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Vascular flora of Lençóis Maranhenses National Park, Maranhão State, Brazil: checklist, floristic affinities and phytophysiognomies of *restingas* in the municipality of Barreirinhas

Misael Lira Rodrigues[1*], Nara Furtado de Oliveira Mota[2], Pedro Lage Viana[1,2], Ana Kelly Koch[3] and Ricardo de S. Secco[2]

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ABSTRACT

This study presents a floristic survey of the vascular plants of *restingas* of Lençóis Maranheses National Park, in the municipality of Barreirinhas, Maranhão, Brazil, including descriptions of the principal phytophysiognomies and similarity analyses including other restinga areas in North and Northeastern Brazil. Samples from the study area deposited in the herbaria MG, IAN and MAR were inventoried and fieldwork for the collection of additional botanical samples was undertaken between September 2015 and August 2017. Unweighted pair group method with arithmetic mean (UPGMA) using Jaccard index was used to calculate the similarity among floras of the *restingas* of the states of Pará, Piauí, Ceará and Maranhão. A total of 289 species in 189 genera and 73 families was recorded, including 56 new occurence records for the state of Maranhão. The richest families were Poaceae, Cyperaceae, Fabaceae, Rubiaceae, Eriocaulaceae and Myrtaceae. Similarity indexes revealed low similarity among the selected areas, suggesting high floristic identity for each area, as well as possible collection bias among the areas.

Keywords: dunes, floristics, new occurrence records, seed plants, white sand vegetation

Introduction

Maranhão state is situated in the Northeastern region of Brazil and occupies an area of more than 330,000 km^2. It is situated within an area of transition between three different biomes: Cerrado, Amazon and Caatinga (Aragão & Conceição 2008). Among the different vegetation types found in this state, the *restinga* is a coastal scrub occurring always along the sandy coast in the Amazon and Atlantic Forest biomes (Maranhão 2002).

In the northeastern region of Maranhão state there is an extensive area dominated by sandy sedimentary eolic deposits occupying approximately 18,000 km^2 concentrated in the coastal region (Bandeira 2013). This area is situated in the transition between the three biomes found in the state, forming a mosaic of environments associated with sandy ecosystems, considered unique in Brazil (Saraiva & Fernandes-Pinto 2007). According to the Brazilian vegetation map (IBGE 2012), this area is dominated by pioneering formations with the occurence of vegetation with a marine influence (*restingas*, mangroves), associated with savannas and tension zones between savanna and seasonal forest (Castro & Piorski 2002). Situated in this region, the Lençóis Maranhenses National Park (PNLM) is considered a 'tropical desert' constituted by extensive dunes

1 Programa de Pós-Graduação em Ciências Biológicas, Museu Paraense Emílio Goeldi/Universidade Federal Rural da Amazônia, 66077-530, Belém, PA, Brazil
2 Coordenação de Botânica, Museu Paraense Emílio Goeldi, 66077-530, Belém, PA, Brazil
3 Departamento de Botânica e Ecologia, Instituto de Biociências, Universidade Federal de Mato Grosso, 79060-900, Cuiabá, MT, Brazil

* Corresponding author: mlirarodrigues@gmail.com

and thousands of freshwater lakes (Damme & Dumont 2010), of notable scenic beauty. According to Moschini-Carlos *et al.* (2008), the Lençóis Maranhenses correspond to a single series of dunes that extend from the Gulf of Maranhão up to the Parnaíba river, begining at the coast and advancing towards the continent for around 50 km, influenced by river courses and the sea.

A total of 3064 species of Angiosperm are attributed to Maranhão state, ranking as 19th in floristic richness amonst the states of Brazil (Flora do Brasil 2020 2018). Despite including part of three major Brazilian biomes, the flora documented in Maranhão corresponds to only a little more than 9 % of the Brazilian flora (Flora do Brasil 2020 2018). Important studies on coastal vegetation in the state of Maranhão were carried out, such as those of Araújo *et al.* (2016) and Lima & Almeida Júnior (2018). However, collection efforts are necessary to enhance the extant collections and in order to produce more precise evaluation of the state's floristic composition.

Floristic inventories were carried out in some *restinga* areas in Maranhão (Serra *et al.* 2016; Almeida Júnior *et al.* 2017; Lima & Almeida Júnior 2018), however, few studies on the flora have been developed specifically for the PNLM, apart from some scattered specimens deposited in herbaria, and the study by Moschini-Carlos *et al.* (2008), that describe the morphometric, physical and chemical variables of the ponds in PNLM, with emphasis on the planktonic community. Despite the importance of these studies, knowledge of the park's flora remains elementary.

The objective of this paper is to complete a first survey of the vascular flora in the Lençóis Maranhenses National Park, municipality of Barreirinhas, including a description of the principal phytophysiognomies as well as to carry out floristic comparisons with other *restingas* in the North and Northeastern regions of Brazil.

Materials and methods

Study area

This study was carried out in the Lençóis Maranhenses National Park (PLNM) located on the eastern coast of the state, 2°38'24"S 42°50'48"W (Fig. 1). The PNLM, established 2nd June 1981 by decree number 86,060 (ICMBIO 2016), consists of around 155 thousand hectares dominated by areas of *restinga*, encompassing the municipalities of Primeira Cruz, Santo Amaro and Barreirinhas. The sampling was restricted to the municipality of Barreirinhas, within

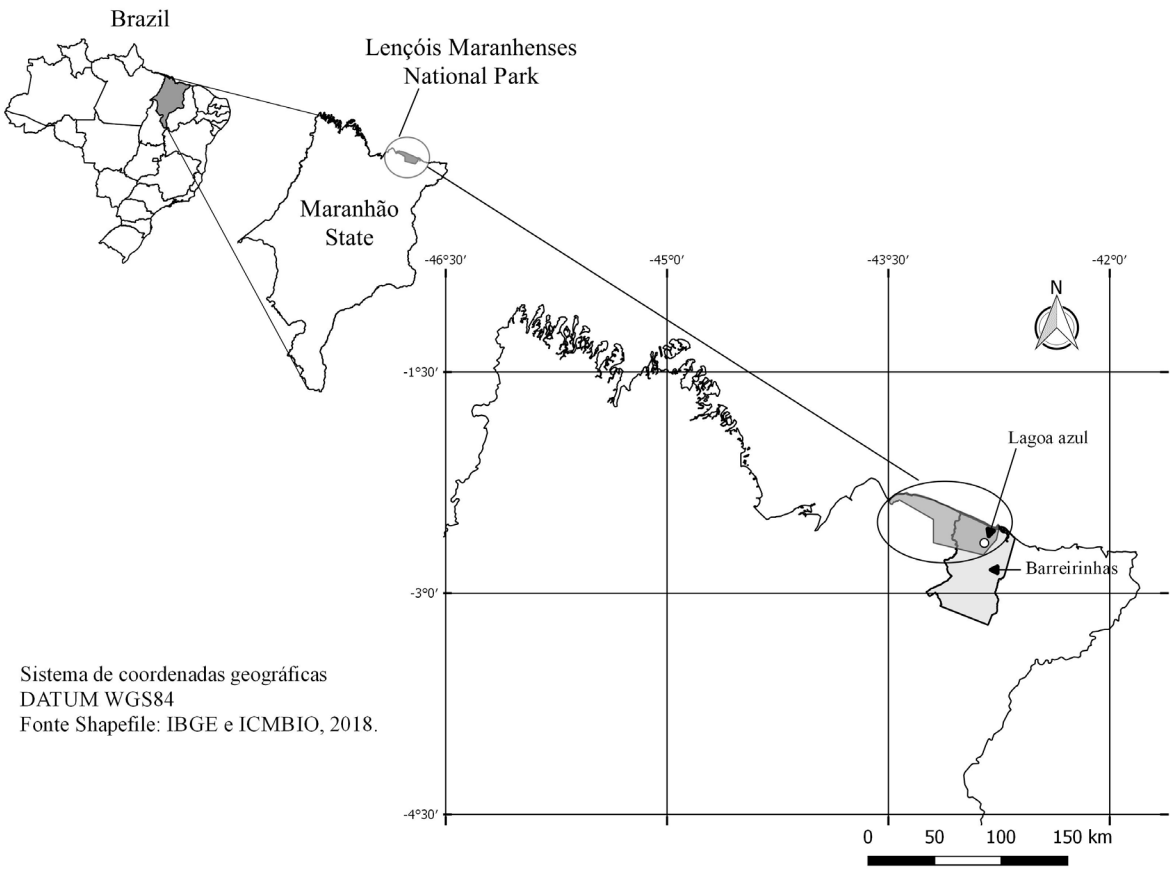

Figure 1. Map showing the study area: municipality of Barreirinhas in the Lençóis Maranhenses National Park.

the PNLM, covering 302 hectares. The average annual temperature of the region is 28.5 ºC, with most frequent precipitation in February and May, and a dry season from June to January (Miranda *et al.* 2012; ICMBIO 2016). Considered a transition zone between the semi-arid climate and equatorial humidity, the landscape of the Lençóis Maranhenses is shaped by rivers carrying sediments in the direction of the coast, causing the formation of the *restingas* in these zones. These landscapes are characteristic to the region and consist of white dunes populated by a particular vegetation (Moschini-Carlos & Pompêo 2016). This vegetation is composed of a mosaic of phytophysiognomies, generally dominated by coastal environments such as *restingas* and mangroves. Considering its peculiar phytophysiognomies, a brief description of the types found within the study area is proposed in this work, adapted from Bastos (1995) and Bastos *et al.* (2003) for the restingas of coastal Pará state.

Botanical collections and herborization

Seven expeditions for the collection of botanical material, each lasting at least five days, were carried out from September 2015 to December 2017, considering dry and wet periods. Collections were restricted to vascular plants, seeking to sample all of the habitats of the study area. Only fertile samples were collected. The samples were herborized according to appropriate techniques (Fidalgo & Bononi 1989; IBGE 2012; Walter & Fagg 2015) and incorporated into the MG Herbarium (herbarium acronyms according to Thiers 2009).

Herbarium survey

Parallel to the fieldwork, collections of the herbaria MG, IAN, and MAR were studied and inventoried, seeking samples from the municipality of Barreirinhas with the aim of adding them to the PNLM database that was used to generate the species list presented in this work.

Identification of botanical samples

The collections studied were identified with reference to the relevant taxonomical bibliography; comparison with samples previously deposited in the Herbarium MG and identified by specialists; and, when necessary, duplicates were sent to specialists to confirm the identifications.

Preparation of species list

Based on the specimen database from the study area, a list of vascular plants was generated, alphabetically organized according to family, indicating, for each species: voucher (collector + collector number + herbarium); distribution in Brazil by biome based on the Flora of Brazil online 2020 (FLORA DO BRASIL 2020 2018); habitat, based on the description of the vegetation proposed here, and habit, based on the categories followed by Flora do Brasil 2020 (2018).

The angiosperm list follows the APG IV (2016) classification system, with exception of Cordiaceae and Heliotropiaceae kept apart from Boraginaceae s.l. (BWG 2016) and Passifloraceae s.s. For ferns, Smith et al. (2006) and Rothfels et al. (2012) were followed, while for the lycophytes, Kramer & Green (1990).

The species list of the PNLM was compared with the threatened species list for the flora of Brazil online (MMA 2014), available at the National Centre of Conservation of Flora, for the confirmation of the occurrence of species threatened with extinction in the study area (CNCFLORA 2018).

Similarity analysis

The floristic composition of the area studied was compared with surveys completed in areas of restinga Northern and Northeastern Brazil: data from two areas in the state of Pará, in the municipalities of Algodoal/Maiandeua and Crispim/Marapanim (Amaral et al. 2008) were compiled and merged into a list for Pará state restingas; a first compilation of the vascular flora of the restingas in Maranhão state, based on herbarium survey (Almeida Júnior et al. 2017); restingas in Piauí state, in the municipalities of Ilha Grande, Parnaíba, Luís Correia and Cajueiro da Praia (Santos-Filho et al. 2015); and a checklist of the restingas in the state of Ceará (Santos-Filho et al. 2011). All of these listings had synonymy adjusted manually according to consultation of the Flora of Brazil 2020 database. Imprecisely identified (cf. or aff.) or material not identified to species level was excluded from the analysis. The species lists of the compared areas are available as supplementary material. The similarity analysis was completed utilizing the Jaccard index (Sneath & Sokal 1973), by the non-weighted pair method with Arithmetic Mean (UPGMA).

Results

Checklist

The specimens compiled from the studied herbaria comprised 59 herbarium sheets from MG, 154 from IAN and 347 from MAR. The fieldwork contributed 525 samples, which are deposited in MG, thus totalling 1085 materials from the Barreirinhas municipality.

The analysis of these samples revealed the occurrence of 289 species, consisting of 286 angiosperms, two ferns and one lycophyte. Within the angiosperms, 63 % of the species are Eudicots (178 species), 36 % are Monocots (105 species) and 1 % of the group belongs to the Magnoliids (three species, Tab. 1).

Table 1. Checklist of the vascular plant species in the Lençóis Maranhenses National Park Barreirinhas, Maranhão state, Brazil. Abbreviations for collector names: Mo = N.F.O. Mota; S = O. Silva; Marc = M.C.F.V. dos Santos; Mt = K.L.Martins; M = R.C. de Mendonça; B = J.M.Brito; Ca = G.C.A Carvalho; La = D.M.A Lacerda; Sa = S.M. Santos; Ex = E.F.B. de Carvalho; Cb = C. Cabral; Me = F.N.Mendes; Rm = M.C.Ramos; Rh = R. Henriques; O = R.P. Orlandi; Bo = C.B. de A. Bohrer; R = M.L. Rodrigues. Biomes: Amz = Amazon rainforest; Atl = Atlantic rainforest; Caa = Caatinga; Cer = Cerrado; Pmp = Pampa; Pnt = Pantanal. Habitats: Hv = Halophytic Vegetation; Rfi = Restinga fields; Sr = Shrubby Restinga; Sc = Scrub; Il = Interdunal lagoons; Rfo = Restinga forest; Cf = Cocais forest; Gf = Gallery forest and Mangroves. Habits: He = Herb; Sh = Shrub; Tr = Tree; Vi = Vine. First records for the state of Maranhão are assigned with +, endangered species with *.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
FERNS AND LYCOPHYTES				
DENNSTAEDTIACEAE				
Pteridium arachnoideum (Kaulf.) Maxon +	R 40 (MG-225203)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
LYCOPODIACEAE				
Palhinhaea cernua (L.) Franco & Vasc.	Mo 3120 (MG-214749)	Amz, Cer, Atl, Pmp, Pnt	Rfi	He
SCHIZAEACEAE				
Actinostachys pennula (Sw.) Hook. +	Mo 3197 (MG-214826)	Amz, Cer, Atl	Rfi	He
ANGIOSPERMS				
ACANTHACEAE				
Thyrsacanthus secundus (Leonard) A.Cortês & Rapini	R 243 (MG-228215)	Amz	Sr	Sh
ALISMATACEAE				
Helanthium tenellum (Mart.) Britton	R 12 (MG-225175); Cb 319 (MAR-2714)	Amz, Caa, Cer, Atl	Rfi	He
ALSTROEMERIACEAE				
Bomarea edulis (Tussac) Herb.	B 48 (MG-154873)	Amz, Caa, Cer, Atl, Pnt	Sc	Vi
AMARANTHACEAE				
Blutaparon portulacoides (A.St.-Hil.) Mears	R 90 (MG-225253)	Cer, Atl	Hv	He
Gomphrena sp.	Mo 3233 (MG-214862)		Rfi	He
AMARYLLIDACEAE				
Zephyranthes cearensis (Herb.) Baker	S 42 (IAN-181074); Ca 25 (IAN-185249)	Caa, Cer	Sr	He
ANACARDIACEAE				
Anacardium occidentale L.	B 16 (MG-154815); R 01 (MG-225164); Sa 15 (MAR-5970)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sc	Tr
Tapirira guianensis Aubl.	R 60 (MG-225223)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	Tr
ANNONACEAE				
Duguetia echinophora R.E.Fr.	S 25 (MG-178602); R 155 (MG-225737)	Amz, Cer	Sr	Tr
Xylopia sericea A.St.-Hil.	B 27 (MG-154822)	Amz, Cer, Atl	Rs	Sh/Tr
APOCYNACEAE				
Allamanda blanchetii A.DC.	Bo 45 (MG-154824), Bo 46 (MG-154825)	Caa, Cer	Sr	Sh
Blepharodon pictum (Vahl) W.D.Stevens	S 75 (MAR-6162); Sa s.n (MAR-6606).	Amz, Caa, Cer, Atl	Sr	Vi
Ditassa banksii R.Br. ex Schult.	Sa s.n. (MAR-6605)	Atl	Sr	Sh
Hancornia speciosa Gomes	B 29 (MG-154823)	Amz, Caa, Cer, Atl	Sr	Tr
Himatanthus articulatus (Vahl) Woodson +	R 23 (MG-225186), R 180 (MG-225762); Ca 23 (IAN-185247); S 17 (MAR-6120)	Amz, Cer	Sr	Tr
Mandevilla hirsuta (A.Rich.) K.Schum.	R 242 (MG-228214); S 86 (MAR6112)	Amz, Caa, Cer, Atl	Sr	Vi
Mandevilla scabra (Hoffmanns. ex Roem. & Schult.) K.Schum.	Mo 3106 (MG-214735; R 120 (MG-225702), R 122 (MG-225704)	Amz, Caa, Cer, Atl	Sr/Rfi	Vi
Secondatia densiflora A.DC.	Sa 22 (IAN-187629)	Amz, Caa, Cer, Atl	Sr	Vi
ARECACEAE				
Astrocaryum chambira Burret	Sa s.n (MAR-6100)	Amz	Sr/Cf	Tr
Copernicia prunifera (Mill.) H.E.Moore	R 57 (MG-225220); Sa s.n. (MAR-6099)	Caa, Cer	Sr/Cf	Tr
ASTERACEAE				
Lepidaploa arenaria (Mart. ex DC) H.Rob. +	Mo 3213 (MG-214842); Sa s.n. (MAR-6092); S 771 (MAR-6042)	Amz, Atl	Sr	Sh
Stilpnopappus cearensis Huber +	Mo 3232 (MG-214861)	Caa	Sr	He
Tilesia baccata (L.F.) Pruski	S 31 (MG-178149); R 216 (MG-225798); Mo 3226 (MG-214855)	Amz, Caa, Cer, Mata Atlêntica	Sr	Sh
BIGNONIACEAE				
Adenocalymma validum L.G.Lohmann	Rm 68 (MG-174775)	Amz, Caa, Atl	Rfo	Vi
Cuspidaria lateriflora (Mart.) DC.	S 39 (MG-178157)	Amz, Caa, Cer, Atl	Sr/Rfo	Vi
Fridericia dispar (Bureau ex K. Schum.) L.G.Lohmann +	S 38 (MG-178156)	Caa, Cer	Sr	Sh/Vi

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Tabebuia roseoalba (Ridl.) Sandwith	R 290 (MG-228262)	Caa, Cer, Atl	Sr	Tr
BURMANNIACEAE				
Burmania capitata (Walter ex J.F.Gmel) Mart.	Mo 3174 (MG-214803)	Amz, Cer, Atl	Rfi	He
BURSERACEAE				
Protium heptaphyllum subsp. *ulei* (Swart) Daly	Mo 3069 (MG-214698); R 79 (MG-225242); R 81 (MG-225244); R 281 (MG-228253); Sa 13 (IAN-187623); S 06 (MAR-6044)	Amz	Rfo	Tr
CACTACEAE				
Pilosocereus catingicola subsp. *Salvadorensis* (Werderm.) Zappi +	R 55 (MG-225218)	Caa, Atl	Rfo	Tr/Sh
CALOPHYLLACEAE				
Calophyllum brasiliense Cambess. +	R 183 (MG-225765)	Amz, Caa, Cer, Atl	Sr	Tr
CARYOCARACEAE				
Caryocar brasiliense Cambess. +	Sa 08 (MAR-6078)	Amz, Caa, Cer, Atl	Rfo	Tr
CELASTRACEAE				
Monteverdia erythroxyla (Reissek) Biral	Mo 3059 (MG-214688), Mo 3163 (MG-214792); R 42 (MG-225205), R 135 (MG-225717), R 157 (MG-225739)	Caa, Cer, Atl	Sr	Tr/Sh
CHRYSOBALANACEAE				
Chrysobalanus icaco L.	Mo 3126 (MG-214755); R 31 (MG-225194), R 84 (MG-225247), R 127 (MG-225709), R 201 (MG-225783); Sa 05 (MAR-5962), Sa 25 (MAR-5966); S 01 (MAR-6114)	Amz, Atl	Sc/Sr	Sh/Tr
Couepia guianensis subsp. *glandulosa* (Miq.) Prance	S 41 (IAN-181362)	Amz	Sr	Tr
Hirtella ciliata Mart. & Zucc.	La s.n. (MAR-7071)	Amz, Caa, Cer, Atl	Sr	Sh/Tr
CLUSIACEAE				
Clusia grandiflora Splitg.	Mo 3103 (MG-214732); R 56 (MG-225219), R 133 (MG-225715); Sa 20 (IAN-188976); S 80 (MAR-6167)	Amz	Sr	Tr
COMBRETACEAE				
Conocarpus erectus L.	Mo3151 (MG-214780); R 91 (MG-225254), R 221 (MG-225803), R 314 (MG-228286);	Amz, Atl	Hv	Sh
CONNARACEAE				
Connarus favosus Planch.	B 57 (MG-154874)	Amz, Caa	Rfo	Sh/Vi
CONVOLVULACEAE				
Ipomoea blanchetii Choisy	Mo 3072 (MG-214701)	Amz, Caa, Cer, Atl	Sr	Vi
Ipomoea brasiliana (Choisy) Meisn.	Mo 3055 (MG-214684); R 165 (MG-225747); S 22 (MG-178138); Ca 49 (IAN-185224)	Caa, Cer	Sr	Vi
Ipomoea pes-caprae (L.) R.Br.	R 66 (MG-225229)	Amz, Atl	Sr/Sc	He/Vi
Ipomoea sp.	S 49 (IAN-181346)	-	Sr	Vi
CYPERACEAE				
Bulbostylis cf. capillaris (L.) C.B.Clarcke	Mo 3071 (MG-214700)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Bulbostylis conifera (Kunth) C.B.Clarcke	Mo 3081 (MG-214710), Mo 3122 (MG-214751); R 139 (MG-225721), R 208 (MG-225790)	Amz, Caa, Cer, Atl	Rfi	He
Bulbostylis junciformis (Kunth.) C.B.Clarke	R 137 (MG-225719), R 173 (MG-225755), R 204 (MG-225786)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi	He
Bulbostylis lagoensis (Boeck) Prata & M.G.Lopez +	Mo 3051 (MG-214680)	Cer	Rfi	He
Bulbostylis lanata (Kunth) Lindm.	Mo 3102 (MG-214731); R 30 (MG-225193), R 82 (225245), R 143 (MG-225725), R 145 (MG-225727)	Amz, Cer, Atl	Sr	He
Cyperus articulatus L.	Mo 3025 (MG-214654)	Amz, Caa, Mata Atlêntica	Hv	He
Cyperus compressus L.	Mo 3032 (MG-214661)	Amz, Caa, Cer, Atl, Pnt	Rfi	He
Cyperus crassipes Vahl	R 197 (MG-225779), R 308 (MG-228280)	Caa, Atl	Sc	He
Cyperus haspan L.	Mo 3124 (MG-214753), Mo 3166 (MG-214795); R 260 (MG-228232), R 311 (MG-228283)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi	He

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Cyperus ligularis L.	Mo 3022 (MG-214651); R 195 (MG-225777), R 310 (MG-228282)	Amz, Caa, Cer, Atl	Sr	He
Cyperus obtusatus (J.Presl. & C.Presl.) Mattf. & Kük.	Mo 3030 (MG-214659); R 77 (MG-225240), R 198 (MG-225780), R 228 (MG-225810)	Amz, Caa, Cer, Atl, Pmp, Pnt	Hv	He
Cyperus odoratus L.	Mo 3216 (MG-214845)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Cyperus subsquarrosus (Muhl.) Bauters	Mo 3024 (MG-214653)	Amz, Caa, Cer, Atl, Pmp, Pnt	Hv	He
Cyperus tenuispica Steud. +	Mo 3155 (MG-214784)	Amz, Cer	Rfi	He
Eleocharis endounifascis Hinchliff & Roalson	Mo 3127 (MG-214756); R 146 (MG-225728), R 261 (MG-228233)	Amz, Caa, Atl, Pmp	Rfi	He
Eleocharis geniculata (L.) Roem & Schult.	Mo 3029 (MG-214658), Mo 3035 (MG-214664); R 09 (MG-225172), R 76 (MG-225239), R 224 (MG-225806), R 317 (MG-228289)	Amz, Caa, Cer, Atl, Pmp, Pnt	Hv/Rfi	He
Eleocharis nana Kunth	Mo 3048 (MG-214677); R 17 (MG-225180)	Amz, Caa, Cer, Atl	Rfi	He
Fimbristylis cymosa R.Br.	Mo 3019 (MG-214648), Mo 3144 (MG-214773); R 86 (MG-225249), R 227 (MG-225809)	Amz, Caa, Cer, Atl	Hv/Rfi	He
Fimbristylis dichotoma (L.) Vahl	Mo 3148 (MG-214777); R 88 (MG-225251)	Amz, Caa, Cer, Atl, Pmp, Pnt	Hv	He
Fimbristylis miliacea (L.) Vahl	R 168 (MG-225750)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Fimbristylis spadicea (L.) Vahl	R 231 (MG-225813)	Amz, Caa, Cer, Atl	Sc	He
Fuirena umbellata Rottb.	Mo 3185 (MG-214814)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi	He
Hypolytrum pulchrum (Rudge) H.Pfeiff +	Mo 3219 (MG-214848); R 172 (MG-225754)	Amz, Atl	Sr	He
Lagenocarpus guianensis Lindl. ex Nees	Mo 3087 (MG-214716)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Lagenocarpus rigidus Nees	Mo 3184 (MG-214813); R 53 (MG-225216), R 62 (MG-225225)	Amz, Caa, Cer, Atl, Pnt	Sr/Rfi	He
Lagenocarpus cf. sabanensis Gilly	R 147 (MG-225729)	Amz, Caa, Cer, Atl, Pnt	Sr/Rfi	He
Lagenocarpus verticillatus (Spreng.) T.Koyama & Maguire	R 50 (MG-225213), R 142 (225724); Mo 3179 (MG-214808)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Lagenocarpus sp.	R 148 (MG-225730), R 262 (MG-228234)	-	Sr/Rfi	He
Rhynchospora barbata (Vahl) Kunth	Mo 3082 (MG-214711), Mo 3092 (MG-214721); R 26 (MG-225189), R 138 (MG-225720), R 141 (MG-225723), R 259 (MG-228231) R 296 (MG-228268); Ca 14 (IAN-185238)	Amz, Caa, Cer	Sr/Rfi	He
Rhynchospora curvula Griseb. +	Mo 3169 (MG-214798)	Caa	Rfi	He
Rhynchospora filiformis Vahl. +	R 144 (MG-225726)	Amz, Caa, Cer	Rfi	He
Rhynchospora hirsuta (Vahl) Vahl	Mo 3093 (MG-214722), Mo 3114 (MG-214743)	Amz, Cer	Rfi	He
Rhynchospora holoschoenoides (Rich.) Herter	R 171 (MG-225753); Mo 3090 (MG-214719), Mo 3218 (MG-214847)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr/Rfi	He
Rhynchospora tenuis Link.	Mo 3020 (MG-214649), Mo 3073 (MG-214702), Mo 3136 (MG-214765); R 20 (MG-225183)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sc/Rfi	He
Scleria martii (Nees) Steud.	Mo 3180 (MG-214809); R 52 (MG-225215), R 149 (MG-225731)	Amz, Cer	Sr/Rfi	He
Scleria microcarpa Nees	Mo 3101 (MG-214730); R 174 (MG-225756)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
DILLENIACEAE				
Davilla cearensis Huber	B 41 (MG-154872); R 58 (MG-225221); S 08 (MAR-6048)	Amz, Cer, Atl	Sr	Vi
Doliocarpus spraguei Cheesman +	Mo 3109 (MG-214738); R 234 (MG-225816); Sa 05 (IAN-188962)	Amz	Sr	Sh/Vi
DIOSCOREACEAE				
Dioscorea multiflora Mart. ex Griseb.	Mo 3053 (MG-214682); R 160 (MG-225742)	Amz, Cer, Atl	Sr	Vi
DROSERACEAE				
Drosera sessilifolia A.St.-Hil.	R 249 (MG-228221), R 295 (MG-228267); Sa s/n (MAR-6613)	Amz, Caa, Cer, Atl, Pnt	Rfi	He
ERIOCAULACEAE				

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Eriocaulon cinereum R.Br. +	R 13 (MG-225176), R 316 (MG-228288); Mo 3203 (MG-214832)	Amz, Caa, Cer, Pnt	Il/Sc/ Rfi	He
Eriocaulon setaceum L.	R 255 (MG-228227), R 272 (MG-228244)	Amz, Caa, Cer, Pnt	Sr/Il	He
Paepalanthus bifidus (Schard.) Kunth	Cb 11 (MAR-2634)	Amz, Caa, Cer, Atl	Rfi	He
Paepalanthus polytrichoides Kunth +	Cb 8 (MAR-2633), Cb 14 (MAR-2635)	Amz	Rfi	He
Paepalanthus sessiliflorus Mart. ex Körn. +	Mo 3217 (MG-214846)	Amz, Caa, Cer	Il	He
Paepalanthus subtilis Miq.	Mo 3156 (MG-214785)	Amz, Caa, Cer, Atl	Sr	He
Syngonanthus cuyabenses (Bong.) Giul., Helsond & L.R.Parra	R 18 (MG-225181), R 252 (MG-228224)	Amz, Caa, Cer	Sr/Rfi	He
Syngonanthus heteropeplus (Koern.) Ruhland	R 253 (MG-228225)	Amz, Cer	Sr	He
Syngonanthus philodicoides (Körn.) Ruhland +	R 293 (MG-228265)	Cer	Rfi	He
Syngonanthus umbellatus (Lam.) Ruhland +	R 45 (MG-225208)	Amz, Cer	Sr	He
EUPHORBIACEAE				
Croton pycnadenius Müll. Arg.	R 238 (MG-25820); Mo 3199 (MG-214828); S 57 (IAN-181347), S 68 (IAN-181357)	Amz, Cer	Sr	He
Croton sp.	R 163 (MG-225745)	-	Sr	Tr
Dalechampia scandens L.	R 193 (MG-225775)	Amz, Caa, Cer, Atl, Pnt	Sr	Vi
Euphorbia bahiensis (Klotzsch & Garcke) Boiss	Mo 3210 (MG-214839)	Atl	Sr	He
Mabea pohliana (Benth.) Müll.Arg.	R 239 (MG-225821)	Amz, Cer	Sr	Sh/Tr
Microstachys corniculata (Vahl) Griseb.	Mo 3140 (MG-214769)	Amz, Caa, Cer, Atl	Rfi	He
FABACEAE				
Abarema cochleata (Willd.) Barnabey & J.W.Grimes	R 03 (MG-225166); Mo 3228 (MG-214857); Sa 21 (MAR-5968); Ex 77 (MAR-3243)	Amz	Sr/Rfo	Tr
Aeschynomene brevipes Benth.	Mo 3205 (MG-214834); R 309 (MG-228281); Ca 55 (IAN-185220)	Amz, Caa, Cer	Sr/ Rfi	Sh/He
Andira vermifuga (Mart.) Benth.	R 237 (MG-225819); Mo 3204 (MG-214833)	Amz, Caa, Cer, Atl	Rfo	Tr
Bauhinia cf. dubia G.Don.	Mo 3237 (MG-214866); S 36 (MG-178154); B 35 (MG-154868)	Amz, Cer	Sr	Sh
Calliandra dysantha Benth. +	R 192 (MG-225774), R 279 (MG-228251); Mo 3049 (MG-214678); S 67 (MG-181356)	Caa, Cer	Sr	Sh
Calliandra sessilis Benth.	B 67 (MG-154877)	Amz, Caa, Cer	Sr	Tr
Centrosema brasilianum (L.) Benth.	S 32 (MG-178150); Sa 11 (MG-188969)	Amz, Caa, Cer, Atl, Pnt	Sr	Vi
Centrosema pascuorum Mart. ex Benth. +	Mo 3130 (MG-214759)	Amz, Caa, Cer, Atl, Pnt	Sr	Vi
Chamaecrista flexuosa (L.) Green	Mo 3206 (MG-214835); R 05 (MG-225168)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr/Sc	Sh/He
Chamaecrista ramosa (Vogel) H.S.Irwin & Barneby	O 648 (MG-136967); Mo 3123 (MG-214752); R 33 (MG-225196), R 116 (MG-225698) R 124 (MG-225706), R 186 (MG-225768); S 50 (IAN-181363); Sa 07 (MAR-5967); Ca 05 (MAR-6590)	Amz, Caa, Cer, Atl, Pnt	Sr/Rfi	Sh
Clitoria stipularis Benth.	Mo 3149 (MG-214778)	Amz, Caa	Rfi	Sh/ He/Vi
Copaifera martii Hayne	Mo 3060 (MG-214689); S 63 (MG-154829); R 61 (MG-225224), R 154 (MG-225736); Ca s.n. (IAN-185276); S 21 (MAR-6055)	Amz, Caa, Cer	Sr/Rfo	Sh/Tr
Desmodium barbatum (L.) Benth.	Mo 3194 (MG-214823)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Diplotropis sp.	S 23 (MG-178140)	-	Sr	Tr
Dimorphandra gardneriana Tul.	B 59 (MG-154827)	Caa, Cer	Rfo	Tr
Dioclea cf. virgata (Rich.) Amshoff	Sa 09 (IAN-188967); R 196 (MG-225778)	Amz, Caa, Cer, Atl, Pnt	Sr	Vi
Hymenaea velutina Ducke	Mo 2760 (MG-211453), Mo 3192 (MG-214821); S 18 (MG-174297); R 54 (MG-225217), R 131 (MG-225713); Sa 12 (IAN-187622); Ca 08 (MAR-6589)	Caa, Cer	Sr/Rfo	Tr/Sh
Indigofera microcarpa Desv.	Mo 3038 (MG-214667); R 68 (MG-225231)	Caa, Atl	Sc	He
Leptolobium nitens Vogel +	S 64 (IAN-181087)	Amz	Rfo	Tr
Mimosa sp.	Mo 3135 (MG-214764), Mo 3231 (MG-214860); R 185 (MG-225767)	-	Sr	Sh
Periandra mediterranea (Vell.) Taub.	R 217 (MG-225799), R 278 (MG-228250); S 48 (MAR-6169)	Amz, Caa, Cer, Atl	Sr	Sh

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Plathymenia reticulata Benth.	B 30 (MG-154866); Me 85 (MG-174784)	Amz, Caa, Cer, Atl	Rfo	Tr
Poincianella pyramidalis (Tul.) L.P.Queiroz	Marc s.n.(MAR-7302)	Amz, Caa	Rfo	Tr/Sh
Pterocarpus santalinoides L'Hér. ex DC.	R 280 (MG-228552)	Amz, Cer, Pnt	Sr	Tr
Senna obtusifolia (L.) H.S. Irwin & Barneby	R 152 (MG-225734)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He/Sh
Senna pendula (Humb. & Bonpl. ex Willd.) H.S.Irwin & Barneby	R 241 (MG-228213)	Amz, Caa, Cer, Atl, Pnt	Sr	Sh/Tr/Vi
Stryphnodendron coriaceum Benth.	R 199 (MG-225781), R 233 (MG-225815); Sa 20 (MAR-5996); Mo 3107 (MG-214736)	Caa, Cer	Rfi	Tr
Stylosanthes angustifolia Vogel	Mo 3080 (MG-214709), Mo 3138 (MG-214767), Mo 3181 (MG-214810); R 222 (MG-225804), R 267 (MG-228239)	Amz, Caa, Cer, Atl	Sr/Rfi	Sh
Stylosanthes guianensis (Aubl.) Sw.	S 33 (MG-178151); Mo 3202 (MG-214831)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Vatairea sericea (Ducke) Ducke +	B 17 (MG-154816)	Amz	Rfo	Tr
Zornia latifolia Sm.	Mo 3145 (MG-214774), Mo 3153 (MG-214782); Sa 10 (IAN-188968)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi	He
GENTIANACEAE				
Schultesia guianensis (Aubl.) Malme	Mo 3043 (MG-214672); R 16 (MG-225179), R 78 (MG-225241), R 211 (MG-225793), R 277 (MG-228249); Sa 27 (IAN-187633); Ca 16 (IAN-185240)	Amz, Caa, Cer, Atl	Rfi/Il/Sr	He
HELIOTROPIACEAE				
Euploca polyphylla (Lehm.) J.I.M.Melo & Semir	R 74 (MG-225237), R 170 (MG-225752), R 194 (MG-225776), R 220 (MG-225802); Mo 3063 (MG-214692); S 24 (MG-178601); Sa 28 (MAR-5960)	Amz, Caa, Atl	Sr/Rfi	He
HUMIRIACEAE				
Humiria balsamifera (Aubl.) A.St.-Hil.	Mo3121 (MG-214750), Mo 3193 (MG-214822); R 32 (MG-225195), R 132 (MG-225714), R 269 (MG-228241); S 18 (MAR-6055), S 20 (MG-174309); Ca 02 (IAN-185226)	Amz, Caa, Cer, Atl	Sr/Rfo	Tr/Sh
HYPERICACEAE				
Vismia guianensis (Aubl.) Choisy	R 300 (MG-228272)	Amz, Caa, Cer, Atl	Sr	Sh/Tr
KRAMERIACEAE				
Krameria tomentosa A.St.-Hil.	Mo 3104 (MG-214733); R 85 (MG-225248), R 299 (MG-228271); Sa s.n. (MAR-6075), Sa s.n. (MAR-6076)	Amz, Caa, Cer, Atl	Sr/Rfo	Sh
LAMIACEAE				
Amasonia campestris (Aubl.) Moldenke	Mo 3212 (MG-214841), Mo 3234 (214863); R 240 (MG-225822)	Amz, Caa, Cer, Atl	Sr	Sh
Hyptis atrorubens Poit.	R 189 (MG-225771)	Amz, Cer, Atl	Sr	He
LAURACEAE				
Cassytha filiformis L.	Mo 3115 (MG-214744); R 39 (MG-225202), R 184 (MG-225766), R 257 (MG-228229); Sa 39 (MAR-5965); S 03 (MG-174305)	Amz, Caa, Cer, Atl	Sr	Vi
LECYTHIDACEAE				
Eschweilera decolorans Sandwith +	B 023 (MG-154819)	Amz	Sr	Tr
LENTIBULARIACEAE				
Utricularia adpressa Salzm. ex A.St.-Hil. & Girard.	Mo 3178 (MG-214807), Mo 3183 (MG-214812)	Amz, Cer	Rfi	He
Utricularia benjaminiana Oliv. +	R 244 (MG-228216)	Amz	Rfi	He
Utricularia cornuta Michx.	Mo 3177 (MG-214806), Mo 3044 (MG-214673); R 10 (MG-225173), R 92 (MG-225255), R 246 (MG-228218), R 303 (MG-228275), R 304 (MG-228276)	Cer	Rfi/Il/Sc	He
Utricularia myriocista A.St.-Hil. & Girard. +	Mo 3125 (MG-214754) R 302 (MG-228274)	Amz, Cer, Atl	Rfi	He
Utricularia simulans Pilg.	Mo 3172 (MG-214801)	Amz, Caa, Cer, Atl	Rfi	He

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Utricularia subulata L.	R 8 (MG-225171), R 247 (MG-228219), R 248 (MG-228220), R 294 (MG-228266); Mo 3045 (MG-214674), Mo 3046 (MG-214675), Mo 3154 (MG-214783), Mo 3189 (MG-214818)	Amz, Caa, Cer, Atl	Rfi/Il/ Sr	He
LORANTHACEAE				
Passovia pedunculata (Jacq.) Kuijt	B 61 (MG-154828), B 66 (MG-154876); Mo 3182 (MG-214811)	Amz, Cer	Rfi	He
Passovia ovata (Pohl ex DC.) Eichler	S 10 (MG-174310)	Amz, Caa, Cer	Sr	He
Psittacanthus robustus (Mart.) Mart.	R 02 (MG-225165)	Amz, Caa, Cer, Atl, Pnt	Sc	He
LYTHRACEAE				
Cuphea antisyphilitica Kunth.	Mo 3100 (MG-214729), Mo 3171 (MG-214800); R 245 (MG-228217)	Amz, Cer, Atl	Sr/Rfi	Sh
Cuphea ericoides Cham. & Schltdl.	R 27 (MG-225190), R 119 (MG-225701), R 191 (MG-225773); Mo 3089 (MG-214718); S 04 (IAN-181091)	Caa, Cer	Sr/Rfi	Sh
Lafoensia pacari A.St.-Hill.	B 13 (MG-146979)	Cer	Sr	Tr
MALPIGHIACEAE				
Byrsonima laevis Nied. +	R 130 (MG-225712), R 232 (MG-225814); Mo 3110 (MG-214739); B 14 (MG-154813)	Amz	Sc/Sr	Tr
Byrsonima sericea DC.	R 04 (MG-225167),R 129 (MG-225711), R 275 (MG-228247); S 13 (MG-174301)	Amz, Caa, Cer, Atl	Sc/Sr	Sh
Byrsonima sp.	Mo 3128 (MG-214757) S 09 (MG-174302)	-	Sr	Tr/Sh
Heteropterys nervosa A.Juss. +	S 05 (MG-174312); Ca 03 (MAR-6591)	Amz, Cer, Atl	Sc/Sr	Vi
Niedenzuella sp.	B 02 (MG-146969)	-	-	Vi
Stigmaphyllon paralias A.Juss.	S 34 (MG-178152); R 125 (MG-225707), R 159 (MG-225741); Mo 3074 (MG-214703); B 34 (MG-154867)	Caa, Cer, Atl	Sr	Sh
MALVACEAE				
Sida castanocarpa Kaprov.	Sa 13 (IAN-188970)	Caa, Cer	Sr	He
Sida cordifolia L.	R 067 (MG-225230)	Amz, Caa, Cer, Atl	Sc	He
Sterculia sp.	Sa 11 (IAN-187621)	-	-	Sh
MAYACACEAE				
Mayaca longipes Mart. ex Seub. +	Mo 3224 (MG-214853)	Amz, Cer, Atl, Pnt	Rfi/Il	He
MELASTOMATACEAE				
Comolia villosa (Aubl.) Triana	S 35 (MG-178153); Mo 3220 (MG-214849), Mo 3023 (MG-214652, Mo 3097 (MG-214726); R 47 (MG-225210), R 115 (MG-225697), R 190 (MG-225772), R 219 (MG-225801), R 263 (MG-228235), R 282 (MG-228254), R 305 (MG-228277); Ca 11 (IAN-185235)	Amazônica, Caa, Atl	Sr/Rfi	Sh
Mouriri guianensis Aubl.	R 35 (MG-225198), R 134 (MG-225716), R 235 (MG-225817); Mo 3129 (MG-214758); Ca 11 (MAR-6585), Ca 17 (IAN-185241); B 26 (MG-154821)	Amz, Cer, Atl, Pnt	Sr/Sc	Sh/Tr
Siphanthera cordifolia (Benth.) Gleason +	Sa 36 (MAR-5992); R 11 (MG-225174), R 14 (MG-225177), R 251 (MG-228223)	Amz, Atl	Rfi/Il	He
MENYANTHACEAE				
Nymphoides humboldtiana (Kunth) Kuntze	Mo 3042 (MG-214671); R 187 (MG-225769), R 301 (MG-228273); Sa 31 (MAR-5995)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi/Il	He
MYRTACEAE				
Eugenia biflora (L.) DC.	R 44 (MG-225207), R 287 (MG-228259)	Amz, Caa, Cer	Sr	Sh/Tr
Eugenia punicifolia (Kunth.) DC.	Mo 3207 (MG-214836)	Amz, Caa, Cer, Atl	Sr	Sh
Eugenia sp.	R 162 (MG-225744), R 164 (MG-225746); B 38 (MG-154870); Mo 3214 (MG-214843); S 30 (MG-173148)	-	Sr	Sh

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Myrcia multiflora (Lam.) DC.	R 22 (MG225185), R 36 (MG-225199), R 182 (MG-225764), R 268 (MG-228240)	Amz, Caa, Cer, Atl	Rfo	Sh/Tr
Myrcia splendens (Sw.) DC.	R 41 (MG-225204), R 156 (MG-225738); B 65 (MG-154830)	Amz, Caa, Cer, Atl	Rfo	Tr
Myrcia sylvatica (G.Mey) DC.	Mo 3070 (MG-214699)	Amz, Caa, Cer	Rfo	Tr
Myrcia tomentosa (Aubl.) DC.	R 59 (MG-225222); B 70 (MG-154830)	Amz, Caa, Cer, Atl	Sr	Tr
Myrcia sp.	R 38 (MG-225201), R 43 (MG-225206)	-	Rfo	Tr
Myrciaria floribunda (H.West ex Willd.) O.Berg. +	B 25 (MG-154820)	Amz, Caa, Cer, Atl	Rfo	Tr
NYCTAGYNACEAE				
Guapira pernambucensis (Casar.) Lundell.	Mo 3161 (MG-214790); Sa s.n. (MAR-6628)	Atl	Sr	Sh
OCHNACEAE				
Ouratea caudata Engl.	Mo 3108 (MG-214737); R 34 (MG-225197), R 158 (MG-225740), R 175 (MG-225757), R 285 (MG-228257), R 298 (MG-228270); Ca 06 (IAN-185220), Ca 20 (IAN-185244); S 15 (MG-174313)	Amz, Cer	Sr	Sh
Sauvagesia sp.	Mo 3176 (MG-214805)	-	Sr	Sh/He
ONAGRACEAE				
Ludwigia leptocarpa (Nutt.) H.Hara	Cb 15 (MAR-2646)	Amz, Caa, Cer, Atl, Pnt	Rfi	Sh/E
Ludwigia octovalvis (Jacq.) P.H.Raven +	Mo 3230 (MG-214859)	Amz, Caa, Cer, Atl, Pnt	Rfi	Sh/He
Ludwigia sp.	Mo 3190 (MG-214819); R 75 (MG-225238); Ex s.n. (MAR-3244)	-	Rfi	He
ORCHIDACEAE				
Habenaria depressifolia Hoehne +	Mo 3201 (MG-214830)	Amz, Cer	Rfi	He
Habenaria leprieuri Rchb.F. +	Mo 3175 (MG-214804)	Amz, Cer	Rfi	He
Habenaria ludibundiciliata J.A.N.Batista & Bianch	Mo 3198 (MG-214827)	Amz, Cer	Rfi	He
Habenaria orchiocalcar Hoehne	Mo 3173 (MG-214802)	Amz, Cer	Rfi	He
Habenaria sprucei Cogn.	Mo 3165 (MG-214794), Mo 3079 (MG-214708)	Amz, Caa, Cer	Rfi	He
Trichocentrum sprucei (Lindl.) M.W.Chase & N.H.Williams +	R 283 (MG-228255)	Amz	Rfo	He
PASSIFLORACEAE				
Passiflora foetida L.	Mo 3191 (MG-214820); R 64 (MG-225227)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	Vi
PENTAPHYLACACEAE				
Ternstroemia delicatula Choisy +	Ca 10 (MAR-6593)	Amz	Sr	Sh
PHYLLANTACEAE				
Phyllanthus hyssopifolioides Kunth +	Mo 3227 (MG-214856)	Amz, Cer	Sr	He
Phyllanthus orbiculatus Rich.	Mo 3209 (MG-214838)	Amz, Caa, Cer	Sr	He
Phyllanthus stipulatus (Raf.) G.L.Webster	Mo 3065 (MG-214694)	Amz, Cer, Atl	Sr	He
PLANTAGINACEAE				
Bacopa cochlearia (Huber) L.B.Sm. *+	R 15 (MG-225178)	Caa	Il	He
Bacopa imbricata (Benth.) Pennell	R 319 (MG-228291)	Amz	Sc	He
Bacopa reflexa (Benth.) Edwall	Mo 3047 (MG-214676)	Amz, Cer	Rfi	He
Bacopa salzmannii (Benth.) Wettst. ex Edwall	Mo 3037 (MG-214666)	Amz, Caa, Cer, Atl, Pnt	Sc	He
Dizygostemon sp.	Mo 3099 (MG-214728)	Caa	Rfi	He
Tetraulacium veroniciforme Turcz.	Mo 3067 (MG-214696), Mo 3131 (MG-214760)	Caa, Atl, Pnt	Rfi	He
POACEAE				
Andropogon bicornis L	R 176 (MG-225758)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr	He
Andropogon leucostachyus Kunth.	R 24 (MG-225187), R 177 (MG-225759), R 206 (MG-225788); Mo 3028 (MG-214657)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sr/Sc	He
Andropogon virgatus Desv.	Mo 3088 (MG-214717)	Amz, Caa, Cer, Atl, Pmp	Rfi	He
Aristida longifolia Trin.	Mo 3105 (MG-214734); R 80 (MG-225243), R 288 (MG-228260)	Amz, Caa, Cer	Sr/Rfi	He
Axonopus capillaris (Lam.) Chase	Mo 3056 (MG-214685), Mo 3215 (MG-214844)	Amz, Caa, Cer, Atl	Sr/Rfi	He

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Axonopus polydactylus (Steud.) Dedecca	Mo 3058 (MG-214687), Mo 3141 (MG-214770); R 179 (MG-225761)	Cer, Atl	Sr/Rfi	He
Axonopus purpusii (Mez.) Chase	Mo 3075 (MG-214704), Mo 3137 (MG-214766); R 29 (MG-225192)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Cenchrus brownii Roem. & Schult. +	Mo 3142 (MG-214771); R 70 (MG-225233)	Amz, Caa, Cer, Atl, Pnt	Cr/Sc	He
Coleataenia stenodes (Griseb) Soreng. +	Mo 3085 (MG-214714)	Amz, Cer	Rfi	He
Cyphonathus discrepans (Döll) Zuloaga & Morrone	Mo 3050 (MG-214679)	Amz, Cer, Atl	Rfi	He
Digitaria cuyabensis (Trin.) Parodi +	Mo 3158 (MG-214787); R 213 (MG-225795)	Caa, Cer, Atl, Pmp, Pnt	Sc	He
Eragrostis guianensis Hitchc. +	R 83 (MG-225246), R 202 (MG-225784), R 229 (MG-225811), R 230 (MG-225812); Mo 3027 (MG-214656)	Amz	Sc/Rfi	He
Eragrostis maypurensis (Kunth) Steud	R 289 (MG-228261)	Amz, Caa, Cer, Atl	Sr	He
Gymnopogon foliosus (Willd.) Nees	R 48 (MG-225211)	Amz, Caa, Cer, Atl	Sr	He
Homolepis isocalycia (G. Mey.) Chase	S 44 (MAR-6061)	Amz, Caa, Cer, Atl	Sr	He
Mesosetum loliiforme (Hochst. ex Steud.) Chase	Mo 3052 (MG-214681)	Amz, Caa, Cer, Atl, Pnt	Sr/Rfi	He
Mesosetum sp. nov.	R 72, 93, R 205 (MG-225787), 210; Mo 3040, 3112	-	Rfi/Sc	He
Panicum aquaticum Poir.	Mo 3041 (MG-214670)	Amz, Caa, Cer, Atl, Pmp, Pnt	Sc/Il	He
Panicum trichoides Sw.	Mo 3208 (MG-214837)	Amz, Caa, Cer, Atl, Pnt	Sr	He
Paspalidium geminatum (Forssk.) Stapf.	Mo 3021 (MG-214650)	Amz, Caa, Atl, Pnt	Sc	He
Paspalum carinatum Humb. & Bonpl. ex Flüggé	Mo 3076 (MG-214705)	Amz, Caa, Cer, Atl, Pnt	Sr/Rfi	He
Paspalum ligulare Nees	Mo 3033 (MG-214662)	Amz, Caa, Atl	Sc	He
Paspalum pulchellum Kunth	Mo 3170 (MG-214799), Mo 3077 (MG-214706); R 28 (MG-225191)	Amz, Cer	Sr/Rfi	He
Paspalum pumilum Nees +	Mo 3062 (MG-214691)	Amz, Cer, Atl, Pmp	Sr	He
Paspalum spissum Swallen	R 178 (MG-225760)	Amz, Cer	Sr	He
Paspalum vaginatum Sw.	R 225 (MG-225807); Mo 3031 (MG-214660)	Amz, Caa, Cer, Atl, Pmp, Pnt	Hv	He
Reimarochloa aberrans (Döll) Chase +	R 214 (MG-225796); Mo 3159 (MG-214788)	Amz	Sc	He
Rhytachne guianensis (Hitchc.) Clayton +	Mo 3186 (MG-214815)	Amz	Rfi	He
Sacciolepis vilvoides (Trin.) Chase +	R 256 (MG-228228)	Amz, Caa, Cer, Atl	Sr	He
Spartina alterniflora Loisel.	R 89 (MG-225252), R 223 (MG-225805), R 313 (MG-228285)	Amz, Atl, Pmp	Hv/Sc	He
Sporobolus virginicus (L.) Kunth	R 87 (MG-225250), R 226 (MG-225808); Mo 3034 (MG-214663)	Amz, Caa, Cer, Atl, Pmp	Hv	He
Streptostachys asperifolia Desv.	R 166 (MG-225748); Mo 3054 (MG-214683), Mo 3211 (MG-214840)	Amz, Caa, Cer, Atl	Sr	He
Trachypogon spicatus (L.f.) Kuntze	R 06 (MG-225169), R 07 (MG-225170), R 150 (MG-225732), R 203 (MG-225785) R 207 (MG225789), R 307 (MG-228279); Mo 3078 (MG-214707), Mo 3111 (MG-214740)	Amz, Caa, Cer, Atl	Rfi	He
Trachypogon vestitus Andersson	Sa 02 (MAR-6095)	Amz, Caa, Cer, Atl	Sr	He
Trichanthecium polycomum (Trin.) Zuloaga & Morrone +	Mo 2775 (MG-211468); R 46 (MG-225209)	Amz, Caa, Atl	Sr	He
Trichanthecium nervosum (Lam.) Zuloaga & Morrone +	Mo 3084 (MG-214713)	Amz, Caa, Cer, Atl, Pnt	Rfi	He
POLYGALACEAE				
Asemeia rhodoptera (Mart. ex A.W.Benn.) J.F.B.Pastore & J.R. Abbott +	Mo 3096 (MG-214725)	Cer	Rfi	He
Polygala adenophora DC.	Mo 3222 (MG-214851)	Amz, Cer, Atl	Sr/Rfi	He
Polygala appressa Benth.	Mo 3083 (MG-214712), Mo 3236 (MG-214865); R 117 (MG-225699)	Amz, Cer, Atl	Sr/Rfi	He
Polygala glochidata Kunth	Mo 3039 (MG-214668), Mo 3143 (MG-214772)	Amz, Caa, Cer, Atl	Rfi	He

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
Polygala sedoides A.W.Benn	R 306 (MG-228278)	Amz, Cer, Atl	Rfi	He
Polygala subtilis Kunth	Mo 3095 (MG-214724)	Amz, Cer	Rfi	He
Polygala trichosperma Jacq.	Mo 3098 (MG-214727), Mo 3134 (MG-214763), Mo 3229 (MG-214858); R 25 (MG-225188), R 118 (MG-225700), R 121 (MG-225703), R 123 (MG-225705), R 188 (MG-225770), R 212 (MG-225794), R 292 (MG-228264); Ca 01 (IAN-185225), Ca 21 (MAR-6598)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Securidaca bialata Benth	Ca 09 (IAN-185233)	Amz, Cer	Sr	Vi
POLYGONACEAE				
Coccoloba ramosissima Wedd.	S 29 (MG-178147)	Amz, Atl	Sr/Sc/Rfo	Sh/Tr
PORTULACACEAE				
Portulaca oleracea L.	Rh 302 (MAR-1634)	Amz, Caa, Cer, Atl	Es/Sr	He
RHIZOPHORACEAE				
Rhizophora harrisonii Leechm.	Marc s.n. (MAR-2179)	Amz	Gf	Tr
Rhizophora racemosa G.Mey	Marc s.n. (MAR-2177)	Amz	Gf	Tr
RUBIACEAE				
Borreria paraensis E.L.Cabral & Bacigalupo +	Mo 3160 (MG-214789)	Amz	Sr	Sh/He
Borreria remota (Lam.) Bacigalupo & E.L.Cabral +	Mo 3057 (MG-214686), Mo 3064 (MG-214693), Mo 3118 (MG-214747)	Amz, Cer, Atl	Sr	Sh/He
Borreria verticillata (L.) G.F.W.Mey	O 35 (MG-133375); Mo 3116 (MG-214745), Mo 3195 (MG-214824); R 69 (MG-225232), R 73 (MG-225236), R 209 (MG-225791), R 297 (MG-228269), R 312 (MG-228284); Ca 15 (MAR-6342);.Sa 03 (IAN-188960)	Amz, Caa, Cer, Atl	Sr/Rfi	Sh
Chiococca alba (L.) Hitch.	B s.n. (MG-154862)	Amz, Caa, Cer, Atl, Pnt	Sr	Sh
Duroia paraensis Ducke +	R 284 (MG-228256)	Amamzônia	Sr	Tr
Guettarda platypoda DC.	R 136 (MG-225718);.Sa 17 (MAR-6080)	Amamzônia, Atl	Sr/Rfi	Sh
Hexasepalum apiculatum (Willd.) Delprete & J.Kirkbr.	Sa s.n. (MAR-6608)	Amz, Caa, Cer, Pmp	Sr	Sh
Hexasepalum teres (Walter) J.H.Kirkbr.	Mo 3139 (MG-214768)	Amz, Caa, Cer, Atl, Pmp, Pnt	Rfi	He
Mitracarpus strigosus (Thunb.) P.L.R.Moraes, Smedt & Hjertson	Mo 3066 (MG-214695), Mo 3132 (MG-214761), Mo 3147 (MG-214776); R 65 (MG-225228)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Oldenlandia tenuis K. Schum.	Mo 3146 (MG-214775)	Amz, Caa	Rfi	He
Pagamea guianensis Aubl.	R 37 (MG-225200), R 264 (MG-228236); Mo 3196 (MG-214825)	Amz, Caa, Cer, Atl	Sr	Sh/Tr
Perama hirsuta Aubl.	Mo 3094 (MG-214723); R 128 (MG-225710)	Amz, Caa, Cer, Atl	Rfi	He
Psychotria hoffmannseggiana (Willd. ex Schult) Müll.Arg.	Mo 3225 (214854); S 55 (IAN-181348)	Amz, Cer, Atl	Sr	Sh
Staelia virgata (Link ex Roem. & Schult.) K.Schum.	Mo 3164 (MG-214793)	Amz, Caa, Cer, Atl, Pnt	Sr	Sh/He
Spermacoce prostrata Aubl. +	Mo 3150 (MG-214854)	Amz, Caa, Cer, Atl	Rfi	He
Tocoyena brasiliensis Mart.	Mt 31 (MAR-7093); S 43 (MAR-6059)	Amz, Caa, Cer, Atl	Sr/Sc	Sh/Tr
Tocoyena hispidula Standl.	R 169 (MG-225751), R 200 (MG-225782)	Amz, Caa, Cer	Sr/Rfi	Sh
SAPINDACEAE				
Matayba discolor (Spreng.) Radk. +	S 28 (MG-178603); Mo 3061 (MG-214690); R 151 (MG-225733), R 181 (MG-225763)	Atl	Rfo	Tr/Sh
SAPOTACEAE				
Manilkara triflora (Allemão) Monach.	Mo 3117 (MG-214776); Sa 14 (IAN-188971), Sa 35 (MAR-5963)	Amz, Caa, Cer, Atl	Rfo	Tr/Sh
Pouteria ramiflora (Mart.) Radlk.	S 16 (MAR-6068)	Amz, Caa, Cer, Atl	Sr	Sh/Tr
SIMAROUBACEAE				
Homalolepis trichilioides (A.St.-Hil.) Devecchi & Pirani	R 114 (MG-225257), R 286 (MG-228258); Ca 07 (MAR-6601); S 19 (MAR-6119)	Cer, Atl	Sr	Tr
SMILACACEAE				
Smilax syphilitica Humb. & Bonpl. ex Willd.	R 271 (MG-228243)	Amz, Caa, Cer, Atl	Sr	Vi

Table 1. Cont.

Family/ Species	Voucher	Occurence by biome	Habitat	Habit
SOLANACEAE				
Schwenckia americana Rooyen ex L.	Mo 3157 (MG- 214786)	Amz, Caa, Cer, Atl	Sr/Rfi	He
Solanum paludosum Moric.	Sa s.n. (MAR-6616)	Amz, Caa, Atl	Sc	Sh
TURNERACEAE				
Piriqueta duarteana (Cambess) Urb.	Mo 3235 (MG-214864)	Amz, Caa, Cer, Atl	Sr	He/Sh
Turnera melochioides cf. var. *arenaria* Urb.	Ca 13 (MAR-6587)	Amz, Caa, Cer	Sr/Sc	Sh
Turnera melochioides var. *latifolia* Urb.	Mo 3200 (MG-214829); R 126 (MG-225708), R 153 (MG-225735), R 215 (MG-225797)	Amz, Caa, Cer, Atl	Sr	Sh
Turnera melochioides var. *melochioides* Cambess.	S 37 (MG-178155)	Amz, Caa, Cer, Atl	Sr	Sh
VERBENACEAE				
Casselia integrifolia Nees & Mart. +	S 26 (MG-178144); R 161 (MG-225743), R 167 (MG-225749)	Caa, Cer, Atl	Sr	He
Lantana cf. fucata Lindl.	S 27 (MG-178145)	Caa, Cer, Atl	Sr	Sh
Stachytarpheta jamaicensis (L.) Vahl	Sa 06 (MAR-188963)	Amz, Atl	Sr	He/Sh
VIOLACEAE				
Pombalia calceolaria (L.) Paula-Souza	Mo 3152 (MG-214781); R 71 (MG-225234)	Amz, Caa, Cer, Atl, Pnt	Rfi	He
VOCHYSIACEAE				
Salvertia convallariodora A.St.-Hil.	B 15 (MG-154814)	Amz, Caa, Cer, Atl	Sr	Tr
Qualea parviflora Mart.	S 40 (MAR-6070)	Amz, Caa, Cer, Atl	Sr	Sh/Tr
XYRIDACEAE				
Abolboda poarchon Seub.	Mo 3167 (MG-214796); R 140 (MG-225722), R 258 (MG-228230)	Amz, Cer	Rfi	He
Xyris anceps Lam.	Cb 04 (MAR-2650)	Amz, Cer, Atl	Sr/Rfi	He
Xyris fallax Malme	Mo 3168 (MG-214797)	Amz, Caa, Cer	Rfi	He
Xyris jupicai Rich	Mo 2774 (MG-211467), Mo 3119 (MG-214748); R 19 (MG-225182)	Amz, Caa, Cer, Mata Atl, Pmp, Pnt	Rfi/Il	He
Xyris paraensis Poepp. ex Kunth	Mo 2812 (MG-211505), Mo 3188 (MG-214817); R 51 (MG-225214), R 250 (MG-228222), R 291 (MG-228263); Sa s.n. (MAR-6614)	Amz, Caa, Cer	Sr/Sc	He
Xyris savanensis Miq.	Mo 3187 (MG-214816)	Amz, Caa, Cer, Atl, Pmp , Pnt	Rfi	He
Xirys sp. nov.	Mo 2851 (MG-211544), Mo 3162 (MG-214791); R 19 (MG-225182, R 21 (MG-225184), R 51 (MG-22514)	-	Il	He

The 289 recorded species are distributed in 189 genera and 73 families (Tab. 1), and the most representative families were Poaceae with 37 species (12 %), Cyperaceae 35 ssp. (12 %), Fabaceae 31 spp. (10 %), Rubiaceae 17 spp. (5 %), Eriocaulaceae ten spp. (3 %), Myrtaceae nine spp. (3 %), Apocynaceae and Polygalaceae eight spp. (2 %), Xyridaceae seven spp. (2 %) and Euphorbiaceae six spp. (2 %) (Fig. 2).

The predominant habit was herbaceous, with 53.28 % of the species, followed by shrubs and trees, with 13.14 % and 12.45 %, respectively. Representing less than 8 % of the species, the lianescent habit was the least abundant in the study area (Fig. 3).

In this study, 56 new species records were made for Maranhão state (Tab. 1), including 15 species widely distributed in Brazil: *Actinostachys pennula* (Schizaeaceae), *Calophyllum brasiliense* (Calophyllaceae), *Rhynchospora filiformis* (Cyperaceae), *Eriocaulon cinereum* (Eriocaulaceae), *Centrosema pascuorum* (Fabaceae), *Utricularia myriocista* (Lentibulariaceae), *Heteropterys nervosa* (Malpighiaceae), *Mayaca longipes* (Mayacaceae), *Myrciaria floribunda* (Myrtaceae), *Paspalum pumilum*, *Trichanthecium polycomum*, *Sacciolepis vilvoides* (Poaceae), and *Spermacoce prostrata* (Rubiaceae) (Flora do Brasil 2020 2018).

Two undescribed species were recorded, *Mesosetum* sp. nov. (Poaceae) and *Xyris* sp. nov. (Xyridaceae), which are undergoing description prior to publication. The only species considered threatened with extinction, in the endangered (EN) category, was Bacopa cochlearia (MMA 2014), with only one record for the PNLM, referring to an interdunal lagoon (Lagoa Azul).

Description of phytophysiognomies

The vegetation in the study area is classified here under eight distinct phytophysiognomies, occurring with most frequency in the PNLM and characterized as following:

1) Halophytic Vegetation: tidal areas with plants that have some resistance to salinity (Fig. 4A-B). In this formation we can observe herbaceous plants such

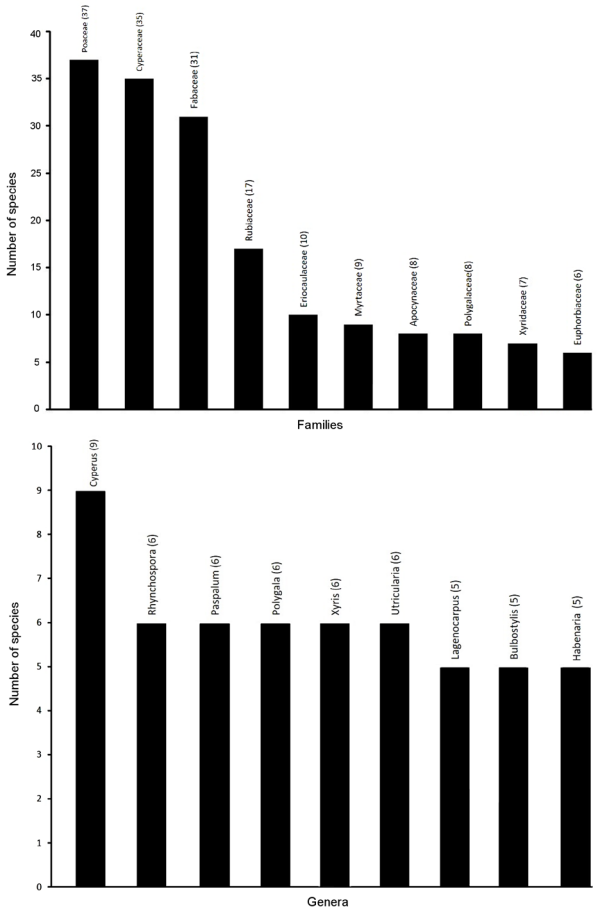

Figure 2. Richest families and genera of PNLM. Number of species for each taxon in parentheses.

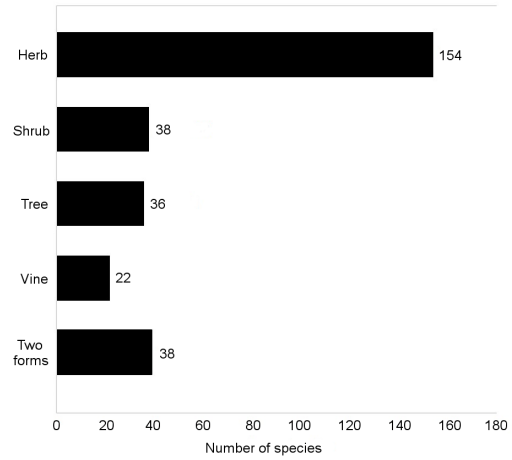

Figure 3. Habits of the species occurring in the PNLM.

as *Blutaparon portulacoides* (Amaranthaceae), *Cyperus articulatus*, *C. obtusatus*, *C. subsquarrosus*, *Eleocharis geniculata* (Cyperaceae), *Paspalum vaginatum*, *Spartina alternifolia*, *Sporobolus virginicus* (Poaceae), and sparse shrubs of *Conocarpus erectus* (Combretaceae);

2) Scrub: Scrub formations around dunes are generally localized on top of dunes, composed of gnarled trees and shrubs, many times with stems completely buried in sand (Fig. 4C-D). Common shrub species include *Anacardium occidentale* (Anacardiaceae), *Chrysobalanus icaco* (Chrysobalanaceae), *Chamaecrista flexuosa* and *Indigofera microcarpa* (Fabaceae), *Byrsonima laevis* and *B. sericea* (Malpighiaceae), *Mouriri guianensis* (Melastomataceae). Within the herbaceous species, *Cyperus crassipes* and *Rhynchospora tenuis* (Cyperaceae), *Chamaecrista flexuosa* and *Indigofera microcarpa* (Fabaceae) *and Trachypogon spicatus* (Poaceae) stand out;

3) Interdunal lagoons: lagoons/ ponds that form as a result of the accumulation of precipitation during the rainy period (Fig. 4E-F). These water bodies present vegetation constituted primarily by annual herbs, such as *Helantium tenellum* (Alismataceae), *Eriocaulon cinereum*, *E. setaceum* and *Paepalanthus sessiliflorus* (Eriocaulaceae), *Schultesia guianensis* (Gentianaceae), *Utricularia cornuta* and *U. subulata* (Lentibulariaceae), *Bacopa cochlearia* (Plantaginaceae), *Xyris jupicai* and *Xyris* sp. nov. (Xyridaceae) that appear in the margins of the lagoons at the beginning of the dry period and dominate the entire bed of the lagoon in the peak of drought, when they are completely empty. Few perennial species are observed in this environment, though *Panicum aquaticum* (Poaceae) and *Nymphoides humboldtiana* (Menyanthaceae) are generally found in the lagoons during the rainy season;

4) Restinga fields: Hydromorphic fields or sandy marshes of oligotrophic soils with mostly continuous stratum (Fig. 5A-B). During the rainy season they can become flooded and are also characterized by a large number of annual species such as *Burmania capitata* (Burmaniceae), *Drosera sessilifolia* (Droseraceae), *Paepalanthus bifidus*, *P. polytrichoides* and *Syngonanthus cuyabenses* (Eriocaulaceae), *Utricularia benjaminiana* and *U. myriocista* (Lentibulariaceae), *Polygala adenophora* (Polygalaceae), *Habenaria* spp. (Orchidaceae), *Xyris paraensis* (Xyridaceae), amongst others. Herbaceous perennial species are also observed, including *Euploca polyphylla* (Heliotropiaceae), *Gomphrena* sp. (Amaranthaceae), *Bulbostylis conifera*, *B. junciformis*, *Cyperus haspan*, *Lagenocarpus* spp. (Cyperaceae), *Abolboda pulchella* (Xyridaceae), *Tetraulacium veroniciforme* (Plantaginaceae). Within these, shrub species *Krameria tomentosa* (Krameriaceae), *Cuphea antisyphilitica* (Lythraceae), *Comolia villosa* (Melastomataceae) and *Dizygostemon* sp. (Plantaginaceae) stand out;

5) Shrubby Restinga: an area formed from both continuous and discontinuous ground cover, with a higher frequency of shrubs and isolated trees, also forming clumps, with physiognomy resembling Cerrado *sensu strictu* (Fig. 5C). Within the tree and shrub species, *Himatanthus articulatus* (Apocynaceae), *Monteverdia erythroxyla* (Celastraceae), *Chrysobalanus icaco* (Chrysobalanaceae), *Clusia grandiflora* (Clusiaceae), *Humiria balsamifera* (Humiriaceae), *Vismia guianensis* (Hypericaceae), *Byrsonima sericea* (Malpighiaceae), *Eugenia punicifolia* (Myrtaceae)

and *Ouratea caudata* (Ochnaceae) stand out. *Lagenocarpus guianensis* (Cyperaceae), *Andropogon leucostachyus*, *Mesosetum loliiforme*, *Paspalum carinatum*, *Streptostachys asperifolia* (Poaceae) are some of the herbaceous species found in this phytophysiognomy. Lianescent species are frequently observed, such as *Mandevilla hirsuta* and *M. scabra* (Apocynaceae), *Ipomoea* spp. (Convolvulaceae), *Davilla cearensis* and *Doliocarpus spraguei* (Dilleniaceae), and *Passiflora foetida* (Passifloraceae);

6) *Restinga* forest: formed by a dense layer of trees and shrubs, producing a continuous canopy. Generally, presents individuals with thin, gnarled trunks growing on ground with accumulated organic material, and this is loose in comparison to what is seen in open restinga. Another defining characteristic of species is their pronounced deciduousness, with a xeromorphic aspect (Fig. 5D). In this formation the prominent presence of *Protium heptaphyllum* subsp. *ulei* (Burseraceae), *Caryocar brasiliense*

Figure 4. Main phytophysiognomies of the PNLM. **A-B.** Halophytic vegetation. **C-D.** Scrub. **E-F.** Interdunal Lagoons. Photographs by Pedro Viana (A-C, E-F) and Nara Mota (D).

(Caryocaraceae), *Abarema cochleata*, *Andira vermifuga*, *Copaifera martii*, *Dimorphandra gardneriana* and *Hymenaea velutina* (Fabaceae), *Myrcia multiflora* and *Myrcia splendens* (Myrtaceae), *Matayba discolor* (Sapindaceae), *Manilkara triflora* (Sapotaceae) are observed;

7) Cocais forest: phytophysiognomy characterized by the abundant presence of palms *Copernicia prunifera*, occasionally occurring sympatrically with *Mauritia flexuosa*.

8) Gallery forest and Mangroves: vegetation occurring in the banks of the Preguiça River and its tributaries (Fig. 5E). Proximity to the ocean determines the composition of species of this physiognomy. Close to the estuary, the vegetation is typically of mangroves with low species richness and the predominance of few tree species (Fig. 5F), such as *Rhizophora harrisonii* and *R. racemosa* (Rhizophoraceae). As distance from the ocean increases and salinity falls,

Figure 5. Main phytophysiognomies of the PNLM. **A-B.** *Restinga* fields. **C.** Shruby *Restinga*. **D.** Shruby *Restinga* and in the background *restinga* forest. **E.** Gallery Forest. **F.** River Preguiça mouth, showing the mangrove. Photographs by Nara Mota (A-D) and Pedro Viana (E-F).

the species richness increases, and species of Arecaceae, such as *Mauritia flexuosa*, some Annonaceae and Araceae can be observed.

Floristic similarity

The similarity indexes calculated between the areas (Tab. 2) ranged from 0.082 (Pará and Piauí states restingas) to 0.197 (this study and Pará state restingas). According to Kent & Coker (1992), values larger than or equal to 0.5 indicate high similarity. Therefore, it can be inferred that the similarity between the areas is to be considered low.

The clustering analysis (Fig. 6) revealed a group formed between the study area and *restingas* of Pará state, which, in turn, is related with the restingas of Maranhão, but with low similarity (similarity index 0.178).

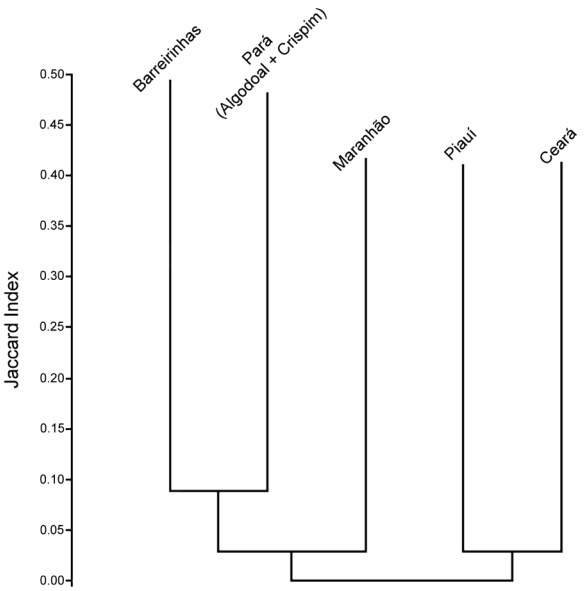

Figure 6. Dendogram of Floristic Similarity between the study areas analysed: Barreirinhas: this study; Pará state: Algodoal/ Maiandeua and Crispim/Marapanim (Amaral *et al.* 2008); Piauí state (Santos-Filho *et al.* 2015); Maranhão state (Almeida Junior *et al.* 2017); Ceará state (Santos-Filho *et al.* 2011).

Discussion

The families with higher species richness in this research coincide with the richest families for other studies of Brazilian *restingas* (Araújo 2000; Pereira & Araújo 2000; Santos *et al.* 2003; Almeida Júnior *et al.* 2007; 2017; Amaral *et al.* 2008; Santos-Filho *et al.* 2011; 2015; Gomes & Guedes 2014; Serra *et al.* 2016). According to Melo Júnior & Boeger (2015), families like Fabaceae and Myrtaceae present high numbers of species in the restinga. Amaral *et al.* (2008) detected Fabaceae, Poaceae and Cyperaceae as the richest families on the restinga in Pará and Amapá states.

The low number of fern species and lycophytes may be explained by the biological particularities of these groups, which are largely dependent on factors such as the climate, availability of water and substrate type (Gonzatti *et al.* 2014). The PNLM presents a longer period of drought, associated with sandy soil with low water retention, which can discourage the establishment of fern and lycophyte species.

Although southeastern Maranhão is considered one of the largest knowledge gaps for the understanding of the Brazilian flora (BFG 2015), the presence of 56 new records for the state within the PNLM, along with the two new species (Tab. 1), demonstrates that, in reality, the whole of Maranhão state, including the *restingas* (Zickel *et al.* 2004; Ribeiro 2011) represents a huge knowledge gap and needs careful botanical exploration. There is a need for botanical research into the different vegetal formations of Maranhão to better understand the floristic richness of the state.

The breakdown of the new records found within this work is interesting. Some were previously cited predominantly for the Amazon biome: *Paepalanthus polytrichoides* (Eriocaulaceae), *Doliocarpus spraguei* (Dilleniaceae), *Leptolobium nitens*, *Vatairea sericea* (Fabaceae), *Eschweilera decolorans* (Lecythidaceae), *Utricularia benjaminiana* (Lentibulariaceae), *Borreria paraensis*, *Duroia paraensis* (Rubiaceae), *Ternstroemia delicatula* (Pentaphyllaceae), *Eragrostis guianensis*, *Reimarochloa aberrans*, *Rhytachne guianensis* (Poaceae). Four were cited, in Brazil, for the Cerrado: *Lepidaploa rufogrisea* (Asteraceae), *Bulbostylis lagoensis* (Cyperaceae), *Syngonanthus philodicoides* (Eriocaulaceae), *Asemeia rhodoptera* (Polygalaceae). Finally, three were previously cited for the Caatinga biome: *Stilpnopappus cearensis* (Asteraceae), *Rhynchospora curvula* (Cyperaceae) and *Bacopa cochlearia* (Plantaginaceae). These results demonstrate how these three biomes contribute to the composition of the PNLM flora, revealing its ecotonal character (Santos-Filho *et al.* 2013a). In this way, different features and plant synusia typical of the mid-Northern region of Brazil can be found, accompanied by corresponding soil and climate variations (Santos-Filho *et al.* 2013b).

Table 2. Matrix of similarity coefficients (Jaccard) between the compared areas. Barreirinhas: this study; Pará state: Algodoal/ Maiandeua and Crispim/Marapanim (Amaral *et al.* 2008); Piauí state (Santos-Filho *et al.* 2015); Maranhão state (Almeida Junior *et al.* 2017); Ceará state (Santos-Filho *et al.* 2011).

	Barreirinhas	Pará state	Piauí state	Maranhão state
Pará state	0.19789474	1		
Piauí state	0.093587522	0.082236842	1	
Maranhão state	0.12457338	0.17869416	0.18167457	1
Ceará state	0.10869565	0.10754414	0.23278689	0.15727003

In relation to the species habit, the data was found to be similar to other flora studies of *restingas* in Northern and Northeastern Brazil (*e.g.* Amaral *et al*. 2008; Santos-Filho *et al*. 2015; Oliveira *et al*. 2015), with the predominance of herbaceous species, followed by shrub and tree species, reinforcing the vegetation classification of the region (sensu IBGE 2012) as pioneer formations, with a higher number of species adapted to survive in adverse situation (Oliveira *et al*. 2015). According to Martins & Batalha (2011) herbs, in general, present the best resistence to drought, withstanding high luminosity and strong winds, making it possible for them to survive in different *restinga* physiognomies in the PNLM. The high similarity between the *restinga* flora in PNLM Barreirinhas and the *restingas* in Pará state suggests the colonization of coastal areas of Maranhão from the Amazon biome. These facts are also corroborated by the new records the PNLM flora, where the Amazonian Rainforest contributes with the largest number of exclusive species (12 spp.), when compared with the Cerrado and Caatinga (four species each).

The similarity of PNLM flora with the areas compared in this study is considered low. This panorama can be explained by the location of PNLM, which is an area of transition between three biomes. In the study area they were recorded as species from the Amazon, Caatinga and Cerrado, revealing a unique character towards its flora. Compared with areas of *restinga* found exclusively in the Caatinga or Amazon biomes, the similarity of PNLM flora is clearly demonstrated to be low. Nevertheless, these results could be influenced by eventual discrepancies in the sampling efforts utilized in the different studies.

Based on these results it may be concluded that the *restingas* of the PNLM in the municipality of Barreirinhas present a high number of species, including many that have not been previously recorded from Maranhão. This high number of new records highlights the necessity to increase collections in Maranhão state, including all its plant formations. The peculiarity of the flora in the study area was revealed through the occurrence of new species. The low similarity with other areas of *restinga* studied justifies the importance of continuing floristic studies in the PNLM, especially in areas not covered by the present study.

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