



UNIVERSIDADE ESTADUAL PAULISTA
“JÚLIO DE MESQUIA FILHO”
Instituto de Biociências – Câmpus de Botucatu/Rio Claro
Seção Técnica de Pós-Graduação



**PROGRAMA DE PÓS-GRADUAÇÃO EM BIOLOGIA VEGETAL
(INTERUNIDADES)**

**REVISÃO DA SUBTRIBO MALAXIDINAE (ORCHIDACEAE) NO
BRASIL E ESPÉCIES NOVAS DE MALAXIS SOL. EX SW**

THIAGO FARIA DOS SANTOS

Tese apresentada ao Instituto de Biociências, Câmpus de Rio Claro, UNESP, para obtenção do título de Doutor no Programa de Pós-Graduação em Biologia Vegetal, Interunidades entre o Instituto de Biociências do câmpus de Botucatu e Instituto de Biociências do câmpus de Rio Claro.

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ORIENTADOR: ERIC DE CAMARGO SMIDT

COORDINADOR: ALESSANDRA IKE COAN

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do Câmpus de Rio Claro, Universidade
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Lembre-mos sempre, ao subir a montanha, de contemplar não apenas o topo, mas também o caminho percorrido, pois é na jornada que encontramos as verdadeiras riquezas da experiência.

Resumo

A subtribo Malaxidinae, pertencente à família Orchidaceae, destaca-se como uma das poucas subtribos com significativa diversidade de espécies epífitas ou terrícolas, distribuídas em diferentes continentes. Abrange cerca de 14 gêneros, dois dos quais são encontrados no território brasileiro. Estudos recentes sobre a filogenia desse grupo revelaram o polifiletismo dos gêneros, indicando que os clados formados com base em informações do DNA estão correlacionados com características morfológicas das folhas e hábitos de vida das espécies. Dada a complexidade na classificação da Malaxidinae, este estudo teve como objetivo uma compreensão descritiva e comparativa da morfologia e características ecológicas das espécies de *Malaxis* e *Liparis* no Brasil, identificando caracteres que contribuem para a elucidação da taxonomia do grupo. Como suporte para essas investigações, foram realizadas revisões taxonômicas dos táxons da subtribo presentes no território nacional, através de notas taxonômicas, diagnoses, ilustrações, chaves de identificação, mapas de distribuição, avaliação do estado de conservação. No gênero *Liparis*, nove lectotipificações e seis neotipificações foram incluídas, com a proposta de reclassificação de *Liparis inundata* como sinônimo de *Liparis nervosa* totalizando três espécies para o Brasil. Para o gênero *Malaxis*, sete lectotipificações e três neotipificações foram propostas, juntamente com a sugestão de sinonimizar *Malaxis jaraguae* com *Malaxis ovatilabia*. O estudo também inclui a descrição de duas novas espécies no gênero, *Malaxis engelsii* e *Malaxis ybytus*, totalizando 12 espécies para o Brasil.

Palavras-chave: Estado de conservação, *Liparis*, Malaxidinae, *Malaxis*, Orchidaceae, Sistemática, Taxonomia.

Abstract

The subtribe Malaxidinae, belonging to the Orchidaceae family, stands out as one of the few subtribes with a significant diversity of epiphytic or terrestrial species distributed across different continents. It encompasses approximately 14 genera, two of which are found in Brazilian territory. Recent studies on the phylogeny of this group have revealed the polyphyly of the genera, indicating that clades formed based on DNA information are correlated with morphological characteristics of leaves and lifestyles of the species. Given the complexity of the classification of Malaxidinae, this study aimed for a descriptive and comparative understanding of the morphology and ecological characteristics of *Malaxis* and *Liparis* species in Brazil, identifying traits contributing to clarifying the group's taxonomy. In support of these investigations, taxonomic reviews of the subtribe's taxa present in the national territory were conducted, including taxonomic notes, diagnoses, illustrations, identification keys, distribution maps, and conservation status assessments. In the *Liparis* genus, nine lectotypifications and six neotypifications were included, along with the proposal to reclassify *Liparis inundata* as a synonym of *Liparis nervosa*, totaling three species for Brazil. For the *Malaxis* genus, seven lectotypifications and three neotypifications were proposed, along with the suggestion to synonymize *Malaxis jaraguae* with *Malaxis ovatilabia*. The study also includes the description of two new species in the genus, *Malaxis engelsii* and *Malaxis ybytus*, totaling 12 species for Brazil.

Key-words: Conservation Status, *Liparis*, Malaxidinae, *Malaxis*, Orchidaceae, Systematics, Taxonomy

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INTRODUÇÃO GERAL

A família Orchidaceae Juss., com cerca de 27.800 espécies, é considerada uma das maiores entre as Angiospermas (The Plant List 2024). Posiciona-se na ordem Asparagales (APG IV 2016) e divide-se em cinco subfamílias: Apostasioideae, Vanilloideae, Cyripedioideae, Orchidoideae e Epidendroideae (Chase *et al.* 2003, 2015).

Com aproximadamente 650 gêneros e 18.000 espécies, distribuição cosmopolita a exceção de desertos e regiões polares, e congregando-se em 16 tribos, Epidendroideae é a subfamília mais diversa das Orchidaceae (Pridgeon *et al.* 2005). Em Epidendroideae, a tribo Malaxideae, com cerca de 1000 espécies presentes nas áreas tropicais e temperadas do globo (Cameron 2005), é composta pelas subtribos Dendrobiinae e Malaxidinae, atualmente com dois e 14 gêneros respectivamente (Chase *et al.* 2015). Malaxidinae é uma das poucas subtribos com grande quantidade de espécies epífitas ou terrícolas obrigatórias, que possui gêneros ocorrendo em mais de um continente, como os gêneros *Liparis* Rich. e *Malaxis* Sol. ex Sw., ultrapassando 300 espécies cada e com representantes nas Américas, África, Ásia e Europa (Dressler 1981; Atwood 1986). O primeiro com 11 registradas em território nacional, e o segundo com 3, distribuídas por todo Brasil, predominantemente na região sudeste (Santos & Smidt, Flora do Brasil 2020 em construção).

Os estudos filogenéticos mais recentes de Malaxidinae demonstram que essa subtribo é polifilética e, ao contrário da maioria das Angiospermas, o epifitismo se apresenta como a forma de vida plesiomórfica (Neyland & Urbatsch 1995; Cameron 2005). As relações entre os táxons do grupo são delimitadas pelo hábito de crescimento e formato das folhas; por exemplo, espécies de *Liparis* terrícolas apresentam alto grau de proximidade com *Malaxis*, e espécies epífitas formam um clado com *Oberonia* Lindl. (Fig. 1) (Cameron 2005; Tsutsumi *et al.* 2007; Li & Yan 2013).

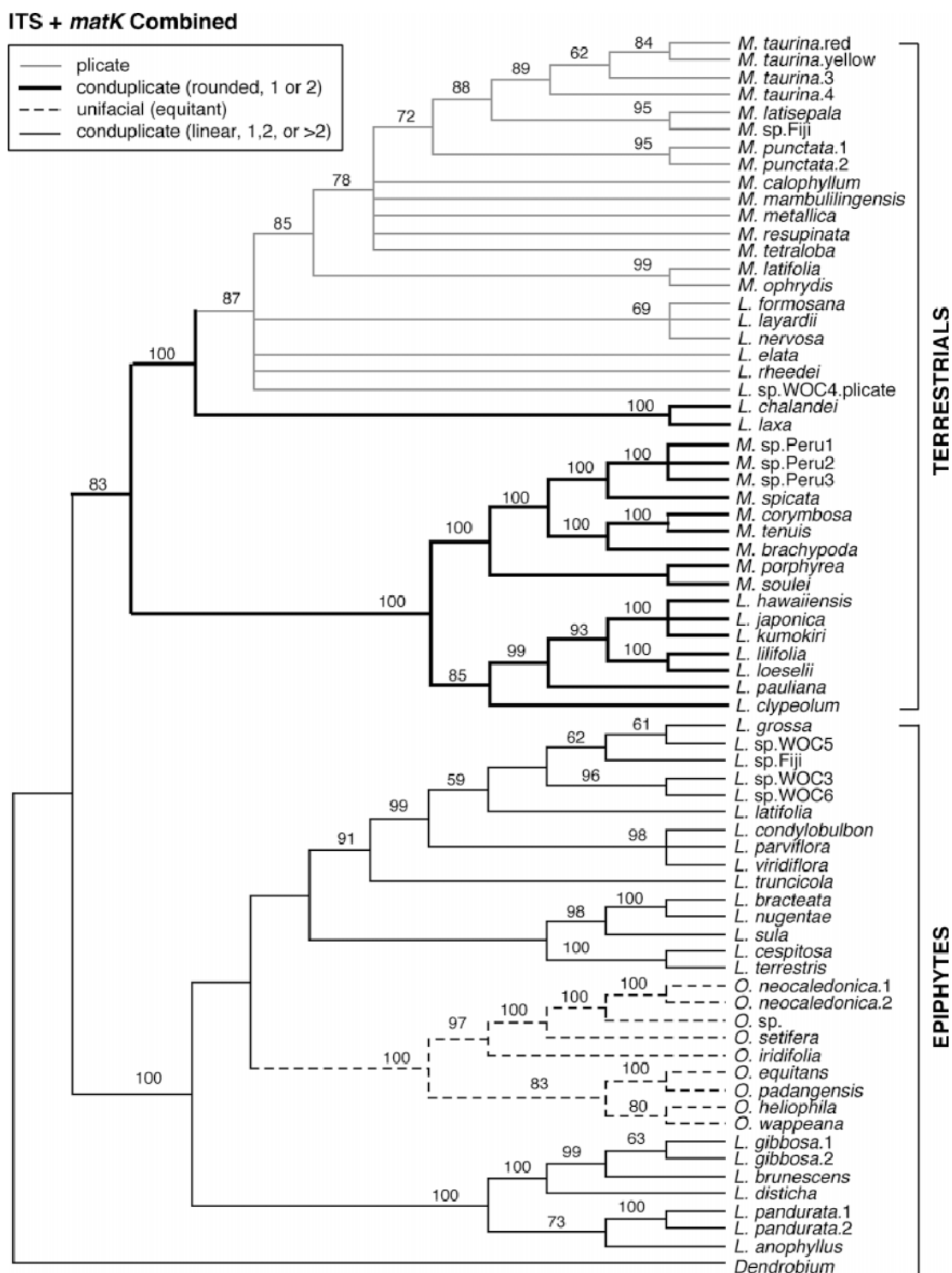


Fig. 1. Árvore filogenética de Malaxidinae (regiões ITS e MatK combinadas), demonstrando o parentesco de espécies de *Liparis*, *Malaxis* e *Oberonia* em relação ao hábito de vida (extraída de Cameron 2005).

Liparis foi proposto por Louis-Claude Marie Richard em 1817 através de *Ophrys loeselii* L. (Fig. 2A, a), espécie com distribuição da Europa a América do Norte, que atualmente apresenta populações ameaçadas e protegidas por lei na maioria dos países europeus (Pillon *et al.* 2007). O gênero é caracterizado pela presença de ervas epífitas ou terrícolas, com flores ressupinadas, de pétalas lineares, labelo inteiro e reflexo na porção mediana, geralmente com um calo bilobado na porção basal, e pela coluna sempre alada e arqueada, com duas tétrades de políneas com a parede lisa (Pridgeon *et al.* 2005).

Malaxis, que é um gênero reconhecido em países asiáticos pela sua importância na medicina tradicional (Chauhan 1990; Sharma *et al.* 2014), foi proposto por Olof Swartz em 1788 através das espécies jamaicanas *Malaxis spicata* Sw. (Fig. 2B, b) e *Malaxis umbelliflora* Sw. (Fig. 2C, c). É caracterizado pela predominância de espécies terrestres, com raízes pubescentes e caules cilíndricos emergindo dos pseudobulbos até o racemo apical; no aspecto reprodutivo, as inflorescências são racemosas ou sub-umbeladas com flores não ressupinadas, pétalas e sépala dorsal livres, e sépalas laterais livres ou raramente parcialmente conadas (Kalanowska 2014).

Os tratamentos taxonômicos recentes vêm desmembrando os gêneros de Malaxidinae e novos gêneros vêm sendo propostos (Tamayo & Szlachetko 1998; Margońska & Szlachetko 2001; Margońska 2003, 2006; Szlachetko & Margońska 2006). Porém, são fundamentados principalmente em caracteres morfológicos florais, atributos que, segundo Cameron (2005), devem ser considerados secundários para a caracterização genérica em Malaxidinae, construindo agrupamentos atuais nos gêneros, que não refletem a história evolutiva da subtribo, e portanto devem ser revistos. Vale ressaltar que a delimitação de *Malaxis* e *Liparis* é foco de antiga discussão, mas que se mantém contemporânea em Orchidaceae (Thouars & Du Petit 1809; Kuntze 1891; Dressler 1981; Radins *et al.* 2014).

Ao propor *Malaxis irmae* Radins *et al.* (2014: 126) criticaram a revisão de Malaxidinae de Margońska *et al.* (2012) que, de maneira equivocada, reconhece seções e subseções nos níveis infragenéricos se baseando em caracteres morfológicos como a robustez do caule, entre outros: e.g. “agrupando espécies distintas e separando semelhantes”.

Radins *et al.* (2014) também estudaram a filogenia do grupo através de informações contidas nas regiões *ITS* do ribossomo nuclear e *MatK* do genoma plastídico. Os autores amostraram 28 espécies de Malaxideae dos Neotrópicos e alocaram a nova espécie *M. irmae* como irmã de *Malaxis cipoensis* F. Barros, única distribuída em território brasileiro com informações moleculares levantadas até o momento.

Considerando a problemática já antiga na classificação de Malaxidinae, propomos a revisão dos táxons de *Malaxis* e *Liparis*, visando resolver a taxonomia das espécies do grupo no Brasil.

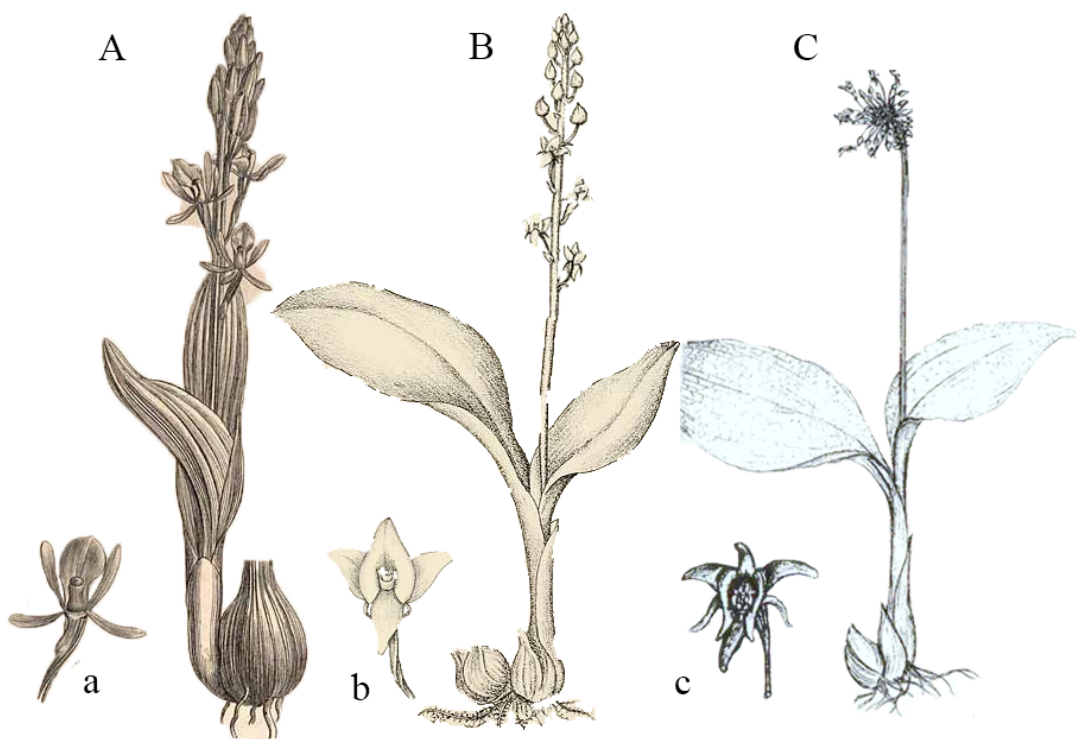


Fig. 2. Espécies de *Liparis* e *Malaxis* utilizadas nas obras príncipes dos gêneros. **A.** *Liparis loeselii*, planta inteira. **a.** Flor. **B.** *Malaxis spicata*, planta inteira. **b.** Flor. **C.** *Malaxis umbelliflora*, planta inteira. **c.** Flor. Modificados de: **A.** Nees von Esenbeck (1843). **B.** Fawcett & Rendle (1910). **C.** Swartz, O. (não publicado, disponível online em “Swedish Royal Museum of Natural History”).

OBJETIVO GERAL E ESTRUTURA DA TESE

- Revisar as espécies dos gêneros *Malaxis* e *Liparis* ocorrentes em território nacional, propondo reconhecimento dos táxons, notas taxonômicas, diagnoses, ilustrações, chaves de identificação, mapas de distribuição e avaliação do estado de conservação das espécies.

Para alcançar o objetivo da Tese, a mesma foi estruturada em 4 capítulos:

I) Revision of *Liparis* (Orchidaceae, Epidendroideae, Malaxidinae) in Brazil.

Este capítulo investiga a presença do gênero *Liparis* no Brasil, revisando os táxons que ocorrem no país. O estudo examinou 767 exsicatas, identificando três espécies distintas do gênero presentes no território brasileiro. A pesquisa inclui nove lectotipificações e seis neotipificações, além da proposição da reclassificação de *Liparis inundata* (Barb. Rodr.) A.W. Hill como sinônimo de *Liparis nervosa* (Thunb.) Lindl. As espécies podem ser diferenciadas por características como a lâmina foliar, o número de folhas por pseudobulbo e a presença e forma dos calos no labelo. Entre as espécies, apenas a *Liparis cogniauxiana* F. Barros & L.R.S. Guim. é endêmica do Brasil, restrita ao bioma Cerrado. *Liparis nervosa* é encontrada em todos os biomas brasileiros, incluindo Pampas e Caatinga, enquanto a *L. vexillifera* (Lex.) Cogn. ocorre na Mata Atlântica, Amazônia e Cerrado. Seguindo os critérios da IUCN,

L. cogniauxiana, *L. nervosa* e *L. vexillifera* são classificadas como 'Pouco Preocupante (LC)', devido à ampla distribuição, número de ocorrências, presença em áreas protegidas e baixa pressão de coleta indiscriminada.

II) Revision of *Malaxis* (Orchidaceae, Epidendroideae, Malaxidinae) in Brazil.

Este capítulo identifica e analisa as espécies de *Malaxis* no território nacional. O estudo examinou 363 exemplares, identificando 12 espécies distintas do gênero presentes no território brasileiro. Taxonomicamente, *Malaxis excavata* (Lindl.) Kuntze foi determinada como não ocorrendo no Brasil, sendo que espécimes anteriormente identificados foram reclassificados como *Malaxis caracasana* (Klotzsch ex Ridl.) Kuntze. O status taxonômico de *Malaxis brasiliensis* Spreng. foi considerado incerto. Foram propostas sete lectotipificações e três neotipificações, juntamente com a sugestão de sinonimizar *Malaxis jaraguae* (Hoehne & Schltr.) Pabst com *Malaxis ovatilabia* (Schltr.) Santos *et al.* Adicionalmente, *Microstylis ovatilabia* Schltr. foi reclassificada como *Malaxis ovatilabia*. Entre as espécies, apenas *M. caracasana* e *Malaxis parthoni* C. Morren não são endêmicas do Brasil. Os biomas da Mata Atlântica e Cerrado abrigam a maior diversidade de espécies de *Malaxis*. Alguns espécimes foram documentados de forma limitada na região amazônica, e estes potencialmente representam táxons não descritos ou novos registros para o Brasil. Não há registros de espécies de *Malaxis* documentadas nos biomas da Caatinga, Pantanal e Pampas. De acordo com a IUCN, *M. caracasana*, *M. ovatilabia* e *M. parthoni* são classificadas como "Pouco Preocupante (LC)". *Malaxis cogniauxiana* é "Quase Ameaçada (NT)". *Malaxis cipoensis* F. Barros, *Malaxis sertulifera* (Barb. Rodr.) Pabst e *Malaxis warmingii* (Rchb. f.) Kuntze estão "Em Perigo (EN)". *Malaxis cordilabia* Portalet e *Malaxis ybytyus* T.F. Santos & E.C. Smidt estão "Criticamente Em Perigo (CR)". *Malaxis engelsii* T.F. Santos & E.C. Smidt, *Malaxis pabstii* (Schltr.) Pabst e *Malaxis pubescens* (Lindl.) Kuntze são consideradas "Dados Insuficientes (DD)".

III) A new epiphyte *Malaxis* (Orchidaceae: Malaxidinae) from the upper montane forest of the Atlantic Rainforest in southern Brazil.

Este capítulo apresenta a recém-descoberta orquídea epífita *Malaxis engelsii*, encontrada em floresta alto-montana da Mata Atlântica no Paraná. Esta é a única espécie epífita de *Malaxis* conhecida no país, sendo caracterizada por seu tamanho pequeno, folhas elípticas, flores com sépalas parcialmente conadas e labelo com quatro fôveas. Propomos descrição detalhada, fotografias, ilustrações e comparações com espécies semelhantes, como *Malaxis cipoensis*, *Malaxis sertulifera* e *Malaxis ybytus*. Atualmente, a classificação da espécie é "Dados Insuficientes (DD)".

IV) A new *Malaxis* (Orchidaceae: Malaxidinae) from the *Campos de Altitude* of the Atlantic Rainforest in southern Brazil.

Este capítulo propõe *Malaxis ybytus* como uma nova espécie encontrada nos campos de altitude da Mata Atlântica no sul do Brasil, na cadeia de montanhas da Serra do Araçatuba/Papanduva. A nova espécie é descrita, ilustrada e comparada com outras similares, especialmente *Malaxis cipoensis* e *Malaxis sertulifera*. *M. ybytus* é caracterizada por suas folhas planas a ligeiramente conduplicadas, inflorescência densamente congestionada com flores pequenas que possuem sépalas laterais livres e quatro fôveas no labelo. Devido ao alto grau de endemismo nesse ambiente, à escassez de registros de coleta e à pressão antrópica na região, inferimos que a espécie está Criticamente Ameaçada (CR).

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CAPITULO 1) Revision of *Liparis* (Orchidaceae, Epidendroideae, Malaxidinae) in Brazil

Revisão de *Liparis* (Orchidaceae, Epidendroideae, Malaxidinae) no Brasil

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Revision of *Liparis* in Brazil

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Abstract

The presence of *Liparis* occurring in Brazil was revised, resulting in three taxons confirmed in national territory. Nine lectotypifications and six neotypifications, together with *L. inundata* being demoted to a synonym of *L. nervosa*, are proposed. Species can be distinguished by the leaf blade, the number of leaves per pseudobulb and the presence of calluses in the lip. From those, only *L. cogniauxiana* is endemic to the country, being restricted to the Cerrado biome. *Liparis nervosa* occurs in all Brazilian biomes and is the only one registered in the Pampas and the Caatinga, while *L. vexillifera* occurs in the Atlantic Forest, Amazon and Cerrado biomes. According to the IUCN criteria, *L. cogniauxiana*, *L. nervosa* and *L. vexillifera* are in the “Least Concern (LC)” category due to a broad distribution, the number of occurrences, presence in protected areas and low pressure from indiscriminate collecting.

Keywords: nomenclature, South America, systematics, taxonomy

Resumo

A presença de *Liparis* no Brasil foi revisada, resultando em três táxons confirmados em território nacional. São apresentadas nove lectotipificações e seis neotipificações, junto com a proposta para rebaixar *L. inundata* a sinônimo de *L. nervosa*. As espécies podem ser distintas pela lâmina foliar, número de folhas por pseudobulbo e pela presença de calos no labelo. Dessas, apenas *L. cogniauxiana* é endêmica do país, estando restrita ao bioma Cerrado. *Liparis nervosa* ocorre em todos os biomas brasileiros e é a única registrada nos Pampas e Caatinga, enquanto *L. vexillifera* ocorre nos biomas Mata Atlântica, Amazônia e Cerrado. De acordo com os critérios da IUCN, *L. cogniauxiana*, *L. nervosa* and *L. vexillifera* estão na categoria de “Pouco Preocupante (LC)” devido a ampla distribuição, número de ocorrências, presença em áreas protegidas e baixa pressão de coleta indiscriminada.

Palavras-chave: nomenclatura, América do Sul, sistemática, taxonomia

Introduction

Orchidaceae is one of the richest plant families (Chase *et al.* 2015), assuredly well represented in Brazil, with 251 genera and approximately 2,500 species, of which almost 1,500 are endemic to the country (BFG 2018). Although *Liparis* Richard (1817: 39) is a cosmopolitan group with more than 300 species (Cameron 2005), only three are traditionally recognized as occurring in Brazil (Santos & Smidt 2020).

Liparis was described in 1817 by Louis-Claude Marie Richard, having *Ophrys loeselii* Linneus (1753: 947) as type species, based on a specimen from Sweden that honours the plant collector Peter Johann Loesel, a german botanist from the 1600s who studied the Prussian flora (Loesel 1703). Linnaeus described this species as plants with bifoliar and lanceolate leaves showing glabrous inflorescence with 5 to 8 flowers, petals slightly reflex, and lip strongly ovate. The most complete taxonomic approach that classifies *Liparis* at the infrageneric level was carried out by Garay & Romero-Gonzalez (1999), who proposed a key for identifying the taxons. The authors indicate four subgenera and 19 sections.

Liparis is historically splitted into different smaller groups based solely on morphological characteristics, and some of the subgenera and sections can be interpreted as separate genera according to some authors (du Petit Thouars 1809; Pfitzer 1887; Margońska & Szlachetko 2001; Jones & Clements 2005), nonetheless, these classifications rarely or never represents the evolutionary pattern for the group (Cameron 2005; Pridgeon *et al.* 2005). Since there's much historical confusion concerning the *Liparis* taxonomy, for now, it is better to not adopt an infrageneric classification until a more robust phylogeny is proposed for the Neotropics (Pridgeon *et al.* 2005; Radins *et al.* 2014).

This research aimed to revise the *Liparis* species recorded in Brazil. We present taxonomic notes, complete descriptive comments with ecological information, diagnoses, illustrations, photographs, identification keys, distribution maps and assessment of the conservation status of those species.

Material and Methods

Taxonomy, fieldwork and herbarium material:—Morphological studies were realized based on exsiccates available online or deposited at visited national herbariums (acronyms according to Thiers (2023), continuously updated): ALCB, ASE, BHCB, BHZB, BOTU, CEN, CEPEC, CESJ, CNMT, CRI, CTBS, EFC, ESA, ESAL, FCAB, FLOR, FUEL, FURB, HAS, HBG, HCF, HRJ, HRCB, HST, HUCS, HUCP, HUEFS, HUESB, HUFU, HUNI, HURB, HVASF, IAC, IAN, ICN, INPA, IPA, JOI, MAC, MBM, MBML, OUPR, PACA-AGP, PEL, R, RB, RBR, RFA, RON, SHPR, SJRP, SP, SPF, SPSF, TANG, UB, UEC, UESC, UFMT, UFP, UPCB, USP, VIC; data available online from the respective foreign herbaria were also consulted: AMO, AMES, BR, BM, G, GH, GOET, K, LE, M, MA, MO, NY, P, PO, R, UPS, US, YU. Additional analyses were made based on specimens obtained during field excursions around Brazil from 2019 to 2023, aiming to cover all vegetation types in the country. Illustrations and photographs were taken from live plants, exposing the plant habit, inflorescence and floral features. Collections were built according to Fidalgo & Bononi (1984) and deposited at the UPCB herbarium, and some material was also preserved in formalin-acetic acid-alcohol (FAA, Johansen 1940) for future studies. We delimited the species and proposed a dichotomous key for its recognition.

Specimens were identified to the lowest taxonomic level through the analysis of the protologues and nomenclatural types consultation and compared with descriptions in other works that contemplate *Liparis* (Cogniaux 1896; Barbosa Rodrigues 1882; Pabst & Dungs 1977). For the descriptions, we adopted the terminology of Rizzini (1977), Weberling (1989) and Stearn (2004). Abbreviations of authors followed Brummitt & Powell (1992), and for scientific journals, we followed “The Botanical Periodicum Huntianum, Suppl. (BPH)”. Distribution maps and conservation status of taxa were built using the programs DIVA-GIS 7.5 (Hijmans *et al.* 2012) and GeoCat (Bachman *et al.* 2011), respectively, following the IUCN (2020) guidelines.

Results

A total of 767 exsiccates were studied, 736 from specimens collected in Brazil and 31 from other countries. A total of 50 vouchers belong to *Liparis cogniauxiana* F. Barros & L.R.S. Guimarães (2010: 31), 562 of *Liparis nervosa* (Thunberg 1784: 814) Lindley (1830: 26) and 124 of *Liparis vexillifera* Cogniaux (1896: 289). From those, only *L. cogniauxiana* is endemic to the country, being restricted to the Cerrado biome. *Liparis nervosa* occurs in all Brazilian biomes and is the only one registered in the Pampas and the Caatinga, while *L. vexillifera* occurs in the Atlantic Forest, Amazon and Cerrado biomes (Fig. 1).

We propose nine lectotypifications: *L. guineensis* Lindley (1834: 20), *L. kappleri* Reichenbach (1861: 218), *L. eggersii* Reichenbach (1885: 278), *L. elata* var. *latifolia* Ridley (1886: 22), *L. elata* var. *rufina* Ridley (1886: 22), *L. elata* var. *longifolia* Cogniaux (1896: 287), *L. vexillifera* var. *latifolia*

Cogniaux (1896: 290), *L. otophyllon* Schlechter (1922: 41), and *Leptorchis campestris* (Barbosa Rodrigues 1877: 36) Kuntze (1891: 671), and six neotypifications: *L. elata* var. *purpurascens* Regel (1856: 374), *L. odontostoma* Reichenbach (1877: 97), *L. bituberculata* var. *hasiana* Hooker (1890: 696), *L. vexillifera* subsp. *lindeniana* (Richard & Galeotti 1845: 18) Dressler (1997: 264), *L. vexillifera* var. *galeottiana* (Richard & Galeotti 1845: 18) Ames & Correl (1942: 79), and *Leptorchis elliptica* (Reichenbach 1850: 833) Kuntze (1891: 671). *Liparis inundata* Barbosa Rodrigues (1877: 36) is demoted to synonym of *Liparis nervosa* (Thunb.) Lindl.

Taxonomy

Identification Key for *Liparis* in Brazil (Fig. 2).

- 1. Leaves conduplicate or flat, 1 per pseudobulbs..... 3. *Liparis vexillifera*
- 1'. Leaves plicate 2-5 per pseudobulbs..... 2
 - 2. Usually more than 3 leaves per pseudobulbs; lip with 2 prominent tooth-like calluses 2. *Liparis nervosa*
 - 2'. Usually 2-3 leaves per pseudobulbs; lip with 2 inconspicuous rounded calluses..... 1. *Liparis cogniauxiana*

- 1. *Liparis cogniauxiana* (Cogn.) F. Barros & L.R.S. Guim., Neodiversity 5(1): 31. 2010. Type:

BRASIL. São Paulo: Itu, February 1834, *Riedel L. 81* (Holotype BR, Holotype image BR [0000006573621]!).

Fig. 3.

= *Liparis bifolia* Cogn. *Fl. bras.* 3(4): 289. 1896. *nom illeg.*

Herb 51–149 mm. Roots 30–69.3 mm length, cylindrical, thin or thick. Pseudobulbs 11–29 × 8–19 mm, ellipsoid; covered by white or brown deciduous foliaceous sheets. Leaves 52–94 × 27–45 mm, green, 2–3 per pseudobulbs, several layers of a sheath-like petiole 13–58 mm length; lamina plicate, membranaceous, elliptical, rarely lanceolate, margin undulate, apex acute or obtuse. Inflorescence 125–159 mm raceme; floral bracts in the base of the pedicels, acuminate. Flowers resupinate; green, purple or green with purple stains; pedicels 3–11 mm length; ovary 2–3 mm length. Dorsal sepal 4–7 × 0.6–3 mm, oblong or oblong-lanceolate, margin entire and revolute, apex obtuse or slightly acute. Lateral sepals 4–6 × 2–4 mm, free, oblong or oblong-lanceolate, margin entire and revolute, apex obtuse or slightly acute. Petals 4–7 × 0.2–2 mm; linear; margin entire and revolute; apex obtuse. Lip 4–7 × 2–6 mm, trilobate, glabrous; base with two rounded inconspicuous callus, with three internal thin vein; lateral lobes in the base of the lip, inconspicuous, rounded; mid lobe obovate, strongly reflexed, margin entire, slightly undulate near the apex, apex emarginate. Column 4–6 mm length, slightly arched; foot short, apex winged; anther green, yellow or purple. Pollinarium with two ovoid, bipartite pollinia.

Distribution:—This species is endemic to Brazil. Occurs in the central west, southeast and northeast regions in the states of Distrito Federal, Goiás, Mato Grosso, Minas Gerais, Pernambuco and São Paulo (POWO 2022).

Characterization and ecology:—*Liparis cogniauxiana* is characterized by its small size with a terrestrial habit and two or rarely three plicate leaves emerging from the lateral or apex of the entirely or mostly above-ground pseudobulb.

It can be recognized and distinguished from the other two species of the genus, in vegetative morphology, by the more compactness between the pseudobulb and leaves with a short petiole; and in the flowers by the two inconspicuous calluses in the base of the lip. This species resembles *Liparis nervosa*, being distinguished by the vegetative size of 51–149 mm instead of 92–520 mm in length, by the presence of two or rarely three leaves per pseudobulbs, and by the rounded calluses on the lip.

Liparis cogniauxiana is endemic to the Cerrado biome, usually occurring in low-altitude areas inside the forest formation of the dry woods, but occasionally can be found exposed to the sun in the formations of dry or rupestrian fields. It blooms from December to April, being fertile from the beginning to the end of summer. With an extent of occurrence (EOO) of approximately 1,402,367.520 km² and an area of occupancy (AOO) of approximately 200,000 km², together with several records inside protected areas, this taxon falls into the category of “Least Concern (LC)”.

Selected examined material: BRAZIL. DISTRITO FEDERAL: Brasília. Chapada da Contagem, 15.II.1973, *E.P. Heringer* 12270 (UB). Brasília. Chapada da Contagem, 8.II.1999, *D. Bertioli* 37 (CEN). Brasília. Estrada para Santo Antônio do Descoberto, 7.III.1998, *J.A.N. Batista* 785 (CEN). Brasília, Lago Azul, 12.II.1995, *R.S. Oliveira* 97 (UB). Brasília, Mansões do Lago Norte, 10.II.1992, *J.A.N. Batista* 283 (CEN). Brasília, Reserva Ecológica do Guará, 15.XI.1994, *Z.J.G. Miranda* 6 (UB). Brasília, Sobradinho, 20.IV.2009, *T.C.E. Meneguzzo* 130 (RB; UB). GOIÁS: 1896, *A. Glaziou* 22168 (K). Alto

Paraíso. 8.I.2001, *J.A.N. Batista* 1134 (CEN). Alto Paraíso. Estrada Alto Paraíso-Colina do Sul, 20.II.1991, *B.A.S Pereira* 1505 (CEN; ICN). Alto Paraíso. Alto Paraíso, 16.II.1979, *B. Gates* 227 (RB; SP; UB). Alto Paraíso. Chapada dos Veadeiros, 27.I.1993, *J.A.N. Batista* 390 (CEN). Alto Paraíso. Colinas do Sul, 27.I.1997, *B.M.T. Walter* 3635 (CEN; SP). Alto Paraíso. Colinas do Sul, 8.II.1987, *S.R. Neto* 617 (SP). Alto Paraíso. Alto Paraíso de Goiás, 16.II.1979, *B. Gates* 227 (SP; UB). Cavalcante. Cachoeira Santa Bárbara, 7.III.2003, *J.F.B. Pastore* 395 (CEN; HUEFS). Cavalcante. Comunidade Kalunga, 3.II.2004, *J.F.B. Pastore* 833 (CEN). Chapada dos Veadeiros. 15.II.1966, *H.S. Irwin* 12573 (UB). Cocalzinho de Goiás. 26.IV.2016, *L.B. Bosquetti* 498 (ESA). Cristalina. BR-040, 11.III.1999, *J.A.N. Batista* 883 (CEN). Cristalina. Cristalina, 4.III.1966, *H.S. Irwin* 13422 (UB). Pirenópolis. 15.I.1972, *H.S. Irwin* 34217 (UB). Pirenópolis. 16.I.1991, *J.A.N. Batista* 167 (CEN). Pirenópolis. Pirenópolis-Cocalzinho, 22.II.1993, *L. Bianchetii* 1470 (CEN). Pirenópolis. Morro do Cabeludo, 19.II.1995, *J.A.N. Batista* 537 (CEN). Pirenópolis. Morro do Cabeludo, 17.I.1992, *J.A.N. Batista* 236 (CEN). Teresina de Goiás. BR-GO 118, 2.I.2001, *E.R. Pansarin* 887 (UEC). MATO GROSSO: Itaúba. Floresta do Planalto dos Parecis, 17.XII.2015, *M.E. Engels* 4037 (CNMT; HCF; MBM; RB; TANG). Itaúba. Lote A de Supressão, 20.II.2017, *D.C. Dias* 80 (CNMT). MINAS GERAIS: Jaboticatubas. Conceição do Mato Dentro, 4.I.1973, *M. Sazima* 13417 (UEC). Jaboticatubas. Serra do Cipó, 7.I.1973, *J. Semir* 3809 (SP). Jaboticatubas. 18.XII.2015, *A.C.D. Munhoz* 110 (BHCB). Santana do Riacho. Serra do Cipó, 27.IV.2013, *J.A.N. Batista* 3278 (BHCB). Santana do Riacho. Serra do Cipó, 27.I.1990, *R. S. Bianchini* 11688 (SP). Santana do Riacho. Cachoeira da Farofa, 10.I.2000, *J.A.N. Batista* 1010 (CEN). São Roque de Minas. Serra da Canastra, 10.I.2007, *J.A.N. Batista* 1820 (BHCB; CEN). PERNAMBUCO: Gravatá. 18.VII.1995, *L.P. Félix* 7174 (FCAB; HST). Gravatá. 20.VII.1997, *L.P. Félix* 8343 (HST).

2. *Liparis nervosa* (Thunb.) Lindl., Gen. Sp. Orchid. Pl.: 26. 1830; *Ophrys nervosa* Thunb., Fl. Jap.: 27. 1784; *Epidendrum nervosum* (Thunb.) Thunb., Trans. Linn. Soc. London 2: 327. 1794; *Cymbidium nervosum* (Thunb.) Sw., Nova Acta Regiae Soc. Sci. Upsal 6: 76. 1799; *Malaxis nervosa* (Thunb.) Sw., Kongl. Vetensk. Acad. Nya Handl. 21: 235. 1800; *Lebine nervosa* (Thunb.) Raf., Fl. Teller. 4:39. 1838; *Sturmia nervosa* (Thunb.) Rchb.f., Bonplandia 3: 250. 1855. Type: JAPAN. Between Osaka and Tokyo: without date, (Holotype UPS [V-091916]).

Fig. 4.

= *Liparis bituberculata* (Hook.) Lindl., Bot. Reg. 11: t. 882. 1825; *Cymbidium bituberculatum* Hook. Exot. Fl. 2(13): 116. 1824; *Leptorchis bituberculata* (Hook.) Kuntze, Revis. Gen. Pl. 2: 671. 1891; *Sturmia bituberculata* (Hook.) Rchb.f., Bonplandia 2: 22. 1854. Type: NEPAL. *J. Cooper without number* (Holotype lost, Lectotype designated here: illustration reproduced in Exot. Fl. 2(13), t. 166. 1824).

= *Liparis elata* Lindl., Bot. Reg. 14: 1175. 1828; *Diteilis elata* (Lindl.) M.A. Clem. & D.L. Jones, Orchadian 15(1): 40. 2005. Type: BRAZIL. Rio de Janeiro: 1826, flowering in cultivation in August of 1827, *H. Chamberlain without number* (Holotype K! [000463109]).

= *Liparis guineensis* Lindl., Edwards's Bot. Reg. 20: 1671. 1834. Type: SIERRA LEONE: May of 1834, *Ridgway J. 169* (Holotype lost; Lectotype designated here: illustration reproduced in Edwards's Bot. Reg. 20: t. 1671. 1834).

= *Liparis elata* var. *purpurascens* Regel, Ann. Sci. Nat., Bot. 4(6): 374. 1856. Type: BRAZIL. Alagoas: Marechal Deodoro, 24 of May of 2000, *R.P. Lyra-Lemos 4618* (Neotype HUEFS! [000127526] designated here).

= *Liparis kappleri* (Rchb. f.) Reichb.f., Ann. Bot. Syst. 6: 218. 1861; *Sturmia kappleri* Reichb.f., Linnea 22: 833. 1850. Type: SURINAMI. in paludibus distr. Para: April 1844, *Kappler A. 1491* (Lectotype P

designated here, Lectotype P! image [00347774]; Isolectotypes AMES! image [00052492, 00271895]).

= *Liparis elata* var. *inundata* Barb. Rodr., Gen. Sp. Orchid. 1: 36. 1877. Type: BRAZIL. Minas Gerais: Les marais des bordes du Ribeirão dos Bugres et du Rio Verde à Caldas, February, *J. Barbosa Rodrigues without number* (Holotype lost; Lectotype designated by Pansarin *et al.* (2020): illustration reproduced in *Iconographie des orchidées du Brésil* 1: t. 36, copied and reproduced in color in Springer *et al.* (1996)). *syn. nov.*

= *Liparis odontostoma* Rehb.f., Linnaea 41(1): 97. 1876. Type: INDIA. Sikkim: without date, *Hooker J.D. without number* (Holotype lost; Neotype K! [000387773] designated here: INDIA. Mount Khasi, *Hooker J.D. without number*).

= *Liparis eggersii* Rehb.f., Ber. Deutsch. Bot. Ges. 3: 278. 1885. Type: PUERTO RICO. Mayagüez: in sylvis montis Mesa, October 1884, *Sintenis P. 497* (Lectotype GOET designated here, Lectotype GOET! image [008575]; Isolectotype K! [000583624]; Isolectotype M! image [0226365]; Isolectotype LE! image [00006493]; Isolectotype G! image [00354719]; Isolectotype G! image [00354720]).

= *Liparis elata* var. *latifolia* Ridl., J. Linn. Soc., Bot. 22: 260. 1886. Type: CUBA. Monte Verde, 1860, *Wright C. 1495* (Lectotype BM designated here, Lectotype BM! image [000074263]; Isolectotype P! image [00347787]; Isolectotype GOET! image [013954]; Isolectotype LE! image [00006494]; Isolectotype YU! image [030290]; Isolectotype MA! image [607121]; Isolectotype GH! image [00033805]; Isolectotype K! [000583625]). PARAGUAY. Vallée de l'Y-acan-guaja: près de Valenzuela, 16 of March of 1884, *Balansa B. 4542* (Remaining syntype P! image [00338289, 00338287, 00338288]).

= *Liparis elata* var. *rufina* Ridl., J. Linn. Soc., Bot. 22: 260. 1886. Type: NIGERIA. Lagos: *Barter without number* (Lectotype K! [000242156] designated here). SIERRA LEONE. without locality or date. *Morson without number* (Remaining syntype K! [000242155]).

= *Liparis bituberculata* var. *khasiana* Hook. f., Fl. Brit. India 5(16): 696. 1890. Type: INDIA. Mount

Khasi, *Griffith W. without number* (Holotype lost, Neotype K designated here, Neotype K! image [000387771]): INDIA. East Bengal: without date, *Griffith W. 5068*).

= *Liparis bambusifolia* Makino, Bot. Mag. (Tokyo) 6 (60): 48. 1892. *nom. nud.*

= *Liparis elata* var. *longifolia* Cogn., Fl. Bras. (Martius) 3(4): 287. 1896. Type: PARAGUAY. Vallée de l'Y-acan-guaja: près de Valenzuela, 16 March of 1884, *Balansa B. 4542* (Lectotype P designated here, Lectotype P! image [00338287]; Isolectotypes P! image [00338288, 00338289]).

= *Liparis violaceo-nervosa* Guillaumin, Bull. Mus. Natl. Hist. Nat. Série 2, 33: 434. 1961. Type: VIETNAM. Annam: Dalat, 1959, *Tixier 13-59* (Holotype P! image [P00327707]).

Herb 92–520 mm. Roots 32–153 mm length, cylindrical, thick. Pseudobulbs 23–78 × 8–46 mm, ellipsoid, fusiform or rarely oblongoid; covered by white, green or brown perennial foliaceous sheaths. Leaves 41–224 × 19–133 mm, green, 2–5 per pseudobulbs, several layers of a sheath-like petiole 22–124 mm length; lamina plicate, membranaceous, elliptical, rarely oblong-lanceolate or lanceolate, margin entire or undulate, apex acute or obtuse. Inflorescence 119–590 mm raceme; floral bracts in the base of the pedicels, acuminate. Flowers resupinate; purple or greenish-purple, rarely yellow; pedicels 3–10 mm length; ovary 3–5 mm length. Dorsal sepal 5–9 × 1–3 mm, oblong or oblong-lanceolate, margin entire, usually revolute, apex obtuse or slightly acute. Lateral sepals 5–6 × 2–4 mm, free, oblong or oblong-lanceolate, margin entire, usually revolute, apex obtuse or slightly acute. Petals 4–9 × 0.5–2 mm; linear; margin entire and revolute; apex obtuse. Lip 4–8 × 4–6 mm, trilobate, glabrous; base with two tooth-like calluses, with one to three internal thin vein; lateral lobes in the base of the lip, rounded; mid lobe obovate, strongly reflexed, margin entire, slightly undulate near the apex, apex emarginate or rarely rounded. Column 3–5 mm length, slightly arched; foot short, apex winged; anther green, yellow or greenish-purple. Pollinarium with two ovoid, bipartite pollinia.

Distribution:—This species is pantropical. In Brazil, it occurs practically in all national territories, lacking record only in Acre, Amapá, Ceará, Maranhão, Paraíba, Piauí, Rio Grande do Norte and Tocantins states (POWO 2022).

Taxonomic notes:—*Cymbidium bituberculatum* protologue mentions a collection of *J. Cooper* from Nepal that could not be found in any herbarium, and the information in the text is insufficient to clearly define if it was ever herborized. In the same work from Hooker (1824), an illustration based on the specimen used to describe his species is presented, hence, it is designated as the lectotype here.

The collection of “*Ridgway J. 169*, May of 1834” used in the description for *Liparis guineensis* could not be found and is probably lost, hence the illustration based on the same exemplar (Lindley 1834) is here designated as the lectotype.

Liparis elata var. *purpurascens* identity is uncertain. The protologue lacks indication of an original material and the only two information given are —“purple leaves and erect bracts”. Even though it is unclear the diagnosis of this taxon as a variety of *Liparis nervosa*, for taxonomical balance, we still opted to designate a collection as the Neotype: “*R.P. Lyra-Lemos 4618*” (MAC11091), as it bears the purplish leaves interpreted in the protologue.

There are three syntypes of *Liparis kappleri* (AMES00052492; AMES00271895; P00347774). As no holotype is indicated among these duplicates in the protologue of the species and the material deposited at P (00347774) is in better quality, it is here designated as the lectotype.

The *Liparis odontostoma* holotype collection made by *Hooker J.D.* in the Sikkim state region of India is probably lost, and as no other original material seems to exist, we choose to designate the

collection of *Hooker J.D. without number* (K000387773) from Mount Khasi in Meghalaya state region as the neotype, due to being well preserved and found occurring in a nearby area in India, representing the taxon accordingly.

There are multiple syntypes of *Liparis eggersii* deposited at distinct herbarium. Therefore, we here designate the collection of GOET (008575) as the lectotype, choosing it among the duplicates due to the good condition of the exsiccate, which presents complete inflorescence with fruits and flowers.

The description of *Liparis elata* var. *latifolia* by Ridley (1886) emphasizes the broad leaves as a morphological characteristic to recognize the species. The protologue indicates two distinctive collections as types, with multiple duplicates spread across different herbaria. The collection of *Balansa B. 4542* from Paraguay presents specimens with more narrow leaves than the collections of *Wright C. 1495* from Cuba, thereby, being discarded to be selected as a lectotype. Among the duplicates of *Wright C. 1495*, the material deposited at BM (000074263) is chosen to be designated here as the lectotype due to the good condition of the exsiccate – with complete vegetative and reproductive parts – as well as for displaying morphological characteristics close related to the original description of the taxon.

Liparis elata var. *rufina* protologue indicates two distinguished materials that are herborized in the same exsiccate, while the collection of *Morson without number* (K000242155) comprises only an inflorescence and a drawing of a flower belonging to one specimen, the collection of *Barter without number* (K000242156) otherwise, is complete – composed by vegetative and reproductive parts from two individuals, additionally to the drawing of a flower, hence, it is here designated as the lectotype.

Liparis bituberculata var. *khasiana* holotype is lost and no other original material seems to exist, ergo, we designated the collection of *Griffith W. 5068* (K000387771) as the neotype, as it supports the characteristics described by the author and it was collected as well in India. This same exsiccate is sharing another collection (K000387770) identified as *L. bituberculata* var. *khasiana*; however, this one lacks information about the collector and the specimen could even belong to another species, as it does

have some unique features such as elongated stem and absence of pseudobulbs, therefore, it should be disregarded.

Three duplicate collections of original material belonging to *Liparis elata* var. *longifolia* can be found deposited at P (P00338287; P00338288; P00338289). Even though they are all in good condition, we opted to designate here the collection of P (00338287) as the lectotype, as it is the only one that sustains flowers and fruits in the same exsiccate.

While studying *Liparis nervosa* we noticed that some plant collections had smaller size and oblong-lanceolate leaves. These exemplars with these morphological features generally inhabit wetlands in open fields, with some exceptions in the Amazon Forest, where this morphotype (Fig. 3a) is also found vegetating in the forests near the Rio Negro river.

The variations in vegetative morphology of these specimens have caused taxonomic controversy, even though the shape and size of floral parts have no difference from a common *L. nervosa*. This morphotype was recognized previously as *Liparis elata* var. *inundata* (Barbosa Rodrigues 1877; Cogniaux 1896; Hill 1926), a synonym of *L. nervosa* that was recently disassociated from the variety position and elevated to the species status as *Liparis inundata* by Pansarin *et al.* (2020). Nonetheless, the difference in phenology within populations was used as a comparative feature between this morphotype and a common *L. nervosa*; however, we recommend caution when using this characteristic since populations may differ in their flowering season depending on their occurrence; these varieties could be attributes of the habitat itself, driving populations to flower in separate moments of the year.

For now, we prefer to keep *L. inundata* as a synonym of *L. nervosa* since the morphological and ecological characteristics used to discern them are not sufficient, and it is not hard to find plants with intermediate morphology (Fig. 3b), which can cause even more taxonomical instability concerning this taxon. One future approach could be to manually cross-pollinate these different morphotypes, monitoring the offspring generated between populations, and comparing the morphological

characteristics of the different individuals generated.

Characterization and ecology:—*Liparis nervosa* is characterized by its wide range in vegetative size and terrestrial habit, but occasionally, it is found growing on organic matter accumulated between tree trunks or rocks. Mature individuals always have more than two leaves, which are deciduous and show rapid growth after falling, emerging from the lateral or from the apex of the entirely or mostly above-ground pseudobulb. The flowers are usually fertile in succession in a spiral conformation from the base of the inflorescence up to its apex.

It can be recognized and distinguished from the other two native species by its usually larger size with many leaves and its pseudobulbs always bearing long and thick roots. The flowers are similar to *Liparis cogniauxiana* but can be distinguished by the two tooth-like calluses presented at the base of the lip.

Liparis nervosa can be found in all Brazilian biomes, flowering from January to December. Commonly occurs inside lowland forests, montane forests, and marshes, but sometimes can be found exposed to the sun in open flooded fields or on the roadsides near forests. With an extent of occurrence (EOO) of approximately 6,702,407.731 km² and area of occupancy (AOO) of approximately 2,128.000 km², and the presence in all Brazilian biomes, the taxon falls into the category of “Least Concern (LC)”.

Selected examined material: BRAZIL. Without locality: without date, *Schwacke* 7767 (RB). III.1837, *G. Gardner* 675 (SP). ALAGOAS: Chã Preta. Serra Lisa, 28.VII.2009, *Chagas-Mota* 4512 (MAC). Chã Preta. Serra Lisa, 6.V.2009, *Chagas-Mota* 3447 (MAC). Ibateguara. Cerrado da Burra, 1.VIII.2003, *A.*

Siqueira Filho 1388 (HVASF; USP). Ibateguara. Coimbra, 7.V.2002, *M. Oliveira* 930 (IPA; MAC; UFP). Maceió. Serra da Saudinha, 14.VI.2008, *Chagas-Mota* 632 (MAC). Maceió. Serra da Saudinha, 29.IX.2007, *Chagas-Mota* 39 (MAC). Maceió. APA do Catolé, 11.VIII.2010, *M.N. Rodrigues* 51339 (MAC). Marechal Deodoro. 20.VIII.2007, *R.P. Lyra-Lemos* 4618 (MAC). Marechal Deodoro. APA de Santa Rita, 16.V.1988, *G.L. esteves* 2021 (MAC). Marechal Deodoro. APA de Santa Rita, 20.II.1991, *F.B.P. Moura* 20 (MAC). Marechal Deodoro. APA de Santa Rita, 16.V.1988, *G.L. esteves* 2021 (MAC). Marechal Deodoro. Campo Grande, 18.VI.2000, *A.M. Amorim* 3477 (CEPEC). Marechal Deodoro. Dunas do Cavalo Russo, 27.VIII.2008, *Chagas-Mota* 1063 (MAC). Marechal Deodoro. Margem da AL-101, 24.V.2000, *R.P. Lyra-Lemos* 4618 (HUEFS). Marechal Deodoro. Sítio Campo Grande, 18.VI.2000, *A.M. Amorim* 3477 (MBM; MBML). Messias. Barra da Cachoeira, 11.VI.1980, *V.C. Lima* 31 (IPA). Murici. Águas Belas, 24.IV.2008, *Chagas-Mota* 547 (MAC). Murici. Fazenda Poço D'antas, 5.VI.1993, *R.P. Lyra-Lemos* 2792 (MAC). Murici. Serra do Ouro, 3.IV.2009, *A.I.L. Pinheiro* 658 (MAC). Paripueira. RPPN Sabiá, 29.VIII.2009, *Chagas-Mota* 5135 (MAC). São José da Laje. Mata do Pinto, 18.VIII.2009, *Chagas-Mota* 5098 (MAC). Tanque d' Arca. Morro do Cruzeiro, 8.VII.2016, *M.C.S. Mota* 12859 (MAC). Quebrangulo. Reserva Biológica de Pedra Talhada, 13.V.2009, *A.A. Araújo* 1268 (UFP). Quebrangulo. Reserva Biológica de Pedra Talhada, 22.V.2014, *L. Nussbaumer* 4102 (MAC; UFP). Quebrangulo. Reserva Biológica de Pedra Talhada, 12.VI.2011, *R.P. Lyra-Lemos* 13364 (MAC). Quebrangulo. Reserva Biológica de Pedra Talhada, 5.X.2010, *Chagas-Mota* 8848 (MAC). Quebrangulo. Reserva Biológica de Pedra Talhada, 12.VI.2011, *R.P. Lyra-Lemos* 13412 (MAC). Quebrangulo. Reserva Biológica de Pedra Talhada, 24.IX.1987, *M.N. Rodrigues* 1180 (IPA; MAC). Quebrangulo. Serra dos Bois, 27.VI.1985, *R.P. Lyra-Lemos* 947 (MAC). Quebrangulo. Serra das Guaribas, 25.VI.2009, *Chagas-Mota* 4169 (MAC). AMAZONAS: Manicoré. Cachoeira do Paricá, 15.IV.1985, *C.A.C. Ferreira* 5574 (INPA). Novo Airão. Parna Jaú, 27.VI.2019, *V.P. Klein* 325 (INPA). Rio Negro. Morcego, 18.V.1948, *G.A. Black* 2771 (IAN). Rio Negro. Rio Içana, 17.V.1948, *G.A. Black*

2749 (IAN; IPA). São Gabriel da Cachoeira. Camanaus, 31.X.1971, *G.T. Prance 15906* (INPA).

BAHIA: Almadina. Serra do Corcovado, 19.III.2006, *J.L. Paixão 887* (CEPEC; HUEFS; MBML; RB).

Amargosa. Serra do Timbó, 29.IV.2007, *J.L. Paixão 1173* (HUEFS). Belmonte. 2.XI.2014, *J.P. Souza 6097* (ESA). Cruz das Almas. Recôncavo Sul, II.1984, *G.C.P. Pinto without number* (ALCB). Entre Rios. Estrada para Subaúma, 28.IV.1981, *S.A.Mori without number* (CEPEC). Entre Rios. Fazenda Rio do Negro, 12.V.2011, *A.V. Popovkin 868* (HUEFS). Entre Rios. Rio Subaúma Mirim, 5.VII.2009, *C.N. Fraga 2604* (RB). Esplanada. Fazenda Chapada, 9.V.2000, *M.R. Fonseca 1382* (ALCB; CEPEC; HUEFS; HUESB; UESC). Ipirá. Serra do Engenho, 15.V.2007, *E. Melo 4769* (HUEFS). Irajuba. Fazenda Alegre Nova, 8.IX.2017, *G.E.L. Macedo 2689* (HUESB). Mata de São João. 12.VI.2012, *A.M.Miranda 6522* (HST; HUEFS; RB). Mata de São João. Sete Pontes, 17.IX.2016, *F.F.V.A. Barberena 385* (ALCB). Mucugê. Parque Nacional da Chapada da Diamantina, 23.VII.2014, *J.A. Siqueira Filho 3201* (HVASF). Município Cruz das Almas. Bosques Unidos, 1959, *G. Luiz without number* (CEPEC).

Nova Viçosa. 27.VII.1979, *G. Martinelli 6011* (CEPEC; RB). Paulo Afonso. Estação Ecológica do Raso da Catarina, 9.VI.1983, *L.P. Queiroz 575* (ALCB). Prado. Praia da Amendoeira, 11.VI.1995, *E. Melo 1277* (BHCB; HUEFS). Salvador. 10.VI.1993, *L.P. Queiroz 3222* (HUEFS). Salvador. Abaeté, 1.IV.1996, *B.F. Viana 133* (HUEFS). Salvador. Barragem do Cobre, 16.IV.2012, *E.P. Queiroz 5317* (ALCB). Salvador. Ilha dos Frades, IX.2012, *P.E. Mattos Andrade 102* (ALCB). Salvador. Parque das Dunas, 6.VI.2016, *F.F.V.A. Barberena 369* (ALCB; HUEFS). Salvador. Parque das Dunas, 6.VI.2016, *F.F.V.A. Barberena 371* (ALCB; RB). Salvador. Parque das Dunas, 10.VI.2015, *F.F.V.A. Barberena 337* (ALCB). Salvador. Itapuã, 19.VI.1985, *R. Rebouças without number* (ALCB). Santa Luzia. Piatã, 16.VII.2007, *C. van den Berg 1848* (HUEFS). São Gonçalo dos Campos. Fazenda do Azulão, 12.V.2011, *W.O. Fonseca 486* (HURB). Una. Fazenda Bolandeira, 17.VII.2007, *L.A. Mattos Silva 4655* (ALCB). Vera Cruz. Catu, 28.IX.2011, *E.N. Matos 565* (HUEFS). Wenceslau Guimarães. 14.I.2011, *P.A. Ferreira 14* (ALCB). Wenceslau Guimarães. Nova Esperança, 22.V.2005, *A.M. Amorim 5077*

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Schlieben 1764 (P). VIETNAM. Quangnam-Danang: Ngoc Linh Mountain, 23.III.1995, *L. Averyanov* 883 (P).

3. *Liparis vexillifera* (Lex.) Cogn., Fl. Bras. 3(4): 289. 1896. *Cymbidium vexilliferum* Lex., Nov.Veg. Descr. 2: 11. 1825; *Leptorkis vexillifera* (Lex.) Kuntze, Revis. Gen. Pl. 3(3): 300. 1898. Type: MEXICO. Michoacan: Morelia, 28 August 1986, *Espejo S. 2723* (Neotype AMO designated by Espejo, A. (1987)).

Fig. 5.

= *Liparis vexillifera* subsp. *lindeniana* (A. Rich. & Galeotti) Dressler, Orquideologia 20(3): 264. 1997; *Liparis lindeniana* (A. Rich. & Galeotti) Hemsl., Gard. Chron. n.s., 11: 559. 1879; *Malaxis lindeniana* A. Rich. & Galeotti, Ann. Sci. Nat., Bot. ser 3, 3: 18. 1845. Type: MEXICO. Cordillera: Près Morelia, 1840, *H. Galeotti 5213* (Neotype P designated here; Neotype P! image [00347743]).

= *Liparis campestris* Barb. Rodr., Gen. Sp. Orchid. 1: 36. 1877; *Leptorchis campestris* (Barb. Rodr.) Kuntze, Revis. Gen. Pl. 2: 671. 1891. Type: BRAZIL. São Paulo: Serra do Cajuru, February, *J. Barbosa Rodrigues without number* (Holotype lost; lectotype designated here: illustration reproduced in Iconographie des orchidées du Brésil 1: t. 443B, copied and reproduced in colour in Sprunger *et al.* (1996)).

= *Liparis jamaicensis* (Rchb.f.) Lindl. ex Griseb., Cat. Pl. Cub. [Grisebach] 261. 1866; *Leptorchis elliptica* (Rchb.f.) Kuntze, Revis. Gen. Pl. 2: 671. 1891; *Liparis elliptica* (Rchb.f.) Rchb.f., Ann. Bot. Syst. (Walpers) 6(2): 218. 1861; *Sturmia elliptica* Rchb.f., Linnaea 22(7): 833. 1850. Type: Brazil. Minas Gerais: Serra do Espinhaço, 21.III.1970, *H.S. Irwin 28030* (Neotype K! [000940647] designated here, isoneotype UB! [0016698]).

= *Liparis vexillifera* var. *latifolia* Cogn., Fl. Bras. 3(4): 290. 1896. Type: ARGENTINA. Sierra de

Tucumán: Cuesta del Garabatal, January 1874, *Lorentz P.G. 876* (Lectotype GOET designated here, lectotype GOET! image [008576]; islectotype NYBG! image [00004197]); ARGENTINA. Salta: Yacone, March 1873, *Lorentz P.G. 306* (Remaining syntype GOET! image [013960]).

= *Liparis colombiana* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 7: 75. 1920. Type: COLOMBIA. Cauca: Steinige bei Quentama, *F.C. Lehmann 8862* (Holotype image K! [000583623]).

= *Liparis otophyllon* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 10: 41. 1922. Type: BOLÍVIA: Pinos Bei Tarija, 11 January 1904, *K. Friebrig 2634a* (Lectotype K designated here, lectotype K! image [000583622]; islectotype GH! image [00100901]; islectotype BM! image [000058845]; islectotype M! image [0226379]).

= *Liparis vexillifera* var. *galeottiana* (A. Rich. & Galeotti) Ames & Correl, Bot. Mus. Leaflet. 10: 79. 1942. *Liparis galeottiana* (A. Rich. & Galeotti) Hemsl., Gard. Chron. n.s., 11: 559. 1879. *Malaxis galeottiana* A. Rich. & Galeotti, Ann. Sci. Nat., Bot. ser. 3, 3: 18. 1845. Type: MEXICO. Vera Cruz: Champ de terre chaude, 1840, *Galeotti H. 5138* (Neotype P designated here; Neotype P! image [00347727]).

Herb 67–196 mm. Roots 4–42 mm length, cylindrical, thin. Pseudobulbs 8–18 × 6–16 mm, ellipsoid or rarely oblongoid; covered by white, green or brown deciduous foliaceous sheaths. Leaves 47–160 × 10–83 mm, green, one per pseudobulbs, several layers of a sheath-like petiole 8–58 mm length; lamina conduplicate or flat, sometimes involving the floral stem, coriaceous, oblong-lanceolate, lanceolate, rarely elliptical, margin entire or undulate, apex acute, rarely obtuse. Inflorescence 25–163 mm raceme; floral bracts in the base of the pedicels, acuminate. Flowers resupinate; yellow or green, sometimes purplish or reddish only in the lip; pedicels 3–8 mm length; ovary 2–7 mm length. Dorsal sepal 6–8 × 1–2 mm, oblong or oblong-lanceolate, margin entire and revolute, apex obtuse or slightly acute. Lateral sepals 5–7 × 0.5–2 mm, free, oblong or oblong-lanceolate, margin entire and revolute, apex obtuse or

slightly acute. Petals $5-9 \times 0.4-1$ mm; linear; margin entire and revolute; apex obtuse. Lip $6-7 \times 4-6$ mm, trilobate, glabrous; base with two longitudinal calluses that extend up to the apex of the lip, with one internal robust vein; lateral lobes extending from the base up to the middle of the lip, rounded; mid-lobe ovate or rarely obovate, slightly reflexed, margin entire, slightly undulate near the apex; apex rounded, rarely emarginate. Column 4–5 mm length, slightly arched; foot short, apex winged; anther green or yellow. Pollinarium with two ovoid, bipartite pollinia.

Distribution:—This species is native to El Salvador, Guatemala, Honduras, México, Nicaragua and Panamá (POWO 2022), but this occurrence does not consider *Liparis jamaicensis* Lindley ex Grisebach (1866) as a synonym of *L. vexillifera*, proposed already by Cogniaux (1896). When treating both as a single species, the countries Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Guyana, Jamaica, Puerto Rico, Trinidad-Tobago and Venezuela should be included in the distribution.

In Brazil, it occurs from the south to the north and from the east to the central-west regions in the following states: Goiás, Minas Gerais, Pará, Paraná, Pernambuco, Rio Grande do Sul, Santa Catarina, São Paulo, Sergipe and Distrito Federal.

Taxonomic notes:—*Malaxis lindeniana* and *Malaxis galeottiana* protologues lack any typification. The illustrations cited as “*tab.4, f.1* and *tab.4, f.2*” were never published, and the sketching could not be found. It is unclear which *H. Galeotti* collection from Mexico was used in the description for both and as no other original material seems to exist, the collection of *H. Galeotti* 5213 deposited at P (00347743) is here designated as the neotype for *M. lindeniana*, since it has “oblong erect lip”, the same feature described by Richard & Galeotti (1845). The collection of *H. Galeotti* 5138 deposited at P

(00347727) is selected here as the neotype for *M. galeottiana*, as it possesses “elliptic leaves with acute apex”, the same morphological characteristic described as well in the protologue.

Since the collections from Barbosa Rodrigues were all lost (Mori & Ferreira 1987; Sprunger *et al.* 1996), the only original material of *Liparis campestris* is the illustration “t. 443B” deposited in the Rio de Janeiro Botanical Garden library and reproduced in Sprunger *et al.* (1996), this material is here designated as the lectotype.

Reichenbach (1850) cited two distinct collections while describing *Sturmia elliptica*, J.W.K. Moritz 889 in Colombia and *Schomburgk s.n.* in Guyana; both could not be found deposited at any herbarium and are probably lost. Since no other original material exists, we designated here as the neotype the collection identified as *Liparis elliptica* of H.S. Irwin 28030 deposited at K (000940647), as it presents good condition and similar morphological features to what is described as *S. elliptica*.

There are three syntypes of *Liparis vexillifera* var. *latifolia*, of which one is a duplicate. The collection of P.G. Lorentz 876 deposited in GOET (008576) is of better quality than the rest of the original material and is designated as the lectotype. The duplicate deposited at NYBG (00004197) becomes an isoelectotype, and the collection of Lorentz P.G. 306 deposited at GOET (013960) is considered a remaining syntype.

Liparis otophyllon has four syntypes deposited at distinct herbarium. Therefore, due to the good condition of the exsiccate, exhibiting complete vegetative and reproductive parts on two specimens, here we designated the material deposited at K (000583622) as the lectotype.

Characterization and ecology:—*Liparis vexillifera* is characterized by its small to medium size, with terrestrial habit, possessing conduplicate or rarely flat single leaf, normally growing erectly and parallel to the floral stem, and emerging from the lateral of the completely or mostly buried beneath the ground

pseudobulb.

It can be recognized and distinguished from the other two species by the pseudobulbs with short and thin roots, with only one flat or conduplicate leaf, and by the flowers with two prominent longitudinal calluses with one internal robust vein that extends from the base to the apex of the lip.

It is similar to *Liparis loeselii* (L.) Richard, a species that does not occur in Brazil (POWO 2022). In addition to the differences in their calluses on the lip, *Liparis vexillifera* is distinguished by the number of leaves per pseudobulbs since the foreign species always has more than one.

Liparis vexillifera occurs mainly in high-altitude areas in the rupestrian fields of the Atlantic Forest, in the Amazon and Cerrado biomes, flowering from January to December. Usually is found close to flooded environments and exposed to the sun, but it can also be seen in dry areas near roads mixed with the low vegetation of the natural fields. With an extent of occurrence (EOO) of approximately 3,687,567.586 km² and an area of occupancy (AOO) of approximately 460,000 km², and even though this plant is restricted to high altitude ambients and has several records inside protected areas, this taxon falls into the category of “Least Concern (NT)”.

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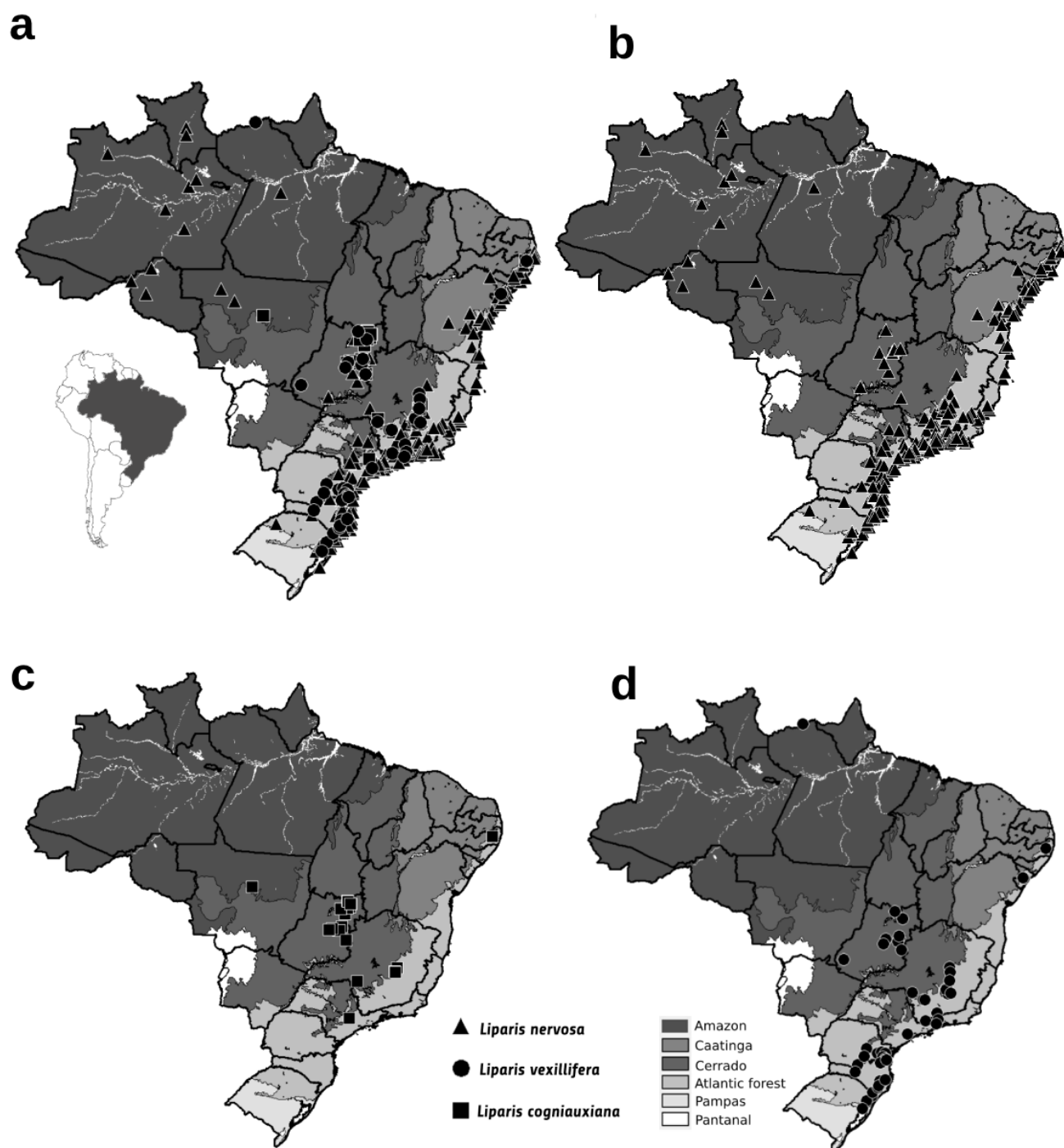


Figure 1 – a-d. Distribution of *Liparis* – a. occurrence of all species in Brazil and indication of the country's position in South America; b. occurrence of *Liparis nervosa*; c. occurrence of *Liparis cogniauxiana*; d. occurrence of *Liparis vexillifera*.

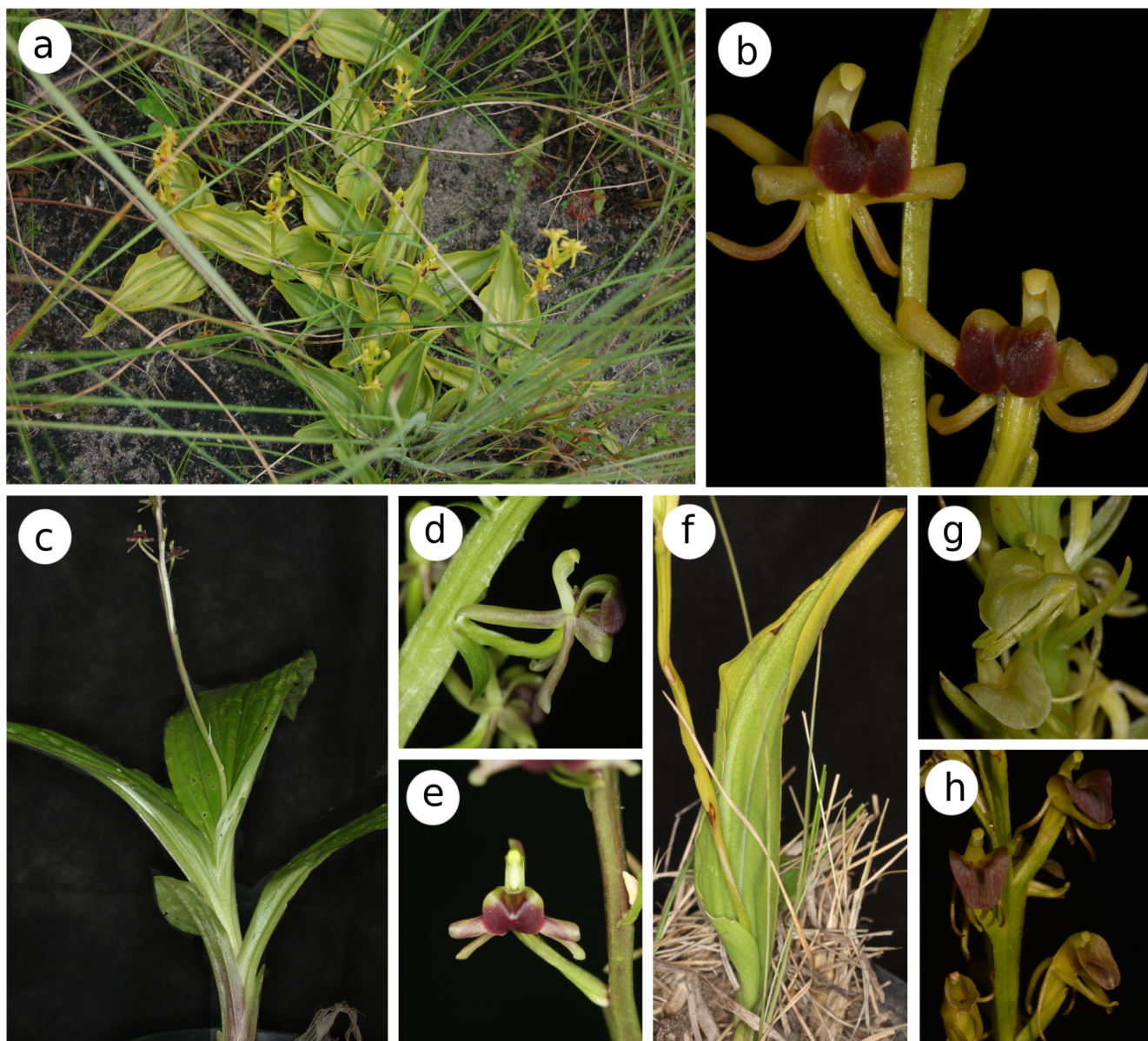


Figure 2 – a-h. Species of *Liparis* from Brazil. *Liparis cogniauxiana* – a. habit; b. frontal view of flowers. c-e. *Liparis nervosa* – c. habit; d. lateral view of flower; e. frontal view of flower. f-h. *Liparis vexillifera* – f. habit; g. frontal view of flowers (yellow); h. frontal view of flowers (purple). (a-b. J.A.N. Batista 2961; c-e. T.F. Santos 60; f. T.F. Santos 350; g. J.A.N. Batista 1704; h. J.A.N. Batista 3507). (Photos: a, b, g, h, by J.A.N. Batista; c, d, e, f, by E.C. Smidt).

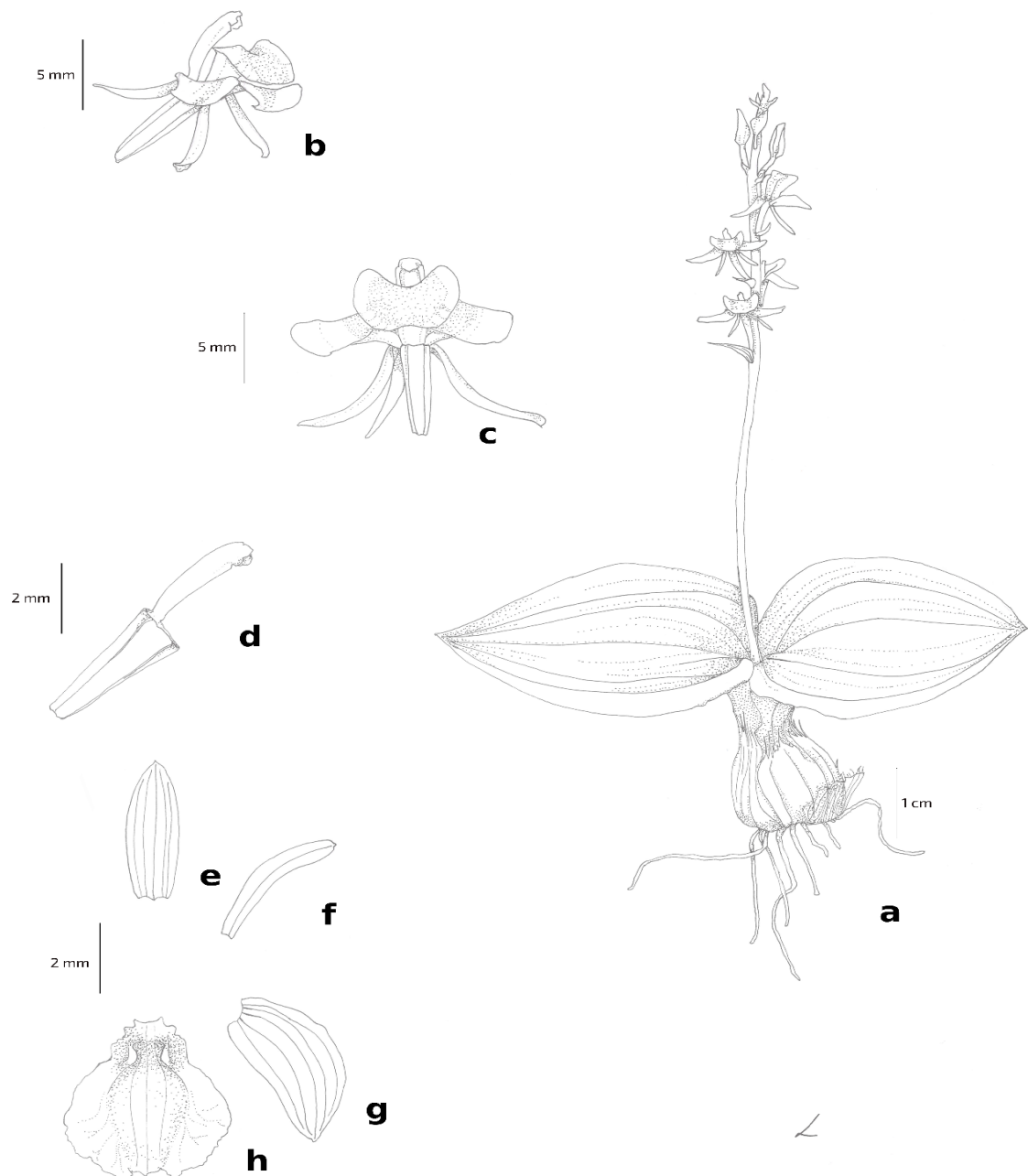


Figure 3 – a-h. Illustration of *Liparis cogniauxiana* – a. habit; b. lateral view of the flower; c. frontal view of the flower; d. lateral view of the column attached to the ovary; e. dorsal sepal; f. petal; g. lateral sepal; h. lip. (based on J.A.N. Batista 2961; 883; 1134).

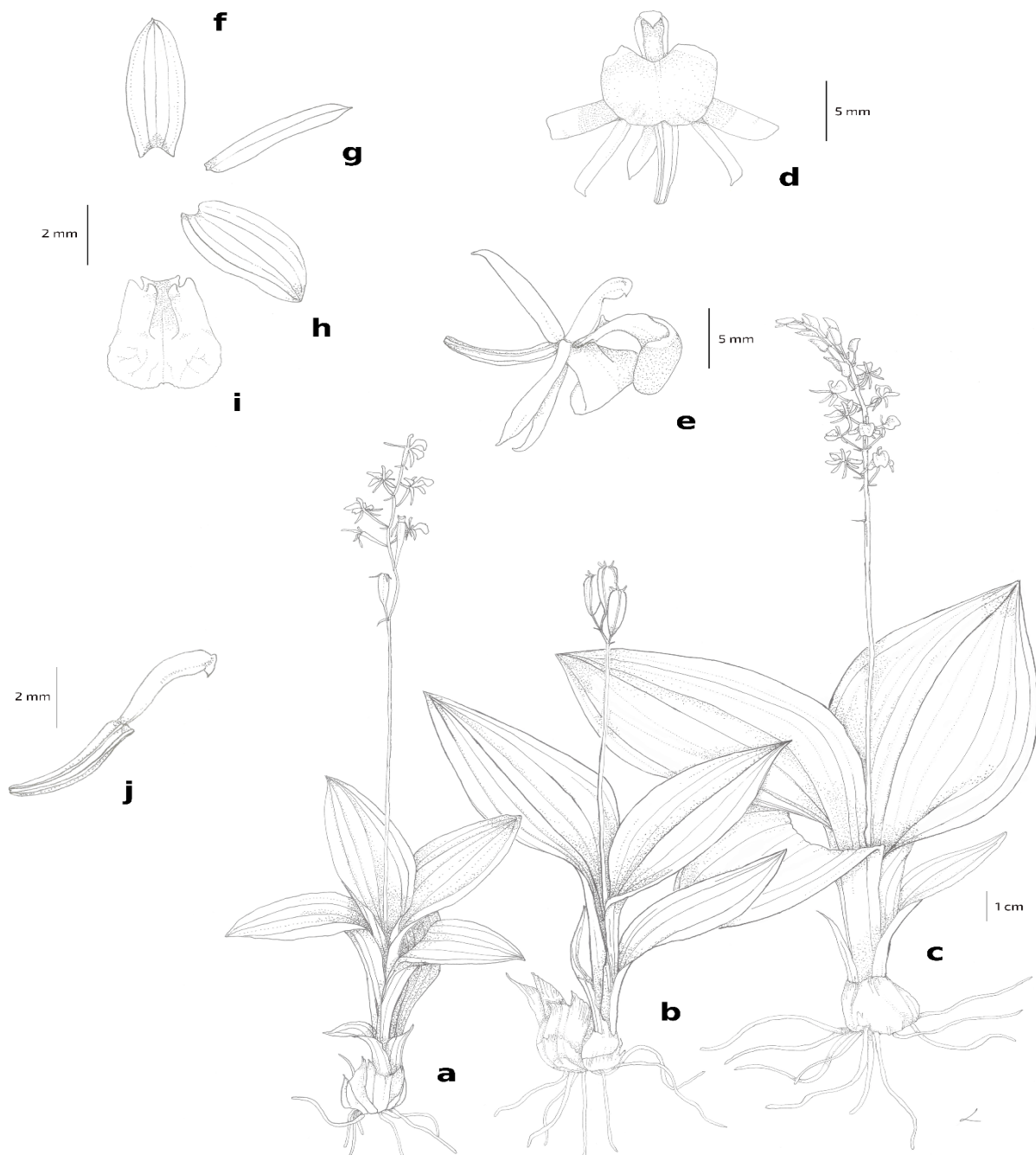


Figure 4 – a-j. Illustration of *Liparis nervosa* – a. habit of the morphotype previously called *Liparis inundata*; b. habit of the intermediate morphotype between *L. inundata* and common *Liparis nervosa*; c. habit of common *L. nervosa*; d. frontal view of the flower; e. lateral view of the flower; f. dorsal sepal; g. petal; h. lateral sepal; i. lip; j. lateral view of the column attached to the ovary (a, based on G.A. Black 2749; 2771. b, based on G.T. Prance 15906. c, e, d, f, g, h, i, j, based on T.F. Santos 60).

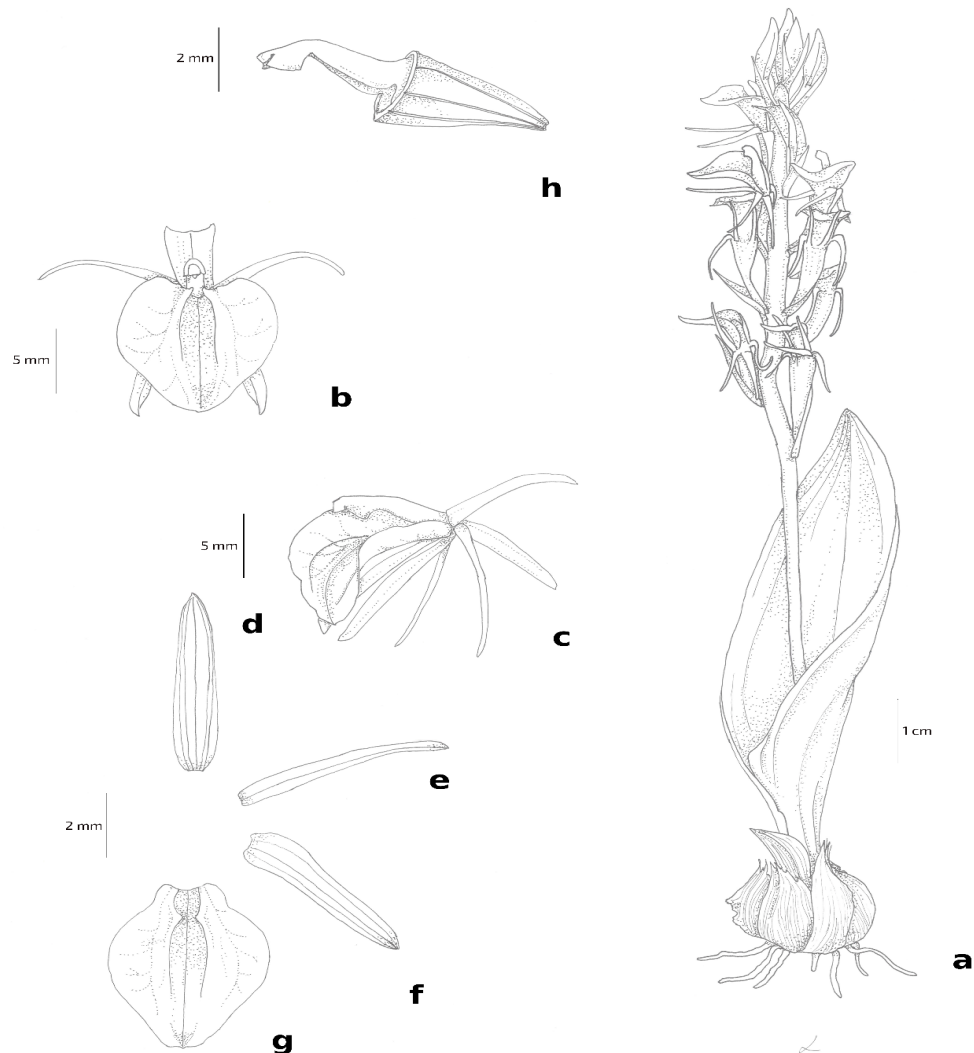


Figure 5 – a-h. Illustration of *Liparis vexillifera* – a. habit; b. frontal view of the flower; c. lateral view of the flower; d. dorsal sepal; e. petal; f. lateral sepal; g. lip; h. lateral view of the column (all based on *T.F. Santos 350*).

CAPÍTULO II) Revision of *Malaxis* (Orchidaceae, Epidendroideae, Malaxidinae) in Brazil

Revision of *Malaxis* (Orchidaceae, Epidendroideae, Malaxidinae) in Brazil

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Abstract

This study identifies and analyzes the *Malaxis* species within Brazil. We examined 363 specimens, identifying 12 distinct species of the genus present in Brazilian territory. Taxonomically, *Malaxis excavata* was determined not to occur in Brazil, with previously identified specimens being reclassified as *M. caracasana*. The taxonomic status of *Malaxis brasiliensis* was considered uncertain. Lectotypifications and neotypifications were proposed, along with the suggestion to synonymize *Malaxis jaraguae* with *M. ovatilabia*. Additionally, *Microstylis ovatilabia* was reclassified as *Malaxis ovatilabia*. Among the species, *M. caracasana* and *M. parthoni* are non-endemic. The Atlantic Rainforest and Cerrado biomes harbor diverse *Malaxis* species, including endemic ones. Limited documented specimens from Amazon regions potentially represent undescribed taxa or new records. No records of *Malaxis* species have been documented in the Caatinga, Pantanal and Pampas biomes. Based on the IUCN, *M. caracasana*, *M. ovatilabia*, and *M. parthoni* are classified as "Least Concern (LC)"; *M. cogniauxiana* is "Near Threatened (NT)"; *M. cipoensis*, *M. sertulifera*, and *M. warmingii* are "Endangered (EN)"; *M. cordilabia* and *M. ybytus* are "Critically Endangered (CR)"; and *M. engelsii*, *M. pabstii* and *M. pubescens* are considered "Data Deficient (DD)".

Keywords: Biomes, conservation, Malaxidinae, systematics, taxonomy

Introduction

Malaxidineae Bentham & Hooker (1883: 465) belongs to the Malaxideae tribe, which is an important representative of the Epidendroideae subfamily, the most diverse subfamily within Orchidaceae (Pridgeon 2005). Comprising 14 genera (Chase *et al.* 2015) and encompassing over 600 terrestrial or epiphytic species across the Neotropics, Africa, Asia, and Europe, Malaxidineae is acknowledged as a cosmopolitan group (Dressler 1981; Atwood 1986). In the Neotropics, five genera are currently recognised: *Crossoglossa* Dressler & Dodson (148: 1993), *Crossoliparis* Margońska (2009: 298), *Liparis* Richard (1817: 21, 30, 38), *Malaxis* Solander ex Swartz (1788: 119), and *Tamayorkis* Szlachetko (1995: 121). In Brazil, only two genera, *Liparis* and *Malaxis* are found (Pabst & Dungs 1977).

The genus *Malaxis* was originally established by the Swedish naturalist Daniel Carlsson Solander, albeit six years after his passing. Olof Swartz (1788) furthered Solander's research utilizing two Jamaican species, *Malaxis spicata* Swartz (1788: 119) and *Malaxis umbelliflora* Swartz (1788: 119), delineating the genus. Later, the typification was rectified with the selection of *M. spicata* as the type species for the group (Britton & Bown 1913).

Malaxis is mainly characterised by its predominantly terrestrial species with pubescent roots and cylindrical stems that emerge from the pseudobulbs to form apical racemes (Szlachetko & Kolanowska 2014). In terms of reproductive characteristics their inflorescences are either a lax-raceme or umbellate-like congest raceme. The petals and dorsal sepal are free, while the lateral sepals are either free or partially connate (Kolanowska 2014). Traditionally, *Malaxis* has been considered a cosmopolitan genus, comprising approximately 300 species (Pridgeon 2005). However, due to its polyphyletic nature

and uncertain classification (Cameron 2005; Radins *et al.* 2014), it is now believed that the group should be divided into smaller genera based on their global distribution, as the species likely followed distinct evolutionary paths (Szlachetko & Margońska 2006; Morales *et al.* 2017).

Prior to the studies conducted by Pabst & Dungs (1977), all *Malaxis* species in Brazil were classified under the genus *Microstylis* (Nuttall 1818: 196) Eaton (1822: 115), with the number of registered species in the country varying greatly depending on the viewpoint of each author (Barbosa Rodrigues 1882; Cogniaux 1896; Hoehne 1949). Following the reclassification of these taxa to the genus *Malaxis* and based on the most recent data surveys conducted by The Brazilian Flora Group (BFG 2018), a total of 10 species are currently recognized in Brazil. However, it should be noted that this number is revised here.

The aim of this research is to conduct a thorough revision of the *Malaxis* species found in Brazil. This includes providing taxonomic notes, offering complete diagnoses with descriptive comments, presenting information on ecological features, including photographs and illustrations when available, developing identification keys, creating distribution maps, and assessing the conservation status of the species.

Material and Methods

Taxonomy, fieldwork and herbarium material:—Morphological studies were realized based on exsiccates available online or deposited at visited national herbariums: BHCB, CEN, CEPEC, CESJ, CRI, EFC, ESA, FLOR, FURB, HB, HRCB, HST, HUCS, HUEFS, HURB, HVASF, HVAT, IAC, IAN, ICN, INPA, IPA, JOI, LIL, MAC, MBM, MBML, OUPR, PACA-AGP, PEL, RB, REAL, RFA, SJRP,

SMDB, SP, SPF, SPSF, UB, UEC, UFP, UPCB, VIC, VIES and consultations of data available online from the respective foreign herbariums: AMES, BM, BR, G, HAS, HBG, K, MO, NY, R, S, SBT, US (acronyms follow Thiers *et al.* continuously update). Additional analyses were made based on specimens obtained in field excursions around Brazil, realized from the years 2019 to 2024, aiming to cover all vegetation types in the country. Illustrations and photographs were taken from live plants, exposing the plant habit, inflorescence and floral features. Collections were built according to Fidalgo & Bononi (1984), deposited at the UPCB herbarium. The species were delimited and a dichotomous key is proposed for its recognition. Specimens were identified to the lowest taxonomic level through protologue and nomenclatural type consultation, and compared with descriptions in other works that contemplate *Malaxis* (e.g. Barbosa Rodrigues 1882; Cogniaux 1896; Pabst & Dungs 1977). For the descriptions, we adopted the terminology of Rizzini (1977), Weberling (1989) and Stearn (2004). Distribution maps and conservation status of taxa were built using the programs DIVA-GIS 7.5 (Hijmans *et al.* 2012) and GeoCat (Bachman *et al.* 2011) respectively, following the IUCN (2022) guidelines.

Results

We examine a total of 364 herbarium specimens, 358 collected in Brazil and 5 in other countries. Our investigation identified 12 species that occur within the national territory. The most significant species in terms of representation was *Malaxis caracasana* (Klotzsch ex Ridley 1888: 325) Kuntze (1891: 673), which had 171 vouchers. It is followed by *Malaxis parthoni* Charles Morren (1838: 485) with 91, *Malaxis ovatilabia* (Schlechter 1920: 330) T.F. Santos *et al.* (2023: comb. nov.) with 45, *Malaxis cogniauxiana* (Schlechter 1920: 331) Pabst (1967b: 164) with 27, *Malaxis warmingii* (Reichenbach

1878: 94) Kuntze (1891: 673) with 10, *Malaxis sertulifera* (Barbosa Rodrigues 1877: 29) Pabst (1967a: 112) with four, *Malaxis cordilabia* Portalet (2016: 494), *Malaxis cipoensis* Fábio de Barros (1996: 15), *Malaxis engelsii* T.F. Santos & E.C. Smidt (2024: unpublished) and *Malaxis pubescens* (Lindley 1843: 662) Kuntze (1891: 662) each with three records, *Malaxis ybytus* T.F. Santos & E.C. Smidt (2023: 2) with two, and *Malaxis pabstii* (Schlechter 1921: 13) Pabst (1967b: 164) with only one.

Among the *Malaxis* collected in Brazil, *M. caracasana*, *M. parthoni*, *M. ovatilabia*, and *M. cogniauxiana* collectively account for approximately 92% of the total specimens. This substantial representation underscores the rarity of the remaining species, emphasizing the need for continued collection efforts to improve our knowledge and facilitate ecological conservation measures for the elusive *Malaxis* found within the country's borders.

Malaxis caracasana and *M. parthoni* are the only confirmed non-endemic species to Brazil. Among Brazil's diverse biomes, the Atlantic Rainforest and the Cerrado stand out as the most representative. The Atlantic Rainforest is a host to a variety of *Malaxis* species, including *M. caracasana*, *M. cogniauxiana*, *M. parthoni*, *M. pubescens*, *M. pabstii*, *M. ovatilabia*, *M. warmingii*, *M. engelsii*, *M. cordilabia*, and *M. ybytus*. Notably, the latter seven are exclusively found in the Atlantic Rainforest. Conversely, the Cerrado biome accommodates *M. caracasana*, *M. cogniauxiana*, *M. parthoni*, *M. cipoensis*, and *M. sertulifera*, with the last two being endemic. The Amazon, on the other hand, have few registered exemplars, which are possibly undescribed taxa or new records for the country, and are currently being treated as *incertae sedis* due to the limited quality of the available material. No species of *Malaxis* has been documented in the Caatinga, Pampas or Pantanal (Fig. 1).

In the taxonomic study, it is inferred that *Malaxis excavata* (Lindley 1838: 51) Kuntze (1891: 673) does not occur in Brazil. The specimens previously identified as belonging to this taxon are actually *M. caracasana*. The classification of *Malaxis brasiliensis* Sprengel (1826: 740) is addressed as *incertae sedis*. The proposal includes the lectotypification of seven taxa: *Microstylis quadrangularis*

Cogniaux (1896: 552), *Microstylis paranaensis* Schlechter (1920: 330), *Microstylis cogniauxiana* Schlechter (1920: 331), *Microstylis jaraguae* Hoehne & Schlechter (1926: 196), *Malaxis parthoni* Charles Morren (1838: 485), *Microstylis pubescens* Lindley (1843: 662), and *Cheiropterocephalus sertuliferus* Barbosa Rodrigues (1877: 29). Additionally, three neotypifications are indicated: *Microstylis muelleri* Schlechter (1921: 12), *Microstylis pabstii* Schlechter (1921: 13), and *Microstylis warmingii* Reichenbach (1878: 94). Furthermore, the synonymization of *Malaxis jaraguae* (Hoehne & Schlechter 1926: 196) Pabst (1967b: 164) with *M. ovatilabia* is suggested, and a *combinatio nova* is presented by reclassifying *Microstylis ovatilabia* Schlechter (1920: 330) as *Malaxis ovatilabia*.

According to the IUCN classification, the conservation status of the Brazilian *Malaxis* species is as follows: *M. caracasana*, *M. ovatilabia*, and *M. parthoni* are classified as "Least Concern (LC)"; *M. cogniauxiana* is categorized as "Near Threatened (NT)"; *M. cipoensis*, *M. sertulifera*, and *M. warmingii* are listed as "Endangered (EN)"; *M. cordilabia* and *M. ybytus* are designated as "Critically Endangered (CR)"; and *M. engelsii*, *M. pabstii* and *M. pubescens* are considered "Data Deficient (DD)".

Taxonomy

Identification key for *Malaxis* in Brazil (Fig. 2)

- | | | |
|----|--|-------------------------|
| 1. | Presence of two leaves emerging from the pseudobulb..... | 2 |
| - | Presence of more than two leaves, pseudobulb absent..... | 11. <i>M. warmingii</i> |
| 2. | Lip with more than two internal foveas..... | 3 |
| - | Lip with two internal foveas..... | 5 |
| 3. | Lateral sepals free..... | 12. <i>M. ybytus</i> |
| - | Lateral sepals partially connate..... | 4 |

- 4. Species with elliptic-cordiform leaves, column wings acute..... 4. *M. engelsii*
- Species with oblong-lanceolate leaves, column wings rounded..... 10. *M. sertulifera*
- 5. Lip apex trifid..... 1. *M. caracasana*
- Lip apex not trifid..... 6
- 6. Pubescent lip..... 9. *M. pubescens*
- Glabrous lip..... 7
- 7. Petioles are partially imbricated with each other..... 8
- Petioles are fully imbricated with each other..... 9
- 8. Two longitudinal canals are present in the lip foveas..... 3. *M. cogniauxiana*
- No longitudinal canals are present in the lip foveas..... 5. *M. cordilabia*
- 9. Plants measuring approximately 15–45 mm..... 2. *M. cipoensis*
- Plants measuring approximately 90–450 mm..... 10
- 10. Lateral sepals partially connate, lip lateral lobes acute..... 7. *M. pabstii*
- Lateral sepals free, lip lateral lobes rounded..... 11
- 11. Broadly elliptical leaves, lip lateral lobes usually inconspicuous..... 6. *M. ovatilabia*
- Oblong-lanceolate or elliptic-lanceolate leaves, lip lateral lobes always conspicuous..... 8. *M. parthoni*

1. *Malaxis caracasana* (Klotzsch ex Ridley 1888: 325) *Kuntze* (1891: 673); *Microstylis caracasana* Klotzsch ex Ridley (1888: 325). Type:—COLOMBIA: without locality or date, *Karsten* 22 (holotype: BM 000088209 [digital image!]; isotype: HAL 0109686 [digital image!]).

= *Microstylis quadrangularis* Cogniaux (1896: 551). Type:—BRAZIL. São Paulo: Ribeirão Pires, without date, *Löfgren* 2014 (holotype: lost; lectotype designated here: illustration reproduced in *Flora Brasiliensis* 3(6): pl. 114, fig. II).

= *Microstylis paranaensis* Schlechter (1920: 330). Type:—BRAZIL. Paraná: Curitiba, in silvula, *Lange* without number (lectotype designated here: S-R-3527 [digital image!]; isotype: SI 001665 [digital images!]).

= *Microstylis muelleri* Schlechter (1921: 12). Type:—BRAZIL. Santa Catarina: Blumenau, June 1890, *F. Müller without number* (holotype lost; neotype designated here:—BRAZIL. Santa Catarina: Santo Amaro da Imperatriz, Hotel Plaza Caldas da Imperatriz, 28.V.2007, *J.Z. de Matos 95* (FLOR 38645!)).

= *Pycnantha orchiioides* Ravenna (2011: 31). Type:—ARGENTINA. Jujuy: Lagunas de Yala, 01 dezembro 1966, *Cabrera A.L. 17413* (Holotype BAA 00000196 [digital image!]).

Fig. 3

Herb 92–222 mm tall, rhizome inconspicuous. Roots 12–58 mm long, thick. Pseudobulbs 15–38 × 10–32 mm, oblong or elliptical, covered by greenish or brownish deciduous foliaceous sheets. Leaves 55–126 × 32–68 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 32–100 mm long, imbricated in each other entirely or near to the apex; lamina oblong, oblong-lanceolate, elliptic-lanceolate, flat, plicate, coriaceous, margin entire, apex acute. Inflorescence 98–343 mm long; congested or loose umbel; floral bracts pale greenish or brownish; emerging in the apex of the peduncle, before the pedicels, triangular or linear. Flowers non-resupinate, greenish; pedicels 6–15 mm long; ovary 1–4 mm long. Dorsal sepal 2.5–7 × 0.5–3 mm; oblong, oblong-lanceolate; margin entire; apex acute. Lateral sepals 2–4.7 × 1–2 mm; free; oblong to oblong-lanceolate, usually broader than the dorsal; margin entire; apex acute to slight obtuse. Petals 1.5–4.1 mm long; linear, usually twisted, margin entire; apex obtuse. Lip 1.8–5 × 1.5–2.5 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes acuminate; mid lobe triangular, 2 oblong disk foveas, margin entire, apex trifid. Column vertically compressed; yellow-greenish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species occurs in Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Peru and Venezuela (POWO 2022); distribution from countries of Central America are disregarded.

In Brazil, it occurs in the south, southeast, midwest and northeast, registered in the states of Alagoas, Bahia, Distrito Federal, Espírito Santo, Minas Gerais, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina and São Paulo.

Taxonomic notes:—*M. caracasana* was historically misidentified with the Central American species *M. excavata* (Lindley) Kuntze due to both having a trifid apex in the lip. However, we contend that they represent distinct species. The flowers of *M. caracasana* are smaller, and the sepals of *M. caracasana* are noticeably narrower in comparison to those of *M. excavata*. In terms of vegetative aspect, *M. caracasana* is usually smaller with narrower lanceolate leaves. Nevertheless, there are instances where the leaf shapes of both species exhibit similarities. Treating *M. caracasana* separately from other morphologically similar taxa from Central America is currently more appropriate.

The original material collected by Löfgren in Brazil, in the state of São Paulo, for both *M. quadrangularis* and *M. spiralipetala*, has been lost. The illustration published by Cogniaux (1896) for *M. quadrangularis* was undoubtedly based on Löfgren's collection, as no other material is indicated for the taxon in the protologue. Therefore, we designate this specific illustration presented in plate 114, Figure 2, as the lectotype for *M. quadrangularis*.

The description of *M. spiralipetala* mentions broad leaves and an inconspicuously trilobate lip, showing some similarity to *M. cogniauxiana* (referred to as *Microstylis gracilis* Cogniaux (1896: 549) in the description of *M. spiralipetala*). This resemblance may be attributed to the oval-triangular shape of the lip. However, without direct examination of the original material, definitive identification of *M. spiralipetala* remains challenging. Considering the described morphological characteristics, it is more appropriate to refrain from treating it as a synonym of *M. caracasana*. Instead, we propose classifying this taxon as *incertae sedis* since distinguishing it from *M. gracilis*, *M. parthoni*, or *M. ovatilabia* solely based on the provided description is not feasible.

Schlechter did not indicate an holotype when proposing *M. paranaensis*, and cited three distinctive collections, *Lange without number* (S-R-3527; SI 001665), *Dusén 152156* (S-R-3525) and *Dusén without number* (S-R-3526). Among them, the material deposited in the Swedish Museum of Natural History Department of Botany (S-R-3527) exhibits flowering individuals collected in excellent conditions. Hence, we designate this material as the lectotype.

The original collection of *M. muellerii* by Fritz Muller is lost. Schlechter (1921) described it as having a narrower flower lip than usual. However, this is a common variation in *M. caracasana*. Consequently, we designate the collection of *J.Z. de Matos 95* (FLOR 38645) as the neotype, considering its excellent specimen quality and its accurate representation of the taxon.

While the Surinamese species *Malaxis maguirei* Schweinfurth ex Maguire (1948: 217) shares similarities with *M. caracasana*, we hesitate to classify them as the same species. Apart from the broader leaves, *M. maguirei* also displays a wider lip with a more prominent tridentate apex.

Characterization and ecology:—*M. caracasana* is characterized by its small to medium size and terrestrial habit. It features two plicate, oblong-lanceolate to elliptic-lanceolate leaves, usually with imbricated petioles, emerging from the mostly buried beneath the litters of plants pseudobulbs.

This species can be easily distinguished from other Brazilian species by the trifid apex of the flower lip. *M. caracasana* is typically found in montane forests, occasionally occurring in low-altitude forests within the Atlantic Forest and Cerrado biomes. It blooms from September to June and is fertile during the spring to autumn seasons.

With an extent of occurrence (EOO) spanning approximately 1,917,529.390 km² and an area of occupancy (AOO) of around 650 km², coupled with numerous records within protected areas, this taxon falls under the IUCN category of "Least Concern (NT)".

Selected examined material:—BRAZIL. ALAGOAS: 19.V.1998, *L.P. Felix* 8464 (TEPB; UFACPZ). Flexeira, Fazenda Triunfo, 19.IV.2008, *Chagas-Mota* 10520 (MAC). Ibateguara, Cerrado da Burra, 7.V.2002, *M. Oliveira* 960 (IPA, UFP). Ibateguara, Cerrado da Burra, 1.VIII.2003, *J.A. Siqueira Filho* 1384 (HVASF, UFP). Ibateguara, Coimbra, 29.III.2011, *Chagas-Mota* 10697 (MAC). BAHIA: Almadina, Serra do Corcovado, 23.V.2006, *M.M.M. Lopes* 726 (CEPEC). Arataca, RPPN Caminho das Pedras, 15.IV.2006, *A.M. Amorim* 5811 (CEPEC, HUEFS). Arataca, RPPN do IESB, 19.IV.2009, *L. Daneu* 48 (CEPEC). Barro Preto, Serra da Pedra Lascada, 26.IV.2004, *A.M. Amorim* 4037 (CEPEC, SP). Barro Preto, Serra da Pedra Lascada, 21.V.2006, *M.M.M. Lopes* 676 (HUEFS). Barro Preto, Serra da Pedra Lascada, 25.III.2018, *T.L. Vieira* 345 (HUEFS). Camacan, RPPN Serra Bonita, 5.VI.2005, *J.L. Paixão* 436 (HUEFS). Ilhéus, 23.IV.2019, *L.Y.S. Aona* 4984 (HURB). Ilhéus, 23.IV.2019, *L.Y.S. Aona* 4985 (HURB). Ilhéus, RPPN do IESB, 19.V.2009, *L. Daneu* 48 (UPCB). Santa Terezinha, Vila da Pedra Branca, 11.VII.2000, *M. Alves* 1994 (CEPEC). Wenceslau Guimarães, Estação Ecológica Estadual Nova Esperança, 4.V.2007, *J.G. Jardim* 5084 (CEPEC). Wenceslau Guimarães, Reserva Estadual Wenceslau Guimarães, 14.IV.1992, *W.W. Thomas* 9260 (CEPEC). DISTRITO FEDERAL: APA do Gama, Cabeça de Veado, 10.I.1993, *B.A.S. Pereira* s.n. (CEN). Asa Noroeste, Parque Nacional de Brasília, 4.IV.1990, *C.M. Maury* 6 (CEN). Brasília, Mata do Córrego Três, 27.I.1995, *J.A.N. Batista* s.n. (CEN). Brasília,

APA do Gama, 10.I.1993, *B.A.S. Pereira* 2359 (BHCB). Brasília, Reserva Ecológica do IBGE, 10.II.1992, *D. Alvarenga* 849 (RB). Brasília, Mata do Córrego Três Barras, 20.XII.1992, *L.B. Bianchetti* 10 (CEN). ESPÍRITO SANTO: Castelo, Parque Estadual do Forno Grande, 7.XI.2006, *L. Kollmann* 9390 (MBML). Guarapari, Parque Estadual Paulo César Vinha, 30.IX.1999, *C. N. de Fraga* 506 (MBML). Itaguaçu, Pedra do Caraó, 10.IV.2004, *A. P. Fontana* 863 (MBML). Itaguaçu, Pedra do Caraó, 23.IV.2005, *A. P. Fontana* 1355 (MBML). Iúna, Serra do Valentim, 30.XI.2013, *J.P.F. Zorzanelli* 881 (VIES). Santa Leopoldina, Luxemburgo, 16.IV.2008, *A. P. Fontana* 5020 (MBML). Santa Maria, Itaguaçu, 25.V.1946, *A.C. Brade* 18396 (RB). Santa Maria de Jetibá, Alto São Sebastião, 16.V.2006, *A.P. Fontana* 2126 (RB). São Roque do Canaã, Alto Misterioso, 19.III.2004, *A.P. Fontana* 790 (MBML). São Roque do Canaã, Alto Misterioso, 13.XII.2004, *A.P. Fontana* 1035 (MBML). São Roque do Canaã, Alto Misterioso, 11.V.2015, *T. Bochorony* 142 (MBML). Santa Teresa, Estação Biológica Caixa D'Água, 5.V.2000, *V. Demuner* 985 (MBML). Santa Teresa, Nova Lombardia, 16.IV.2002, *R.R. Vervloet* 137 (MBML). Santa Teresa, Reserva Augusto Rusch, 8.V.2018, *G.A. Marcusso* 1143 (HRCB). Santa Teresa, Santo Anselmo, 23.III.2006, *A. P. Fontana* 2049 (MBML). Vargem Alta, Cachoeiro de Itapemirim, 23.V.1949, *A.C. Brade* 19886 (RB). MINAS GERAIS: Without locality, 2.XII.2003, *L. Menini Neto* 72 (R). Caldas, 12.II.2004, *C. van den Berg* 1284 (HUEFS). Camanducaia, 28.II.2000, *R.B. Torres* 1096 (IAC). Catas Altas, Serra do Caraça, 15.XII.2000, *R.C. Mota* 1120 (CEN). Catas Altas, Serra do Caraça, 15.XII.2000, *J. Ordones* 598 (BHCB). Delfim Moreira, Fazenda da Onça, 17.III.2011, *L.L. Giacomini* 1473 (BHCB). Gonçalves, XI.1997, *L.V.C. Costa* s.n. (BHCB). Itamonte, Parque Nacional do Itatiaia, 25.I.2009, *F.F.V.A. Barberena* 124 (RB). Lima Duarte, Parque Estadual do Ibitipoca, 20.I.2005, *R.C. Forzza* 3968 (RB). Lagoa Santa, without date, *without collector* (OUPR). Lima Duarte, Parque Estadual do Ibitipoca, XII.2000, *F.R.G. Salimena* s.n. (CESJ). Lima Duarte, Parque Estadual do Ibitipoca, 18.XII.2015, *G.B. Oliveira* 103 (CESJ). Machado, 7.III.1950, *C. Carcerelli* 4 (RB). Moeda, Grotão do Lopes, 22.IV.2006, *L.H.Y. Kamino* 347 (BHCB). Nova Lima,

Mina Capitão do Mato, 5.XII.2019, *S.G. Resende 8424* (BHCB). Ouro Branco, Serra do Ouro Branco, 25.VI.2014, *T.L. Vieira 207* (SP). Ouro Branco, Serra do Ouro Branco, 8.XII.2002, *C.C. Paula 529* (VIC). Ouro Preto, Parque Estadual do Itacolomi, 24.II.1987, *M.V. Peron s.n.* (OUPR). Ouro Preto, Parque Estadual do Itacolomi, 20.VI.2018, *L.G. Pedrosa 463* (OUPR). Ouro Preto, Serra da Capanema, 7.VII.2008, *F.F. Carmo 3393* (BHCB). Ouro Preto, Parque Estadual do Itacolomi, 11.IV.2018, *L.G. Pedrosa 166* (OUPR). Olaria, Serra do Cruz, 11.IX.2010, *F.E. Alves 19* (CESJ). Poço de Caldas, Mata do Retiro Branco, 29.X.1981, *J.Y. Tamashiro 1644* (UEC). São Roque de Minas, Parque Nacional da Serra da Canastra, 13.XII.2007, *J.A.N. Batista 2345* (CEN). Serra do Caraça, Catas Altas, 15.XII.2000, *R.C. Mota 1120* (BHCB). Serra do Caraça, Catas Altas, 5.I.2005, *R.C. Mota 2378* (BHCB). Serra do Gandarela, Morro Vermelho, 11.XII.2019, *S.G. Rezende 8015* (BHCB). Serra do Gandarela, Santa Bárbara, 26.XI.2008, *F.F. Carmo 3522* (BHCB). Serra do Gandarela, Santa Bárbara, 17.VII.2013, *N.E. Tameirão 5364* (BHCB). Serra do Gandarela, Rio Acima, 12.XII.2017, *S.G. Resende 6695* (BHCB). Serra do Ibitipoca, Pico do Pião, 12.V.1970, *D. Sucre 6723* (RB). PARANÁ: Campina Grande do Sul, Capivari Grande, without date, *G. Hatschbach 16216* (MBM). Campina Grande do Sul, Ibitiraquire-Caratuva, without date, *O.S. Ribas 7198* (MBM). Curitiba, Região Metropolitana, 22.X.1947, *A. Hatschbach 808* (MBM). Curitiba. Capão Cifloma, 24.X.2017, *I. Souza s.n.* (EFC). Guaratuba, Serra do Araraquara, 25.VI.1968, *G. Hatschbach 19428* (MBM). Marmeleiro, Estrada Marmeleiro-Campo Erê, 21.II.1971, *G. Hatschbach 25383* (MBM). Piên, 8.III.1967, *G. Hatschbach 16102* (MBM). São José dos Pinhais, Contenda, 28.II.1967, *G. Hatschbach 16081* (UPCB). São José dos Pinhais, Contenda, 10.VI.2019, *I. Souza 501* (EFC). São José dos Pinhais, Contenda, 28.II.1967, *G. Hatschbach 16081* (MBM). Tibagi, Guartelá, 18.V.2011, *W.S. Mancinelli s.n.* (JOI). Tunas do Paraná, Estrada para o Parque Lauráceas, 23.III.2001, *J.M. Silva 3347* (MBM). PERNAMBUCO: Bonito, Reserva Ecológica, 2.VIII.1995, *Felix L.P. 7218* (HST). Bonito, Reserva Ecológica, 2.VIII.1995, *Felix L.P. 8464* (HST). Bonito, Reserva Ecológica, 14.VIII.1996, *Felix L.P. s.n.* (UFP). Bonito, Reserva Ecológica, 24.VI.1995,

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 Palmares, Serra do Urubu, V.1986, *J.G. Gomes s.n.* (UFP). RIO DE JANEIRO: Itatiaia, Lote 88,
 8.II.1942, *A.C. Brade 17150* (RB). Itatiaia, Macieiras, *A.C. Brade 17486* (RB). Petrópolis, VIII.1927, *C. Spannagel 227* (SP). Petrópolis, Parque Natural Municipal de Petrópolis, 12.VIII.2011, *M.O.O. Pellegrini 167* (RB). Petrópolis, Parque Natural Municipal de Petrópolis, 21.VI.2011, *M.O.O. Pellegrini 88* (RB). Petrópolis, Serra de Petrópolis, 1.IV.1959, *A.P. Duarte 4664* (RB). Santa Maria Madalena, Muribeca, 2.III.1934, *S. Lima 13327* (RB). Santa Maria Madalena, Serra da Forquilha, 4.III.1935, *S.L. Brade 14314* (RB). Serra dos Órgãos, Rio Paquequer, VIII.1940, *A.C. Brade 16744* (RB). Teresópolis, 29.III.1917, *A.J. Sampaio 1997* (R). Teresópolis, 1918, *A. Frasso s.n.* (RB). RIO GRANDE DO SUL: Guaritas, Caçapava, 30.V.1976, *J.L. Waechter 282* (ICN). Mato Castelhana, Floresta Nacional de Passo Fundo, 25.IV.2013, *M. Verdi 6399* (FURB). Osório, Fazenda do Arroio, 11.XI.2015, *J. Gaio 489* (HUCS, MBM). Parque de Torres, 11.VII.1972, *B.E. Irgang s.n.* (ICN). Pelotas, Morro Quilongongo, 15.V.2009, *T. Perleberg 317* (ECT). Pelotas, Morro Quilongongo, 29.IV.2008, *T. Perleberg 195* (ECT). Pelotas, Morro Quilongongo, 15.III.2008, *T. Perleberg 235* (ECT). Porto Alegre, Morro São Pedro, 23.I.2009, *M. Grings 1412* (ICN). Santa Maria, Três Barras, 12.VII.2012, *Portalet A.A. 21* (SMDB). SANTA CATARINA: Armazém, São José dos Macacos, 7.IV.2010, *M. Verdi 4240* (FURB). Balneário Rincão, 12.VI.2018, *A.K. Filho 2841* (FURB). Benedito Novo, 15.IV.2013, *J.O. Caetano 35* (FURB). Benedito Novo, Campo de Zinco, 11.III.2010, *A. Korte 2107* (FURB). Botuverá, Localidade 60, 30.VI.2009, *M. Verdi 2436* (FURB). Campo Alegre, Serra do Quiriri, 12.II.2005, *O.S. Ribas 6698* (MBM). Celso Ramos, Laje da Pedra, 18.VII.2011, *A. Korte 7070* (FURB). Chapecó, Escola Agrícola, 7.VI.1994, *R. Santos 80* (CRI). Concórdia, 16.V.2017, *A.K. Filho 505* (FURB). Florianópolis, Morro da Lagoa, 1.VI.2004, *T.S. Kunz s.n.* (FLOR). Florianópolis, Represa da Lagoa, 1.VII.1981, *A. Bresolin 1444* (FLOR). Garopaba, Morro da Ressacada, 28.IV.2010, *M. Verdi 4524* (FURB). Herval d'Oeste, Linha Barreiras, 27.III.2019, *A.K. Filho 4996* (FURB). Imaruí, Alto Rio da Una, 10.V.1973, *A. Bresolin*

739 (FLOR). Indaial, Parque Nacional da Serra do Itajaí, 21.V.2010, *A. Korte* 3353 (FURB). Indaial, Warnow Alto, 14.V.2010, *A. Korte* 3247 (FURB). Joinville, 6.V.2010, *T.J. Cadorin* 2005 (FURB). Joinville, 10.XII.2009, *T.J. Cadorin* 950 (FURB). Joinville, Morro da Tromba, 26.IX.2006, *W.S. Mancinelli* 731 (JOI). Joinville, Morro da Tromba, 22.VII.2010, *W.S. Mancinelli* 1246 (JOI). Nova Teutônia, 10.II.1944, *F. Plaumann* 384 (RB). Palhoça, Morro do Cambirela, 24.VI.1971, *R.M. Klein* 9545 (FLOR). Pedra Branca, Aparados da Serra, 25.V.2010, *M. Verdi* 4741 (FURB). Praia Grande, Aparados da Serra, 1.XI.2000, *R. Santos s.n.* (CRI). Santo Amaro da Imperatriz, Hotel Plaza Caldas da Imperatriz, 2.V.2007, *J.Z. de Matos s.n.* (FLOR). Santo Amaro da Imperatriz, Guarda do Cubatão, 11.VII.2010, *A.S. Santos* 3273 (FURB). Treviso, III.2018, *R. Colares s.n.* (CRI). Urubici, Parque Nacional de São Joaquim, 16.XII.2018, *L.A. Funez* 8503 (FURB). Urussanga, 23.VI.2010, *Michele s.n.* (CRI). SÃO PAULO: without date, *Tamandaré s.n.* (SP). Biritiba-Mirim, Estação Biológica de Boracéia, 28.XII.1983, *A.C. Filho* 2090 (SP). Biritiba-Mirim, Estação Biológica de Boracéia, 8.VII.1983, *A.C. Filho* 56 (SP). Campos do Jordão, 22.X.1938, *G. Hashimoto* 47 (SP). Campos do Jordão, 5.II.1937, *P. Campos-Porto* 3223 (RB). Cananéia, 1.III.2005, *A. Oriani* 715 (ESA). Cruzeiro, Pico Itaguaré, 4.VI.1996, *A.M. Giulietti s.n.* (SPF). Juquitiba, 1.VI.1980, *F. Barros* 253 (SP). Miracatu, Sítio Irapuã, 19.V.1985, *P. Martuscelli* 130 (SP). Mogi das Cruzes, IV.2007, *V.T. Rodrigues* 88 (SP). Santo André, Paranapiacaba, 10.V.1975, *O. Handro* 2275 (SBT, SP, SPF). São Bernardo do Campo, Parque Caminhos do Mar, 14.VI.1994, *Guerra, T.P.* 171 (SP). São Lourenço da Serra, RPPN Paiol Maria, 26.IV.2011, *J.A. Lombardi* 8525 (HRCB, UEC). São Paulo, Jardim Botânico, 25.II.1930, *F.C. Hoehne s.n.* (SP). São Paulo, Mata do Governo, 8.V.1924, *A. Gehrt s.n.* (SP). São Paulo, Morro do Jaraguá, 21.IV.1921, *F.C. Hoehne s.n.* (SP). São Paulo, Morro do Jaraguá, 17.III.1907, *A. Usteri s.n.* (SP). São Paulo, Parelheiros Rodoanel Mário Covas, 2.VII.2008, *R.T. Shirasuna* 1488 (SP). São Paulo, Parque Estadual da Serra do Mar, 14.IV.2001, *J.P. Souza* 3549 (ESA, SPSF, UEC). Serra da Bocaina, V.1951, *A.C. Brade s.n.* (RB). Sertão do Rio Vermelho, Serra da Bocaina, V.1936, *A.C. Brade s.n.* (RB).

Selected additional examined material:—COLOMBIA. Magdalena: Sierra Nevada de Santa Marta, 16.VII.1977, *M.R. Jaramillo 5160* (U 1470069).

2. *Malaxis cipoensis* Fábio de Barros (1996: 15). Type:—BRAZIL. Minas Gerais. Serra do Cipó, 01 February 1987, *F. Barros 1299* (holotype: SP 231990!).

Fig. 4

Herb 15–45 mm tall, rhizome inconspicuous. Roots 8–12 mm long, thin. Pseudobulbs 9–12 × 7–8 mm, elliptical; covered by white or greenish deciduous foliaceous sheets. Leaves 9–14 × 7–8 mm, opposite, two per pseudobulbs; several layers of sheetlike petioles 5–6 mm long, imbricated in each other entirely; lamina elliptic, flat, sometimes slightly conduplicate in the base, membranaceous, margin entire, apex obtuse. Inflorescence 26–38 mm long; densely congested umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular to acuminate. Flowers non-resupinate, orange, orange-greenish; pedicels 0.8–1 mm long; ovary 0.7–1.2 mm long. Dorsal sepal 1.5–2 × 1–1.4 mm; oblong to oblong-lanceolate; margin entire; apex slightly acute. Lateral sepals 1.6–2.1 × 1.3–2 mm; free; elliptical, usually broader than the dorsal; margin entire; apex obtuse. Petals 0.8–1.2 mm long; linear, usually twisted, margin entire; apex obtuse. Lip 2–2.4 × 2.1–3 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes oblong, rounded, conspicuous elongate; mid lobe oval-triangular, 2 elliptic to obovate disk foveas, margin entire, apex apiculate. Column vertically compressed; yellow-greenish; wings inconspicuous. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022). It occurs in the southeast and midwest

of the country in the states of Goiás and Minas Gerais.

Characterization and ecology:—*M. cipoensis* is characterized by its diminutive size and terrestrial growth habit, with two flat to slightly conduplicate elliptic leaves. These leaves usually exhibit imbricated petioles, overlapping each other towards the apex, emerging from the mostly buried pseudobulbs hidden beneath the plant litter.

This species can be distinguished from the majority of other native species by its reduced size and a lip with rounded and well-developed lateral lobes. It bears resemblance to *M. cogniauxiana* but is set apart by its smaller vegetative size with entirely imbricated foliar petioles.

M. cipoensis primarily occurs in high-altitude areas within the Brazilian Cerrado, typically inhabiting the low vegetation of rupestrian fields in humid areas near streams. It undergoes flowering from December to February and remains fertile during the summer months.

With an estimated extent of occurrence (EOO) of approximately 35,810.775 km² and an area of occupancy (AOO) of approximately 12 km², alongside the limited documented records within protected areas, according to the IUCN criteria this taxon is classified as "Endangered (EN) [EN B2a,b(ii,iii)]".

Additional examined material:—BRAZIL. GOIÁS: Alto Paraíso de Goiás. Chapada dos Veadeiros, 4.II.1979, *G.F. Gates 132* (UB). MINAS GERAIS: Belo Horizonte. Serra da Moeda, 7.XII.2007, *J.A.N. Batista 2328* (BHCB).

3. *Malaxis cogniauxiana* (Schlechter 1920: 331) Pabst (1967b: 164); *Microstylis cogniauxiana* Schlechter (1920: 331); *Microstylis gracilis* Cogniaux (1896: 549) *nom. inv.* Type:—BRAZIL. Minas Gerais: Serra do Itatiaia, 4 January 1896, *E. Ule 3756* (lectotype designated here: BR 0000006572457 [digital image!]); Isolectotype: HBG 500367 [digital image!]).

Fig. 5

Herb 72–241 mm tall, rhizome inconspicuous. Roots 10–32 mm long, thin. Pseudobulbs 8–28 × 4–17 mm, oblong, covered by white or greenish deciduous foliaceous sheets. Leaves 23–70 × 18–58 mm, opposite, two per pseudobulbs; one or two layers of a sheetlike petioles 30–88 mm long, partially imbricated in each other; lamina elliptic, rarely elliptic-lanceolate, flat, plicate, slightly conduplicate near the base, membranaceous, margin entire, apex obtuse to slightly acute. Inflorescence 52–140 mm long; loose umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, linear to triangular. Flowers non-resupinate, orange, orange-greenish; pedicels 9–15 mm long; ovary 2–4 mm long. Dorsal sepal 3.8–5.8 × 2.5–4.2 mm; elliptical to elliptic-lanceolate; margin entire; apex obtuse to slightly acute. Lateral sepals 3.8–5 × 2.5–3.8 mm; free; elliptical to elliptic-lanceolate, usually narrower than the dorsal; margin entire; apex obtuse to slightly acute. Petals 3–4.1 mm long; oblong to oblong-lanceolate, margin entire; apex acute. Lip 1.8–3.6 × 2–4 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes rounded, elongate; mid lobe oval-triangular, 2 oblong to elliptic disk foveas with two longitudinal canals, margin entire, apex rounded to slightly acute. Column vertically compressed; yellow-greenish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022). It occurs in the south, southeast, midwest and northeast regions in the states of Bahia, Espírito Santo, Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina and São Paulo.

Taxonomic notes:—Two syntype collections (BR 0000006572457; HBG 500367) were deposited by *Ule* 3756, currently housed in separate herbaria. Hence, we have chosen the material deposited in the

BR herbarium as the lectotype due to its high quality and because it includes the original illustration published by Cogniaux (1896) alongside the specimen in the exsiccate.

Characterization and ecology:—*M. cogniauxiana* is characterized by its small to medium size and terrestrial habit. It exhibits two plicate elliptic leaves that usually emerge from the pseudobulbs buried beneath the litter, with the petioles partially imbricating each other.

It can be recognized and distinguished from the majority of other species by the large size of its dorsal sepal, which is longer and wider than the lateral sepals. Additionally, the lip exhibits well-developed rounded lateral lobes, along with two longitudinal canals present in the foveas of the lip.

M. cogniauxiana primarily occurs in the forests of high-elevation areas within the Atlantic Forest and Cerrado biomes. It is typically found in dark and moist regions concealed within the vegetation. The species blooms from December to February and is fertile during the summer.

With an extent of occurrence (EOO) of approximately 1090.600,660 km² and an area of occupancy (AOO) estimated to be around 92 km², combined with multiple records outside protected areas in regions experiencing increasing deforestation, this taxon is classified according to the IUCN criteria as "Near Threatened (NT)".

Additional examined material:—BRAZIL. BAHIA: Abaíra. Tijuquinho, 24.II.1992, *T. Laessoe* H52189A (HUEFS; K; SPF). Elísio Medrado. Serra da Jibóia, without date, *E.C. Smidt* 323 (HUEFS). ESPÍRITO SANTO: Fundão. Goiapaba-açu, 11.X.2003, *A.P. Fontana* 625 (MBML). Fundão. Goiapaba-açu, 11.X.2003, *A.P. Fontana* 625 (MBML). MINAS GERAIS: Airuoca. Parque Estadual do Papagaio, 18.I.2008, *J.A.N Batista* 2440 (BHCB). Catas Altas. Serra do Caraça, 5.I.2005, *R.C. Mota* 2381 (BHCB). Itamonte. Parque Estadual do Papagaio, 7.XI.2007, *N.F.O. Mota* 979 (BHCB). Teófilo Otoni. Pedra da Boca, 18.IX.2016, *L.F.A. de Paula* 1111 (BHCB). PARANÁ: Campina Grande do Sul.

Ibitiraquire-Abrigo 1, 23.I.1970, *G. Hatschbach* 23396 (MBM, SBT). Guaratuba. Serra do Araçatuba, 21.I.1994, *R. Kummrow* 3380 (MBM). RIO DE JANEIRO: Itatiaia. Estrada para Agulhas Negras, 17.I.1979, *P. Occhioni* 8710 (RFA). Itatiaia. PARNA do Itatiaia, without date, *G. Azul* without number (HRCB). Itatiaia. Ponte do Maromba, 28.III.1995, *J.M.A. Braga* 2286 (RB). Itatiaia. Subida para o Planalto, 4.III.2013, *J.A.N. Batista* 3224 (BHCB; CEN). Rio de Janeiro. FEEMA, 10.VIII.1982, *E. Costa* 173 (RB). SANTA CATARINA: Campos Novos, 16.IV.2011, *A. Korte* 6656 (FURB). Orleans. 15.VIII.1990, *V.C. Zanette* 941 (CRI). SÃO PAULO: Campos do Jordão. Umuarama, 1.II.1935, *M. Kuhlmann* without number (SP). Campos do Jordão. 20.XII.1946, *G.F.J. Pabst* 340 (SP).

4. *Malaxis engelsii* T.F. Santos & E.C. Smidt (2023: in press). **Type**—BRAZIL. Paraná: Campina Grande do Sul, Trilha para o Morro Getúlio e Caratuba, 15.I.2019, *M.E. Engels* 6579 (holotype: MBM 439143!; isotype: HCF 35625!).

Fig. 6

Herb 40–70 mm tall, rhizome inconspicuous. Roots 8–40 mm long, thick. Pseudobulbs 5–10 × 4–5 mm, oblong, covered by whitish to brownish deciduous foliaceous sheets. **Leaves** 25–45 × 28–36 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 10–30 mm long, imbricate in each other from the base to near the apex; lamina elliptic-cordiform, flat, coriaceous, margin entire, apex obtuse to slightly acute. Inflorescence 64–120 mm long; umbel-like raceme; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular. Flowers non-resupinate, orange greenish; pedicels 2–8 mm long; ovary 1 mm long. Dorsal sepal 2.2–2.7 × 1–1.4 mm; 3-veined; oblong or oblong-lanceolate; margin entire; apex acute. Lateral sepals 1.7–2 × 1–1.5 mm; free; 3-veined; oblong, length similar to the dorsal; margin entire; apex obtuse to slightly acute. Petals 1.5–2 mm long; 1-veined; linear, usually twisted, margin entire; apex obtuse. Lip 1.2–1.5 × 1.1–1.2 mm; trilobate;

glabrous; callus absent in the internal portion; base truncate, attached to the column; lateral lobes acuminate; mid lobe triangular, internal central portion is thickened, forming a longitudinal callus on the adaxial face, four oblong to obovate foveas, margin entire, apex acute. Column vertically compressed; yellowish; wings acute. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Paraná state in the south of Brazil.

Characterization and ecology:—*M. engelsii* is characterized by its small size and epiphytic habit. It exhibits two plicate elliptic-cordiform leaves, with the petioles partially overlapping each other. This species shares similarities with *M. cipoensis*, *M. sertulifera*, and *M. ybytus*. However, it can be distinguished from *M. cipoensis* by its lip with four foveas instead of two, from *M. sertulifera* by its elliptical leaves instead of oblong-lanceolate, and from *M. ybytus* by its partially connate lateral sepals instead of free.

M. engelsii occurs in the upper montane forest of the Atlantic Rainforest in the Paraná state. It blooms in December and January during the summer season.

Based on the limited availability of only two recorded collections of the species, the current material is inadequate for a precise assessment of its conservation status. In accordance with the IUCN guidelines (2022), we classify the taxon as "Data Deficient (DD)".

Additional examined material:—Paraná: Piraquara, Queimada, Morro Albino de Souza, 27.XII.1947, G. Hatschbach 817 (paratypes: MBM 49978!; SP 54728!).

5. *Malaxis cordilabia* Portalet (2016: 494). Type:—BRAZIL. Rio Grande do Sul: Tres Barras, May 2015, A.A. Portalet 122 (holotype: SMDB 16740!).

Fig. 7

Herb 80–150 mm tall, rhizome inconspicuous. Roots 12–28 mm long, thick. Pseudobulbs 10–18 × 8–12 mm, oblong, covered by greenish deciduous foliaceous sheets. Leaves 25–45 × 28–36 mm, opposite, two per pseudobulbs; one or two layers of a sheetlike petiole 22–82 mm long, partially imbricated in each other; lamina oblong to oblong-lanceolate, flat, plicate, slightly conduplicate near the base, coriaceous, margin entire, apex obtuse to slightly acute. Inflorescence 92–340 mm long; congested umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular. Flowers non-resupinate, greenish; pedicels 5–9 mm long; ovary 2–4 mm long. Dorsal sepal 2.6–3.2 × 1.2–1.4 mm; oblong-lanceolate; margin entire; apex acute. Lateral sepals 2–3 × 1.5–2 mm; free; oblong-lanceolate, usually broader than the dorsal; margin entire; apex acute. Petals 1.8–3 mm long, linear, usually twisted, margin entire; apex obtuse. Lip 4 × 4.5 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes rounded, inconspicuous; mid lobe oval-triangular, 2 obovate disk foveas, margin entire, apex apiculate. Column vertically compressed; yellow-greenish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022). It occurs in the south, endemic to the Rio Grande do Sul state.

Characterization and ecology:—*M. cordilabia* is characterized by its small to medium size and terrestrial habit, with two plicate oblong-lanceolate leaves. The leaves usually have petioles partially imbricated in each other, emerging from the mostly buried pseudobulbs beneath the plant litter.

It is similar to *M. parthoni* and *M. ovatilabia*, and can be distinguished from the former by the more rounded and inconspicuous lateral lobes of the flower lip, and from both species by the petioles that are partially imbricated with each other, unlike being completely imbricated.

M. cordilabia occurs in the sub-montane and montane forests within the Central Depression physiographic region, in the Atlantic Rainforest, specifically between the municipalities of Dom Pedro de Alcântara and Santa Maria in the state of Rio Grande do Sul, Brazil. It blooms in June during the autumn season.

With an estimated extent of occurrence (EOO) of approximately 59,912.023 km² and an area of occupancy (AOO) of around 8 km², coupled with few recorded occurrences in nearby areas, according to the IUCN criteria this taxon is classified as "Critically Endangered (CR) [CR B1 B2a,b(i,iii,iv)]".

Additional examined material:—BRAZIL. RIO GRANDE DO SUL: Santa Maria. Tres Barras, 12.V.2015, *A.A. Portalet 124* (SMDB). Dom Pedro de Alcântara. Mata da Cova Funda, 8.VI.2000, *C.F. Jurinitz 33* (ICN).

6. *Malaxis ovatilabia* (Schlechter 1920: 330) T.F. Santos *et al.* (2023: comb. nov.); *Microstylis ovatilabia* Schltr. (1920: 330). Type—Brazil: Paraná, Morretes, Jaguariahyva, in silvula primaeva, april 1910, *P. Dusén 9780* (holotype: S-R-3523 [digital image!]; Isotypes: AMES 00101730, HBG 506869, NY 00009092 [digital images!], V 0361242F). comb. nov.

= *Malaxis jaraguae* (Hoehne & Schlechter 1926: 196) Pabst (1967b: 164); *Microstylis jaraguae* Hoehne & Schlechter (1926: 196). Type:—BRAZIL. São Paulo: Morro do Jaraguá, 29 April 1921, *Gehrdt A. without number* (lectotype designated here: SP5517!; isoelectotype: NY01032131 [digital image!]). new syn.

Fig. 8

Herb 110–337 mm tall, rhizome inconspicuous. Roots 27–80 mm long, thick. Pseudobulbs 35–55 × 13–22 mm, oblong or elliptical, covered by greenish deciduous foliaceous sheets. Leaves 72–128 × 37–86 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 21–105 mm long, imbricated in each other entirely; lamina elliptic, elliptic-lanceolate, flat, plicate, coriaceous, margin entire, apex obtuse or acute. Inflorescence 180–321 mm long; congested umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular or linear. Flowers non-resupinate, greenish; pedicels 4–9 mm long; ovary 1–3 mm long. Dorsal sepal 2.1–4.1 × 1.1–2.3 mm; oblong; margin entire; apex obtuse to slight acute. Lateral sepals 2.1–4.2 × 1–2.1 mm; free; oblong to oblong-lanceolate, usually broader than the dorsal; margin entire; apex acute. Petals 1.8–4 mm long; linear, usually twisted, margin entire; apex acute. Lip 2.1–3 × 2.2–4. mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes rounded, rarely inconspicuous; mid lobe oval-triangular, 2 oblong disk foveas, margin entire, apex cuspidate. Column vertically compressed; yellow-greenish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022). It occurs in the south, southeast and northeast, in the states of Bahia, Espírito Santo, Paraná, Rio Grande do Sul, Rio de Janeiro, Santa Catarina and São Paulo.

Taxonomic notes:—Hoehne & Schlechter (1926) originally described *M. jaraguae* based on the collection of Gehrt A. without number, making a comparative assessment with *M. ovatilabia* and emphasizing the morphological disparity of the flower lip, which was described as entire rather than trilobed. However, upon examination of the original material, we did not observe the aforementioned characteristic attributed to *M. jaraguae*. Additionally, disparities were detected between Hoehne's

published illustration of their species and our observations. Our analysis confirms that the original material specimen possesses a trilobed lip, although the lobes may be inconspicuous, and the flower morphology found is consistent with what we have observed in other collections of *M. ovatilabia*. Therefore, we propose the synonymization of *M. jaraguae* with *M. ovatilabia*, recognizing the older name as the accepted one.

The protologue of *Microstylis ovatilabia* includes a reference to the misidentification of the species as *Microstylis parthoni* by Kränzlin. The specimen registered in the herbarium S (S-R-3523) bears a label with this incorrect identification, which provides clear evidence that this particular specimen, among the duplicates of the original material (AMES 00101730, HBG 506869, NY 00009092, V 0361242F), is the collection used to describe the species and should be treated as the holotype.

Characterization and ecology:—*M. ovatilabia* is predominantly terrestrial, with the occasional occurrence of epiphytic and rupicolous habits. It features two plicate, elliptic, or elliptic-lanceolate leaves, typically with fully imbricated petioles. While sharing similarities with *M. parthoni*, it can be distinguished by the more rounded lateral lobes of the flower lip and larger elliptical leaves.

The distribution of *M. ovatilabia* is primarily concentrated in coastal areas, with limited occurrences further inland. This endemic species is found in the montane and sub-montane forests of the Atlantic Forest biome. It undergoes blooming from November to June and remains fertile throughout the spring to autumn period.

With an estimated extent of occurrence (EOO) of approximately 879,834.580 km² and an area of occupancy (AOO) of around 140 km², alongside several documented records within protected areas, according to the IUCN criteria this taxon is classified as "Least Concern (NT)".

Selected examined material:—BRAZIL. BAHIA: Barro Preto, Serra da Pedra Lascada, 26.IV.2004, *A.M. Amorim 4073* (MBML, RB). ESPÍRITO SANTO: Santa Maria de Jetibá, Rio das Pedras, 23.III.2007, *A.P. Fontana 3130* (RB). Parana: Foz de Iguaçu, Parque Nacional do Iguaçu, 7.V.1949, *A.P. Duarte 1844* (RB). Guaratuba, Serra do Araçatuba, 20.III.20001, *E.P. Santos 972* (UPCB). Telêmaco Borba, Área de Alagamento da UHE Mauá, 20.VI.2011, *M.A. Milaneze-Gutierrez without number* (HUEM). RIO DE JANEIRO: Mangaratiba, Itatiaia, 1967, *P. Campos-Porto without number* (RB). Mangaratiba, RPPN Rio das Pedras, 4.IX.2003, *E. Saddi 130* (RB). Miguel Pereira, Mata do Retiro das Palmeiras, 18.X.2004, *C.F. Mattos 32* (RB). Saquarema, 25.VI.1990, *T. Fontoura 177* (RB). Santa Maria Madalena, Parque Estadual do Desengano, 24.VII.2012, *C. Mynssen 1318* (RB). Serra dos Órgãos, Pedra Chapadão, VIII.1940, *A.C. Brade 16702* (RB). RIO GRANDE DO SUL: Itati, Reserva Biológica da Mata Paludosa, III.2017, *R.M. Senna 1670* (HAS). Porto Alegre, Bairro Belém Velho, 21.06.1956, *A.R. Schultz 1321* (ICN). Putinga, PCH Salto do Forqueta, 23.II.2001, *E. Freitas without number* (HVAT). Santa Cruz do Sul, Trombudo, 18.II.1980, *J.L. Waechter 1562* (ICN). Torres, Morro Azul, 25.III.1977, *J.L. Waechter 477* (ICN). Vale do Sol, Linha XV de Novembro, 27.II.1993, *J.A. Jarenkow 2346* (FLOR, MBM, PEL). SANTA CATARINA: Armazém, 6.VI.2018, *A.K. Filho 3004* (FURB). Concórdia, 16.V.2017, *A. Krassner 505* (RB). Florianópolis, Barreiro, 18.III.1971, *A. Bresolin 216* (FLOR). Florianópolis, Morro do Ribeirão, 20.VI.1967, *R.M. Klein 7452* (FLOR). Florianópolis, Morro da Lagoa, 23.II.2010, *T.J. Cadorin 1444* (FURB). Ipira, Linha Lambedor, 29.IV.2013, *D.C. Imig 156* (UPCB). Itapema, Canto da Praia, 3.V.2010, *A.S. Santos 2683* (FURB). Nova Fátima, Santa Rosa de Lima, 5.V.2010, *M. Verdi 4682* (FURB). Orleans, Florística IFFSC 97, 22.II.2010, *M. Verdi 3706* (UPCB). Orleans, Rio Novo, 30.IV.1992, *V.C. Zanette 1415* (CRI). Orleans, Rio Novo, 30.IV.1992, *C. Vanilde 1415* (UPCB). Orleans, Taipa, 24.II.2010, *M. Verdi 3739* (FURB). Praia Grande, Trilha do Rio do Boi, 27.IV.2010, *J.L. Schmitt 2056* (FURB). Rio do Sul, Fazenda Mirador, 17.II.2010, *J.L. Schmitt 1406* (FURB). Siderópolis, Serrinha, 19.XI.2009, *J.L. Schmitt 653* (FURB). Taió, Florística IFFSC 62,

18.II.2010, *A. Korte 1863* (UPCB). Urussanga, Linha Pacheco, 17.II.2010, *M. Verdi 3616* (FURB, UPCB). SÃO PAULO: São José do Barreiro, Parque Nacional da Serra da Bocaina, 2.II.2018, *J.A.N. Batista 3523* (BHCB). São Paulo, Morro Jaraguá, III.1913, *T. Toledo 511* (RB).

7. *Malaxis pabstii* (Schlechter 1921: 13) Pabst (1967b: 164); *Microstylis pabstii* Schlechter (1921: 13). Type:—BRAZIL. Santa Catarina: without locality or date, *Pabst 842* (holotype: lost; neotype designated here: BRAZIL. Rio Grande do Sul: Sapucaia, Morro Steinkopf, 24.VIII.1968, *Fertsch D. 81* (HB 42141!)).

Description solely based on Schlechter (1921) and Pabst & Dungs illustration (1977).

Herb ca. 450 mm tall, rhizome inconspicuous. Pseudobulbs 50×10 mm, elliptical. Leaves $150\text{--}185 \times 60\text{--}100$ mm, opposite, two per pseudobulbs; petiole 139 mm long, lamina elliptic-lanceolate, plicate, coriaceous, margin entire, apex acute. Inflorescence ca. 200 mm long; congested umbel. Flowers non-resupinate. Dorsal sepal 3.5 mm long; oblong-lanceolate; apex acute to obtuse. Lateral sepals 2.7 mm long; partially connate; oblong-lanceolate, apex acute to obtuse. Petals 1.8–3 mm long; linear, usually twisted, margin entire; apex obtuse. Lip 2×2.2 mm; trilobate; glabrous; callus absent; base truncate, lateral lobes acute; mid lobe triangular, 2 obovate disk foveas, margin entire, apex acute. Column vertically compressed.

Distribution:—This species is endemic to Brazil (POWO 2022).

Occurs in the south, in the states of Santa Catarina and Rio Grande do Sul.

Taxonomic notes:—The original material collected by *Pabst 842* is lost, and the only remaining material found for this taxon is the collection made by *Steinkopf 81* (HB 42141). The plant's vegetative

material on the exsiccata specimen is damaged, and only an illustration of the vegetative parts with infructescence, and a flower drawn by Pabst & Dungs (1977) is included in the exsiccate. Due to being the only material available, we have selected it as the neotype for *M. pabstii*.

Characterization and ecology:—*M. pabstii* is characterized by its large size and terrestrial habit, with two plicate, elliptic-lanceolate leaves that usually have petioles imbricated in each other entirely, emerging from the pseudobulbs mostly buried beneath the plant's litter.

It can be recognized and distinguished from other species by the large vegetative size, with flowers that have partially connate sepals and a lip with acute elongated lateral lobes.

Apart from the lost type collection of *Pabst 842* in an unknown environment in the state of Santa Catarina, *M. pabstii* has only been recorded occurring in a montane region in the municipality of Sapucaia do Sul, within the Atlantic Forest biome of Rio Grande do Sul. It blooms in August during the winter.

Due to the lack of historical records and the only available material being the specimen sheet from 1968, it is difficult to establish the IUCN criteria for this taxon. Therefore, we infer that this taxon should be classified as "Data Deficient (DD)".

8. *Malaxis parthoni* Charles Morren (1838: 485); *Microstylis parthoni* (Charles Morren 1838: 485) Reichenbach (1861: 206). Type:—BRAZIL: without locality or date, *Parthon de von without number* (holotype: lost; lectotype designated here: illustration reproduced in Bulletin de l'Academie Royale des Sciences et Belles-lettres de Bruxelles 5: pl. 486, fig. I).

= *Malaxis argentinensis* Williams (1939). Type:—ARGENTINA. Tucumán: Tafi, january 1920, *S. Venturi 34* (holotype: LIL 000244 [digital image!]).

Fig. 9

Herb 90–234 mm tall, rhizome inconspicuous. Roots 10–52 mm long, thick. Pseudobulbs 19–40 × 10–18 mm, oblong to conical, covered by greenish or brownish deciduous foliaceous sheets. Leaves 73–111 × 28–59 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 71–130 mm long, imbricated in each other entirely; lamina oblong-lanceolate, elliptic-lanceolate, plicate, coriaceous, margin entire, apex obtuse or acute. Inflorescence 160–378 mm long; congested umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular or linear. Flowers non-resupinate, greenish; pedicels 4–10 mm long; ovary 1–5 mm long. Dorsal sepal 2.3–4 × 0.8–1.5 mm; oblong; margin entire; apex obtuse. Lateral sepals 2.3–3.8 × 1–2.5 mm; free; oblong, usually broader or same width than the dorsal; margin entire; apex obtuse. Petals 2–2.7 mm long; linear, usually twisted, margin entire; apex acute. Lip 2–3.8 × 1.1–2 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes rounded; mid lobe oval-triangular, 2 oblong disk foveas, margin entire, apex acute. Column vertically compressed; yellow-greenish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—According to the Plants of the World Online (POWO 2022) database, the native range of this species extends from Mexico to South Tropical America. However, we have only confirmed its presence in Brazil and Argentina, although it is possible that it also occurs in other countries across South America.

In Brazil, it can be found in multiple regions, including the south, southeast, midwest, and northeast, specifically in the states of Bahia, Distrito Federal, Espírito Santo, Minas Gerais, Paraná, Rio Grande do Sul, Rio de Janeiro, Santa Catarina, and São Paulo.

Taxonomic notes:—*M. parthoni* was described using material collected in an unspecified locality provided by Parthon de Von (Morren 1838). Unfortunately, the original material is presumed to be lost. Therefore, we designate the illustration on page 486, fig. I, from the species description as the lectotype, as it is based on the material sent by Parthon de Von.

Characterization and ecology:—*M. parthoni* is characterized by its medium size and terrestrial habit. It has two plicate, oblong-lanceolate to elliptic-lanceolate leaves, typically with completely imbricated petioles, emerging from pseudobulbs mostly buried beneath the litter layer.

This species resembles *M. ovatilabia* and *M. cordilabia*, but can be distinguished from both by its thinner lip with larger lateral lobes. In terms of vegetative features, *M. parthoni* stands apart due to its oblong-lanceolate leaves.

Typically, *M. parthoni* is found in montane forests within the Cerrado and Atlantic Forest biomes. Occasionally, it can also occur in low-altitude forests along the Atlantic Forest coastal regions. It blooms from December to June, primarily during the summer to autumn seasons.

Considering its extent of occurrence (EOO) of approximately 1,583,668.052 km² and an area of occupancy (AOO) of approximately 356 km², along with numerous recorded collections within protected areas, according to the IUCN criteria this taxon falls into the "Least Concern (NT)" category.

Selected examined material:—BRAZIL. BAHIA: Camacan, RPPN Serra Bonita, 21.VI.2008, *A.M. Amorim* 7446 (CEPEC). DISTRITO FEDERAL: Brasília, Mata do Ribeirão do Gama, 4.II.1996, *J.A.N. Batista* 604 (CEN). ESPÍRITO SANTO: Cariacica, Pau Amarelo, 12.IV.2009, *A.P. Fontana* 5873 (RB). Santa Maria de Jetibá, Pedra do Garrafão, 21.IV.2003, *M.V.S. Berger* 79 (MBML). Santa Teresa, Estação Biológica de Santa Lúcia, 12.IV.1989, *H.Q.B. Fernandes* 2720 (MBML). Santa Teresa, Estação Biológica de Santa Lúcia, 5.IV.1989, *H.Q.B. Fernandes* 2713 (MBML). Santa Teresa, Estação

Biológica de Santa Lúcia, 11.IV.2003, *R.P. Oliveira* 838 (MBML). Santa Teresa, Estação Biológica de Santa Lúcia, 19.IV.2000, *L. Kollmann* 2865 (MBML). Santa Teresa, Nova Lombardia, 30.I.2002, *L. Kollmann* 5397 (MBML). Santa Teresa, Nova Lombardia, 28.VIII.2002, *R.R. Vervloet* 770 (MBML). Santa Teresa, Nova Lombardia, 11.III.2003, *R.R. Vervloet* 1965 (MBML). Santa Teresa, Nova Lombardia, 17.IV.2003, *R.R. Vervloet* 2248 (MBML). Santa Teresa, RPPN Vale do Sol, 11.IV.2015, *A.D. Ferreira* 261 (MBML). Santa Teresa, Santo Anselmo, 24.III.2006, *L. Kollmann* 8801 (MBML).

MINAS GERAIS: Camanducaia, Monte Verde, 31.X.2001, *L.D. Meireles* 714 (UEC). Fervedouro, Parque Estadual da Serra do Brigadeiro, 15.II.2008, *J.A.N. Batista* 2575 (BHCB). Passa Quatro, XI.1948, *J. Vidal* 2133 (R). São Gonçalo do Rio Negro, Parque Estadual do Rio Negro, 19.IV.2007, *D.T. Souza* 103 (BHCB). RIO DE JANEIRO: Cantagalo, without date, *C. Schreiner* without number (R). Itatiaia, Parque Nacional do Itatiaia, 5.III.2013, *J.A.N. Batista* 3250 (BHCB). Itatiaia, Subida Para o Planalto, 4.III.2013, *J.A.N. Batista* 3245 (BHCB). Rio de Janeiro, Gávea Pequena, 4.V.1966, *C.L. Schaso* 34 (RB). RIO GRANDE DO SUL: Capitão, Linha Alegre, 27.VIII.2016, *E. Freitas* without number (HVAT). Encruzilhada do Sul, Fazenda Xafri, Boqueirão, 2.VIII.2003, *V.F. Kinupp* 2653 (ICN). Guaíba, Passo do Petim, 28.IV.1994, *V.F. Nunes* 1403 (ICN). Guaíba, Passo do Petim, 16.V.1994, *V.F. Nunes* 1407 (ICN). Imigrante, 6.IV.2003, *E. Santos* without number (HVAT). Imigrante, Morro da Pedra Branca, 3.VI.2000, *A. Jasper* without number (HVAT). Lajeado, Bairro Carneiros, 31.VII.1999, *E. Freitas* without number (HVAT). Lajeado, Bairro Carneiros, 25.IV.2013, *F. Lucheta* without number (HVAT). Lajeado, Bairro Centenário, 20.IX.2008, *E. Freitas* without number (HVAT). Marques de Souza, Tamanduá, 21.VI.2013, *E. Freitas* without number (HVAT). Nova Boêmia, Agudo, 23.III.1981, *Adelino* without number (SMDB). Porto Alegre, 22.V.1932, *J. Dutra* 1144 (ICN). Porto Alegre, 1946, *B. Rambo* without number (PACA-AGP). Porto Alegre, Bairro Belém Velho, 21.VI.1956, *A.R. Schultz* 1321 (ICN). Porto Alegre, Esteio, 18.IV.1949, *B. Rambo* without number (PACA-AGP). Porto Alegre, Morro da Glória, 4.V.1932, *C. Orth* without number (SP). Pouso Novo, 23.III.2013, *V. Klein* without

number (PEL). Rolante, Cascata do Chuvisqueiro, 30.V.1988, *S. Diesel without number* (PACA-AGP). Santa Maria, 10.I.1956, *O.R. Camargo 514* (PACA-AGP). Santa Maria, Itaara, 30.VI.1995, *T.B. Breier without number* (SMDB). Santa Maria, Lar Metodista, 4.V.1985, *M.E.G. Sobral 3873* (INPA). Santa Maria, Morro Pedra do Lagarto, 29.IV.2015, *L. Essi 917* (SMDB). Santa Maria, Perau, 19.V.1979, *A.A. Filho 398* (SMDB). Santa Maria, Perau, 23.V.1980, *Gonçalves K.L. without number* (SMDB). Santa Maria, Reserva do Ibicuí-Mirim, IV.1985, *M. Neves 531* (HAS). Santa Maria, Sanga da Alemoa, 15.IV.2010, *A.A. Portalet 76* (SMDB). Santa Maria, Três Barras, 28.IV.2012, *A.A. Portalet 63* (SMDB). Santana da Boa Vista, 12.IV.1995, *J.A. Jarenkow 2638* (PEL). São Francisco de Paula, Itaimbezinho, 7.II.1941, *B. Rambo without number* (PACA-AGP). São Francisco de Paula, Itaimbezinho, 18.XII.1950, *B. Rambo without number* (PACA-AGP). São Francisco de Paula, Parque Municipal da Ronda, 7.I.2007, *J. Brustulin 50* (PACA-AGP). Sapiranga, Picada Verão, 15.X.1984, *A. Nilson without number* (PACA-AGP). Sapiranga, Recanto da Cascata, 20.VII.1991, *V. F. Nunes 1288* (PACA-AGP). Sapucaia do Sul, Morro Sapucaia, 3.VII.1978, *J.L. Waechter 873* (ICN). Sério, 1.VII.2001, *E. Freitas without number* (HVAT). Sério, Araguari, 21.V.2003, *E. Freitas without number* (HVAT). Tavares, Parque Nacional Lagoa do Peixe, 8.I.2014, *R. Záchia 5627* (ICN). Teutônia, 13.VI.2010, *E. Freitas without number* (HVAT). Torres, Faxinal, 31.III.1978, *J.L. Waechter 776* (ICN). Tramandaí, 26.VII.1977, *V. Citadini without number* (ICN). Vespasiano Correa, 2.VI.2009, *W. Heberle without number* (HVAT). Viamão, Morro do Coco, 10.XII.1986, *K. Potter without number* (PACA-AGP). Viamão, Parque Estadual de Itapuã, 11.VI.1989, *M. Haussen without number* (PACA-AGP). Viamão, Parque Estadual de Itapuã, 30.VIII.2009, *E. Freitas without number* (HVAT). Viamão, Parque Saint-Hilaire, 26.VII.1977, *J.L. Waechter 250* (ICN). Viamão, Parque Saint-Hilaire, 29.IV.1976, *J.L. Waechter 250* (ICN). Vila Manresa, 5.V.1932, *B. Rambo without number* (PACA-AGP). PARANÁ: Capão Grande, 3.II.1909, *P.K.H. Dusén 7668* (AMES, V, NYBG, SBT). Guaíra, 7 Quedas, 23.IV.1968, *G. Hatschbach 19136* (MBM). Irati, 11.II.2021, *F. Marinero 1562* (MBM). Pérola d'Oeste, Família Funguetto, without date,

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Additional examined material:—ARGENTINA. JUJUY: Parque Nacional Calilegua, 26.I.1999, *A.E. Johnson* 820 (MBM).

9. *Malaxis pubescens* (Lindley 1843: 662) Kuntze (1891: 673); *Microstylis pubescens* Lindley (1843: 662). Type:—BRAZIL. Rio de Janeiro: Serra dos Orgãos, March 1857, *Gardner* 674 (lectotype designated here: G 00354706 [digital image!]; isoelectotypes: AMES 00271903 [digital image!]; BM 000088227 [digital image!]).

Descriptions of reproductive components based on Lindley's (1843) work, and for vegetative features, we relied on digital images of the type specimens.

Herb ca. 52–132 mm tall, rhizome inconspicuous. Roots 6–32 mm long, thin. Pseudobulbs ca. 8–22 × 8–14 mm, oblong, covered by brownish deciduous foliaceous sheets. Leaves ca. 33–62 × 22–49 mm, opposite, two per pseudobulbs; one or two layers of a sheetlike petiole ca. 31–42 mm long, partially imbricated in each other; lamina oblong-lanceolate or lanceolate, flat, coriaceous, margin entire, apex acute to acuminate. Inflorescence ca. 82–198 mm long; densely congested umbel. Petals setaceous. Lip oval-triangular, pubescent.

Distribution:—This species is endemic to Brazil (POWO 2022).

Occurs in the southeast in the Rio de Janeiro state.

Taxonomic notes:—Three syntype collections of *M. pubescens* were successfully located (AMES 00271903, BM 000088227, G 00354706). Among them, the specimen deposited in Geneva is in excellent condition, with the fertile plant well-preserved. Consequently, we designate the original material (G 00354706) as the lectotype for this species.

Characterization and ecology:—*M. pubescens* is a small to medium-sized species with a terrestrial growth habit. It features two flat, oblong-lanceolate to lanceolate leaves with partially imbricated petioles. The plant's distinct characteristics include its elongated and densely congested inflorescence, bearing small flowers with pubescent petals and a pubescent lip.

Despite the good quality of specimens deposited in the herbarium, the analysis through digital images hindered the observation of trichomes on the lip and petals, as described in the original work on the species. Apparently, if this pubescence indeed exists, it may have deteriorated over the years spent in

the herbarium, causing the plant to lose this characteristic. Hence, future analyses might alter the taxonomic status of *M. pubescens*, potentially even leading to its synonymization with *M. parthoni*.

M. pubescens has been found only once in the Atlantic Forest of the Serra dos Órgãos, associated with Gallery Forests. Its flowering period occurs in March, towards the end of the summer season.

Based on the limited availability of recorded collections of the species, the current material is inadequate for a precise assessment of its conservation status. In accordance with the IUCN guidelines (2022), we classify the taxon as "Data Deficient (DD)".

10. *Malaxis sertulifera* (Barbosa Rodrigues 1877: 29) Pabst (1967a: 112); *Microstylis sertulifera* (Barbosa Rodrigues 1877: 29) Schlechter (1925: 46); *Cheiropterocephalus sertuliferus* Barbosa Rodrigues (1877: 29). Type:—BRAZIL. Goiás: Serra de Caldas, october, without year, *Barbosa Rodrigues without number* (holotype: lost; neotype designated here: illustration reproduced in ‘‘*Flora brasiliensis*’’: Tab. 68, Fig. 2).

Fig. 10

Herb 54–85 mm tall, rhizome inconspicuous. Roots 6–9 mm long, thin. Pseudobulbs 20–24 × 8–9 mm, oblong, covered by brownish deciduous foliaceous sheets. Leaves 27–43 × 11–21 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 9–42 mm long, partially imbricated in each other; lamina oblong-lanceolate, flat, coriaceous, margin entire, apex acute. Inflorescence 14–65 mm long; congested or loose umbel; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular. Flowers non-resupinate, greenish or brownish; pedicels 2–5 mm long; ovary 1–2 mm long. Dorsal sepal 2.3–3 × 0.8–1.3 mm; oblong; margin entire; apex obtuse. Lateral sepals 1.7–1.8

× 1.2–1.5 mm; partially connated; oblong to elliptic, usually narrower than the dorsal; margin entire; apex obtuse. Petals 1–1.5 mm long; linear, usually twisted, margin entire; apex obtuse. Lip 1.8–2 × 1.4–1.8 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes acute; mid lobe triangular, 4 oblong to obovate disk foveas, margin entire, apex acute. Column vertically compressed; greenish or brownish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022).

Occurs from the southeast to the midwest of Brazil, in Goiás, Distrito Federal and Minas Gerais states.

Taxonomic notes:—*M. sertulifera* was mistakenly identified as *Microstylis hastilabia* Reichenbach (1866: 101) by Cogniaux (1896) in the *Flora Brasiliensis* publication. However, *M. sertulifera* is a valid taxon that has fallen into obscurity due to Cogniaux's proposed synonymization (Pabst 1967a). It is important to note that *M. hastilabia* does not occur in Brazil, being native to Central America.

The Orchidaceae specimens collected by Barbosa Rodrigues unfortunately succumbed to a flood event, resulting in the loss of the type material (Mori & Ferreira, 1987; Sprunger et al., 1996). Furthermore, attempts to locate the original illustration referenced in "Iconographie des Orchidées du Brésil" as "tab. 396" (unpublished), have proven futile.

Given the unavailability of the original material, we propose designating the illustration "Tab. 68, fig. 2", attributed to *M. hastilabia* in Cogniaux's *Flora Brasiliensis* (1896), as the neotype. This selection is predicated upon its manifestation of morphological traits consistent with the original description by Barbosa Rodrigues and other collections for the species in question.

Characterization and ecology:—*M. sertulifera* is characterized by its small size and terrestrial habit, displaying two flat, oblong-lanceolate leaves. These leaves often have partially imbricated petioles and emerge from pseudobulbs that are mostly buried beneath the litter layer.

M. sertulifera exhibits similarities to *M. engelsii*, *M. warmingii*, and *M. ybytus*, with its narrower and oblong-lanceolate leaves serving as a primary distinguishing feature.

This species is predominantly found in the Cerrado biome, specifically in the southeast and midwest regions of Brazil. It tends to thrive in humid montane forests close to streams. The flowering period of *M. sertulifera* occurs from January to March, during the summer season.

Considering its extent of occurrence (EOO) of approximately 175,205.837 km² and an area of occupancy (AOO) of approximately 12 km², along with limited records within protected areas, according to the IUCN criteria, this taxon is classified as “Endangered (EN) [EN B2a,b(ii,iii)]”.

Additional examined material:—BRAZIL. DISTRITO FEDERAL: Brasília. Reserva Ecológica do IBGE, 21.II.2003, *J.A.N. Batista 1398* (BHCB, CEN). MINAS GERAIS: Aiuruoca, Parque Estadual da Serra do Papagaio, 18.I.2008, *J.A.N. Batista 2441* (BHCB). Araponga, Parque Estadual da Serra do Brigadeiro, 13.II.2018, *G. Cuz-Lustre 386* (BHCB).

11. *Malaxis warmingii* (Reichenbach 1878: 94) Kuntze (1891: 673); *Microstylis warmingii* Reichenbach (1878: 94). Type:—BRAZIL. SÃO PAULO: Rio Grande da Serra, 01.VIII.1997, *A.D. Faria 97/194* (neotype designated here: UEC 034210!).

Fig. 11

Herb 45–80 mm tall, rhizome absent. Roots 24–45 mm long, thick. Pseudobulbs absent. Leaves 42–48 × 28–30 mm, alternate, 3–5 per branch; one or two layers of a sheetlike petiole 50–62 mm long, partially imbricated in each other; lamina oblong to slightly elliptic, flat, coriaceous, margin entire, apex obtuse. Inflorescence 35–44 mm long; congested umbel to raceme while fruits are forming; floral bracts pale brownish; emerging in the apex of the peduncle, before the pedicels, triangular. Flowers non-resupinate, greenish; pedicels 3–4 mm long; ovary 1–2 mm long. Dorsal sepal 3.2–4 × 2.1–3 mm; oblong; oblong-lanceolate, margin entire; apex acute. Lateral sepals 2.2–3.3 × 2.5–3.5 mm; free; oblong, usually narrower than the dorsal; margin entire; apex acute. Petals 1–1.3 mm long; linear, usually twisted, margin entire; apex acute. Lip 1.8–2 × 2.5–3 mm; trilobate; glabrous; callus absent; base truncate, attached to the column apex; lateral lobes rounded; mid lobe triangular, 4 oblong disk foveas, margin entire, apex cuspidate. Column vertically compressed; greenish or brownish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Brazil (POWO 2022). Occurs in the south to southeast, registered in Rio Grande do Sul, Paraná and São Paulo states.

Taxonomic notes:—The protologue of *M. warmingii* does not specify the material used for the taxon's description.

Despite the existence of a collection of *M. warmingii* in Minas Gerais by Eugenius Bülow Warming, as cited by Cogniaux (1896), we were unable to determine the location where the material was deposited. Furthermore, the lack of direct indication in the main work prevents the confirmation of its recognition as the holotype of the species. Therefore, we have designated the specimen of *A.D. Faria* 97/194 (UEC 034210) as the neotype, chosen for its exceptional quality. This exemplar includes

well-preserved fruits and flowers, as well as vegetative material that accurately represents the taxon described.

Characterization and ecology:—*M. warmingii* is characterized by its medium to large size and terrestrial habit, featuring four to five long-petiolate, alternate leaves with partially imbricated petioles, and the absence of pseudobulbs. It can be distinguished from other species by its unique vegetative appearance and transition of its inflorescence into a racemous form during fruit formation.

Endemic to the Atlantic Forest biome in the south and southeast regions of Brazil, *M. warmingii* is typically found in sub-montane forests near streams and wetlands. Its flowering period occurs during the spring season. Given its extent of occurrence (EOO) spanning approximately 37,046.020 km² and an area of occupancy (AOO) of approximately 24 km², coupled with the majority of records being outside protected areas in regions experiencing increased deforestation, according to the IUCN criteria this taxon falls into the category of “Endangered (EN) [EN B2b(ii,iii),c(ii,iii)]”.

Additional examined material:—BRAZIL. MINAS GERAIS: Paraopeba, *E.P. Heringer 3981* (UB). PARANÁ: Quatro Barras, *T.F. Santos & M. Engels s.n.* (UPCB). RIO GRANDE DO SUL: Without locality, 18.VI.1892, *C.A.M. Lindmann A.877* (S). Tavares, Parna Lagoa do Peixe, 16.IX.2004, *R.A. Záchia 5765* (ICN). SÃO PAULO: Biritiba Ussu, 25.VII.1983, *J.R. Pirani 729* (SP, SPF). Itapeccerica, Paiol do Meio, 6.V.1936, *F.C. Hoehne s.n.* (SP). Juquitiba, 1.VI.1980, *F. Barros 253* (SP). Moóca, 6.X.1912, *A.C. Brade 6219* (HB). Rio Grande da Serra, Paranapiacaba, 1.VI.1997, *A.D. Faria s.n.* (UEC).

12. *Malaxis ybytus* T.F. Santos & E.C. Smidt (2023: 2). **Type**—BRAZIL. Paraná: Tijucas do Sul, Serra do Papanduva, 15.XII.1997, *O.S. Ribas 2132* (holotype: MBM 218837!).

Fig. 12

Herb 31–73 mm tall, rhizome inconspicuous. Roots 8–22 mm long, thin. 5–10 × 6–10 mm, oblong, covered by whitish to brownish deciduous foliaceous sheets. Leaves 27–43 × 11–21 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 4–22 mm long, imbricate in each other from the base to near the apex; lamina oblong or oblong-elliptic, flat or slight conduplicate, coriaceous, margin entire, apex obtuse to slightly acute. Inflorescence 40–89 mm long; umbel-like densely congested raceme; floral bracts pale greenish; emerging in the apex of the peduncle, before the pedicels, triangular. Flowers non-resupinate, whitish yellow; twisted pedicels 2–5 mm long; ovary 1 mm long. Dorsal sepal 2.5–3.2 × 0.5–1 mm; 3-veined; oblong-lanceolate; margin entire; apex obtuse. Lateral sepals 2.7–3.5 × 1.5–2 mm; free; 3-veined; oblong, usually wider than the dorsal; margin entire; apex obtuse. Petals 1–2 mm long; 1-veined; linear, usually twisted, margin entire; apex obtuse. Lip 1.8–2.2 × 1.4–1.8 mm; trilobate; glabrous; callus absent; base truncate, attached to the column; lateral lobes acute to acuminate; mid lobe triangular, four oblong foveas, margin entire, apex acute. Column vertically compressed; yellowish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Distribution:—This species is endemic to Paraná state in the south of Brazil.

Characterization and ecology:—*M. ybytus* shares the closest resemblance to *M. engelsii* and *M. sertulifera*, but can be distinguished from them by its possession of free lateral sepals instead of partially connate.

This species is registered only in the Campos de Altitude of the Atlantic Forest in Paraná state. The blooming period of *M. ybytus* is in December and January, in the summer season.

Given the limited availability of records and collection information, making it challenging to determine the precise conservation status of *M. ybytus*, it is possible to infer it within the Data Deficient (DD) category according to the IUCN (2022) guidelines. However, it is important to note that the species has not been observed for the past 26 years, despite numerous field campaigns in the type-collection locality. Considering the significant degree of endemism in the Campos de Altitude (Ribeiro *et al.* 2007; Vasconcelos 2011) and the ongoing anthropic pressure on the Araçatuba mountain range, we propose that *M. ybytus* should be designated as "Critically Endangered (CR) [CR B2a,b(i,ii,iii)]".

Additional examined material:—BRAZIL. Paraná: Guaratuba, Serra do Araçatuba, 21.I.1994, *R. Kummrow 3381* (paratype: MBM167056!).

Incertae sedis

Malaxis brasiliensis Sprengel (1826: 740) is described as having lanceolate leaves and a “subcorneous” apex of the flower's lip, suggesting a possible affinity with *M. caracasana*. However, the lack of original material and a comprehensive taxonomic description pose challenges in determining and defining its precise identity. Consequently, we propose that this taxon should be treated as *incertae sedis* due to the uncertainty surrounding its classification.

Considering the described morphological characteristics of *M. spiralipetala*, it is inappropriate to regard it as a synonym of *M. caracasana*. Instead, we propose assigning an *incertae sedis* classification

to this taxon due to the inability to differentiate it from *M. cogniauxiana*, *M. parthoni*, or *M. ovatilabia* solely based on the provided description.

Unidentified material: Two distinct *Malaxis* materials collected in the state of Amazonas could not be identified to the species level due to the poor quality of the samples. The specimens lacked flowers and suffered significant damage in their vegetative parts. The first exemplar, collected by *W.A. Rodrigues 9873* (INPA 71533) in the Amazonian forest in the Pico da Neblina, was initially wrongly determined as *M. parthoni* based on its resemblance to this species. However, the locality, larger vegetative size and the thicker rhizome of the Pico da Neblina specimen lead us to conclude that it is unlikely to be the same species. Nevertheless, providing a more precise identification remains challenging.

The second sample comprises two specimens collected by *P.J.M. Maas 6829* (INPA 158255) within the *Campinarana* ecosystem of the Amazonian forest along the Rio Negro, near the Xié River. These specimens exhibit compact growth habits, with two to three broadly elliptical leaves emerging from the pseudobulbs. The discernible uniqueness of these vegetative traits, if accurately identified under optimal conditions, suggests the likelihood of a new species or, at the very least, a novel record for Brazil. Notably, no other known Brazilian species demonstrates comparable morphological characteristics. Thus, based on the current limitations in identification this material, its pending future collections and thorough taxonomic investigation to be precisely recognized.

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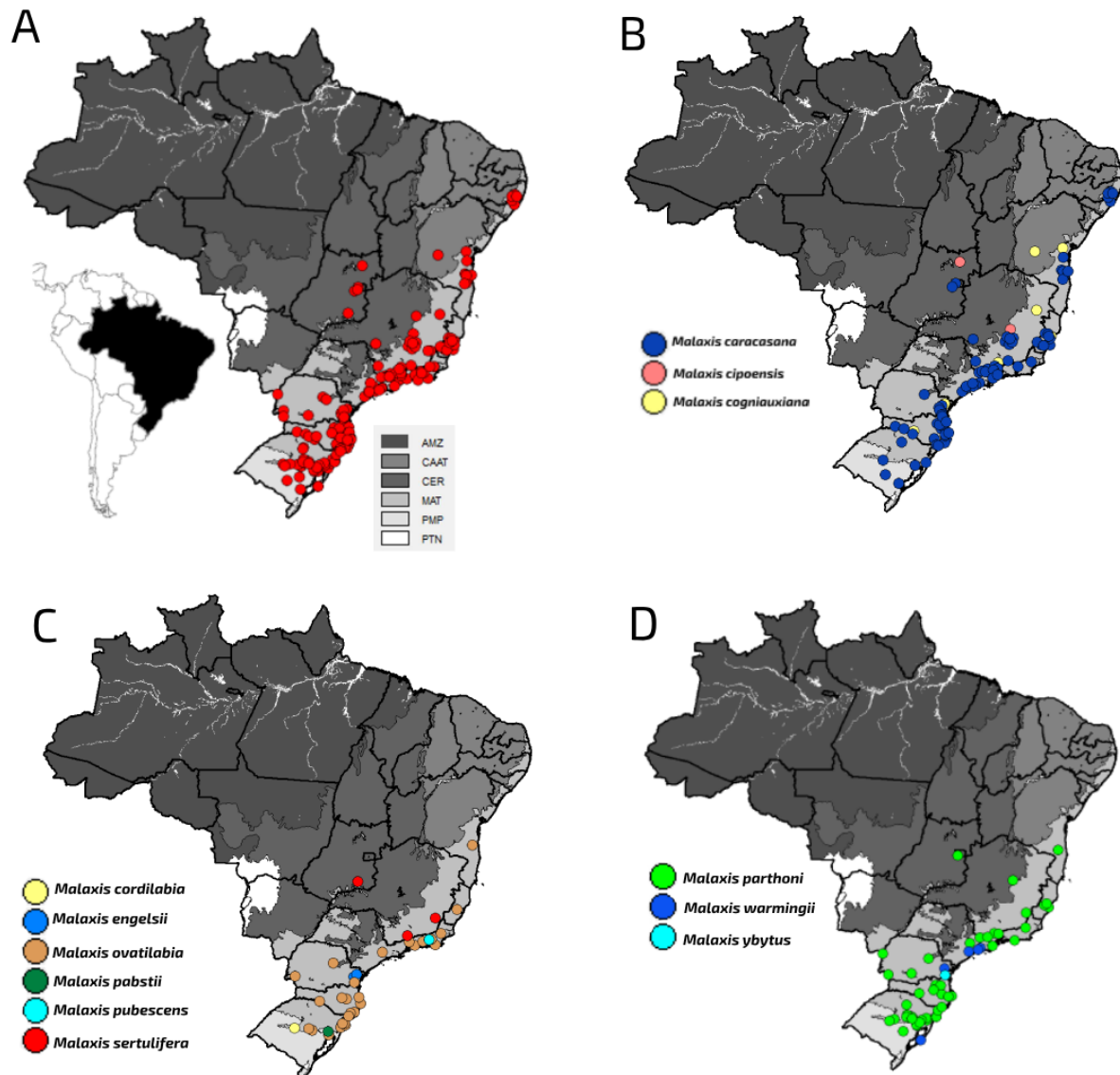


Figure 1. Distribution of *Malaxis* in Brazil. A. Occurrence of *Malaxis* in Brazilian Biomes and the country's location in South America; AMZ: Amazon, CAAT: Caatinga, CER: Cerrado, MAT: Atlantic Rainforest, PMP: Pampas, PTN: Pantanal. B. Distribution of *Malaxis caracasana*, *Malaxis cipoensis* and *Malaxis cogniauxiana*. C. Distribution of *Malaxis cordilabia*, *Malaxis engelsii*, *Malaxis ovatilabia*, *Malaxis pabstii*, *Malaxis pubescens*, *Malaxis sertulifera*. D. Distribution of *Malaxis parthoni*, *Malaxis warmingii*, *Malaxis ybytus*.

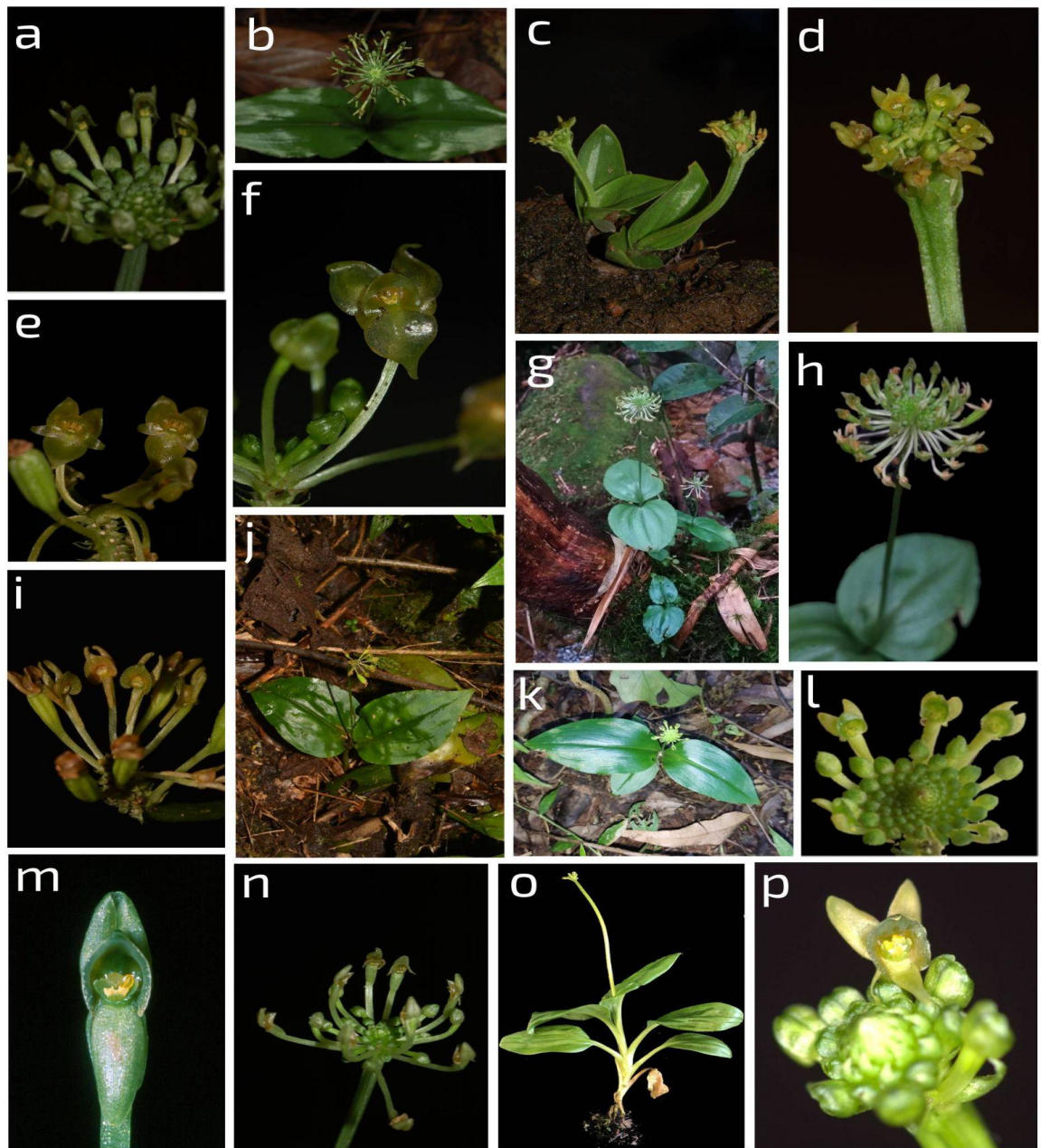


Figure 2. Some species of *Malaxis* from Brazil. a.b. *Malaxis caracasana* – a. inflorescence; b. habit. c-d. *Malaxis cipoensis* – c. habit; d. inflorescence. e-f. *Malaxis cogniauxiana* – e. inflorescence; f. flower. g-h. *Malaxis engelsii* – g. habit; h. inflorescence. i-j. *Malaxis ovatilabia* – i. inflorescence; j. habit. k-l. *Malaxis parthoni* – k. habit; l. inflorescence. m-n. *Malaxis sertulifera* – m. flower; n. inflorescence. o-p. *Malaxis warmingii* – o. habit; p. inflorescence. (Photos: a, b, c, d, e, f, i, j, m, n, by J.A.N. Batista; g, h, by M. Engels; k, l, by T.F. Santos; o, p, by E.C. Smidt).

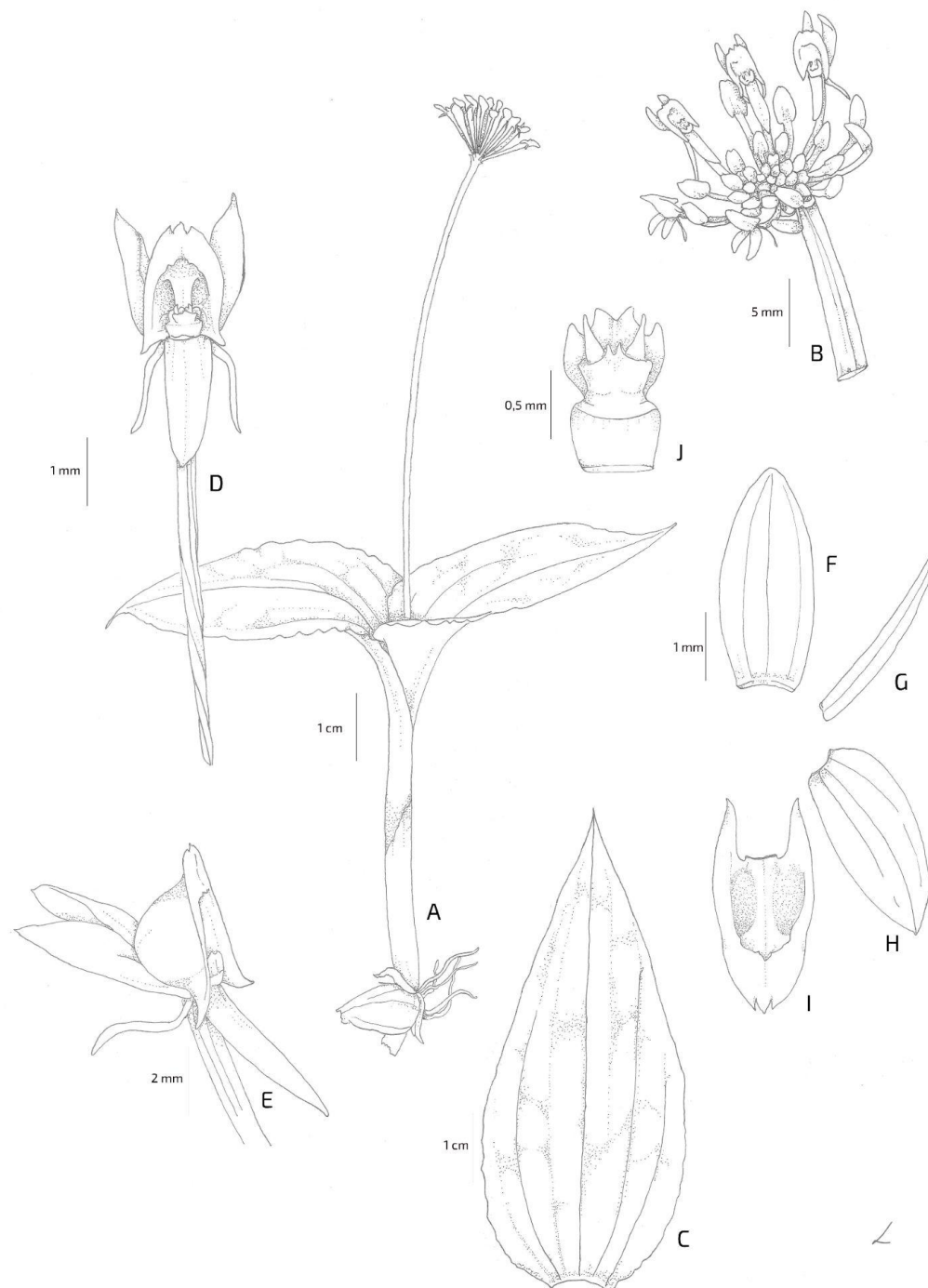


Figure 3. A-J. Illustration of *Malaxis caracasana* – A. habit; B. inflorescence; C. leaf lamina; D. frontal view of the flower; E. lateral view of the flower; F. dorsal sepal; G. petal; H. lateral sepal; I. lip; J. column.

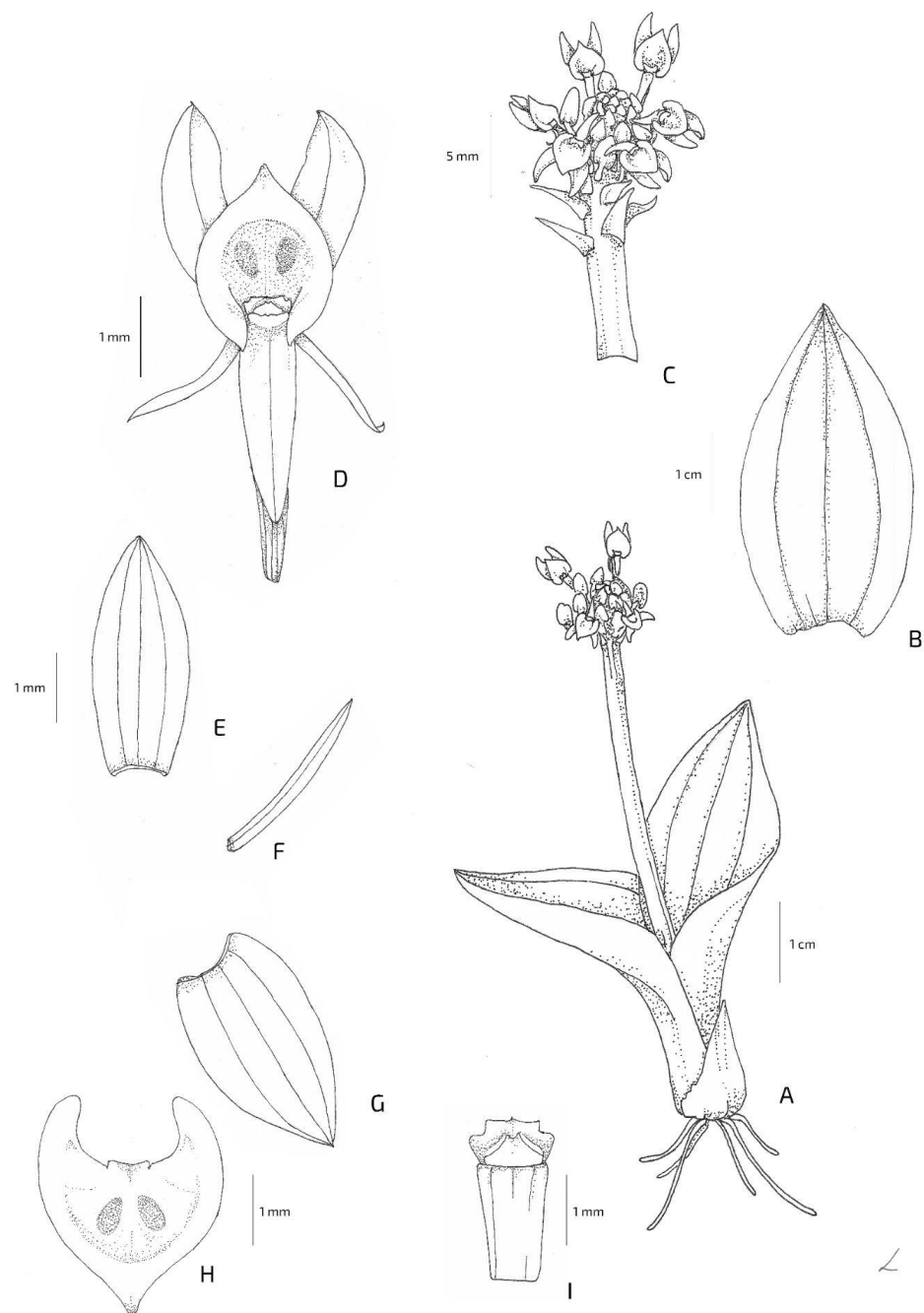


Figure 4. A-I. Illustration of *Malaxis cipoensis* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

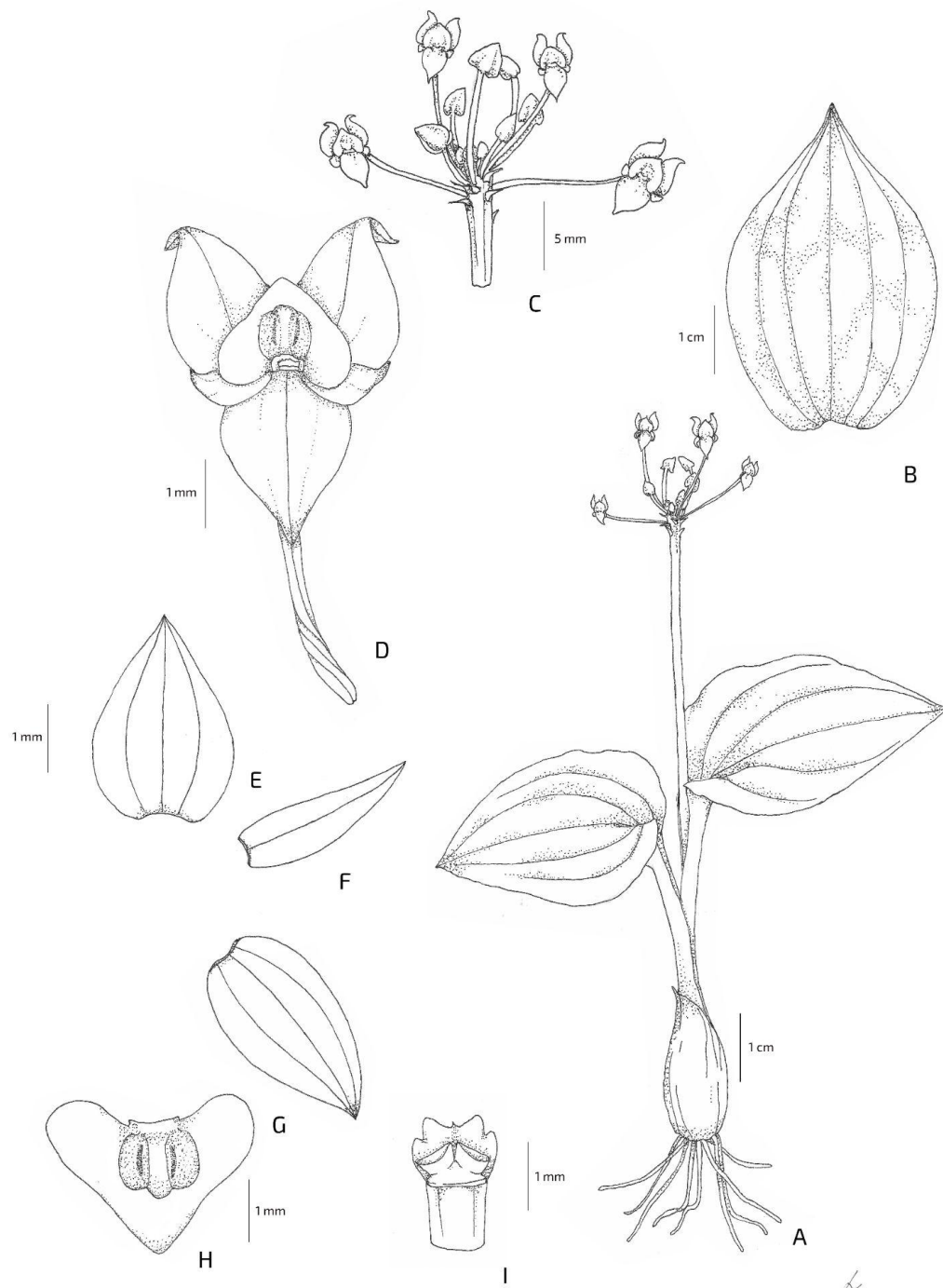


Figure 5. A-I. Illustration of *Malaxis cogniauxiana* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

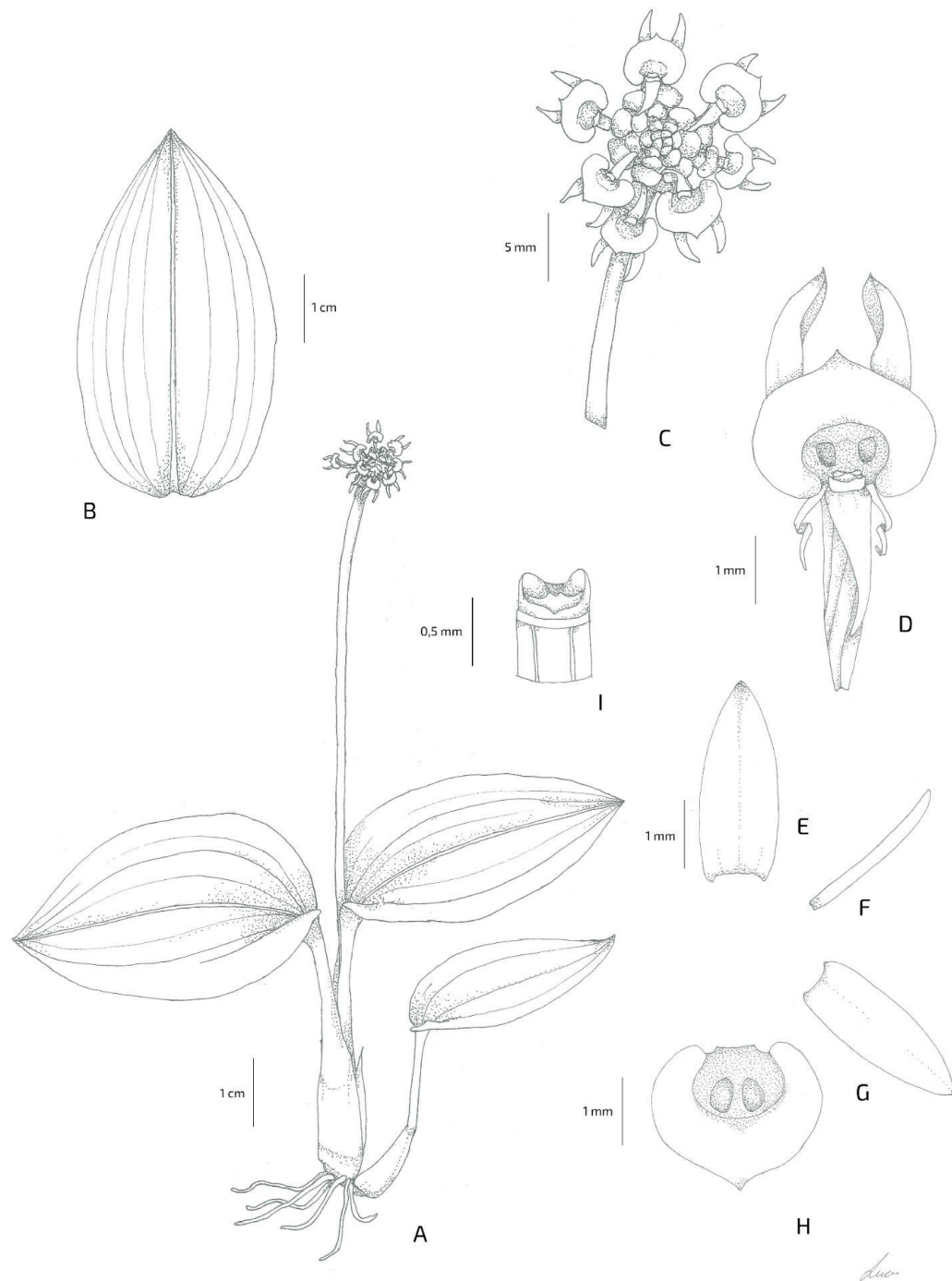


Figure 6. A-I. Illustration of *Malaxis cordilabia* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

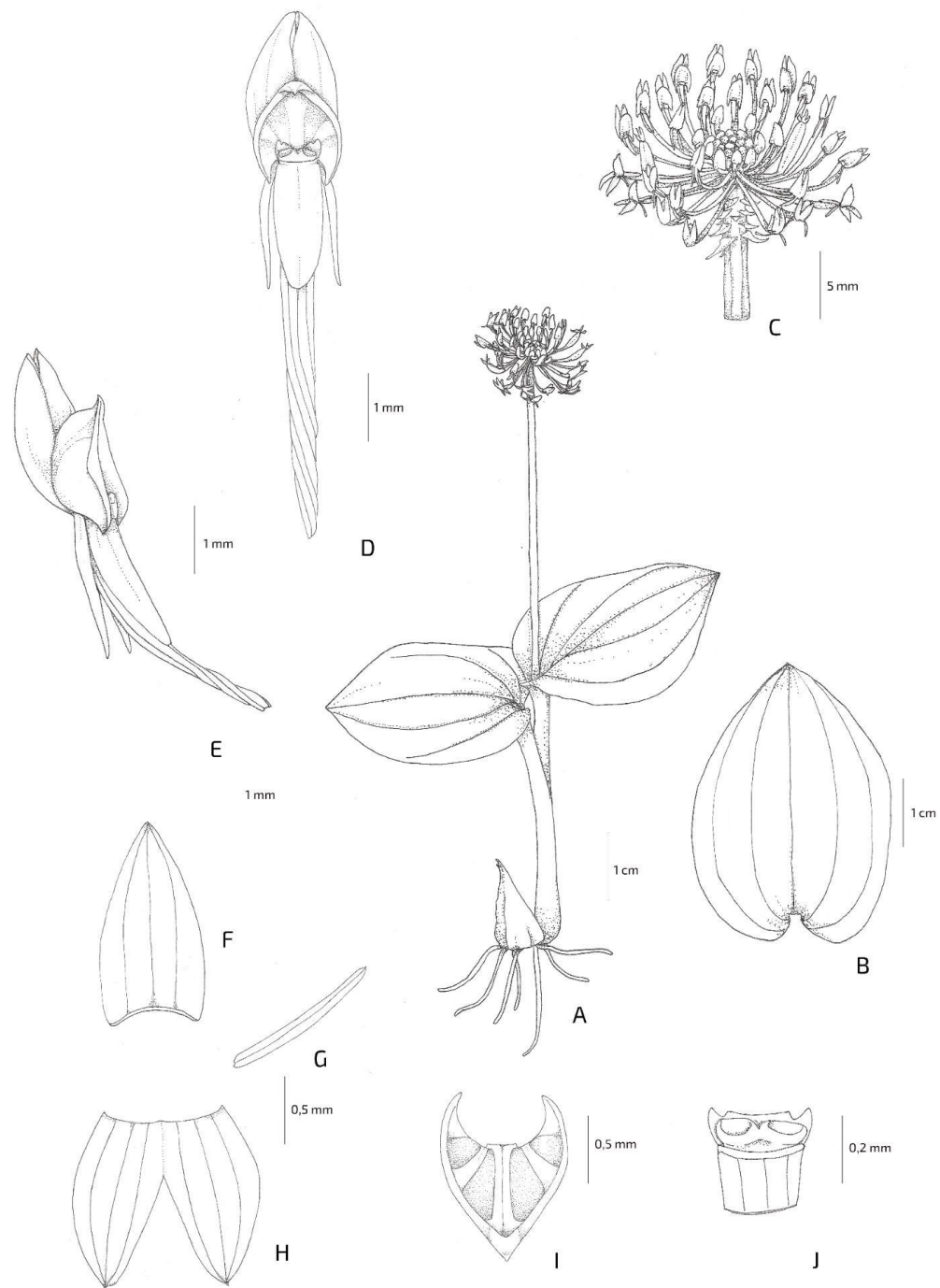


Figure 7. A-J. Illustration published in Santos T.F. & Smidt E.C. (2024: in press) of *Malaxis engelsii* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. lateral view of the flower; F. dorsal sepal; G. petal; H. lateral sepal; I. lip; J. column.

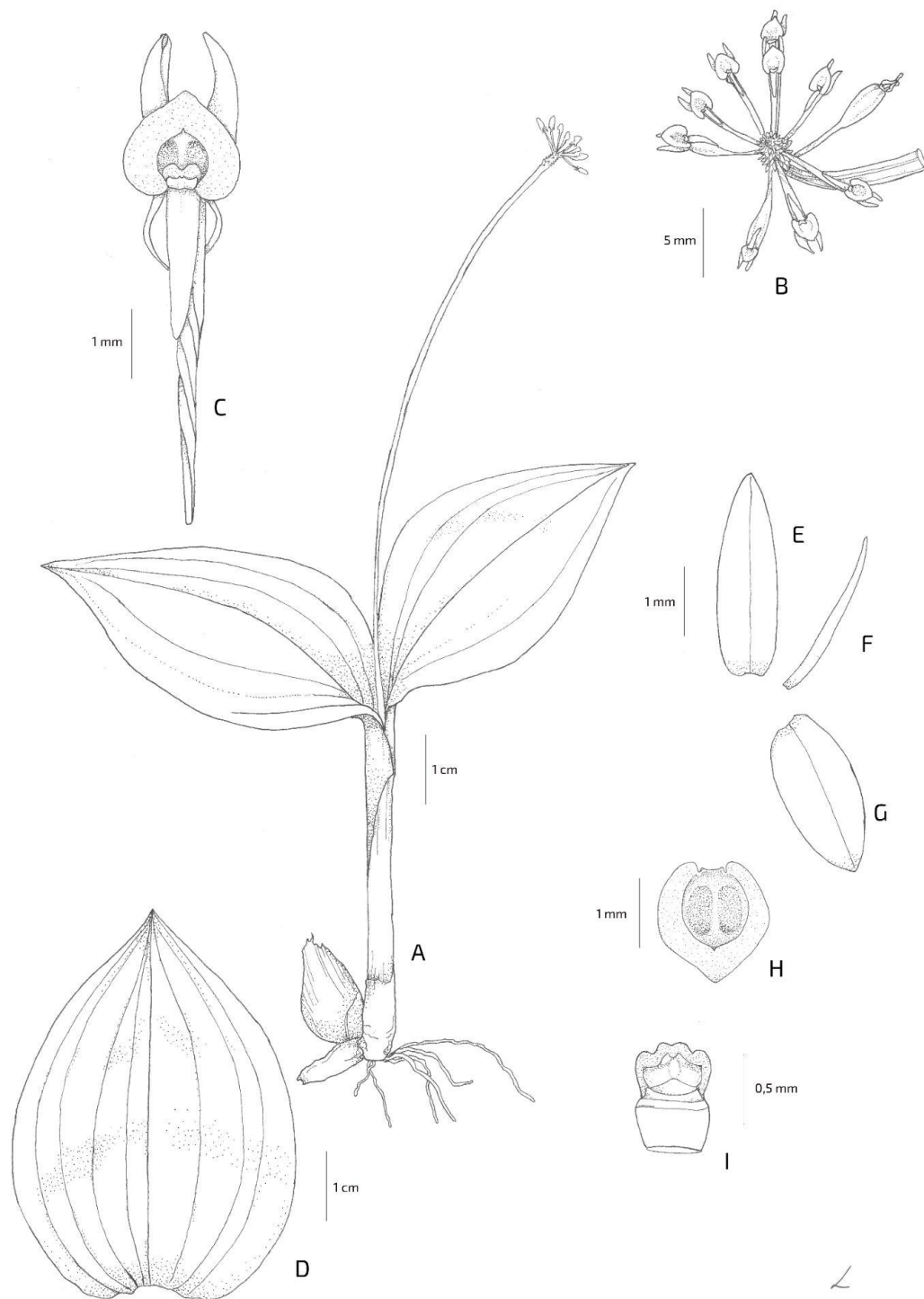


Figure 8. A-I. Illustration of *Malaxis ovatilabia* – A. habit; B. inflorescence; C. frontal view of the flower; D. leaf lamina; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

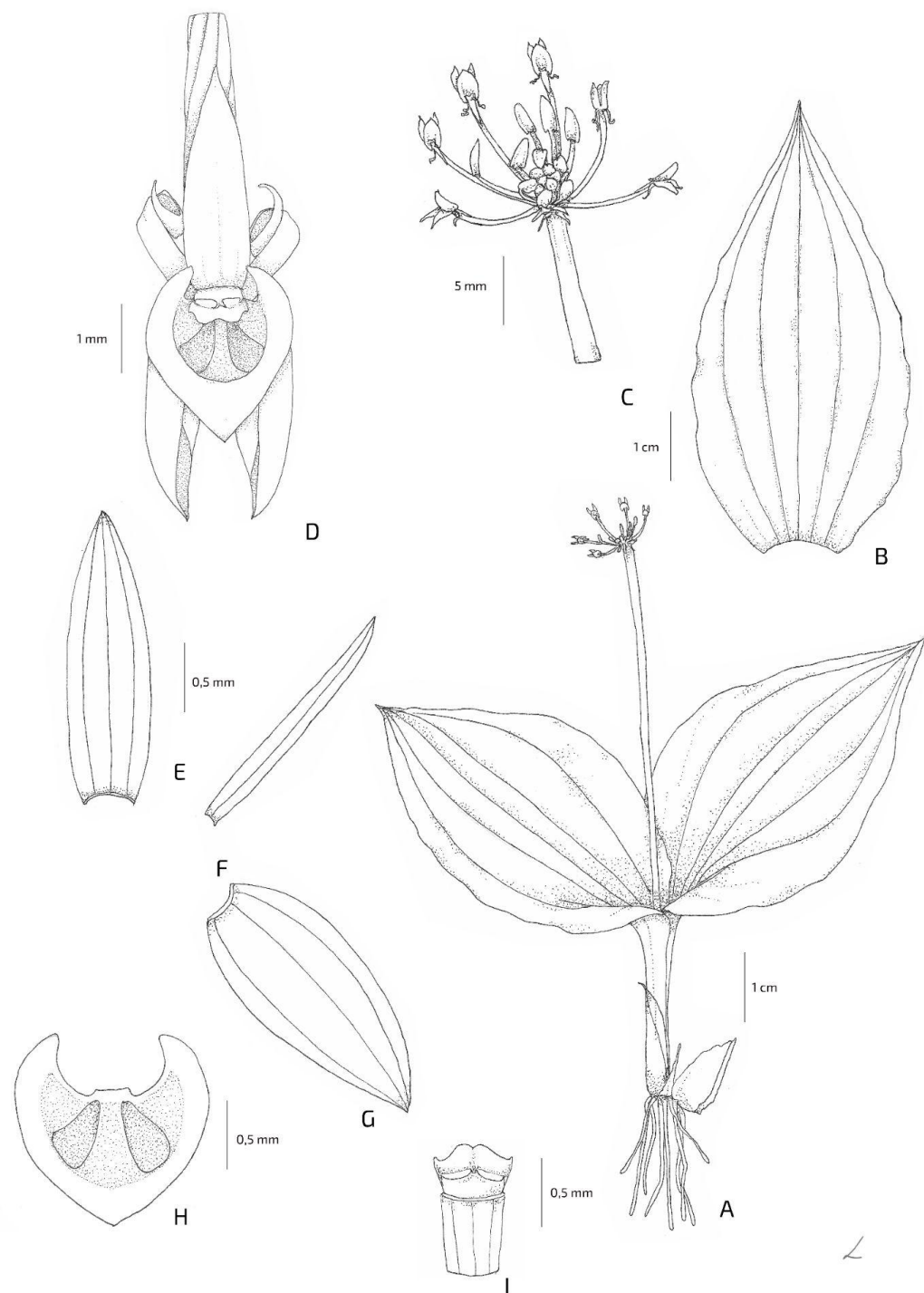


Figure 9. A-I. Illustration of *Malaxis parthoni*– A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

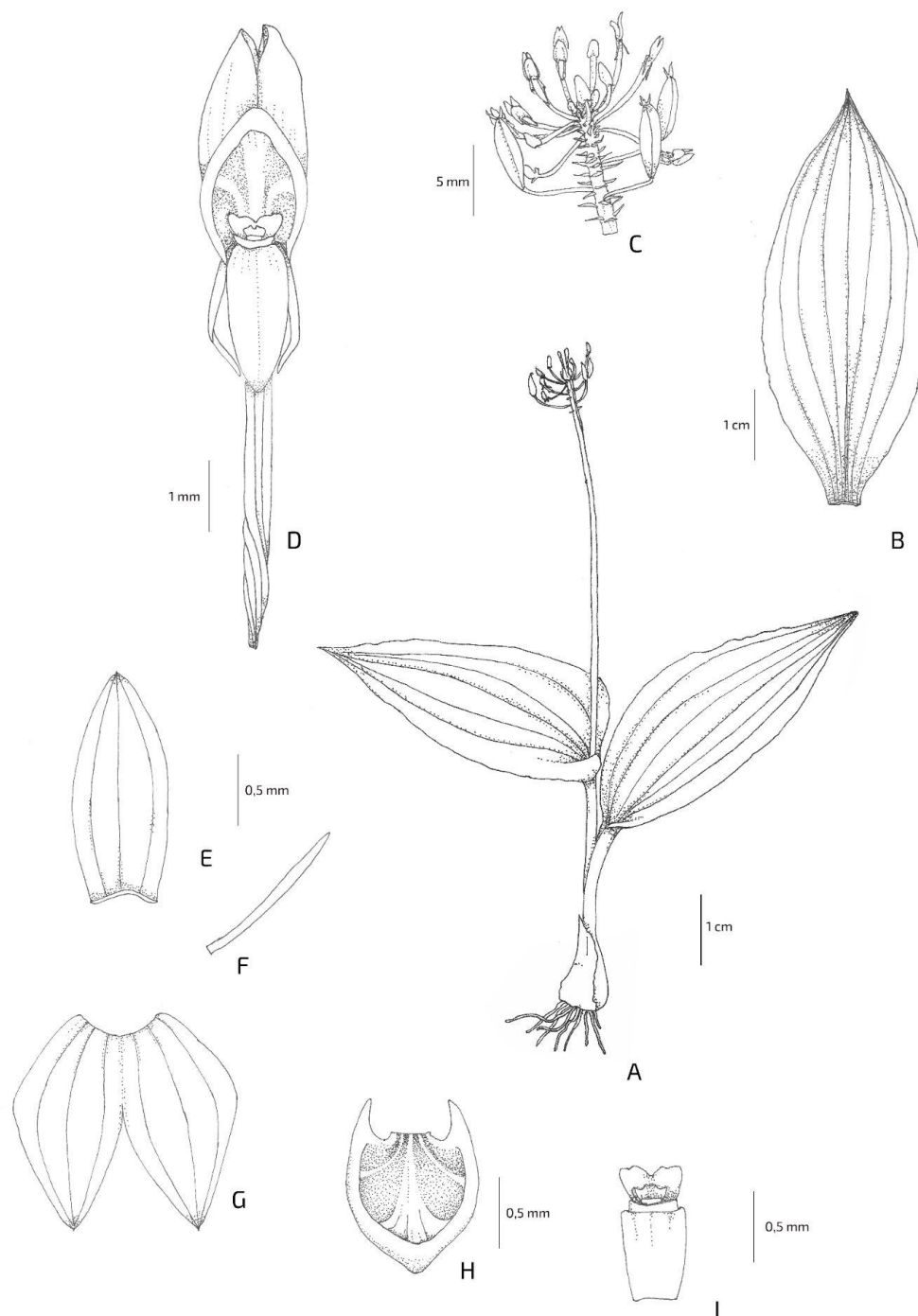


Figure 10. A-I. Illustration of *Malaxis sertulifera* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

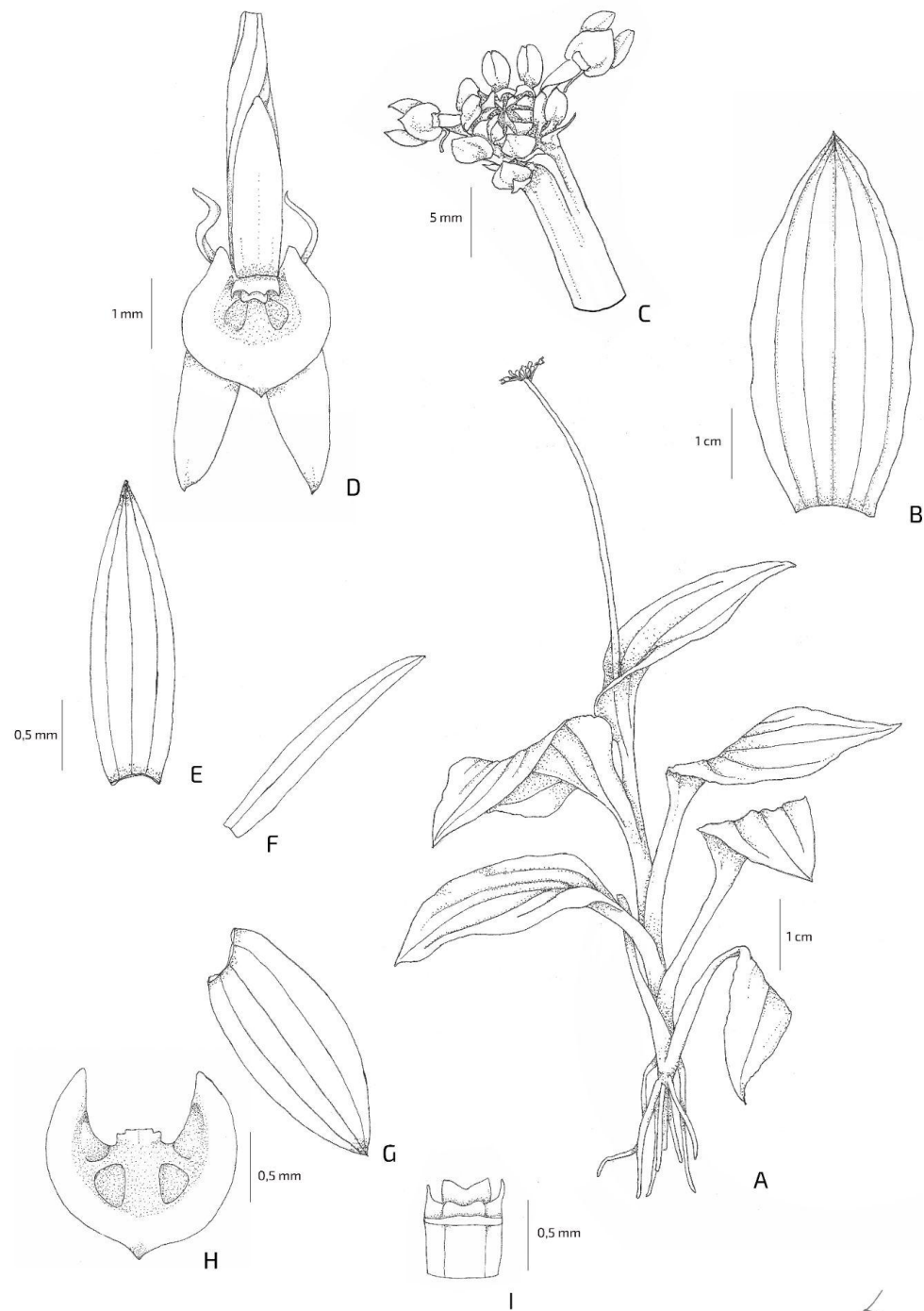


Figure 11. A-I. Illustration of *Malaxis warmingii* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

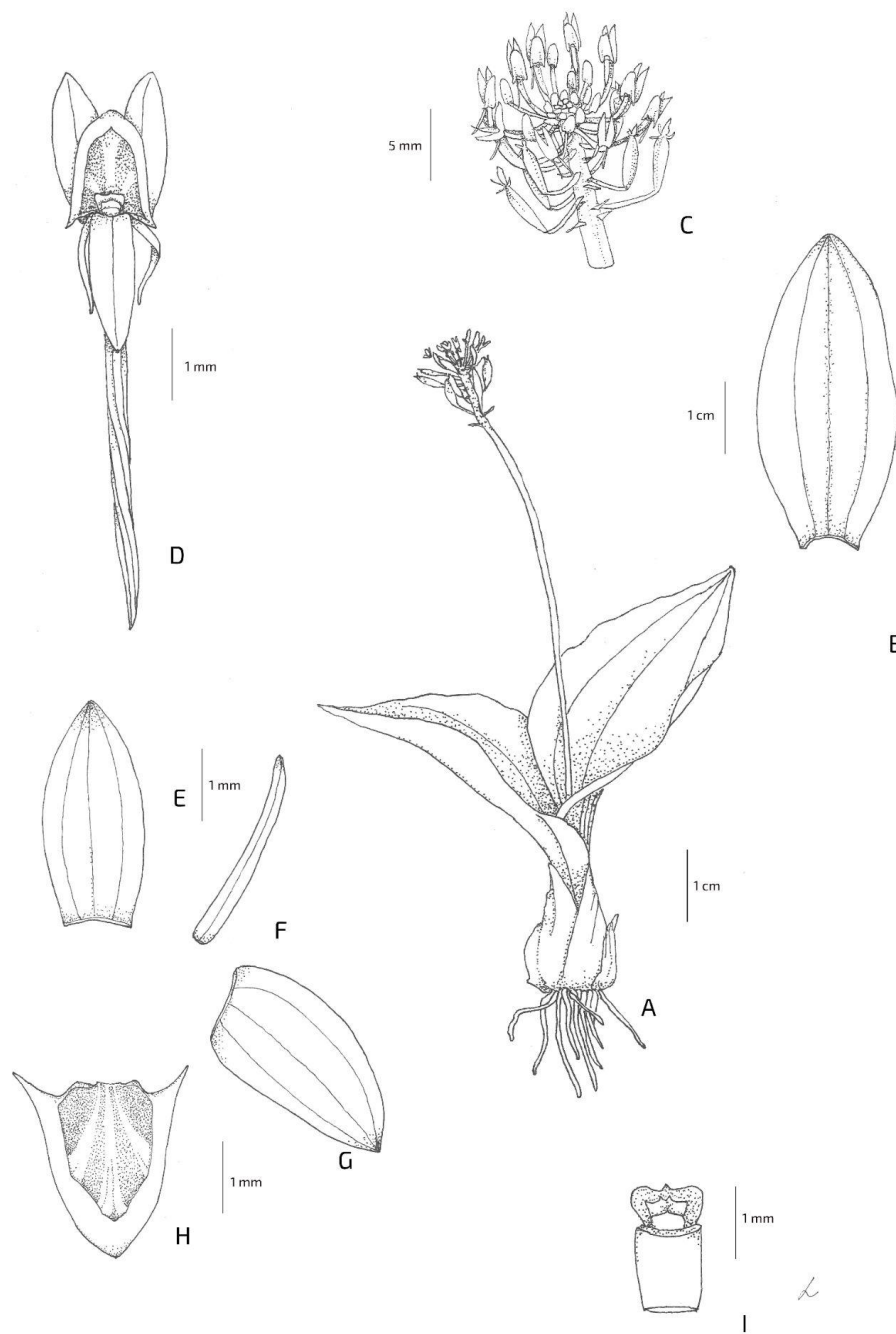


Figure 12. A-I. Illustration of *Malaxis ybytus* – A. habit; B. leaf lamina; C. inflorescence; D. frontal view of the flower; E. dorsal sepal; F. petal; G. lateral sepal; H. lip; I. column.

CAPÍTULO III) A new epiphyte *Malaxis* (Orchidaceae: Malaxidinae) from the upper montane forest of the Atlantic Rainforest in southern Brazil

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Artigo submetido ao periódico *Lankesteriana*:

Santos, T. F. & Smidt, E.C. (2023). A new epiphyte *Malaxis* (Orchidaceae: Malaxidinae) from the upper montane forest of the Atlantic Rainforest in southern Brazil

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Abstract. *Malaxis engelsii* is a newly discovered epiphytic orchid found in the upper montane forests of the Atlantic Rainforest in Paraná, Brazil. It is the only known strictly epiphytic species of *Malaxis* in the country. This species is characterized by its small size, elliptic leaves, flowers with partially connate sepals, and trilobate lip with four foveas. A detailed description, photographs, illustration, and

comparison with similar species, *Malaxis cipoensis*, *Malaxis sertulifera* and *Malaxis ybytus*, are provided. Currently, it is classified according to the IUCN guidelines as Data Deficient (DD) due to limited data.

Keywords: Cloud Forest, Epiphytism, Montane forest, New species, Orchid, Taxonomy.

Malaxis engelsii: epiphytic *Malaxis* from Brazil's Cloud Forest

Introduction

Malaxis Solander ex Swartz (1788: 119) belongs to the subtribe Malaxidinae Bentham & Hooker (1883: 465) and has traditionally been regarded as a cosmopolitan genus, encompassing over 300 species across the Americas, Asia, and Europe (Cribb 2005).

The application of molecular studies has led to a reevaluation of the subtribe taxonomy (Cameron 2005). Additionally, the existing classification system within *Malaxis* fails to arrange species based on their evolutionary lineages, and the distribution is probably primarily limited to the Americas, with only a few species extending into the temperate regions of Eurasia (Radins et al. 2014).

The upper montane forest ecosystems of the Floresta Ombrófila Densa Altomontana (Montane Dense Rainforest), also known as Cloud Forest, are marked by its hydrophilic nature. This is attributed to several characteristics, but primarily to the persistent presence of clouds at higher elevations on mountains (Bruijnzeel & Hamilton 2000). Within these upper montane ridges, the forest exhibits a singular vertical stratum composed of small-sized trees (Leigh 1975). As a result of the perpetual humidity, these trees provide a habitat for an abundance of epiphytes (Leigh 1975, Blum et al. 2011).

In Brazil, ten species of *Malaxis* are registered within the country's territory (Smidt & Santos

2023). However, an ongoing genus revision is revealing new species, indicating that this number is subject to change (Santos & Smidt unpublished).

During an expedition to the upper montane forests of Ibitiraquire mountain range, a previously undescribed epiphyte *Malaxis* was discovered. Consequently, we present this taxon, providing a detailed description, diagnosis, photographs showcasing the species in its natural habitat, a plate displaying the type collections, comments on its ecological features, conservation status, illustrations, and comparison with morphologically similar species.

Materials and methods

We examined the morphological characteristics of materials collected by M.E. Engels 6579 (MBM439143) and G. Hatschbach 817 (MBM49978; SP54728). The first was designated as the holotype due to its excellent material quality, including well-preserved herbarium specimens and spirit material. We followed the morphological terminology guidelines of Rizzini (1977), Beentje (2010), and Stearn (2004) for descriptions, drawings, and plates, which were based on the types. We also used photographs of specimens in their natural environment. For species with similarities, we consulted exemplars from the following herbaria: BHCB, CEN, CEPEC, CESJ, CRI, EFC, ESA, FLOR, FURB, HRCB, HST, HUCCS, HUEFS, HVASF, IAN, ICN, INPA, IPA, JOI, MAC, MBM, MBML, MO, OUPR, PACA-AGP, PEL, RB, RFA, RON, SP, SPF, UB, UEC, UFP, UPCB, USP. In terms of conservation status, we followed the IUCN (2022) guidelines.

Taxonomic Treatment

Malaxis engelsii Santos & E.C.Smidt, sp. nov. (Fig. 1-3).

Type—BRAZIL. Paraná: Campina Grande do Sul, Trilha para o Morro Getúlio e Caratuva, 954m, 15.I.2019, *M.E. Engels 6579* (holotype: MBM439143). —Paraná: Piraquara, Queimada, Morro Albino

de Souza, 27.XII.1947, *G. Hatschbach 817* (paratype: MBM49978; SP54728).

Diagnosis.—It is most similar to *Malaxis cipoensis* Barros (1996: 31); *Malaxis sertulifera* (Barbosa Rodrigues 1877: 29) Pabst (1967: 112) and *Malaxis ybytus* (Santos & Smidt in press). The species can be differentiated from *M. cipoensis* by its lip with four foveas instead of two, from *M. sertulifera* by its elliptical leaves instead of oblong-lanceolate, and from *M. ybytus* by its partially connate lateral sepals instead of free. Additionally, its epiphytic habit distinguishes it from these primarily terricolous species.

Plant 40.0–70.0 mm tall, rhizome inconspicuous. Roots 8.0–40.0 mm long, thick. Pseudobulbs 5.0–10.0 × 4.0–5.0 mm, oblongoid, covered by whitish to brownish deciduous foliaceous sheets. Leaves 20.0–45.0 × 20.0–31.0 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 10.0–30.0 mm long, imbricate in each other from the base to near the apex; lamina elliptic-cordiform, flat, coriaceous, margin entire, apex obtuse to slightly acute, base rounded or cordate. Inflorescence 64.0–120.0 mm long; an umbel-like congested raceme; floral bracts pale greenish; emerging in the apex of the peduncle, below the pedicels, triangular. Flowers non-resupinate, orange-greenish; twisted pedicels 2.0–8.0 mm long. Ovary cylindric 1.0 × 1.0 mm. Dorsal sepal 2.2–2.7 × 1.0–1.4 mm; 3-veined; oblong or oblong-lanceolate; margin entire; apex acute. Lateral sepals 1.7–2.0 × 1.0–1.5 mm; free; 3-veined; oblong, length similar to the dorsal; margin entire; apex obtuse to slightly acute. Petals 1.5–2.0 mm; 1-veined; linear, usually twisted, margin entire; apex obtuse. Lip 1.2–1.5 × 1.1–1.2 mm; trilobate; glabrous; base truncate, attached to the column; lateral lobes acuminate; mid lobe triangular, internal central portion is thickened, four oblong to obovate foveas in the internal portion, margin entire, callus on the adaxial face near the apex of the lip, apex acute. Column vertically compressed; yellowish; wings acute. Pollinarium with two ovoid bipartite naked pollinia.

Additional specimens examined (similar species).—*Malaxis cipoensis*; GOIÁS: Alto Paraíso de Goiás. Chapada dos Veadeiros, 4.II.1979, G.F. Gates 132 (UB). MINAS GERAIS: Belo Horizonte. Serra da Moeda, 7.XII.2007, J.A.N. Batista 2328 (BHCB).—*Malaxis sertulifera*; DISTRITO FEDERAL: Brasília. Reserva Ecológica do IBGE, 21.II.2003, J.A.N. Batista 1398 (BHCB, CEN). MINAS GERAIS: Aiuruoca, Parque Estadual da Serra do Papagaio, 18.I.2008, J.A.N. Batista 2441 (BHCB).—*Malaxis ybytus*; PARANÁ: Guaratuba, Serra do Araçatuba, 21.I.1994, R. Kummrow 3381 (MBM). Tijucas do Sul, Serra do Papanduva, 15.XII.1997, O.S. Ribas 2132 (MBM).

Etymology.—In honor of Mathias Engels, the botanist who rediscovered the species in the field. We acknowledge that the excellent condition of his collected material made recognizing and describing the species possible.

Distribution and ecology.—Two collections have been documented in the Atlantic Rainforest of Paraná state. The species was first recorded by *G. Hatschbach* 817 in 1947 within the Baitaca mountain range (25°24'S, 49°00'W) (Fig. 4A; C) in the Piraquara municipality. It was rediscovered 72 years later in 2019 in a nearby region by *M.E. Engels* 6579 in the Ibitiraquire mountain range (25°14.5'S, 48°50'W) (Fig. 4B; D) of the Campina Grande do Sul municipality. Both localities belong to the Serra do Mar of Paraná, a range of elevations formed by tectonic processes involving vertical movements that originated during the Cenozoic era (Almeida & Carneiro 1998; Santos et al. 2006). This mountainous region currently separates the inland region from the coastal area of the Paraná state (Maack 1981).

The landscape of the localities is defined by the presence of Mixed Ombrophilous Forest, ecotones between Mixed Ombrophilous Forest and Dense Ombrophilous Forest, and Dense Ombrophilous Forest on higher elevations, with the summits of mountains marked by the presence of the subformation of upper montane forest (Scheer & Mocochinski 2009).

Malaxis engelsii was found as an epiphyte within hydrophilic environment near streams in the cloud forests of Serra do Mar in the Ibitiraquire and Baitaca mountain range (Fig 4C; D), representing the only known strictly epiphytic species of *Malaxis* in Brazil. However, it should be noted that further fieldwork may reveal the presence of terricolous plants within the same habitat, potentially expanding our understanding of the species distribution and ecological preferences.

Conservation status.—Based on the limited availability of only two recorded collections of the species, the current material is inadequate for a precise assessment of its conservation status. In accordance with the IUCN guidelines (2022), we classify the taxon as Data Deficient (DD) due to insufficient data. As a result, further research and collection endeavors are imperative to acquire a comprehensive understanding of the conservation status and actions to preserve this species.

Discussion

It differs from most Brazilian *Malaxis* species primarily due to its epiphytic habit and reduced vegetative and reproductive parts size. However, it shares morphological similarities with *Malaxis cipoensis*, *Malaxis sertulifera*, and *Malaxis ybytus*. The following characteristics can differentiate these species: In terms of habit, vegetation domain and biome, *M. engelsii* is recognized as an epiphytic orchid in the upper montane forest of the Atlantic Rainforest biome. In contrast, *M. cipoensis* is terricolous and usually found in the Campos Rupestres of the Cerrado biome. *M. sertulifera* shares this terricolous habitat and can occur in any forested environment, predominantly in the Cerrado biome. Conversely, *M. ybytus* is also terricolous but exclusive to the Campos de Altitude of the Atlantic Rainforest biome (Santos & Smidt 2023).

Considering their plant sizes, *Malaxis engelsii* typically ranges from 40.0 to 70.0 mm tall, while *Malaxis cipoensis* exhibits sizes varying between 20.0 and 62.0 mm. Otherwise, *Malaxis sertulifera*

displays a broader size range, ranging from 54.0 to 115.0 mm, and *Malaxis ybytus* falls within a size range of 31.0 to 73.0 mm.

In examining leaf types and shapes, *Malaxis engelsii* is recognized for its flat leaves with elliptic shapes, whereas *Malaxis cipoensis* features flat to slightly conduplicate leaves with elliptic shapes. *Malaxis sertulifera* presents lanceolate to oblong-lanceolate leaves, and *Malaxis ybytus* oblong to oblong-elliptic leaf shapes.

Furthermore, distinguishing characteristics can be observed in the junction of the lateral sepals among these species. *Malaxis engelsii* have partially connate lateral sepals, contrasting with *Malaxis cipoensis*, which exhibits free lateral sepals. Similarly, *Malaxis sertulifera* shares the partial connation of lateral sepals with *M. engelsii*, while *Malaxis ybytus* aligns with *M. cipoensis*, possessing free lateral sepals.

Petals and lip characteristics further differentiate these species. *Malaxis engelsii* features petals ranging from 1.5×2.0 mm long and a lip measuring $1.2\text{--}1.5 \times 1.1\text{--}1.2$ mm with acuminate lateral lobes and four lip foveas. *Malaxis cipoensis* displays 1.0 mm long petals, a $0.8\text{--}1.0 \times 1.0$ mm lip with rounded lateral lobes, and two lip foveas. *Malaxis sertulifera* presents petals measuring 1.5–2.0 mm and a lip of $1.5\text{--}2.0 \times 1.0\text{--}2.0$ mm with acuminate lateral lobes and four lip foveas. Lastly, *Malaxis ybytus* showcases 1.8–2.0 mm petals, a lip measuring $1.8\text{--}2.2 \times 1.4\text{--}1.8$ mm with acuminate lateral lobes, and four lip foveas. Furthermore, *M. engelsii* is the only species featuring a longitudinal callus on the adaxial surface near the apex of the lip.

The shape of their column wings differs, *Malaxis engelsii* has an acute column wing while *Malaxis sertulifera* and *Malaxis ybytus* are inconspicuous and rounded.

These *Malaxis* species exhibit a range of distinct characteristics encompassing their habitat preferences, herb sizes, leaf morphology, sepals junctions, petal and lip attributes. These variations serve as essential criteria for differentiating them and contribute to our understanding of their taxonomy

and ecological niches in the diverse Brazilian ecosystems.

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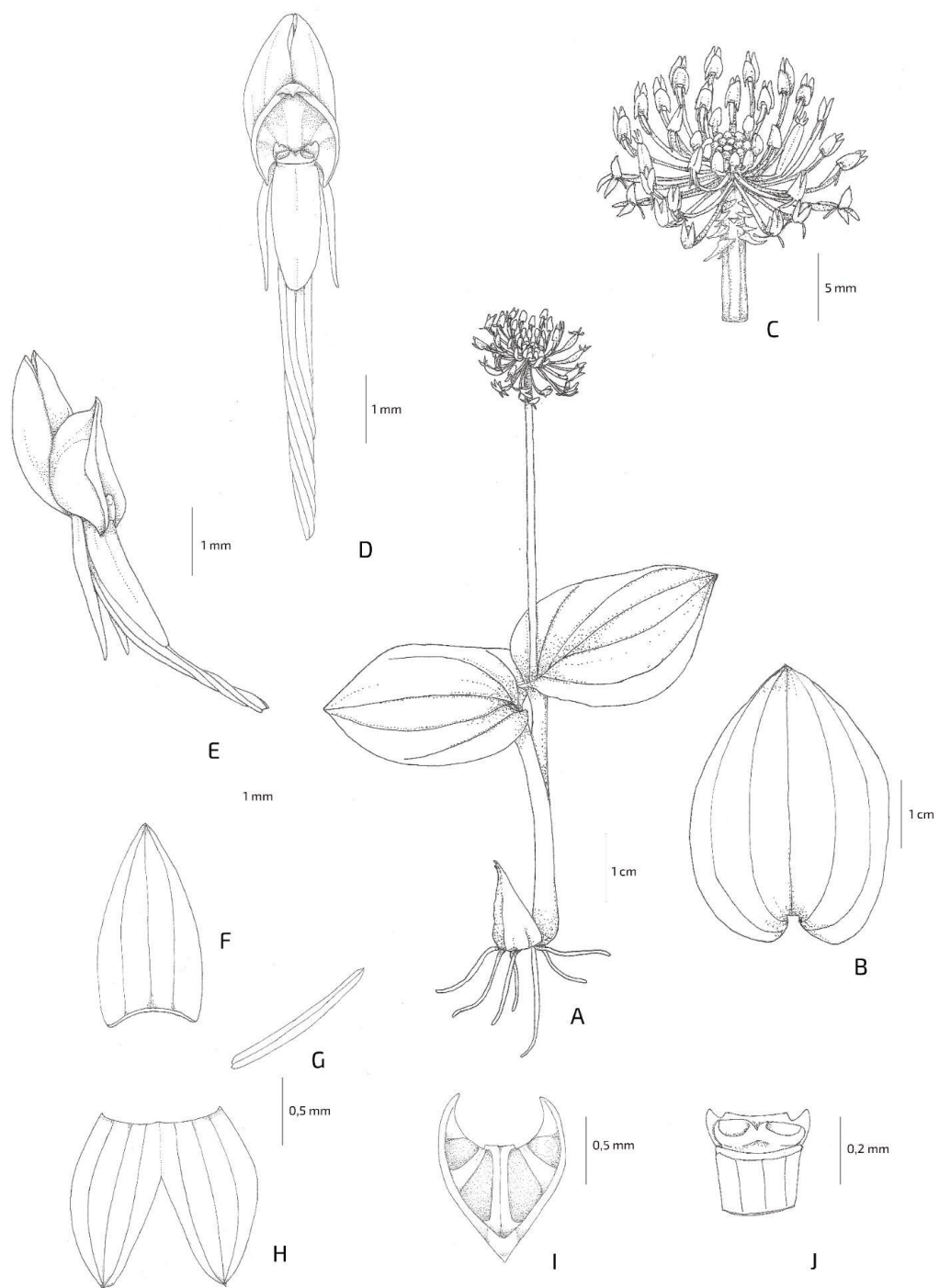


Figure 1. *Malaxis engelsii* illustration. A. Habit. B. Leaf blade. C. Inflorescence. D. Frontal view of the flower attached to the pedicel. E. Lateral view of the flower attached to the pedicel. F. Dorsal petal. G. Petal. H. Connated lateral sepal. I. Lip. J. Column. Illustration by L.K.R. Hinoshita; based on the holotype, spirit material and photographs.

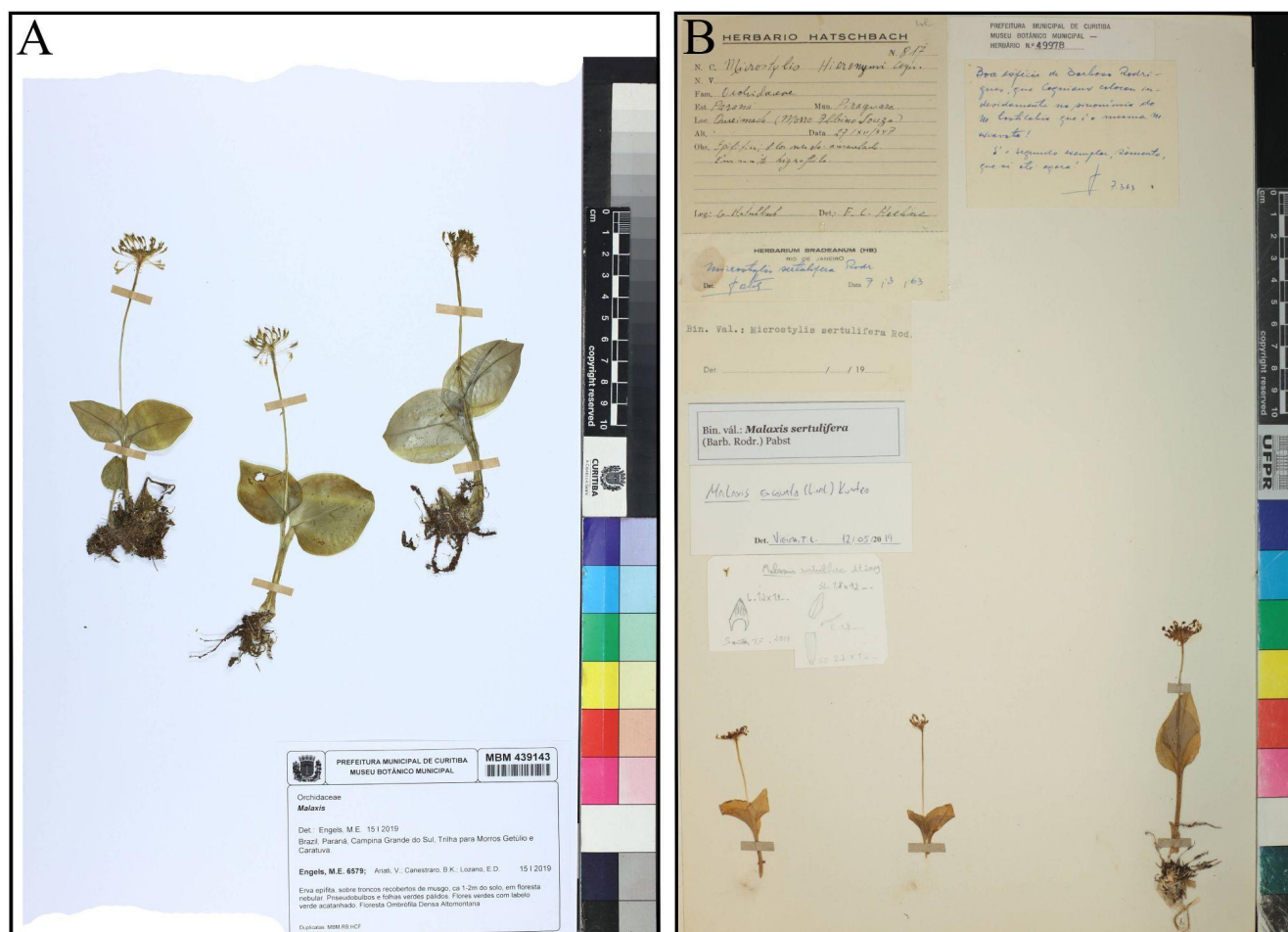


Figure 2. Type specimens of *Malaxis engelsii*. A. Holotype (MBM 439143). B. Paratype (MBM 49978).

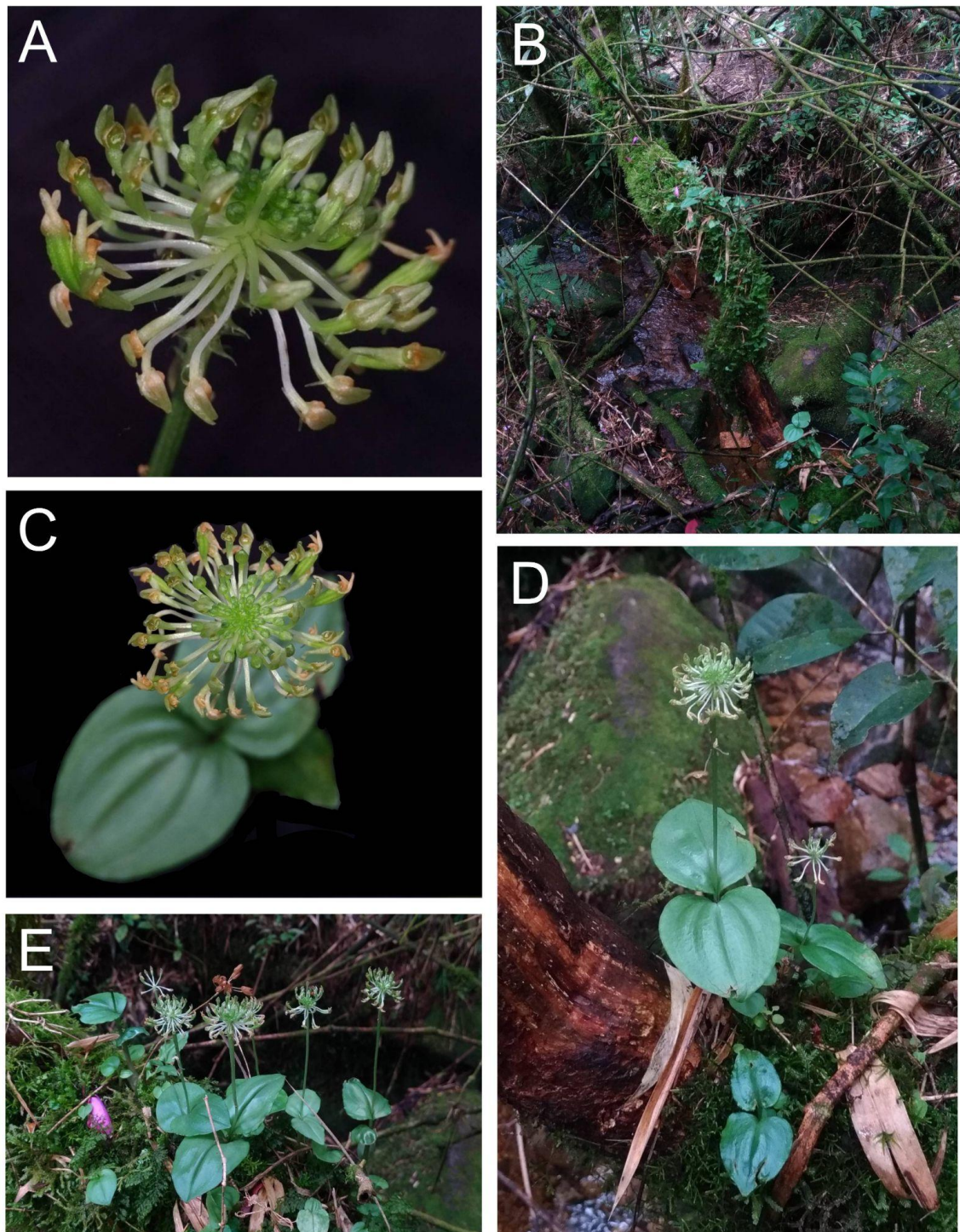


Figure 3. *Malaxis engelsii* in the habitat. A. Inflorescence viewed from the side. B. Population of *M. engelsii* near a stream. C. Inflorescence viewed from above. D. Zoom in on an individual of *M. engelsii* epiphyte at the base of the host plant. E. Zoom in on the epiphytic population of *M. engelsii*. Photographs by M. Engels.

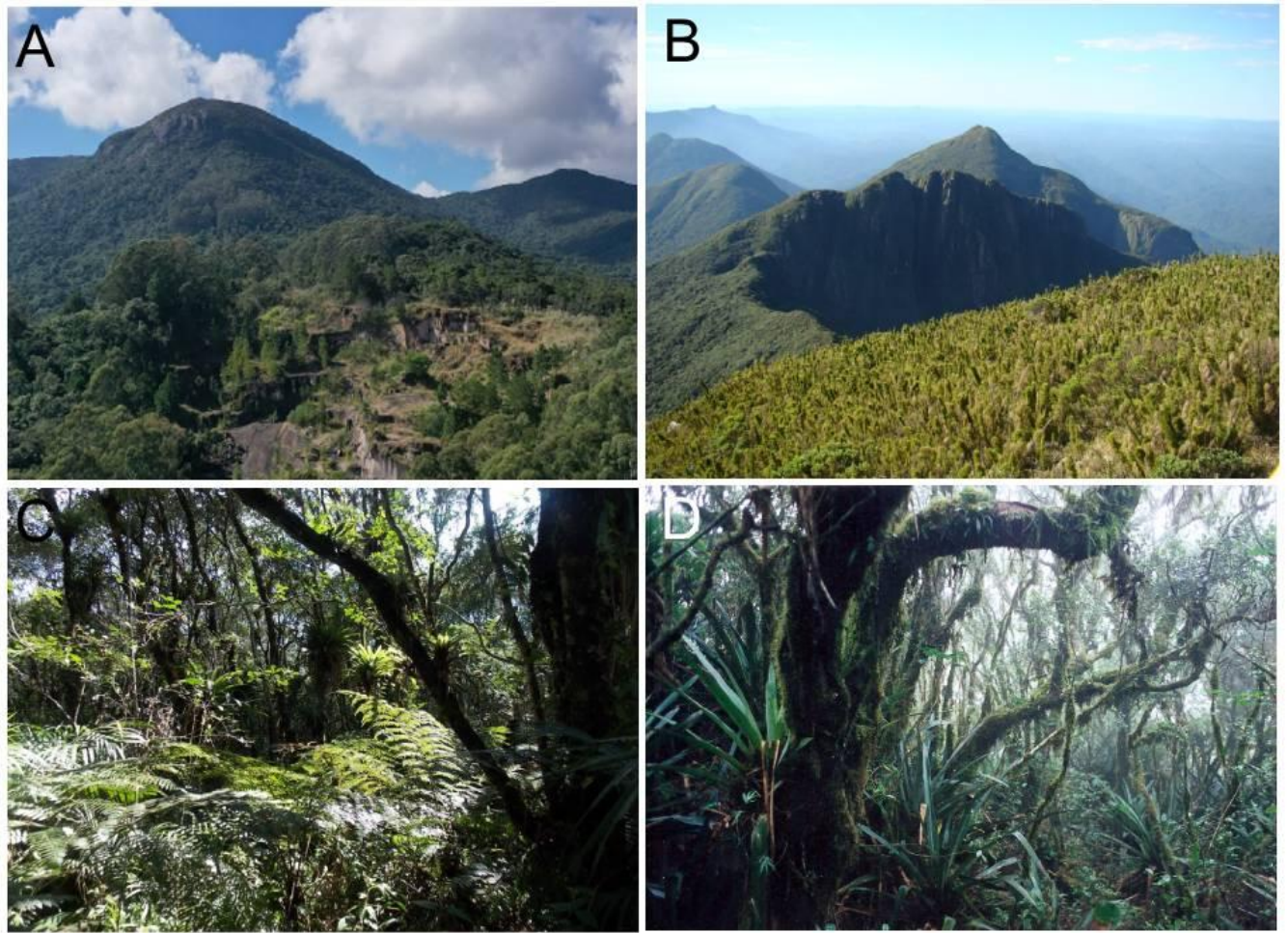


Figure 4. Baitaca and Ibitiraquire mountain ranges within the Paraná region of Serra do Mar. A. Baitaca mountain range. B. Ibitiraquire mountain range. C. Cloud forest within Baitaca; abundant epiphytes. D. Cloud forest within Ibitiraquire; abundant epiphytes. Photographs A and C were taken by Marcos Klingelfus, and photographs B and D by Rodrigo de Andrade Kersten.

CAPÍTULO IV) A new *Malaxis* (Orchidaceae: Malaxidinae) from the *Campos de Altitude* of the Atlantic Rainforest in southern Brazil

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Abstract

Malaxis ybytus is proposed as a new species from the wetlands of the Campos de Altitude of the Atlantic Rainforest of South Brazil, Serra do Araçatuba\Papanduva mountain chain. It is described, illustrated, and compared with other similar species. The new species is similar to *Malaxis cipoensis* and *Malaxis sertulifera*, but it is recognised by its flat to slightly conduplicate leaves, densely congested inflorescence with small flowers bearing free lateral sepals and four foveas in the lip. Due to the high degree of endemism in this environment, the few collection records and the anthropic pressure in the region, we infer that the species is Critically Endangered (CR) based on criterion D of the IUCN.

Keywords: Endangered, high-altitude fields, Monocots, Orchids

Introduction

Malaxis Solander ex Swartz (1788: 119) has been classified under the subtribe Malaxidinae Benthham and Hooker (1883: 465), with a cosmopolitan distribution of over 300 species (Cribb 2005). Currently, ten species are registered in Brazil, where seven of them are probably endemic (Smidt and Santos 2023). Since there have been no specific studies in the genus since that of Pabst & Dungs (1977), a revision can change the number of species and the list of recognized taxa within the country drastically.

Recent molecular studies have revealed that the genus as currently circumscribed is polyphyletic, and so is the current infrageneric classification including *Microstylis* (Nuttall 1818: 196) Eaton (1822: 115). The genus might be restricted to the Americas and temperate regions of Eurasia (Cameron 2005, Radins et al. 2014).

During our research on the Brazilian *Malaxis*, we discovered an undescribed small-size species collected in the *Campos de Altitude* of the Atlantic Rainforest of the Paraná state. Hence, we propose this taxon as new and provide its description, diagnosis, a plate displaying the type, ecological insights, conservation status, illustration, and comparison with morphologically similar species.

Materials and methods

Several field excursions in the area where the species was first collected, aiming to find live material to aid with descriptions, were unsuccessful. The morphological terminology employed in this study adheres to the guidelines provided by Rizzini (1977), Beentje (2010), and Stearn (2004). Descriptions, drawings, and plates were prepared based on the type, whereas additional photographs were taken during field excursions. Specimens from the following herbaria were consulted: BHCB, CEN, CEPEC, CESJ, CRI, EFC, ESA, FLOR, FURB, HRCR, HST, HUCS, HUEFS, HVASF, IAN, ICN, INPA, IPA, JOI, MAC, MBM, MBML, MO, OUPR, PACA-AGP, PEL, RB, RFA, RON, SP, SPF, UB, UEC, UFP, UPCB, USP. The conservation status assessment followed the guidelines provided by the IUCN (2022).

Results and discussion

Malaxis ybytus T.F.Santos & E.C.Smidt.

Type: Brazil. Paraná, Tijucas do Sul, Serra do Papanduva, 15.XII.1997, fl., *O.S. Ribas 2132* (holotype: MBM, barcode 218837).

(Figs. 1, 2).

A species similar to *Malaxis cipoensis* (Barros 1996: 31) and *M. sertulifera* (Barbosa Rodrigues 1877: 29) Pabst (1967: 112), but distinguished from the former by having four foveas on the lip instead of two, and from the latter by having free lateral sepals instead of partially connate ones.

Description

Herb 31–73 mm tall; rhizome inconspicuous. Roots 8–22 mm long, thin. Pseudobulbs 5–10 × 6–10 mm, oblongoid, covered by whitish to brownish deciduous foliaceous sheets. Leaves 27–43 × 11–21 mm, opposite, two per pseudobulbs; several layers of a sheetlike petiole 4–22 mm, imbricate in each other from the base to near the apex; lamina oblong or oblong-elliptic, flat or slight conduplicate, coriaceous, with entire margin, obtuse to slightly acute at apex. Inflorescence 40–89 mm; an umbel-like densely congested raceme; floral bracts pale greenish; emerging at the apex of the peduncle, below the pedicels, triangular. Flowers non-resupinate, whitish yellow; twisted pedicels 2–5 mm; ovary 1 × 1 mm. Dorsal sepal 2.5–3.2 × 0.5–1 mm, 3-veined, oblong-lanceolate; margin entire; apex obtuse. Lateral sepals 2.7–3.5 × 1.5–2 mm, free, 3-veined, oblong, usually wider than dorsal sepals; margin entire; apex obtuse. Petals 1–2 mm long, 1-veined, linear, usually twisted, with entire margin; apex obtuse. Lip 1.8–2.2 × 1.4–1.8 mm, trilobate, glabrous; callus absent; base truncate, attached to the column; lateral lobes acute to acuminate; mid lobe triangular, with four oblong foveas, entire margin and acute apex. Column vertically compressed, yellowish; wings inconspicuous or absent. Pollinarium with two ovoid bipartite naked pollinia.

Additional examined specimen (paratype)

Brazil. Paraná, Guaratuba, Serra do Araçatuba, 21.I.1994, fl., *R. Kummrow 3381* (MBM, barcode 167056!).

Distribution and habitat

Malaxis ybytus has been recorded only in a mountain chain located between the municipalities of Tijucas do Sul and Guaratuba (25°54'S, 49°00'W) (Fig 3). The region is part of the Atlantic Rainforest Biome, with vegetation formations of Mixed Ombrophilous Forest in the lower areas, patches of montane Dense Ombrophilous Forest in higher elevations and near the summits the dominant vegetative conformation is the *Campos de Altitude*, also recognised as the ‘‘Brazilian Páramos’’ (Campos et al. 2018), a type of vegetation dominated by several grass species that grows associated with humidity and the shallow soil of the rock formations (Safford 2007, Campos et al. 2018).

Malaxis ybytus was collected blooming in December and January during the summer in the *Campos de Altitude* wetland fields at about 1500 m elevation, growing in the mountain's hillside, in association with *Xyris lucida* Malme (Lozano et al. 2008), another endemic species of this environment and considered as ‘‘Endangered’’ by CNCFlora (2012).

Conservation status

Malaxis ybytus has been found twice in the same locality, resulting in an AOO (Area of Occupancy) of 8 km², and EOO (Extent of Occurrence) as 0 due to limited records, making it impossible to establish distribution polygons, which typically lead to a classification as data deficient (DD). However, following the IUCN (2022) guidelines, as *M. ybytus* has not been observed for the past 26 years, and several field expeditions in the type-collection locality have been unsuccessful in rediscovering it, together with the high degree of endemism of the *Campos de Altitude* (Ribeiro et al. 2007; Vasconcelos 2011) and the anthropic pressure on the Araçatuba mountain range, that suffers from recurrent fires and the presence of introduced *Pinus sp*, Pinaceae (Fig. 3), we infer that this species should be treated as ‘‘Critically Endangered (CR) [CR D]’’.

Etymology

"Ybytu" means "wind" in Tupi-Guarani, a linguistic group spoken by indigenous nations in diverse regions of South America, particularly along the coast of Brazil. The choice of "Ybytu" symbolically alludes to the constant, strong winds experienced on the mountain summits of the region where the species was discovered and pays homage to the native people who are no longer present in the area. The addition of the letter "s" to the end of the word is for its Latinization, validating it according to the nomenclature code.

Taxonomic Discussion

Malaxis ybytus stands out among most Brazilian *Malaxis* due to its compact size, not exceeding 73 mm in height. It closely resembles *M. cipoensis* and *M. sertulifera*, two species that occurs in the Brazilian Midwest, in the states of Goiás, Minas Gerais, and Distrito Federal.

In terms of habitat, *M. ybytus* is found in the Atlantic Rainforest biome, while *M. cipoensis* is endemic to the Cerrado and *M. sertulifera* has a wider range, inhabiting both the Atlantic Rainforest and Cerrado biomes. As for vegetation, *M. ybytus* is registered in the *Campos de Altitude*, *M. cipoensis* is found in Rupestrian fields, and *M. sertulifera* is associated with forest environments.

In terms of size and morphology, *M. ybytus* is a herb size ranging from 31 to 73 mm, characterized by flat to slightly conduplicate, elliptical to oblong leaves. Normally, *M. cipoensis* is notably smaller, with herb sizes spanning from 20 to 62 mm and featuring flat to slightly conduplicate elliptic leaves. In contrast, *M. sertulifera* tends to be larger, with herb sizes typically in the range of 54 to 115 mm. However, it distinguishes itself by the leaf morphology, characterized by lanceolate or oblong-lanceolate leaves.

The three species share densely congested inflorescences. However, distinct differences emerge in their sepal sizes and morphology. *M. ybytus* has dorsal sepals measuring 2.5–3.2 mm in length and 0.5–1 mm in width, accompanied by free lateral sepals measuring 2.7–3.5 mm in length and 1.5–2 mm

in width. In contrast, *M. cipoensis* possesses smaller dorsal sepals, ranging from 1 to 2 mm in length and 1.5 to 2 mm in width, along with free lateral sepals measuring 1 to 2 mm in length and 1.3 to 1.5 mm in width. In *M. sertulifera* the dorsal sepals are slightly larger, measuring 2.5–3.5 mm in length and 1.5–2 mm in width, while its lateral sepals differ significantly by exhibiting partial connation, and measures 1.7–1.8 mm in length and 1.0–1.5 mm in width.

In their lip characteristics, *M. ybytus* measures 1.8–2.2 mm in length and 1.4–1.8 mm in width, with acuminate lateral lobes and four foveas. In comparison, *M. cipoensis* has a smaller lip, measuring 0.8–1.0 mm in length and 1 mm in width, characterized by rounded lateral lobes and two foveas. In *M. sertulifera*, the lip measures 1.5–2.0 mm in length and 1–2 mm in width, with elongated acuminate lateral lobes and four foveas, presenting similar lip characteristics in size and shape to *M. ybytus*.

Malaxis ybytus primarily distinguishes itself from the closest taxa by its unique characteristics in sepals and lip, as well as its endemic occurrence recorded only in the *Campos de Altitude* within the Atlantic Rainforest biome in the state of Paraná.

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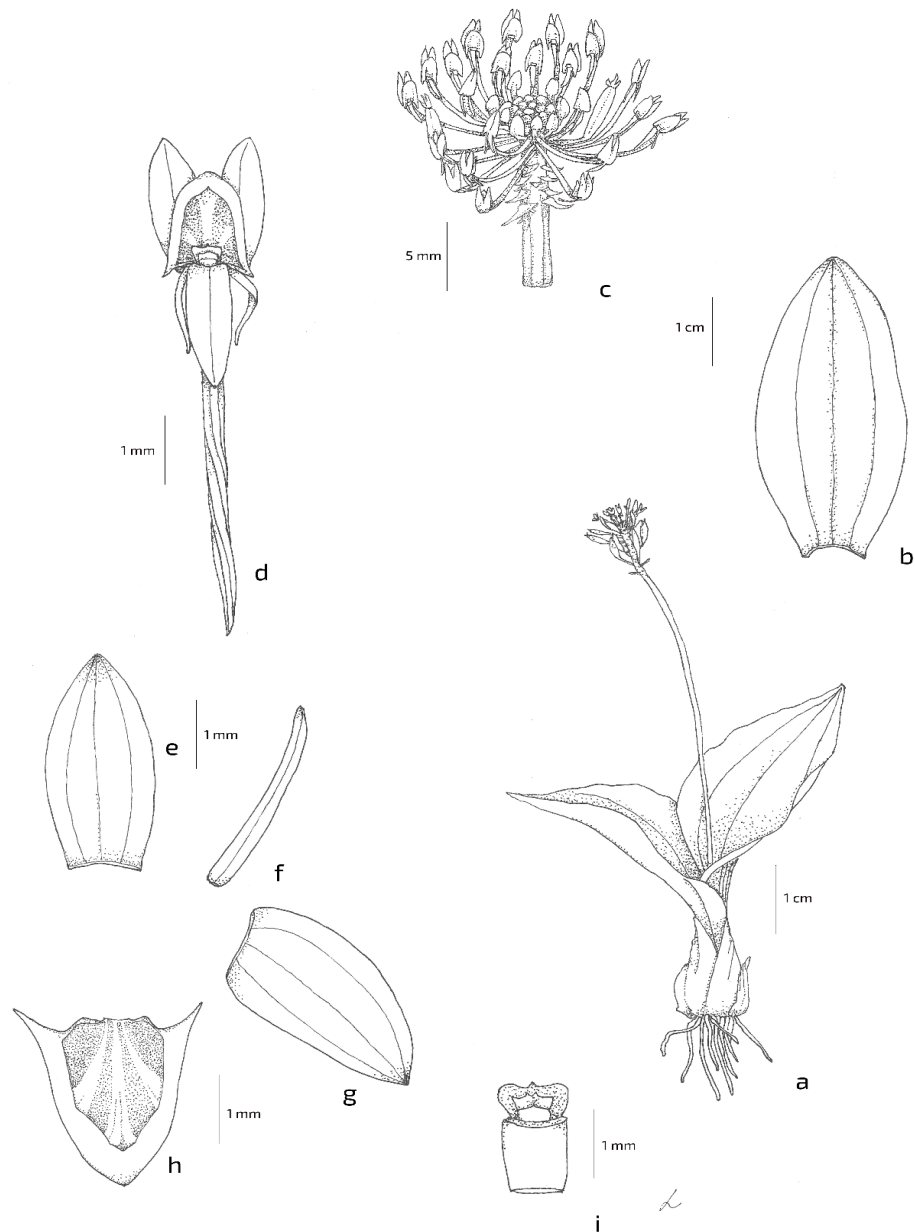


Figure 1. Illustration of *Malaxis ybytus* by L.K.R. Hinoshita; based on the holotype. **a.** Habit. **b.** Leaf blade. **c.** Inflorescence. **d.** Frontal view of the flower attached to the pedicel. **e.** Dorsal sepal. **f.** Petal. **g.** Lateral sepal. **h.** Lip. **i.** Column.

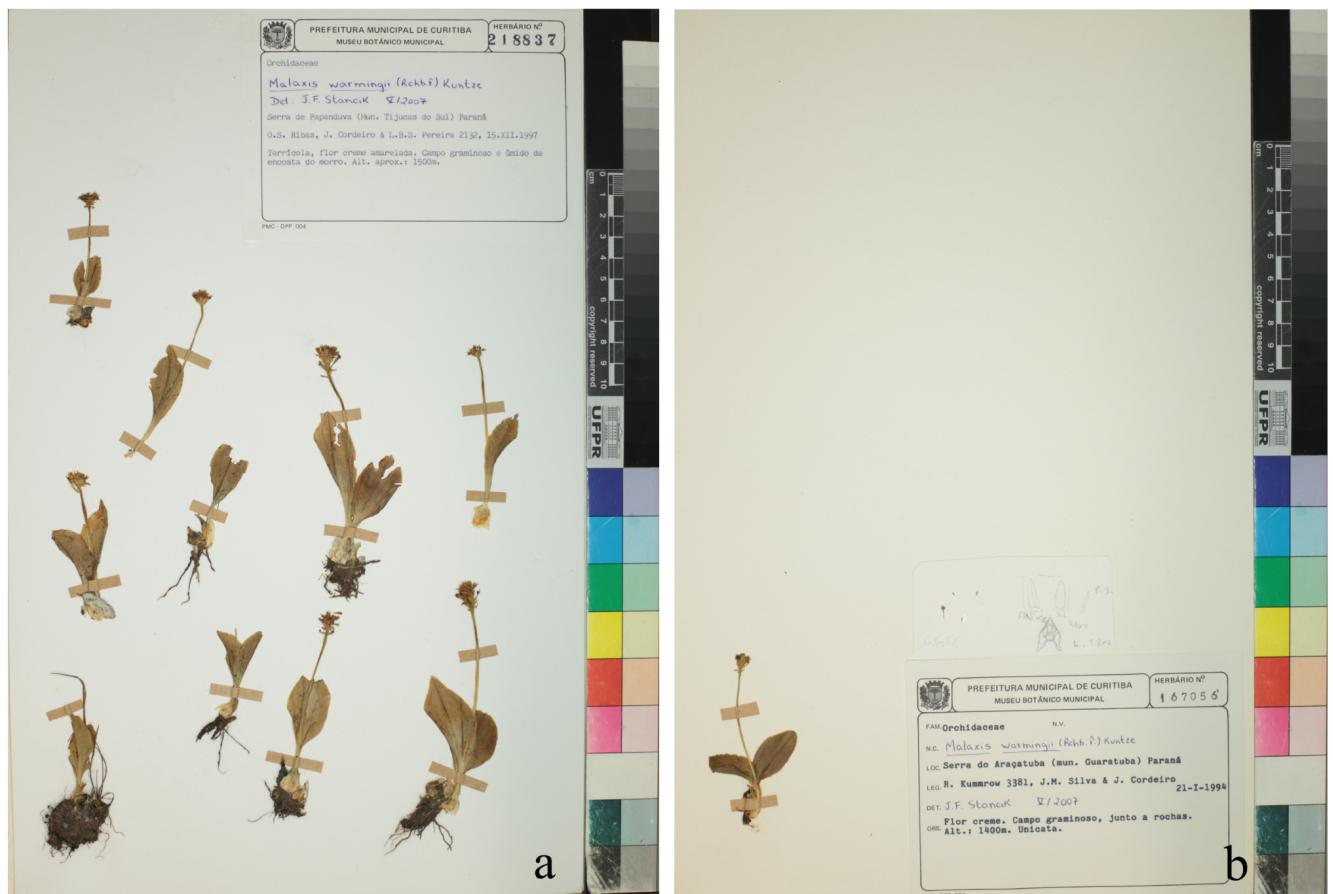


Figure 2. Type specimens of *Malaxis ybytus*. **a**. Holotype (MBM 218837). **b**. Paratype (MBM 167056).



Figure 3. Habitat of *Malaxis ybytus*. **a.** *Campos de Altitude* near the summit of the Araçatuba peak. **b.** Mountain's hillside in the Araçatuba peak, with the presence of an invasive grove of Pinaceae forest in the background of the picture. **c.** Wetlands vegetation on the Mountain's hillside.

CONSIDERAÇÕES FINAIS

Esta pesquisa conduziu uma análise abrangente da subtribo Malaxidinae (Orchidaceae) no Brasil, com ênfase nos gêneros *Liparis* e *Malaxis*, os únicos registrados em território nacional. Na revisão de *Liparis*, foram identificadas nove lectotipificações e seis neotipificações, além da proposta de reclassificação de *Liparis inundata* como sinônimo de *Liparis nervosa*. A diferenciação entre espécies baseou-se em características como lâmina foliar, número de folhas por pseudobulbo e presença de calos no labelo. Três espécies foram identificadas no Brasil, sendo *Liparis cogniauxiana* endêmica do Cerrado, enquanto *L. nervosa* e *L. vexillifera* têm distribuição ampla em vários biomas, todas do gênero classificadas como 'Pouco Preocupante (LC)' pela IUCN.

Na revisão de *Malaxis*, foram destacadas sete lectotipificações e três neotipificações. *Malaxis excavata* foi considerada não ocorrente no Brasil e *Malaxis caracasana* deve ser considerado o nome correto da espécie que está sendo chamada por *M. excavata*. A diversidade de *Malaxis* foi evidenciada com a Mata Atlântica e o Cerrado abrigando a maioria das espécies. Apenas dois exemplares foram registrados de forma limitada na Amazônia, representando potencialmente novas espécies ainda não descritas ou novos registros para o Brasil. No tratamento taxonômico, *Malaxis jaraguae* foi reclassificada como sinônimo de *Malaxis ovatilabia*. Através da IUCN, classificou-se diversas espécies com status variados, sublinhando a importância da conservação. A análise do material tipo digitalizado de *Malaxis pubescens* revelou-se inconclusiva para uma interpretação mais precisa desta espécie. Apesar disso, a decisão foi manter a espécie como aceita, separada das demais do gênero até que um material mais robusto e conclusivo possa ser obtido. Essa abordagem reflete a cautela necessária diante da limitação do material disponível, indicando a importância de futuras explorações de campo ou análise do material tipo em herbário estrangeiro para um entendimento mais aprofundado da espécie em questão.

As revisões dos gêneros e campanhas a campo permitiram o reconhecimento de duas novas espécies de *Malaxis*. *Malaxis engelsii*, uma orquídea epífita encontrada na Mata Atlântica no Paraná, e *Malaxis ybytus*, uma nova espécie nos campos de altitude da Mata Atlântica no mesmo estado.

Além das espécies descritas, um esforço mais significativo em campo pode revelar mais espécies novas de *Malaxis*, dado o fato de ser um gênero pouco coletado e frequentemente negligenciado nas campanhas de coleta botânica. Na Amazônia, especialmente, existe um potencial considerável para encontrar espécies ainda não descritas desse gênero.

Em síntese, esta tese enriqueceu nossa compreensão da diversidade de Malaxidinae no Brasil, proporcionando insights taxonômicos, ecológicos e de conservação. A classificação de novas espécies, estudos de distribuição das espécies e a avaliação do status de conservação oferecem contribuições valiosas para futuras pesquisas e estratégias de preservação da rica biodiversidade das orquídeas brasileiras.

Apêndice I) A new *Octomeria* (Orchidaceae: Pleurothallidinae) and nomenclatural notes for related Southern Brazilian species

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A new *Octomeria* (Orchidaceae: Pleurothallidinae) and nomenclatural notes for related Southern Brazilian species

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Abstract

Octomeria imigiae is proposed as a new species from the Atlantic Rainforest of South Brazil. It is described, illustrated, and compared with sympatric and similar species. An identification key is provided. The new species is recognised by its reptant growth habit and tiny yellow flowers. It is similar to *Octomeria chamaeleptotes* and several other terete-leaved species from which it can be easily distinguished by its vegetative and floral morphology. *Octomeria riograndensis* and *Octomeria sancti-angeli* are proposed as new synonyms of *Octomeria chamaeleptotes*, and typification designations for this complex are made.

Keywords: Diversity, Flora of Brazil, Orchidaceae, Taxonomy

Apêndice II) *Octomeria giordanii* (Orchidaceae—Pleurothallidinae), a new species from Brazil and nomenclatural notes on João Barbosa Rodrigues's species that occurs in Bahia and Minas Gerais

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***Octomeria giordanii* (Orchidaceae—Pleurothallidinae), a new species from Brazil and nomenclatural notes on João Barbosa Rodrigues's species that occurs in Bahia and Minas Gerais**

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Abstract

Octomeria giordanii is proposed as a new species occurring in an ecotone between the Atlantic Rainforest and Cerrado biomes in Minas Gerais, Brazil. This study provides a detailed description, illustrations, and a comparative analysis using an identification key to distinguish it from other *Octomeria* species. The new species is characterized by its small size, rupicolous reptant growth habit, and flowers with multiple colors. It shares similarities with *O. fusiformis* and other *Octomeria* species but can be differentiated by its floral morphology and ecology. The nomenclatural notes include the lectotypification of nine taxa described by João Barbosa Rodrigues that can be found occurring in the states of Bahia and Minas Gerais. Additionally, *O. albiflora* is proposed as a new synonym of *O. lithophila*.

Key words: Atlantic Rainforest, Cerrado, Lectotypification, Orchid