazil**. —ACRE: Cruzeiro do Sul, estrada do Alemanha, 04 Nov. 1966, *G.T. Prance, B.S. Pena & J.F. Ramos 3016* (F, L, NY), ibid., Igarapé Humaitá, 28 Oct. 1991, *C.A.C. Ferreira & L. Luz 10443* (INPA, NY). —ALAGOAS: São Miguel dos Campos, 26 Oct. 1968, *M.T. Monteiro 22823* (PEUFR, RB). —BAHIA: Camamu, Fazenda Zumbi dos Palmares, 22 Feb. 2000, *J.G. Jardim, C. Aguiar, S.C. Sant'Ana, F. Juchum & J. Paixão 2762* (CEPEC); Ilhéus/Una, 42 Km S, 01 Feb. 2009, *J.G. Jardim 5456* (CEN, CEPEC); Itacaré, estrada Ubaitaba/Itacaré, 12 Feb. 2011, *T. Araújo, J.L. Paixão & C. Vivas 75* (CEPEC); Jaguaquara, Área do EBDA, 05 Dec. 1999, *E. Melo & F. França 3195* (HUEFS); Maracás, Fazenda do Caboclo, Lagoinha, 27 Feb. 2000, *R.P. Oliveira, M.M. Silva, I. Castro & M.A.S. Santos 407* (HUEFS); Santa Terezinha, Serra da Jiboia, 2 Apr. 2004, *M.L.C. Neves 44* (CEN, HUEFS); ibid., 12 Feb. 2011, *E. Melo, F. França, B.M. Silva, P.P. Oliveira & L.A. Jesus Neto 9130* (HUEFS). —ESPIRITO SANTO: Cachoeiro de Itapemirim, Flona de Pacotuba, s.d, *H.M. Dias & A.E. Silva 865* (VIES); Conceição da Barra, Reserva Biológica do Córrego Grande, 20 Dec. 2011, *M. Ribeiro & A.G. Oliveira 738* (SAMES); Guarapari, Parque Estadual Paulo César Vinha, 04 Jan. 2000, *A.M. Assis 772* (RB); ibid., Setiba, 04 Feb. 1992, *L.C. Fabris 685* (VIES); Itapemirim, Região do Gomes, 23 Oct. 2000, *G. Hatschbach, M. Hatschbach & J.M. Silva 71528* (ESA, HUEFS, MBM); Linhares, Reserva Florestal da CVRD, 16 Nov. 1979, *D.A. Folli 168* (RB); Presidente Kennedy, Praia das Neves, 21 Jan. 2015, *J.M.L. Gomes 4199* (RB, VIES); ibid., Restinga, 14 Oct. 2012, *J.M.L. Gomes 4262* (VIES); Regência, Reserva Biológica de Comboios, 11 Oct. 1989, *D.A. Folli 974* (RB); ibid., 15 Jan. 2002, *D.A. Folli 4165* (CVRD);

ibid., Reserva Natural da Vale, 18 Jan. 2018, *G.S. Siqueira 1256* (RB); São Matheus, Pontal do Sul Ilha de Guriri, 16 Jan. 1997, *M.C.F. Jesus 100* (VIES); Serra, Nova Almeida, 19 Feb. 2000, *I.D. Rodrigues 257* (VIES). —MINAS GERAIS: Novo Cruzeiro, Estrada para a fazenda Araras, 02 Oct. 2004, *J.R.Stehmann, R.C.Mota, P.O. Morais & G.S. França 3565* (MBM). —PERNAMBUCO: Recife, Areias, 6 Oct. 1949, *D. Andrade-Lima 49-334* (IPA); ibid., Parque Estadual de Dois Irmãos, 11 Oct. 1968, *D. Andrade-Lima 68-5444* (IPA); Sirinhaém, Engenho Lage, 1 Nov. 1968, *D. P. Lima 12618* (HST, HUEFS, IPA). —RIO DE JANEIRO: Armação de Búzios, Manguinhos, 12 Nov. 1999, *D. Fernandes & J. Caruzo 326* (RB); ibid., Praia Rasa, 16 Dec. 1999, *D. Fernandes & Babintom 374* (RB); Rio de Janeiro, Barra da Tijuca, 30 Dec. 1964, *W. Hoehne 5962* (NY), ibid., Morro de Dona Marta, 11 Aug. 1959, *A.P. Duarte 4971* (RB); ibid., 02 Sep. 1959, *A.P. Duarte 5006* (RB); ibid., Mata de Teixeira Borges, 29 Nov. 1928, *Pessoal do Horto florestal 920* (L, NY, RB); ibid., Parque Nacional da Tijuca, 11 Jan. 2012, *M.F. Santos, A.Q. Lobão & P. Fiachi 798* (SPF, UFP); ibid., Cosme Velho á Laranjeiras, 4 Jul. 1862, *A. Glaziou 109* (P); ibid., Restinga de Copacabana, Sep. 1899, *E. Ule 4281* (L); ibid., Barra da Tijuca, 1948, *D.R. Machado 71* (RB); ibid., Barra da Barra da Tijuca, 30 Aug. 1961, *E. Pereira & A. Lima 5749* (RB); ibid., Barra da Tijuca, 22 Dec. 1944, *O. Machado s.n.* (RB [RB00268620]); ibid., Floresta da Tijuca, 11 Nov. 2001, *D. Fernandes & A. Oliveira 622* (RB); ibid., Grumari, 23 Oct. 1975, *N.F. Marquete & R.H.P. Andreata 54* (RB); ibid., APA Jacarepaguá, 19 Dec. 2001, *H.C. Lima 5971* (RB); ibid., Restinga de Jacarepaguá, 06 Jan. 1972, *D. Araujo 39* (RB), ibid., Corcovado, 05 Nov. 1946, *D. Paulo 408* (RB); ibid., Horto Florestal, 08 Sep. 1989, *V.F. Gonçalves, H.C. Lima, C. Magalhães & J. Caruso 31* (ESA, RB, UFP); ibid., Gávea, 18 Jan. 1929, *J.G. Kuhlmann 1450* (RB); ibid., 31 Jan. 1928, *Pessoal do Horto Florestal 921* (RB); ibid., Horto Florestal, 31 Jan. 1928, *J.G. Kuhlmann s.n.* (RB [RB00770464]); ibid., Horto Florestal da Gávea, 20 Jan. 1971, *P. Occhioni 4236* (MBML); ibid., Recreio dos Bandeirantes, 1955, *G. Barroso s.n.* (RB [RB00268640]); ibid, Pedra do

Marinheiro, 18 Jan. 1969, *D. Sucre 4432 & P.I.S. Braga 1309* (RB); ibid., Laranjeiras, 26 Out. 1872, *A. Glaziou 5889* (P); ibid., 21 Aug. 1874, *A. Glaziou 7522* (F, P, R); Silva Jardim, Reserva Biológica de Poço das Antas, 14 Nov. 1997, *S.V.A. Pessoa s.n.* (RB [RB00511905]). —SERGIPE: Santa Luzia do Itanhy, RPPN Mata do Crasto, 24 Feb. 2012, *L.A. Gomes, R.M. Gomes, E. Santos & G.M.A. Matos 318* (ASE).

5.CATHEDRA RUPESTRIS D.S. Lucena & M. Alves, sp. nov. TYPE: BRAZIL. Bahia: Andaraí, Nova Rodovia Andaraí/Mucugê, 21 Dec. 1979, *S.A. Mori & F.P. Benton 13097* (Holotype: CEPEC! [No. 18843], isotypes: L [Barcode L1665078; Digital image!], NY [Barcode NY00396123; Digital image!], RB! [Barcode RB00268638]).

Cathedra rupestris differs from other species of the genus mainly by the hypogynous disc at the base of the fruits and reddish in color, while in the other species it partially or totally surrounds the fruits and is yellow or greenish in color, in this species the branches are reticulate and in the other species of *Cathedra* are scaly to striated. *Cathedra rupestris* it is morphologically similar to *C. grandiflora* by the shape and size of the leaves, however, they differ in terms of the length of the pedicel in flower (1.5–2.2 vs. 3–7 mm in *C. grandiflora*) and petals (3–3.5 vs. 4–5.5 mm) and proportion of the hypogynous disk in relation to the fruit (hypogynous disk restricted to the base of drupe vs. completely surrounded by the hypogynous disk).

Trees, 2.5–3.5 m tall. **Bark** reticulate without lenticels. **Leaves** discolorous. Petioles 7–9 mm long; blades 6.5–11 × 2.3–4 cm, elliptical to ovate, margin entire, not

revolute, apex acute, base rounded to rarely cuneate, secondary veins 8–10. **Flowers** 6–9 (per inflorescence); bracts ca. 0.3 mm long, triangular to narrowly triangular; pedicel 1.5–2.2 mm long, calyx slightly 6-denticulate, 1 × 2–2.5 mm; hypogynous disk enveloping the ovary, ca. 1 × 2 mm; corolla 6-merous, petals 3–3.5 × 1 mm, lanceolate; stamens 6, filaments 0.8–1 mm long, anthers 0.8–1 mm long; gynoecium ca. 4 mm long, ovary depressed, ovoid, stigma slightly conical, smooth. **Drupe** 15–19 × 16–20 mm, globoid, hypogynous disk in the base of drupe, 3–4 mm long; calyx accrescent, apex entire, 1 mm long × 6 mm diam; epicalyx ca. 0.5 mm long; pedicel 1–2 mm long, smooth with spaced striations. Figure 3I–P.

Common Names— Mãe-doquinha

Distribution and Habitat —*Cathedra rupestris* is known only from the municipalities of Andaraí and Mucugê, state of Bahia, northeastern Brazil, at altitudes ranging from 900 to 1200 meters. The area is part of the Diamantina Plateau, in the northern portion of the Espinhaço Range, mainly covered by Campos Rupestres which are characterized by the dominance of herbaceous plants with spaced small trees and shrubs; the litholic soils and quartz sand with rock outcrops also characterize the type locality (Giulietti and Pirani 1988; Zappi et al. 2003). Due to the high richness and high number of endemic species, this region is considered a priority for species conservation (Watanabe et al. 2009). Figure 4.

Conservation Status and Occurrence in Conservation Units— It is restricted to a small region of the Campos Rupestres in Bahia state and with a very limited area of occupancy. Since it has not been recollected for over 30 years (CRIA 2020) and the known samples were collected by a roadside that has undergone an expansion process in recent

years and the area still suffers from mining exploitation (IBGE 2020b), the species is recommended as Critically Endangered (CR) [B1ab(i,ii,iii) + B2ab(i,ii,iii)].

Despite being collected in locations close to the Chapada Diamantina National Park, created in 1985, *Cathedra rupestris* has not yet been registered in any Conservation Unit.

Etymology— The epithet refers to the vegetation type and environment where the species was recorded, areas of rocky outcrops or rocky slopes.

Notes— *Cathedra rupestris* has often been misidentified as *C. rubricaulis* probably because in both species the drupe is globoid, but the new species here described differs by several characters of the flowers and fruits. It can be morphologically distinguished from *C. rubricaulis* by the length of the pedicel (1.5–2.2 mm vs. sessile in *C. rubricaulis*) and petals (3–3.2 vs. 1.1–1.2 mm) and also the proportion of the hypogynous disk in the fruits (restricted to the base vs. ½ to ⅔ or rarely almost the length of the fruits).

Phenology— The species was collected in flower in August and September and in fruit in November, December and January. According to the information from exsiccate labels, *Cathedra rupestris* has white to cream-colored flowers and a remarkable, red hypogynous disk which is yellowish in the other species of the genus.

Additional Specimens Examined (Paratypes)—**Brazil**. —BAHIA: Andaraí, Serra de Andarái, Nov. 1973, *G.C.P. Pinto s.n.* (ALCB [ALCB00998]); ibid., Rodovia Andaraí/Mucugê (BA 142), 12 Jan. 1983, *L.A.M. Silva & E.M.C. Leme 1611* (CEPEC, RB); ibid., Serra da Cotiguiba, 25 Aug. 1986, *R.P. Orlandi 772* (RB); Mucugê, Estrada Andaraí–Mucugê com 4–5 km de Andaraí, 08 Sep. 1981, *J.R. Pirani, A. Furlan, M.L. Kawasaki, J. Diacui, M.C.E. Amaral & N.M. Castro s.n.* (HUEFS [HUEFS000031167], NY [NY01023594]).

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Author Contributions

All authors contributed to the development of the manuscript, Danielly Lucena was responsible for visiting the herbaria, analyzing the specimens and writing the manuscript. Francione Gomes analyzed the Conservation Status of the species, prepared the maps and added suggestions to the final text. Marccus Alves discussed results, added suggestions to the final text and supervised the PhD research project of the first author.

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Figures

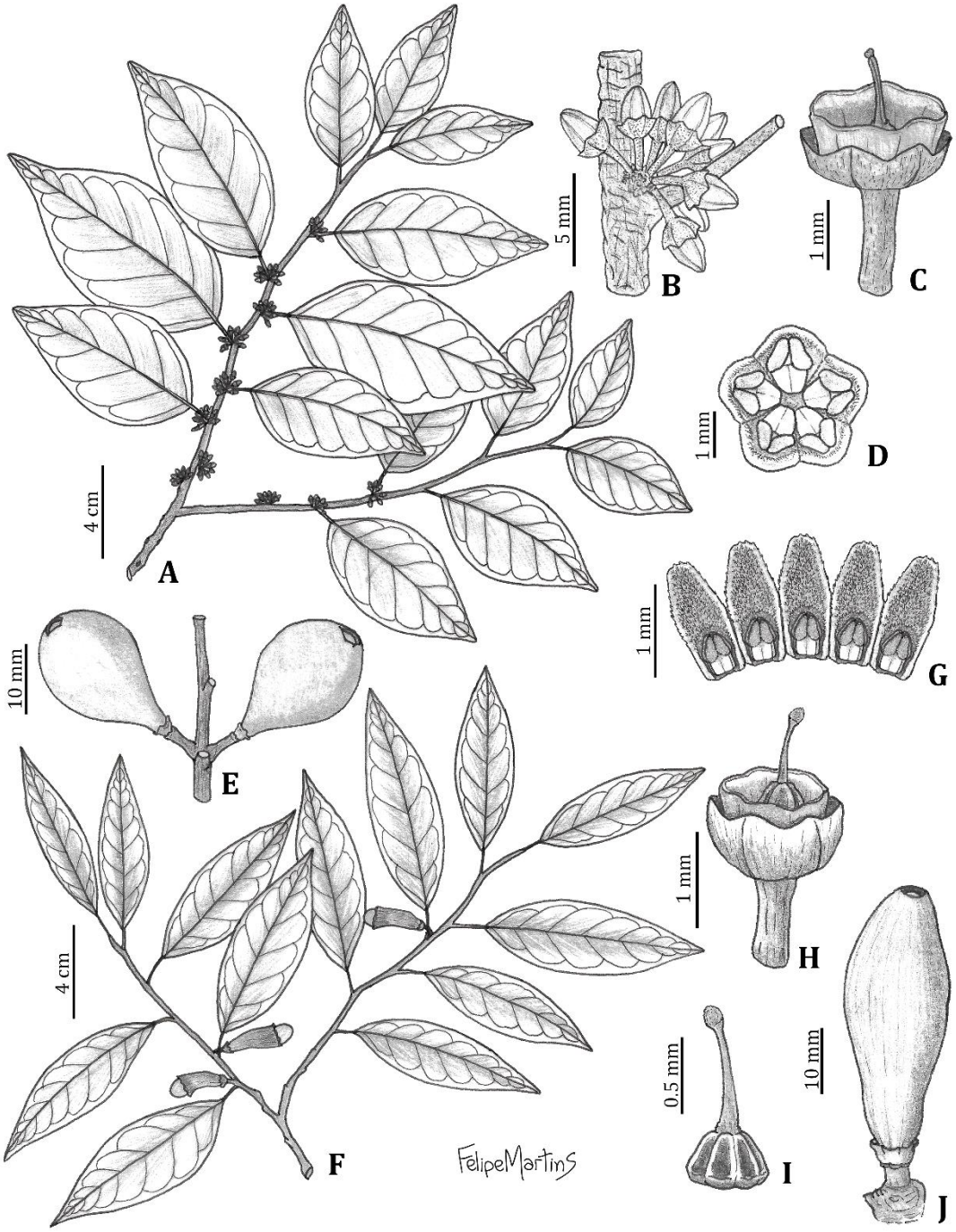

FIG. 1. A–E. *Cathedra acuminata* (Benth.) Miers. A. Flowering branch. B. Inflorescence (in bud). C. Details of calyx, hypogynous disk and part of gynoecium. D. Overview of the open flower with androecium. E. Fruits. (Drawn from: A, *D.B. Fanshawe 5580.* B–D, *N.M. Ivanauskas et al. 2112.* E, *C.A. Sothers 65*). F–J. *C. bahiensis* Sleumer. F. Fruiting branch (immature fruits). G. Petals and androecium. H. Details of calyx, hypogynous disk and part of gynoecium. I. Gynoecium. J. Fruit. (Drawn from: F, *E. Matos et al. 920.* G–I, *O.J. Pereira et al. 3849.* J, *V. Demuner* & *E. Bausen 562*).

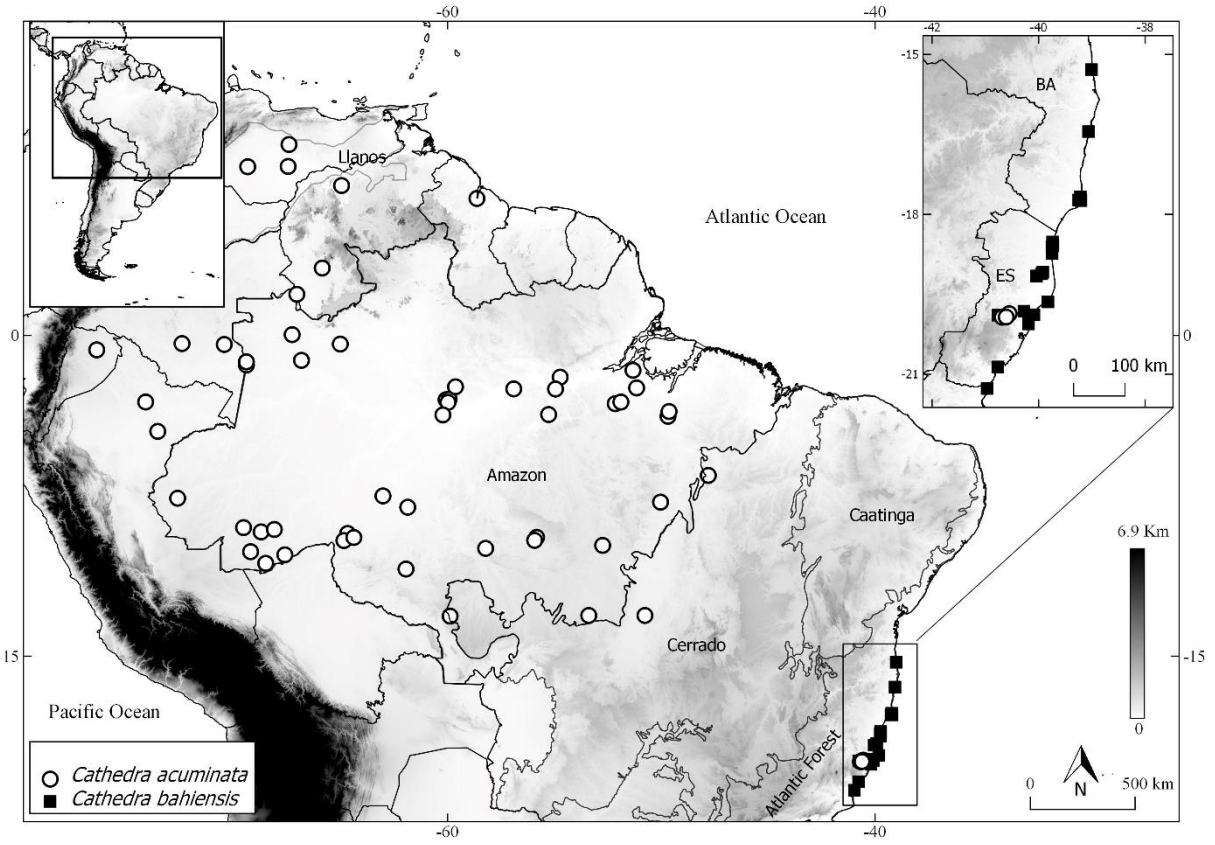

FIG. 2. Geographic distribution of *Cathedra acuminata* (Benth.) Miers. and *C. bahiensis* Sleumer. BA (Bahia), ES (Espírito Santo).

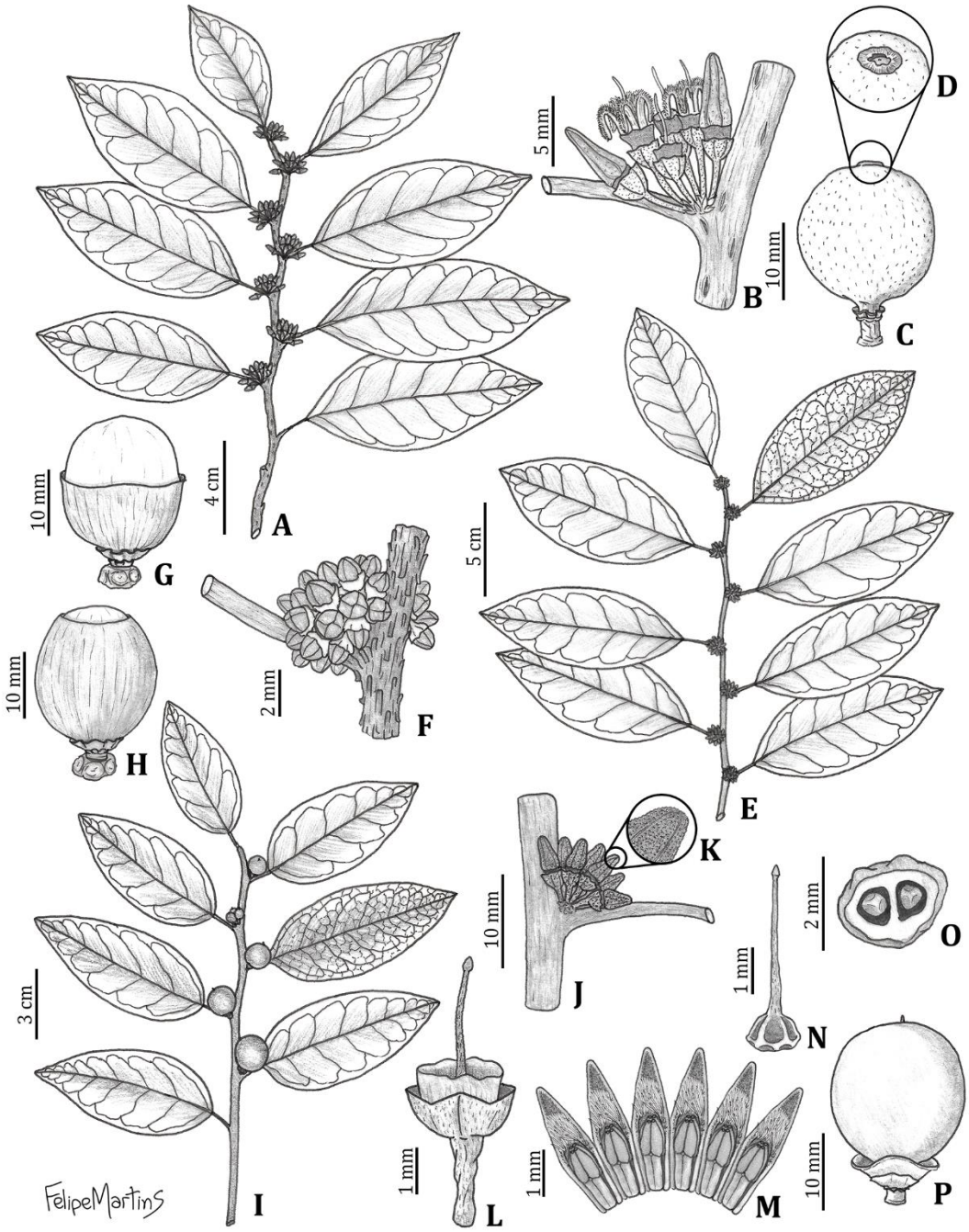

FIG. 3. A–D. *Cathedra grandiflora* Loes. A. Flowering branch. B. Inflorescence (flower and buds). C. Fruits. D. Detail of the apex of the fruit. (Drawn from: A–B, *R.R. Vervloet* & *E. Bausen 188.* C–D, *W.W. Thomas et al. 14587*). E–H. *C. rubricaulis* Miers. E. Flowering branch. F. Inflorescence (buds). G. Fruit ½ surrounded by the hypogynous disk. H. Fruit, almost the entire length surrounded by the hypogynous disk. (Drawn from: E–F, *V.F. Gonçalves et al. 31.* G, *M.F. Santos et al. 798.* H, *M.L.C. Neves 44*). I–P. *C. rupestris* D.S. Lucena & M. Alves. I. Fruiting branch. J. Inflorescence (buds). K. Detail of papillose adaxial surface of corolla. L. Details of calyx, hypogynous disk and part of gynoecium. M. Petals and androecium. N. Gynoecium. O. Cross-section of the ovary showing locules and ovules. P. Fruit. (Drawn from: I and P, *S.A. Mori & F.P. Benton 13097* (Drawn from the holotype). J–O, *J.R. Pirani et al. s.n.* (HUEFS [HUEFS000031167], NY [NY01023594])).

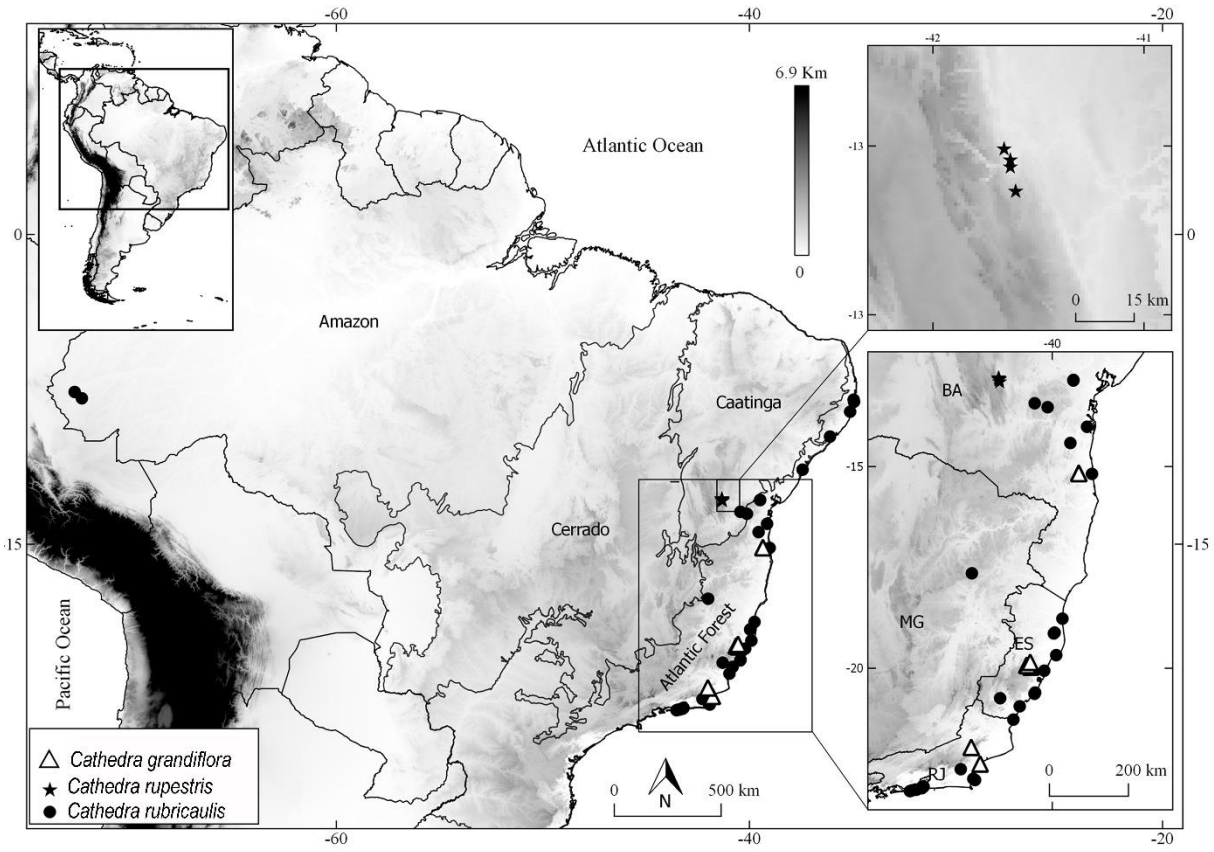

FIG. 4. Geographic distribution of *Cathedra grandiflora* Loes, *C. rubricaulis* Miers and *C. rupestris* D.S. Lucena & M. Alves. BA (Bahia), ES (Espírito Santo), MG (Minas Gerais), RJ (Rio de Janeiro).

3.2 ARTIGO 2 – A NEW SPECIES AND A NEW RECORD OF *HEISTERIA* JACQ. (OLACACEAE *S.L.*) FROM THE BRAZILIAN ATLANTIC FOREST

Manuscrito aceito – Revista Acta Botanica Brasilica

Original Article

A new species and a new record of *Heisteria* Jacq. (Olacaceae *s.l.*) from the Brazilian Atlantic Forest

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Abstract

During taxonomic studies of extra-Amazonian species of *Heisteria*, a new record (*Heisteria maytenoides*) and new species (*Heisteria longipedicellata*) from the Atlantic Forest of Espírito Santo were identified. Morphological descriptions, illustrations, the geographic distribution, and conservation status are provided for these species; an identification key for species of *Heisteria* of the state is also presented. *Heisteria longipedicellata* is known only from the type locality and recognized mainly by the long pedicel of the fruits (ca. 67 mm long). It is morphologically similar to *H. blanchetiana*, however, it differs by the length of the pedicel in fruit, diameter of the accrescent calyx in fruit and drupe size. *Heisteria maytenoides*, until now registered only in the phytogeographic domain of the Amazon in Colombia and Venezuela, had its distribution confirmed to Brazil, in the phytogeographic domain of the Atlantic Forest, in the state of Espírito Santo; it is recognized mainly by its coriaceous leaves and globoid fruits. In this study the richness of *Heisteria* for the Espírito Santo state is updated to five species. *Heisteria blanchetiana*, previously registered only to the state of Bahia, had its distribution expanded to include Espírito Santo.

Keywords: Atlantic Forest, Espírito Santo, biodiversity hotspot, Santalales, taxonomy

Introduction

Heisteria Jacq. is the second most representative genus in Olacaceae *s.l.*, composed of 34 species distributed in North and South America (31 spp.) and in Africa (3 spp.). The Neotropical region is the center of diversity for the genus and Brazil has the greatest richness, with 21 species (Sleumer 1984; Gentry 1993; Christenhusz *et al.* 2017), distributed in the phytogeographical domains of the Amazon, Caatinga, Cerrado and Atlantic Forest. The Amazonian domain is the most expressive with 17 species, followed by the Atlantic Forest, with five species registered so far (Flora do Brasil 2020).

Heisteria species are trees, shrubs or rarely lianas. Members of the genus are morphologically characterized by their simple, alternate, glabrous and discolorous leaves, with inconspicuous latex, entire and often revolute margins, canaliculate petioles, often thicker in their upper half and slightly curved. Inflorescences are arranged in axillary fascicles, with up to 20 flowers, sessile or pedicellate, subtended by two to three bracts at the base, calyx cupulate, small at anthesis and accrescent in fruit. The fruits are drupes with a single seed and a persistent, expanded and colorful calyx (Sleumer 1984; Kuijt 2015).

In general, species of *Heisteria* are morphologically very similar to each other, as mentioned by Engler (1872) and Sleumer (1984). Flowers are morphologically homogeneous, except for the length of the pedicel and number of stamens (10−12, rarely 5−6). Species are distinguished mainly by a combination of leaf and fruit characters. Leaf morphological characters such as texture, shape, size and color when dried, number of secondary veins and the pattern of reticulation are taxonomically important at the species level in *Heisteria* (Sleumer 1984), as well as the shapes of the fruit, diameter of the persistent calyx and the length of the pedicel.

During taxonomic studies of extra-Amazonian species of *Heisteria*, a new record for Brazil (*H. maytenoides* Spruce ex Engl.) and a new species have been identified in the Atlantic Forest of Espírito Santo. Morphological descriptions, illustrations, information about the geographic distribution and conservation status are provided for these species, and an identification key for the other species of the genus recorded in Espírito Santo state are also presented.

Materials and methods

This paper is part of the taxonomic studies of the extra-Amazonian species of *Heisteria* Jacq. for which specimens from the following herbaria were consulted: ALCB, *ASU, *BM, *BR, CEN, *CESJ, CEPEC, *COAH, EAC, EAN, ESA, *F, FLOR, FURB, HB, *HCF, HST, HUEFS, IPA, JPB, *K, *L, M, MAC, MBML, MBM, *MO, *NY, PEUFR, R, RB, SPSF, SP, SPF, *TCD, *U, UB, UFRN, UFP, UPCB, *US and VIES (acronyms according to Thiers 2020 [continuously updated], except, HST (Herbário Sérgio Tavares) – Universidade Federal Rural de Pernambuco). For the herbaria marked with asterisks, only images were seen.

Morphological descriptions were elaborated based on herbarium specimens, following Stearn (1995) and Harris and Harris (2000). Protologs, local floras and taxonomic reviews (Sleumer 1984; Cabral & Agra 1999; Ribeiro *et al.* 1999; Rodrigues & Rossi 2002; Assis 2004; Meirelles & Fernandes Junior 2017) were also consulted. Data on geographic distribution, habitat, and phenology were obtained from specimen labels. A preliminary conservation status was proposed for these two species based on the criteria and categories established by the IUCN (2017), the extent of occurrence (EOO) and area of occupancy (AOO) were evaluated by GeoCat software (Bachman *et al.* 2011), using only occurrence points of samples with confirmed identification. The geographic distribution map was elaborated using Quantum

Geographic System (QGIS), v.2.18.6 (QGIS Development Team 2015).

Results and discussion

Taxonomic treatment

1. *Heisteria longipedicellata* D.S. Lucena & M. Alves, sp. nov. Type: BRAZIL. Espírito Santo: Itapemirim, região do Gomes, 23 October 2000, *G. Hatschbach, M. Hatschbach, J.M. Silva, 71534* (Holotype, M – 0244279!).

Heisteria longipedicellata is morphologically similar to *H. blanchetiana* (Engl.) Sleumer, including by the length of the pedicel in the flowers (ca. 3 *vs.* 3–5 mm in *H. blanchetiana*), however it differs by the length of the pedicel in fruit (ca. 67 *vs.* 7–12 mm long), diameter of the accrescent calyx in fruits (ca. 25 *vs.* 45–70 mm) and drupe size (7–11 × 5–7 *vs.* 11–14 × 9–11 mm).

Trees, 2–5 m tall. Branches glabrous, longitudinally striate. Leaves chartaceous, simple, alternate, glabrous; petiole 6–15 mm long, cylindrical, canaliculate, glabrous, longitudinally striate; blades 12–16 × 3.5–5.5 cm, oblong to lanceolate, adaxial surface dull, base rounded to cuneate, apex acute to acuminate, margin entire, venation brochidodromous, main midrib flat to lightly impressed on adaxial surface and prominent on abaxial surface, secondary veins 8–12, flat on adaxial surface, prominent on abaxial surface. Inflorescences in axillary fascicles, sessile, bearing 12–15 flowers. Flowers bisexual; bracts 2–3, ca. 2 mm long, triangular; pedicel ca. 3 mm long; calyx lobes alternating with the corolla lobes, 5-merous, connate up to 0.2 mm long, lobes 1 mm long, triangular, apex acuminate, margin papillate; corolla 5-merous, petals ca. 1.2 × 0.4 mm, free, ovate, villous up to the middle portion on adaxial surface; stamens 10, 5 shorter and opposite the petals, filaments 0.3–0.4 mm long, 5 longer and alternating with the petals, filaments 0.6–0.7 mm long, anthers 0.2 mm long, basifixed, subglobose, dehiscence

rimose; gynoecium 1 mm long, stigma slightly trilobed, ovary superior, depressed-globose, glabrous, 4-locular, 4-ovulate. Drupe 7–11 × 5–7 mm, oblongoid, longitudinally striated, apex apiculate; calyx accrescent, ca. 25 mm diam., deeply lobed, 5-lobed, connate at base up to 4–5 mm, lobes free 9 × 11 mm, apex rounded to acute, pedicel ca. 67 mm long. Fig. 1.

Distribution and Habitat: The species is known only from the type locality: the region of Gomes, in the municipality of Itapemirim, Espírito Santo state (Fig. 2). No precise geographic coordinates are available on the herbarium label. The locality (Region of Gomes) suggests that the type locality is a fragment of *Restinga* forest located between Lagoa do Guanandy, also called Lagoa do Gomes or Lagoa das Sete Pontas and Praia da Marinha. This area is composed of a mosaic of vegetation types, including herbaceous, shrub and forest formations, both spaced and dense. The site presents stretches of flooded soils, pasture areas and small fragments in the process of natural regeneration (Leite 2010).

Phenology: It was found with flowers and fruits in October.

Etymology: The specific epithet of this new species refers to the exceptionally long and accrescent pedicel of the fruit (ca. 67 mm long), which in other species of *Heisteria* ranges from 1 to 20 mm long (Sleumer 1984).

Conservation status and occurrence in Conservation Units: According to the criteria established by the IUCN (2017), if a taxon is known only from the type locality it is recommended to be included, even if provisionally, in category DD (data deficient), due to the absence of data to calculate the extent of occurrence (EOO) and the occupation area (AOO) of the taxon. Even so, it is important to mention that although inserted in the Área de Proteção Ambiental Lagoa do Guarandy (area of sustainable use), the locality where *H. longipedicelata* was collected is under strong anthropic pressure mainly due to sand extraction, selective cutting of wood and fires which constitute a threat to the conservation of local biodiversity, especially for endemic species (Leite 2010; Valadares & Sakuragui 2016).

Observations: The type specimen is part of a set of samples with the same collection number (G. Hatschbach, M. Hatschbbach & J.M. Silva 71534), previously identified as *H. perianthomega* (Vell.) Sleumer, and with duplicates distributed to several Brazilian herbaria, and also in the United States and Germany. However, two species are mixed, the samples deposited at ASU, CESJ, HCF, MBM, RB, SPF, SPSF and U were analyzed and confirmed to fit under the circumscription of *H. perianthomega* (Vell.) Sleumer. The sample at M presents the stunning morphological feature of the long pedicel, which distinguishes it from the others and represents the new species of *Heisteria* describe here.

Heisteria longipedicellata is also morphologically similar to *H. perianthomega* (Vell.) Sleumer, mainly by the shape of the fruits. It differs by the slightly longer pedicel in the flowers (ca. 3 *vs.* 0.5–1 mm long in *H. perianthomega*) and exceptionally long one in fruit (ca. 67 *vs.* 4–7 mm long), as well as by a slightly smaller accrescent calyx diameter in the fruits (ca. 25 *vs.* 27–40 mm diam.). As mentioned in the diagnosis, *Heisteria longipedicellata* is similar to *H. blanchetiana* in terms of the length of the pedicel in the flowers, but when herborized samples of *H. blanchetiana* have the adaxial surface of the leaf blade shiny which is not seen in *H. longipedicellata* and can be helpful to identify specimens with flowers or immature fruits. The other species of *Heisteria* that occur in the state of Espírito Santo are easily differentiated from *H. longipedicellata*, as can be seen below in the identification key.

2. *Heisteria maytenoides* Spruce ex Engl. Fl. Bras. (Martius) 12 (2): 15 (1872). Type: VENEZUELA/COLOMBIA. Guainia vel Rio Negro supra ostium fluminis Casiquiari, 1854, *R. Spruce 3508* (Holotype: BR [Barcode BR528997; digital image]!; Isotypes: BM [Barcode BM000839920; digital image]!, K [Barcode K000584506; digital image]!, MO [Barcode MO1624771; digital image]!, NY [Barcode NY00285475; digital image]!, P [Barcode P02441921; digital image]!, TCD [Barcode TCD0004101; digital image]!).

Trees 3–15 m tall. Branches glabrous, longitudinally striate on younger parts. Leaves coriaceous, simple, alternate, glabrous; petiole 5–11 mm long, cylindrical, canaliculate, glabrous, longitudinally striate; blades 5.5–8.5(–11.5) × (2.7–)3–4.1 cm, oblong, elliptical, adaxial surface dull, base cuneate, apex acute, margin entire, venation brochidodromous, main midrib flat to lightly impressed on adaxial surface and prominent on abaxial surface, secondary veins 7–10, flat and inconspicuous on the adaxial and abaxial surfaces. Inflorescences in axillary fascicles, sessile, bearing 7–10 flowers. Flowers bisexual; bracts 2–3; ca. 2 mm long, triangular; pedicel 1–1.5 mm long; calyx lobes alternating with the corolla lobes, 5-merous, connate up to 0.2 mm long, lobes 1.5 mm long, triangular, apex acuminate, margin papillate; corolla 5-merous, petals ca. 1.8 × 1 mm, free, lanceolate, villous up to the middle portion on the adaxial surface; stamens 10, 5 shorter and opposite the petals, filaments ca. 0.5 mm long, 5 longer and alternating with the petals, filaments ca. 0.9 mm long, anthers 0.5 mm long, basifixed, slightly quadrangular, rimose; gynoecium 1 mm long, stigma slightly trilobed, ovary superior, depressed-globose, glabrous, 4-locular, 4-ovulate. Fruits drupes, when mature 12 × 13 mm, globoid, longitudinally striated, apex apiculate; calyx accrescent, 37–55 mm diam., deeply lobed, 5-lobed, connate at base up to 7–9 mm, lobes free 11 × 11 mm, apex acute, involving the fruits when immature and patent when mature, pedicel 15 mm long. Fig. 1.

Distribution and Habitat: In this study, *H. maytenoides* is confirmed to Brazil, Colombia and Venezuela (Fig. 2). In Colombia and Venezuela, it is distributed along the banks of the upper Rio Negro, in the department of Guainía and in the state of Amazonas, respectively. It is an area inserted in the Amazon domain, with altitudes ranging from 120 to 150 meters asl with sandy, flooded, light-colored and nutrient-poor soils. The vegetation is characterized mainly by having spaced trees, with small diameter trunks and canopies, and often bearing coriaceous leaves (Anderson 1981; Adeney *et al.* 2016; Kvarnbäck & Bosque 2017).

In Brazil, records of this species have been confirmed so far only for the Atlantic Forest domain, in the state of Espírito Santo, in two locations of Dense Ombrophilous Forest, with altitudes ranging from 700 to 950 meters asl. The specimens were collected in the basin of the Rio Bonito and in the Parque Natural Municipal de São Lourenço, an area cut by numerous streams that flow into Rio São Lourenço. *Heisteria* species commonly grow close to streams and small rivers, as is the case in the area of the new record of *H. maytenoides*.

Ramos (2020) listed this species to the Brazilian Amazon domain. However, the specimens cited by the author (JA Silva 207 and EG Holt & ER Blake 576) correspond to *H. amazonica* Sleumer and *H. duckei* Sleumer, respectively. MacDougal (2003) also mentions the distribution of *H. maytenoides* as Brazil, Colombia and Peru, but the samples analyzed from Brazil (EG Holt & ER Blake 576) and Peru (V. Huashikat 337) do not correspond to this species but to *H. duckei* and *H. ovata* Benth, respectively.

With a distribution along the banks of the Rio Negro and close to the border with the Brazilian territory, it is possible that this species also occurs in the Brazilian Amazon domain, but so far, no record has been found in the collections analyzed. A disjunct distribution of *H. maytenoides* is confirmed here to the Amazonian domain, Colombia and Venezuela, and to the Atlantic Forest domain in Brazil, a pattern already reported for several botanical families and for other genera of Olacaceae (Rizzini 1963; Prance 1982; Fiaschi & Pirani 2009; Turchetto-Zolet *et al.* 2012).

Phenology: It was collected with flowers and fruits in January, and only with fruits between May and July. It has cream to greenish flowers and green fruits with the accrescent calyx an intense red.

Conservation status and occurrence in Conservation Units: This species has an occupation area of less than 500 m^2, occurring in few localities, and with a reduced number of mature

individuals known to date. According to the criteria established by IUCN (2017), *H. maytenoides* Spruce is indicated as Endangered (EN) [B2b (ii, iv)].

In this study, two specimens were cataloged in Conservation Units in Venezuela (Reserva Forestal El Sipapo) and Brazil (Parque Natural Municipal São Lourenço), showing the importance of these areas in the preservation of this species.

Observations: *Heisteria maytenoides* differs from other species that occur in the state of Espírito Santo State by its coriaceous leaves, flat and inconspicuous secondary veins on the abaxial surface and globoid drupes. Among the collections studied, some species of *Heisteria* are misidentified as *H. maytenoides.* They actually are *H. duckei*, *H. amazonica* or *H. ovata.* However, *H. maytenoides* is easily differentiated from *H. duckei*, mainly by the shape of the blade (oblong to elliptical *vs.* obovate to rarely elliptical in *H. duckei*) and leaf apex (acute *vs.* strongly acuminate), as well as the shape of the fruits (globoid *vs.* ellipsoid); from *H. amazonica* by the shape of the leaf apex (acute *vs.* acuminate in *H. amazonica*) and lateral veins (flat and inconspicuous on the abaxial surface *vs.* prominent on abaxial surface), and from *H. ovata* by the shape of the fruit (globoid *vs.* frequently oblongoid in *H. ovata*) and the diameter of the accrescent calyx in the mature fruits (37–55 mm *vs.* 10–25 mm).

Specimens Examined: BRAZIL. Espírito Santo: Santa Teresa, Cabeceira do rio bonito, 31 January 2002, *L. Kollmann 5462* (HUEFS!, MBML!); Santa Teresa, Parque Natural Municipal de São Lourenço, 16 May 2003, *T.A. Cruz 65* (MBML!). COLOMBIA. Guainía, Inírida, 09 May 2007, *D. Cárdenas et al. 20560* (NY [digital image]!). VENEZUELA. Amazonas, 6–19 July, *G.S. Bunting, L.M.A. Akkermans* & *J.V. Rooden 4064* (U [digital image]!); Rio Orinoco opposite mouth of Rio Atabapo, 05 June 1959, *J.J. Wurdack* & *L.S. Adderley 42811* (U [digital image]!, F [digital image]!, US [digital image]!); Rio Orinoco, Yapacana, 17 June 1959, *J.J. Wurdack* & *L.S. Adderley 43017* (US [digital image]!); Reserva Florestal El Sipapo, May 1971,

C. Blanco 1134 (US [digital image]!); San Carlos de Rio Negro, 08 May 1980, *H.L. Clark & P. Maquirino 7990* (L [digital image]!).

In addition to *Heisteria longipedicellata* and *H. maytenoides*, other species of *Heisteria* are registered for the state of Espírito Santo, such as *H. blanchetiana*, *H. perianthomega* and *H. silvianii* Schwacke. During this study, the richness of *Heisteria* for the state was updated, from two (*H. perianthomega* and *H. silvianii*) to five species. *Heisteria blanchetiana* previously registered only to the state of Bahia, mainly in gallery forests in the Cerrado domain (Sleumer 1984; Flora do Brasil 2020), is now expanded to Espírito Santo State. The number of species of *Heisteria* for the Brazilian Atlantic Forest domain has also been increased from five (Flora do Brasil 2020) to seven species. An identification key for *Heisteria* species that occur in the state of Espírito Santo is provided below.

Key to the species of *Heisteria* occurring in Espírito Santo

1. Secondary veins ≥18; floral pedicel 5.5–7 mm long; calyx in fruit slightly lobed..... *H. silvianii*

1. Secondary veins 6–13; floral pedicel 0.5–5 mm long; calyx in fruit deeply lobed.....2

2. Leaves coriaceous, secondary veins flat and inconspicuous on the abaxial surface; drupes globoid..... *H. maytenoides*

2. Leaves chartaceous, secondary veins prominent and conspicuous on the abaxial surface; drupes oblongoid, ovoid or subgloboid.....3

3. Adaxial surface of the leaf blade shiny; floral pedicel 3–5 mm long; calyx in fruit 45–70 mm diam..... *H. blanchetiana*

3. Adaxial surface of the leaf blade dull; floral pedicel 0.5–3 mm long; calyx in fruit 25–40 mm diam.....4

4. Floral pedicel 0.5–1 mm long; pedicel in the fruit 4–7 mm long, calyx in fruit 27–40 mm diam..... *H. perianthomega*

4. Floral pedicel ca. 3 mm long; pedicel in the fruit ca. 67 mm long, calyx in fruits ca. 25 mm diam.....*H. longipedicellata*

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Figures

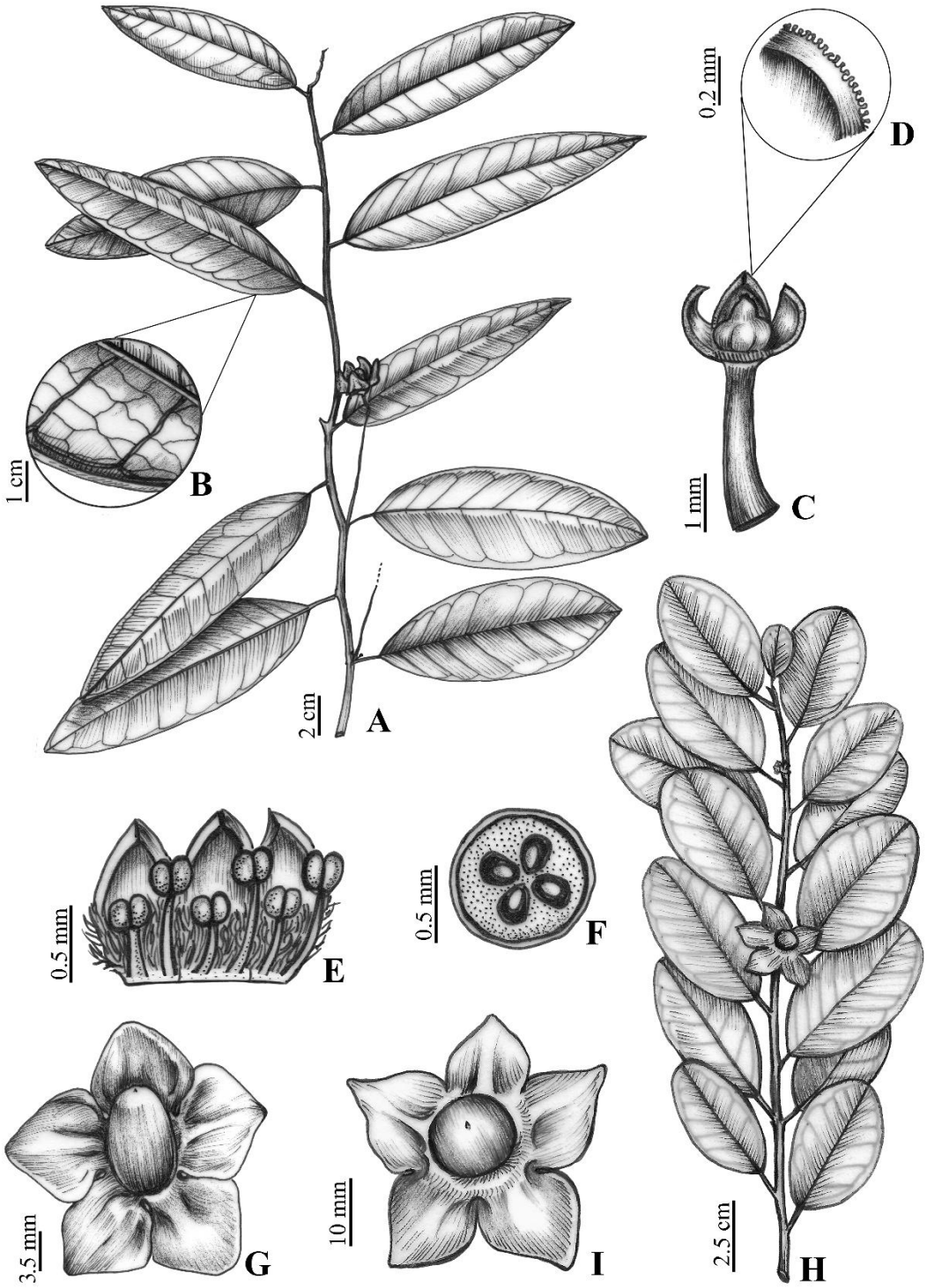

FIG. 1. A–G. *Heisteria longipedicellata* D.S. Lucena & M. Alves. A. Reproductive branch. B. Detail of the secondary and tertiary veins. C. Pedicel, part of calyx and gynoecium. D. Detail of calyx margin. E. Part of corolla and androecium. F. Cross-section of the ovary showing locules and ovules. G. Fruit. (A–G, *G. Hatschbach, M. Hatschbbach & J.M. Silva 71534* (holotype M)). H–I. *Heisteria maytenoides* Spruce ex. Engl. H. Reproductive branch. I. Fruit (*L. Kollmann 5462*). Illustrated by Regina Carvalho.

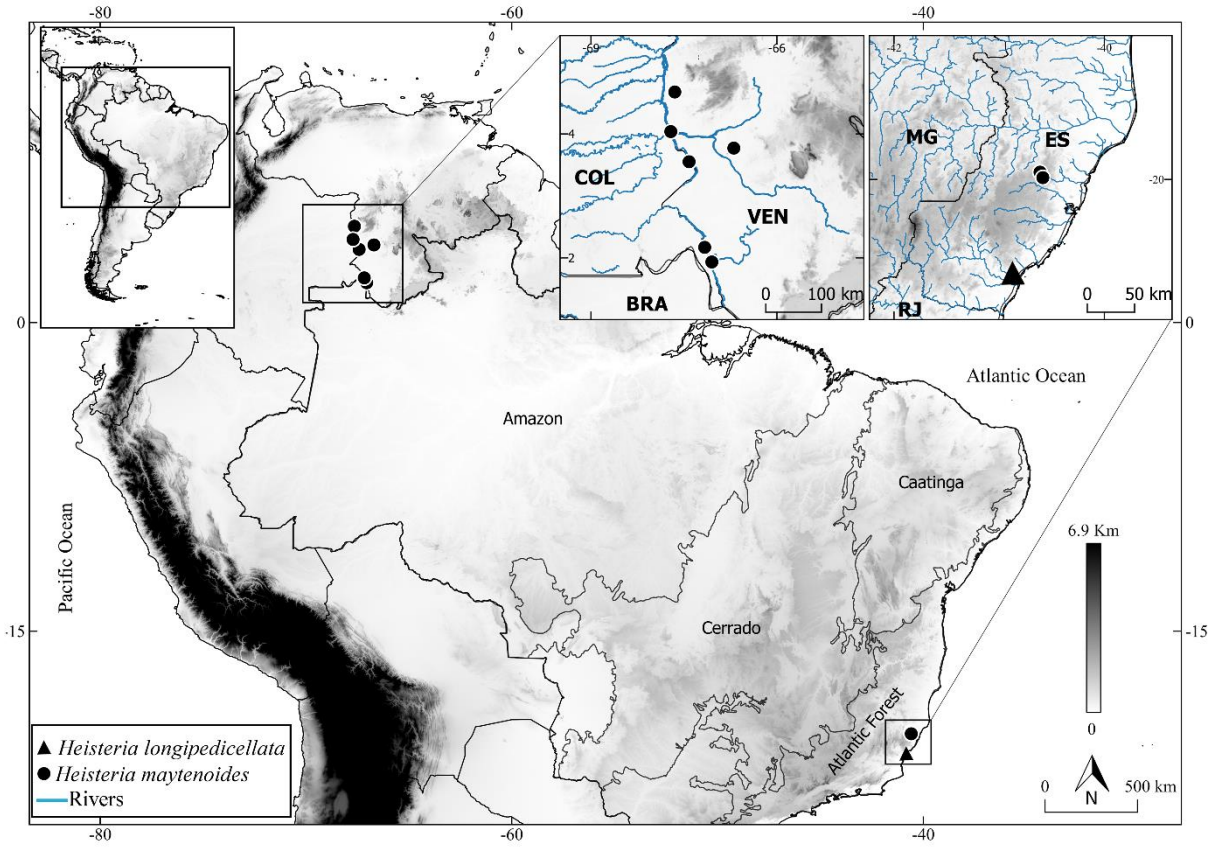

FIG. 2. Geographical distribution of *Heisteria longipedicellata* D.S. Lucena & M. Alves and *Heisteria maytenoides* Spruce ex. Engl. ES (Espírito Santo), MG (Minas Gerais), RJ (Rio de Janeiro).

3.3 ARTIGO 3 – TAXONOMIC STUDIES IN *HEISTERIA* JACQ. (OLACACEAE *S.L.*) FROM EXTRA-AMAZONIAN BRAZIL

Manuscrito a ser submetido - Phytotaxa

Taxonomic studies in *Heisteria* Jacq. (Olacaceae *s.l.*) from extra-Amazonian Brazil

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Abstract

The present study comprises the survey and morphological characterization of *Heisteria* species, which occur in extra-Amazonian Brazil. The taxonomic treatment presented here was produced based on the physical and virtual analysis of specimens deposited in several herbaria, from Brazil and the world, as well as, collected during field expeditions. Seven species were identified for the studied area, among them *H. ovata*, *H. perianthomega* and *H. silvianii* are widely distributed and suggested in the conservation status Least Concern, while *Heisteria blanchetiana*, *H. citrifolia* and *H. maytenoides* have restricted distribution and they are suggested as Endangered and, *H. longipedicellata* is represented by a single specimen, being suggested as Data Deficient. Morphological descriptions, taxonomic comments, habitat information, geographical distribution, phenology, conservation status and occurrence in conservation units are provided for all registered species, in addition to an identification key and diagnostic character illustrations. The synonymization of *H. salicifolia* in *H. perianthomega* is also proposed here.

Key words: conservation status, conservation units, morphology, Santalales, taxonomy

Resumo

O presente estudo compreende o levantamento e caracterização morfológica das espécies de *Heisteria*, que ocorrem no Brasil extra-amazônico. O tratamento taxonômico aqui apresentado foi produzido com base na análise física e virtual de espécimes depositados em diversos herbários, do Brasil e do mundo, bem como, coletados durante expedições de campo. Sete espécies foram identificadas para a área estudada, dentre essas *H. ovata*, *H. perianthomega* e

H. silvianii são amplamente distribuídas e sugeridas no status de conservação de Menor Preocupação, enquanto *Heisteria blanchetiana, H. citrifolia* e *H. maytenoides* apresentam distribuição restrita e são sugeridas como Em Perigo e, *H. longipedicellata* é representada por um único espécime, sendo sugerida como Dados deficientes. Descrições morfológicas, comentários taxonômicos, informações sobre habitat, distribuição geográfica, fenologia, status de conservação e ocorrência em unidades de conservação são fornecidas para todas as espécies registradas, além de uma chave de identificação e ilustrações dos caracteres diagnósticos. A sinonimização de *H. salicifolia* em *H. perianthomega* também é proposta aqui.

Palavras-chave: status de conservação, unidades de conservação, morfologia, Santalales, taxonomia

Introduction

The genus *Heisteria* was described by Jacquin (1760), based on a few characters from the flowers and fruits of *H. coccinea*. In 1763, the same author provided a detailed description of this species, indicating the origin of the analyzed material (Martinique Island - in the Caribbean Sea, department of France) and an illustration. Later one, several species were described in *Heisteria* (Rees 1819, Poeppig 1843, Hooker 1851, Engler 1872, Sleumer 1935, 1984), expanding the circumscription and richness of the genus.

Currently, *Heisteria* is composed by 34 species distributed in the American (31 spp.) and African (3 spp.) continents (Christenhusz *et al.* 2017). Brazil holds the greatest richness, with 20 species occurring in the phytogeographic domains of the Amazon (16 spp.), Caatinga (3 spp.), Cerrado (4 spp.) and Atlantic Forest (4 spp.) (Sleumer 1984, Costa-Lima & Chagas 2020, Ramos 2020).

The species in this genus are trees, shrubs, or lianas, recognized mainly by simple, alternate leaves, canaliculate petiole, inflorescences in axillary fascicles, subtended by two to three bracts, with calyx accrescent in fruits (MacDougal 2003). Morphologically they are similar to *Cathedra* Miers. (Olacaceae *s.l*), especially in the flowering phenophase representatives of these two are often confused in the collections.

The main taxonomic reference for *Heisteria* is the Flora Neotropica, published by Sleumer (1984). However, he recommends the continuity of studies with the group, stressing out that some specimens in flower, or with immature fruits have been provisionally identified, and possibly represent new species not yet described. Several gaps on the geographic distribution, illustrations, morphology, and conservation still remain for these species.

For Brazil, in addition to the Flora Neotropica (Sleumer 1984), information about the morphology of species in *Heisteria* is also available in local floras (Guimarães *et al*. 1971, Cabral & Agra 1999, Ribeiro *et al*. 1999, Rodrigues & Rossi 2002, Assis 2004, Meirelles & Fernandes Junior 2017). They include just a few species of the genus (one to four species). Recently, however, Ramos (2020) provides descriptions, an identification key for 16 species registered to the Amazon, in addition to ecological comments, one synonymization and six lectotypifications.

For the extra Amazonian phytogeographic domains in Brazil, knowledge about the richness and distribution of *Heisteria* still weak and mainly restricted to general floristic inventories (Sampaio *et al*. 2005, Barbosa *et al*. 2006, Rolim *et al*. 2006, Stehmann *et al*. 2009, Matos & Felfili 2010) and local floras (Guimarães *et al*. 1971, Cabral & Agra 1999, Rodrigues & Rossi 2002, Assis 2004) which lack detailed morphology, geographic distribution, conservation status and main nomenclatural issues.

In this context, the main objective of this study is to survey and characterize morphologically the extra-Amazonian species of *Heisteria* Jacq. from Brazil. Morphological

descriptions, illustrations, information about the geographic distribution, Conservation Status and an identification key are provided.

Material and methods

The study area comprises the phytogeographic domains of the Atlantic Forest, Caatinga, Cerrado, Pampas and Pantanal. This work was carried out based on an analysis of specimens deposited at ALCB, *ASE, *ASU, *B, *BM, *BR, *C, CEN, CEPEC, *CESJ, *COAH, CSTR, *CVRD, *E, EAC, EAN, ESA, *F, FLOR, FURB, *G, *GH, *GOET, HB, *HCF, HST, HUEFS, IPA, *INPA, JPB, *K, *L, *LD, *M, MAC, MBML, MBM, *MO, *NY, *P, PEUFR, R, RB, *S, *SAMES, SPSF, SP, SPF, *TCD, *U, UB, UFG, UFRN, UFP, UPCB, *US, *VEM, and VIES, including an analysis of type specimens. The herbaria abbreviation followed the Index Herbariorum (Thiers 2020 [continuously updated]), except HST (Herbário Sérgio Tavares) – Universidade Federal Rural de Pernambuco. For the herbaria marked with asterisks, only images were seen.

Descriptions were elaborated based on morphological analyses only of specimens that occur in the study area. The morphological terminology followed Stearn (1995) and Harris & Harris (2000). Protologues, local floras and taxonomic reviews (Sleumer 1984, Ribeiro *et al*. 1999, Rodrigues & Rossi 2002, Meirelles & Fernandes Junior 2017) were also used. Based on the analyzed specimens an identification key, illustrations, and maps of geographic distribution (using the software QGIS v.2.18.6, QGIS Development Team 2015) were elaborated. For each species additional information is provided on habitat, common names, ecological and morphological notes, phenology, and conservation status. Some data (common names, habitat, phenology) came from labels of herbarium specimens, although for some species these data remain unknown. Up to three specimens in each state were cited in the examined material prioritizing specimens in different phenophases and phytogeographic domains.

Conservation status was proposed for species following the criteria and categories established by the IUCN (2017); the extent of occurrence (EOO) and area of occupancy (AOO) were evaluated by GeoCat software (Bachman *et al.* 2011). It was proposed considering the entire geographic distribution of the species, not only its occurrence in the study area.

Results and discussion

Seven species were identified in this study, distributed in the phytogeographic domains of Caatinga (4 spp.), Cerrado (4 spp) and Altlântica Forest (6 spp.). The states of Bahia and Espírito Santo have greater richness, with four and five species registered, respectively. Among the identified species, *Heisteria ovata* Benth., *H. perianthomega* (Vell.) Sleumer and *H. silvianii* Schwacke are widely distributed in the study area, while *H. blanchetiana* (Engl.) Sleumer, *H. citrifolia* Engl., *H. maytenoides* Spruce ex Engl. and *H. longipedicellata* have a restricted distribution to one or two states. Six of the seven species identified in this study occur in Conservation Units (Table 1).

Five species are endemic to the study area (*H. blanchetiana*, *H. citrifolia*, *H. longipedicellata*, *H. perianthomega* and *H. silvianii*) and have not been treated in the most recent work for the genus carried out in the Brazilian Amazon domain (Ramos 2020).

Taxonomic treatment

Heisteria Jacq., Enum. Syst. Pl. 4, 20 (1760).

Shrubs to trees. Branches glabrous, longitudinally striate. Leaves alternate, glabrous; petiole cylindrical, canaliculate, glabrous; blades with entire to often revolute margin, main midrid flat to slightly impressed on adaxial surface, prominent on abaxial face; brochidodromous venation. Inflorescences in axillary fascicles, sessile. Flowers bisexual, with 2–3 bracts, ca. 1–2 mm long,

triangular; calyx and corolla lobes alternate, 5-merous, gamosepalous, margin papillate; corolla 5-merous, dialipetalous, reflexed, villosous up to the middle portion on adaxial surface; stamens 10, 5 alternipetalous, 5 oppositipetalous, anthers basifixed, rimose; stigma slightly 3–4-lobed, ovary superior, depressed-globose, glabrous. Fruit 1-seed; calyx accrescent, 5-lobed, patent when mature.

In the study area, species of the genus *Cathedra* Miers. they are morphologically similar to *Heisteria*, mainly in the flowering phenophase. Along this research many herbaria samples belonging to *Cathedra* were found mixed to collection of *Heisteria*, therefore, here we provide morphological characters that facilitate the delimitation of these genera. *Cathedra* presents flowers with cupular calyx, hypogynous disk present, enveloping the ovary and anthers poricidal, while in *Heisteria* the flowers have a lobed calyx, hypogynous disk absent e anthers rimose. The fruits in *Cathedra* have epicalyx, calyx and hypogynous disk accrescent, the latter covering part or all of the fruit, while in *Heisteria* epicalyx and hypogynous disk are absent, and the calyx accrescent is patent to the fruits.

Key to Brazilian extra-Amazonian species of *Heisteria*

1. Secondary veins ≥18; floral pedicel 5.5–7 mm long..... *H. silvianii*

-. Secondary veins 6–13; floral pedicel 0.5–5 mm long.....2

2. Secondary veins flat and inconspicuous on the abaxial surface; drupe globoid…….… *H. maytenoides*

-. Secondary veins prominent on the abaxial surface; drupe ellipsoid, oblongoid, ovoid or subgloboid……...……3

3. Adaxial surface of the leaf blade shiny; floral pedicel 3–5 mm long; calyx in the fruit 45–70 mm diam..... *H. blanchetiana*

-. Adaxial surface of the leaf blade opaque; floral pedicel 0.5–3 mm long; calyx in the fruit 10–40 mm diam.....4

4. Branches with lenticels; calyx in the fruits slightly lobed, 10–20 mm diam……...……...……..*H. ovata*

-. Branches without lenticels; calyx in the fruits deeply lobed, 25–40 mm diam…….……5

5. Leaves coriaceous…..…….……*H. citrifolia*

-. Leaves chartaceous…….6

6. Floral pedicel 0.5–1.5 mm long; pedicel in the fruit 4–8 mm long, calyx in the fruit 27–40 mm diam..... *H. perianthomega*

-. Floral pedicel ca. 3 mm long; pedicel in the fruit > 50 mm long, calyx in the fruits ca. 25 mm diam.....*H. longipedicellata*

1. *Heisteria blanchetiana* (Engl.) Sleumer, Fl. Neotrop. Monogr. 38: 80 (1984). [Figs. 1A–E]. Basionym: *Heisteria brasiliensis* var. *blanchetiana* Engl. Fl. Bras. (Martius) 12 (2): 19 (1872). Type: — BRAZIL. Bahia, Jacobina, 1857, fr., *Blanchet 3581* (holotype: G [not seen]; isotypes: BM BM000617117 [digital image!], BR BR528119 [digital image!], C C10016058 [digital image!], F F876529, F940187 [digital image!], GH GH00035952 [digital image!], K K000580561 [digital image!], L L0038994 [digital image!], LE LE00001634 [digital image!], P P02441933, P02441934 [digital image!]).

Shrubs to trees, 4–20 m tall.. Branches with lenticels spaced, absent in young branches. Leaves chartaceous; petiole 6–14 mm long, fissured; blades 8–15 × 2.3–5.5 cm, elliptic, oblong to oval, base cuneate, rarely rounded, apex acute to acuminate, or rarely rounded, often shiny on adaxial surface, secondary veins 6–9, flat, inconspicuous on adaxial surface, prominent on abaxial surface. Inflorescences with 14–21 flowers. Floral pedicel 3–5 mm long; calyx connate up to 0.2–0.3 mm long, lobes 0.8 mm long, triangular, apex acute; petals 2.5–3 × 1 mm, elliptic, apex acute; anthers 0.2 mm long, filaments 1.5–2 mm long; gynoecium 1.2 mm long, ovary 3–4-locular, 3–4-ovulate. Drupe white, 11–14 × 8–11 mm, ellipsoid, ovoid to oblongoid, longitudinally striate, apex apiculate; calyx in fruits deeply lobed, 45–70 mm diam., connate at base up to 5–12 mm, lobes 19 × 20 mm, triangular, apex acute, pedicel 7–12 mm long.

Distribution and Habitat: — Endemic to Brazil, occurring in the states of Bahia and Espírito Santo (Figure 2). It is registered in the Atlantic Forest domains phytogeographic, as well as in transition areas between the Caatinga and Cerrado in Chapada Diamantina, central portion of the state of Bahia, where it is collected mainly in riparian forest environments, with sandy soils and rocky outcrops. In the Atlantic Forest domain, it is registered in areas of Dense Ombrophilous Forest, in the South of Bahia and Espírito Santo. Distributed at altitudes ranging from 400 to 1300m.

Conservation Status: — According to IUCN (2017) criteria the species could be suggested as Endangered (EN) [B2ab (ii, iii)]. With area of occupancy less 500 km^2, *H. blanchetiana* (Engl.) Sleumer occurs in environments historically threatened by anthropic action, with burning, removal of plants for trade, use of the soil for pasture (Harley 1995) and cultivation of sugar cane (Ribeiro et al. 2009). Few individuals are known in Conservation Units (Table 1).

Notes: — *Heisteria blanchetiana* is morphologically similar to *H. longipedicellata* by the length of the pedicel in the flowers. It differs mainly having a shiny adaxial surface of the leaf blade (*vs.* opaque in *H. longipedicellata*), petals elliptic (*vs.* ovate), diameter of the accrescent

calyx in the fruits (45–70 *vs.* ca. 25 mm), and length of the pedicel in fruits (7–12 *vs.* ca. 67 mm).

Phenology: — Registered with flowers in January, September and October, with fruits between January and July and in the months of November and December.

Selected materials examined: — BRAZIL. Bahia: Lençóis, caminho para Barro Branco, 02 march 1980, fl., *S. Mori & R. Funch 13352* (CEPEC); Rio de Contas, 28 November 2020, fr., *M.J.S. Lemos et al. 137* (BHCB, HUEFS, UPCB); Una, Reserva Biológica de Una, 23 January 2006, fl., *J.L. Paixão et al. 659* (CEPEC). Espírito Santo: Santa Maria de Jetibá, 19 November 2002, fr., *L. Kollmann et al. 5759* (MBML); Santa Teresa, Reserva Biológica Augusto Ruschi, 02 September 2003, fl., *J. Rossini et al. 516* (MBML); *ibid.*, 24 October 2002, fl., *R.R. Vervloet et al. 1277* (MBML).

2. *Heisteria citrifolia* Engl., Fl. Bras. (Martius) 12(2): 18 (1872). [Figs. 1F–I]. Type: — BRAZIL. Minas Gerais, Rio Fanado, s.d., fl., *Pohl s.n.* (holotype: W W0071209 [digital image!]; isotypes: M M19084 [digital image!]).

Shrubs, 1–4 m tall.. Branches without lenticels. Leaves coriaceous; petiole 3–6 mm long, fissured; blades 6.5–11 × 3.5–5.5 cm, oval, rarely elliptic, base rounded, rarely cuneate, apex acute, opaque adaxial surface, secondary veins 9–12, impressed on adaxial surface, rarely flat, prominent on abaxial surface. Inflorescences with 10–15 flowers. Floral pedicel 1–1.5 mm long; calyx connate up to 0.2 mm long, lobes 0.8 mm long, narrowly triangular, apex acute; petals 1.8–2 × 1 mm, elliptic, apex acute, anthers 0.2 mm long, filaments 1–1.5 mm long; gynoecium 1 mm long, ovary 3-locular, 3-ovulate. Drupe white, 9–11 × 6–8 mm, oblongoid, longitudinally striate, apex apiculate; calyx in fruits deeply lobed, 25–35 mm diam., connate at base up to 5–7 mm, lobes 9 × 13 mm, triangular, apex acute, pedicel 5–8 mm long.

Distribution and Habitat: — Endemic to Brazil, being registered so far only for the state of Minas Gerais (Figure 2). Occurs in the phytogeographic domain of the Cerrado in areas of Campos Rupestres, as well as in transition environments between Caatinga and Cerrado, and between Atlantic Forest and Cerrado, in habitats with deeper and often flooded soils. Distributed at altitudes ranging from 700 to 900m.

In the collections, many specimens of *H. ovata* Benth. are identified as *H. citrifolia*, therefore, some databases (Flora do Brasil 2020, Splink 2020, Gbif 2020) show that this species has records for Bahia, Distrito Federal Mato Grosso, and Minas Gerais. In this study, we updated the distribution of *H. citrifolia*, which is endemic to the state of Minas Gerais.

Conservation Status: — *Heisteria citrifolia* Engl. has area of occupancy less 500 km^2 is distributed in a few locations and has no record in Conservation Units. According with criteria and categories of the IUCN (2017) this species is suggested as Endangered (EN) [B2ab (ii, iii)].

The expansion of agricultural and livestock activities, as well as mineral exploration, historically present in the state of Minas Gerais, constitute threats to the conservation of species (Maurenza et al. 2015), mainly those that present restricted distribution without registration in Conservation Units, such as *H. citrifolia* for example.

Notes: — *Heisteria ovata* Benth. is morphologically variable and one of morphotypes found with leaf blade ovate resembles *H. citrifolia* but differs by the presence of lenticels in the branches (*vs.* absent in *H. citrifolia*), leaf blade chartaceous (*vs.* coriaceous), pedicel length in flowers (2–3 *vs.* 1–1.5 mm), calyx accrescent in fruits slightly lobed (*vs.* deeply lobed), diameter of calyx in the fruits (10–20 *vs.* 25–35 mm).

In addition to the morphological characters already mentioned, the presence of galls on the branches and leaves of *H. ovata* is commonly observed in the specimens deposited in the collections, while in *H. citrifolia* they were not identified.

Phenology: — Registered with flowers in July, August, September and November, with fruits in Mach, November and December.

Materials examined: — BRAZIL. Minas Gerais: Coronel Murta, Serra da Lagoa Nova, Mach 1997, fr., *E. Tameirão Neto 2480* (BHCB, ESA); Grão-Mogol, Bacia do Córrego da morte, 04 November 1987, fl., *M.C. Assis et al. 11527* (BHCB, MBM, UB); *ibid.*, 21 July 1985, fl., *G. Martinelli et al. 11231* (BHCB, RB).

3. *Heisteria longipedicellata* D.S. Lucena & M. Alves, Acta Bot. Bras. Accept. [Figs. 1J–K]. Type: — BRAZIL. Espírito Santo, Itapemirim, região do Gomes, 23 October 2000, fl. and fr., *G. Hatschbach et al. 71534* (holotype: M M0244279!).

Trees, 2–5 m tall.. Branches without lenticels. Leaves chartaceous; petiole 6–15 mm long, slightly fissured; blades 12–16 × 3.5–5.5 cm, oblong to lanceolate, base rounded to cuneate, apex acute to acuminate, opaque adaxial surface, secundary veins 8–12, flat on adaxial surface, prominent on abaxial surface. Inflorescences with 12–15 flowers. Floral pedicel ca. 3 mm long; calyx connate up to 0.2 mm long, lobes 1 mm long, triangular, apex acuminate; petals ca. 1.2 × 0.4 mm, ovate, apex acute, anthers 0.2 mm long, filaments 0.3–0.7 mm long; gynoecium 1 mm long, ovary 4-locular, 4-ovulate. Drupe unknown color, 7–11 × 5–7 mm, oblongoid, longitudinally striate, apex apiculate; calyx in fruits deeply lobed, ca. 25 mm diam., connate at base up to 4–5 mm, lobes 9 × 11 mm, triangular, apex rounded to acute, pedicel ca. 67 mm long.

Distribution and Habitat: — The species is endemic to Brazil and known only from the type locality called Gomes (municipality of Itapemirim, Espírito Santo state) (Figure 2). The information available on the specimen label indicates that the type locality is a fragment of Restinga forest, located between Lagoa do Guanandy, also called Lagoa do Gomes or Lagoa

das Sete Pontas and Praia da Marinha. This area is composed of a mosaic of vegetation types, including forest formations fragmented, herbaceous and shrubby areas (Leite 2010).

Conservation Status: — *Heisteria longipedicellata* is suggested here as Deficient Data (DD), due to the absence of data to calculate the Extent of Occurrence (EOO) and Area of Occupation (AOO) (IUCN 2017). Despite being inserted in a Conservation Unit for sustainable use (Table 1), the area where this species was collected, is under strong anthropic pressure mainly with sand extraction, selective cutting of wood and fires (Leite 2010; Valadares & Sakuragui 2016).

Notes: — Morphologically, *Heisteria longipedicellata* can be confused with *H. blanchetiana.* Similarities and morphological differences between both are commented on in the description of *H. blanchetiana*. Its shape and size of leaves and fruits are also similar to *H. perianthomega* but differs mainly by longer pedicel in the flowers (ca. 3 *vs.* 0.5–1.5 mm in *H. perianthomega*), smaller diameter of the calyx in fruits (ca. 25 *vs.* 27–40 mm) and much longer pedicel size on fruits (ca. 67 *vs.* 4–8 mm).

Phenology : — It was collected with flowers and fruits in October.

4. *Heisteria maytenoides* Spruce ex Engl., Fl. Bras. (Martius) 12 (2): 15 (1872). [Figs. 3A–B]. Type: — VENEZUELA/COLOMBIA. Guainia vel Rio Negro supra ostium fluminis Casiquiari, 1854, *R. Spruce 3508* (Holotype: BR BR528997 [digital image!]; Isotypes: BM BM000839920 [digital image!], K K000584506 [digital image!], MO MO1624771 [digital image!], NY NY00285475 [digital image!], P P02441921 [digital image!], TCD TCD0004101 [digital image!]).

Trees, 3–15 m tall.. Branches without lenticels. Leaves coriaceous; petiole 5–11 mm long, fissured; blades 5.5–8.5 × 3–4.1 cm, oblong to elliptic, base cuneate, apex acute, opaque adaxial

surface, secondary veins 7–10, flat, inconspicuous on the adaxial and abaxial surfaces. Inflorescences with 7–10 flowers. Floral pedicel 1–1.5 mm long; calyx connate up to 0.2 mm long, lobes 1.5 mm long, triangular, apex acute; petals ca. 1.8 × 1 mm, lanceolate, apex acute, anthers 0.5 mm long, filaments ca. 0.5– 0.9 mm long; gynoecium 1 mm long, ovary 4-locular, 4-ovulate. Drupe unknown color, 12 × 13 mm, globoid, longitudinally striate, apex apiculate; calyx in fruits deeply lobed, 37–55 mm diam., connate at base up to 7–9 mm, lobos 11 × 11–15 mm, triangular, apex acute to rounded, pedicel 15 mm long.

Distribution and Habitat:— Occurs in Brazil, Colombia, and Venezuela. In Brazil, is registered only to the Atlantic Forest domain, in the state of Espírito Santo, in Dense Ombrophylous Forest, with altitudes ranging from 700 to 950 meters (Figure 2). The specimens were collected in basin of Rio Bonito, an area cut by numerous streams that flow into Rio São Lourenço. Ramos (2020) listed *H. maytenoides* Spruce ex Engl to the Brazilian Amazon domain. However the specimens cited (JA Silva 207 and EG Holt & ER Blake 576) correspond to *H. amazonica* Sleumer and *H. duckei* Sleumer, respectively. So far, there are no records to confirm the occurrence of this species in the Brazilian Amazon.

The disjunct distribution observed for *H. maytenoides* is a pattern already reported for several botanical families and for other genera of Olacaceae (Prance 1982; Fiaschi & Pirani 2009; Turchetto-Zolet *et al.* 2012).

Conservation Status: — According to the criteria established by IUCN (2017), *H. maytenoides* Spruce ex Engl. is recommended Endangered (EN) [B2b (ii, iv)]. This species has an reduced number of mature individuals, occurring few localities and with occupation area of less than 500 km^2. In the study area, only one specimen is registered in Conservation Units (Table 1).

Notes: — *Heisteria maytenoides* is similar to *H. citrifolia* mainly because of the consistency of the leaf blade, size of the pedicel in the flowers, and the calyx in the deeply lobed fruits. They are differentiated by oblong to elliptic leaf blade (*vs.* oval in *H. citrifolia*), inconspicuous secondary veins on the abaxial surface (*vs.* prominent), lanceolate petals (*vs.* elliptical), fruit globoid (oblongoid), calyx diameter accrescent in the fruits (37–55 *vs.* 25–35 mm) and pedicel length on fruits (15 *vs.* 5–7 mm long).

Phenology: — It was collected with flowers and fruits in January, and only with fruits in May.

Materials selected examined: — BRAZIL. Espírito Santo, Santa Teresa, Cabeceira do Rio Bonito, 31 January 2002, fl. and fr., *L. Kollmann 5462* (HUEFS, MBML); *ibid.*, Parque Natural Municipal de São Lourenço, 16 May 2003, fr., *T.A. Cruz 65* (MBML).

5. *Heisteria ovata* Benth., Hooker's J. Bot. Kew Gard. Misc. 3: 366 (1851). [Figs. 3C–E]. Type: — BRAZIL. Piauí, Serra da Batalha, Rio Preto, September 1839, *Gardner 2787* (Holotype: K K000580566 [digital image!]; Isotypes: B B100248589 [digital image!], BM BM000839919 [digital image!], E E00313891 [digital image!], K K000580565 [digital image!], L L0039021 fragment [digital image!], LIL LIL002172 fragment [digital image!]).

Shrubs to trees, 3–18 m tall.. Branches with lenticels. Leaves chartaceous; petiole 6–10 mm long, fissured; blades 7.3–16 × 2–7.5 cm, elliptic, oblong, ovate, base rounded or cuneate, apex acute to acuminate, opaque adaxial surface, secondary veins 7–13, flat on adaxial surface, prominent on abaxial surface. Inflorescences with 12–15 flowers. Floral pedicel 2–3 mm long; calyx connate up to 0.5 mm long, lobes 0.5 mm long, triangular, apex acute; petals 2.5–3 × 1 mm, elliptic, apex acute to acuminate, anthers 0.3 mm long, filaments 1.5–2 mm long; gynoecium 1.5 mm long, ovary 2–3-locular, 2–3-ovulate. Drupe green, 8–10 × 5–7 mm, oblongoid, rarely subgloboid, longitudinally striated, apex apiculate; calyx in fruits slightly

lobed, 10–15(–20) mm diam., connate at base up to 3.2 mm, lobes 2 × 4.2–7 mm, triangular, apex rounded to acute, pedicel 5–15 mm long.

Distribution and Habitat: — It occurs in Brazil, Bolivia, Colombia, French Guiana, Guyana, Peru, Suriname and Venezuela (Sleumer 1984, MacDougal 2003, Ramos 2020). In Brazil it is registered in the phytogeographic domains of the Amazon, Caatinga, Cerrado and Atlantic Forest. Occurring in the states of Acre, Amapá, Amazonas, Bahia, Ceará, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Piauí, Rondônia, Roraima and Tocantins. In the study area it is common in the Cerrado formations and in transition areas between Cerrado and Caatinga, occurring mainly in areas with sandy, reddish and, with the presence of rocky outcrops, as well as, in the gallery forests, some specimens are also recorded in Restinga areas in the states of Bahia and Ceará (Figure 4). Distributed at altitudes ranging from 40 to 1170m.

Conservation Status and Occurence in Conservation Units: — This species is widely distributed in South America, occurring in several Conservation Units (Table 1), being here recommended as Least Concern (LC), according to IUCN (2017).

Notes: — *Heisteria ovata* is morphologically similar to *H. citrifolia*, useful morphological characters for the delimitation of these species are commented under the later one.

Phenology: — Known with flowers between the months of February and August, with fruits in Mach and between the months of July and November.

Materials selected examined: — BRAZIL. Bahia, Correntina, 27 August 1989, fr., *M. Pereira Neto et al. 384* (IBGE); Cristópolis, 13 July 1979, fl., *G. Hatchbach et al. 42316* (UB); Formosa do Rio Preto, 28 March 2000, fl., *R.M. Harley et al. 53777* (HUEFS). Ceará, Aquiráz, Serrote da Preaoca, 26 April 2002, fl., *A.S.F. Castro s.n* (EAC 28354); Crateús, Serra das Almas, 19 August 2003, fr., *R.C. Costa 285* (EAC); Ubajara, Parque Nacional de Ubajara, 23.IX.1978, fr.,

A. Fernandes s.n (EAC 5025). Distrito Federal, Brasília, Reserva Biológica de Águas Emendadas, 10 September 1982, fr., *Amaury 200* (CEN); *ibid.*, Parque Municipal do Gama, 24 July 1965, fl., *R. Martin 445* (UB); *ibid.*, Reserva Biológica de Contagem, 18 August 2011, fr., *M.R.V. Zanata et al. 652* (UB). Goiás, Cristalina, Reserva Particular do Patrimônio Natural Linda Serra dos Topázios, 18 June 1996, fl., *C. Proença et al. 1439* (IBGE, MBM, UB), Minaçu, Fazenda Santa Isabel, 23 June 1995, fl., *B.M.T. Walter et al. 2423* (CEN); Niquelandia, Porção Sul da Serra Negra, 08 July 1997, fl., *B.M.T. Walter et al. 3778* (CEN). Maranhão, Carolina, Parque Nacional da Chapada das Mesas, 19 October 2015, fr., *A.C. Sevilha et al. 5359* (CEN); Lôreto, Ilha das Balsas, 01 June 1962, fl., *G. Eiten & L.T. Eiten 4816* (SP); São Domingos do Maranhão, Fazenda Viola, 17 July 1975, fl., *D.P Lima 13383* (IBGE). Mato Grosso, Cuiabá, 03 October 1993, fr., *M. Macedo et al. 3149* (UB); Nobres, Serra da Caixa Furada, 19 May 1997, fl., *V.C. Souza et al. 16465* (ESA); Nova Mutum, 29 July 2011, fr., *A. Francener 1104* (UFG). Mato Grosso do Sul, Rio Negro, 27 August 1998, fr., *G.A. Damasceno et al. 1247* (MBM). Minas Gerais, Arinos, RPPN Arara Vermelha, 26 May 2004, fl., *M.L. Fonseca et al. 5430* (IBGE, SPF); Januária, Vale do Peruaçu, 24 October 1997, fr., *A. Salino & L.C.N. Melo 3620* (BHCB); Perdizes, 24 June 1994, fl., *E. Tameirão-Neto 1639* (BHCB, MBM). Piauí, Barreiras do Piauí, Fazenda Fortaleza, 23 August 1996, fr., *A. Fernandes s.n* (EAC 24235); Caracol, 17 July 2011, fr., *E. Melo et al. 10125* (HUEFS); Piracuruca, Parque Nacional Sete Cidades, 22 August 2006, fr., *C.B.R. Munhoz et al. 3143* (CEN, RB). Tocantins, Almas, Bacia do Rio Tocantins, 10 October 2008, fr., *R.C. Mendonça et al. 6274* (IBGE, SPF); Gurupi, 06 July 2007, fl., *R.F. Haidar et al. 678* (CEN); Lagoa da Confusão, Parque Nacional do Araguaia, 20 March 1999, fl., *R.C. Mendonça et al. 3931* (IBGE).

6. *Heisteria perianthomega* (Vell.) Sleumer, Fl. Neotrop. Monogr. 38: 76–77. 1984. [Figs. 3F–H].

Basionym: *Hesioda perianthomega* Vell., Fl. Flumin. 185 (1829). Type: — BRAZIL. Rio de Janeiro, s.d, *Vellozo s.n* (Holotype: T. 140. in Fl. Flum. Vol. 4. 1827).

Heisteria salicifolia Engl., Fl. Bras. (Martius) 12(2): 20 (1872). Type: — BRAZIL. Santa Catarina : Ile de Ste. Cathérine, 1835, *Gaudichaud 848* (Holotype: B B100248576 [digital image!]; Isotypes: F F936317 fragment [digital image!], L L0039028 fragment [digital image!], P P02441901, P02441902, P02441903 [digital image!]) ***Syn. Nov.***

Shrubs to trees, 8–22 m tall.. Branches without lenticels. Leaves chartaceous; petiole 5–11(–23) mm long, fissured; blades 6.5–18(–21) × 2.5–9 cm, elliptic to oblong, base obtuse to rounded, apex acuminate, occasionally subfalcate, opaque adaxial surface, secondary veins 7–13, flat on adaxial surface, prominent on abaxial surface. Inflorescences with 7–9 flowers. Floral pedicel 0.5–1.5 mm long; calyx connate up to 0.3 mm long, lobes 1.8 mm long, triangular to lanceolate, apex acute to acuminate; petals 2 × 0.7–1 mm, elliptic, apex acute, anthers 0.2 mm long, filaments 0.8–1.2 mm long; gynoecium 1 mm long, ovary 3–4-locular, 3–4-ovulate. Drupe green to white, 7–11 × 5.5–9 mm, ovoid to oblongoid, longitudinally striated, apex apiculate; calyx in fruits deeply lobed, 27–40 mm diam., connate at base up to 4–11 mm, lobes 11–15 × 11–14 mm, triangular, apex rounded to acute, pedicel 4–8 mm long.

Distribution and Habitat: — Endemic to Brazil, occurring in the states of Alagoas, Bahia, Espírito Santo, Minas Gerais, Paraíba, Pernambuco, Rio de Janeiro, Santa Catarina and Sergipe. Registered for the Caatinga and Atlantic Forest domains, in the latter, occurs in areas of ombrophilous, montane, submontane and lowland forests in Restinga, as well as in hygrophilous forest, commonly registered in areas with Sandy clay soils (Figure 4). This species occurs forest fragments, at altitudes ranging from 30 to 1350 meters.

The flora do Brasil (2020) mentions *H. perianthomega* for the phytogeographic domain of the Amazon, however, there are no records that confirm the occurrence of this species in the respective domain (Ramos 2020).

Conservation Status: — Following the IUCN (2017) criteria and categories, *Heisteria perianthomega* is suggested as Least Concern (LC). This species has a wide range of occurrence, is distributed in eight Brazilian states and registered in at least one conservation unit in each of these states.

Notes: — *Heisteria perianthomega* is morphologically similar to *H. longipedicellata*, useful morphological characters for the delimitation of these species are commented on in the description of the later one.

We propose here the synonymization of *Heisteria salicifolia* Engl.. This name was described by Engler (1872) in *Flora brasiliensis*, based on specimens collected on the Island of Santa Catarina (Ile de Sainte Cathérine) by Gaudichaud (848) who provided a detailed description of leaves and fruits. Sleumer (1984) accepted it but did not add new morphological information and, highlighted that no new collection were found since then. Analyzing the protologue of *H. salicifolia* it was possible to verify that all the morphological characters mentioned for this species are also registered for *H. perianthomega*, being considered here a new synonym for *H. perianthomega.*

Phenology: — Registered with flowers and fruits throughout the year.

Materials selected examined: — BRAZIL. Alagoas, Flexeiras, Fazenda São João, 16 August 1968, fl., *M.T. Monteiro 22704* (IPA); Murici, Estação Ecológica de Murici, 20 November 2012, fr., *M.C.S. Mota & E.C.O. Chagas 11791* (MAC); Quebrangulo, Reserva Biológica de Pedra Talhada, 09 December 1994, fr., *A.C. Cervi et al. 7280* (NY). Bahia, Porto Seguro, Reserva Biológica do Pau-Brasil, 11 December 1971, fr., *A. Eupucino 69* (CEPEC); Rio de Contas, Serra das Almas, December 2008, fl., *F.H.F. Nascimento 546* (HUEFS); Salvador, Ilha

dos Frades, 21 August 2014, fr., *A.M. Miranda 6272* (HST). Espírito Santo, Águia Branca, 03 October 2007, fl., *H.Q.B. Fernandes et al. 3441* (MBML); Guarapari, Parque Estadual Paulo César Vinha, 25 November 1999, fr., *A.M. Assis 749* (VIES); Linhares, Floresta Nacional de Goytacazes, 24 October 2010, fr., *J.M.L. Gomes 3850* (VIES). Minas Gerais, Frei Inocêncio, 12 December 2001, fr., *R.C. Mota 1328* (BHCB). Paraíba, Areia, 9 December 2011, fr., *E. Melo et al. 10767* (HUEFS). Pernambuco, Goiana, Reserva Particular do Patrimônio Natural. Fazenda Tabatinga, 14 October 2011, fr., *D. Cavalcant1 et al. 619* (UFP); Jaqueira, Reserva Particular do Patrimônio Natural Frei Caneca, Mata do Ageró, 20 September 2011, fl., *B.S. Amorim 1079* (JPB, UFP); São Vicente Férrer, Mata do Estado, 2 July 2017, fr., *D.S. Lucena et al. 835* (UFP). Rio de Janeiro, Cabo Frio, 22 October 2013, fr., *H.F. Uller & G. Terra 496* (HUEFS, MBM); Rio das Ostras, Reserva Biológica União, 17 November 1997, fl., *P.P. Oliveira 379* (BHCB); Silva Jardim, Reserva Biológica Poço das Antas, 24 November 1992, fr., *H.C. Lima 4431* (BHCB, UB). Santa Catarina, 1835, fr., *Gaudichaud 848* (B, F, L, P). Sergipe, Santa Luzia do Itanhy, Reserva Particular do Patrimônio Natural Mata do Castro, 11 October 2011, fl. and fr., *R.M. Deda & E. Santos 75* (SPF).

7. *Heisteria silvianii* Schwacke, Pl. Nov. Mineir. 2: 3 (1900). Type: — BRAZIL. Minas Gerais, Rio Novo, s.d., *W. Schwacke 8921* (Holotype: RB RB00542425!; Isotype: B B100248574[digital image!]).

Shrubs to trees, 1.5–28 m tall.. Branches without lenticels. Leaves chartaceous; petiole 6–10 mm long., fissured; blades 6–11.5 × 2.5–4 cm, elliptic, base cuneate, apex acute, rarely acuminate to long acuminate, opaque adaxial surface, secondary veins ≥ 18, flat to slightly prominent on adaxial surface, prominent on abaxial surface. Inflorescences with 08–22 flowers. Floral pedicel 5.5–7 mm long; calyx connate up to 0.5 mm long, lobes 1 mm long, triangular,

apex acute; petals 3 × 0.6 mm, free, ovate, apex acute, anthers 0.3 mm long, filaments 1–1.8 mm long; gynoecium 1.2 mm long, ovary 2–4-locular, 2–4-ovulate. Drupe white to yellowish, 11–15 × 9–15 mm, oblongoid, rarely subgloboid, longitudinally striated, apex apiculate; calyx in fruits slightly lobed, 27–40 mm diam., conate at base up to ca. 5 mm, lobes 7–10 × 8–9 mm, triangular, apex acute, pedicel 7–22 mm long.

Common Names: — Brinco de Mulata, Canela, Casco de Tatu, Gumbijava Brava

Distribution and Habitat: — It is endemic to Brazil, registered in the phytogeographic domains of the Cerrado and Atlantic Forest, in the latter occurs in areas of dense montane rainforest and lowland rainforest, as well as in restinga environments (Figure 4). Distributed at altitudes ranging from 100 to 1000 meters.

Conservation Status: — Following IUCN (2017) criteria and categories *Heisteria silvianii* is suggested here as Least Concern (LC). Despite having an occupancy area of less than 500 km^2, this species has a wide range of occurrence and is registered in some conservation units (Table 1)

Notes: — *Heisteria silvianii* differs from other species in the study area by the number of secondary veins (≥ 18), size of the pedicel in the flowers (5.5–7 mm long), calyx accrescent in the fruits slightly lobed and with a diameter of 27–40 mm. The observation of these characters makes it possible to recognize this species.

Phenology : — Registered with flowers between the months of September and November, with fruits between the months of December and April.

Materials selected examined: BRAZIL. Bahia, Camacan, Reserva Particular do Patrimônio Natural serra bonita, 05 March 2008, fr., *A.M. Amorim 7203* (SPF); Arataca, Serra Peito de Moça, 19 January 2006, fr., *W.W. Thomas et al. 14582* (HUEFS). Espírito Santo, Conceição do Castelo, 06 November 1986, fl., *G. Hatschbach 50712* (MBM); Santa Teresa, 27 January 1999,

fr., *L. Kollmann et al*. *1707* (HUEFS, MBML); *Ibid.*, São Lourenço, 27 November 1998, fl., *L. Kollmann et al*. *801* (MBML). Minas Gerais, Caeté, 13 April 2013, fr., *C.V. Vidal 1215* (BHCB); Faria Lemos, Fazenda Santa Rita, 06 October 2008, fl., *L.S. Leoni & J.H.D. Pacheco 7263* (RB); Pico do Itambé, 02 February 1972, fr., *W.R. Anderson et al. 35702* (HB). Paraná, Antonina, Reserva Biológica de Sapitandur, 03 October 1986, fl., *A.C. Cervi 2379* (UPCB); Guaraqueçaba, 27 November 2001, fr., *G. Hatschbach et al. 72721* (ALCB, HUEFS, MBM); Morretes, Serra da Prata, 29 September 1999, fl., *J.M. Silva et al. 3065* (UB). Rio de Janeiro, Magé, Centro de Primatologia, 19 November 1986, fr., *A.M.S.F. Vaz 434* (HRB); Nova Iguaçu, 11 December 2001, fr., *S.J. Silva Neto et al. 1567* (RB); Paraty, Fazenda São Roque, 13 December 1988, fr., *M. Nadruz et al. 453* (RB). Rio Grande do Sul, Morrinhos do Sul, December 1995, fr., *M. Sobral & J.A. Jarenkow 8024* (HUEFS); Torres, 28 November 1991 fr., *J.A. Jarenkow 1987* (FLOR). Santa Catarina, Ibirama, 20 October 1953, fl., *R.Klein 598* (HB, UPCB); Palhoça, Morro da Cambirela, 20 October 1971, fl., *R.M. Klein & A. Bresolin 9848* (FLOR, MBM); Treviso, Nova Brasília, 30 January 2010, fr., *M. Verdi et al. 3498* (RB). São Paulo, Mairiporã, Parque Estadual da Cantareira, Núcleo Águas Claras, 07 December 2000, fr., *F.A.R.D.P. Arzolla 199* (UB); São Miguel Arcanjo, Parque Estadual de Carlos Botelho, 06-08 September 1994, fl., *P.L.R. Moraes 1055* (ESA); São Paulo, Parque Estadual do Jaraguá, 30 January 2008, fr., *F.M. Souza 1043* (BHCB); Ubatuba, Praia de puruba, 05 September 1996, fr., *V.C. Souza et al*. *12241* (ESA).

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List of examined material:

Alencar ME. 732 (5). **Allemão F.** 163 (5), 164 (5), 962 (5). **Almeida J.** 141 (6). **Almeida LZ.** s.n. (EAC 2027) (5). **Almeida VC.** 43 (7). **Alvarenga D.** 861 (5), 1075 (5), 1008 (5). **Alves LJ.** 312 (6). **Amaury** 200 (5). **Amorim AM.** 7203 (7). **Amorim AMA.** 1474 (6). **Amorim BS.** 1079 (6). **Andrade-Lima D.** 49-393 (6), 54-1903 (6), 74-7945 (5). **Anderson WR.** 35702 (7), 36487 (5), 36768 (5). **Anjos BA.** 52 (5). **Araujo D.** 139 (6). **Araújo FS.** 1274 (5). **Araújo G.** 175 (5). **Árbocz G.** 4667 (5). **Argôlo A.** 68 (6). **Arzolla FARDP.** 199 (7). **Assis AM.** 549 (6), 749 (6). **Assis MC.** 11527 (2), 11528 (2). **Azevedo INC.** 447 (5). **Barroso GM.** 636 (5). **Barreto M.** 5578 (7). **Belém RP.** 3800 (6). **Blanchet M.** 3581 (1). **Bonaldi RA.** 990 (7). **Borges SR.** 02 (5). **Bresolin A.** 478 (7), 1021 (7). **Bridgewater S.** S234 (5), S708 (5), S770 (5). **Brito M.** 20 (5). **Cadorin TJ.** 534 (7). **Cares JE.** 02 (5). **Carvalho AM.** 3202 (6), 3991 (5), 4036 (5). **Castro ASF.** 1017 (5), s.n. (EAC 28354) (5), s.n. (EAC 30078) (5). **Cavalcanti D.** 619 (6). **Caxambu MG.** 3161 (5). **Cervi AC.** 2307 (7), 3186 (7), 7280 (6), 8811 (7). **Cezare CHG.** 178 (5). **Coelho J.** 20 (1). **Cordeiro I.** s.n. (SPF 44547) (2). **Cordovil SP.** 89 (5). **Costa G. 1246** (6). **Costa MAA.** 128 (6), 198 (6). **Costa RC.** 285 (5), 310 (5). **Costa-Lima JL.** 809 (1). **Cruvinel H.** 06 (5). **Cruz TA.** 65 (4). **Dal ACS.** 166 (6), 194 (6). **Damasceno GA.** 1247 (5). **Dantas HG.** 86 (6). **Deda RM.** 75 (6). **Demuner V.** 4575 (6), 4582 (6). **Dias BJ.** 96 (5), 124 (5). **Dreveck S.** 1112 (7), 1118 (7). **Duarte AP.** 9272 (2), 9516 (5). **Ducke A.** 2197 (5). **Eiten G.** 3883 (5), 4816 (5), 8368 (5). **Eupunino A.** 69 (6). **Fabris LC.** 709 (6), 717 (6). **Fagg CW**. 2032 (5). **Farias R.** 156 (5). **Felfile JM.** 344 (5). **Fernandes A**. s.n (EAC 5025) (5), s.n (EAC 24235) (5), s.n (EAC 30078) (5). **Fernandez MM.** 04 (5). **Fernandes HQB.** 3399 (6), 3441 (6). **Ferraz EMN.** 550 (6). **Ferreira CAC.** 6084 (5). **Fiaschi P**. 1166 (5), 1185 (6), 2586 (6), 2671 (6), 3472 (6). **Folli DA.** 2040 (7). **Fontella J.** 3888 (6). **Fonseca ML.** 508 (5), 2722 (5), 4837 (5), 5430 (5), 5550 (5), 5604 (5), 6646 (5), 6713 (5). **França F.** 1681 (5), 3649 (5). **Francener A.** 1003 (5), 1104 (5). **Freitas JG.** 566 (5). **Forzza RC.** 1563 (5), 2064 (7). **Funch LS.** 70 (1). **Funez LA.** 2491 (7). **Ganev W.** 1612 (1), 2425 (1). **Gibbs PE.** 3485 (7). **Giulietti AM.** 1543 (1). **Glaziou A.** 7656 (7), 14529 (2), 18152 (5). **Glocimar PS.** 881 (5). **Godinho R.** 40 (5). **Goes BTPM.** 138 (5). **Gomes FS.** 1003 (5), 1038 (5). **Gomes JML.** 1329 (6), 3850 (6), 3882 (6). **Gomes-Klein VL.** 3337 (5). **Gouvêa E.** 19/88 (1). **Guarim Neto G.** 1291 (5). **Guedes ML.** 827 (5), 1491 (1), 1524 (1), 7371 (6), 7457 (1), 10854 (5), 12651 (5), 13756 (5), 14439 (1), 25217 (5). **Gurtler J.** 179 (6). **Hage JL.** 1404 (6). **Haidar RF.** 25 (5), 65 (5), 678 (5), 1004 (5), 1112 (5), 1274 (5), 1318 (5), 1427 (5). **Harley RM.** 10067 (5), 21786 (5), 21796 (5), 21943 (5), 27731 (1), 53777 (5), 53880 (5), 55245 (1), 56745 (1). **Hatschbach G.** 18111 (7), 42316 (5), 45756 (7), 50184 (2), 50521 (5), 50712 (7), 53542 (7), 58058 (5), 71221 (5), 71534 (6), 71534 (M – 0244279) (3), 72721 (7), 73436 (5), 74436 (2). **Heiden G.** 918 (6). **Heringer EP.** 1624 (5), 1661 (5), 1814 (5), 1889 (5), 15502 (5). **Heron L.** 84 (6). **Hoehne W.** 5913 (6). **Ivanauskas NM.** 457 (7). **Irwin HS.** 5708 (5). **Jarenkow JA.** 1987 (7). **Jost T.** 154 (5). **Junqueira DI.** 584 (5). **Kirkbride Júnior** 4517 (5). **Klein RM.** 598 (7), 1735 (7), 1787 (7), 6294 (7), 9758 (7), 9806 (7), 9848 (7). **Kollmann L.** 801 (7), 1058 (7), 1260 (1), 1707 (7), 3422 (6), 5462 (4), 5759 (1). **Korte A.** 885 (7). **Koscinski M.** 4975 (7). **Krapovickas A.** 43542 (7). **Leitão Filho HF.** 158 (7). **Lemos MJS.** 137 (1). **Leoni LS.** 5159 (7), 7263 (7). **Lima DP.** 12613 (6), 12728 (6), 12742 (6), 13383 (5). **Lima HC.** 2279 (7), 4431 (6). **Lima HS.** 555 (5). **Lima MPM.** 345 (5). **Lima-Verde LW**. 2961 (5). **Lira OC.** 83-67 (6). **Lordêlo RP.** 56 (6). **Lube GGK.** 139 (6). **Lucena DS.** 835 (6). **Lúcia S.** 513 (7), 2990 (7). **Macedo A.** 3840 (5). **Macedo GEL.** 525 (6), 1035 (6). **Macedo M.** 3149 (5). **Machado JWB.** 311 (5), 311A (5). **Magnago LFS.** 1683 (6). **Marli PM.** 345 (5). **Marquete R.** 201 (6). **Martin R.** 445 (5). **Martinelli G.** 11231 (2). **Matos FB.** 1966 (6). **Melo E.** 2768 (5), 5310 (1), 7181 (5), 8264 (5), 8321 (5), 10125 (5), 10767 (6). **Mendes MS.** 543 (1). **Mendonça RC**. 1493 (5), 2252 (5), 2259 (5), 2368 (5), 2608 (5), 2637 (5), 3269 (5), 3931 (5), 4341 (5), 6061 (5), 6274 (5). **Miranda**

AM. 5807 (5), 6772 (6). **Monteiro MT.** 22704 (6), 22765 (6), 22806 (6). **Moraes PLR.** 1055 (7). **Mori S.** 13352 (1), 16830 (5). **Mota MCS.** 11791 (6). **Mota RC.** 1328 (6). **Munhoz CBR.** 3143 (5). **Nadruz M.** 453 (7). **Nascimento FHF.** 546 (6). **Negrelle RB.** A-619 (7). **Nuernberg A.** 533 (7). **Nunes TS.** 850 (1). **Ogasawara HA.** 416 (5). **Oliveira AA.** 231 (5). **Oliveira FCA.** 1065 (5). **Oliveira PEAM.** 89 (5). **Oliveira PP.** 07 (6), 379 (6), 379B (6), 720 (6), 720A (6). **Pabst GFJ.** 9712 (6). **Paiva VF**. 696 (5). **Paixão JL.** 659 (1). **Paula JE.** 3125 (5), 3136 (5), 3137 (5). **Paula-Souza J.** 9092 (5), 9309 (5). **Pereira Neto M**. 384 (5), 434 (5). **Pereira-Silva G.** 10612 (5), 10680 (5), 11629 (5), 13017 (5). **Pereira BAS.** 280 (5), 1104 (5), 1283 (5), 1341 (5). **Pereira FMB.** 18/61 (7), 19/41 (7). **Pereira OJ.** 177 (6), 985 (6), 1015 (6), 1051 (6), 1056 (6), 1148 (6), 1849 (6), 2233 (6), 2236 (6), 2271 (6), 3916 (6), 4361 (6), 4891 (6), 5211 (6), 5677 (6), 6238 (6), 7757 (6), s.n. (VIES 171) (6). **Pimentel LB.** s.n. (MBM 398201) (6). **Pinheiro H.** 119 (6). **Pinheiro RS.** 1893 (6), 2279 (6). **Pinheiro WG.** 01 (5). **Pinto RC.** 112 (6). **Pirani JR.** 1980 (1), 12667 (2). **Pires JM**. 9308 (5), 56863 (5). **Prance GT.** 58595 (5), 59202 (5). **Proença C.** 837 (5), 1439 (5), 1771 (5), 2802 (5). **Queiroz EP.** 1258 (6), 3163 (5). **Queiroz LP.** 12098 (1). **Ratter JA.** 1711 (5), 2007 (5), 2022 (5), 4741 (5). **Ramos AE.** 2199 (5), 2220 (5). **Reis A.** 2474 (7). **Reitz PR.** 5780 (7). **Ribeiro-Filho AA.** 13 (1), 33 (1), 82 (1), 93 (1). **Rizzo JA.** 2153 (5), 6662 (5). **Roderjan CV.** 223 (7), 612 (7). **Rodrigues EA.** 337 (7). **Rodrigues S.** s.n (UFMT 20204) (5). **Roque N.** 936 (1). **Rosário RF.** 76 (5). **Rossi L.** 492 (7). **Rossini J.** 516 (1). **Salino A.** 3620 (5). **Sampaio AB**. 45 (5). **Sampaio D.** 58 (7). **Santana DL.** 445 (5). **Santos AA.** 1480 (5). **Santos HGP.** 402 (5). **Santos MG.** 503 (6). **Santos TS.** 474 (6), 481 (6), 1119 (1), 1274 (6), 3982 (6). **Scariot AO**. 685 (5), 888 (5), 898 (5). **Sevilha AC.** 5359 (5). **Silva AF**. 1309 (5). **Silva AP.** 123b (5). **Silva GP.** 881 (5), 13285 (5). **Silva IA.** 351 (6). **Silva JM.** 1781 (7), 3065 (7), 3795 (7). **Silva LA.** 513 (6). **Silva LAM.** 812 (6), 1455 (6), 1479 (6). **Silva LHS.** 926 (5). **Silva MA**. 1328 (5), 1348 (5), 1485 (5), 3437 (5), 4029 (5). **Silva MAS.** 3437 (5), 8411 (5). **Silva Neto SJ.** 1567 (7). **Silva PEN.** 159 (5). **Simonelli M.** 116 (6), 1444 (7). **Soares J.** s.n (HST 2016, IPA 75724, PEUFR 15451) (6). **Soares EA.** 1403 (5). **Sobral M.** 5524 (6), 8024 (7). **Sousa LA.** 270 (1). **Souza FBC.** 85 (6). **Souza FM.** 1043 (7). **Souza VC.** 12241 (7),16465 (5), 17358 (5), 18045 (5). **Stannard B.** 52716 (1). **Stehmann JR.** 3404 (7). **Stival-Santos A.** 978 (7), 1388 (7). **Stradmann MTS.** 0098 (1), 0755 (1), 1120 (1). **Sucre D.** 8043 (6), s.n. (RB 173403) (6). **Tameirão Neto E.** 1636 (5), 1639 (5), 2480 (2), 3585 (2). **Teixeira G.** 2886 (6). **Thomas WW**. 9008 (6), 6844 (6), 6856 (6), 12691 (6), 13879 (6), 14582 (7). **Thomaz LD.** 589 (6). **Trovó MLO.** 305 (5). **Uesugi CH.** 2 (5). **Uller HF.** 91 (7), 384 (6), 385 (6), 496 (6). **Vaz AMSF**. 434 (7). **Verdi M.** 3498 (7), 5808 (7). **Vervloet RR.** 1277 (1). **Viana PI.** 4232 (5). **Vidal CV.** 1215 (7). **Vinha SG.** 69 (6). **Walter BMT.** 2423 (5), 3300 (5), 3778 (5). **Weinberg B.** 918 (6), 927 (6). **Yano T.** 54 (7). **Zambom O.** 09 (6), 93 (6), 101 (6). **Zanatta MRV.** 652 (5).

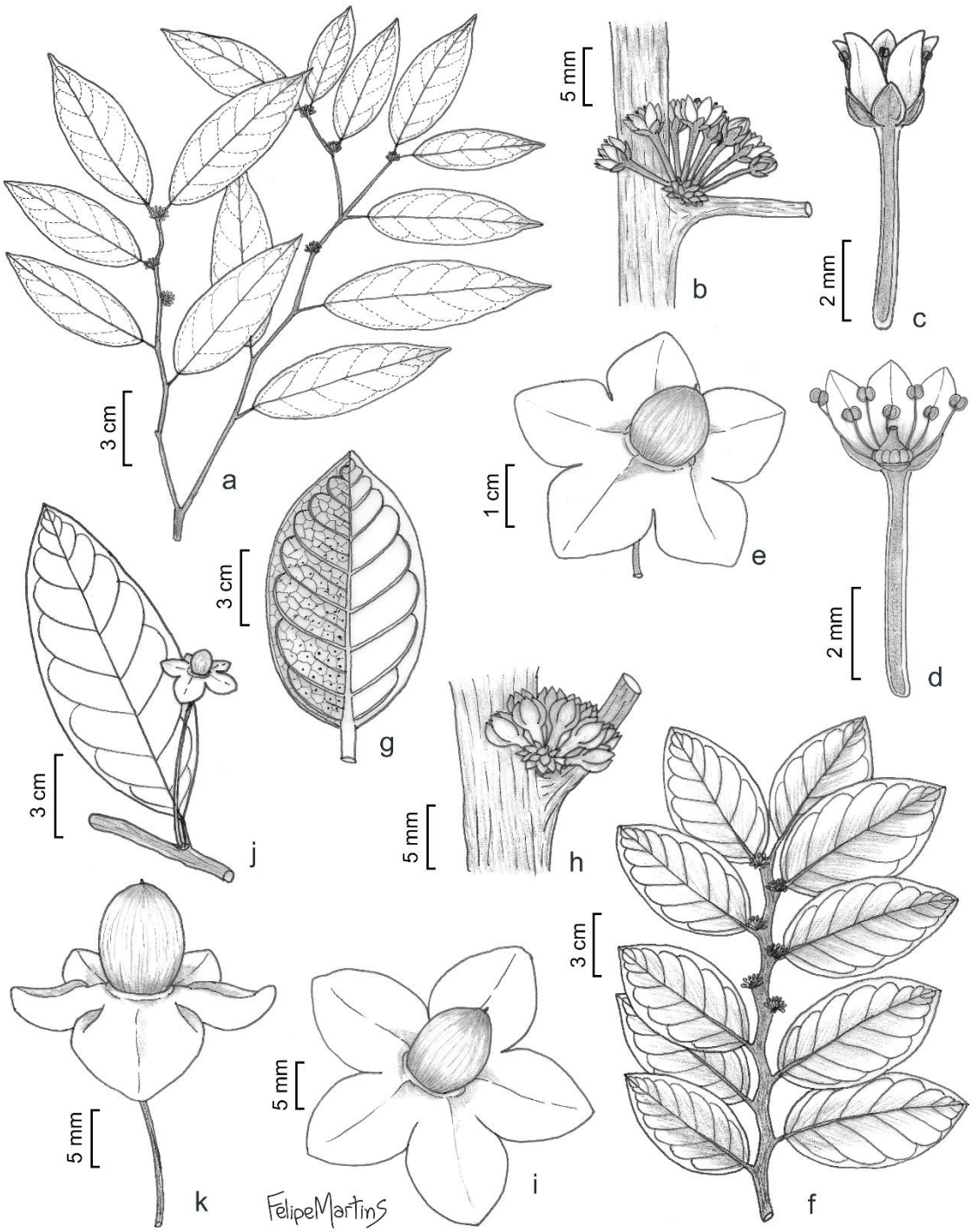

FIGURE 1. A–E. *Heisteria blanchetiana* (*R.R. Vervloet et al. 1277, S. Mori & R. Funch 13352*) —A. Flowering branch, B. Inflorescence, C. Flower, D. Flower with gynoecium and androecium detail, E. Fruit; F–I. *Heisteria citrifolia* (*G. Martinelli 11231, M.C. Assis et al. 11527*) — F. Flowering branch, G. Leaf, H. Inflorescence (flower buds), I. Fruit; J–K. *Heisteria longipedicellata* (*G. Hatschbach et al. 71534*) — J. Leaf and Fruit, K. Fruit.

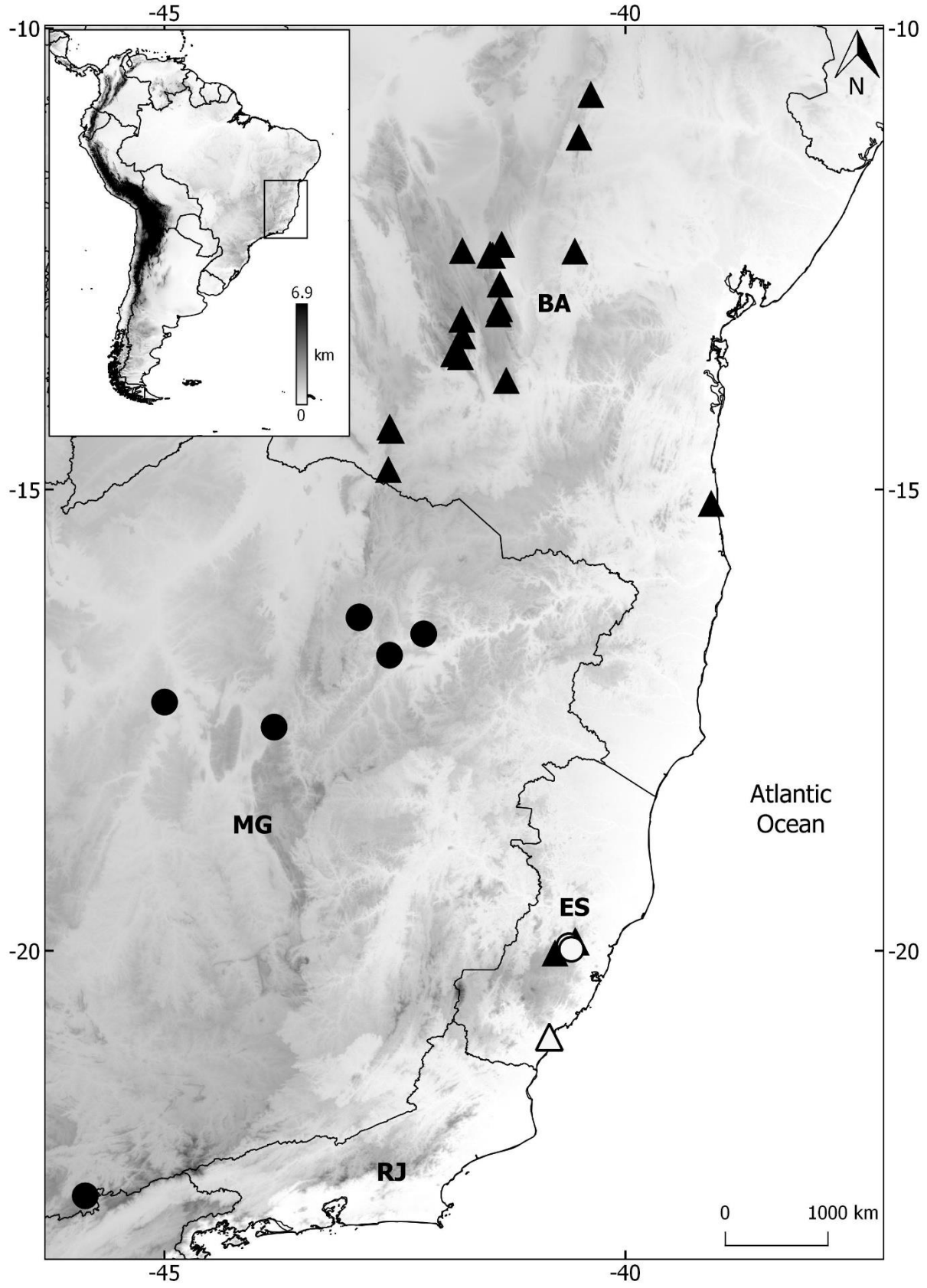

FIGURE 2. Distribution map of *Heisteria* from extra-Amazonian Brazil. *H. blanchetiana* (Black triangle), *H. citrifolia* (black circle), *H. longipedicellata* (white triangle), *H. maytenoides* (white circle).

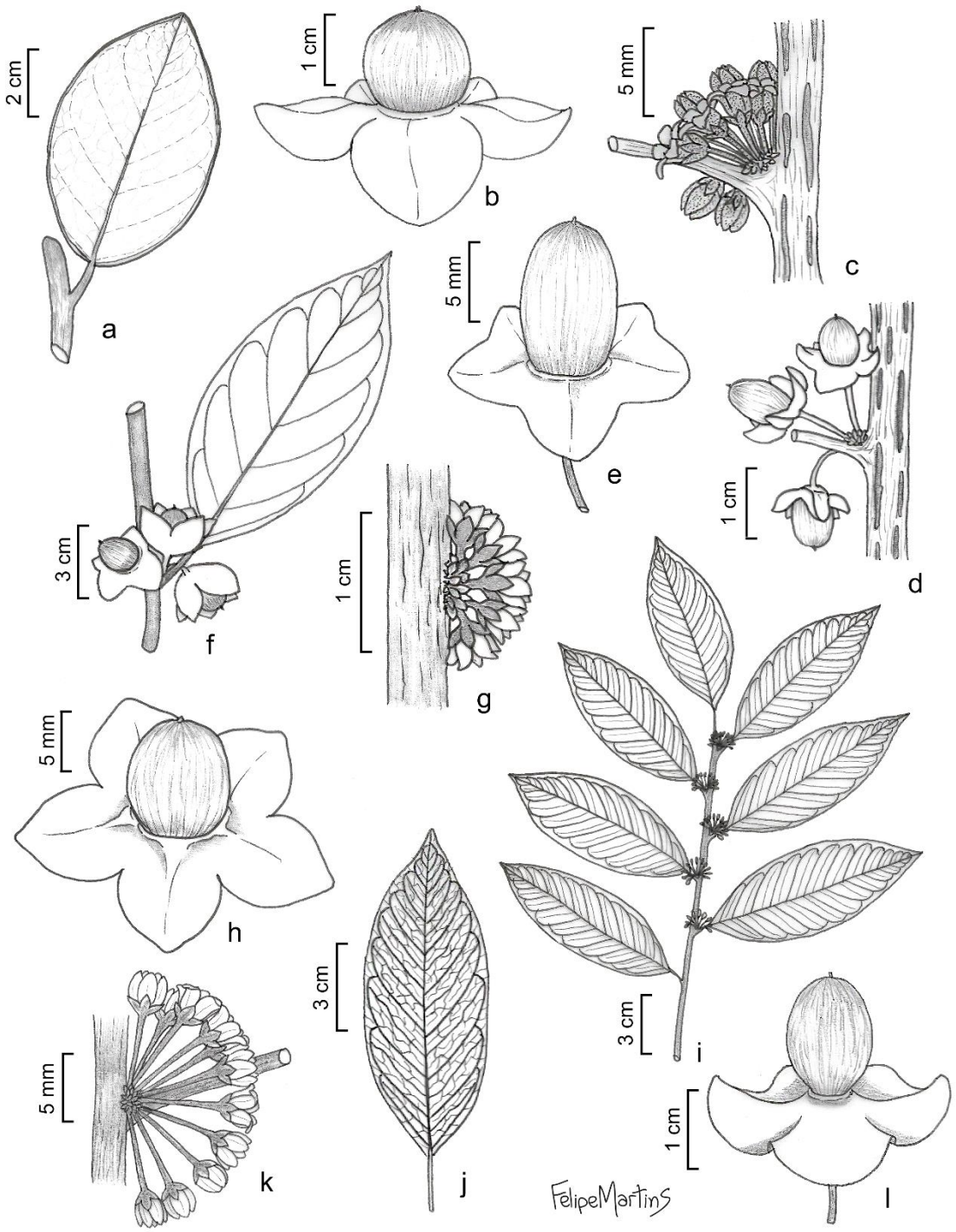

FIGURE 3. A–B. *Heisteria maytenoides* (*T.A. Cruz 65*) —A. Leaf, B. Fruit; C–E. *H. ovata* (*A. Francener 1104, E. Tameirão Neto 1639*) —C. Inflorescence, D. Infructescence, E. Fruit; F–H. *H. perianthomega* (*J.M.L. Gomes 3850, M.T. Monteiro 22704*) —F. Leaf and Infructescence, G. Inflorescence, H. Fruit; I–L. *H. silvianii* (*J.M. Silva et al. 3065, L. Kollmann 1707*) —I. Flowering branch, J. Leaf, K. Inflorescence, L. Fruit.

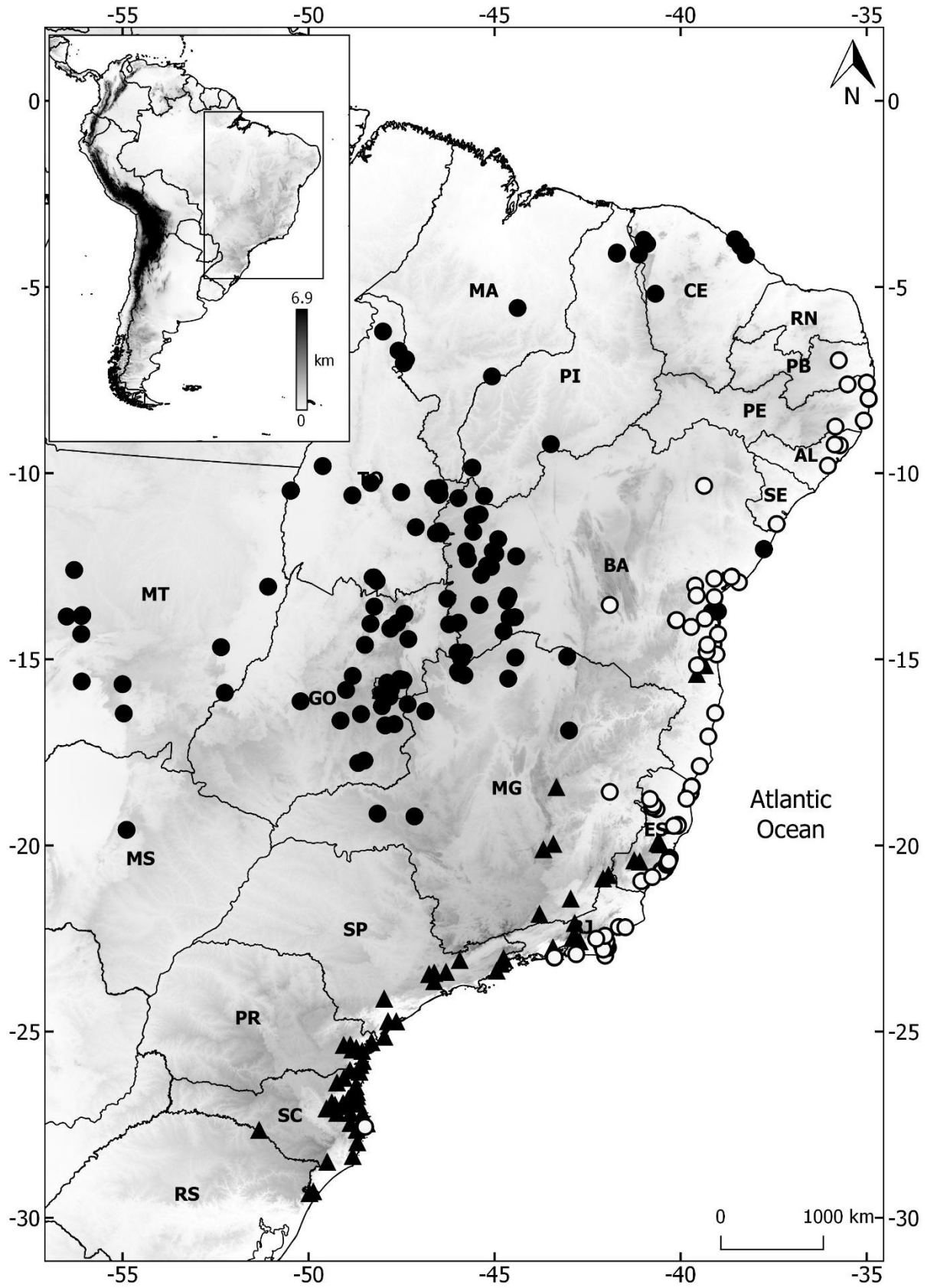

FIGURE 4. Distribution map of *Heisteria* from extra-Amazonian Brazil. *H. ovata* (black circle), *H. perianthomega* (white circle), *H. silvianii* (black triangle).

Table 1. Species of *Heisteria* registered in Conservation Units (UCs) federal and state, full protection (Ecological Station – ESEC, National Park – PARNA, State Park, Biological Reserve – REBIO, Wildlife Refuge) or sustainable use (Environmental Protection area – APA, National forest – FLONA, Private Reserve of Natural Patrimony – RPPN) that occur extra-Amazonian Brazil (Alagoas – AL, Bahia – BA, Ceará – CE, Espírito Santo – ES, Goiás – GO, Maranhão – MA, Minas Gerais – MG, Pernambuco – PE, Paraná – PR, Piauí – PI, Rio de Janeiro – RJ, São Paulo – SP, Santa Catarina – SC, Tocantis –TO).

Species	**UCs**
Heisteria blanchetiana (Engl.) Sleumer	**BA:** PARNA da Chapada Diamantina, REBIO de Una. **ES:** REBIO de Augusto Ruschi.
Heisteria longipedicellata D.S. Lucena & M.Alves	**ES:** APA Lagoa do Guarandy
Heisteria maytenoides Spruce ex Engl.	**ES:** Parque Natural Municipal de São Lourenço.
Heisteria ovata Benth.	**CE**: PARNA Ubajara. **GO**: PARNA Chapada dos Veadeiros, Parque Estadual Serra de Caldas Novas, REBIO Águas Emendadas, REBIO de Contagem, REBIO Profº José Angelo Rizzo, RPPN Linda Serra dos Topázios, Refúgio de Vida Silvestre Vaga Fogo. **MA:** PARNA da Chapada das Mesas. **MG:** PARNA Grande Sertão Veredas, RPPN Arara Vermelha. **PI:** PARNA Sete Cidades. **TO:** APA do Jalapão,

	ESEC Serra Geral do Tocantins, PARNA do Araguaia.
Heisteria perianthomega (Vell.) Sleumer	**AL:** ESEC Murici, REBIO Pedra Talhada. **BA:** REBIO do Pau-Brasil. **ES:** FLONA de Goytacazes, Parque Estadual Paulo César Vinha. **PE:** RPPN Fazenda Tabatinga, RPPN Frei Caneca, Parque Estadual de Dois Irmãos. **RJ:** REBIO Poço das Antas, REBIO União. **SE:** RPPN Mata do Castro.
Heisteria silvianii Schwacke	**BA:** RPPN Serra Bonita. **ES:** REBIO caixa d'água, REBIO da represa do grama. **PR:** REBIO Sapitandur. **RJ:** ESEC estadual de Paraiso. **SP:** Parque Estadual Carlos Botelho, Parque Estadual da Cantareira, Parque Estadual Ilha do Cardoso, Parque Estadual Jaraguá. **SC:** RPPN Caraguatá.

4 CONSIDERAÇÕES FINAIS

Os resultados obtidos possibilitaram o acréscimo de informações sobre a morfologia, riqueza, distribuição, status de conservação e atualizações nomenclaturais, para uma porcentagem significativa das espécies de Olacaceae registradas no Brasil.

Com base nesses resultados, observamos que a riqueza de Olacaceae e Schoepfiaceae para a porção oriental do Nordeste brasileiro pode ter atingido a estabilidade. Em nosso estudo nenhuma espécie foi acrescentada, contudo, equívocos nas identificações foram detectados, o que dificultava o conhecimento sobre a ocorrência e distribuição dessas espécies na área estudada. Os dados gerados auxiliarão na correta identificação dos táxons, diminuindo assim, informações equivocadas sobre a identidade das espécies nas bases de dados e coleções.

Os resultados obtidos com os estudos em *Cathedra* e *Heisteria* reforçam a importância das coleções biológicas para o conhecimento da biodiversidade. Informações sobre a riqueza, morfologia e distribuição das espécies foram obtidas com base na análise dos espécimes depositados em herbários.

Para *Cathedra*, além da morfologia dos frutos e disco hipógino, o comprimento do pedicelo, das pétalas e a forma do estigma nas flores também são taxonomicamente informativos para a delimitação das espécies. Já em *Heisteria,* além do comprimento do pedicelo nas flores, da forma e tamanho da drupa e do cálice acrescente nos frutos, a consistência das folhas e o número de nervuras secundárias, também são importantes para a identificação das espécies.

A lista vermelha de espécies ameaçadas da IUCN cita somente uma espécie de *Cathedra*, contudo, todas as espécies do gênero estão categorizadas em algum grau de ameaça. Para *Heisteria,* somente três das sete espécies tratadas nesse estudo são avaliadas nessa lista, sendo necessário uma atualização nessa base de dados.

A maior riqueza para o gênero *Cathedra* é registrada no Sul do Espírito Santo, onde quatro, das cinco espécies conhecidas foram identificadas. Esse Estado também registra maior riqueza para *Heisteria,* onde cinco, das sete espécies tratadas nesse estudo foram registradas.

Com exceção de *Cathedra rupestris* e *Heisteria citrifolia*, todas as espécies de Olacaceae tratadas nesse estudo têm ao menos um espécime registrado em Unidades de Conservação, reforçando a importância dessas áreas para manutenção da diversidade Biológica.

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APENDICE A

ARTIGO PUBLICADO NA REVISTA RODRIGUÉSIA

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Original Paper

Olacaceae and Schoepfiaceae in eastern Northeast Brazil

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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 Schoepfiaceae 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.

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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).

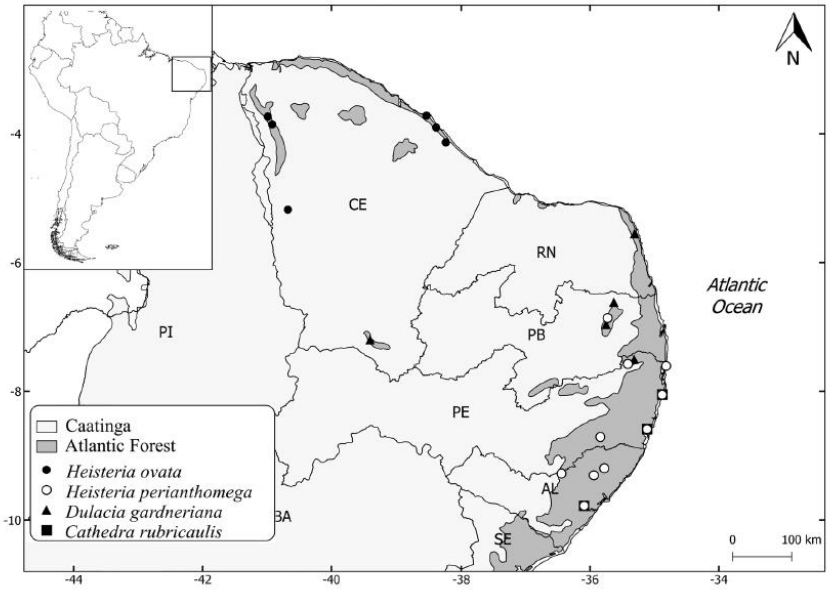

Figure 1 – Geographical distribution of *Cathedra rubricaulis*, *Dulacia gardneriana*, *Heisteria ovata* and *Heisteria perianthomega* in the eastern portion of Northeastern Brazil.

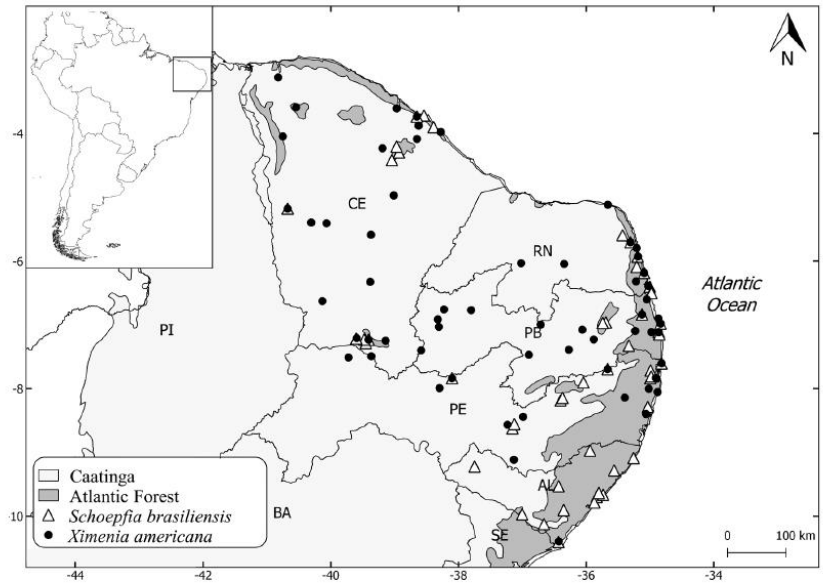

Figure 2 – Geographical distribution of *Schoepfia brasiliensis* and *Ximenia americana* in the eastern portion of Northeastern Brazil.

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*

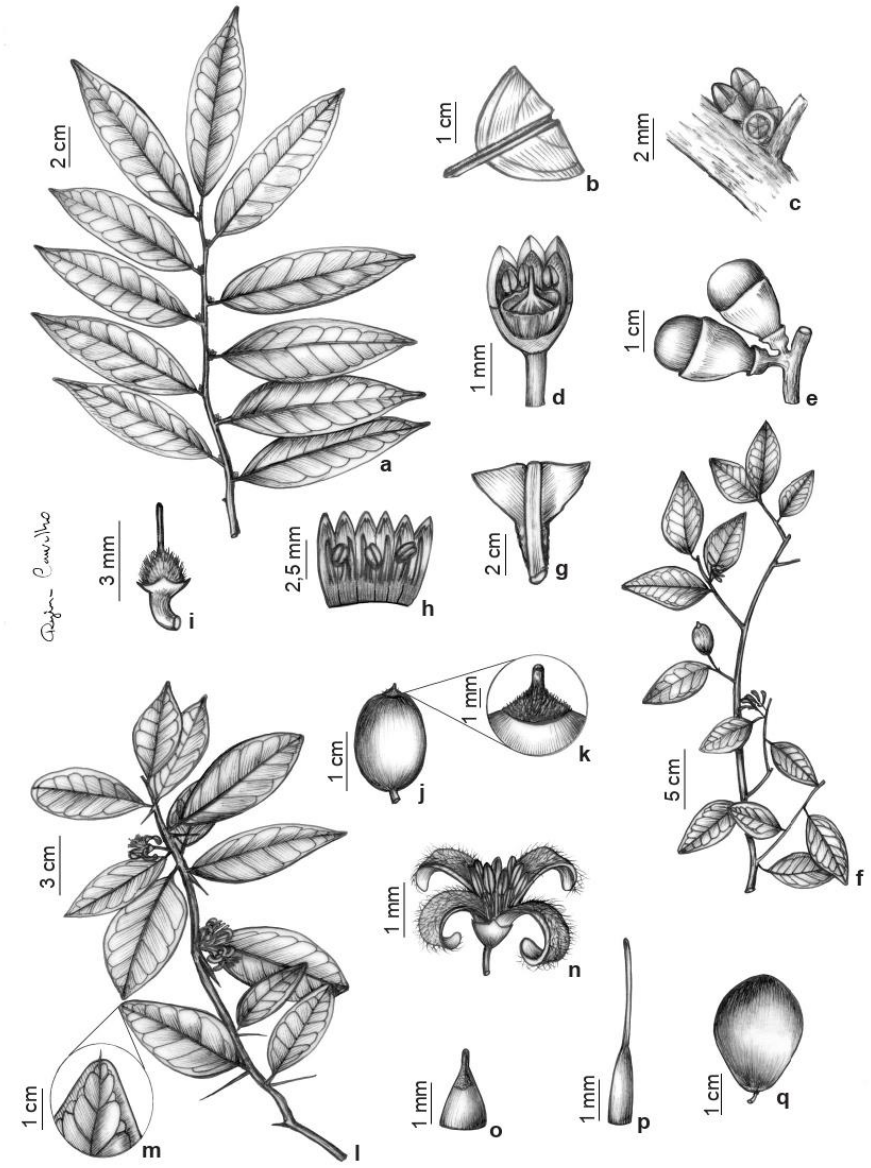

Figure 3 – a-e. *Cathedra rubricaulis* – a. branch with flowers; b. detail of the midvein on the adaxial surface; c. inflorescence; d. longitudinal view of the flower, evidencing the sepals, petals, sessile stamens, hypogynous disk and gynoecium; e. fruit. f-k. *Dulacia gardneriana* – f. branch with 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

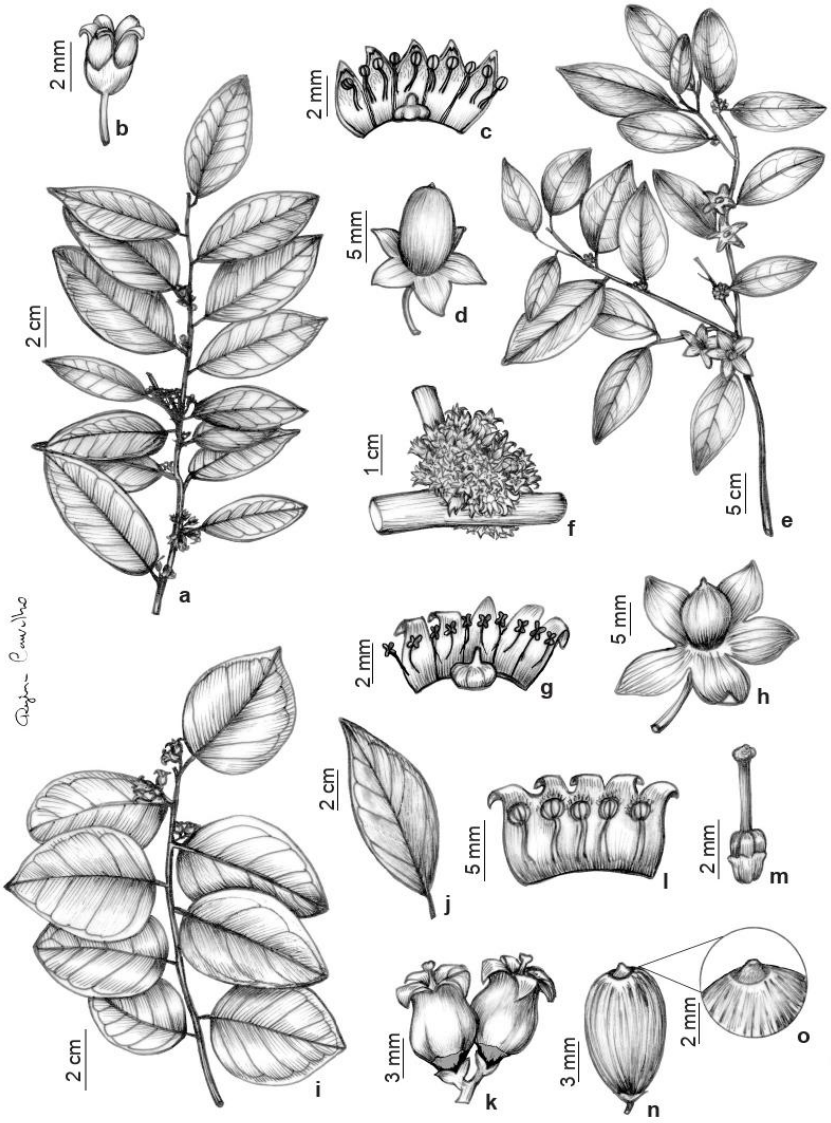

Figura 4 – a-d. *Heisteria ovata* – a. flowering branch; b. flower; c. internal view of the flower, showing the androecium and gynoecium; d. fruit. e-h. *Heisteria perianthomega* – e. branch with flowers and fruits; f. inflorescences; g. internal view of the flower, showing the androecium and gynoecium; 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*

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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).

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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).

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ANEXO A

NORMAS PARA PUBLICAÇÃO NOS PERIÓDICOS

NORMAS PARA PUBLICAÇÃO NO PERIÓDICO ACTA BOTANICA BRASILICA.

Disponível em: https://www.scielo.br/revistas/abb/iinstruc.htm

NORMAS PARA PUBLICAÇÃO NO PERIÓDICO PHYTOTAXA

Disponível em: https://www.mapress.com/j/pt/pages/view/forauthors

NORMAS PARA PUBLICAÇÃO NO PERIÓDICO RODRIGUÉSIA

Disponível em: https://www.scielo.br/revistas/rod/iinstruc.htm

NORMAS PARA PUBLICAÇÃO NO PERIÓDICO SYSTEMATIC BOTANY

Disponível em: https://bioone.org/journals/systematic-botany/author-guidelines