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Original Paper

Ferns of Viçosa, Minas Gerais, Brazil: Didymochlaenaceae and Dryopteridaceae

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Abstract

We present a taxonomic treatment for the species of Didymochlaenaceae and Dryopteridaceae occurring in the region of Viçosa, Minas Gerais, Brazil. This study was based on 50 herbarium gatherings from IAN, K, NY, PACA, RB, SP, UPCB, US, and VIC. Didymochlaenaceae is represented by a single species, *Didymochlaena truncatula*, whereas Dryopteridaceae has 11 infrageneric taxa in seven genera: *Ctenitis* (four taxa, including two varieties), *Megalastrum* (two species), *Mickelia*, *Parapolystichum*, *Polybotrya*, *Rumohra*, and *Stigmatopteris* (one species each). Among the 12 infrageneric taxa here recognized, seven are endemic to the Brazilian Atlantic Forest. *Ctenitis distans* var. *isabellina*, *Megalastrum connexum*, and *Polybotrya speciosa* are here reported for the first time in Viçosa. Identification keys, descriptions, illustrations, geographical distribution, and comments are presented to all taxa.

Key words: bolbitidoids, lastreopsids, polybotryoids, pteridophytes, taxonomy.

Resumo

Apresentamos o tratamento taxonômico para as espécies de Didymochlaenaceae e Dryopteridaceae ocorrentes na região de Viçosa, Minas Gerais, Brasil. Este estudo foi baseado na análise de 50 coletas dos herbários IAN, K, NY, PACA, RB, SP, UPCB, US e VIC. Didymochlaenaceae está representada por uma única espécie, *Didymochlaena truncatula*, enquanto Dryopteridaceae apresenta 11 táxons infragenéricos em sete gêneros: *Ctenitis* (quatro táxons, incluindo duas variedades), *Megalastrum* (duas espécies), *Mickelia*, *Parapolystichum*, *Polybotrya*, *Rumohra* e *Stigmatopteris* (uma espécie cada). Dentre os 12 táxons infragenéricos aqui reconhecidos, sete são endêmicos da Floresta Atlântica brasileira. *Ctenitis distans* var. *isabellina*, *Megalastrum connexum* e *Polybotrya speciosa* são aqui mencionados pela primeira vez em Viçosa. Chaves de identificação, descrições, ilustrações, distribuição geográfica e comentários são apresentados para todos os táxons.

Palavras-chave: bolbitidóides, lastreopsidas, polibotrióides, pteridófitas, taxonomia.

Introduction

Didymochlaenaceae and Dryopteridaceae belong to the order Polypodiales, suborder Polypodiineae (PPG I 2016), which is equivalent to the "eupolypods I" in Smith *et al.* (2006).

Didymochlaenaceae was only recently segregated from Dryopteridaceae by Zhang & Zhang (2015), who recovered it as sister to the remaining "eupolypods I". The family was originally believed to comprise a single, pantropical species (Zhang & Zhang 2015; PPG I 2016), until Shang *et al.* (2020) recognized six species in Madagascar and, later (Shang *et al.* 2021), seven species in Asia and islands of the Pacific region. The number of species in the Neotropics is unknown, but a preliminary study (Shang *et al.* unpubl.) suggests that the family might contain up to 25 species worldwide (Shang *et al.* 2020). Regardless of the number of species, Didymochlaenaceae can be easily distinguished by the unique horseshoe-shaped sori with elliptic indusia, the large 2-pinnate leaves with dimidiate pinnules, and the presence of finger-like emergences at the junctures of rachis, pinna-rachises, and pinnules adaxially (Mickel & Smith 2004; Kessler & Smith 2018).

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Dryopteridaceae is the largest family of ferns. It is cosmopolitan and comprises ca. 2115 species in 26 genera (PPG I 2016). Recent phylogenetic studies have placed a monophyletic Dryopteridaceae as sister to most other eupolypod I families, excluding Didymochlaenaecae and Hypodematiaceae (Schuettpelz & Pryer 2007; Liu *et al.* 2016; PPG I 2016). While strongly supported by molecular data, there are no unique morphological or anatomical features that characterize the family (Kessler *et al.* 2018). Its members, however, can be usually recognized by the combination of: scaly stems; basally attached stem scales; non-articulate petioles containing three or more vascular bundles (as seen in cross-section); usually continuous (from an axis to the next) adaxial grooves on the rachises and costae; non-anastomosing veins or if anastomosing usually without included veinlets; abaxial, non-marginal sori that are either round and usually indusiate, or acrostichoid; monolete spores; and a base chromosome number of $x = 41$ (Smith *et al.* 2006).

In spite of their differences, Didymochlaenaceae and Dryopteridaceae are here presented together as part of an ongoing project focused on the ferns and lycophytes of Viçosa, Minas Gerais, Brazil. Three other papers have already been published from this project, covering the Salviniales (Miranda & Schwartsburd 2016), the Schizaeales (Rabelo & Schwartsburd 2016), and the Polypodiaceae (Gonçalves da Silva & Schwartsburd 2017).

The municipality of Viçosa has a rich pteridological history. This is mainly due to the activities of Mexican-American botanist Ynes E. J. Mexia (1870–1938), who established headquarters at the Agricultural College (which currently corresponds to the Universidade Federal de Viçosa) and collected exhaustively in the region from December 16th, 1929 to January 15th, 1931 (Bracelin 1935). During this period, she made 1087 gatherings in Viçosa (Bracelin 1935), of which ca. 10% are ferns (pers. obs., based on VIC's herbarium catalog). The main set of her collections is at UC, but duplicates have been widely distributed worldwide (Stafleu & Cowan 1981), with a nearly complete set of her ferns from Viçosa at VIC (pers. obs.). Although there are no floristic studies on the Dryopteridaceae of Viçosa, nearly all collections made by Mexia have been included in monographs focused on the different genera of the family (*e.g.*, Moran 1987, 1991; Moran *et al.* 2009; Viveros *et al.* 2018). These authors have greatly benefited from the fact that most of Mexia's collections were first identified by Carl Christensen (Danish botanist, 1872–1942), who was a leading authority on the family (pers. obs.).

There are about 190 species of Dryopteridaceae in Brazil (Matos *et al.* 2022). The first contributions to the knowledge of this family in the country were given by Raddi (1819), Presl (1822), Schrader (1824), Martius (1828–1834), Fée (1869, 1873), Baker (1870), and Christensen (1913, 1920). More recently, there were the contributions by Brade (1961, 1972), Sundue *et al.* (2013), Prado *et al.* (2014), Canestraro & Labiak (2015), Engels & Canestraro (2017), Schwartsburd *et al.* (2018), Bohn *et al.* (2020), and Matos *et al.* (2022) – in addition to the monographs already mentioned in the previous paragraph and some regional floras (*e.g.*, Brade 1946; Sehnem 1979; Salino & Carvalho 2005; Garcia & Salino 2008; Prado *et al.* 2017). Garcia & Salino (2008) studied the species of Dryopteridaceae from Minas Gerais but adopted a different circumscription for the family (*i.e.*, that of Moran & Riba 1995, which included *Didymochlaena*, but excluded *Bolbitis*, *Ctenitis*, *Elaphoglossum*, *Lastreopsis*, *Megalastrum*, *Mickelia*, and *Parapolystichum*). Only two specimens of Dryopteridaceae from Viçosa were cited by Garcia & Salino (2008). One of these specimens referred to *Rumohra adiantiformis* (G.Forst.) Ching (*Kuhlmann s.n.*, VIC-1883), whereas the other was identified as *Stigmatopteris brevinervis* (Fée) R.C.Moran (*Valente 899*, VIC).

Our goal is to present a modern taxonomic treatment for all species of Didymochlaenaceae and Dryopteridaceae (sensu PPG I 2016) that occur in Viçosa. We provide identification keys, descriptions, illustrations, geographical distribution, and comments to all species.

Material and Methods

The Brazilian municipality of Viçosa (20°45'S, 42°53'W) has an area of about 300 km^2 (IBGE 2022) and elevations from 600 to 850 m above sea level (CGG, 1930). It is located in southeast Minas Gerais, within a region locally known as "Zona da Mata Mineira". The original vegetation is primarily composed of submontane, semideciduous forests with strong floristic links to the lowland forests of Espírito Santo and southern Bahia (Oliveira-Filho & Fontes 2000). Unfortunately, most of the remaining forest fragments are less than 100 years

old, and pristine vegetation is extremely rare (<1% of the fragments) (Ribon *et al.* 2003). The climate is mesothermic humid, with rainy summers, dry winters, and the mean temperature of the warmest month higher than 22 ºC (Cwa in Köppen's classification) (Vianello & Alves 1991). Monthly precipitation varies from 7.5 mm (July) to 255.3 mm (December), and the mean annual rainfall is 1,289 mm. Minimum and maximum mean temperatures are 16.2 ºC (July) and 22.9 ºC (February). The annual mean temperature is 20.1 ºC and relative humidity reaches 84% (INMET 2022).

To get this study started, we went through all specimens of Didymochlaenaceae and Dryopteridaceae deposited at VIC and separated the collections from Viçosa. We then revised the identification of each specimen, using the taxonomic literature pertinent to each group (see taxonomic treatment below). We also searched for herbarium specimens from Viçosa online, using herbarium websites and online databases such as GBIF (2021), REFLORA (2021), and SpeciesLink (2021). All gatherings were represented at VIC, except *Kuhlmann s.n.* (RB-00687792), *Mexia 4601-a* (US-01548431), *Mexia 4845* (NY-00840475), and *Mexia 4893-a* (UC). Duplicates of collections by Ynes Mexia were found in many herbaria, including IAN, K, NY, RB, S, UC, and US. Only imaged records from these herbaria were added to our specimen database, which comprises a total of 50 gatherings. Data on the habitat and ecology of the species were obtained from herbarium labels and occasional observations in the field. From 2012 to 2021, we visited some of the main forest patches in the region of Viçosa, including Mata do Paraíso, Mata do Nico (also known as Sítio Bom Sucesso), and Recanto das Cigarras. Vouchers of our collections were deposited at VIC, and duplicates were distributed to NY, RB, and UPCB when available.

In the treatment below, the species descriptions are detailed, but those for families and genera are kept to a minimum because they are widely available in other floras. Descriptions for families and genera were included in this manuscript to keep the format of the Flora of Viçosa (i.e., Miranda & Schwartsburd 2016; Rabelo & Schwartsburd 2016; Gonçalves da Silva & Schwartsburd 2017). The descriptions are based exclusively on specimens from Viçosa. Morphological terms follow Moran (1987, 1991), Lellinger (2002), Moran *et al.* (2009, 2010), and Viveros *et al.* (2018). We used the following abbreviations for some common localities in the material examined: ESAV (= Escola Superior de Agricultura e Veterinária, which is now the Universidade Federal de Viçosa), and UFV (= Universidade Federal de Viçosa). With the exceptions of *Mexia 5492* and *Schwartsburd et al. 4361 and 4362*, which were respectively collected in the nearby localities of Visconde do Rio Branco and Piranga, all vouchers are from "Brazil. Minas Gerais: Viçosa". This information was omitted from the specimen citations below.

Results and Discussion

In the region of Viçosa, we found one species of Didymochlaenaceae and 11 infrageneric taxa of Dryopteridaceae. The most species-rich genus in Dryopteridaceae was *Ctenitis*, with four taxa (including two varieties), followed by *Megalastrum* (two species), and then *Mickelia*, *Parapolystichum*, *Polybotrya*, *Rumohra*, and *Stigmatopteris* (all with a single species). Only two taxa, *Ctenitis submarginalis* var. *tenuifolia* (C.Presl) R.S.Viveros & Salino and *Rumohra adiantiformis* (G.Forst.) Ching, were not found by us in the field. *Ctenitis distans* var. *isabellina* (Fée) R.S.Viveros & Salino, *Megalastrum connexum* (Kaulf.) A.R.Sm. & R.C.Moran, and *Polybotrya speciosa* Schott are reported for the first time in Viçosa. Among the 12 infrageneric taxa here recognized, seven are endemic to the Brazilian Atlantic Forest: *Ctenitis aspidioides* (C.Presl) Copel., *C. distans* (Brack.) Ching var. *distans, C. distans* var. *isabellina, C. submarginalis* var. *tenuifolia, Mickelia scandens* (Raddi) R.C.Moran, Labiak & Sundue, *Polybotrya speciosa*, and *Stigmatopteris prionites* (Kunze) C.Chr. A complete taxonomic treatment for these species is provided below.

Didymochlaenaceae

Stems erect, scaly; leaves approximate, the sterile and fertile monomorphic; petioles with 4 or more circular vascular bundles at the base (as seen in cross-section), two always adaxial and enlarged; laminae 2-pinnate, the basal pinnae symmetrical, the apices conform; pinnules almost rectangular, subdimidiate, subsessile, articulate to the pinna-rachis; rachises and pinna-rachises grooved adaxially, the grooves decurrent into those of the next lower order, with several spine-like projections (ca. 1 mm long) at the junctures of the grooves; axes scaly; veins free, the tips hydathodous; sori elliptic, along both sides of the vein and curved around its apex, embossed adaxially; indusia present, elliptic,

rounded distally, cordate or sagittate proximally; spores monolete; x=41. Pantropical, consisting of one genus and 13 to 25 species (Shang *et al.* 2020, 2021).

1. *Didymochlaena* Desv.

Terrestrial; same characters as the family.

According to Shang *et al.* (2020), *Didymochlaena* is pantropical and might contain up to 25 species worldwide. In Brazil there is only one species, *D. truncatula* (Sw.) J. Sm., which is described below.

1.1. *Didymochlaena truncatula* (Sw.) Smith (1841: 196). *Aspidium truncatulum* Swartz (1801: 36).

Fig. 1a-e

Stem scales 10–30 × 0.3–2 mm, linear-lanceolate, entire to irregularly fimbriate, orange to brown; leaves up to 3 m long; laminae up to 2 × 0.7 m, oblong-elliptic, 2-pinnate, with a conform terminal segment; rachises scaly, the scales up to 1 cm long, filiform or linear to lanceolate, brownish, often bearing long and tortuous hair-like processes along the margins; pinnae forming 15 or more pairs, medial ones the largest, 23–36 × 3–4.2 cm, oblong, symmetrical, sessile or nearly so; pinnules 1–2.5 × 0.5–1.2 cm, almost rectangular, apices obtuse, margins entire to crenulate, the basal acroscopic pinnule of each pinna overlapping the rachis; adaxial pinna axes scaly and with spine-like projections, the scales similar to those of the rachises, the spine-like projections ca. 1 mm long, antrorse, usually clustered at pinnule attachments, rarely on veins; adaxial laminar surface between veins glabrous; abaxial pinna axes with scales similar to those of the adaxial side; abaxial laminar surface between veins with scattered filiform scales; veins free, hydathodous; sori elliptic, along both sides of the vein and curved around its apex, embossed adaxially; indusia present, elliptic, fixed to vein along medial line, entire, glabrous.

Material examined: Mata do Nico, 20°47' S, 42°51' W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2639* (VIC); 15.XII.2014, *P.B. Schwartsburd et al. 3448* (UPCB, VIC); Estrada Viçosa-Coimbra, BR-120, fazenda em frente ao trevo da UFV, mata do Sr. Nico, 8.X.1998, *G.E. Valente 360* (VIC); BR-120, Viçosa-Coimbra, Sítio Bom Sucesso, 1.XI.2000, *G.E. Valente 592* (SP, UPCB, VIC); 26.III.2002, *G.E. Valente & Z.V. Pereira 897* (UPCB, VIC); 3.II.2005, *G.E. Valente et al. 1627* (SP, UPCB, VIC).

The species is distributed in the Greater Antilles; southern Mexico to northern Argentina, Paraguay, and Brazil; Africa and Tropical Asia (Kessler & Smith 2018; Shang *et al.* 2020). In Brazil it is known from the north (Acre, Amazonas, Amapá, Pará, Roraima), northeast (Alagoas, Bahia, Paraíba, Pernambuco), central-west (Mato Grosso do Sul), southeast (Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo), and south (Paraná, Rio Grande do Sul, and Santa Catarina) (Prado 2022). In Viçosa it is known only from Mata do Nico. Terrestrial in humid forests; 800 m.

Didymochlaena truncatula is unique among the "eupolypods I" (sensu Schuettpelz & Pryer 2007) by having elongate sori and minute spine-like projections on laminar axes adaxially. The elongate sori are similar to those of some Aspleniaceae and Athyriaceae of "eupolypods II", which differ by fewer vascular bundles in the petiole bases (2 vs. 4 or more, as seen in cross-section) and absence of spine-like projections on the laminar axes. Outside of Brazil, *D. truncatula* is widely sold in the horticultural trade as "mahogany fern" (Hoshizaki & Moran 2001). The species is highly attractive because its young unfurling leaves are reddish-brown (hence the common name) and its adult leaves are large, 2-pinnate, and form a basket-shaped whorl around the stem. The numerous, rectangular, dimidiate pinnules and the horseshoe-shaped sori give the plants added ornamental interest (Hoshizaki & Moran 2001).

Dryopteridaceae

Stems long- to short-creeping or erect, scaly; leaves approximate to remote, the sterile and fertile monomorphic or dimorphic; petioles with 3 or more circular vascular bundles at the base (as seen in cross-section), two always adaxial and enlarged; laminae 1–5-pinnate at the base (simple in *Elaphoglossum*, a genus that does not occur in Viçosa), the basal pinnae symmetrical or asymmetrical, the apices conform or tapered; pinnules non-articulate, of various shapes, sessile or stalked; rachises and costae grooved or terete adaxially, the grooves (when present) usually decurrent into those of the next lower order, without spine-like projections at the junctures of the grooves; axes scaly or with hairs; veins free or (less commonly) anastomosing, the tips hydathodous or not; sori round, coenosoric, or acrostichoid; indusia present or absent; spores monolete; x=41. Cosmopolitan, consisting of 26 genera and an estimated 2115 species (PPG I 2016). In Brazil, it is represented by 16 genera and 191 species (Matos *et al.* 2022).

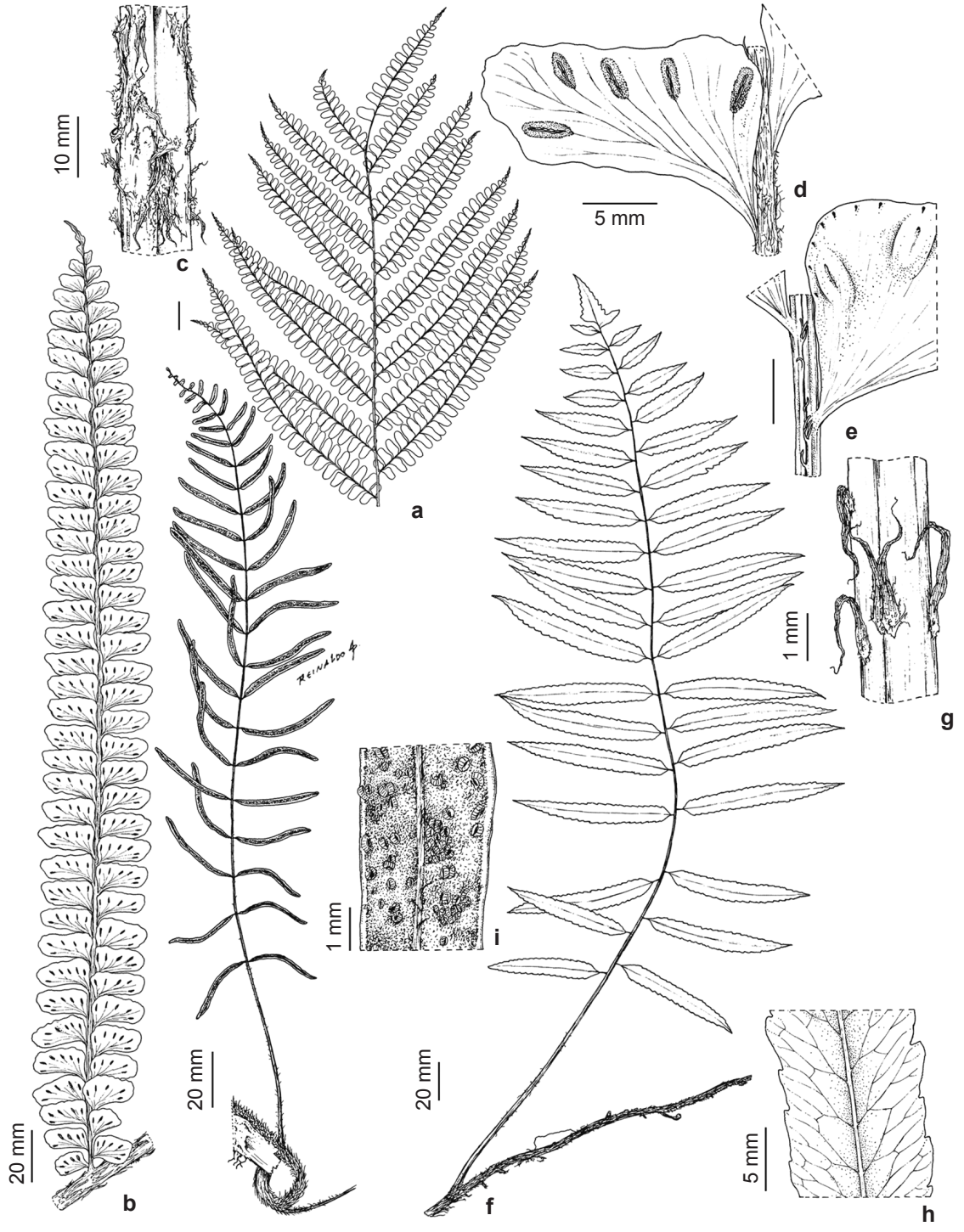

Figure 1 – a–e. *Didymochlaena truncatula* – a. leaf apex; b. fertile pinna abaxially; c. petiole detail; d. fertile pinnule abaxially, with elongate sori and indusia; e. fertile pinnule adaxially, with embossed sori, hydathodes, and spine-like projections. f–j. *Mickelia scandens* – f. habit, sterile leaf; g. petiole detail; h. sterile pinna with anastomosing veins; i. habit, fertile leaf; j. fertile pinna. (a–e. *Schwartsburd 3448*, VIC; f–j. *Schwartsburd 3447*, VIC).

Key to the genera of Dryopteridaceae from Viçosa

1. Stems long-creeping; fertile and sterile leaves dimorphic; sori acrostichoid or coenosoric, the sporangia uniformly widespread on the surface of fertile segments; indusia absent 2
   2. Sterile laminae 1-pinnate; veins areolate ..... 3. *Mickelia*
   2'. Sterile laminae 2-pinnate-pinnatifid to 3-pinnate; veins free ..... 5. *Polybotrya*
1'. Stems erect to short-creeping; fertile and sterile leaves monomorphic or nearly so; sori round, discrete; indusia present or absent 3
   3. Laminae 1-pinnate-pinnatifid or 1-pinnate-pinnatisect; basal pinnae symmetrical or nearly so 4
      4. Rachises and costae flat to rounded (not grooved) adaxially; laminae without internal punctate glands; veins ending at or before the margin, tips narrow (not enlarged) ..... 1. *Ctenitis*
      4'. Rachises and costae grooved adaxially; laminae with internal punctate glands (best seen in transmitted light); veins ending before the margin in clavate hydathodes ..... 7. *Stigmatopteris*
   3'. Laminae 2-pinnate or more divided; basal pinnae asymmetrical 5
      5. Rachises and costae glabrous adaxially; indusia peltate ..... 6. *Rumohra*
      5'. Rachises and costae pubescent adaxially; indusia lacking or attached at sinus 6
         6. Buds absent distally on rachis; rachises without ridges adaxially ..... 2. *Megalastrum*
         6'. Buds present distally on rachis; rachises with 2 prominent ridges adaxially, these continuous with the thickened margins of the ultimate segments ..... 4. *Parapolystichum*

1. *Ctenitis* (C. Chr.) C. Chr.

Terrestrial; stems short-creeping to erect or decumbent; leaves approximate, the sterile and fertile monomorphic or nearly so; laminae 1-pinnate-pinnatifid to 1-pinnate-pinnatisect (to 4-pinnate-pinnatifid outside of Viçosa), the basal pinnae symmetrical or nearly so, the apices tapered or (more rarely) conform; rachises and costae not grooved adaxially, the rachises not alate; axes scaly abaxially (the scales clathrate or subclathrate, flattish to bullate), pubescent adaxially (the hairs catenate); veins free, the tips narrow (non-hydathodous), ending at the margin (or rarely before margin, outside Viçosa), basal vein of distal pinnules springing from the costule; sori round; indusia absent or present, round-reniform, attached at sinus.

Ctenitis is pantropical, consisting of about 125 species (PPG I 2016). In Brazil, there are 22 infrageneric taxa (20 species and two varieties), 13 of which are endemic (Viveros *et al.* 2018).

Key to the species of *Ctenitis* from Viçosa

1. Lamina apices conform or subconform; pinnae incised 1/4–2/3 of the distance between segment apices and costa; basal veins from adjacent segments reaching the margin at the sinuses ..... 1.1. *Ctenitis aspidioides*
1'. Lamina apices tapered; pinnae incised more than 2/3 of the distance between segment apices and costa; basal veins from adjacent segments reaching the margin well above the sinuses 2
   2. Indusia absent or inconspicuous; larger rachis scales light brown ..... 1.4. *Ctenitis submarginalis* var. *tenuifolia*
   2'. Indusia conspicuous; larger rachis scales dark brown to black 3
      3. Stem scales up to 2.5 mm wide, dark brown; rachis scales up to 1 mm wide, strongly clathrate; larger scales of abaxial costae lanceolate to ovate, dark brown to black, strongly clathrate ..... 1.2. *Ctenitis distans* var. *distans*
      3'. Stem scales up to 0.8 mm wide, orange to light brown; rachis scales up to 0.3 mm wide, subclathrate; larger scales of abaxial costae linear-lanceolate, orange brown to black, subclathrate ..... 1.3. *Ctenitis distans* var. *isabellina*

1.1. *Ctenitis aspidioides* (C.Presl) Copel., Gen. Fil. 124. 1947. *Polypodium aspidioides* C.Presl, Delic. Prag. 1: 170. 1822. Fig. 2a-d

Stem scales 6–11 × 0.3–1.2 mm, lanceolate, entire to slightly denticulate, without fimbriae, light brown; leaves up to 75 cm long; laminae up to 36 × 22 cm, lanceolate, 1-pinnate-pinnatifid, with a conform or subconform terminal pinna; rachises scaly and pubescent, the scales 1–2.5 × 0.1–0.2 mm, linear-lanceolate, dark brown to black, subclathrate, entire to slightly denticulate, the hairs 0.1–0.5 mm long, catenate, brownish; pinnae 9–14 pairs, medial ones the largest, 8.5–11.5 × 2–3 cm, lanceolate, incised to 2/3 of the distance between segment apices and costa, symmetrical or nearly so, stalks to 2.5 mm long; adaxial pinna axes pubescent, hairs 0.1–1 mm long, catenate, dense on costae, sparse on costules, rare on veins; adaxial laminar surface between veins glabrous; abaxial pinna axes scaly and hairy, scales 0.5–2 × 0.1–0.2 mm, linear to lanceolate, dark brown to black, subclathrate, sparse on costae, rare on costules, microscales to 0.5 mm long sparse on costules, hairs 0.1–0.2 mm long, catenate, sparse on costae, costules, and veins; abaxial laminar surface between veins glabrous or with sparse catenate hairs 0.1–0.2 mm long; sori round, medial or inframedial; indusia conspicuous, entire or fimbriate, glabrous.

Material examined: Fazenda de Faziuma, 700 m, 27.V.1930, *Y. Mexia 4750* pro parte (F barcode C0661624F); Fazenda de Enjenho [Fazendo do Engenho], 720 m, 11.XII.1930, *Y. Mexia 5406* (IAN, K, NY, RB, US, VIC); Mata do Nico, 20°47' S, 42°51' W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2622* (UPCB, VIC).

The species is endemic to the Brazilian Atlantic Forest, from Bahia to Paraná (Viveros *et al.* 2018). In Viçosa it is known from Fazenda do Engenho, Sítio Bom Sucesso (Mata do Nico), and possibly Fazenda Faziuma (other duplicates of *Mexia 4750* represent *C. distans* var. *distans*; see discussion below). Terrestrial on steep, wooded slopes; 720–800 m.

Ctenitis aspidioides is characterized by light brown stem scales, 1-pinnate-pinnatifid laminae, medial pinnae cut 1/4–2/3 to the costa, laminar apices conform (*i.e.*, resembling the lateral pinnae) or subconform (*i.e.*, the apical pinna with a large adnate lobe), rachis scales dark brown to black and subclathrate, and indusia conspicuous (Fig. 2a–d). The most similar species in Brazil is *C. nervata* (Fée) R.S.Viveros & Salino, which does not occur in Minas Gerais. It is similar to *C. aspidioides* in pinnae incision (the two are less incised than most South American species of *Ctenitis*), but differs by tapered laminar apices and absent indusia (Viveros *et al.* 2018).

Viveros *et al.* (2018) cited "*Mexia 5406* (R)" under *Ctenitis aspidioides* and "*Mexia 4750* (F, GH, MO, NY, UC)" under *C. distans* var. *distans*. However, we found a second sheet of *Mexia 4750* at F (barcode C0661624F) that represents *C. aspidioides*. This admixture raises doubts about the occurrence of this species on Fazenda Faziuma.

1.2. *Ctenitis distans* (Brack.) Ching (1938: 277) var. distans. *Lastrea distans* Brackenridge (1854: 192). Fig. 3a-f

Stem scales 1.5–15 × 0.2–2.5 mm, lanceolate, entire or nearly so, with or without some short fimbriae at the base, dark brown; leaves up to 125 cm long; laminae up to 80 × 40 cm, lanceolate or ovate, 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, gradually tapering towards apices; rachises scaly and pubescent, the scales 0.5–7 × 0.1–1 mm, linear-lanceolate to lanceolate, dark brown to black, strongly clathrate, denticulate, with short fimbriae at base, the hairs 0.1–0.3 mm long, catenate, yellowish to reddish; pinnae 12–30 pairs, basal or medial ones the largest, 7.5–20 × 1.8–4 cm, lanceolate, incised more than 3/4 of the distance between segment apices and costa, symmetrical or nearly so, stalks to 5 mm long; adaxial pinna axes sparsely scaly and densely pubescent, scales 0.6–3 × 0.05–0.2 mm, linear to linear-lanceolate, dark brown to black, hairs 0.1–0.5 mm long, catenate, dense on costae and costules, sparse on veins; adaxial laminar surface between veins glabrous; abaxial pinna axes sparsely to densely scaly and pubescent, scales 0.5–4 × 0.1–1 mm, the smaller ones filiform to linear-lanceolate, the larger ones lanceolate to ovate, uniformly dark brown to black or darker towards the apex, strongly clathrate, sparse to dense on costae and costules, microscales 0.5–3 mm long sparse or absent on costules, hairs 0.1–0.2 mm long, bacilliform, catenate, or glandular, sparse or absent on costae, costules, and veins; abaxial laminar surface between veins glabrous or with sparse bacilliform hairs 0.1–0.2 mm long; sori round, inframedial; indusia conspicuous, entire or fimbriate, with bacilliform hairs.

Material examined: Fazenda de Faziuma, 700 m, 27.V.1930, *Y. Mexia 4750* pro parte (F barcode

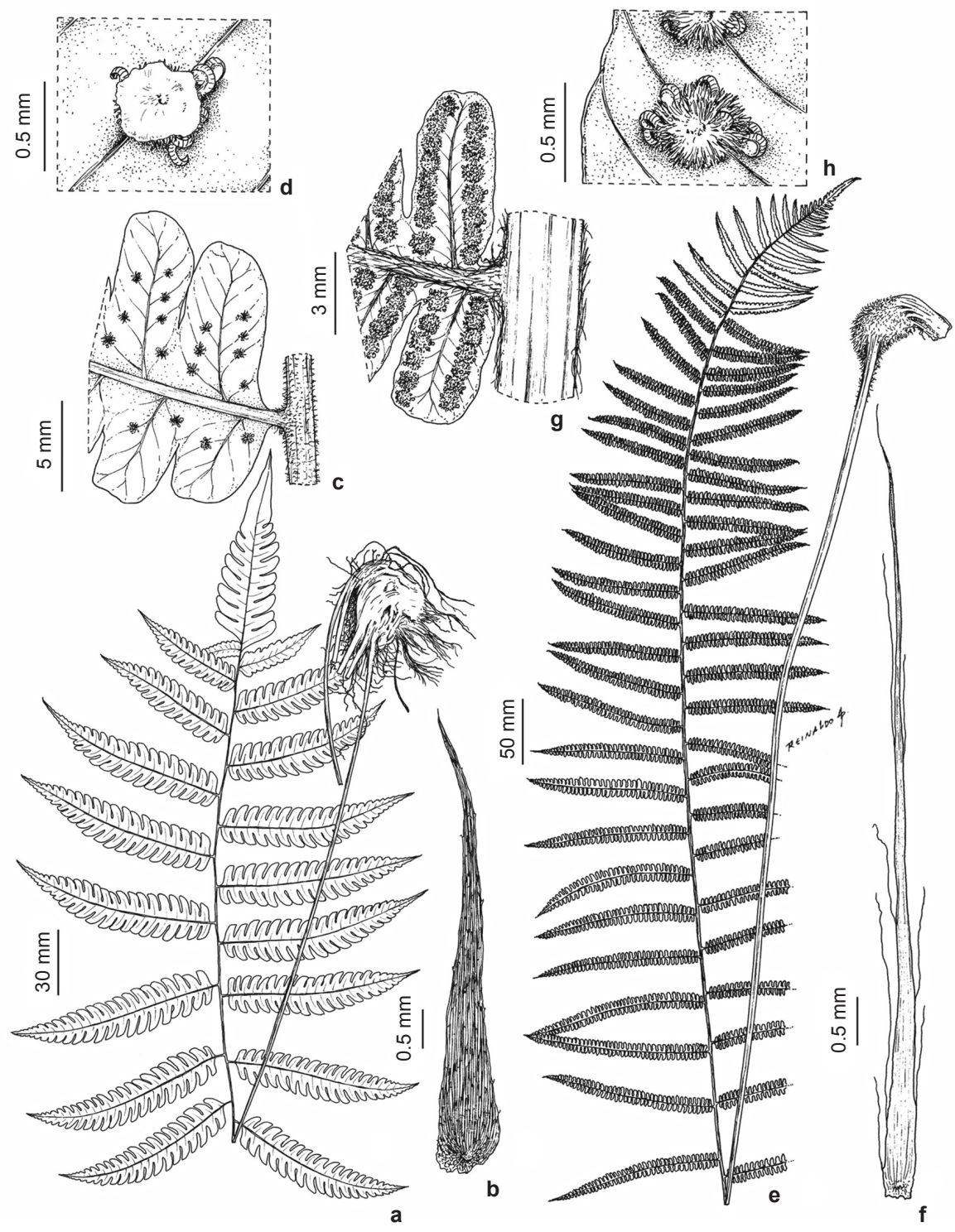

Figure 2 – a–d. *Ctenitis aspidioides* – a. habit; b. stem scale; c. rachis and pinna abaxially; d. sorus with indusium; e–h. *Ctenitis submarginalis* var. *tenuifolia* – e. habit; f. stem scale; g. rachis and pinna abaxially; h. sorus without indusium. (a–b. *Mexia 5406*, VIC; c–d. *Schwartsburd 2622*, VIC; e–h. *Mexia 5282*, VIC).

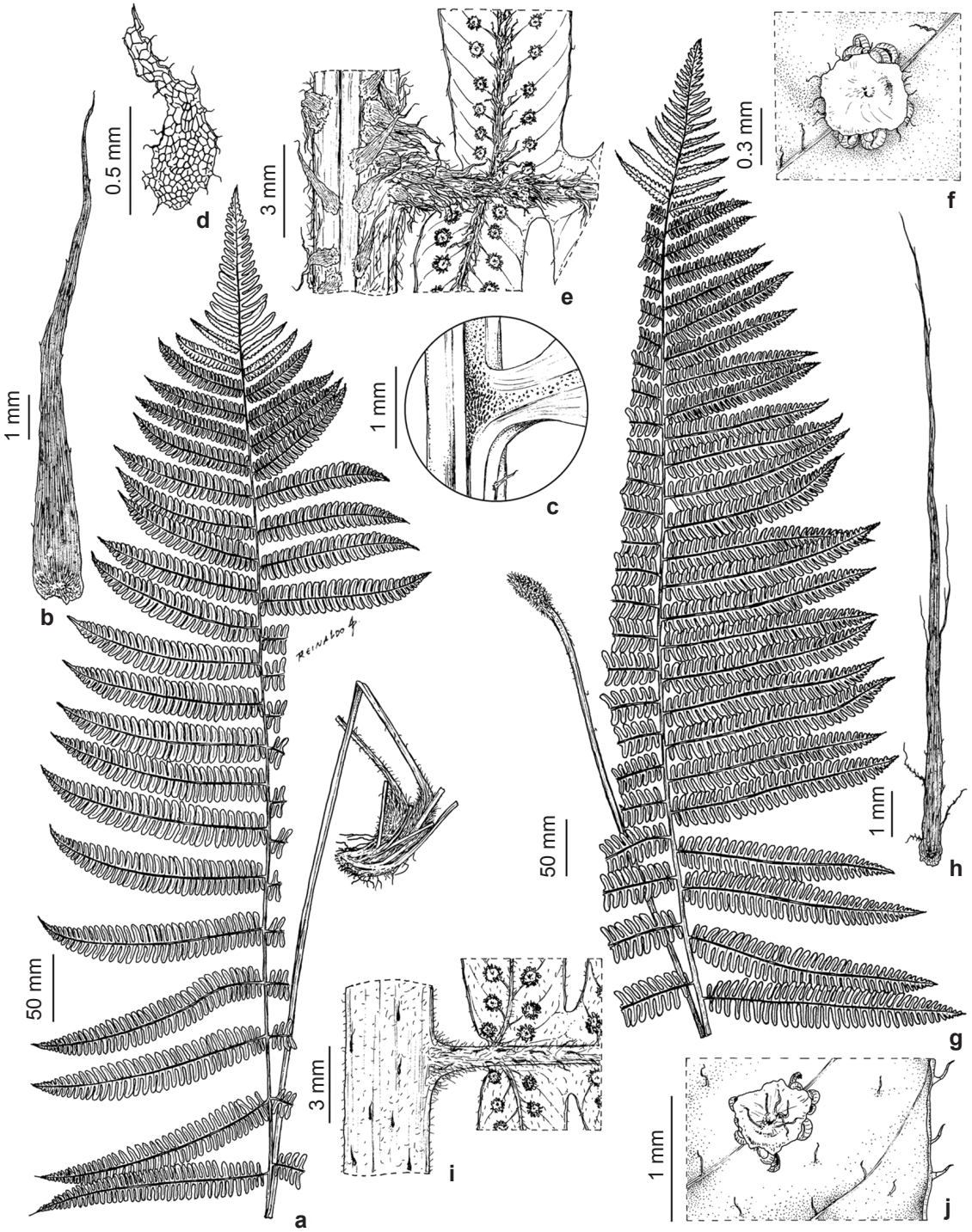

Figure 3 – a–f. *Ctenitis distans* var. *distans* – a. habit; b. stem scale; c. rachis-costa juncture; d. rachis scale; e. rachis and pinna abaxially; f. sorus with indusium. g–j. *Ctenitis distans* var. *isabellina* – g. habit; h. stem scale; i. rachis and pinna abaxially; j. sorus with indusium. (a–f. *Schwartsburd 2830*, VIC; g–j. *Schwartsburd 3425*, VIC).

C0361523F, GH, IAN, MO, NY, RB, S-3 sheets, SP, US, VIC); Mata do Nico, 20°47' S, 42°51' W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2628* (UPCB, VIC); Campus da UFV, Mata da Biologia, trilha principal, 20°45'31" S, 42°51'56" W, 750 m, 16.VIII.2013, *P.B. Schwartsburd et al. 2830* (UPCB, VIC); Mata do Seu Nico, 15.XII.2014, *P.B. Schwartsburd et al. 3446* (UPCB, VIC); BR-120, Viçosa-Coimbra, Sítio Bom Sucesso, 6.XI.2001, *G.E. Valente & J.A.A.M. Neto 849* (SP, UPCB, VIC).

Additional specimen examined: Brazil, Minas Gerais: entre Piranga e São João de Pirapitinga, 600–700 m, 21.X.2017, *P.B. Schwartsburd et al. 4361* (VIC).

The species is endemic to the Brazilian Atlantic Forest, from Ceará to Santa Catarina (Viveros *et al.* 2018). In Viçosa it is known from Fazenda de Faziuma, Sítio Bom Sucesso (Mata do Nico), and Mata da Biologia (UFV). Terrestrial in humid forests, in dense shade and rich humus; 600–800 m.

Ctenitis distans var. *distans* is characterized by dark brown stem scales, 1-pinnate-pinnatifid to 1-pinnate-pinnatisect laminae, medial pinnae cut more than 3/4 to the costa, laminar apices tapered, rachis scales dark brown to black and strongly clathrate, and indusia conspicuous (Fig. 3a–f). It is similar to *C. deflexa* (Kaulf.) Copel., which is known from the surroundings of Viçosa (e.g., *Mexia 4960*, *5028*, MO, NY, VIC), but differs by rachis scales uniformly dark brown to black (vs. dark brown with pale edges) and costal scales uniformly dark brown to black or sometimes darker towards the apices (vs. uniformly light brown). Additionally, the rachis scales of *C. distans* are not fimbriate or have only short fimbriae at the base, whereas those of *C. deflexa* have many short and long fimbriae along the whole margin (Viveros *et al.* 2018). The typical variety differs from var. *isabellina* (Fée) R.S.Viveros & Salino mainly by the characters given in the key. The abaxial costal scales of var. *distans* are strongly clathrate, meaning that their cell walls are thick and blackish, whereas their lumens are translucent and nearly colorless. In contrast, the costal scales of var. *isabellina* are subclathrate, meaning that they are uniformly blackish (their cell walls are thick and their lumens are colored, albeit slightly weaker).

Viveros *et al.* (2018) cited "*Mexia 4750* (F, GH, MO, NY, UC)" under *Ctenitis distans* var. *distans*. We found additional duplicates of this gathering at IAN, RB, S, SP, US, and VIC. Another specimen of this gathering at F (barcode C0661624F) refers to *C. aspidioides*.

1.3. *Ctenitis distans* var. ***isabellina*** (Fée) Viveros & Salino in Viveros *et al*. (2018: 41). *Aspidium isabellinum* Fée (1869: 137). Fig. 3g-j

Stem scales 1–20 × 0.1–0.8 mm, linear-lanceolate, entire or nearly so, with or without some short fimbriae at the base, orange to light brown; leaves up to 140 cm long; laminae up to 90 × 45 cm, lanceolate or ovate, 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, gradually tapering towards apices; rachises scaly and pubescent, the scales 0.5–3 × 0.1–0.3 mm, linear-lanceolate or lanceolate, dark brown to black, subclathrate, denticulate, with or without few short fimbriae at base, the hairs 0.1–0.3 mm long, catenate, pale yellowish to reddish; pinnae 16–30 pairs, basal or medial ones the largest, 10.5–22 × 2–4.5 cm, lanceolate, incised more than 3/4 of the distance between segment apices and costa, symmetrical or nearly so, stalks to 3 mm long; adaxial pinna axes sparsely scaly and densely pubescent, scales 0.3–1.5 × 0.05–0.1 mm, linear to linear-lanceolate, dark brown to black, hairs 0.1–0.3 mm long, catenate, dense on costae and costules, sparse on veins; abaxial pinna axes sparsely to densely scaly and pubescent, scales 0.5–2.5 × 0.05–0.3 mm, the smaller ones filiform, the larger ones linear-lanceolate, orange to light brown or black, often bicolorous (orange brown at base, blackish towards the apex), subclathrate, dense on costae, absent to sparse on costules, microscales up to 1 mm long sparse to dense on costules, hairs 0.1–0.2 mm long, bacilliform, catenate, or glandular, sparse to dense on costae, costules, and veins; abaxial laminar surface between veins with sparse catenate hairs 0.1–0.2 mm long; sori round, inframedial; indusia conspicuous, entire or fimbriate, with bacilliform hairs.

Material examined: Campus da UFV, Mata da Silvicultura, V.1994, *J.A. Meira Neto 2219* (VIC); [UFV], Reserva Mata do Paraíso, trilha dos Gigantes, 20°47'52''S, 42°51'42''W, 800 m, 11.IX.2012, *P.B. Schwartsburd & S. Ferreira da Silva 2608* (UPCB, VIC); UFV, Mata do Paraíso, 20°48'S, 42°51'W, 750 m, 14.XI.2014, *P.B. Schwartsburd & C.V. Miranda 3425* (VIC); Mata do Seu Nico, 15.XII.2014, *P.B. Schwartsburd et al. 3439* (UPCB, VIC).

The species is endemic to the Brazilian Atlantic Forest, from Minas Gerais and Espírito Santo to Paraná (Viveros *et al.* 2018). In Viçosa, it is known from Mata da Silvicultura (UFV), Mata do Paraíso (UFV), and Mata do Seu Nico. Terrestrial in humid forests; 750–800 m.

Ctenitis distans var. *isabellina* is characterized by orange to light brown stem scales, 1-pinnate-

pinnatifid to 1-pinnate-pinnatisect laminae (one specimen with a free pair of lobes at the base of proximal pinnae), medial pinnae cut more than 3/4 to the costa, laminar apices tapered, rachis scales dark brown to black and subclathrate, and indusia conspicuous (Fig. 3g–j). *Ctenitis distans* var. *isabellina* has a mixture of the characters found in *C. distans* var. *distans* and *C. submarginalis* var. *tenuifolia*. The presence of conspicuous indusia and the dark rachis scales resemble *C. distans* var. *distans*, whereas the narrow, orange to light brown stem scales and filiform to linear-lanceolate costal scales resemble *C. submarginalis* var. *tenuifolia*. The color of its costal scales is also intermediate between *C. distans* var. *distans* (dark brown to black, clathrate) and *C. submarginalis* var. *tenuifolia* (orange to light brown, subclathrate). In fact, some costal scales of *C. distans* var. *isabellina* are bicolorous (orange to light brown at base, dark brown to black at apex). This mixture of characters could be an indication that *C. distans* var. *isabellina* might be a hybrid involving *C. distans* (var. *distans*) and *C. submarginalis* (var. *tenuifolia*). We did not find additional evidence to support this hypothesis, but we think this is a good project to pursue in the future. Although there are no reported hybrids in *Ctenitis*, hybridization and polyploidy are known to be widespread in Dryopteridaceae (*e.g.*, Barrington 1990, Sessa *et al.* 2012, Engels & Canestraro 2017).

1.4. *Ctenitis submarginalis* var. ***tenuifolia*** (C.Presl) Viveros & Salino in Viveros *et al*. (2018: 73). *Lastrea tenuifolia* Presl (1851: 37).

Fig. 2e-h

Stem scales 10–36 × 0.5–2.0 mm, lanceolate, entire or nearly so, with or without fimbriae at base, orange to light brown; leaves up to 1.9 m long (but the label on *Mexia 4753* mentions leaves up to 2.5 m long); laminae up to 102 × 42 cm, lanceolate or ovate, 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, gradually tapering towards apices; rachises scaly and pubescent, the scales 1–10 × 0.1–0.5 mm, linear to lanceolate, light brown (rarely darker), subclathrate, entire to slightly denticulate, with or without some short fimbriae at base, the hairs 0.1–0.3 mm long, catenate or glandular, reddish to brownish; pinnae 28–33 pairs, medial ones the largest, 10–21 × 1.5–3 cm, lanceolate, incised more than 3/4 of the distance between segment apices and costa, symmetrical or nearly so, stalks to 5 mm long; adaxial pinna axes sparsely scaly and densely pubescent, scales 1–2 × 0.05 mm, filiform, light brown (rarely dark brown), hairs 0.1–0.5 mm long, catenate, dense on costae, sparse on costules and veins; adaxial laminar surface between veins glabrous or with sparse catenate hairs 0.1–0.2 mm long; abaxial pinna axes sparsely to densely scaly and pubescent, scales 1–4 × 0.05–0.2 mm, filiform to linear-lanceolate, orange to light brown, subclathrate, dense on costae, microscales to 0.7 mm long sparse on costules, hairs 0.1–0.2 mm long, bacilliform, catenate, or glandular, brownish, sparse or absent on costae, costules, and veins; abaxial laminar surface between veins glabrous or with sparse catenate and bacilliform hairs, 0.1–0.3 mm long; sori round, medial or supramedial; indusia absent or small and inconspicuous.

Material examined: Agricultural College, old road around hill northwest of main buildings, 675 m, 11.IV.1930, *Y. Mexia 4601-a* (US); Agricultural College lands, disused Cha-cha Valley road, [Fazenda do Chá-chá], 680 m, 27.V.1930, *Y. Mexia 4753* (IAN, NY, RB, US, VIC-2 sheets); Horticultural Hill, 670 m, 3.VII.1930, *Y. Mexia 4832* (IAN, K, NY, RB, US, VIC-3 sheets); 7.VII.1930, *Y. Mexia 4845* (NY, US); [ESAV], Fazenda de F. Lopez, Pau Daai [Fazenda Pau d'Alho], 710 m, 11.XI.1930, *Y. Mexia 5282* (NY, RB-2 sheets, US, VIC).

The species is endemic to the Atlantic Forest, from northeast to south and central-western Brazil (Viveros *et al.* 2018). In Viçosa it is known only from historical collections made by Ynes Mexia in 1930, in the surroundings of the "Agricultural College" (currently UFV). Terrestrial in the partial shade of cut-over woods, forest edges, or wooded gulches; 670–710 m.

Ctenitis submarginalis var. *tenuifolia* is characterized by orange to light brown stem scales, laminae 1-pinnate-pinnatifid to 1-pinnate-pinnatisect, medial pinnae cut 3/4–1/2 to the costa, laminar apices tapered, rachis scales light brown, and indusia absent or inconspicuous (Fig. 2e–h). It differs from the other two *Ctenitis* with tapered apices in Viçosa (*i.e.*, *C. distans* var. *distans* and *C. distans* var. *isabellina*) by the lighter color of its larger rachis scales (mostly light brown vs. dark brown to black) and lack of conspicuous indusia. According to Viveros *et al.* (2018), *C. submarginalis* is the most widely distributed species of *Ctenitis*, occurring from southeastern United States and the Antilles to Uruguay and Brazil. The morphological variation across this wide latitudinal range is so great that Christensen (1913) proposed six infraspecific taxa for *C. submarginalis*. More recently, Viveros *et al.* (2018) recognized two varieties: *C. submarginalis* var. *submarginalis* (costal scales lanceolate with cordate bases) and *C. submarginalis* var. *tenuifolia* (costal scales linear or filiform with truncate or round

bases). The specimens from Viçosa match var. *tenuifolia*, and Viveros *et al.* (2018) cited *Mexia 4753* (RB) under this name.

One specimen of *Mexia 4601* at IAN (barcode 082150) refers to *Christella patens* (Sw.) Holttum (Thelypteridaceae), and this is probably why the collection number of the specimen at US (barcode 01548431) received a suffix (i.e., *Mexia 4601-a*).

2. *Megalastrum* J.Sm. *ex* Holttum

Terrestrial; stems erect to decumbent; leaves approximate, the sterile and fertile monomorphic; laminae 2–4 pinnate, the basal pinnae asymmetrical and enlarged basiscopically, the apices tapered; rachises and costae not grooved or only shallowly so adaxially, the rachises not alate; axes glabrous to scaly (the scales not clathrate to subclathrate, flat to bullate), glandular, pubescent abaxially, densely pubescent adaxially (the hairs multicellular, whitish, patent to antrorsely strigose); veins free, the tips clavate (hydathodous), not reaching the margin, basal vein of distal pinnules springing from the costa, not the costule; sori round; indusia absent or present, round-reniform, attached at sinus.

Megalastrum is mostly neotropical, consisting of about 90 species (PPG I 2016). Three species occur in the African-Madagascan region (Rouhan & Moran 2011) and seven in the circum-austral region (Sundue *et al.* 2010). In Brazil, there are 18 species, 13 of which are endemic (Moran *et al.* 2009).

Key to the species of *Megalastrum* from Viçosa

1. Lamina 2-pinnate-pinnatifid at base; indusia absent; abaxial lamina surface between veins non-glandular and glabrous, rarely with appressed, uniseriate scales ca. 0.2 mm long ..... 2.1. *Megalastrum connexum*

1'. Laminae 4-pinnate at base; indusia present; abaxial lamina surface between veins densely glandular and pubescent ..... 2.2. *Megalastrum crenulans*

2.1. *Megalastrum connexum* (Kaulf.) Smith & Moran (1987: 127). *Polypodium connexum* Kaulfuss (1824: 120). Fig. 4a-c

Stem scales 1.5–15 × 0.1–0.8 mm, linear to lanceolate, sparsely denticulate, light brown to yellowish or golden; leaves up to 110 cm long; laminae up to 65 × 50 cm, deltate to lanceolate, 2-pinnate-pinnatifid at the base, 2-pinnate-pinnatifid medially, gradually tapering towards apices; rachises scaly and pubescent, non-glandular, the scales up to 3 mm long, linear, denticulate, brown to castaneous, the hairs 0.1–0.8 mm long, 2–5-celled, hyaline to reddish; pinnae forming up to 10 pairs, basal ones the largest, to ca. 50 × 12 cm, triangular, asymmetrical and enlarged basiscopically, stalks to 10 mm long; adaxial pinna axes densely pubescent, hairs 0.1–0.6 mm long, 2-5-celled, hyaline to brownish; adaxial laminar surfaces between veins non-glandular and glabrous; abaxial pinna axes sparsely pubescent and scaly (especially at pinna base), the hairs similar to those adaxially, the scales to 2.5 mm long, linear, denticulate, brown to castaneous; abaxial laminar surface between veins non-glandular and glabrous, sometimes with sparse uniseriate scales ca. 0.2 mm long, appressed, reddish; sori round; indusia absent.

Material examined: Mata do Seu Nico, 15.XII.2014, *P.B. Schwartsburd et al. 3453* (VIC).

The species is distributed in Argentina, Paraguay, Uruguay, and Brazil, from Bahia to Rio Grande do Sul (Moran *et al.* 2009). This is the first record of this species from Viçosa, where it is known only from Mata do Seu Nico. Terrestrial in humid forests; 800 m.

Megalastrum connexum is the most common species of the genus in Brazil (Moran *et al.* 2009). It is characterized by laminar surfaces glabrous on both sides between veins, lamina axes non-glandular, and sori non-indusiate (Fig. 4a–c). Also distinctive are the stem scales, which are linear to lanceolate, light brown to yellowish or golden, twisted or crispate, forming a dense wool around the stem and petiole bases. The specimen from Viçosa (*Schwartsburd 3453*, VIC) differs from typical *M. connexum* by the presence of hairs on the pinna rachises abaxially. Moran *et al.* (2009) reported this same variation in pubescence for the costules, veins, and lamina margins (but not for the pinna rachises). Because there are no other differences correlating with the presence of these hairs, we consider our specimen part of the variation within *M. connexum*.

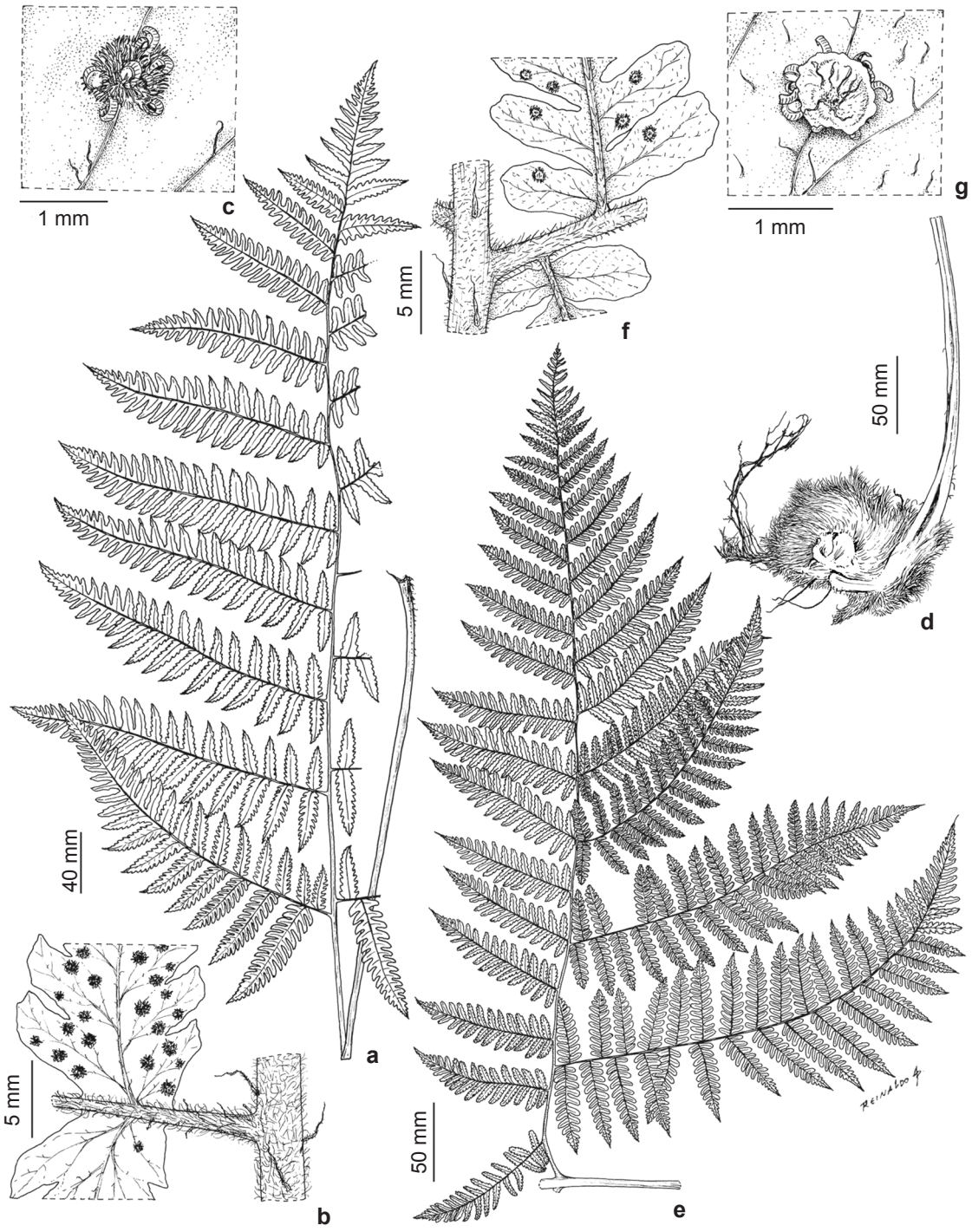

Figure 4 – a–c. *Megalastrum connexum* – a. leaf; b. rachis and pinna abaxially; c. sorus without indusium. d–g. *Megalastrum crenulans* – d. stem; e. basal pinna; f. rachis and pinna abaxially; g. sorus with indusium. (a–c. *Schwartsburd 3453*, VIC; d. *Valente 898*, VIC; e–g. *Schwartsburd 2638*, VIC).

2.2. *Megalastrum crenulans* (Fée) Smith & Moran (1987: 127). *Aspidium crenulans* Fée (1869: 139). Fig. 4d-g

Stem scales ca. 0.4–20 × 0.1–12 mm, linear-lanceolate, sparsely denticulate, golden brown; leaves up to 250 cm long; laminae up to 100 × 50 cm, deltate, 4-pinnate at base, 3-pinnate-pinnatifid medially, gradually tapering towards apices; rachises glandular, scaly, and pubescent, the glands ca. 0.1 mm long, spherical, sessile to stalked, hyaline to reddish, the scales ca. 1 mm long, lanceolate, subentire, brown, the hairs 0.8–1.2 mm long, 3- to 6-celled, hyaline to reddish; pinnae 13–16 pairs, basal ones the largest, to ca. 50 × 30 cm, triangular, asymmetrical and enlarged basiscopically, stalks to 25 mm long; adaxial pinna axes glandular and pubescent, glands like those of the rachises, hairs 0.4–0.8 mm long, 1-3-celled, hyaline to brownish; adaxial laminar surface between veins glabrous or sparsely glandular; abaxial pinna axes glandular, pubescent, and scaly, glands like those of the rachises, hairs 0.2–0.4 mm long, 1–3 celled, scales ca. 1 mm long, bullate, subclathrate, subentire; abaxial laminar surface between veins densely glandular and pubescent, glands and hairs ca. 0.1 mm long, 1-celled, whitish to yellowish; sori round; indusia present, glandular and pubescent.

Material examined: Fazenda de Aguada, 725 m, 17.IX.1930, *Y. Mexia 5060* (NY, S, UC, US-2 sheets, VIC); Sítio Bom Sucesso, Mata do Sr. Nico, 20°47'42''S, 42°50'44''W, 730 m, 29.XII.2009, *J. Prado & G.E. Valente 2026* (MBM, NY-5 sheets, UPCB, VIC); Mata do Nico, 20°47' S, 42°51' W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2638* (UPCB, VIC); 15.XII.2014, *P.B. Schwartsburd et al. 3452* (UPCB, VIC); Estrada Viçosa-Coimbra [BR-120], fazenda em frente ao trevo da UFV, mata do Sr. Nico, 20°47'42''S, 42°50'44''W, 730 m, 26.III.2002, *G.E. Valente 363* (RB, SP, VIC-2 sheets); 29.XII.2009, *G.E. Valente & Z.V. Pereira 898* (UPCB, VIC).

The species is distributed in Venezuela, Paraguay, and Brazil, from Bahia to Rio Grande do Sul (Prado *et al.* 2022). In Viçosa it is known from Fazenda de Aguada and Sítio Bom Sucesso (Mata do Nico). Terrestrial in tall, dense forests, usually in valleys; 725–800 m.

Megalastrum crenulans is nearly unique among the Brazilian species of the genus by having a large persistent indusium (Fig. 4g). It is further distinguished by glands on both surfaces of the laminae and bullate scales on the abaxial surfaces. The only other species of *Megalastrum* with indusiate sori in Brazil is *M. indusiatum* (Alagoas and Bahia), but its indusium is much smaller, only about the size of a single sporangial capsule, and easily overlooked (Moran *et al.* 2009). The gathering by *Mexia 5060* (NY, S, UC, US, VIC) was cited by Moran *et al.* (2009) under *M. crenulans*.

3. *Mickelia* R.C.Moran, Labiak & Sundue

Hemiepiphytic and terrestrial; stems long-creeping; leaves distant, the sterile and fertile dimorphic; laminae 1-pinnate, the basal pinnae symmetrical, the apices tapered to subconform; rachises and costae not grooved adaxially, the rachises alate; axes with scattered scales abaxially (the scales reddish, linear to lanceolate), glabrous adaxially; veins areolate, the areoles without included veinlets, the tips narrow (not hydathodous), ending at the margin; sori acrostichoid; indusia absent.

Mickelia is entirely neotropical, consisting of 10 species (Moran *et al.* 2010). In Brazil, there are eight species, four of which are endemic (Matos & Labiak 2022a).

3.1. *Mickelia scandens* (Raddi) Moran *et al.* (2010: 354). *Acrostichum scandens* Raddi (1819: 6). Fig. 1f-j

Stem scales 1–6 × 0.1–0.8 mm, lanceolate, entire or with glandular projections, dark brown to black; leaves up to 90 cm long; laminae up to 65 × 30 cm, lanceolate to elliptic, 1-pinnate, tapered toward the apex or with a subconform terminal segment; rachises glabrous to sparsely scaly (sometimes also with small, reddish, glandular dots), the scales 0.2–2 × 0.1–0.5 mm, linear to lanceolate, dark brown to black, subclathrate, entire or nearly so; pinnae 9–29 pairs, medial ones the largest, 5–15 × 1.5–2 cm, lanceolate, serrate, symmetrical, sessile or stalked to 1 mm long, articulate to rachis; adaxial pinna axes glabrous or with sparse lanceolate scales up to 0.5 mm long; adaxial laminar surface between veins glabrous; abaxial pinna axes scaly, the scales 0.1–15 × 0.1–0.5 mm, linear to lanceolate, brown to black, common on costae, rare on veins; abaxial laminar surface between veins glabrous or with sparse microscales; sori acrostichoid; indusia absent.

Material examined: *J.G. Kuhlmann* (RB, barcode 00687792); Bom Sucesso, Mata do Sr. Nico, 20°47'42"S, 42°50'44"W, 730 m, 29.VII.2009, *J. Prado & G.E. Valente 2029* (NY, SP, VIC); Mata do Nico, 20°47'S, 42°51'W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2631* (VIC-2 sheets); 15.XII.2014, *P.B. Schwartsburd et al. 3447* (VIC); Estrada Viçosa-Coimbra [BR-120], Sítio Bom Sucesso, 3.II.2005, *G.E. Valente et al. 1626* (SP, UPCB, VIC).

Additional specimen examined: Brazil, Minas Gerais: entre Piranga e São João de Pirapitinga, 600–700 m, 21.X.2017, *P.B. Schwartsburd et al. 4362* (VIC).

The species is endemic to the Brazilian Atlantic Forest, from Pernambuco to Rio Grande do Sul (Moran *et al.* 2010; Matos & Labiak 2022a). In Viçosa it is known only from Sítio Bom Sucesso (Mata do Seu Nico). Hemiepiphytic and terrestrial in wet forests; 600–800 m.

Mickelia scandens is characterized by long-creeping stems, 1-pinnate leaves, laminar apices tapered or with a subconform terminal segment, areolate veins (the areoles without included veinlets), and acrostichoid sori (Fig. 1f–j). This species has long been considered a synonym of *M. guianensis* (Aubl.) R.C.Moran, Labiak & Sundue, being often treated as *Lomagramma guianensis* (Aubl.) Ching (*e.g.*, Pichi Sermolli & Bizzarri 2005). According to Moran *et al.* (2010), *Mickelia scandens* differs from *M. guianensis* by laminae gradually reduced toward the apex (vs. abruptly reduced), 16–25 (vs. 9–13) pairs of pinnae on the climbing leaves, and 2–3 (vs. 3–4) series of areoles between the costa and margin. In the region of Viçosa, this species is not easily confused with any other fern.

4. *Parapolystichum* (Keyserl.) Ching

Terrestrial; stems short-creeping; leaves approximate, the sterile and fertile monomorphic; laminae 3-pinnate to 4-pinnate-pinnatifid, the basal pinnae strongly asymmetrical and enlarged basiscopically, the apices tapered, usually with a scaly bud in the axil of a distal pinna; rachises and costae not grooved adaxially, but with two prominent ridges, these continuous with the thickened margins of the ultimate segments; axes puberulent abaxially and adaxially (the hairs hyaline, septate, blunt), also with appressed orangish elongate glands on laminar surfaces and veins; veins free, the tips narrow (not hydathodous), ending at or near the margin; sori round; indusia absent.

Parapolystichum is pantropical, consisting of about 30 species (Sánchez & Labiak 2019). In Brazil, there are two species, one of which is endemic (Labiak *et al.* 2015).

4.1. *Parapolystichum effusum* (Sw.) Ching (1940: 239). *Polypodium effusum* Swartz (1788: 134).

Fig. 5a-d

Stem scales 2–15 × 0.2–2 mm, lanceolate, entire to slightly denticulate, dark brown to black; leaves up to 250 cm long; laminae up to 95 × 100 cm, deltate, to 4-pinnate-pinnatifid at base, 3-pinnate-pinnatifid medially, gradually tapering towards apices; rachises glandular, scaly, and pubescent, often with a scaly bud in the axil of a distal pinna, the glands ca. 0.1 mm long, cylindrical, yellow, shiny, rare on both sides; the scales to ca. 15 × 0.2 mm, filiform to lanceolate, entire, dark brown, rare on both sides; the hairs 0.1–0.3 mm long, patent, articulated, sparse abaxially, dense in the adaxial grooves; pinnae 11–18 pairs, basal ones the largest, 25–50 × 19–42 cm, triangular, strongly asymmetrical and enlarged basiscopically, stalks to 45 mm long; adaxial pinna axes glandulose-pubescent, hairs 0.1–0.2 mm long, dense on costae and costules, sparse to absent on veins, glandular hairs ca. 0.1 mm long, cylindrical, yellow, shiny; adaxial laminar surface between veins glabrous; abaxial pinna axes glandular, scaly, and pubescent, the glands, hairs, and scales similar to those of the adaxial side, but less dense; abaxial laminar surface between veins glandulose by scattered, short, cylindrical, yellow, shining glandular hairs ca. 0.1 mm; sori round; indusia absent.

Material examined: Agricultural College lands, road to São Miguel, about Km 3, 685 m, 18.III.1930, *Y. Mexia 4478-a* pro parte (US barcode 01560497, VIC); Agricultural College land, North slope of Barbado, 705 m, 22.IV.1930, *Y. Mexia 4615* (IAN, K-2 sheets, NY, RB, US, VIC-2 sheets); Fazenda de Deserto, Burraca Frio [Buraco Frio], 700 m, 12.V.1930, *Y. Mexia 4684* (IAN, K-2 sheets, NY, RB, US, VIC-3 sheets); UFV, Mata do Paraíso, 700 m, 25.V.2015, *P.B. Schwartsburd et al. 3508* (UPCB, VIC); 9.II.2017, *P.B. Schwartsburd et al. 3870* (UPCB, VIC).

The species is distributed in the Greater and Lesser Antilles; Mexico to Paraguay, Argentina, and Brazil (Labiak *et al.* 2015). In Viçosa it is known from the "Agricultural College" (currently UFV) and Fazenda Deserto. Terrestrial in the dense shade of cut-over woods, often in gulches, and usually forming colonies due to proliferous buds on the apices of the leaves; 685–705 m.

All species of *Parapolystichum* used to be treated in *Lastreopsis*, but recent molecular phylogenetic studies have shown that *Parapolystichum* is distinct (Labiak *et al.* 2014, 2015). Morphologically, *Lastreopsis* and *Parapolystichum* are considered indistinguishable (Labiak *et al.* 2015), but *P. effusum* has buds on the distal parts of the laminae (a character absent in *Lastreopsis*) (Fig. 5d). In addition to these buds, *P. effusum* is distinct from all other Dryopteridaceae in Viçosa by the shape of its laminar axes adaxially. The rachis has two ridges and is densely puberulent

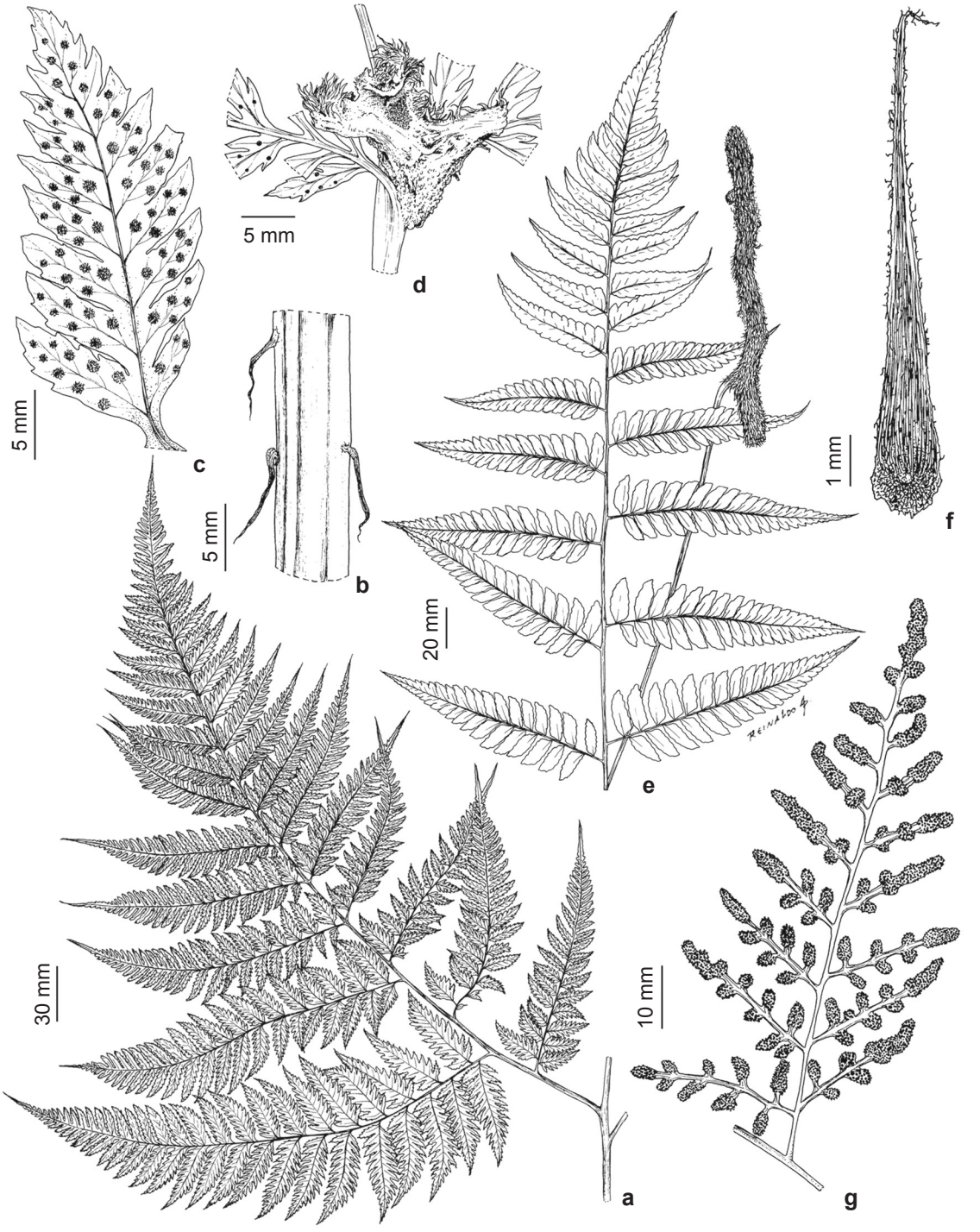

Figure 5 – a–d. *Parapolystichum effusum* – a. basal pinna; b. petiole detail; c. pinnule abaxially; d. rachis bud at the axil of a distal pinna. e–g. *Polybotrya speciosa* – e. habit; f. stem scale; g. fertile pinna. (a–d. *Schwartsburd 3508*, VIC; e–f. *Schwartsburd 3438*, VIC; g. *Brade 9843*, VIC).

between them. The ridges are continuous with the decurrent margins of the pinnules. The central part of the axes is raised (not grooved, as in most of the Dryopteridaceae). A similar rachis-costa architecture is found in *Rumohra adiantiformis*, which differs by axes adaxially glabrous and indusiate sori.

Some specimens of *Mexia 4478* at IAN, MO, NY, and US refer to *Christella patens* (Sw.) Holttum (Thelypteridaceae). Another specimen at US (barcode 01617636) refers to *Mutisia speciosa* Aiton ex Hook. (Asteraceae). To distinguish the specimens of *Parapolystichum effusum* from others with the same number, we adopted the suffix "a" (i.e., *Mexia 4478-a*, as seen on the specimen at US, barcode 01560497).

5. *Polybotrya* Humb. & Bonpl. *ex* Willd.

Terrestrial and scandent; stems long-creeping; leaves distant (10–15 cm apart), the sterile and fertile strongly dimorphic (fertile leaves like a skeletonized version of the sterile ones); laminae to 3-pinnate, but mostly 2-pinnate-pinnatifid throughout, the basal pinnae symmetrical or nearly so, the apices tapered; rachises and costae grooved adaxially, the grooves decurrent into those of the next lower order, the rachises not alate; axes glabrous to subglabrous abaxially, pubescent adaxially (the hairs abundant, matted in the grooves); veins free, the tips narrow (not hydathodous), ending near the margin; sori coenosoric, formed by the fusion of several different sori; indusia absent.

Polybotrya is neotropical, consisting of 36 species (Moran 1987; Canestraro & Labiak 2015). In Brazil, there are 16 species, seven of which are endemic (Canestraro 2022). Two Brazilian species of *Polybotrya* are known to hybridize with *Cyclodium meniscioides* (Willd.) C. Presl, resulting in the hybrid genus ×*Cyclobotrya* (Engels & Canestraro 2017, Schwartsburd *et al.* 2018).

5.1. *Polybotrya speciosa* Schott (1834: t. 7).

Fig. 5e-g

Stem scales 7–20 × 0.3–1.5 mm, linear-lanceolate, denticulate to strongly erose, brown, usually with a dark central stripe; leaves up to 110 cm long; laminae 35–65 × 25–85 cm, lanceolate to ovate, to 3-pinnate, but mostly 2-pinnate-pinnatifid throughout, gradually tapering towards apices; rachises scaly and pubescent, the scales to ca. 15 × 0.2 mm, filiform to lanceolate, slightly denticulate, mostly appressed, dark brown, the hairs 0.3–15 mm long, rather straight but flexible, patent, whitish to reddish, particularly dense in the adaxial grooves, uniseriate microscales ca. 0.2 mm long also present; pinnae 7–15 pairs, basal ones the largest, 12–42 × 4–18 cm, deltate, symmetrical or nearly so, stalks to 30 mm long; adaxial pinna axes pubescent, hairs 0.4–10 mm long, dense on costa, sparse on costules, absent on veins, blunt hairs and minute microscales 0.1–0.3 mm long also present; adaxial laminar surface between veins glabrous; abaxial pinna axes scaly, sometimes with a few scattered hairs shorter than 0.2 mm long, the scales 0.1–20 mm long, filiform to lanceolate, entire to denticulate, dark brown; abaxial laminar surface between veins subglabrous, with sparse uniseriate microscales ca. 0.2 mm long; sori coenosoric; indusia absent, but paraphyses present and conspicuously branched.

Material examined: Mata do Nico, 20°47' S, 42°51' W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2635* (UPCB, VIC); 15.XII.2014, *P.B. Schwartsburd et al. 3438*, *3440* (VIC).

The species is endemic to southeastern Brazil, with records from Minas Gerais, Rio de Janeiro, and São Paulo (Moran 1987; Garcia & Salino 2008). This is the first record of this species from Viçosa, where it is known only from Sítio Bom Sucesso (Mata do Seu Nico). Terrestrial and scandent in humid forests; 800 m. Apparently, most species of *Polybotrya* begin growth on the forest floor, either on mineral soil or rotting logs, and then climb upon encountering a tree trunk (Canestraro *et al.* 2014). The fertile (spore-bearing) leaves are produced only on the climbing part of the stem. They resemble skeletonized versions of the sterile (photosynthetic) ones. After the spores are shed, the fertile leaves wilt, but the vegetative ones persist (pers. obs.).

Polybotrya speciosa is characterized by the combination of strongly denticulate, brown stem scales (Fig. 5f), finely cut lamina (to 3-pinnate, but mostly 2-pinnate-pinnatifid throughout) (Fig. 5e, g), and multicellular, branched paraphyses (Moran 1987). Only two other species of *Polybotrya* have branched paraphyses: *P. pilosa* Brade and *P. tomentosa* Brade. *Polybotrya speciosa* differs from these two species by characteristics of the pubescence. The hairs on the abaxial laminar surfaces of *P. speciosa* are absent or shorter than 0.2 mm long, whereas those of *P. tomentosa* have 0.2–0.6 mm long, and those of *P. pilosa* 1–2.5 mm long. *Polybotrya tomentosa* further differs from *P. speciosa* by having these hairs also between the veins (vs. hairs restricted to veins and major axes in *P. speciosa*) (Moran 1987; Canestraro & Labiak 2015).

6. *Rumohra* Raddi

Terrestrial, epipetric, or epiphytic; stems long-creeping; leaves distant, the sterile and fertile monomorphic; laminae 3-pinnate-pinnatifid proximally, becoming gradually less divided distally, the basal pinnae slightly asymmetrical and enlarged basiscopically, the apices tapered; rachises and costae with a raised medial ridge flanked on both sides by a groove and lateral ridge, the grooves decurrent into those of the next lower order, the lateral ridges continuous with the leaf margin; axes scaly abaxially (the scales pale to medium-brown, lanceolate), glabrous to moderately glandular adaxially (the glands hyaline to reddish brown, capitate); veins free, the tips narrow (not hydathodous), ending at the margin; sori round; indusia circular, peltate.

Rumohra is mostly pantropical, consisting of eight species (PPG I 2016). In Brazil, there are three species, including two narrow endemics, *R. glandulosissima* Sundue & J.Prado and *R. quadrangularis* (Fée) Brade, and the circum-austral *R. adiantiformis* (G.Forst) Ching (Sundue *et al.* 2013).

6.1. *Rumohra adiantiformis* (G.Forst.) Ching (1934: 70). *Polypodium adiantiforme* Forster (1786: 82). Fig. 6a-c

Stem scales 4–13 × 1.5–4.5 mm, ovate to lanceolate, entire to slightly denticulate, medium brown; leaves up to 45 cm long; laminae ca. 25 × 15 cm (but our specimen is incomplete; usually 12–40 × 14–28 cm), ovate to lanceolate, 3-pinnate-pinnatifid at base, 2 pinnate-pinnatifid medially, gradually tapering towards apices; rachises scaly, the scales up to 4 × 1.2 mm, lanceolate, entire or with ciliate margins, pale- to dark-brown, more abundant abaxially; pinnae 3 pairs (usually 8–15 pairs), basal ones the largest, ca. 15.5 × 13 cm, lanceolate, slightly asymmetrical and enlarged basiscopically, stalks to 15 mm long; adaxial pinna axes scaly, the scales like those of the rachises, but smaller, up to 0.5–2 × 0.1–0.4 mm, sparse on costae, absent on costules and veins; adaxial laminar surface between veins glabrous; abaxial pinna axes scaly, the scales like those of the adaxial side, but quite dense on costae and costules, sparse on veins; abaxial laminar surface between veins glabrous; sori medial; indusia present.

Material examined: Escola [de Agricultura], [without day and month] 1935, *J.G. Kuhlmann* (VIC barcode 1883).

The species is widely distributed throughout the tropics and subtropics, primarily in the Southern Hemisphere. In the Paleotropics it is known from Africa, Madagascar, Papua New Guinea, Australia, and New Zealand. In the Neotropics, it is known from the Greater Antilles, Bermuda, and South America, from Venezuela to Uruguay and Brazil, as well as the Galapagos and the Juan Fernández Islands (Sundue *et al.* 2013). In Minas Gerais, it is widely distributed and occurs in a great variety of habitats, from 400 to 2020 m in elevation (Garcia & Salino 2008). In Viçosa, it is known from a single collection made at the "Agricultural College" (currently UFV) by João Geraldo Kuhlmann in 1935. Unfortunately, there was no information about habitat on the herbarium label provided by Kuhlmann.

Rumohra adiantiformis is characterized by long-creeping stems, monomorphic fertile-sterile leaves, 2–3-pinnate-pinnatifid laminae, pinnules of the lower pinnae arranged anadromically, rachises with two adaxial grooves separated by a raised medial ridge, round sori, and peltate indusia (Fig. 6a–c). The most similar species in Viçosa is probably *Parapolystichum effusum*, which has similar rachis-costa architecture, but differs by axes adaxially puberulent (vs. glabrous in *R. adiantiformis*), proliferous buds present (vs. absent) near the apex of the lamina, and sori without indusia (vs. sori with peltate indusia). *Rumohra adiantiformis* is among the most familiar fern species in the world, being widely used in the florist trade (Sundue *et al.* 2013). In the southern region of Brazil, the extraction and commercialization of its leaves have become the main source of income for some families (Ribas & Miguel 2004). The fact that such a ubiquitous plant was collected in Viçosa only once, over 80 years ago, could be an indication that *Kuhlmann s.n.* (VIC barcode 1883) came from a cultivated plant. This was one of the few specimens from Viçosa that were cited by Garcia & Salino (2008).

7. *Stigmatopteris* C. Chr.

Terrestrial; stems short-creeping; leaves approximate, the sterile and fertile monomorphic; laminae 1-pinnate-pinnatifid, the basal pinnae symmetrical, the apices tapered; rachises and costae grooved adaxially, the grooves continuous; axes scaly abaxially (the scales brown), pubescent adaxially (the hairs 1- or 2-celled, reddish, usually blunt-tipped); veins free, the tips clavate (hydathodous), not reaching the margin; laminae

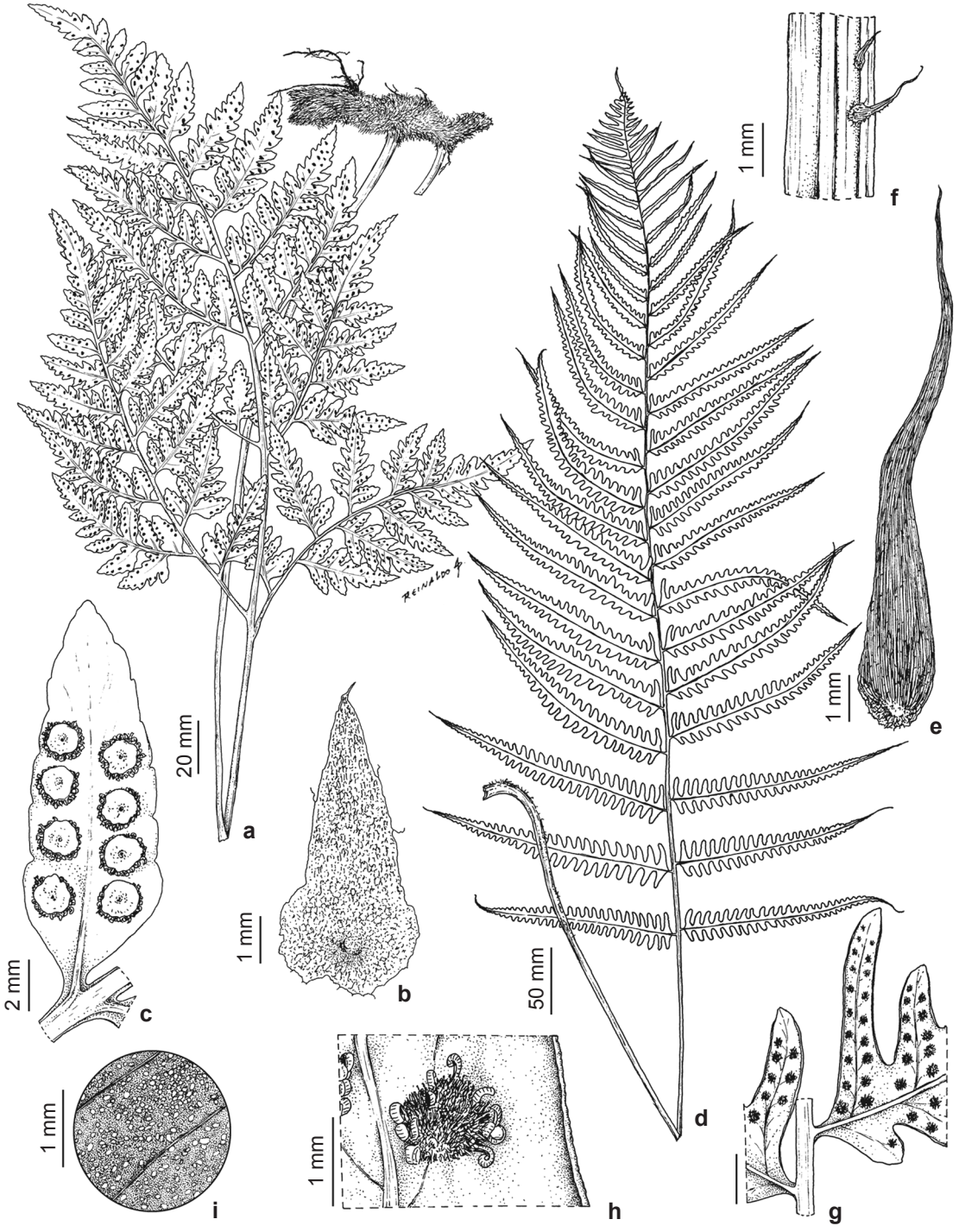

Figure 6 – a–c. *Rumohra adiantiformis* – a. habit; b. stem scale; c. pinnule abaxially, showing sori with peltate indusia. d–i. *Stigmatopteris prionites* – d. leaf; e. stem scale; f. petiole adaxially; g. rachis and pinna abaxially; h. sori; i. laminar tissue with internal punctate glands. (a–b. *Schwartsburd 2540*, VIC; c. *Valente* 561, VIC; d–g. *Valente 899*, VIC).

between veins with internal punctate glands; sori round or slightly oblong near the costae; indusia absent.

Stigmatopteris is entirely neotropical, consisting of 24 species (Moran 1991). In Brazil, there are seven species, six of which are endemic (Matos & Labiak 2022b).

7.1. *Stigmatopteris prionites* (Kunze) Christensen (1909: 298). *Polypodium prionites* Kunze (1839: 29). Fig. 6d-i

Stem scales 4–15 × 0.5–2 mm, lanceolate, entire, dark brown; leaves up to 160 cm long; laminae up to 100 × 42 cm, lanceolate, 1-pinnate-pinnatifid, gradually tapering towards apices; rachises scaly and pubescent, the scales up to 5 × 0.5 mm, ovate to lanceolate, usually with irregular marginal processes, brown, the hairs 0.1–0.2 mm long, bacilliform, patent, reddish to brown, particularly common in the adaxial grooves and at the junction of most pinnae, branched microscales ca. 0.2 mm also present; pinnae 15–27 pairs, medial ones the largest, 11–20 × 1–2.5 cm, linear to narrowly oblong, incised 1/4–1/2 of the distance between segment apices and costa, sinuses U-shaped, symmetrical or nearly so (the proximal pair of lobes usually enlarged acroscopically), sessile or nearly so; adaxial pinna axes scaly and pubescent at the base of costae, scales and hairs like those of the rachises; adaxial laminar surface between veins glabrous; abaxial pinna axes scaly, the scales 0.5–2 × 0.1–0.5 mm, filiform to lanceolate or ovate, light brown, margins with irregular processes, microscales to 0.5 mm long sparse on costae and costules; abaxial laminar surface between veins glabrous; sori inframedial; indusia absent.

Material examined: Agricultural College, Corrigo Riberro [Córrego Ribeiro], 675 m, 22.VII.1930, *Y. Mexia 4893-a* (UC); Mata do Nico, 20°47'S, 42°51'W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2636* (UPCB, VIC); 15.XII.2014, *P.B. Schwartsburd et al. 3444* (UPCB, VIC); BR-120, Viçosa-Coimbra, Sítio Bom Sucesso, 26.III.2002, *G.E. Valente & Z.V. Pereira 899* (SP, UPCB, VIC).

Additional specimen examined: Brazil, Minas Gerais: [Visconde do] Rio Branco, Retiro de Antonio Avelino, 8.XII.1931, *Y. Mexia 5492* (F, IAN, K, NY, P, PACA, RB-2 sheets, UC, US, VIC).

The species is endemic to the Brazilian Atlantic Forest, from Pernambuco to Minas Gerais and Rio de Janeiro (Moran 1991; Matos & Labiak 2022b). In Viçosa it is known from the "Agricultural College" (currently UFV) and Sítio Bom Sucesso (Mata do Seu Nico). Also known from the nearby municipality of Visconde do Rio Branco. Terrestrial in humid forests; 675–800 m.

Stigmatopteris prionites is characterized by 1-pinnate-pinnatifid laminae, with pinna cut 1/2 or less to the costa, the lobes separated by U-shaped sinuses, round sori, and no indusia (Fig. 6d–i). It is most similar to its sister species, *S. tyucana* (Raddi) C.Chr. (Moran & Labiak 2016), from which it differs by narrower pinnae (1.1–2.3 vs. 2.5–4 cm wide), U-shaped sinuses (vs. V-shaped), fewer veins per lobe (3–5 vs. 4–7), and inframedial sori (vs. medial to supramedial) (Moran 1991). Garcia & Salino (2008) cited one specimen from Viçosa (*Valente 899*, VIC) under *S. brevinervis* (Fée) R.C.Moran (= *S. bradei* Rosenst., see Matos & Labiak 2022b). That species, however, differs from *S. prionites* by broader (2.5–4 vs. 1.1–2.5 cm wide) and more deeply cut (1/2–2/3 vs. 1/4–1/2 to costa) sterile pinnae, V-shaped sinuses (vs. U-shaped), and more veins per lobe (5–10 vs. 3–5).

Moran (1991) cited two specimens of *Stigmatopteris prionites* from the region of Viçosa (*Mexia 4893a, 5492*). The specimen from Visconde do Rio Branco (*Mexia 5492*) was cited by Garcia & Salino (2008) under *S. brevinervis*.

Two additional varieties have been described for *Stigmatopteris prionites: S. prionites* var. *denticulata* (Fée) C.Chr. and *S. prionites* var. *pseudocaudata* Brade. The former variety was synonymized by Moran (1991) under *S. prionites,* who judged the denticulate apices of the segments only a regular variation within the species. Unfortunately, Moran (1991) did not cite the latter variety. According to Brade (1946), *S. prionites* var. *pseudocaudata* is known only for Jatiboca, Espírito Santo, and presents intermediate morphology between *S. prionites* (*var. denticulata*) and *S. caudata*, where the three taxa occur sympatrically. Possibly, *S. prionites* var. *pseudocaudata* might represent a hybrid between these two species, but further studies are necessary. Here, we opted to regard *S. prionites* only at the species level.

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