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Original Paper

Taxonomic study of *Epidendrum* (Laeliinae–Orchidaceae) in the state of Maranhão, northeastern Brazil

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Abstract

The Brazilian state of Maranhão is located in a transition zone between the Amazon and Cerrado domains; its geographic position enables the coexistence of species from both biomes. Taxonomic information of Orchidaceae and especially *Epidendrum* in the state are scarce; thus this study aimed to provide a taxonomic treatment for the genus based on field expeditions and analyses of herbarium specimens (IAN, MAR, MG, NY, SLUI, and UB). *Epidendrum* is represented in Maranhão by 10 species, of which three are new records: *E. amapense*, *E. anceps*, and *E. carpophorum*. Another three previously cited species, *E. nocturnum*, *E. sculptum*, and *E. viviparum*, were not collected and also not found in the herbaria visited; moreover, these records represent misidentifications. The majority of the species is distributed in the Amazon domain; however, *E. macrocarpum* is recorded for the first time for the Brazilian Cerrado. Here we provide an identification key, descriptions, photographs, and a distribution map of the species in the state.

Key words: Amazon, Cerrado, Neotropics, taxonomic synopsis.

Resumo

O estado do Maranhão está situado numa região de transição entre os domínios da Amazônia e do Cerrado, e esta posição geográfica possibilita a coexistência de espécies de ambos os biomas. Informações sobre Orchidaceae, e, mais especificamente, de *Epidendrum* são escassas para o estado. Desta forma, o presente estudo teve como objetivo desenvolver um tratamento taxonômico do gênero baseado em expedições de campo e consulta a herbários com amostras do estado (IAN, MAR, MG, NY, SLUI e UB). *Epidendrum* está representado no Maranhão por 10 espécies, das quais três são novos registros: *E. amapense*, *E. anceps* e *E. carpophorum*. Outras três espécies previamente citadas para o estado, *E. nocturnum*, *E. sculptum* e *E. viviparum*, não foram coletados ou encontrados vouchers nos herbários analisados, e representavam erros de identificação. A maioria das espécies está distribuída no domínio amazônico, porém *E. macrocarpum* é registrado pela primeira vez para o Cerrado Brasileiro. São apresentados chave de identificação, descrições, prancha fotográfica e um mapa de distribuição geográfica das espécies no estado.

Palavras-chave: Amazônia, Cerrado, Neotrópicos, sinopse taxonômica.

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Introduction

Epidendrum L. is distributed exclusively in the Neotropical region and is one of the most diverse genera in Orchidaceae with over 1,400 species (Hágsater & Soto-Arenas 2005; Chase *et al.* 2015). It is a member of Laeliinae (tribe Epidendreae, subfamily Epidendroideae) (Chase *et al.* 2015) and is distinguished among the related genera by the column being fully adnate to the lip claw (rarely free at the apex [Klein *et al.* 2019]), the anther dorsal to apical, the rostellum parallel to the column axis, and the presence of a cuniculus (Hágsater & Soto-Arenas 2005).

The proposal of Hágsater (1985, continuously updated in Hágsater & Saldaña 2001, 2004, 2006, 2007, 2008, 2009, 2010, 2013, 2015; Hágsater & Santiago 2018a, 2018b, 2019, 2020), which organizes the genus into several informal groups of similar species, has been widely applied (*e.g.*, Carnevali & Romero 1992; Pessoa *et al.* 2012a, 2014, 2016; Barberena & Gonzaga 2016; Cardoso-Gustavson *et al.* 2018; Sambin *et al*. 2018; Klein *et al*. 2019). Molecular phylogenetic studies have preliminarily confirmed the monophyly of some of these groups, whereas other groups have been shown not to be monophyletic (Hágsater & Soto-Arenas 2005; Pinheiro *et al.* 2009; Cardoso-Gustavson *et al.* 2018; Klein *et al.* 2019; Pessoa *et al*. 2020), and a well-sampled phylogenetic analysis of the genus is still needed.

Around 120 species of *Epidendrum* are recorded to Brazil, of which 69 are endemic (Pessoa 2020). These species are widespread in the country, except in the state of Piauí, with higher diversity in the Amazon and Atlantic Forest (BFG 2018; Pessoa 2020), where they grow in humid forests, dunes, palustrine areas, opened savannas, rocky outcrops, and tepuis (Hágsater & Soto-Arenas 2005; Stancik *et al.* 2009; Hágsater & Santiago 2018a, 2018b).

The genus is represented in northeastern Brazil by 50 species, while, until now, 10 are cited to Maranhão (BFG 2018; Pessoa 2020). However, the richness of the genus in the state is unreliable since these records are based mainly on the list of Orchidaceae of Silva *et al*. (1999) that cited few vouchers, and some of the cited vouchers were actually collections from the neighboring state of Pará.

A more comprehensive checklist of the *Epidendrum* species in the state of Maranhão isneeded. Therefore, this study aims to provide a taxonomic study of these species, providing morphological descriptions, an identification key, photographs, comments on ecology and distribution, and a map of the geographic distribution of the confirmed taxa in the state.

Material and Methods

The Brazilian state of Maranhão has a total area of 333,365.6 km², it is located in the western portion of the Brazilian Northeast (IMESC 2008; IBGE 2015). Its territory includes parts of the Amazon (46%), Cerrado (53%), and Caatinga (1%) domains (Abreu 1949; Froés 1953; Ribeiro 1971; Almeida & Vieira 2010; Silva *et al.* 2017). The weather is Tropical Savanna, dry in the summer along the coast (*As*, *sensu* Köppen [1948]), while dry in the winter inland (*Aw*, *sensu* Köppen [1948]), the annual mean temperature is 26–27 °C, and precipitation varies from 700–1,700 mm in the southern half of the state to 1,700–2,900 mm in the northern half (Montes *et al*. 1997; Maranhão 2011; Beck *et al*. 2018).

The checklist was based on the preliminary lists of Silva *et al*. (1999) and Pessoa *et al*. (2020), subsequently field expeditions and analyses of herbarium material were undertaken. Fieldwork was carried out between 2015 and 2020, the material collected was processed following the standard methods of Gadelha-Neto *et al*. (2013), then deposited in the SLUI herbarium (according to Thiers, continuously updated). The following municipalities were included in the field expeditions: Bequimão, Cândido Mendes, Imperatriz, Maracaçumé, Morros, Pedro do Rosário, Pinheiro, Presidente Sarney, Santa Helena, São Luís and São Raimundo das Mangabeiras. The Brazilian herbaria with most of the specimens of *Epidendrum* from Maranhão were analyzed (MAR, IAC*, IAN, SLUI, MG, NY* and UB, according to Thiers [continuously updated], *photographs only).

The identification of the species was based upon the most important references of Orchidaceae taxonomy for species in northern and northeastern Brazil (Dunsterville & Garay 1959, 1961, 1965, 1966, 1972, 1976; Pabst & Dungs 1975, 1977; Carnevali *et al.* 2003; Toscano-de-Brito & Cribb 2005), the online key for the Brazilian species of the genus in Pessoa *et al.* (2020), and the analysis of type specimens when available online or in the herbaria visited. The morphological terminology follows Radford *et al.* (1974) and Dressler (1981).

The data on the flowering period are based on field collections in Maranhão and information

from herbarium specimen labels. The geographic distribution was retrieved from Govaerts *et al*. (2020) and Pessoa (2020). A database of geographical coordinates from field collections and herbarium specimens was prepared, non-geo-referenced specimens had their localities determined using an online gazetteer (Google Earth). The database was used to prepare a distribution map of the species in the state using the software QGIS (QGIS Development Team 2020).

Results and Discussion

Of the 10 species of *Epidendrum* cited by Pessoa (2020) to Maranhão, seven are confirmed: *E. amblostomoides* Hoehne (1938: 18), *E. ciliare* Linnaeus (1759: 1246), *E. flexuosum* Meyer (1818: 260), *E. macrocarpum* Richard (1792: 112), *E. purpurascens* Focke (1851: 64), *E. rigidum* Jacquin (1760: 29), and *E. strobiliferum* Reichenbach (1859: 333), whereas *E. nocturnum* Jacquin (1760: 29), *E. sculptum* Reichenbach (1854: 89), and *E. viviparum* Lindley (1841: 10) were not collected in our expeditions and were not found in the herbaria visited; the vouchers cited by Silva *et al*. (1999) correspond to specimens from Pará (MG 146052, MG 138854, MG 139444, respectively). Thus, the distributions of these species in the state were not confirmed and the species excluded.

Silva *et al*. (1999) cited *E. difforme* Jacquin (1760: 29), a species endemic to the Antilles (Govaerts *et al*. 2020) to the state, but due to the lack of a voucher from the area, this was not followed by Pessoa (2020) nor us. Furthermore, a specimen identified as *E. denticulatum* Barbosa Rodrigues (1881: 143) in SLUI (*J.A.C.S. Filho.* SLUI 2770) actually corresponds to the ornamental, exotic species *Arundina bambusifolia* Lindl., collected in the capital city of São Luís.

On the other hand, *E. amapense* Hágsater & L. Sanchez (1993: 105), *E. anceps* Jacquin (1763: 138), and *E. carpophorum* Barb. Rodr. are new records for the state, and together with the seven previously cited species, the updated checklist includes 10 species. Among the taxa, eight were collected in our expeditions, while two, *E. amapense* (*R.L. Froes. 34390* (IAN)) and *E. flexuosum* (*M. Pires & G.A. Black 1753* (IAC, IAN)), are known only from old herbarium material (collected at least 60 years ago). The putative rareness of these species in the state is feasible, and future collection effort is still necessary to rediscover these species in Maranhão. These two specimens are examples of the importance of herbarium collections, not only for taxonomy but also for conservation of biodiversity, since these institutions organize the occurrence records that are used, for example, to classify taxa in IUCN threat categories (Funk 2009; Forzza *et al*. 2012).

Epidendrum is often included as one of the most representative genera of Orchidaceae in areas of northeastern Brazil (Azevedo & van den Berg 2007; Pessoa & Alves 2011, 2012b, 2014, 2015; Bastos & van den Berg 2012; Rêgo & Azevedo 2017). In Maranhão, the genus is the third most representative after *Habenaria* (15 spp.) and *Catasetum* (14 spp.) (BFG 2018). However, unlike the results of these other studies that include many endemic species, in *Epidendrum* only *E. amblostomoides* is restricted to Brazil (Pessoa 2020), the other species are widespread in South America (Govaerts *et al.* 2020).

All species are epiphytic or, occasionally, saxicolous (*E. carpophorum*), part of this result could be biased by the fact that 90% of the species are found in the Amazon domain (Fig. 1). The exceptions are *E. macrocarpum*, found growing in two domains (Amazon and Cerrado) in Maranhão, which represents the first record of this species in Cerrado, and *E. amblostomoides*, which only grows in the Cerrado domain. Studies in other regions of Brazil have shown that in areas of Cerrado *s.s.* there is a predominance of terrestrial species of Orchidaceae, while the epiphytes are confined to gallery forests (Batista & Bianchetti 2003; Batista *et al*. 2005). However, in general, very few terrestrial species of *Epidendrum* have been recorded in the neighboring states of Pará, Piauí, and Tocantins (*e.g*., *E. dendrobioides* Thunberg (1818: 17)., *E. orchidiflorum* Salzm. *ex* Lindley (1831:103) and *E. secundum* Jacquin (1760: 29), Pessoa *et al*. 2020), which can explain the low number of species found in the state studied. The high humidity in the north of the state may serve as an explanation for the establishment of most of the *Epidendrum* species in this region, since precipitation is one of the most important factors predicting epiphyte richness (Benzing 1990, 1995; Woods *et al*. 2015).

Although it includes 90% of the species of *Epidendrum* in the state, the Amazon domain in Maranhão suffers from strong anthropization, especially fire and deforestation (Ferrante & Fearnside 2019). Another important factor that is threatening biodiversity is illegal wood extraction in areas such as the locally called "*Mosaico Gurupi*" (Celentano 2017). Included in the "Belém

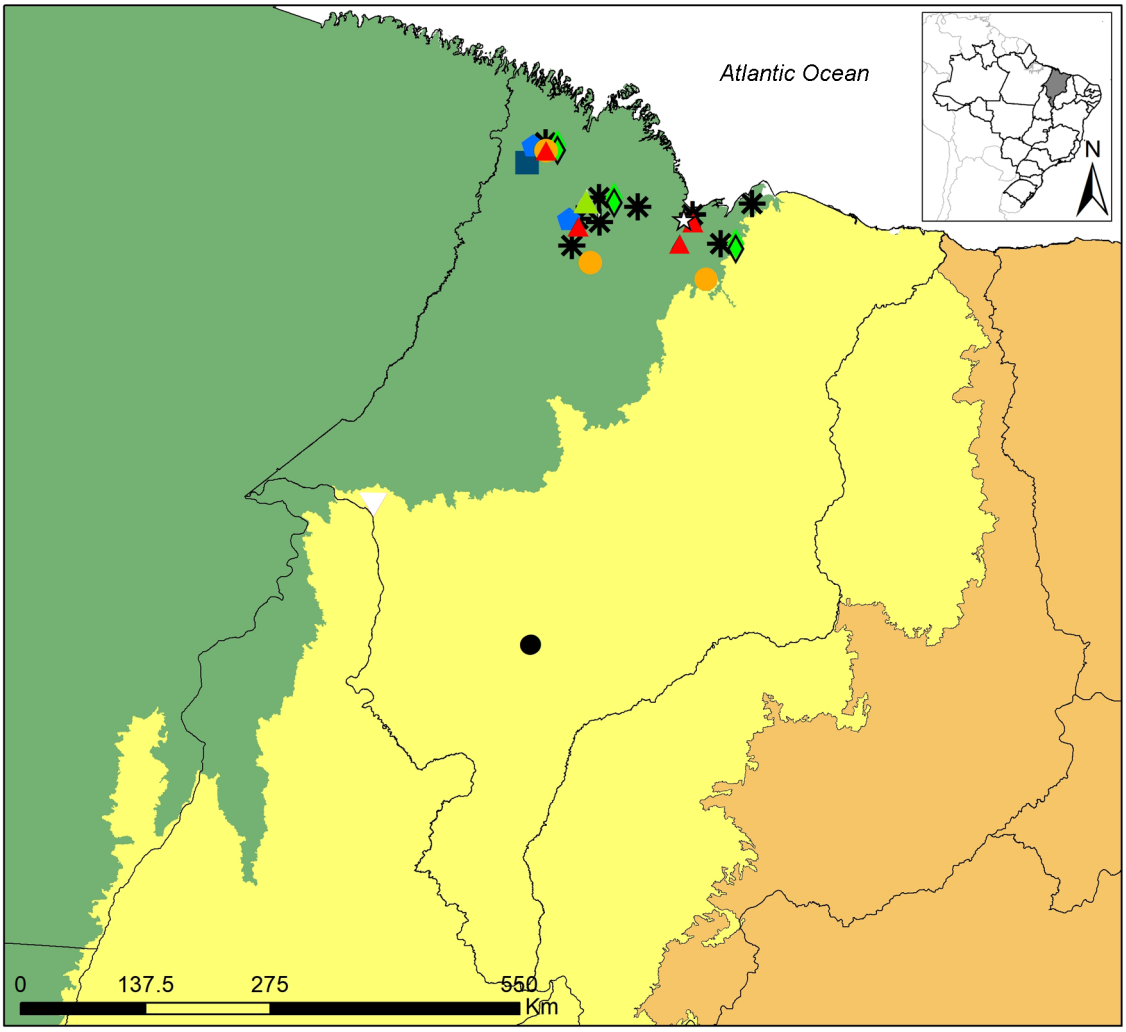

Figure 1 – Distribution of the species of *Epidendrum* in Maranhão, Brazil. The area in green corresponds to the Amazon domain; in yellow, the Cerrado; and orange, the Caatinga. Red triangle = *E. strobiliferum*; orange circle = *Epidendrum rigidum*; blue pentagon = *Epidendrum purpurascens*; green diamond = *Epidendrum macrocarpum*; white inverted triangle = *Epidendrum flexuosum*; white star = *Epidendrum ciliare*; black asterisk = *Epidendrum carpophorum*; green triangle = *Epidendrum anceps*; black circle = *Epidendrum amblostomoides*; blue square = *Epidendrum amapense*.

endemism center", the most destroyed among the Amazonian endemism centers with 76% of the original area deforested (Almeida & Vieira 2010), the portion of the Amazon domain in Maranhão is poorly studied, and this study is one of the first contributions to Orchidaceae in the area.

Key to species of *Epidendrum* from the state of Maranhão, northeastern Brazil

1. Pseudobulbs present, ellipsoidal or narrow-ellipsoidal.
   2. Leaves linear; floral bracts 0.2–0.3 cm long ..... 2. *Epidendrum amblostomoides*
   2'. Leaves oblong to elliptical; floral bracts ≥ 1.6 cm long 3
      3. Lateral lobes of the lip with margin erose ..... 8. *Epidendrum purpurascens*
      3'. Lateral lobes of the lip with margin deeply fringed ..... 5. *Epidendrum ciliare*

1'. Pseudobulbs absent, stems cylindrical or laterally compressed.

4. Rachis completely covered by bracts; lip entire.
   5. Leaves 0.5–0.7 cm wide; flowers white-cream, lip cordate.....10. *Epidendrum strobiliferum*
   5'. Leaves 0.8–1.4 cm wide; flowers green, lip suborbicular.....9. *Epidendrum rigidum*

4'. Rachis exposed (not covered by bracts); lip obscurely to clearly 3-lobed.
   6. Inflorescence sessile or short-pedunculate (< 0.5 cm long).....7
      7. Sepals < 2.0 cm long, oblanceolate..... 1. *Epidendrum amapense*
      7'. Sepals > 4.3 cm long, narrow-elliptical to oblong-lanceolate....4. *Epidendrum carpophorum*
   6'. Inflorescence long pedunculate (> 1.6 cm long).....8
      8. Peduncle completely covered by bracts; lip margin entire .....3. *Epidendrum anceps*
      8'. Peduncle exposed; lip margin denticulate.....9
         9. Flowers orange to red, lip blade > 2.0 cm long, clearly 3-lobed.....
         .....7. *Epidendrum macrocarpum*
         9'. Flowers pink, lip blade < 1.0 cm long, obscurely 3-lobed..... 6. *Epidendrum flexuosum*

1. *Epidendrum amapense* Hágsater & L. Sanchez. Icon. Orchid. 2:16, t. 105 1993.

Epiphytes, Pseudobulbs absent, stems cylindrical to laterally compressed, 4–18 cm long. Leaves 2.5–7.5 × 0.7–2.0 cm, oblong-elliptical. Inflorescence 1–3-flowered, short-pedunculate, rachis 0.2–0.5 cm long, exposed; floral bracts 0.3–0.6 cm long, ovate. Flowers green; ovary pedicellate, 0.1–0.3 cm long; dorsal sepal 1.0–2.0 × 0.3–0.6 cm, oblanceolate, apex acute; lateral sepals 1.2–2.0 × 0.3–0.45 cm, oblanceolate, sub-falcate, apex acute; petals 1.2–1.7 × 0.1–0.2 cm, linear-oblanceolate, apex acute; lip blade 0.6–1.0 × 1.2–2.0 cm, clearly 3-lobed, with two globose calli at the base, lateral lobes subovate, margin entire to slightly erose, apex rounded, mid-lobe transversely oblong, margin entire to slightly erose, apex cuspidate; column 0.8–1.2 cm long. Fruits not seen.

Illustration in Hágsater & Salazar (1993).

Material examined: Maracaçumé, Rio Maraçumé, VI.1958, fl., *R.L. Froes 34390* (IAN).

This species is distributed in French Guiana and Brazil (Govaerts *et al.* 2020), where it was previously recorded to the states of Amapá and Pará (Pessoa 2020), here it is cited for the first time for the state. Based on a single specimen deposited at IAN, flowers can be observed in Maranhão in June. This specimen, collected in the Maracaçumé River more than 60 years ago (1958), is the only known record to the state and was misidentified as *E. difforme* at IAN. Among the species in the area, its vegetative portion can be confused with *E. rigidum*, however, the developed peduncle and rachis completely covered by floral bracts distinguish *E. amapense* (*vs.* peduncle inconspicuous, rachis exposed).

2. *Epidendrum amblostomoides* Hoehne, Arq. Bot. Estado São Paulo, n.s., f.m., 1(1): 18. 1938.

Fig. 2a

Epiphytes, Pseudobulbs present, narrow-ellipsoidal, 3–6.5 cm long. Leaves 4.5–12.5 × 0.2–0.4 cm, linear. Inflorescence 8–13-flowered, peduncle 1.5 cm long, exposed, rachis 3–4 cm long, exposed; floral bracts 0.2–0.3 cm long, ovate. Flowers whitish; ovary pedicellate, 0.7–1.2 cm long; dorsal sepal 0.5–0.6 × ca. 0.2 cm, oblanceolate, apex acute; lateral sepals 0.5–0.7 × ca. 0.2 cm, oblanceolate, sub-falcate, apex acute; petals 0.5 × 0.1 cm, linear-elliptical, apex acute to obtuse; lip blade 0.4–0.6 × 0.3–0.6 cm, clearly 3-lobed to obscurely 3-lobed, with three trapezoid calli at base extending to half of the disc, lateral lobes sub-orbicular, margin entire to minutely erose, apex rounded, mid-lobe subovate, margin entire to slightly erose, apex obtuse, rounded or cuspidate; column ca. 0.5 cm long. Fruits not seen.

Material examined: São Raimundo das Mangabeiras, estrada para a Agrosserra, , 10.IV.2017, fl., *M.J.C. Silva et al. 16* (SLUI 5700); 10.IV.2017, fl., *M.J.C. Silva et al. 17* (SLUI, 5701).

This species is restricted to Brazil (Govaerts *et al*. 2020; Pessoa 2020), where it has been cited for the states of Pará, Rondônia, Tocantins, Maranhão, Distrito Federal, Goiás, Mato Grosso do Sul, Mato Grosso and Minas Gerais (Pessoa 2020). In the study area, flowers can be observed in April and May. It was found in an area of seasonal semideciduous forest near an open area of Cerrado *s.s.* (Fig. 1), growing on yellow ipê (*Tabebuia* sp., Bignoniaceae). In the state, it can be confused with young specimens of *E. purpurascens,* but differs by the thinner, linear leaves (0.2–0.4 cm wide *vs.* elliptical to oblong-elliptical, 1.1–2.0 cm wide).

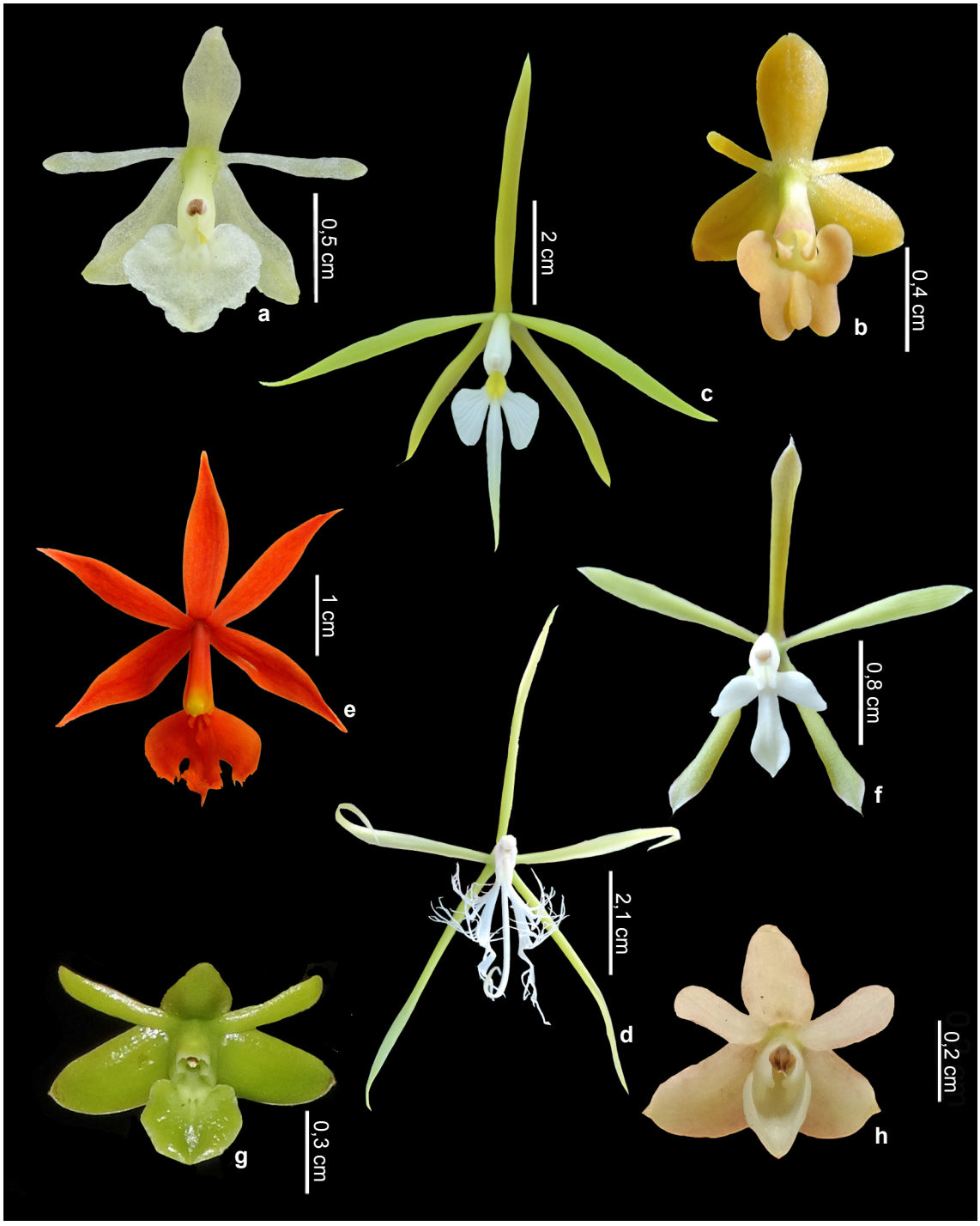

Figure 2 – a-h. Flowers of *Epidendrum* spp. from Maranhão, Brazil – a. *Epidendrum amblostomoides*; b. *Epidendrum anceps*; c. *Epidendrum carpophorum*; d. *Epidendrum ciliare*; e. *Epidendrum macrocarpum*; f. *Epidendrum purpurascens*; g. *Epidendrum rigidum*; h. *Epidendrum strobiliferum*. (a. *MJC Silva et al. 16* [SLUI 5700]; b. *MJC Silva & AWC Ferreira 18* [SLUI 5699]; c. *MJC Silva & AWC Ferreira 20* [SLUI 5702]; d. *AWC Ferreira 29* [SLUI 5711]; e. *AWC Ferreira 33* [SLUI 57114]; f. *MJC Silva & AWC Ferreira 36* [SLUI 5716]; g. *MJC Silva & AWC Ferreira 38* [SLUI 5719]; h. *KN Santos & AWC Ferreira 41* [SLUI 5723]).

3. *Epidendrum anceps* Jacq. Select. Stirp. Amer. Hist. 224, pl. 138. 1763. Fig. 2b

Epiphytes, Pseudobulbs absent, stems laterally compressed, ca. 75 cm long. Leaves 2.5–11.5 × 1.0–2.0 cm, elliptical. Inflorescence 5–11-flowered, peduncle 1.6–4.0 cm long, completely covered by bracts, rachis 1.5–2.0 cm long, exposed; floral bracts 0.1–0.2 cm long, deltoid. Flowers yellowish-brown, pinkish-brown or orangish-brown; ovary pedicellate, 1.0–1.2 cm long; dorsal sepal 0.5–0.8 × 0.2–0.3 cm, oblong to oblanceolate, apex acute; lateral sepals 0.45–0.55 × 0.2–0.25 cm, oblanceolate, sub-falcate, apex acute; petals 0.4–0.5 × 0.1 cm, linear-spatulate, apex obtuse to rounded; lip blade 0.3–0.4 × 0.4–0.5 cm, clearly 3-lobed, with a longitudinal keel along the whole length and more prominent at the apex, lateral lobes sub-orbicular, margin entire to minutely erose, apex rounded, mid-lobe transversely oblong, margin entire, apex emarginate; column 0.4–0.6 cm long. Fruits not seen.

Material examined: Cândido Mendes, Fazenda Sete Irmãos, 14.X.2017, fl., *M.J.C. Silva & A.W.C. Ferreira 18* (SLUI 5699).

This species is widely distributed in the Neotropics, recorded to Costa Rica, Panama, Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico, Trinidad and Tobago, and Brazil (Govaerts *et al.* 2020). In the country it is cited to the states of Acre, Amazonas, Amapá, Pará, Roraima, Bahia, Ceará, Pernambuco, Distrito Federal, Goiás, Mato Grosso, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Rio Grande do Sul, and Santa Catarina (Pessoa 2020), here it is cited for the first time to the state of Maranhão. A single flowering specimen was collected near a river course in the municipality of Cândido Mendes (Fig. 1). We were able to find another young specimen in the area, but it seems to be rare. Flowers can be observed in October and November in Maranhão. Among the species of the area it could be confused with *E. flexuosum* and *E. macrocarpum* due to the often long-pedunculate inflorescence but differs by the peduncle completely covered by bracts (*vs.* exposed) and shorter lip (< 0.4 *vs.* > 0.8 cm long).

4. *Epidendrum carpophorum* Barb. Rodr. Gen. Sp. Orchid. 2: 148. 1882. Fig. 2c

Epiphytes, Pseudobulbs absent, stems cylindrical to laterally compressed, 5–13 cm long. Leaves 4.3–9.0 × 0.8–2.2 cm, elliptical. Inflorescence 1–2-flowered, short-pedunculate, rachis 0.2–0.5 cm long, exposed; floral bracts 0.2–0.4 cm long, deltoid. Flowers greenish with white lip; ovary pedicellate, 5.5–5.6 cm long; dorsal sepal 4.5–4.6 × 0.4–0.5 cm, narrow-elliptical to oblong-lanceolate, apex acute; lateral sepals 4.3–4.5 × 0.6–0.65 cm, narrow-elliptical, sub-falcate, apex acute; petals 4.3–4.5 × 0.2–0.25 cm, linear-elliptical to linear-lanceolate, apex acute; lip blade 4.3–4.4 × 1.6–1.7 cm, clearly 3-lobed, with two trapezoid calli at the base, lateral lobes ovate, margin entire to erose, apex acute to obtuse, mid-lobe linear, margin entire, apex acute; column 1.8–2.0 cm long. Fruits 5.5–6.0 cm × 1.3 cm, fusiform.

Material examined: Bequimão, comunidade Monte Alegre, estrada MA-106, entrada principal do povoado, fl., *A.W.C. Ferreira 19* (SLUI 5698). Cândido Mendes, Fazenda Sete Irmãos, Igarapé Cumaruzal, 15.VI.2017, fl., *M.J.C. Silva & A.W.C. Ferreira 20* (SLUI 5702). Cândido Mendes, Fazenda Sete Irmãos, Rio Macaxeira, 20.II.2020, fl., *A.W.C. Ferreira 21* (SLUI 5703). Morros, Igarapé do Contrato, próximo à pousada Pedra Grande, 20.VII.2019, fl. and fr., *A.W.C. Ferreira 22* (SLUI 5704). Pinheiro, povoado Purão dos Pirróis, 19.III.2015, fl., *A.W.C. Ferreira 23* (SLUI 5705). Pinheiro, São Luís da Chapada, enclave de Cerrado em transição com Amazônia, fl., *A.W.C. Ferreira 24* (SLUI 5706). Pedro do Rosário, Rio Turiaçu, 10.VIII.2015, fl., *A.W.C. Ferreira 25* (SLUI 5707). Presidente Sarney, divisa com Santa Helena (MA), nas margens do Rio Turiaçu, localidade dos "Três Furos", 23.IV.2016, fl., *A.W.C. Ferreira 26* (SLUI 5708). Primeira Cruz, povoado Ronca, 27.IX.2018, *A.B. Almeida* (UB 12352821). Santa Helena, nas margens do Rio Turiaçu, localidade dos "Três Furos", fl., *A.W.C. Ferreira 27* (SLUI 5709). São Luís, UFMA, Campus Dom Delgado, próximo a pista de atletismo, 20.VIII.2019, fl., *K.N. Santos & A.W.C. Ferreira 28* (SLUI 5710).

This species is distributed in Guyana, Suriname, Venezuela, and Brazil (Govaerts *et al.* 2020), where it has been recorded to the states of Amazonas, Amapá, Pará, Roraima, Alagoas, Bahia, Sergipe, Ceará, Pernambuco, Espírito Santo, Minas Gerais, Rio de Janeiro and São Paulo (Pessoa 2020). Here it is cited for the first time for Maranhão. It was collected in areas in the Amazon domain and in a transition to Cerrado vegetation (Fig. 1), where it is relatively frequent. Specimens in urbanized areas growing on exotic phorophytes such as *Mangifera indica* L. (Anacardiaceae) were also observed. In the study area, flowers can be observed between February and August. This species is often confused with the more widespread *E. nocturnum*, as reported by Silva *et al*. (1999), here a more precise analysis of the specimens allowed us to identify the populations

from Maranhão as *E. carpophorum*, distinguished by its compressed stems (*vs.* cylindrical) and longer pedicellate ovary (Hágsater & Saldaña 2010). Its flowers are somewhat similar to *E. ciliare* and *E. purpurascens*, but the presence of pseudobulbs easily distinguish these other two species.

5. *Epidendrum ciliare* L. Syst. Nat. (ed. 10) 2: 1246. 1759. Fig. 2d

Epiphytes, Pseudobulbs present, ellipsoidal, ca. 68 cm long. Leaves 7.5–36 × 2.0–7.0 cm, elliptical to oblong. Inflorescence 2-flowered, peduncle 2.0–5.0 cm long, exposed, rachis 5–6 cm long, exposed; floral bracts 2.0–5.0 cm long, lanceolate. Flowers yellowish to greenish with white lip; ovary pedicellate, 3.0–7.0 cm long; dorsal sepal 4.8–5.1 × ca. 0.3 cm, narrow-elliptical, apex acute; lateral sepals 4.5–6.5 × 0.4–0.9 cm, narrow-elliptical, sub-falcate, apex acute; petals 5.0–6.0 × 0.3–0.6 cm, linear-elliptical, apex acute; lip blade 3–6 × 1.4–1.8 cm, clearly 3-lobed, with two oblong calli at the base, lateral lobes ovate, margin deeply fringed, apex acute, mid-lobe linear, margin entire, apex acute; column 1.2–2.3 cm long. Fruits not seen.

Material examined: São Luís, UFMA, Campus Dom Delgado, próximo à pista de atletismo, 4.II.2015, fl., *A.W.C. Ferreira 29* (SLUI 5711); 8.I.2016, fl., *K.N. Santos & A.W.C. Ferreira 30* (SLUI 5712).

This species is distributed in Mexico, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Puerto Rico, French Guiana, Guyana, Suriname, Venezuela, Colombia, Ecuador, Peru, and Brazil (Govaerts *et al.* 2020), where it is cited to the states of Amazonas, Amapá, Pará, Ceará and Maranhão (Pessoa 2020). In the state of Maranhão it was collected in the Amazon domain near a watercourse in a forest fragment inside the capital city of São Luís (Fig. 1), based on these features of the habitat, this population is considered to be under strong threat. In the study area, flowers can be observed between December and February. Among the species of the area it can be confused with *E. purpurascens,* but differs mainly by the lateral lobes of the lip deeply fringed (*vs.* margin entire).

6. *Epidendrum flexuosum* G. Mey. Prim. Fl. Esseq. 260. 1818.

Epiphytes, Pseudobulbs absent, stems cylindrical, ca. 40 cm long. Leaves 5–19 × 0.4–2.3 cm, oblong-elliptical. Inflorescence 5–7-flowered, peduncle ca. 30 cm long, exposed, rachis ca. 2.2–13 cm long, exposed; floral bracts ca. 0.3–1.3 cm long, deltoid to lanceolate. Flowers pink; ovary pedicellate, ca. 2.3–4.5 cm long; dorsal sepal 1.5–1.9 × 0.3–0.5 cm, elliptical to oblanceolate, apex attenuate; lateral sepals 1.5–1.9 × 0.3–0.5 cm, elliptical to oblanceolate, sub-falcate, apex attenuate; petals 1.4–1.8 × 0.5–0.8 cm, oblanceolate, apex acute; lip blade 0.8–1.0 × 0.7–0.9 cm, obscurely 3-lobed, with two oblong calli at the base and a central, longitudinal keel, lateral lobes transversely oblong, margin deeply denticulate, apex truncate to rounded, mid-lobe suborbicular, margin denticulate, apex cuspidate; column 0.8–1.0 cm long. Fruits not seen.

Illustration in Dunsterville & Garay (1966).

Material examined: Imperatriz, 8.VIII.1949. *M. Pires & G.A. Black 1753* (IAC 12717, IAN 50332).

This species is distributed in Mexico, Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Trinidad and Tobago, French Guiana, Guyana, Suriname, Venezuela, Bolivia, Colombia, Ecuador, Peru, and Brazil (Govaerts *et al.* 2020), where it is recorded to the states of Acre, Amazonas, Amapá, Pará, Rondônia, Roraima, Alagoas, Bahia, Maranhão, Paraíba, Pernambuco, Goiás, Mato Grosso do Sul, Mato Grosso, Espírito Santo, Minas Gerais and Rio de Janeiro (Pessoa 2020). Although widely distributed in Brazil, a single specimen is known from Maranhão. It was collected more than 70 years ago (1949) and is deposited at IAN. The locality of the collection (Imperatriz) (Fig. 1) is characterized as a transition zone between the Amazon and Cerrado domains (Almeida & Vieira 2010). In the study area, flowers can be observed in August. It could be confused with *E. macrocarpum* but is easily distinguished by the pink flowers with a shorter lip blade obscurely 3-lobed (< 1.0 cm long *vs.* orange to red, > 2.0 cm long, clearly 3-lobed).

7. *Epidendrum macrocarpum* Rich. Actes Soc. Hist. Nat. Paris. 1(1): 112. 1792. Fig. 2e

Epiphytes, Pseudobulbs absent, stems cylindrical, ca. 70 cm long. Leaves 6.5–12 × 1–2.8 cm, oblong-elliptical. Inflorescence 3–5-flowered, peduncle 6–17 cm long, exposed, rachis 0.7–2.3 cm long, exposed; floral bracts 0.2–0.9 cm long, deltoid to lanceolate. Flowers orange to red; ovary pedicellate, 3.8–4.0 cm long; dorsal sepal 2.3–2.4 × 0.3–0.4 cm, oblong-elliptical, apex attenuate; lateral sepals 2.2–2.2 × 0.3–0.4 cm, elliptical, sub-falcate, apex attenuate; petals 2.2–2.3 × 0.2–0.4 cm, elliptical, apex attenuate; lip blade 2.0–2.3 × 1.2–1.4 cm, clearly 3-lobed, with two globose calli

at the base and a central, longitudinal, undulating keel, lateral lobes obovate, margin denticulate, apex rounded, mid-lobe oblanceolate, margin denticulate, apex cuspidate; column 1.2–1.4 × 0.4 cm long. Fruits 4.0–5.0 × 1.5–2.0 cm, fusiform.

Material examined: Cândido Mendes, Fazenda Sete Irmãos, Rio Macaxeira, próximo à ponte da estrada antiga, 15.VII.2017, fl., *M.J.C. Silva & A.W.C. Ferreira 32* (SLUI 5713). Morros, Igarapé do Contrato, próximo à pousada Pedra Grande, 23.VII.2019, fl., *A.W.C. Ferreira 33* (SLUI 57114). Pinheiro, São Luís da Chapada, enclave de Cerrado em transição com Amazônia Maranhense, fl., *A.W.C. Ferreira 31* (SLUI 5715).

This species is distributed in Trinidad and Tobago, French Guiana, Guiana, Suriname, Venezuela, Colombia, Ecuador, Peru, Belize, and Brazil (Govaerts *et al.* 2020), where it is cited to the states Amazonas, Amapá, Pará, Roraima, Alagoas, Bahia, Maranhão, Paraíba, Pernambuco, Mato Grosso, and Rio de Janeiro (Pessoa 2020). It was collected near watercourses in the Amazon domain and in an area of Cerrado, growing on a species of Malpighiaceae (Fig. 1). According to Pessoa (2020), *E. macrocarpum* is restricted to the Amazon and Atlantic Forests, however here it is cited for the first time for the Cerrado. In the study area, flowers can be observed between July and September. It could be confused with *E. flexuosum,* but the color and size of the perianth parts can be used to distinguish them as described in the comments above.

8. *Epidendrum purpurascens* Focke. Tijdschr. Wis-Natuurk. Wetensch. Eerste Kl. Kon. Ned. Ins. Wetensch. 4: 64. 1851. Fig. 2f

Epiphytes, Pseudobulbs present, ellipsoidal, 6–45 cm long. Leaves 14.5–25.0 × 1.1–2.0 cm, elliptical to oblong-elliptical. Inflorescence 3–5 flowered, peduncle 6.5–8.0 cm long, exposed, rachis 2.5–5.0 cm long, exposed; floral bracts 1.6–2.3 cm long, lanceolate. Flowers yellowish to greenish with white lip; ovary pedicellate, 4.0–5.7 cm long; dorsal sepal 1.8–2.0 × 0.3–0.35 cm, oblong-oblanceolate, apex acuminate; lateral sepals 1.8–1.9× 0.3–0.35 cm, oblong-oblanceolate, sub-falcate, apex acuminate; petals 1.7–1.7 × 0.1–0.2 cm, narrow-oblanceolate, apex acute; lip blade 0.7–0.8 × 0.8–0.9 cm, 3-lobed, with two oblong calli at the base, lateral lobes ovate, margin erose, apex acute, mid-lobe oblanceolate, margin erose, apex acute; column 1.2–1.3 cm long. Fruits 4.5–6.0 × 1.0–1.5 cm, fusiform.

Material examined: Cândido Mendes, Fazenda Sete Irmãos, Rio Macaxeira, próximo a ponte da estrada antiga, 15.X.2018, fl., A.W.C. *M.J.C. Silva & Ferreira 36* (SLUI 5716). Presidente Sarney, nas margens do Rio Turiaçu, localidade dos "Três Furos", 17.II.2012, fl., *A.W.C. Ferreira 34* (SLUI 5717). Santa Helena, nas margens do Rio Turiaçu, localidade dos "Três Furos", 17.II.2012, fl., *A.W.C. Ferreira 35* (SLUI 5718).

This species is distributed in Costa Rica, French Guiana, Guyana, Suriname, Venezuela, Colombia, and Brazil (Govaerts *et al.* 2020), where it is recorded to the states of Acre, Amazonas, Amapá, Pará, Roraima and Maranhão (Pessoa 2020). It is characteristic of riparian forests in the Amazon domain (Fig. 1), and although it is a frequent species, unfortunately during this study we observed the death of about 50% of its original population by rotting due to the exceptional flood of the Turiaçu River in 2019. In the study area, flowers can be seen between October and February. It is similar to *E. ciliare*, but differs mainly by the mid-lobe of the lip oblanceolate (*vs.* linear) and lateral lobes of the lip with margin erose (*vs.* deeply fringed).

9. *Epidendrum rigidum* Jacq., Enum. Syst. Pl. p. 29. 1760. Fig. 2g

Epiphytes, Pseudobulbs absent, stems cylindrical, ca. 12 cm long. Leaves 2.4–6 × 0.8–1.4 cm, oblong-elliptical. Inflorescence 3–6-flowered, peduncle 0.5–1.3 cm long, exposed, rachis 4–7 cm long, completely covered by bracts; floral bracts 1–1.6 cm long, ovate. Flowers green; ovary pedicellate, 0.8–1.2 cm long; dorsal sepal 0.5–0.7 × 0.3–0.4 cm, elliptical-ovate, apex acute; lateral sepals 0.6–0.7 × 0.2–0.3 cm, ovate, sub-falcate, apex acute; petals 0.6–0.7 × 0.1–0.2 cm, oblong, apex acute to obtuse; lip blade 0.4–0.5 × 0.4–0.5 cm, entire, suborbicular, with two globose calli at base and a central, longitudinal keel, margin entire, apex obtuse; column 0.3–0.4 cm long. Fruits not seen.

Material examined: Cândido Mendes, Fazenda Sete Irmãos, Rio Macaxeira, 15.IV.2019, fl., *M.J.C. Silva & A.W.C. Ferreira 38* (SLUI 5719). Pedro do Rosário, margem MA-006, Igarapé da Ponte, 10.IV.2017, fl., *W.R. Silva-Júnior et al. 37* (SLUI 5720). Peritoró, estrada BR-222, km 64, Capanema to Maranhão, 5.XI.1965, *G.T. Prance 1980* (NY).

This species is distributed in the United States, Mexico, Costa Rica, Honduras, Panama, Bahamas, Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico, Trinidad and Tobago, French Guiana, Guyana, Suriname, Venezuela, Bolivia, Colombia, Ecuador, Peru, Argentina, Paraguay, and Brazil (Govaerts *et al.* 2020), where it is

widespread, occurring in almost all states except Piauí and Rio Grande do Norte (Pessoa 2020). Although widely distributed in Brazil (Pessoa 2020), in Maranhão it is occasional in areas in the Amazon domain near watercourses (Fig. 1), and no big population was seen, only a few isolated individuals. In the study area, flowers can be observed between March and April. It can be confused with *E. strobiliferum* Rchb. f., but differs by the leaves 0.8–1.4 cm wide (vs. 0.5–0.7 cm), flowers green (*vs.* white-cream), the longer rachis (4–7 cm *vs.* 1.2–2 cm) and suborbicular lip (*vs.* cordate).

10. *Epidendrum strobiliferum* Rchb.f., Ned. Kruidk. Arch. 4(3): 333. 1859. Fig. 2h

Epiphytes, Pseudobulbs absent, stems cylindrical, 15–35 cm long. Leaves 2.2–3.8 × 0.5–0.7 cm, lanceolate to oblong-elliptical. Inflorescence 4–7-flowered, peduncle 0.2–0.8 cm long, exposed, rachis 1.2–2 cm long, completely covered by bracts; floral bracts 0.6–0.9 cm long, ovate. Flowers white-cream; ovary pedicellate, 0.4–0.6 cm long; dorsal sepal 0.35–0.4 × ca. 0.1 cm, elliptical-ovate, apex acute to obtuse; lateral sepals 0.3–0.4 × ca. 0.1 cm, elliptical-ovate, sub-falcate, apex acute to acuminate; petals 0.3–0.35 × 0.05 cm, oblong-oblanceolate, apex obtuse; lip blade 0.3–0.4 × 0.2 cm, entire, ovate, with two globose calli at base, margin entire, apex acute; column 0.1–0.15 cm long. Fruits 0.5–0.8 × 0.3–0.4 cm, ovoid.
Material examined: Anajatuba, 20.XI.1978, fl., *L.R. Marinho & G. Pinheiro 620* (IAN). Cândido Mendes, Fazenda Sete Irmãos, Igarapé Cumaruzal, 15.VII.2017, fl., *M.J.C. Silva & A.W.C. Ferreira 40* (SLUI 5721). Santa Helena, nas margens do Rio Turiaçu, localidade dos "Três Furos", 10.VIII.2014, fl., *A.W.C. Ferreira 039* (SLUI 5722). São Luís, UFMA, Campus Dom Delgado, próximo a pista de atletismo, 20.VI.2019, fl., *K.N. Santos & A.W.C. Ferreira 41* (SLUI 5723).

This species is widely distributed in the Neotropics (Govaerts *et al.* 2020), in Brazil it is also widely distributed except for the states of Mato Grosso do Sul, Tocantins, Piauí, Rio Grande do Norte and Paraíba (Pessoa 2020). It is frequent in areas in the Amazon domain (Fig. 1), and has also been observed in urbanized areas growing on *Mangifera indica* L. (Anacardiaceae). In the study area, = flowers can be observed between May and August. It is similar to *E. rigidum* Jacq., but differs by the small branching plants which may form large mats (*vs.* not branched), white-cream flowers (*vs.* green), and the ovary ventrally inflated (*vs.* not inflated).

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