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Original Paper

Flora of Ceará, Brazil: subtribe Gonolobinae (Asclepiadoideae/Apocynaceae)

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Abstract

We performed the taxonomic-floristic survey of subtribe Gonolobinae for the state of Ceará, as part of the "Flora do Ceará: knowing to conserve" project. The study was based on the comparative analysis of morphological characters, specialized bibliography, as well as photos of type-collections. In Ceará, six species of two genera were registered: *Gonolobus rostratus*, *Matelea denticulata*, *M. endressiae*, *M. ganglinosa*, *M. harleyi*, and *M. nigra*. *Matelea ganglinosa* has a broad distribution in the state, while *G. rostratus*, *M. denticulata* and *M. endressiae* are restricted. *Matelea* species were recorded in six Conservation Units and preferably dry environments (Stepic Savanna, Seasonal Deciduous Forest, and Lowland Semideciduous Forest).

Key words: Gentianales, *Gonolobus*, *Matelea*, vines.

Resumo

O estudo consistiu no levantamento florístico-taxônomico da subtribo Gonolobinae no estado do Ceará, como parte do projeto "Flora do Ceará: conhecer para conservar". O trabalho foi baseado na análise comparativa dos caracteres morfológicos, bibliografias especializadas e imagens de coleções-tipo. Para o Ceará, seis espécies pertencentes a dois gêneros foram registradas: *Gonolobus rostratus*, *Matelea denticulata*, *M. endressiae*, *M. ganglinosa*, *M. harleyi* e *M. nigra*. *Matelea ganglinosa* apresentou ampla distribuição no estado, enquanto *G. rostratus*, *M. denticulata* e *M. endressiae* são restritas. As espécies de *Matelea* foram registradas em seis Unidades de Conservação e ocorrem, preferencialmente, em ambientes secos (Savana Estépica, Floresta Estacional Decidual e Floresta Estacional Semidecidual das Terras Baixas).

Palavras-chave: Gentianales, *Gonolobus*, *Matelea*, trepadeiras.

Introduction

Gonolobinae, a subtribe belonging to Asclepiadoideae (Apocynaceae), has distribution that is restricted to the New World (Liede 1997; Morillo 2012). In Brazil, the subtribe is represented by the genera *Gonolobus* (three spp.), *Macroscepis* (six spp.), *Matelea* (46 spp.) and *Rhytidostemma* (one species), with distribution in the Amazon, Caatinga, Cerrado and Atlantic Forest phytogeographic domains (BFG 2018).

The subtribe consists of herbs, vines or shrubs with white latex, single or mixed (two types) trichomes, leaves single, opposite, distichous, with colleters at the base; inflorescences racemiform

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or umbeliform, extra-axillary; corolla rotaceous, campanulate or tubular, corona ring-shaped or fimbriated, gynostegium sessile or pedunculated, subhorizontal to horizontal, attached to the caudicle, and subsequently to the retinaculum; fruits simple, smooth or rough, flattened, denticulated and comose seeds (Liede 1997; Morillo 1997, 2012).

The circumscription of Gonolobinae is considered the most complex and inconclusive within Asclepiadoideae, as it still lacks consistent delimitation of the subtribe and relationships among its taxa (Rapini 2012). Some generic taxa, such as *Matelea*, also present problems in their circumscription, with the reestablishment of synonymized genera under *Matelea*, such as *Ibatia*, the subject of discussion (Morillo 2012, 2013; Rapini 2012). However, for *Gonolobus*, plastid (*trnL-F*, *rps16*) and nuclear (*LEAFY*) molecular data corroborate the current genus circumscription (Krings *et al.* 2008; Rapini 2012).

Classical taxonomic-floristic studies, including the Gonolobinae representatives, especially from the Neotropical region, began in the 20th century with Woodson (1941), followed by Liede & Kunze (1993) and Liede (1997), and more recently by Stevens & Morales (2008), Krings (2011) and Morillo (2012, 2013, 2015). Studies focusing on the diversity of subtribe taxa have been designed for *Gonolobus*, *Macroscepis* and *Matelea* occurring in the New World (Rapini *et al.* 2003, 2007). From a phylogenetic perspective, a treatment with Gonolobinae representatives from South America (Rapini *et al.* 2006) was elaborated, as well as the *Gonolobus* genus circumscription (Krings *et al.* 2008).

In Brazil, representatives of the Gonolobinae subtribe were contemplated in various works. The first systematic study covering the species from the Brazilian territory was developed by Araújo (1950), and later focused on the Southeast region (Fontella-Pereira *et al.* 1989, 1995; Rapini *et al.* 2001; Fontella-Pereira & Goes 2009; Goes & Fontella-Pereira 2009a; Rapini 2010). In the Northeast region, species were treated in floras from states such as Bahia (Watanabe *et al.* 2009), Alagoas (Lemos *et al.* 2010), Sergipe (Farinaccio *et al.* 2013), Rio Grande do Norte (Sousa Júnior 2016) and Pernambuco (Coutinho & Louzada 2018).

In the state of Ceará, no studies about Asclepidoideae and specifically Gonolobinae have been conducted thus far. Within the scope of the project "Flora of Ceará: knowing to conserve", which aims to increase knowledge about diversity and geographical distribution of species of the state's flora, we aimed to carry out the floristic-taxonomic survey of Gonolobinae species in Ceará, as well as provide identification key, morphological descriptions, comments on morphological affinities, distribution, ecology, phenology, common names, map, illustration and photographic plates of registered taxa.

Material and Methods

This study was based on field populations collected and observed during expeditions conducted between 2012 and 2019 and comparative analysis of specimens deposited in the herbaria ALCB, EAC, HUEFS, HUVA, HVASF, JPB, K, MO, MOSS, NY, P, R, RB, S, SP and US, acronyms according to Thiers (continuously updated).

Taxa were identified by consulting specialized bibliographies (Roemer & Schultes 1820; Fontella-Pereira & Schwarz 1981; Morillo & Fontella-Pereira 1990; Fontella-Pereira & Morillo 1994; Rapini & Farinaccio 2008; Goes & Fontella-Pereira 2009b) and confirmed through image analysis of type-collections available on the REFLORA Virtual Herbarium (2019+) (<http://reflora.jbrj.gov.br/reflora/herbarioVirtual/>) and Global Plants on JSTOR (2019+) (https://plants.jstor.org). The names of authors were based on IPNI (2019+).

The taxa identification key was based on descriptions from this study and includes vegetative and reproductive morphological characteristics visible to the naked eye, except for *Matelea harleyi* Fontella & Morillo and *M. nigra* (Decne.) Morillo & Fontella. Given that most of the previous studies prioritized particular floral characters of the species, this key is an important contribution for the identification of fertile or infertile specimens, whether by Botanical specialists or non-specialists.

The terminology used for vegetative structures followed Radford *et al.* (1974) and Harris & Harris (2001) and for reproductive structures followed Rapini (2000). Descriptions were made based on samples from the state of Ceará. Eventually additional material from other states or information from the protologues were used to complement the descriptions of flowers and/or fruits.

Data regarding growth form (habit), habitat, flowering and fruiting period and common names were obtained from exsiccate labels. The illustrations of the species were drawn freehand or with a stereo microscope equipped with light

camera (Nikon SMZ 1500) and covered with ink. Photographic plates of species in the field were created with the GNU Image Manipulation Program (GIMP), Version 2.10 (GIMP 2019).

The vegetation was classified according to the Technical Manual of the Brazilian Vegetation (IBGE 2012). Regarding species distribution, we used the model proposed by Rebouças *et al.* (2020), which presents the occurrence of representatives by vegetation types registered in Ceará in 0.5° longitude × 0.5° latitude grid squares. Furthermore, the species were classified according to Valente & Porto (2006) as: restricted - when there was no occurrence information recorded between one to four municipalities; moderate - between five and 10 records; and broad - when found in more than 10 municipalities.

Results and Discussion

In Ceará, the subtribe Gonolobinae is represented by six species belonging to two genera: *Gonolobus* (*G. rostratus* (Vahl) R.Br. *ex* Shult.) and *Matelea* (*M. denticulata* (Vahl) Fontella & E.A. Schwarz, *M. endressiae* Fontella & Goes, *M. ganglinosa* (Vell.) Rapini, *M. harleyi* Fontella & Morillo and *M. nigra* (Decne.) Morillo & Fontella).

Even though *Matelea roulinioides* Agra & W.D. Stevens was registered in the state of Ceará at the BFG (2018), it was not treated in this study, since no taxon collection was found for the state. In the speciesLink site database (CRIA 2019), *Matelea maritima* (Jacq.) Woodson was also cited for Ceará; however, the distribution of this taxon is restricted to the Northern region of the country (Rapini & Farinaccio 2008) and was not considered either.

Regarding the distribution of *Gonolobinae* species in Ceará territory, three were considered restricted (*Gonolobus rostratus*, *Matelea denticulata* and *M. endressiae*); two moderate (*M. harleyi* and *M. nigra*) and only one had broad occurrence (*M. ganglinosa*). Species occur preferentially in dry environments such as Stepic Savanna (Caatinga), Seasonal Deciduous Forest (Dry forest) and Lowland Semideciduous Forest (Tableland forest). However, they were also recorded in humid environments in Dense Ombrophylous Forest (Wet forest).

Matelea denticulata, *M. endressiae*, *M. ganglinosa*, *M. harleyi* and *M. nigra* were recorded in six state Conservation Units: Ponta Grossa Environmental Protection Area, Aiuaba Ecological Station, Araripe-Apodi National Forest, Ubajara National Park, Pedra da Andorinha Wildlife Refuge and Private Natural Heritage Reserve Serra das Almas.

The occurrence of five Gonolobinae species (84%) in Ceará Conservation Units indicates that these taxa are less vulnerable to threats, as they were registered in protected areas (Fig. 1). However, this fact does not eliminate the need for collection efforts in other areas of Ceará state and further studies regarding species conservation, especially for species with underestimated sampling such as *Gonolobus rostratus*, *Matelea denticulata*, *M. endressiae*, which are classified herein as restricted.

Taxonomic treatment

Subtribe Gonolobinae

Vines, branches lenticellate or not, trichomes simple or mixed (two types). Petiole with colleters or not. Leaves simple, opposite, narrowly cordiform, cordiform, ovate cordiform, ovate, elliptic to widely elliptic, base truncate, cordate, subcordate, rare rounded, apex acuminate, acute, widely acute, cuspidate, long cuspidate, margins slightly revolute or plane, membranaceous to chartaceous, abaxial surface glabrous, pubescent, sparsely strigose, strigose, densely strigose, densely scabrous, adaxial surface glabrous to sparsely hirsute, sparsely pubescent, sparse strigose, strigose, scabrous; colleters 2–7 adaxially at the base of the midrib. Bract linear, lanceolate or linear lanceolate, pubescent, sericeous, strigose, scabrous. Inflorescence cymose, umbelliform or glomeruliform, axillary or subaxillary, pedunculate or absent. Flower bisexual, actinomorphic, pentamerous, isostemonous and hypogynous. Pedicel sparse strigose, strigose, pubescent, sericeous, sparse to dense scabrous. Calyx valvate; lobes 5, lanceolate, ovate lanceolate, ovate, narrowly triangular, abaxial surface glabrous or strigose, adaxial surface glabrous, sparsely strigose, strigose, scabrous; colleters 2, alternate to the calyx lobes. Corolla rotaceous or campanulate; lobes 5, linear lanceolate to lanceolate, elliptic, widely elliptic, ovate, abaxial surface glabrous or pubescent, adaxial surface glabrous, sparse strigose, strigose or dense scabrous. Corona simple, annular or lobate, carnose or membranaceous. Anthers with dorsal laminar appendages present or no. Retinaculum sagittiform, obovoid, depressed obovoid, broadly obovoid, ovoid, fused to caudicles, thereafter, to pollinia. Gynostegium with style head slightly plane, depressed or crateriform, sessile or stipitate. Ovary pyriform,

botuliform, conical, glabrous. Follicle narrowly pyriform, pyriform, ovoid, glabrous, pubescent, scabrous or strigose, projections present. Seed broadly ellipsoid, ovoid, broadly ovoid, margins denticulate, glabrous, pubescent, strigose, scabrous or verrucose, comose.

Identification key to the Gonolobinae Subtribe species from Ceará

1. Leaf blade elliptic to widely elliptic, abaxial surface glabrous; corolla lobes widely elliptic .... 2.1. *Matelea denticulata*
1'. Leaf blade narrowly cordiform to cordiform, ovate or ovate cordiform, abaxial surface pubescent, sparse strigose, strigose, dense strigose or dense scabrous; corolla lobes linear lanceolate to lanceolate, ovate or elliptic.
    2. Apex leaf blade long cuspidate, abaxial surface sparse strigose and dense scabrous; inflorescence peduncle 2.2–2.8 cm long; follicle with projections hook-shaped, sparse .... 2.2. *Matelea endressiae*
    2'. Apex leaf blade acute, cuspidate or acuminate, abaxial surface glabrous, pubescent, sparse strigose, strigose, dense strigose; inflorescence peduncle ca. 1 cm long or absent; follicle with filiform or tuberculate projections, or costate.
        3. Inflorescence peduncle ca. 1 cm long; corolla lobes 12–22 × 4.3–6.7 mm, linear lanceolate to lanceolate; follicle with costate projections ..... 1. *Gonolobus rostratus*
        3'. Inflorescence peduncle absent; corolla lobes 2.5–9 × 1.6–3 mm, elliptic or ovate; follicle with filiform or tuberculate projections.
            4. Flower 0.3–0.4 cm long; corolla lobes 2.5–3 × 1.6–2 mm, ovate; follicle with filiform projections ..... 2.3. *Matelea ganglinosa*
            4'. Flower 0.7–0.9 cm long; corolla lobes 6–9 × 2.3–3 mm, elliptic; follicle with tuberculate projections.
                5. Corolla campanulate; corona 4–4.7 mm long, lobes slightly tridentate, denticles subequal in length and middle denticle with cuspidate apex .... 2.4. *Matelea harleyi*
                5'. Corolla rotaceous; corona ca. 5.5 mm long, lobes deeply tridentate, denticle middle shorter in length and middle denticle with acuminate apex ..... 2.5. *Matelea nigra*

1. *Gonolobus rostratus* (Vahl) R.Br. *ex* Schult., Syst. Veg. 6: 61. 1820. Figs. 2a; 3a-c

Vine, branches not lenticellate, trichomes simple, sparse pubescent. Petiole 4–5.5 cm long; colleters 2. Leaf blade 5–11 × 2.3–4.9 cm, ovate, base cordate, apex acuminate, margins plane to slightly revolute, entire, ciliate, chartaceous, abaxial surface pubescent, adaxial surface sparse pubescent; colleters 2. Bract 5.1–5.3 × 1–1.1 mm, linear lanceolate, pubescent. Inflorescence umbelliform, axillary, peduncle ca. 1 cm long, 2–3 flowers. Flower 4.5–5.5 cm long; pedicel 3.5–4 cm long, pubescent. Calyx lobes 4.1–8.4 × 1.9–5.5 mm, ovate, abaxial surface pubescent, adaxial surface glabrous. Corolla rotaceous; tube 7–8 mm long; lobes 12–22 × 4.3–6.7 mm, linear lanceolate to lanceolate, margins entire, eciliate, abaxial surface pubescent, adaxial surface glabrous. Corona simple, annular, ca. 4 mm long, not sinuate, glabrous, carnose. Anthers with laminar appendages on dorsal surface. Retinaculum ca. 5 mm long, sagittiform; caudicles ca. 5 mm long; pollinia ca. 1.1 × 0.4 mm, ovoid. Gynostegium with style head ca. 3 mm long, plane, sessile. Ovary ca. 3 × 2.2 mm, conical, glabrous. Follicle ca. 9 × 3 cm, pyriform, glabrous, costate projections. Seed 6–7 × 5–6 mm, ovoid, margins denticulate at the base, pubescent, verrucose.

Examined material: *F.F. Allemão & M. Cysneiros 1000* (R); fl., *F. Allemão & M. Cysneiros 1001* (R); 1816, fl., *Gardner 1758* (P, US); 1839, fl., *Gardner* (K 95695).

Additional material examined: BRAZIL. PERNAMBUCO: Lagoa do Ouro, Reserva Biológica da Pedra Talhada, 9°22'88"S, 36º45'44"W, 30.XII.2014, fl., *L. Nusbaumer & A. Studer 4565* (JPB).

Gonolobus rostratus is a well-defined species; distinguished from the others by inflorescence peduncle ca. 1 cm long; corolla lobes 12–22 × 4.3–6.7 mm, linear-lanceolate to lanceolate and follicle with costate projections.

Gonolobus rostratus is endemic to Brazil with occurrences confirmed in all regions, and, in the Northeast, is restricted to Dense Ombrophylous Forest in the states of Ceará and Pernambuco (BFG 2018). In Ceará state, there are old records dating from the 19th century, and even with collection efforts between 2012 and 2019, the species has not been recollected.

2. *Matelea* Aubl., Hist. Pl. Guiane 1: 277-280, pl. 109. 1775.

Vines. Inflorescence subaxillary. Corolla campanulate or rotaceous; lobes elliptic, widely elliptic, ovate, margins entire, eciliate. Corona simple, annular or lobate. Anthers with laminar appendages on dorsal surface absent. Retinaculum ovoid, obovoid, broadly obovoid, depressed obovoid. Follicle with projections filiform or tuberculate.

Matelea, an exclusive New World genus, is represented by about 300 species (Morillo 1997). In Brazil, 46 taxa were recorded, 30 of which are endemic, distributed throughout the territory (BFG 2018). In Ceará state, five species of *Matelea* were listed associated with dry to humid environments, preferentially occurring in Stepic Savanna (Caatinga). All species from the genus have been recorded in Conservation Units in Ceará.

Matelea has morphological affinities regarding form of branch growth (scandescent), leaf blade, usually cordiform and horizontal pollinia with *Gonolobus*, but is distinguished mainly by the absence of the laminar appendage on the dorsal surface of anthers (*vs.* presence of laminar appendage on the dorsal surface of anthers) (Rapini *et al.* 2001). Although Woodson (1941) had already highlighted this morphological difference, according to Krings *et al.* (2008), it was not used in the concept of the genus *Gonolobus*, and has since been considered a synapomorphy based on its molecular studies.

2.1. *Matelea denticulata* (Vahl) Fontella & E.A.Schwarz, Bol. Mus. Bot. Munic. 46: 4. 1981. Figs. 1; 2b; 3d-e

Vine, branches lenticellate, trichomes simple, sparse hirsute to hirsute. Petiole 3.5–6.5 cm long; colleters 2. Leaf blade 7.1–13.3 × 4–8.8 cm, elliptic to widely elliptic, base cordate, apex acute to widely acute, margins slightly revolute, entire, eciliate, membranaceous, abaxial surface glabrous, adaxial surface glabrous to sparsely hirsute; colleters 4. Bract ca. 3 × 1 mm, linear, sericeous. Inflorescence umbelliform, subaxillary, peduncle 1–1.2 cm long, 2–3 flowers. Flower 0.9–1.1 cm long; pedicel ca. 1.3 cm long, sericeous. Calyx lobes ca. 4.5 × 1.5 mm, lanceolate, abaxial surface glabrous, adaxial surface glabrous to sparse strigose. Corolla rotaceous; tube ca. 2 mm long; lobes ca. 10 × 7 mm, widely elliptic, both the surface glabrous. Corona annular, ca. 0.5 mm long, slightly sinuate, glabrous, carnose. Retinaculum ca. 0.25 mm long, ovoid; caudicle ca. 0.4 mm long; pollinia ca. 0.6 × 0.2 mm, obovoid. Gynostegium with style head ca. 1 mm long, crateriform, sessile. Ovary ca. 2 × 1.8 mm, conical, glabrous. Follicle and seed not observed.

Examined material: 1859, fl., *F. Freire Alemão 998* (R). Guaramiranga, 9.XI.1925, fl., *G. Bolland* (K 95849). Ubajara, Parque Nacional de Ubajara, escritório do ICMBIO, 03°84'21"S, 40º94'33"W, 26.IV.2012, fl., *M.I.B. Loiola et al. 1527* (EAC). Murimbeca, 25.II.1999, *A. Fernandes et al.* (EAC 28015).

Matelea denticulata is characterized by the elliptic to widely elliptic leaf blade, abaxial surface glabrous and corolla lobes widely elliptic. It resembles *M. endressiae* as they both have a rotaceous corolla and cordate leaf base; however, *Matelea denticulata* has an elliptic to widely elliptic (*vs.* cordiform), abaxial surface glabrous (*vs.* dense-scabrous) and acute to widely acute apex (*vs.* long cuspidate apex).

Matelea denticulata has neotropical distribution, occurring in Mexico (the Caribbean region), and Central (Costa Rica, Honduras, Nicaragua, and Panama) and South America (Fontella-Pereira *et al.* 1989; Morillo 1997). In Brazil, the species is registered in all regions, and, in the Northeast, is restricted to the states of Bahia and Ceará (BFG 2018). In Ceará state this species was recorded in the Dense Ombrophylous Forest (wet forest) in the C4, C5 and D8 grid (Fig. 1). It occurs in the Ubajara National Park.

The species flowers in April and November.

2.2. *Matelea endressiae* Fontella & Goes, Novon 19(1): 41. 2009. Figs. 1; 2c-f; 3f-h

Vine, branches not lenticellate, trichomes mixed, strigose and dense scabrous. Petiole 1.7–2 cm long; colleters absent. Leaf blade 3.4–6 × 1.4–4 cm, cordiform, base cordate, apex long cuspidate, margins slightly revolute, entire, eciliate, membranaceous, abaxial surface sparse strigose and dense scabrous, adaxial surface sparse strigose and scabrous; colleters 4–7. Bract 3–4 × 1 mm, linear, strigose and scabrous. Inflorescence umbelliform, subaxillary, peduncle 2.2–2.8 cm

long, 10–14 flowers. Flower 1.9–2.3 cm long; pedicel 1.2–1.4 cm long, sparse strigose and dense scabrous. Calyx lobes ca. 5 × 1 mm, lanceolate, abaxial surface glabrous, adaxial surface sparse strigose and scabrous. Corolla rotaceous; tube ca. 5 mm long; lobes ca. 8 × 4 mm, elliptic, abaxial surface glabrous, adaxial surface strigose and dense scabrous. Corona annular, ca. 1 mm long, slightly sinuate, glabrous, carnose. Retinaculum ca. 1 mm long, obovoid; caudicle ca. 2 mm long; pollinia ca. 5 × 3 mm, ovate. Gynostegium with style head ca. 1.1 mm long, slightly depressed, sessile. Ovary ca. 1.5 × 1.3 mm, pyriform, glabrous. Follicle 5.8–8 × 1–2.1 cm, narrowly pyriform, strigose and scabrous, hook-shaped projections, sparse. Seed ca. 9 × 6 mm, broadly ovoid, margins denticulate at the base, scabrous, verrucose.

Examined material: Barbalha, Floresta Nacional (FLONA) Araripe-Apodi, trilha para as nascentes dos Mundés, 4.VIII.2011, fr., *E.V.R. Ferreira 327* (HVASF). Cedro, 27.II.1910, fl., *J.A.C. Löfgren 62* (S-R). Meruoca, Serra da Meruoca, mirante, 03°61'63"S, 40º39'52"W, 27.IV.2019, fl. *M.I.B. Loiola 2838* (EAC); Palestina, Sítio São Gonçalo, 03°37'47"S, 40º27'44"W, 23.XI.2018, fl., *A.F.B. Silva 136* (HUVA). Quixadá, Juatama, 14.VI.2013, fl. and fr., *A.S.F. Castro 2735* (EAC).

Matelea endressiae is characterized by leaves with long cuspidate apex, abaxial surface sparse strigose and dense scabrous; inflorescence peduncle 2.2–2.8 cm long and follicle with sparse hook-shaped projections. As already mentioned, it shares characters with *M. denticulata* presented herein.

Matelea endressiae is endemic to Brazil (BFG 2018), and is only recorded in the Northeast (Bahia, Ceará, Paraíba, Pernambuco and Rio Grande do Norte) and Southeast (Minas Gerais). In Ceará, it was collected in Stepic Savanna (Caatinga), Seasonal Deciduous Forest (Dry forest) and Dense Ombrophylous Forest (Wet forest) (grid B5, I7 and J7) (Fig. 1). It is registered in the Araripe-Apodi National Forest.

The species Flowers between February to June and November and fruits between June to August.

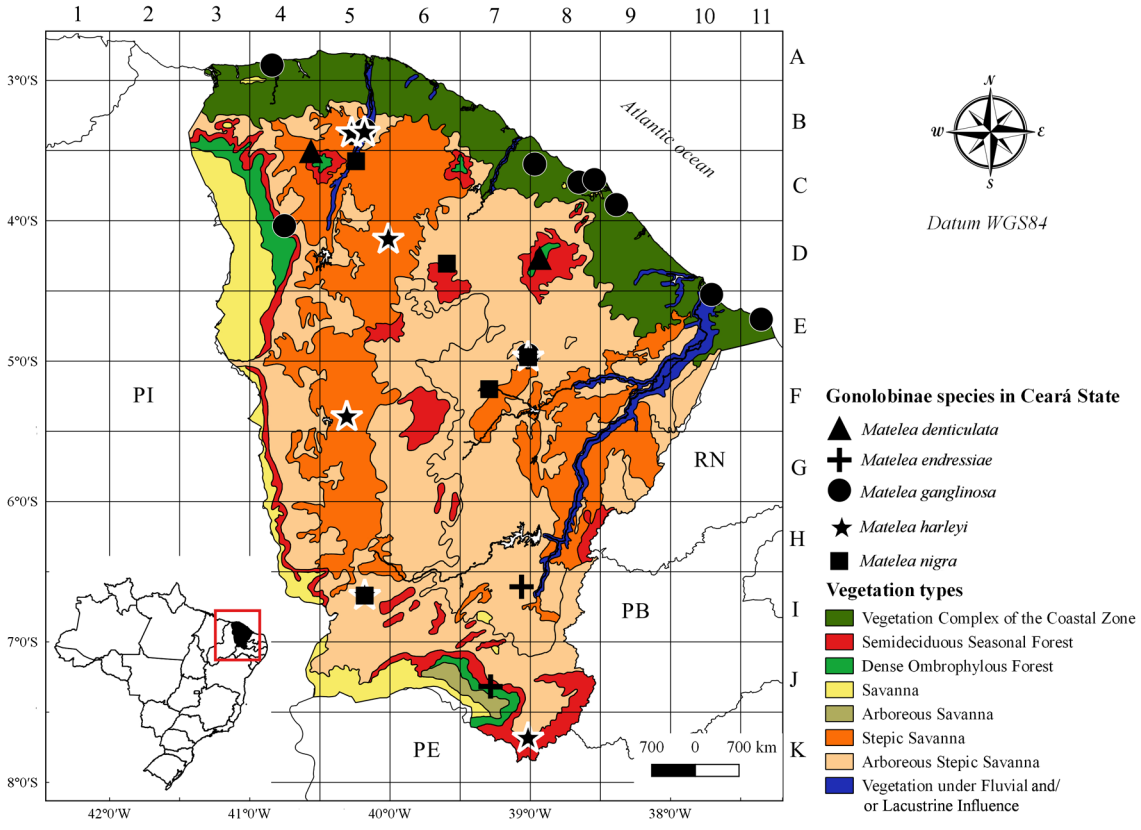

Figure 1 – Geographic distribution of Gonolobinae (Asclepiadoideae/Apocynaceae) species in Ceará state.

2.3. *Matelea ganglinosa* (Vell.) Rapini, Neodiversidade 3(2): 19. 2008. Figs. 1; 2g-j; 3i-l

Vine, branches lenticellate, trichomes simple, dense strigose. Petiole 0.8–2.8 cm long; colleters 2. Leaf blade 2.3–6.6 × 1.1–3.1 cm, cordiform to ovate cordiform, base truncate to subcordate, rare rounded, apex acute or cuspidate, margins slightly revolute, entire, eciliate, membranaceous to chartaceous, abaxial surface dense strigose, adaxial surface strigose; colleters 2–3. Bract ca. 3–4 × 1 mm, linear to lanceolate, strigose. Inflorescence glomeruliform, subaxillary, peduncle absent, 5–6 flowers. Flower 0.3–0.4 cm long; pedicel 0.3–0.5 cm long, strigose. Calyx lobes ca. 2–3 × 1 mm, narrowly triangular, abaxial surface glabrous, adaxial surface strigose. Corolla rotaceous; tube ca. 3.5 mm long; lobes 2.5–3 × 1.6–2 mm, ovate, abaxial surface glabrous, adaxial surface strigose. Corona annular, ca. 0.13 mm long, sinuate, strigose only at the apex, carnose. Retinaculum 2–3 mm long, obovoid; caudicle 2–3 mm long; pollinia ca. 6 × 4 mm, reniform. Gynostegium with style head ca. 1 mm long, crateriform, sessile. Ovary 1.5–1.9 × 1.5–1.6 mm, botuliform, glabrous. Follicle 6–7.3 × 2–3.2 cm, ovoid, strigose, filiform projections. Seed ca. 8 × 3 mm, ovoid, margins denticulate at the base, glabrous, verrucose.

Examined material: Aquiraz, Batoque, 9.VIII.1986, fl., *A. Fernandes & E. Silva 14548* (EAC, MO, RB). Aracati, Canoa Quebrada, 26.VII.1987, fr., *S. Tsugaru B-1204* (NY). Caucaia, 9.VII.2008, fr., *E. Silveira & Chaguinha* (EAC 43053). Camocim, Praia do Farol, 02°51'59"S, 40º51'36"W, 11.XI.2014, fr., *E.B. Souza et al. 3168* (EAC, HUVA). Fortaleza, Campus do Pici, UFC, próximo à Biblioteca Central, 03°44'39"S, 38°39'29"O, 27.VI.2019, fl., *N.C. Rebouças 77* (EAC); bairro Alagadiço (São Gerardo), quintal de casa, 12.IV.1946, fl., *C. de Souza & P. Bezerra 5* (EAC, MO, RB). Graça, Caraúbas, 15.V.2008, fl., *F.C.A. Eufrásio 43* (HUEFS). Icapuí, APA Praia de Ponta Grossa, 30.IV.2000, fl., *I.R. Costa 63* (EAC). Meruoca, Serra da Meruoca, Mirante, 03°61'63"S, 40º39'52"W, 27.IV.2019, fl., *M.I.B. Loiola 2839* (EAC). Quixadá, Açude Cedro, 14.VIII.2014, fr., *M.L. Guedes 22267* (ALCB, HUEFS). São Gonçalo do Amarante, 16.VIII.2005, fl. and fr., *A.S.F. Castro 1608* (EAC). Sobral, Fazenda Experimental da UVA (FAEX), 03°36'55"S, 40º18'12"W, 19.VII.2017, fr., *E.B. Souza et al. 4704* (HUVA).

Matelea ganglinosa has can be distinguished by its small flowers with 0.3–0.4 cm long, corolla lobe 2.5–3 × 1.6–2 mm, ovate and follicle with filiform projections.

Species restricted to the Brazilian territory, with distribution in the Northeast and Southeast regions (Rapini & Farinaccio 2008; BFG 2018). It is commonly confused with *Matelea maritima* (Jacq.) Woodson., which is distinguished by gynostegium flattened (*vs.* rostrate) and distribution in Southeast and Northeast Brazil (*vs.* restricted to the Northern region) (Rapini & Farinaccio 2008). In Ceará, the species was recorded in vegetation of Semideciduous Seasonal Forest (Tableland forest) and Stepic Savanna (Caatinga) (grid A4, B5, C8, C9, D4, E7, E8, E10 and E11) (Fig. 1). The species is registered at the Ponta Grossa Environmental Protection Area.

The species flowers from April to August and fruits from July to November.

2.4. *Matelea harleyi* Fontella & Morillo, Ernstia, ser. 23(3-4): 117-118, 120. 1994.

Figs. 1; 2k-m; 3m-n

Vine, branches lenticellate, trichomes mixed, strigose and sparse scabrous. Petiole 0.9–4.6 cm long; colleters 2 or absent. Leaf blade 3.5–7.7 × 1.3–4.6 cm, narrowly cordiform to cordiform, base subcordate to cordate, apex cuspidate or acuminate, margins plane, entire, ciliate, chartaceous, abaxial surface glabrous to sparse strigose, adaxial surface strigose; colleters 3–4. Bract ca. 2–3 × 1 mm, linear, strigose. Inflorescence glomeruliform, subaxillary, peduncle absent, 2–5 flowers. Flower 0.8–0.9 cm long; pedicel 0.4–0.7 cm long, strigose and sparse scabrous. Calyx lobes 6–7 × 2–2.2 mm, lanceolate to ovate lanceolate, abaxial surface glabrous, adaxial surface sparse strigose and scabrous. Corolla campanulate; tube ca. 4 mm long; lobes 6–9 × 2.5–3 mm, elliptic, abaxial surface glabrous, adaxial surface strigose. Corona lobate, 4–4.7 mm long, not sinuate, lobes tridentate with denticles subequal in length, middle denticle with apex cuspidate, glabrous, membranaceous. Retinaculum 0.5–0.6 mm long, depressed obovoid; caudicle 0.3–0.4 mm long; pollinia 0.6–0.7 × 0.3–0.4 mm, ovoid. Gynostegium with style head ca. 1.1 mm long, crateriform, stipitate. Ovary 1.3–1.4 × 1.2–1.3 mm, pyriform, glabrous. Follicle ca. 5.5 × 2.5 cm, pyriform, strigose, tuberculate projections. Seed ca. 8 × 5 mm, broadly ovoid, margins denticulate at the base, strigose, verrucose.

Examined material: Aiuaba, Milho Amarelo, 11.IV.1991, fl., *M.A. Figueiredo et al. 114* (EAC, MOSS); Volta, 11.IV.1991, fl., *M.A. Figueiredo et al. 164* (EAC). Crateús, RPPN Serra das Almas, 9.V.2002, fl., *F.S. Araújo & S.F. Vasconcelos 1543* (EAC, HUEFS). Jati, lote 05, Açude Atalho, 07°39'13"S, 38º55'17"W, 5.VIII.2011, fr., *E.V.R. Ferreira et al. 346* (HVASF).

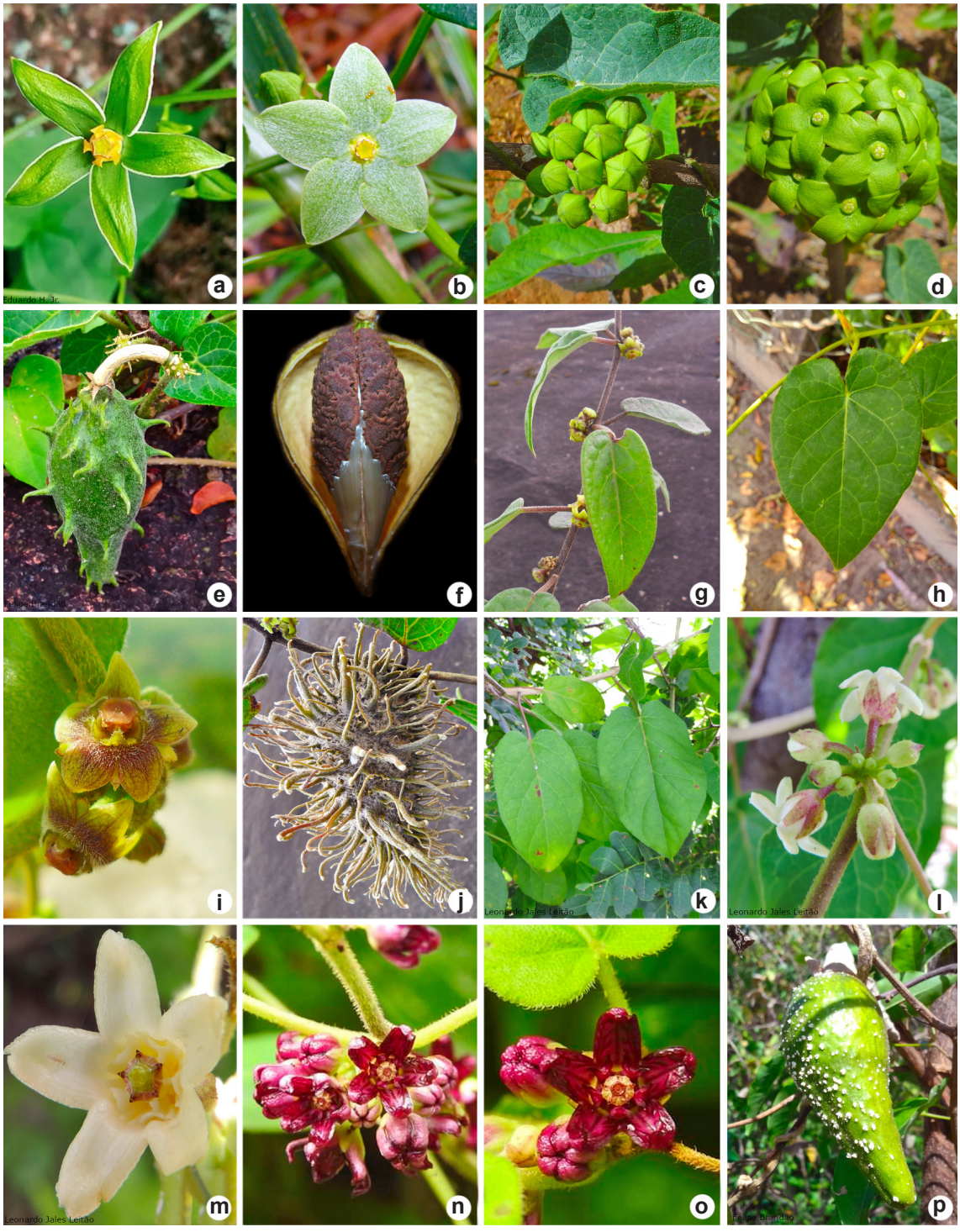

Figure 2 – a-p. Gonolobinae of Ceará – a. *Gonolobus rostratus* – flower; b. *Matelea denticulata* – flower; c-f. *M. endressiae* – c. flower buds; d. umbelliform inflorescence; e. immature follicle; f. ripe follicle; g-j. *M. ganglinosa* – g. branch; h. leaf blade; i. glomeruliform inflorescence; j. immature follicle; k-m. *M. harleyi* – k. branch; l. glomeruliform inflorescence; m. flower; n-p. *M. nigra* – n. glomeruliform inflorescence; o. flower; p. immature follicle. Credits: a. E. Messas Jr.; k-m. L.J. Leitão; e,p. F. Brandão.

Quixadá, Fazenda Iracema, 2.IV.1976, fl., *A. Fernandes* (EAC 2718). Santa Quitéria, Serra Pau Fincado, 04°13'21"S, 40º01'26"W, 15.VII.2005, fr., *J.R. Lemos 413* (HUVA). Sobral, Fazenda Experimental da UVA, Mata ciliar do Rio Acaraú, 03°37'01"S, 40º18'22"W, 10.IX.2015, fl., *E.B. Souza & F.A.A. Nepomuceno 3314* (EAC, HUVA); margem da BR-222, 5.IV.1996, fl., *A.S.F. Castro* (EAC 24029).

Matelea harleyi is characterized by the campanulate corolla, corona 4–4.7 mm long, tridentate lobes with subequal denticles and central denticle with cuspidate apex. The species shares the cordiform leaf blade, corolla lobes elliptic and corona lobate with *Matelea nigra*, characteristics that make it difficult to distinguish between taxa. However, *Matelea harleyi* is distinguished by campanulate corolla (*vs*. rotaceous) and lobes slightly tridentate, denticles subequal in length and middle denticle with cuspidate apex (*vs*. lobes deeply tridentate, denticle middle shorter in length and middle denticle with acuminate apex).

This species is exclusively Brazilian, restricted to the Northeast region, with confirmed occurrence in the states of Bahia, Ceará, Pernambuco, Rio Grande do Norte, and possibly Paraíba, and is endemic to the Caatinga phytogeographic domain (BFG 2018). In Ceará state, it was only recorded in Stepic Savanna (Caatinga), as well as Riparian forest along the banks of the Acaraú River, in the B5, D5, D6, E7, E8, F5, I5 and K7 grid (Fig. 1). The species was registered in the Private Natural Heritage Reserve Serra das Almas.

The species is registered with flowers from April to May and September and fruits in July to August.

2.5. *Matelea nigra* (Decne.) Morillo & Fontella, Ernstia 57: 2. 1990. Figs. 1; 2n-p; 3o-q

Vine, branches lenticellate, trichomes mixed, sparse strigose and scabrous. Petiole 0.9–3.2 cm long; colleters 2. Leaf blade 2.3–9 × 1.2–5 cm, cordiform, rare narrowly cordiform, base cordate, rare subcordate, apex cuspidate, margins slightly revolute, entire, ciliate, chartaceous, abaxial and adaxial surface strigose; colleters 5. Bract 3–4 × 1 mm, linear, strigose. Inflorescence glomeruliform, subaxillary, peduncle absent, 2–6 flowers. Flower 0.7–0.8 cm long; pedicel 0.4–0.6 cm long, strigose, scabrous. Calyx lobes ca. 7.5 × 2.0 mm, lanceolate, abaxial surface glabrous, adaxial surface sparse strigose. Corolla rotaceous; tube ca. 3 mm long; lobe ca. 8 × 2.3 mm, elliptic, abaxial surface glabrous, adaxial surface strigose. Corona lobate, ca. 5.5 mm long, not sinuate, lobes deeply tridentate with middle denticle shorter than laterals, middle denticle with apex acuminate, glabrous, membranaceous. Retinaculum ca. 0.5 mm long, broadly obovoid; caudicle ca. 0.3 mm long; pollinia ca. 0.6 × 0.3 mm, broadly obovoid. Gynostegium with style head ca. 1 mm long, crateriform, stipitate. Ovary ca. 1.1–1.2 × 1.2 mm, pyriform, glabrous. Follicle ca. 8 × 2.8 cm, pyriform, pubescent, tuberculate projections. Seed ca. 6 × 5 mm, ovoid, margins denticulate at the base, strigose, verrucose. **Examined material**: 1860, fl., *F.F. Allemão & M. Cysneiros 996* (R); 12.V.1912, fl., *J.A.C. Löfgren 888* (MO, R, RB, SP). Aiuaba, Estação Ecológica de Aiuaba, Maniçoba, 29.IV.1981, fl., *P. Martins* (EAC 10218; RB 50396); 12.IV.1991, fl., *M.A. Figueiredo et al. 163* (EAC). Meruoca, Serra da Meruoca, mirante, 03°61'63"S, 40º39'52"W, 27.IV.2019, fl., *M.I.B. Loiola 2837* (EAC); Sítio Santa Cruz, trilha do Delta, 03°57'56"S, 40º24'24"W, 21.VIII.2015, fl., *E.B. Souza et al. 3694* (HUVA). Quixadá, Fazenda Não me Deixes, 15.VIII.2014, fr., *M.L. Guedes 22281* (ALCB, HUEFS). Quixeramobim, 25.VII.1995, fr., *A.S.F. Castro* (EAC 23137). Sobral, Taperuaba, Refúgio de Vida Silvestre Pedra da Andorinha (REVIS), 04°03'51"S, 39º59'51"W, 8.III.2016, fr., *E.B. Souza et al. 3856* (HUVA).

Matelea nigra is distinguished by the rotaceous corolla, corona ca. 5.5 mm long, lobes deeply tridentate, denticle middle shorter in length and middle denticle with acuminate apex. Since it has vegetative and reproductive similarities with *M. harleyi*, these species are often confused and the characteristics that separate them are presented in the comments about *M. harleyi*.

The species is endemic to Brazil with confirmed occurrence in the Northeast and Southeast regions, in the Caatinga and Cerrado phytogeographic domains (BFG 2018). In Ceará, the species was found in Stepic Savanna (Caatinga) and Seasonal Deciduous Forest (Dry forest), in the C5, D6, E7, E8, F7 and I5 grid. It is present in two Conservation Units (UC) of Ceará: Aiuaba Ecological Station and Pedra da Andorinha Wildlife Refuge.

The species is collected with flowers in April and August and fruits in March and from July to August. The popular name of this species is cundu.

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Figure 3 – a-c. *Gonolobus rostratus* – a. branch and detail of leaf blade; b. flower with rotaceous corolla; c. follicle. d-e. *Matelea denticulata* – d. branch and detail of leaf blade; e. flower with rotaceous corolla. f-h. *M. endressiae* – f. branch and detail of leaf blade; g. flower with rotaceous corolla; h. follicle. i-l. *M. ganglinosa* – i. branch and detail of leaf blade; j. flower with rotaceous corolla; k. retinaculum, caudicles and polínia structures; l. follicle. m-n. *M. harleyi* – m. flower with campanulate corolla; n. lobate corona with tridentate lobes and subequal denticles in length. o-q. *M. nigra* – o. flower with rotaceous corolla; p. lobate corona with deeply tridentate lobes and middle denticle shorter than laterals; q. follicle. (a-c. *F. Allemão & M. Cysneiros 1001*; d,e. *M.I.B. Loiola et al. 1527*; f-h. *M.I.B. Loiola 2838*, *A.S.F. Castro 2735*; i-l. *N.C. Rebouças 77*, *A.S.F. Castro 1608*; m,n. *F.S. Araújo & S.F. Vasconcelos 1543*; o-q. *M.A. Figueiredo et al. 163*, *A.S.F. Castro* (EAC 23137).

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