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Ferns and Lycophytes as new challenges

Aspleniaceae (Polypodiopsida) in the state of Mato Grosso, Brazil

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Abstract

We present a floristic-taxonomic survey of the species of Aspleniaceae in Mato Grosso as part of a series on the flora of lycophytes and ferns in this state. The study is based on an analysis of national and foreign herbaria specimens. In the state of Mato Grosso, there are two genera and 22 species of Aspleniaceae: *Asplenium abscissum*, *A. angustum*, *A. auritum*, *A. cirrhatum*, *A. claussenii*, *A. cristatum*, *A. dimidiatum*, *A. flabellulatum*, *A. formosum*, *A. hallii*, *A. inaequilaterale*, *A. juglandifolium*, *A. otites*, *A. poloense*, *A. praemorsum*, *A. pumilum*, *A. resiliens*, *A. salicifolium*, *A. serra*, *A. serratum*, *A. stuebelianum*, and *Hymenasplenium delitescens*. This corresponds to 27,5% of the Aspleniaceae species reported for Brazil. The species predominantly occur in forest environments. Dichotomous keys to the genera and species, descriptions, diagnostic illustrations, and notes on the geographic distribution, habitat, and morphological affinities between species are provided.
Key words: *Asplenium*, Central-West Brazil, ferns, floristic, *Hymenasplenium*.

Resumo

O objetivo deste estudo foi realizar o levantamento florístico-taxonômico das espécies de Aspleniaceae ocorrentes no estado do Mato Grosso, em continuidade a uma série sobre a flora de licófitas e samambaias desse Estado. O estudo foi baseado na análise de espécimes depositados em herbários nacionais e estrangeiros. No estado do Mato Grosso ocorrem 22 espécies de Aspleniaceae, distribuídas em dois gêneros, correspondendo a 27,5% das espécies da família reportadas para o Brasil: *Asplenium abscissum*, *A. angustum*, *A. auritum*, *A. cirrhatum*, *A. claussenii*, *A. cristatum*, *A. dimidiatum*, *A. flabellulatum*, *A. formosum*, *A. hallii*, *A. inaequilaterale*, *A. juglandifolium*, *A. otites*, *A. poloense*, *A. praemorsum*, *A. pumilum*, *A. resiliens*, *A. salicifolium*, *A. serra*, *A. serratum*, *A. stuebelianum* and *Hymenasplenium delitescens*. As espécies ocorrem predominantemente em ambiente florestal. São apresentadas chaves dicotômicas para gêneros e espécies, descrições, ilustrações diagnósticas, distribuição geográfica e notas sobre o hábitat e afinidades morfológicas entre as espécies.
Palavras-chave: *Asplenium*, Brasil Central, samambaias, florística, *Hymenasplenium*.

Introduction

Aspleniaceae is one of the most diverse families of leptosporangiate ferns, which comprises about 730 species worldwide but mainly occurs in tropical regions (PPG-I 2016). Several generic classifications have been proposed for the family, although no consensus has been reached for many years. Copeland (1947) recognized nine genera and Pichi-Sermolli (1977) recognized 14 genera. Other authors postulated that the species should be treated as a single but diverse genus, *Asplenium* (Kramer & Viane 1990). However, up to approximately 38 genera were published in different treatments (Xu *et al.* 2019). Based on a plastidial phylogenetic analysis, Schneider (2004) recognized two genera for the family (*Asplenium* and *Hymenasplenium*), and this classification is still used now (PPG-I 2016).

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Aspleniaceae is characterized by having elongated sori arranged laterally to secondary veins, with unilaterally fixed indusia (asplenioid sorus). The scales are clathrate with dark walls and hyaline lumina, and the petiole has two curved vascular bundles connected at the distal portion, forming an X-shape or rarely a V- or U-shape in cross-section. Each sporangium has a uniseriate stalk (Sylvestre 2001; Wetzel *et al.* 2017; Xu *et al.* 2019).

In Brazil, Aspleniaceae is represented by 80 species that occur in all phytogeographic domains, with high diversity in the Atlantic Forest of the Southern and Southeastern regions. There are 75 *Asplenium* species and five *Hymenasplenium* species in the country (Sylvestre 2001; Sylvestre *et al.* 2023).

Due to the intersection of the *Cerrado*, *Pantanal*, and Amazon Rainforest vegetation in Mato Grosso, the state has a high diversity of environments with a rich fern flora. Because Aspleniaceae is most diverse in forest environments, its richness in Mato Grosso is low compared to other states in Brazil, and only 19 species have been reported to the state so far (Sylvestre *et al*. 2023). However, this number is significant since it is the tenth richest fern family in the state (Ferns and Lycophytes in Flora e Funga do Brasil 2023, continuously updated). Therefore, to continue the studies of the fern flora in Mato Grosso initiated by the third author, we present a taxonomic treatment of Aspleniaceae in the state. Identification keys to the genera and species, descriptions, illustrations, and notes on the geographic distribution, habitat, and morphological affinities between species are provided.

Materials and Methods

Mato Grosso state is in the Central-West Region of Brazil, also considered South America's geographic center. The state has an area of 903,207 km^2 and contains three phytogeographic domains: the *Cerrado*, the *Pantanal*, and the Amazon Rainforest (<https://www.ibge.gov.br/cidades-e-estados/mt/>).

This work is part of a series about the fern flora of Mato Grosso state proposed by Windisch (1985). More details about the methodology adopted are in the early works of this series (Windisch 1985, 1994; Windisch & Nonato 1999; Ponce *et al.* 2010; Silva *et al.* 2013, 2015). In addition to the collections made during 24 trips in Mato Grosso by the third author and collaborators, collections deposited in the following main national and foreign herbaria were examined: B, BHCB, BM, CEPEC, CETES, CM, FUFMT, GH, HB, HBRA, HRCB, HSTM, ICN, INPA, IPA, K, MBM, MG, MO, NY, PACA, P, R, RB, RBR, RON, S, SJRP, SPF, UB, UEC, UFC, and US (acronyms follow Thiers, continuously updated). Due to the dynamics of geopolitics in the state, with the constant creation of new municipalities, the localities are cited as on the original labels.

Morphological terminology follows Lellinger (2002). Taxon names are based on the International Plant Names Index (IPNI 2023). Data about habitat were obtained from labels of exsiccatae. The species distribution in Brazil is based on Sylvestre *et al.* (2023). The global distribution was obtained from relevant literature cited in the taxonomic treatment.

For each species, notes on its geographic distribution, habitat and comments on its morphology or similarities with related species were compiled.

Results and Discussion

The family Aspleniaceae is represented in Mato Grosso by two genera and 22 species: *Asplenium abscissum* Willd., *A. angustum* Sw., *A. auritum* Sw., *A. cirrhatum* Willd., *A. claussenii* Hieron., *A. cristatum* Lam., *A. dimidiatum* Sw., *A flabellulatum* Kunze, *A. formosum* Willd., *A hallii* Hook., *A. inaequilaterale* Willd., *A. juglandifolium* Lam. *A. otites* Link, *A. poloense* Rosenst., *A. praemorsum* Sw., *A. pumilum* Sw., *A resiliens* Kunze, *A. salicifolium* L., *A. serra* Langsd. & Fisch., *A. serratum* L., *A. stuebelianum* Hieron, and *Hymenasplenium delitescens* (Maxon) L. Regalado & Prada. This diversity corresponds to 27,5% of the species of Aspleniaceae recorded in Brazil.

Species of Aspleniaceae occur more frequently in forested vegetation in different phytogeographic domains in Mato Grosso (the *Cerrado* [Central Brazilian Savanna, especially in gallery forests], Amazon Rainforest, and *Pantanal*), in addition to the transitional zone between the Amazon Rainforest and *Cerrado* (Tab. 1). Gallery forest in the *Cerrado* has most species (16 species), followed by the transitional area between *Cerrado* and Amazon Rainforest (eight species), and the Amazon Rainforest (eight species). None of the species recorded are endemic to Brazil or included in official lists of threatened species.

Table 1 – Phytogeografic domains of Aspleniaceae species found in the state of Mato Grosso, Brazil: Cerrado (Gallery Forest and Cerrado *sensu strictu*), Amazonia, Pantanal, Amazonia-Cerrado transition.

Species	Cerrado		Amazonia	Pantanal	Amazonia-Cerrado transition
	Gallery forest	Cerrado *s.s.*			
Asplenium abscissum	X				
Asplenium angustum			X		
Asplenium auritum	X	X	X	X	X
Asplenium claussenii	X				
Asplenium cirrhatum			X		
Asplenium cristatum	X				X
Asplenium dimidiatum	X				
Asplenium flabellulatum	X				
Asplenium formosum	X	X			
Asplenium hallii			X		
Asplenium inaequilaterale	X				X
Asplenium juglandifolium					X
Asplenium otites	X				
Asplenium poloense	X		X		X
Asplenium praemorsum	X				
Asplenium pumilum		X			
Asplenium resiliens	X				
Asplenium salicifolium	X				
Asplenium serra	X		X		X
Asplenium serratum	X		X		X
Asplenium stuebelianum	X				X
Hymenasplenium delitescens			X		
Total	**16**	**3**	**8**	**1**	**8**

Taxonomic treatment

Aspleniaceae Newman, Hist. Brit. ferns 6. 1840.

Terrestrial, epiphytic, or epipetric. Stems commonly erect, less often short- to long-creeping, dictyostelic, greenish to blackish, bearing clathrate, linear to obovate, brownish to blackish scales. Leaves monomorphic to sub-dimorphic, small- to moderate-sized. Petioles continuous with the stem, dull to highly lustrous, with two vascular bundles, these connecting in the distal portion and forming an "X" or rarely a "V" or "U" transversal profile, sparsely to densely scaly, scales similar to those on the stem. Laminae simple to decompound, glabrescent, sometimes proliferous at the pinna axils or apex. Rachises lustrous or dull, glabrescent or in some species, densely covered with scales. Veins free, simple to forked, ending at or near the margin with a terminal thickening, or anastomosing, without veinlets included in the network, ending or not by free veins near the margin. Sori linear to elliptic, dorsal, unilateral, or less commonly, diplazioid, covered by a short to elongate (or rarely cuplike) indusium. Spores bilateral, monolete with a cristate, echinate, perforate, or reticulate perispore.

Key to the genera of Aspleniaceae in the state of Mato Grosso

1. Stem erect to ascending, less often creeping, with a typical dictyostele; lamina simple to 4-pinnate; sclerenchymatous cells in the inner cortex of the roots unequally thickened walls ..... 1. *Asplenium*
1'. Stem short- to long-creeping, with a dorsiventral dictyostele; lamina 1-pinnate, rarely simple; sclerenchymatous cells in the inner cortex of the roots with equally thickened walls .... 2. *Hymenasplenium*

1. ***Asplenium*** L., Sp. Pl. 2: 1078. 1753.

Terrestrial, epiphytic, or epipetric. Sclerenchymatous cells in the inner cortex of the roots not equally thickened (circumendodermal band). Stems erect to ascending, forming a typical dictyostele, with a radial arrangement of leaf gaps, green to blackish, moderately to densely covered with scales. Petioles circular, dull to lustrous, glabrescent to densely scaly, usually with wings. Laminae simple to 4-pinnate, membranaceous to coriaceous, essentially glabrous, rarely with minute trichomes or reduced scales, terminating in a conform apical segment, in a pinnatifid apex, or occasionally with a flagellate, proliferous tip. Veins free, simple to forked, or anastomosing in some species. Sori elliptic to linear, unilateral to rarely diplazioid. Spores monolete with a cristate, echinate, or reticulate perispore. Chromosomes X = 36. (Ogura 1972; Rothfels *et al.* 2012; Wetzel *et al.* 2017).

Key to the species of *Asplenium* in the state of Mato Grosso

1. Lamina simple, entire.
    2. Petioles (3–)5–18 cm long, 1/7 to 1/2 the length of the lamina; lamina base abruptly reduced and then long-attenuate; terrestrial or epipetric ..... 1.21. *Asplenium stuebelianum*
    2'. Petioles 2–7.5 cm long, about 1/20 the length of the lamina; lamina cuneate and decurrent at base; epipetric, epiphytic, or less often terrestrial.
        3. Lamina linear-lanceolate, lateral veins arising from costa at 35–45º, lamina apices long attenuate; epiphytic ..... 1.2. *Asplenium angustum*
        3'. Lamina lanceolate, lateral veins arising from costa at 55–75º, lamina apices acuminate; epipetric, epiphytic, or less often terrestrial ..... 1.20. *Asplenium serratum*
1'. Lamina divided, pinnatisect to 1–4-pinate.
    4. Basal pinnae is much more developed basiscopically than acroscopically; lamina with pluricellular whitish trichomes on the rachis, costae, and veins ..... 1.16. *Asplenium pumilum*
    4'. Basal pinnae subequilateral or more strongly produced acroscopically; lamina lacking whitish, pluricellular trichomes.
        5. Petiole and rachis lustrous, dark brownish to blackish.
            6. Rachis with a flagellate, proliferous tip.
                7. Lamina reduced at the base, petiole 0.5–4 cm long ..... 1.10. *Asplenium hallii*
                7'. Lamina truncate at the base, petiole 25–30 cm long.
                    8. Lamina pinnate ..... 1.4. *Asplenium cirrhatum*
                    8'. Lamina bipinnate-pinnatifid, rarely tripinnate .... 1.8. *Asplenium flabellulatum*
            6'. Rachis without a flagellate, proliferous tip.
                9. Lamina pinnate; pinnae deeply incised, especially on the acroscopic side..... ..... 1.9. *Asplenium formosum*
                9'. Lamina pinnate; pinnae entire to slightly crenate ..... 1.17. *Asplenium resiliens*
        5'. Petiole and rachis dull or slightly lustrous, green to grayish brown.
            10. Rachis and lamina sparsely to densely scaly.
                11. Pinnae deeply lobate, margins with cuneiform lobes..... ..... 1.15. *Asplenium praemorsum*
                11'. Pinnae serrate or margins with irregular erose-lacerate lobes.

12. Lamina pinnate, pinnae dimidiate, margin serrate to irregularly erose-lacerate; spores with a cristate perispore ..... 1.7. *Asplenium dimidiatum*

12'. Lamina pinnate, pinnae not dimidiate, margin regularly serrate ..... 1.19. *Asplenium serra*

10'. Rachis and lamina glabrous or with few linear scales, especially on the pinna axis.

13. Lamina bipinnate or more decompound.

14. Lamina bipinnate-pinnatifid, oblong-lanceolate, membranaceous, apex acute to attenuate; indusia thin, membranaceous ..... 1.6. *Asplenium cristatum*

14'. Lamina bipinnate at the base, deltate-lanceolate, chartaceous, apex acute to acuminate; indusia firm and fleshy, coriaceous ..... 1.3. *Asplenium auritum*

13'. Lamina pinnate to pinnate-pinnatifid.

15. Lamina ending in conform or subconform apical pinna (terminal pinna like the lateral ones), spores with echinate perispore.

16. Pinnae with serrate or crenate margin, commonly auriculate at the base ..... 1.18. *Asplenium salicifolium*

16'. Pinnae with entire margin, base equilateral ..... 1.12. *Asplenium juglandifolium*

15'. Lamina ending in a pinnatifid apex; spores with cristate perispore.

17. Lamina pinnate to pinnate-pinnatifid; indusia firm and fleshy, coriaceous ..... 1.3. *Asplenium auritum*

17'. Lamina pinnate; indusia thin, membranaceous.

18. Distal lateral pinnae dimidiate to subdimidiate.

19. Petioles long, 1/4 to 1/2 the length of the lamina, sometimes more; pinnae margin dentate; basal pinnae deflexed, slightly or not reduced, apex pinnatifid, caudate ..... 1.13. *Asplenium otites*

19'. Petioles short, less than 1/4 the length of the lamina; pinnae margins deeply serrate acroscopically, apex long-acuminate, caudate ..... 1.14. *Asplenium poloense*

18'. Distal lateral pinnae subequilateral.

20. Lamina with 35–50 pairs of pinnae; veins simple in the middle region of the pinnae ..... 1.5. *Asplenium claussenii*

20'. Lamina with less than 20 pairs of pinnae; veins forked in the middle region of the pinnae.

21. Lamina deltate to deltate-elongate, 8–15 cm wide at the base; margin of pinnae biserrate to subentire ..... 1.1. *Asplenium abscissum*

21'. Lamina lanceolate to ovate-lanceolate, 4–10 cm wide at the base; margin of pinnae clearly serrate ..... 1.11. *Asplenium inaequilaterale*

1.1. *Asplenium abscissum* Willd., Sp. Pl., ed. 4. 5: 321. 1810. Fig. 1a-c

Terrestrial or epipetric. Stem erect to ascending, scales lanceolate, 1–2.5 × 0.5 mm, darkish brown in the middle, lighter on the margin. Leaves erect. Petiole 13–28 cm long, sulcate adaxially, grayish, dull, narrowly alate along the distal portion, base covered with linear-lanceolate to lanceolate scales. Lamina pinnate, 15–30 cm long, 8–15 cm wide at the base, deltate to deltate-elongate, apex acute, base truncate, glabrous. Rachis grayish, dull, narrowly alate, glabrescent. Pinnae in 7–15 pairs, margin biserrate to subentire, subequilateral, apical pinna pinnatifid. Veins free, 2–3 forked in the middle region of the pinnae, apex thickened. Sori linear to slightly curved, medial, indusia membranaceous. Spores with cristate perispore.

Selected examined material: Cuiabá, III.1883, *H.H. Smith* (P). Juína, Chácaras, 20.VIII.1987, *J. Pivetta 1459* (HB). São Vicente, 19.XI.1958, *R. Schaefer 7391* (PACA).

Additional material: BRAZIL. ESPÍRITO SANTO: Cachoeiro de Itapemirim, 25.V.1949, *A.C. Brade 19900* (RB).

Asplenium abscissum occurs from Florida to Uruguay (Kessler & Smith 2018). In Brazil, it has been recorded in the states of Bahia, Espírito Santo, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Rondônia, Santa Catarina, and São Paulo. It

occurs from 100–450 m elevation along streams in gallery forests.

This species is morphologically similar to *A. inaequilaterale*, mainly because of the pinnate, deltoid laminae, with a truncate base, and lateral pinnae with 2–3-furcated veins. Although, the latter differs by having pinnae with a serrate margin, while *A. abscissum* has a biserrate to subentire margin. It can also be confused with *Hymenasplenium delitescens* by the lamina architecture, but the dorsiventral stem differentiates *Hymenasplenium* species.

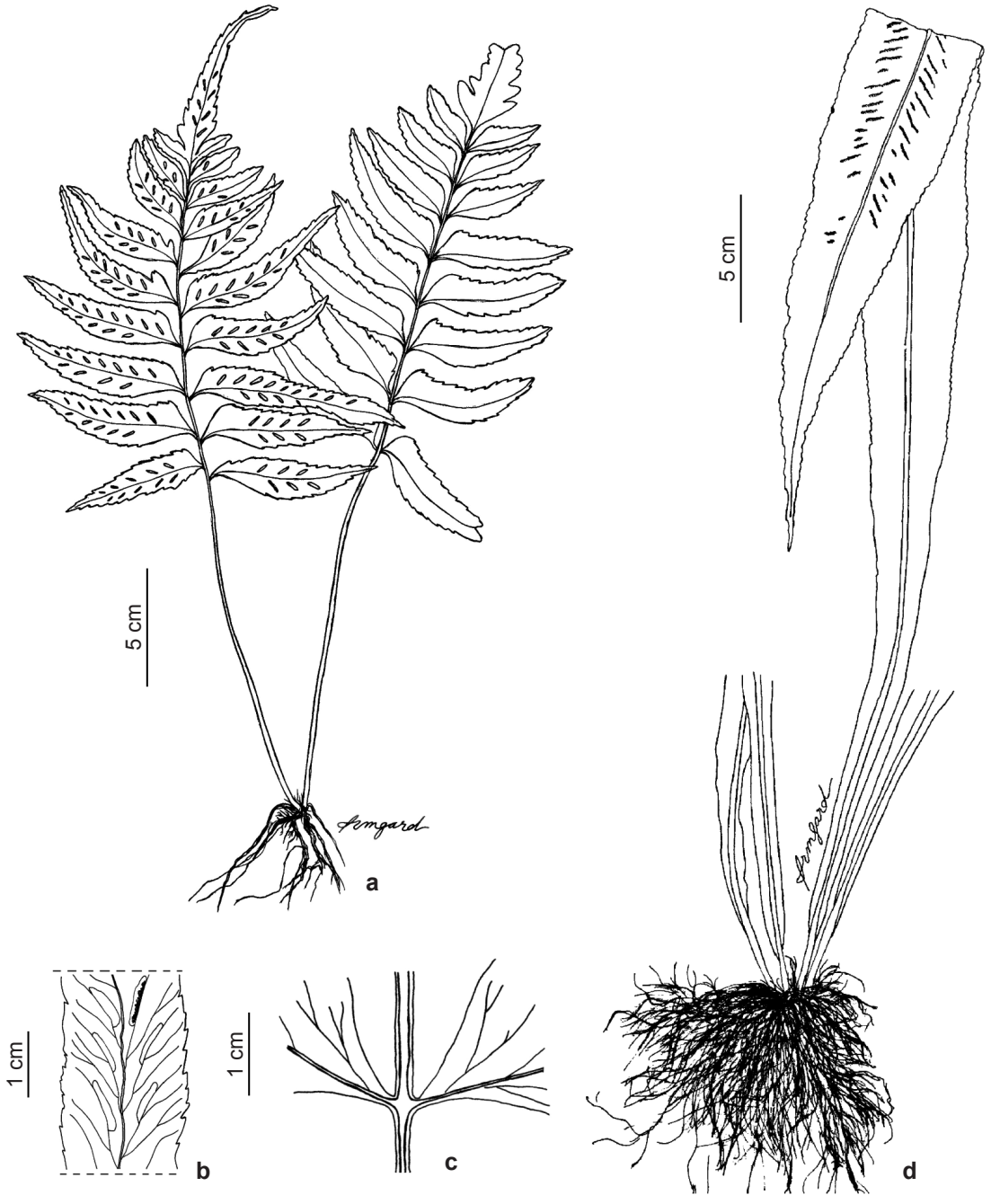

Figure 1 – a-c. *Asplenium abscissum* – a. habit; b. pinna; c. base of the proximal pinna. d. *A. angustum* – habit. (a-c. *A.C. Brade 19900*, RB; d. *J.G. Kuhlmann 1018*, RB).

1.2. ***Asplenium angustum*** Sw., Kongl. Vetensk. Acad. Handl.: 66, t.4, f.1. 1817. Fig. 1d

Epiphytic. Stem erect, short, scales dense, linear-lanceolate, dark brown to black. Leaves erect, fasciculate. Petiole 2–3 cm long, about 1/20 the length of the lamina, planate to sulcate adaxially, dull, greenish to grayish, bearing linear-lanceolate scales at the base. Lamina simple, entire, linear-lanceolate, chartaceous to subcoriaceous, 15–45 × 3–4(–5) cm, apex long attenuate to caudate, base cuneate and decurrent, margin subentire to sinuous. Veins free, spreading at 35°–45° from the midrib, forked in the base, midrib brown adaxially, with a few lanceolate or stellate scales. Sori linear, elongate, about 3/4 the length of lateral veins, indusia membranaceous to coriaceous. Spores with a cristate perispore.

Examined material: Apiacás, Parque Nacional do Juruena, 8.X.2021, *P. Labiak 7799 (*RB).

Additional material: BRAZIL. AMAZONAS: Rio Negro, 31.XII.1923, *J.G. Kuhlmann 1018* (RB).

Asplenium angustum occurs in Bolivia, Colombia, Peru, Guianas, Suriname, and Venezuela (Kessler & Smith 2018). For Brazil, it has been reported for all the states of the North region, with a disjunct occurrence in the states of the Atlantic Forest Domain, such as Minas Gerais, Paraná, Santa Catarina, and São Paulo (Reis 2022). It is the first record to Mato Grosso, where it was found as an epiphyte, growing on the base of trunks. It occurs in shady and wet sites in Amazon Rainforest.

Specimens of *A. angustum* with an intermediate morphology between *A. serratum* Sw. and *A. stuebelianum* are often challenging to differentiate. *A. serratum* differs by the broad lamina (> 4 cm wide) with an acuminate apex and obtuse veins angles (*vs.* narrow lamina, acute to caudate apex, and acute veins angles in *A. angustum*). It differs from *A. stuebelianum* by the abruptly reduced lamina and long petioles (*vs.* decurrent lamina, gradually narrowing toward a very short petiole in *A. angustum* and *A. serratum*).

1.3. ***Asplenium auritum*** Sw., J. Bot. (Schrader) 1800(2): 52. 1801. Fig. 2

Epiphytic or epipetric. Stem erect, scales brown, lanceolate, 3–6 × 0.5–1.5 mm. Leaves erect. Petiole 4–12 cm long, sulcate adaxially, not or scarcely alate, dull, greenish adaxially, and brownish abaxially, with a few linear scales. Lamina pinnate, pinnate-pinnatifid or bipinnate at the base, 5–40 × 3–20 cm, deltate-lanceolate, chartaceous to coriaceous, glabrous, apex acute to acuminate, base truncate. Rachis sulcate adaxially, dull, brown in the middle, scarcely alate, with a few linear scales. Pinnae in (5–)10–25 pairs, entire to pinnatifid, acroscopically auriculate, basiscopically cuneate, apical pinna pinnatifid. Veins free, forked, apex thickened. Sori elliptic, medial, indusia firm and fleshy, coriaceous. Spores with cristate perispore.

Selected examined material: Alta Floresta, 6-7.V.1986, *P.G. Windisch 4757* (FUFMT, SJRP, US). Aripuanã, 6.VI.1979, M.G. *Silva & C. Rosário 4802* (NY). Chapada dos Guimarães, *A. Salino 377* (BHCB, SJRP, UEC, US). Cotriguaçu, 10.VIII.1987, *J. Pivetta 277* (HB). Cuiabá, *C.A.W. Schwacke 4567* (RB). Itaúba, 6.XI.2015, *M.E. Engels 3805* (MBM). Poconé, 20.XII.1893, *C.A.M. Lindman A-2517* (US). Porto Esperidião, XI.1908, *F.C. Hoehne 804*, 805 (R). Vila Bela da Santíssima Trindade, Serra de Ricardo Franco, 29.VII.1974, *P.G. Windisch 641* (HB).

Asplenium auritum occurs from Florida to Argentina, and there are some records from Africa (Kessler & Smith 2018). For Brazil, it has been recorded in most states. It is epipetric or epiphytic, sometimes on decomposing fallen trunks, and occurs from 100–500 m elevation. It grows in all forest formations in Mato Grosso, from Amazon to gallery forests in the *Cerrado*.

The lamina morphology *of Asplenium auritum* is highly variable. The laminae of specimens from Mato Grosso are usually pinnate, sometimes pinnate-pinnatifid or rarely bipinnate at the base, with the basal pair of pinnae with an acroscopic auricle often cut to the costa. Although rare, specimens with prolonged rachis have been recorded (*P.G. Windisch 641*, HB).

1.4. ***Asplenium cirrhatum*** Rich. *ex* Willd., Sp. Pl., ed. 4. 5: 321. 1810. Fig. 3a-c

Terrestrial. Stem erect to ascending, scales lanceolate, 2–6 mm long. Leaves erect. Petiole 5–16 cm long, sulcate adaxially, lustrous, dark brownish to blackish, densely scaly at the base. Lamina pinnate, lanceolate, 10–30 × 3–9.5 cm, papyraceous, truncate at the base. Rachis ending with an elongated, proliferous tip. Pinnae in 11–17 pairs, petiolate, the medial pinnae patent to ascendent, base cuneate, slightly asymmetric, acroscopic auricle sometimes present, margin entire to serrate, apices obtuse, acute or attenuate. Veins 1-furcate. Sori linear, long, about 2/3 the length of lateral veins, indusia membranaceous to coriaceous. Spores with cristate perispore.

Examined material: Apiacás, Parque Nacional do Juruena, 6.X.2021, *P. Labiak 7747* (RB).

Figure 2 – *Asplenium auritum* – digital specimen image at the INCT Virtual Herbarium of Flora and Fungi (<https://specieslink.net/search/>). (*M.E. Engels 3805*, MBM).

Additional material: BRAZIL. RIO DE JANEIRO: Teresópolis, 30.VIII.1940, *A.C. Brade 16598* (RB).

Asplenium cirrhatum occurs from Mexico and Antilles to Bolivia (Kessler & Smith 2018). For Brazil, it has been recorded in the Amazon Rainforest (Acre, Amazonas, Rondônia, and Roraima) and the Atlantic Rainforest (Bahia to Rio Grande do Sul). It is the first record to Mato Grosso, where it grows in moist and shaded soils.

Asplenium cirrhatum and *A. flabellulatum* are representatives of the *Asplenium radicans* L. complex in Mato Grosso. This complex has a

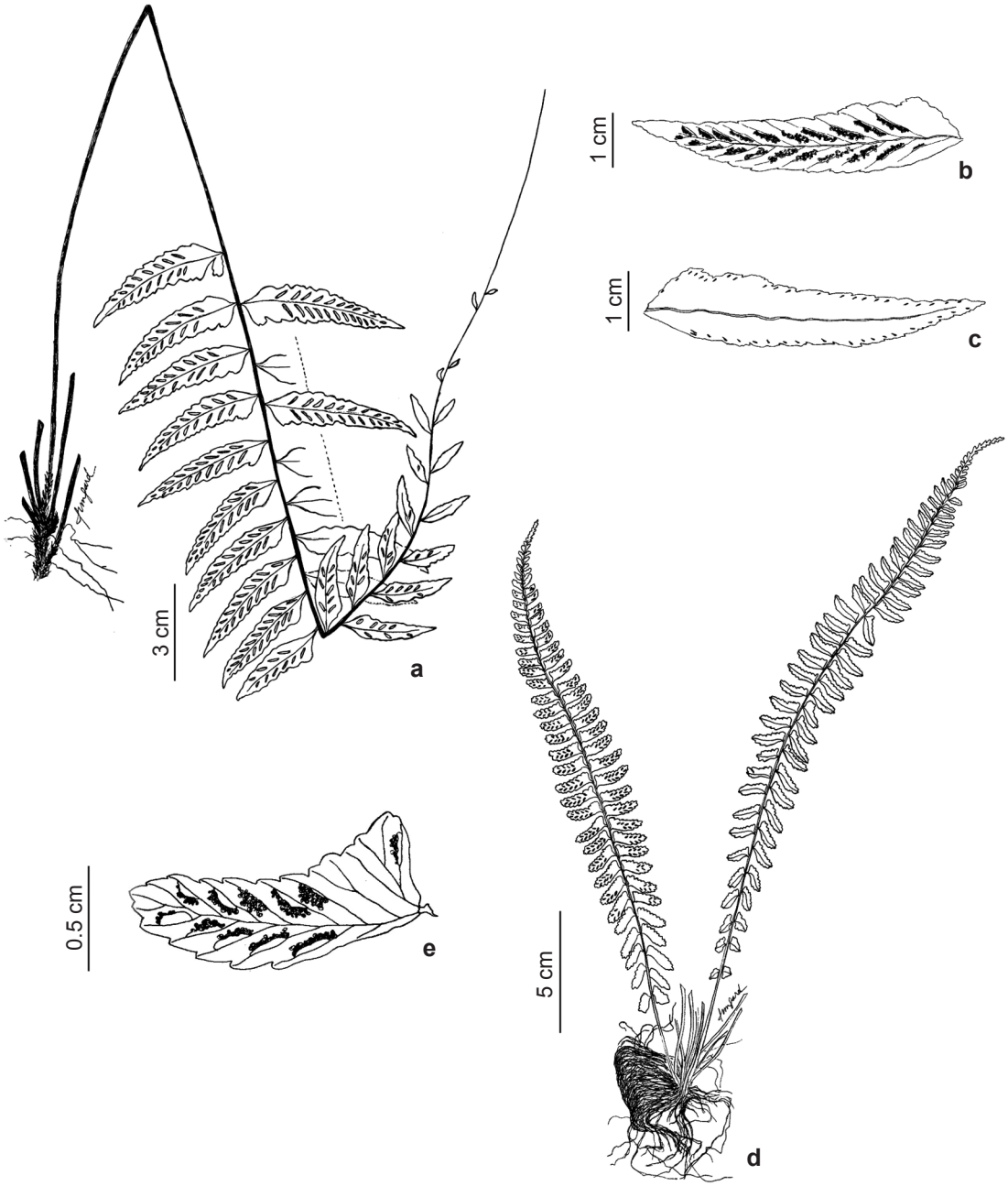

Figure 3 – a-c. *Asplenium cirrhatum* – a. habit; b. pinna (abaxial); c. pinna (adaxial). d-e. *A. claussenii* – d. habit; e. pinna. (a-c. *A.C. Brade 16598*, RB; d-e. *M.G. Santos & F.C. Pinheiro 1081*, RB).

lustrous rachis and petioles, lamina truncated at the base, and long, radicant rachis. *A. flabellulatum* differs by the lamina bipinnate-pinnatifid (*vs*. 1-pinnate in *A. cirrhatum*). *A. hallii* has a similar petiole and rachis, but its pinnae are reduced toward the base.

1.5. ***Asplenium claussenii*** Hieron., Hedwigia 60: 241. 1918. Fig. 3d-e

Terrestrial or epipetric. Stem erect to ascending, scales reddish brown, lanceolate, 2 × 0.5 mm. Leaves erect. Petiole 7–10 cm long, semi-cylindrical, flat adaxially, dull, grayish brown, narrowly alate. Lamina pinnate, lanceolate, 20–40 × 3–4(–5) cm, apex acuminate, base slightly reduced, glabrous. Rachis similar to petiole, glabrescent or with a few filiform scales. Pinnae in 35–50 pairs, subequilateral, with an acroscopic auricle, slightly incised basiscopically. Veins free, simple in the middle of pinnae. Sori medial, short, occasionally diplazioid on the auricle, indusia membranaceous. Spores with a cristate perispore.

Examined material: Cuiabá, Chapada dos Guimarães, 14.II.1988, *A. Salino 336* (UEC, GH, BHCB).

Additional material: BRAZIL. RIO DE JANEIRO: Niterói, Parque Estadual da Serra da Tiririca, 21.X.1998, *M.G. Santos & F.C. Pinheiro 1081*(RB).

Asplenium claussenii occurs in Argentina, Bolivia, Colombia, and Venezuela (Kessler & Smith 2018). For Brazil, it has been recorded in Bahia, Ceará, Mato Grosso, Pernambuco, and all states of the South and Southeast regions. It is terrestrial or epipetric and usually grows in humus on rocks in shaded and moist sites. It occurs inside gallery forests in the *Cerrado*.

1.6. ***Asplenium cristatum*** Lam., Encycl. Méth. 2: 310. 1786. Fig. 4a-b

Terrestrial, epiphytic, or epipetric. Stem short, scales dense, lanceolate, 2–3 × 0.5 mm, with yellowish lumina and brownish walls. Leaves erect. Petiole 3–8 cm long, sulcate adaxially, dull, alate distally, glabrescent. Lamina bipinnate-pinnatifid, oblong-lanceolate, 23–40 × 7–20 cm, membranaceous, apex acute to attenuate, basal pinnae reduced, glabrous. Rachis similar to petiole, with a few linear, brown scales, especially on the pinna axis. Pinnae in 13–32 pairs. Pinnules pinnatifid, basal acroscopic pinnules overlapping the rachis. Veins free, one per segment, apex not thickened. Sori elliptic, short, indusia membranaceous. Spores with a cristate perispore.

Examined material: unspecified locality, *R. Scolink & R. Luti* (US).

Additional material: BRAZIL. ESPÍRITO SANTO: Itaguaçu, 27.V.1946, *A.C. Brade et al. 18431* (RB). PARÁ: Parque Nacional da Amazônia, Base Uruá at km 67, *B.M. Torke et al. 1734* (HSTM).

Asplenium cristatum occurs from Florida to Bolivia (Kessler & Smith 2018). For Brazil, it has been recorded in Alagoas, Bahia, Ceará, Espírito Santo, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo. It grows in soil, or occasionally in humus on rocks, forming clumps in moist and shaded sites. It is found in Amazon Rainforest ecosystems and within gallery forests in the *Cerrado*. It can be confused with *A. cuneatum* Lam., which grows in neighboring states because both are bipinnate. However, *A. cuneatum* has deltoid laminae and proximal pinnae larger than the others, while *A. cristatum* has gradually reduced basal pinnae.

1.7. ***Asplenium dimidiatum*** Sw., Nov. Gen. Sp. Pl. Prod. 129. 1788. Fig. 4c-e

Epipetric or terrestrial. Stem erect, short, scales dark brown to blackish, linear-lanceolate, 5–8 × 0.5 mm. Leaves erect. Petiole 16–20 cm long, sulcate adaxially, dull, brown, with dense scales similar to the stem. Lamina pinnate, lanceolate, 15–29 × 9–12 cm, not or slightly reduced at the base. Rachis abundantly scaly, especially on the abaxial surface, on the pinna axis. Pinnae in 11–12 pairs, 4–8 × 1.3–2 cm, dimidiate, margins lacerate-serrate to deeply and irregularly erose-lacerate. Veins free, pinnate-flabelliform, spreading at 20º from the costa, scaly. Sori linear, covering the entire abaxial surface of the pinnae at maturity, usually ending near the margin. Spores with cristate perispore.

Examined material: unspecified locality, 22.I.1923, *S.C.* (RB 272629).

Additional material: BRAZIL. GOIÁS: Aporé, cachoeira do Rio Correntes, 610 m, 3.IV.1992, *P.G. Windisch et al. 6954* (SJRP). Queixada, 14.IV.1949, *A. Macedo 1853* (MBM, RB, SP, SPF, US).

Asplenium dimidiatum occurs in, Bolivia, Colombia, Costa Rica, the Greater Antilles, Peru, and Venezuela. (Kessler & Smith 2018). It has been recorded for Brazil in the Distrito Federal, Goiás, Mato Grosso, Minas Gerais, and São Paulo. It grows on soil or rocky banks, in shaded and moist sites in gallery forests, at 300–900 m elevation. *Asplenium praemorsum* is the most similar species in Mato Grosso, but it can be distinguished by the cuneiform segments of the pinnae and by the smaller stem scales (3–4 mm long).

1.8. ***Asplenium flabellulatum*** Kunze, Linnea 9: 71. 1834. Figs. 5a, 6

Terrestrial. Stem erect to ascending, scales linear-lanceolate to ovate-lanceolate, 4–7 mm long. Leaves erect, occasionally pendent due to the radicant apex. Petiole 25–30 cm long, sulcate adaxially, lustrous, dark brownish to blackish, densely scaly at the base. Lamina bipinnate-pinnatifid, rarely tripinnate at the base, deltate-lanceolate, 35–60 × 15–20 cm, membranaceous to chartaceous, truncate. Rachis ending in an elongated, proliferous tip. Pinnae in 19–26 pairs, subequilateral, short-petiolulate to subsessile. Pinnae-rachis alate. Pinnules in 6–12 pairs, the basal ones with 2–3 flabelliform segments acroscopically. Veins of segments flabellate. Sori short, 2–3 per segment. Spores with cristate perispore.

Selected examined material: Cuiabá, Chapada dos Guimarães, 14.II.1988, *A. Salino 331* (BHCB, GH,

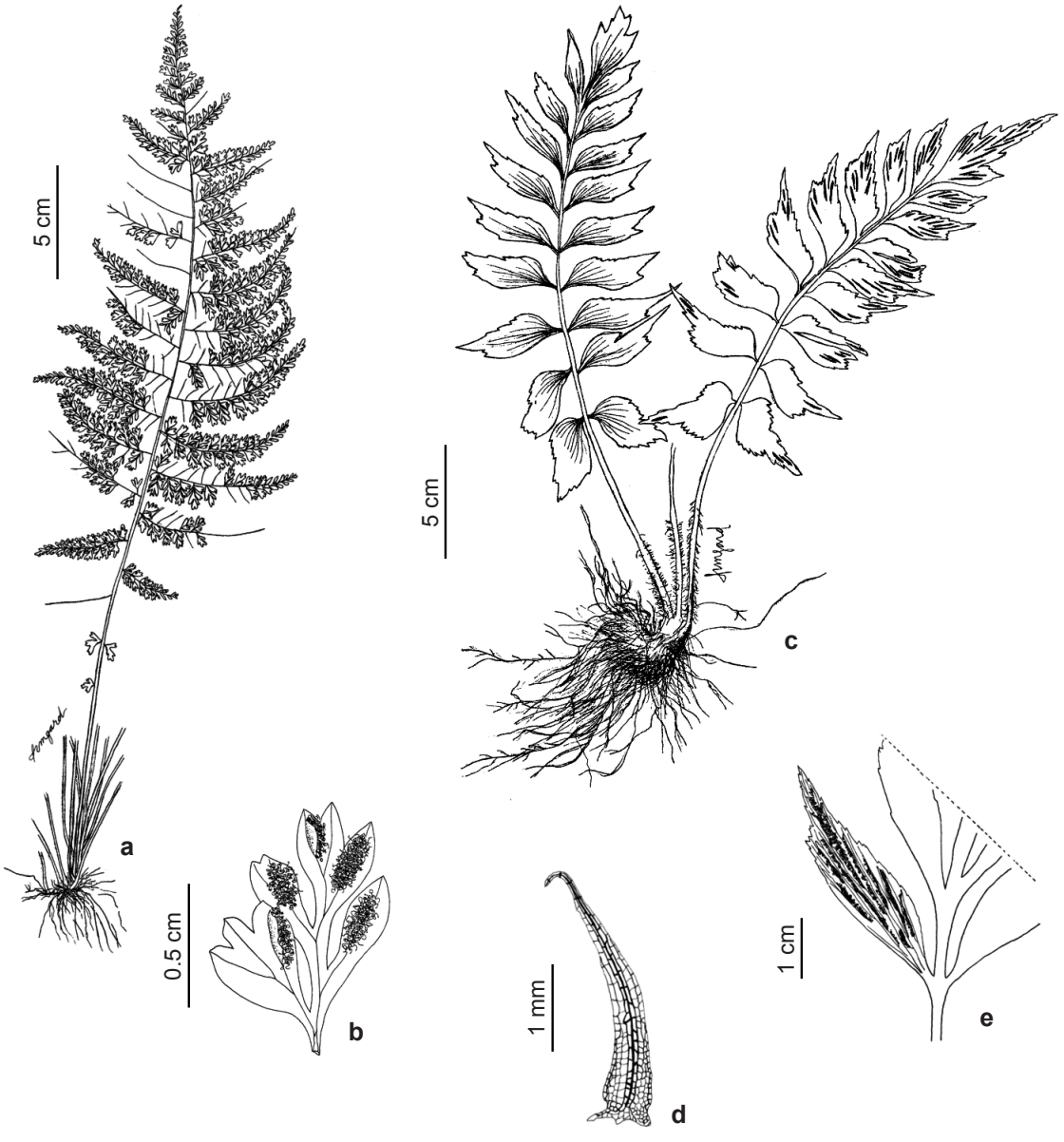

Figure 4 – a-b. *Asplenium cristatum* – a. habit; b. pinna. c-e. *A. dimidiatum* – c. habit; d. stem scale; e. distal pinna. (a-b. *A.C. Brade et al. 18431*, RB; c-e. *A. Macedo 1853*, RB).

MBM, UEC). Rosário Oeste, Santana da Chapada, 3.III.1902, *G.O.A. Malmae 2192* (B). Locality unknown, *Schwacke 4579* (RB).

Asplenium flabellulatum occurs from Mexico to Bolivia (Kessler & Smith 2018). It has been recorded for Brazil in Espírito Santo, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul, and São Paulo. It grows in moist and shaded soils along streams. It is common in gallery forests at 150–660 m elevation. *A. flabellulatum* is a unique representative of the *Asplenium radicans* L. complex in Mato Grosso. This complex has a lustrous rachis and petioles, lamina truncated at the base, and a long, radicant rachis. *A. hallii* has a similar petiole and rachis, but its pinnae are reduced toward the base.

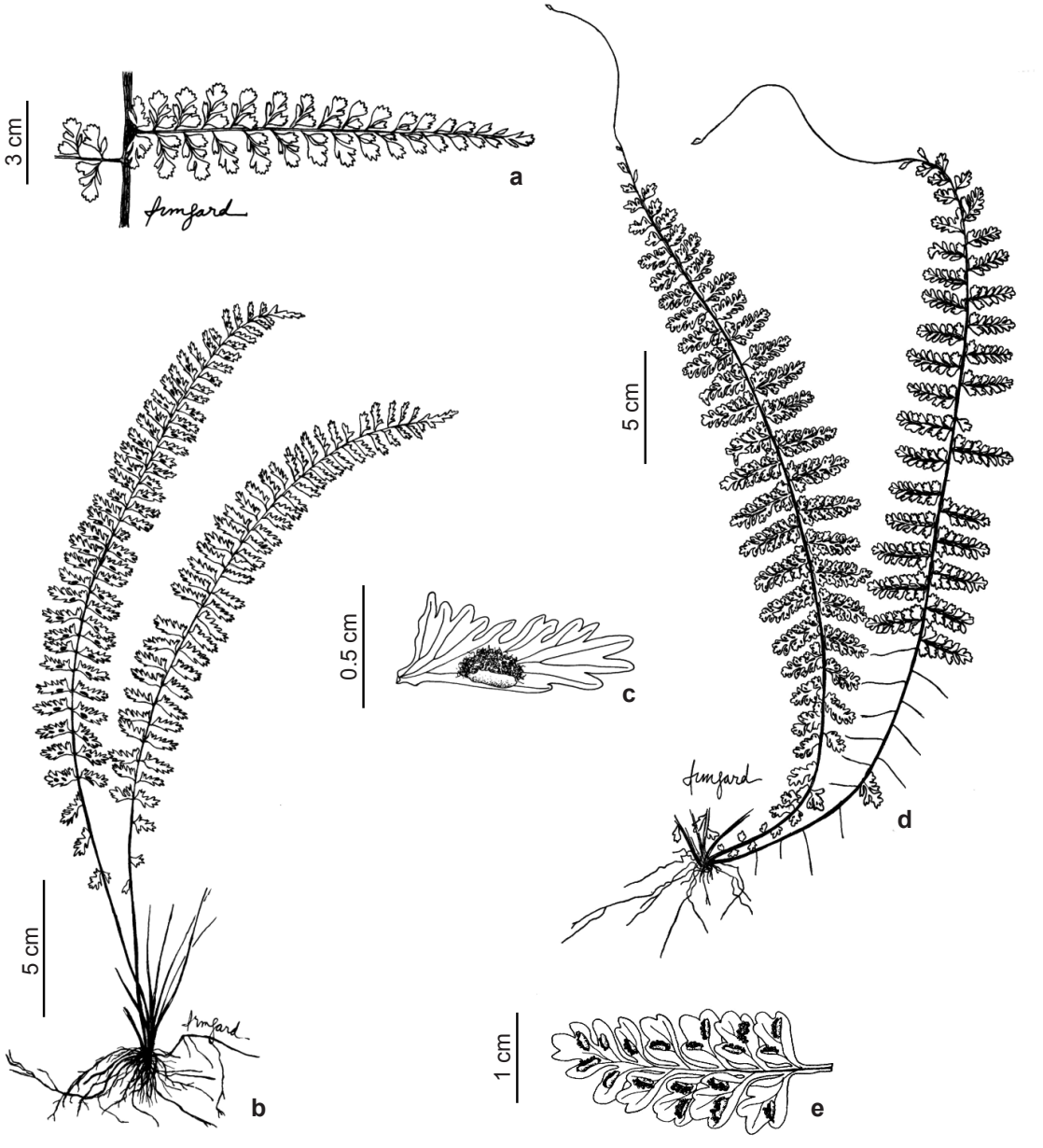

Figure 5 – a. *Asplenium flabellulatum*, pinna. b-c. *A. formosum* – b. habit; c. pinna. d-e. *A. hallii* – d. habit; e. pinna. (a. *Schwacke 4579*, RB; b-c. *A. Macedo 2182*, RB; d-e. *Sucre 9886*, RB).

Figure 6 – *Asplenium flabellulatum* – digital specimen image at the INCT Virtual Herbarium of Flora and Fungi (<https://specieslink.net/search/>). (*A. Salino 331*, BHCB).

1.9. *Asplenium formosum* Willd., Sp. Pl. Ed 4. 5: 329. 1810. Fig. 5b-c

Epipetric or epiphytic. Stem erect, scales slightly bullate, lanceolate, light brown at the margin, and dark brownish at the center. Leaves erect to pendent. Petiole 0.8–5.5 cm long, cylindrical to slightly flattened, lustrous, dark brownish to blackish, scarcely alate, with scales similar to the stem and a few trichomes at the base. Lamina pinnate, linear-lanceolate, chartaceous to coriaceous, 8–31 × 1.6–3(–4.6) cm, apex acute to acuminate. Rachis lustrous, similar to the petiole. Pinnae in 16–46 pairs, 0.7–1.5(–2.3) × 0.3–0.5 cm, short-petiolulate, asymmetric at the base, containing an acroscopic auricle, incised basiscopically, sub dimidiate, apex acute to obtuse, acroscopic margin deeply incised, apical pinna pinnatifid, elongate. Veins free, acroscopically forked at the base. Sori elliptic, short, near the margin, 1–3 on the basiscopic side. Indusia elliptic, membranaceous, margin subentire to slightly lacerate. Spores with cristate perispore.

Selected examined material: Alto Araguaia, 5.VII.1993, *C.E. Rodrigues 571* (SJRP). Alto Garças, 30.IX.1989, *P.G. Windisch 5512* (SJRP). Alto Taquari, 20.II.1996, *M.R. Pietrobom-Silva 2989* (CETES, HB, MBM, SPF). Itaúba, 13.V.2015, *M.E. Engels 3836* (MBM). Pedra Preta, 11.XI.1988, *P.G. Windisch* 5366 (FUFMT, SJRP).

Additional material: BRAZIL. GOIÁS: Queixada, 28.II.1950, *A. Macedo 2182* (MO, RB, US).

Asplenium formosum occurs from Mexico to Argentina and in Africa, Madagascar, southern India, and Sri Lanka (Kessler & Smith 2018). For Brazil, it has been recorded in Alagoas, Amazonas, Ceará, the Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Pernambuco, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo. It grows on mossy rocks or as an epiphyte, commonly along streams or inside wet forests, or rarely in soil covered by dense litter. It occurs in gallery forests in the *Cerrado* and, occasionally, in dry forests. This species can lose its leaves during the dry season, but the stem survives and can produce new leaves when environmental conditions are favorable. This explains its wide occurrence in more arid environments. *A. resiliens* is the most similar species to *A. formosum* in Mato Grosso. Still, it can be distinguished by the pinnae with entire margins, especially on the acroscopic side.

1.10. *Asplenium hallii* Hook., Sp. Fil. 3. 202. 1860. Fig. 5d-e

Epiphytic or hemiepiphytic. Stem erect, short, scales brown, linear-lanceolate, ca. 2.2 × 0.6 mm. Leaves erect to pendent. Petiole 0.5–2 cm long, bisulcate adaxially, lustrous, dark brownish to blackish, glabrous, narrowly alate. Lamina pinnate-pinnatifid, oblong-lanceolate, membranaceous to papyraceous, 10–35.5 × 2.5–5 cm, ending with an acute, proliferous apex. Pinnae in 15–43 pairs, 1.4–2.5 × 0.6–1 cm, basal pinnae reduced, medial pinnae oblong with a slightly developed acroscopic auricle overlapping the rachis, apical pinna rarely pinnatifid. Veins free, commonly not forked. Sori elliptic, short, 1–6 acroscopically, 1–5 basiscopicaly. Spores with cristate perispore.

Examined material: Novo Mundo, Parque Estadual do Cristalino, 1.VI.2007, *G.S. Henicka 69* (INPA). Cachoeira do Escondido, 28.I.2008, *D.C. Zappi et al. 936* (SPF).

Additional material: locality unknown, *D. Sucre 9886* (RB).

Asplenium hallii occurs from Colombia to Bolivia (Kessler & Smith 2018). For Brazil, it has been recorded in Acre, Amazonas, Mato Grosso, and Rondônia. It grows in shady and humid Amazon Rainforest, at 200–300 m elevation, in humus soil or occasionally on the lower branches of trees.

1.11. *Asplenium inaequilaterale* Willd., Sp. Pl. Ed. 4. 5: 322. 1810. Fig. 7a-b

Terrestrial or epipetric. Stem erect to ascending, scales lanceolate, dark brownish in the middle, and lighter on the margin. Leaves erect. Petiole 6.5–20 cm long, sulcate adaxially, gray to stramineous, dull, narrowly alate distally, scaly at the base. Lamina pinnate, lanceolate to ovate-lanceolate, 12–28 × 4–10 cm, membranaceous to papyraceous, glabrous, apex acute to acuminate, base truncate. Rachis narrowly alate, with linear-lanceolate scales, especially in the pinna axils. Pinnae in 11–18 pairs, 2.5–8 × 0.7–1.5, subequilateral, medial pinnae patent to ascending, basal pinnae patent to deflexed, petiolulate, with an acroscopic auricle, margin serrate to biserrate, apical pinna pinnatifid, deltate-elongate. Veins free, spreading at 35°–45° from the costa, 2(–3)-forked, apex slightly thickened, glabrous. Sori linear to curved somewhat, indusia thin, membranaceous. Spores with cristate perispore.

Selected examined material: Alta Floresta, 6-7.V.1986, *P. G. Windisch 4778* (SJRP). Colider, 14.I.1988, *A. Salino 291* (GH, UEC).

Additional material: BRAZIL. RIO GRANDE DO SUL: Sapiranga, 9.III.2000, *L.S. Sylvestre & A. Silva Jr. 1388* (RBR).

Asplenium inaequilaterale occurs in Argentina, Bolivia, and is also reported in Madagascar, the Mascarenes, southern India, and Sri Lanka (Kessler & Smith 2018). For Brazil, it has been recorded in

Alagoas, Bahia, Ceará, Mato Grosso, Mato Grosso do Sul, Pernambuco, and all the states of the South and Southeast regions. It is terrestrial or epipetric and grows in shady and moist sites, especially along streams. It is commonly associated with soils with rocks covered with humus and bryophytes. *A. abscissum* is the most similar species to *A. inaequilaterale* in Mato Grosso.

1.12. ***Asplenium juglandifolium*** Lam., Encycl. Méth. 2: 307. 1786. Fig. 8

Epiphytic. Stem erect, short, scales dark brown, lanceolate, 5–7 × 0.5 mm. Leaves erect. Petiole 6–23 cm long, sulcate adaxially, dull, stramineous, with scales similar to those on the stem. Lamina pinnate, ovate-lanceolate, 12–54 × 8–22 cm, chartaceous, glabrous, not reduced at the base, apical pinna similar to the lateral ones. Rachis stramineous, dull, slightly alate distally, glabrescent. Pinnae in 1–12 pairs, 9–13 × 1,5–2.5 cm, patent, ascending distally, petiolulate, margin entire to short serrate, base equilateral, apices long acuminate. Veins free, 2–3-forked, apex thickened. Sori linear, long, almost the same length as the lateral veins, indusia membranaceous. Spores with echinate perispore.

Examined material: Cotriguaçu, Parque Nacional do Juruena, 13.V.2018, *P. Labiak 7058* (RB).

Additional material: BRAZIL. AMAZONAS: Apuí, Parque Nacional do Juruena, 11.XII.2018, *P. Labiak 7594* (RB, RON).

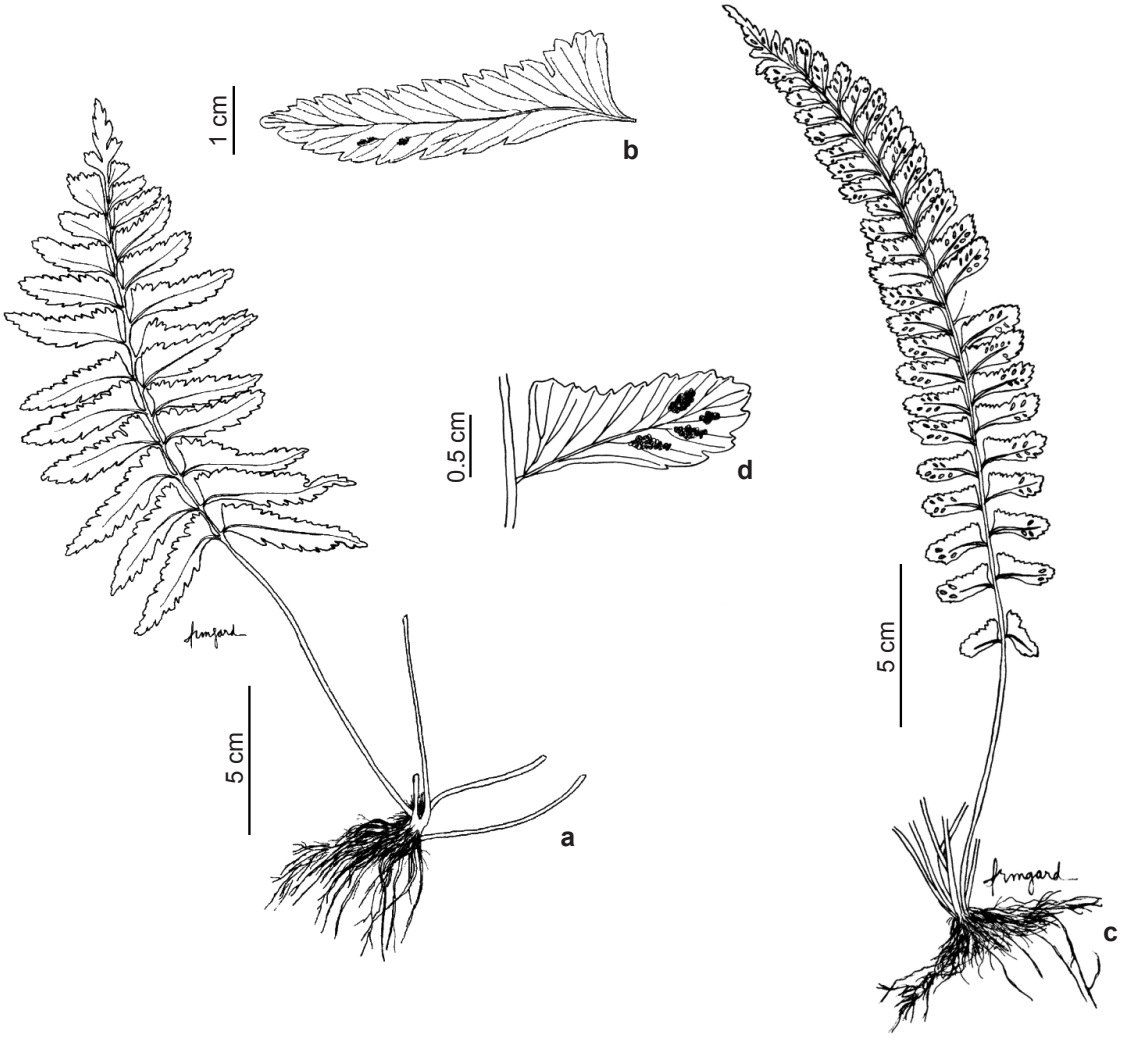

Figure 7 – a-b. *Asplenium inaequilaterale* – a. habit; b. pinna. c-d. *A. otites* – c. habit; d. pinna. (a-b. *L.S. Sylvestre & A. Silva Jr. 1388*, RBR; c-d. *Fernandes et al. 10*, RBR).

Figure 8 – *Asplenium juglandifolium* – digital specimen image at the INCT Virtual Herbarium of Flora and Fungi (<https://specieslink.net/search/>). (*P. Labiak 7594,* RON).

Asplenium juglandifolium occurs in the Antilles and from southern Mexico to Bolivia (Kessler & Smith 2018). In Brazil it has been recorded in Acre, Amazonas, Mato Grosso, Pará, Pernambuco, and Rondônia. It is the first record of Mato Grosso, as an epiphyte in the gallery forest. It is similar to *A. salicifolium*, differing by the subconform apical pinna and the auricle on the acroscopic base of the pinnae, frequently overlapping the rachis (vs. conform apical pinna and pinnae bases not overlapping the rachis in *A. junglandifolium*).

1.13. ***Asplenium otites*** Link., Hort. Berol. 2: 60. 1833. Fig. 7c-d

Terrestrial. Stem erect, short, scales deltate-elongate cells in the middle region with broad lumina and thick, darkish walls, and marginal cells with narrow lumina and light brown walls. Leaves erect to slightly curved. Petiole 4–10 cm long, 1/4 to 1/2 the length of the lamina, sulcate adaxially, green, dull, narrowly alate distally, with linear to linear-lanceolate scales. Lamina pinnate, lanceolate, 13–28 × 3.5–5 cm, membranaceous to papyraceous, glabrous, apex attenuate, base truncate. Rachis narrowly alate, covered with a few linear-filiform scales. Pinnae in 26–30 pairs, 1.5–2.5 × 0.5–0.8 cm, subequilateral, medial pinnae patent to ascending, basal pinnae deflexed, slightly or not reduced, petiolulate, margin irregularly dentate, apical pinna pinnatifid, caudate. Veins free, spreading at ca. 35° from the costa, 2-forked, apex sometimes slightly thickened. Sori elliptic, medial, short, indusia thin, membranaceous. Spores with cristate perispore.

Selected examined material: Alto Taquari, 20.II.1996, *M.R. Pietrobom-Silva 2989* (HB, MBM, SPF). Cáceres, 31.X.1987, *A. Salino 169* (GH, UEC). Cuiabá, Chapada dos Guimarães, 22.III.1983, *L. Carreira et al. 595* (INPA). Serra de Itapirapuan, 22. IV.1894, *C.A.M. Lindman 13369* (US). Vila Bela da Santíssima Trindade, Serra Ricardo Franco, 29.VII.1974, *P.G. Windisch 706* (HB). Unspecified locality, *H.H. Smith 33* (R).

Additional material: BRAZIL. SÃO PAULO: São José do Rio Preto, 22.XI.1997, *F.A. Fernandes et al. 10* (RBR, SJRP).

Asplenium otites occurs in Central America, Colombia, Paraguay, and Venezuela (Sylvestre 2001). For Brazil, it has been recorded in Acre, Bahia, Ceará, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Pernambuco, Rio de Janeiro, and São Paulo. It is terrestrial, grows on banks near streams, forming clumps, or sometimes occurs in humus on rocks or on fallen tree trunks. It is commonly found in gallery forests. This species resembles *A. claussenii* because of its laminar architecture. However, *A. claussenni* has pinnae with more developed auricles, a serrate-crenate margin and non-forked veins (except proximally), whereas *A. otites* have pinnae with a reduced or no auricle, a dentate margin, and forked veins (except distally).

1.14. ***Asplenium poloense*** Rosenst., Repert. Spec. Nov. Regni Veg. 12: 469. 1913. Fig. 9a-b

Terrestrial or epipetric. Stem erect, short, scales deltate-elongate, 1.5–2 × 0.4 mm, middle cells dark brownish to blackish, marginal cells lighter. Leaves erect to slightly curved. Petiole 1–3.5 cm long, less than 1/4 the length of the lamina, sulcate adaxially, greenish, dull, narrowly alate distally, with scales similar to those on the stem proximally and a few filiform, appressed scales distally. Lamina pinnate, deltate-lanceolate, curved, membranaceous, 4–20 × 1.2–3 cm, apex long-acuminate, caudate, slightly reduced at the base, glabrous. Rachis glabrescent, greenish, with a few filiform scales. Pinnae in 5–23 pairs, 0.7–1.5 × 0.3–0.5 cm, subequilateral, ascending, margin deeply serrate acroscopically, entire basiscopically. Veins free, spreading at ca. 45° from the costa, forked acroscopically, simple basiscopically, apex thickened. Sori elliptic, medial, short, indusia thin, membranaceous. Spores with cristate perispore.

Selected examined material: Cuiabá, Chapada dos Guimarães, 27.XII.1994, *P.G. Windisch 7717* (SJRP). Vila Bela da Santíssima Trindade, Serra Ricardo Franco, 29.VII.1977, *P.G. Windisch 1371* (BM, HB, HRCB). Unspecified locality, 1881-1886, *H.H. Smith* (CM 254110).

Additional material: BRAZIL. RONDÔNIA: *W.R. Anderson 12232* (NY, US).

Asplenium poloense occurs in Bolivia and Peru (Kessler & Smith 2018). It has been recorded for Brazil in Acre, Mato Grosso, Mato Grosso do Sul, Pará, and Rondônia. It is terrestrial or sometimes grows in humus on rocks near streams. It occurs in dryland and floodplain forests in Amazonia, and in gallery forests in the *Cerrado*, at 200–800 m elevation. Distinguishing *A. poloense* from *A. otites* and other similar species is complex and needs further study. In the circumscription adopted here, *A. otites* is bigger and has dentate margins, while *A. poloense* is smaller and has deeply incised margins.

1.15. ***Asplenium praemorsum*** Sw., Veg. Ind. Occ. Prodr. 130. 1788. Fig. 9c-d

Epipetric or epiphytic. Stem erect, ascending or creeping, scales dense, dark brownish to blackish, linear-lanceolate, 3–4 mm long. Leaves erect to curved. Petiole 4.5–10 cm long, thin, light brown to stramineous, densely covered with filiform to linear-lanceolate scales. Lamina lanceolate, pinnate to pinnate-pinnatifid, 9–30 × 3–10 cm, chartaceous, with filiform to stellate scales. Rachis with caducous scales similar to those on the stem. Pinnae in 6–16 pairs, 2.5–5 × 1–2.5 cm,

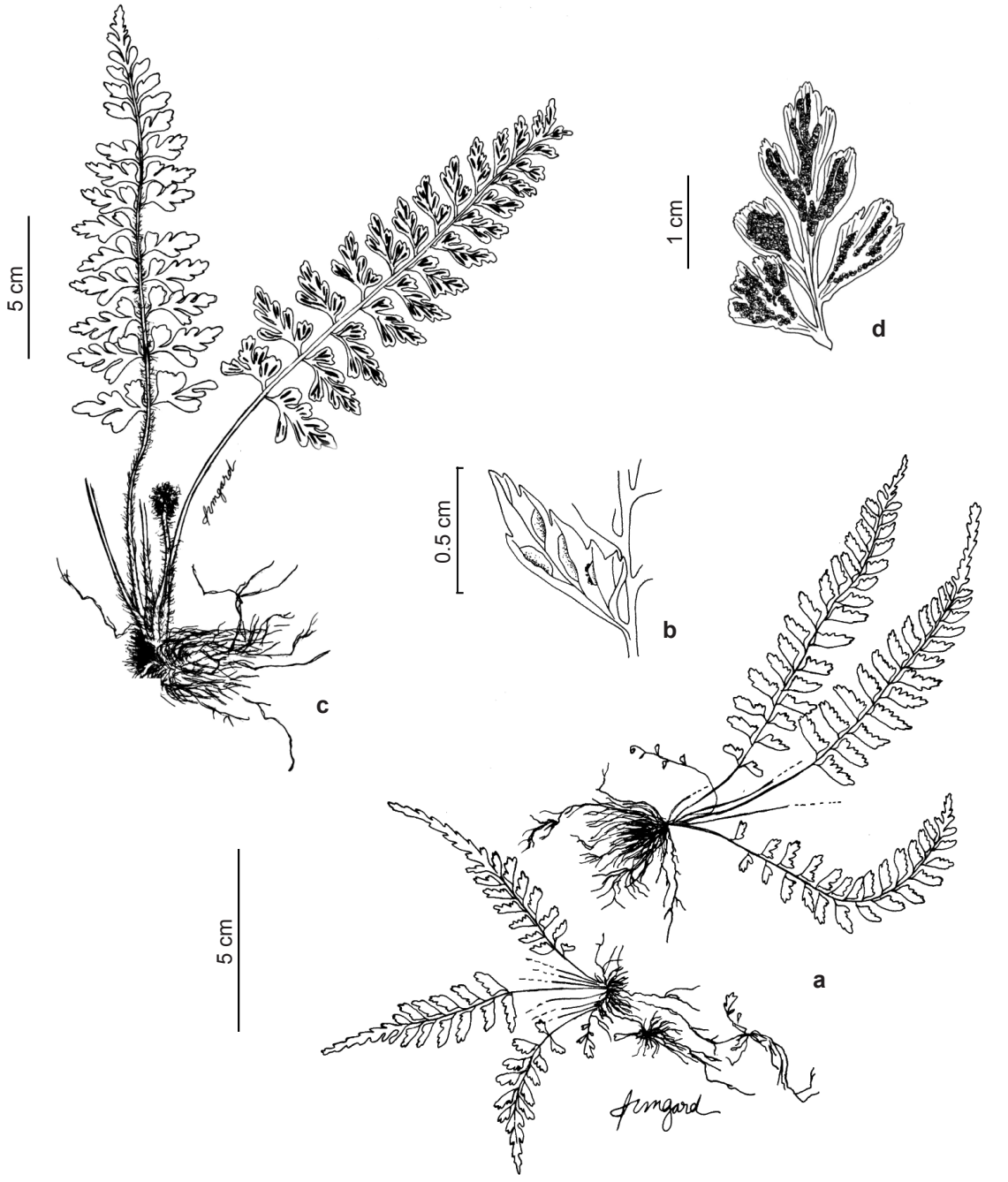

Figure 9 – a-b. *Asplenium poloense* – a. habit; b. pinna. c-d. *A. praemorsum* – c. habit; d. pinna. (a-b. *W.R. Anderson 12232,* NY; c-d. *A.C. Brade 19790*, RB).

subequilateral, margin deeply lobate, lobes 3–6, cuneiform. Veins free, forked, flabelliform in the segments. Sori linear, covering the entire abaxial surface of the segments at maturity, unilateral to rarely diplazioid, indusia coriaceous. Spores with cristate perispore.

Selected examined material: Cuiabá, 1939-1940, *R. Schaefer* (HB 56327). Unspecified locality, *H.H. Smith 34* (R, US).

Additional material: BRAZIL. ESPÍRITO SANTO: Castelo, 25.I.1973, *A.C. Brade 19790* (RB).

Asplenium praemorsum occurs in the Antilles and from Mexico to Argentina (Kessler & Smith 2018). For Brazil, it has been recorded in Bahia, Ceará, the Distrito Federal, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pernambuco, Rio de Janeiro, Santa Catarina, and São Paulo. It is epiphytic or grows in humus on rocks or soil in gallery forests. On farms, it is occasionally found on walls or isolated trees. *A. dimidiatum* is the most similar species.

1.16. ***Asplenium pumilum*** Sw., Nov. Gen Sp. Pl. Prodr. 129. 1788. Fig. 10a

Terrestrial or epipetric. Stems erect, short, scales dark brownish, linear-lanceolate to lanceolate, 2.5 × 0.02–0.03 mm. Leaves erect. Petiole 2.5–10 cm long, lustrous at the base, sulcate adaxially, alate distally, covered with a few long trichomes and linear scales. Lamina pinnate to bipinnate at the base, deltate, membranaceous, green, 3–10 × 4–8 cm, apex acute. Rachis dull to lustrous, blackish in the middle, bearing green wings, covered with pluricellular whitish trichomes adaxially, these sparse abaxially. Pinnae in 1–4 pairs, lanceolate, apex acute to attenuate, margin serrate, basal pinnae longer, 1.8–10 cm long, much more developed basiscopically than acroscopically, medial pinnae 1.2–4 cm long, apical pinna pinnatifid. Veins free, spreading at 50°–55° from the costa, 2–3-forked, flabellate in the young leaves, covered with whitish trichomes. Sori linear, medial, indusia thin, membranaceous. Spores with cristate perispore.

Selected examined material: Cáceres, Serra das Araras, VI.1988, *P.G. Windisch* (RBR 15364). Unspecified locality, *H.H. Smith 41* (R).

Additional material: BRAZIL. BAHIA: Iraquara, 14.VI.1981, *B.M. Boon et al. 1210* (CEPEC, K, MO, NY).

Asplenium pumilum occurs in Florida, the Antilles, from Mexico to Argentina, Africa, Madagascar, and India (Kessler & Smith 2018). It has been recorded for Brazil in Bahia, Ceará, Mato Grosso, Minas Gerais, Pernambuco, São Paulo, and Sergipe. It occurs in *Cerrado* areas, grows on rocks or in stony, dry soil, commonly in shaded sites, and is associated with organic matter. This species has a unique morphology in *Asplenium*, especially due to the reduced number of pinnae, associated with a basal pinna longer than the others, much more developed basiscopically than acroscopically.

1.17. ***Asplenium resiliens*** Kunze, Linnaea 18: 331. 1844. Fig. 10b-c

Epipetric. Stem erect, scales blackish, lanceolate, 2.5–3 × 0.5 mm. Leaves erect to tortuous. Petiole 0.7–1 cm long, lustrous, flattened adaxially, base with scales similar to those on the stem, these filiform to linear distally. Lamina pinnate, linear-lanceolate, 7–12 × 0.7–1.5 cm, apex acute, pinnae reduced to the auriculate basal pair, glabrous. Rachis with filiform to linear scales in the pinna axils. Pinnae subequilateral, margin slightly crenate acroscopically and entire basiscopically, apical pinna subentire, triangular. Veins free, simple, forked in the auricle of the larger pinnae. Sori elliptic, short, 1/2 the length between costa and margin, covering the entire abaxial surface of the pinnae at maturity, indusia thin, membranaceous. Spores with cristate perispore.

Examined material: Barra do Garças, 24.II.1982, *W.R. Anderson 12440* (MBM).

Additional material: BRAZIL. SANTA CATARINA: Lages, IV.1906, *C. Spannagel 240* (HBR, NY, US).

Asplenium resiliens occurs in Jamaica, Hispaniola, and from the southern USA to Argentina (Kessler & Smith 2018). It has been recorded for Brazil in Mato Grosso, Rio de Janeiro, Rio Grande do Sul, and Santa Catarina. It is commonly found in sandstone formations, streams, waterfalls, and in shady sites. It occurs from 300–500 m elevation. The most similar species in Mato Grosso is *A. formosum*.

1.18. ***Asplenium salicifolium*** L., Sp. Pl. 2: 1080. 1753. Fig. 10d-f

Epiphytic, epipetric, or rarely terrestrial. Stem erect, short, scales yellowish brown, lanceolate, 3–6 × 0.5–1.0 mm. Leaves erect. Petiole 7.5–17 cm long, sulcate adaxially, dull, brown to stramineous, with scales similar to those on the stem distally. Lamina pinnate, oblong-lanceolate, 12–35 × 7–15 cm, chartaceous, glabrous, not reduced at the base, apex acute. Rachis stramineous, dull, not or slightly alate distally, glabrescent. Pinnae in 5–15

pairs, 3–8 × 1–2 cm, subequilateral, patent, slightly ascending distally, petiolulate, margin crenate to serrate, with an acroscopic auricle overlapping the rachis, apical pinna subconform, auriculate at the base. Veins free, 1–2-forked at the base, 1-forked in the middle, and simple at the apex of the pinnae. Sori linear, broad, indusia chartaceous. Spores with echinate perispore.

Selected examined material: Alto Taquari, 20.II.1996, *M.R. Pietrobom-Silva 2992* (CETES, SJRP, SPF). Cuiabá, Chapada dos Guimarães, 16.II.1988, *A. Salino* 378 (UEC). Vila Bela da Santíssima Trindade, Serra Ricardo Franco, 19.XII.1977, *P.G. Windisch 1367* (HB, SJRP).

Additional material: BRAZIL. GOIÁS: Goiânia, XII.1936, *A.C. Brade 15352* (HB, RB).

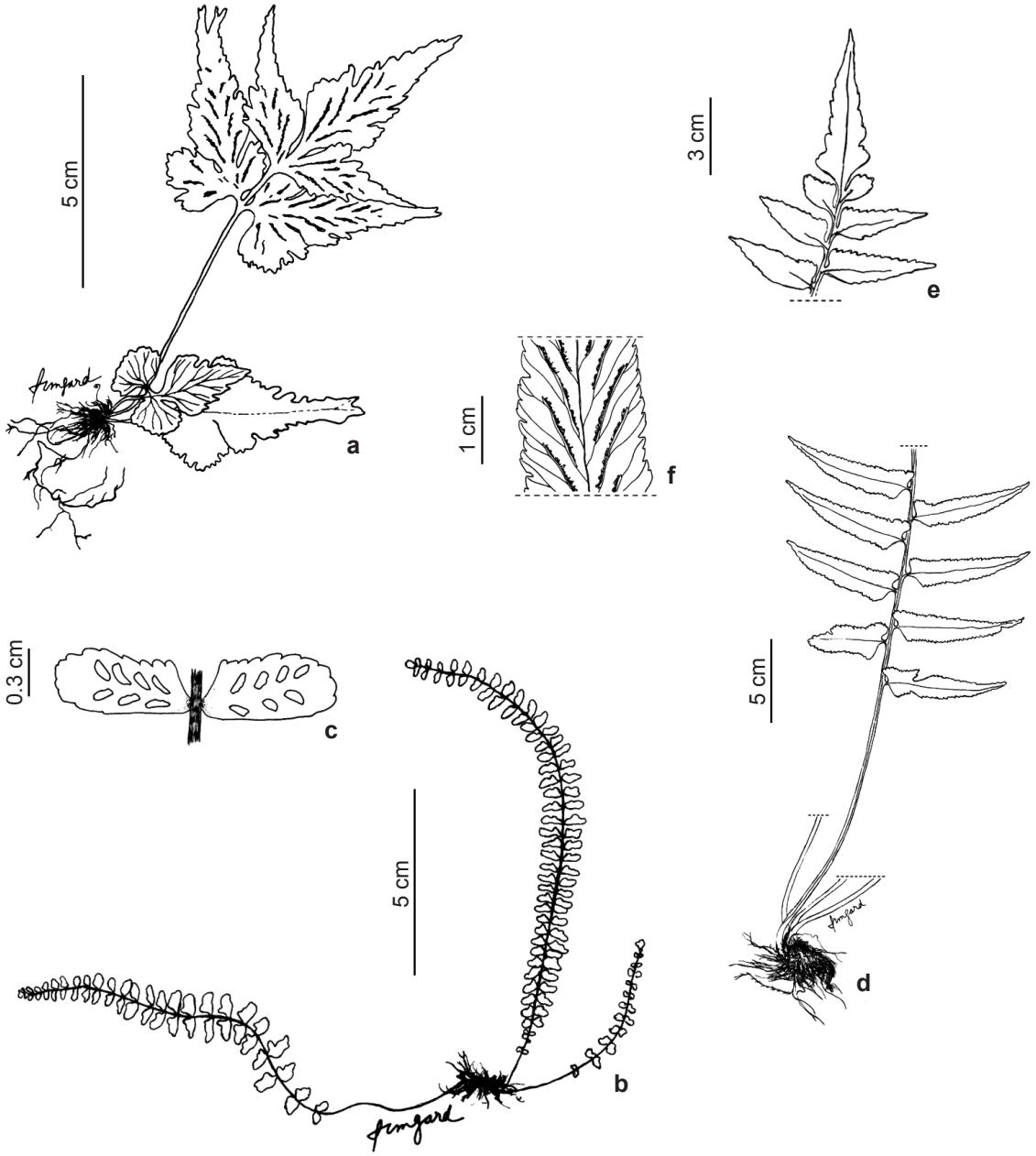

Figure 10 – a. *Asplenium pumilum* – habit. b-c. *A. resiliens* – b. habit; c. pinnae. d-f. *A. salicifolium* – d. habit; e. lamina apices; f. pinna. (a. *B.M. Boon et al. 1210*, NY; b-c. *C. Spannagel 240*, NY; d-f. *A.C. Brade 15352*, HB).

Asplenium salicifolium occurs in the Antilles and from southern Mexico to Bolivia (Kessler & Smith 2018). It has been recorded for Brazil in Amapá, Bahia, Ceará, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Pernambuco, and Roraima. It is epiphytic, grows on humid rocks, or is rarely terrestrial in stony soil. It occurs from 400–700 m elevation in gallery forests and hillside forests in the *Cerrado*. The combination of a pinnate lamina, subconform apical pinna, and echinate spores distinguishes this species. *A. juglandifolium* is differentiated by its pinnae with an equilateral base that does not overlap the rachis.

1.19. *Asplenium serra* Langsd. & Fisch., Pl. Voy. Russes Monde Icon. Fil. 16 (t.19). 1810. Fig. 11

Terrestrial, epipetric, or epiphytic. Stem short to long-creeping, scales dense, dark brownish, lanceolate, with a hyaline lumen. Leaves erect. Petiole 17–55 cm long, sulcate adaxially, dull, brown, with scales similar to those on the stem base and a few (rarely many) thin scales in the middle and distally. Lamina pinnate, chartaceous, 19–40 × 10–22 cm, slightly or not reduced toward the base and apex. Rachis scales with elongated apices, especially in the pinna axils. Pinnae in 7–15 pairs, 5–15 × 1.2–2 cm, subequilateral, patent to ascending, petiolulate, margin regularly serrate, simple or double toothed, deeply serrate on apex pinnae, apical pinna subconform, with a basal lobe on both sides. Veins free, 1–3-forked, with a few small scales. Sori short, approximate, parallel to costae, indusia membranaceous. Spores with reticulate perispore.

Selected examined material: Cuiabá, Chapada dos Guimarães, 27.XII.1994, *P.G. Windisch 7693* (RB, SJRP). Rosário do Oeste, Santana da Chapada, 9.VIII.1902, *G.O.A. Malmae 2233* (US). Rosário do Oeste, Santana da Chapada, 1939-1940, *R. Schaefer* (HB 59502). Unspecified locality, 1881-1886, *H.H. Smith 37* (P, R).

Asplenium serra occurs in the Antilles, from Mexico to Bolivia, Argentina and Uruguay (Kessler & Smith 2018). It has been recorded for Brazil in Acre, Alagoas, Amazonas, Bahia, Ceará, the Distrito Federal, Mato Grosso, Mato Grosso do Sul, Pará, Pernambuco, Roraima, and all the states of the South and Southeast regions. It is commonly terrestrial or less often grows on rocks or as an epiphyte at 150–650 m elevation. This species has a broad circumscription in several neotropical floras and represents a complex of closely related species.

1.20. *Asplenium serratum* L., Sp. Pl. 2: 1079. 1753. Fig. 12

Epiphytic, epipetric, or rarely terrestrial. Stem erect, short, thick, scales dense, linear-lanceolate to lanceolate, brown to dark brownish. Leaves erect, forming a rosette. Petiole 2–7.5 cm long, about 1/20 the length of the lamina, planate to sulcate adaxially, dull, stramineous adaxially, and yellowish brown to blackish abaxially, bearing scales at the base. Lamina simple, entire, lanceolate, chartaceous, 15–100 × 4–12 cm, apex acuminate, base decurrent, margin subentire to serrate. Veins free, spreading at 55°–75° from the midrib, 1–2-forked in the middle, midrib blackish, with a few small, triangular to linear-lanceolate scales. Sori linear, elongate, approximate, ending 1/3 before the lamina margin, indusia membranaceous to coriaceous. Spores with a cristate perispore.

Selected examined material: Alta Floresta, 5.V.1986, *P.G. Windisch 4746* (SJRP, US). Aripuanã, 9.VII.1977, *M.G. Silva & J. Maria 3311* (MG). Colider, 14.I.1988, *A. Salino 296* (BHCB, GH, UEC). Cotriguaçu, 13.V.2018, *P. Labiak 7063* (RB). Figueirópolis D'Oeste, 29.XII.1994, *P.G. Windisch 7380*. Guarantã do Norte, Serra do Cachimbo, 19.VII.1995, *A.P.N. Soares 77* (RBR, SJRP). Novo Mundo, Parque Estadual do Cristalino, 1.VI.2007, *G.S. Henicka 70* (SPF). Vila Bela da Santíssima Trindade, 11-14.I.1987, *J. Prado & A. Salino 21* (HUCS, SPF, UEC).

Asplenium serratum occurs in the Antilles, from Mexico to Bolivia, and in Paraguay and Argentina (Kessler & Smith 2018). It has been reported for almost all the states of Brazil, except Goiás, Rio Grande do Norte, Rio Grande do Sul, and Sergipe. It is commonly found as an epiphyte, on tree trunks or branches, and occasionally forms dense populations in humus on rocks. It occurs in shady and wet sites near rivers and streams in Amazon Rainforest ecosystems.

Specimens of *A. serratum* with an intermediate morphology between *A. angustum* and *A. stuebelianum* are often challenging to differentiate. *A. angustum* differs by the very narrow lamina (< 3.5 cm wide) with an acute to caudate apex and acute vein angles (*vs.* broad lamina, acuminate apex, and obtuse vein angles in *A. serratum*). It differs from *A. stuebelianum* by the abruptly reduced lamina and long petioles (*vs.* decrescent lamina, gradually narrowing toward a very short petiole in *A. serratum*).

1.21. *Asplenium stuebelianum* Hieron., Hedwigia 47: 222. 1908. Fig. 13a

Terrestrial, epipetric, or rarely epiphytic. Stem erect, scales dark brownish, linear-lanceolate

Figure 11 – *Asplenium serra* – digital specimen image at the INCT Virtual Herbarium of Flora and Fungi (<https://specieslink.net/search/>). (*G.O.A. Malmae 2233*, US).

Figure 12 – *Asplenium serratum* – digital specimen image at the INCT Virtual Herbarium of Flora and Fungi (<https://specieslink.net/search/>). (*A. Salino 296*, UEC).

to lanceolate. Leaves erect. Petiole 3(–5)–15 cm long, 1/7 to 1/2 the length of the lamina, planate or rarely sulcate adaxially, dull, stramineous to blackish, non-alate, with scales similar to those on the stem base. Lamina simple, entire, spathulate to elliptic-oblong, membranaceous to chartaceous, 23–73 × 4–9 cm, apex acuminate, occasionally radicant at the end of the midrib, base abruptly reduced and then long-attenuate, margin irregularly serrate, sinuate. Veins free,

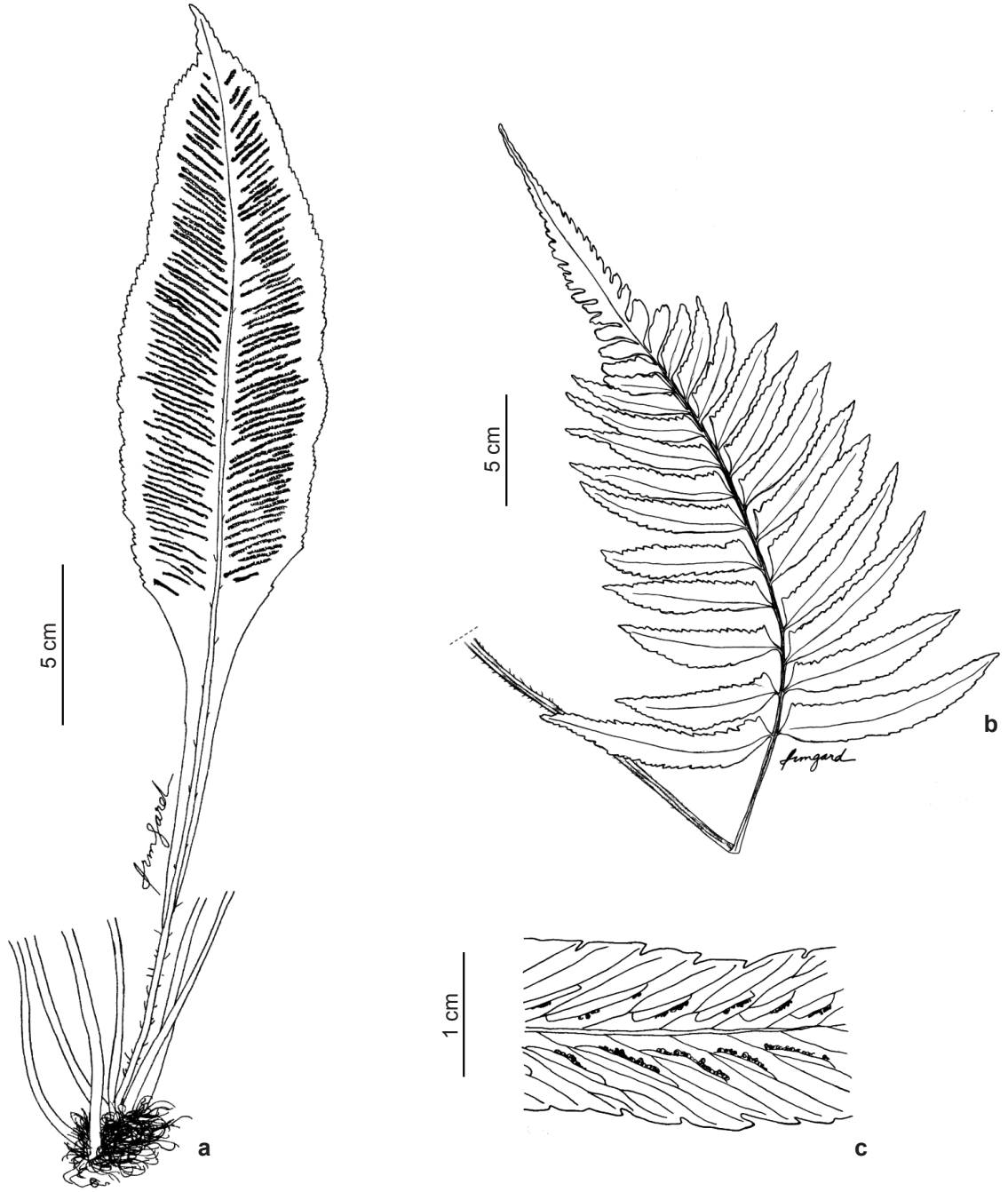

Figure 13 – a. *Asplenium stuebelianum* – habit. b-c. *Hymenasplenium delitescens* – b. habit; c. Pinna. (a. *A.C. Brade et al. 18447,* RB; b-c. *A. Fay & L. Fay 2644*, SJRP).

spreading at 65°–75° from the midrib, 1–2-forked, 1-forked at the base, midrib bearing a few small, brownish, triangular to linear-lanceolate scales. Sori linear, elongate, approximate, ending near margin, indusia membranaceous. Spores with cristate perispore.

Selected examined material: Canarana, 14.X.1990, *P.G. Windisch 5854* (SJRP). Colíder, 22.VI.2016, *M.E. Engels 4619* (MBM, RB). Cuiabá, Chapada dos Guimarães, 14. IX.1981, *G. Guarim Neto et al. 461* (FUFMT, HRCB). Juína, 17.IX.1987, *J. Pivetta 1472* (HB). Jauru, 9.XII.1991, *P.G. Windisch 6730* (SJRP). Marcelândia, 16.VII.1991, *P.G. Windisch 6443* (SJRP). Vila Bela da Santíssima Trindade, Serra de Ricardo Franco, 2.II.1978, *P.G. Windisch 1540* (HB, HRCB). Xavantina, 9.VII.1968, *J.A. Ratter et al. 2116* (K, NY, P, UB, US).

Additional material: BRAZIL. ESPÍRITO SANTO: Itaguaçu, 28.V.1946, *A.C. Brade et al. 18447* (HB, NY, RB).

Asplenium stuebelianum occurs from Venezuela to Bolivia (Kessler & Smith 2018). For Brazil, it has been reported for Acre, Amazonas, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Rondônia, and São Paulo. It occurs in shady and wet sites, near rivers and streams, from 200–850 m elevation. This species is quite common in gallery forests in *Cerrado* in Mato Grosso. The most similar species in the area is *A. serratum*.

2. *Hymenasplenium* Hayata, Bot. Mag. (Tokyo) 41: 712. 1927.

Terrestrial, epipetric, or epiphytic. Sclerenchymatous cells in the inner cortex of the roots equally thick (circumendodermal band). Stems long-creeping, dorsiventral dictyostelic, green to blackish, commonly scaly at the apex. Petioles circular, scaly at the base, and glabrescent distally, alate or non-alate. Lamina 1-pinnate, rarely simple, membranaceous to chartaceous. Veins free, forked, or, less commonly, anastomosing. Sori elliptic to elongate, unilateral to rarely diplazioid. Spores monolete with a cristate, echinate, or reticulate perispore. X = 38 or 39. (Ogura 1972; Wetzel *et al.* 2017).

2.1. *Hymenasplenium delitescens* (Maxon) L. Regalado & Prada, Amer. Fern J. 101(4): 278. 2011. *Diplazium delitescens* Maxon Contr. U.S. Natl. Herb. 10: 497, pl. 56, f. 1. 1908. Fig. 13b-c

Terrestrial or epipetric. Stem short-creeping, scales linear-lanceolate, 2.5 × 0.3–0.5 mm, with blackish cell walls and yellow lumina. Leaves erect. Petiole 14–21.5 cm long, dull, brown to stramineous, non-alate, sulcate adaxially, with trichomes proximally, glabrescent at the apex. Lamina pinnate, ovate-lanceolate, patent, 21–24 × 17–15 cm, not reduced at the base, apex acuminate. Rachis lighter than the petiole, narrowly alate distally. Pinnae in 6–8 pairs, apex acute to acuminate, base asymmetric, margin narrowly serrate, apical pinna pinnatifid. Veins free, 2–3-forked at the apex, often slightly thickened. Sori medial, linear, diplazioid. Spores with a cristate perispore.

Examined material: Colider, Fazenda Gaúcha, 14.I.1988, *A. Salino 295* (BHCB, GH, UEC).

Additional material: BRAZIL. RONDÔNIA: Colorado do Oeste, Sítio Três Irmãos, 12.VII.2007, *S.Z. Neiva 476* (RBR). BOLÍVIA. BENI: Ballivian, 7.VII.1990, *A.Fay & L. Fay 2644* (SJRP).

Hymenasplenium delitescens occurs in Cuba, from Mexico to Venezuela and Bolivia (Kessler & Smith 2018). It has been reported for Brazil in Acre, Mato Grosso, Pará, and Rondônia. It is commonly terrestrial and grows along streams in the Amazonian "Terra Firme" forest. It is similar to *Asplenium abscissum* by the lamina architecture, but the diagnostic characters between genera differentiate these species.

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Data availability statement

In accordance with Open Science communication practices, the authors inform that all data are available within the manuscript.

References

Copeland EB (1947) Genera filicum, the genera of ferns. Chronica Botanica, Waltham. 247p.

Ferns and Lycophytes in Flora e Funga do Brasil (2023, continuously updated) Jardim Botânico do Rio de Janeiro. Available at <https://floradobrasil.jbrj.gov.br/FB128483>. Access on 24 May 2023.

Hayata B (1927) On the systematic importance of the stelar system in the Filicales. Botanical Magazine 41: 697-715. 1927.

Hieronymus G (1908) Plantae Stübelianae. Pteridophyta. Von Dr. Alphons Stuebel auf seinen Reisen nach Südamerika besonders in Colombien, Ecuador, Peru und Bolivien gesammelte Pteridophyten (Gefäßkryptogamen). Hedwigia 47: 204-249.

Hieronymus G (1918 [1819]) Aspleniorum species novae et non satis notae. Hedwigia 60: 210-266.

Hooker WJ (1860) Species Filicum 3. William Pamplin, London. 291p.

IPNI (2023) International Plant Names Index. The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Herbarium. Available at <http://www.ipni.org>. Access on 25 July 2023.

Kessler M & Smith AR (2018) Prodromus of a fern flora for Bolivia. XXIX. Aspleniaceae. Phytotaxa 344: 259-280.

Kramer KU & Viane R (1990) Aspleniaceae. *In*: Pteridophytes and gymnosperms Springer, Berlin, Heidelberg. Pp. 52-57.

Kunze G (1834) Synopsis plantarum Cryptogamicarum. Linnaea 9: 1-111.

Kunze G (1844) Filices a Leiboldo in Mexico lectae. Linnaea 18: 303-352.

Lamarck J (1786) Encyclopédie Méthodique. Botanique 2. Paris. 774p.

Langsdorff GH & Fischer FEL (1810) Plantes Recueillies Pendant le Voyage des Russes Autour du Monde. Tubingen. 26p.

Lellinger DB (2002) A modern multilingual glossary for taxonomic pteridology. The American Fern Society 3: 264.

Link HF (1833) Hortus Regius Botanicus Berolinensis descriptus 2. Berlim. 376p.

Linnaeus C (1753) Species Plantarum 2. L. Salvius, Stockholm. 1200p.

Maxon WR 1908. Studies of Tropical American ferns. No. 1. Diplazium delitescentes. Contributions from the United States National Herbarium 10: 473-503.

Newman E (1840) A history of British ferns. J. Van Voorst, London. 344p.

Ogura Y (1972) Comparative anatomy of vegetative organs of the pteridophytes. Gebr. Borntraeger, Berlin. 502p.

Pichi-Sermolli RE (1977) Tentamen Pteridophytorum genera in taxonomicum ordinem redigendi. Webbia 31: 313-512.

Ponce M, Kieling-Rubio MA & Windisch PG (2010) The genus *Thelypteris* (Thelypteridaceae, Polypodiopsida) in Mato Grosso state, Brazil: subgenera *Goniopteris* (C. Presl) Duek and *Meniscium* (Schreb.) C.F. Reed. Acta Botanica Brasilica 24: 718-726.

PPG-I (2016) A community-derived classification for extant lycophytes and ferns. Journal of Systematics and Evolution 54: 563-603.

Regalado LG & Prada C (2011) The genus Hymenasplenium (Aspleniaceae) in Cuba, including new combinations for the Neotropical species. American Fern Journal 101: 265-281.

Reis A (2022) Taxonomia do complexo *Asplenium serratum* (Aspleniaceae) na Mata Atlântica brasileira. Dissertação de Mestrado. Universidade Federal do Rio de Janeiro, Rio de Janeiro. 77p.

Rosenstock E (1913) Filices novae a cl. Dr. O. Buchtien in Bolivia collectae. Repertorium Specierum Novarum Regni Vegetabilis 12: 468-480.

Rothfels CJ, Sundue MA, Kuo L-Y, Larsson A, Kato M, Schuettpelz E & Pryer KM (2012). A revised family-level classification for eupolypod II ferns (Polypodiidae: Polypodiales). Taxon 63: 515-533.

Schneider H, Russell SJ, Cox CJ, Bakker F, Henderson S, Rumsey F, Barrett J, Gibby M & Vogel JC (2004) Chloroplast phylogeny of asplenioid ferns based on rbcL and trnL-F spacer sequences (Polypodiidae, Aspleniaceae) and its implications for biogeography. Systematic Botany 29: 260-274.

Silva FD, Athayde Filho FP & Windisch PG (2013) Sinopse do gênero *Pteris* L. (Pteridaceae, Polypodiopsida) no estado do Mato Grosso, Brasil. Pesquisas, Botânica 64: 197-205.

Silva FD, Athayde Filho FP & Windisch PG (2015) Schizaeaceae (Polypodiopsida) no estado do Mato Grosso, Brasil. Pesquisas, Botânica 68: 107-118.

Swartz O (1788) Nova Genera & Species Plantarum seu Prodromus descriptionum Vegetabilium, maximam partem incognitorum quae sub itinere in Indiam Occidentalem annis 1783-87. Stockholm. 150p.

Swartz O (1801). Genera et Species Filicum. Journal für die Botanik 1800: 1-120.

Swartz O (1817) Nya Arter of Ormbunkar, (Filices) fran Brasilien. Kongliga Sveska Vetenskaps Academiens Handlingar 3: 53-80.

Sylvestre LS (2001) Revisão taxonômica das espécies da família Aspleniaceae ocorrentes no Brasil. Tese de Doutorado. Universidade de São Paulo, São Paulo. 325p.

Sylvestre LS, Costa TV & Lino VL (2023) Aspleniaceae in Flora e Funga do Brasil. Jardim Botânico do Rio de Janeiro. Available at <https://floradobrasil.jbrj.gov.br/FB90671>. Access on 8 April 2023.

Thiers B (continuously updated) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at <http://sweetgum.nybg.org/science/ih/>. Access on 2 May 2023.

Wetzel MLR, Sylvestre LS, Barros CF & Vieira RC (2017) Vegetative anatomy of Aspleniaceae Newman from Brazilian Atlantic rainforest and its application in taxonomy. Flora 233: 118-126.

Willdenow CL (1810) Species Plantarum 5. Berolini. 542p.

Windisch PG (1985) Pteridófitas do estado de Mato Grosso - considerações gerais e chave para as famílias. Bradea IV: 180-187.

Windisch PG (1994) Pteridófitas do estado de Mato

Grosso: Gleicheniaceae. Bradea VI: 204-311.
Windisch PG & Nonato FR (1999) Pteridophytes of the state of Mato Grosso, Brazil: Vittariaceae. Acta Botanica Brasilica 13: 291-297.
Xu KW, Zhang L, Rothfels CJ, Smith AR, Viane R, Lorence D, Wood KR, Chen C, Knapp R, Zhou L, Lu NT, Zhou X, Wei H, Fan Q, Chen S, Cicuzza D, Gao X, Liao W & Zhang L (2019) A global plastid phylogeny of the fern genus *Asplenium* (Aspleniaceae). Cladistics 0: 1-50.

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