



Checklist of ferns and lycophytes from Parque Estadual Mata das Flores, Castelo, Espírito Santo, Brazil

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Abstract

We present a checklist of ferns and lycophytes from Parque Estadual Mata das Flores, a state park located in Castelo, Espírito Santo, Brazil. The park has an area of 800 ha, and its main vegetation is composed of dry forest (at 150–500 m elev.), and a small portion of wet forest (500–700 m), within the Brazilian Atlantic Rainforest biome. We found 83 taxa, including 75 species, 3 varieties, 4 putative hybrids, and 1 cultivar. Among these, 17 are newly recorded from the Espírito Santo. Twenty-five taxa are endemic to the Atlantic Forest biome, and 5 are endemic to southeastern Brazil, and 2 are narrow endemics to the states of Rio de Janeiro and Espírito Santo. *Anemia blechnoides* is the only vulnerable species found, according to the national red list. We found 4 naturalized species. Among the hybrids, 3 are reported for the first time in literature (*Blechnum asplenioides* × *B. glandulosum*, *Campyloneurum decurrens* × *C. repens*, and *Doryopteris collina* × *D. lorentzii*) and 1 for the first time in Brazil (*B. glandulosum* × *B. polypodioides*).

Key words

Atlantic Forest; ferns; hybrid ferns; new records; Pteridophyta; southeastern Brazil.

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Introduction

The state of Espírito Santo is one of the smallest in Brazil, yet has a huge biodiversity. At present, ca 7150 plant species (including mosses, ferns, their allies, and seed plants) are recognized as naturally occurring there (Brazil Flora Group 2015, Dutra et al. 2015, Costa and Peralta 2015, Prado et al. 2015, Flora do Brasil 2017). This number is still far from final, since the flora of this state has been poorly studied, and in the last several years many new species have been described (e.g., Labiak and

Matos 2009, Goldenberg and Kollmann 2016, Ribeiro et al. 2016).

Although Prado et al. (2015) and Flora do Brasil (2017) list 453 species of ferns and lycophytes from Espírito Santo, there is no comprehensive paper treating these groups from this state, in the sense of plotting species per conservation unit or per geo-floristic region. The main works in this direction are the checklists of Brade (1936, 1947), Behar and Viegas (1992, 1993), Souza (2012), Aquije and Santos (2007), Couto et al. (2016), and Sylvestre et al. (2016). To contribute this type of

knowledge, we provide a checklist of ferns and lycophytes from the Parque Estadual Mata das Flores.

Methods

The Parque Estadual Mata das Flores is a state park located in the Municipality of Castelo, Espírito Santo, Brazil. Its geographical coordinates are ca 20°35'14" S to 20°38'18" S and 041°09'21" to 041°12'09" W. It embraces an area of ca 800 ha (Figs 1, 2). Most of the park is at elevations ranging from 150 to 500 m above sea level, but with a small area on a mountain top from 500 to 750 m (IEMA 2016, personal observation). The park is completely within the Atlantic Rainforest biome, and there are 2 types of physiognomic-physiologic systems there (sensu IBGE 2012): (1) the main vegetation in the lowlands is composed of a dry forest classified as Semi-Deciduous Seasonal Forest from the Lowlands; and (2) the small highland area is a wet forest classified as Dense Ombrophilous Montane Forest, with some rocky outcrops (IBGE 2012, IEMA 2016).

The field expeditions took place during 29 February 2016 to 3 March 2016, during the post-graduation course taught by the senior author to the other authors. We walked through all trails and roads of the park and to sites without trails, aiming to visit all types of microhabitats. Because the area of the park is relatively small and the trails are placed in many different areas, we believe we sampled more than 70% of the area.

We identified the taxa using the following literature: Christensen (1913), Tryon (1942, 1960), Mickel (1962), Brade (1964), Tindale (1965), Hennipman (1977), Tryon and Tryon (1982), Lellinger (1988), Mickel and Beitel (1988), Moran (1995a, 1995b, 2000), Nauman (1995), Prado and Windisch (2000), Hoshizaki and Moran (2001), Sylvestre (2001), Salino and Semir (2002, 2004a, 2004b), Mickel and Smith (2004), Christenhusz (2007), Schwartzburd and Labiak (2007), Winter et al. (2007), Labiak and Prado (2008), Moran et al. (2010), Link-Pérez and Hickey (2011), Mynssen (2011), Windisch (2014), Dittrich et al. (2015), Viveros and Salino (2015), Heringer et al. (2016), Rabelo and Schwartzburd (2016), Salino et al. (2016). Comparisons were made with the fern collection at herbarium VIC (acronym according to Thiers 2017) and online collections through Reflora-Herbário Virtual (2016).

Some names of genera are according to Labiak et al. (2015), Prado et al. (2015), Salino et al. (2015), PPG I (2016), and Flora do Brasil (2017). The classification system adopted is that of PPG I (2016). The taxa are presented in alphabetical order by families, genera, and species. We provide short diagnosis for the taxa newly discovered in Espírito Santo, as well as for the hybrids and their putative parents.

We used the literature to summarize the geographical distributions of all taxa into seven categories: (1) Endemic to the Brazilian Atlantic Forest (then the states specified if a narrower endemic), (2) widely distributed in

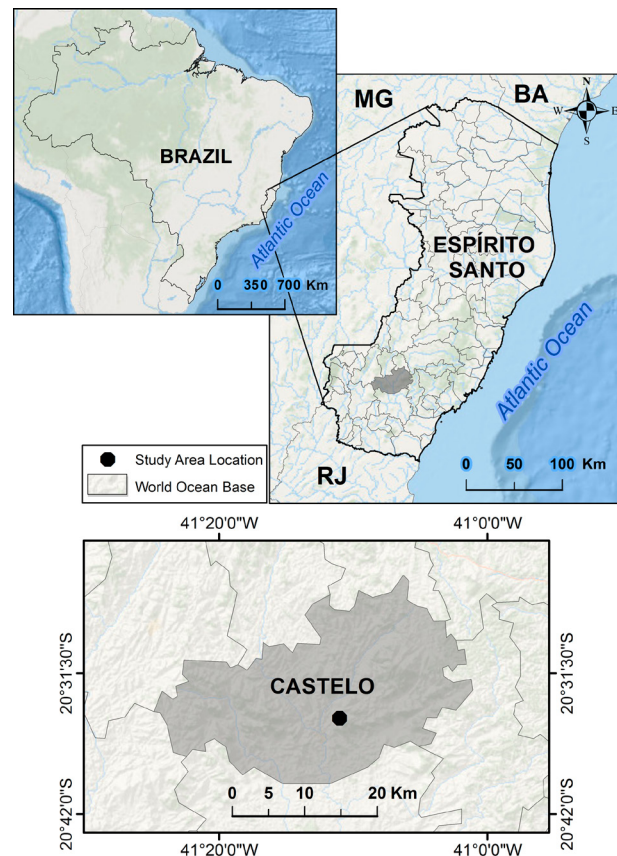


Figure 1. Map of Brazil, the state of Espírito Santo, the municipality of Castelo, and the location of Parque Estadual Mata das Flores.

South America, (3) widely distributed through the Neotropics, (4) pantropical, (5) sub-cosmopolitan (widely distributed around the world), (6) alien invasive (species from abroad, naturalized in Brazil), and (7) uncertain (taxa with a doubtful or unknown distribution).

Our collections are deposited in herbarium VIC, with duplicates sent to herbaria RB, SP, and VIES (acronyms according to Thiers 2017). In the Results, the vouchers are contracted as “Schw.” plus collection numbers and herbaria. They all correspond to: “Brazil, Espírito Santo, Castelo, Parque Estadual Mata das Flores, 29 February 2016 – 3 March 2016, P.B. Schwartzburd et al.” plus collection numbers and herbaria.

Results

We found 83 taxa of ferns and lycophytes within the Parque Estadual Mata das Flores. Among them, only 1 is accounted as vulnerable, in the national red list (MMA 2014). The list of taxa, with their respective geographical distribution, vouchers of specimens, and diagnosis of critical taxa, follows:

Lycophytes (Lycopodiopsida)
Selaginellaceae

Selaginella sulcata (Poir.) Spring

General distribution. South American.

Material examined. Schw. 3678 (VIC), Schw. 3730

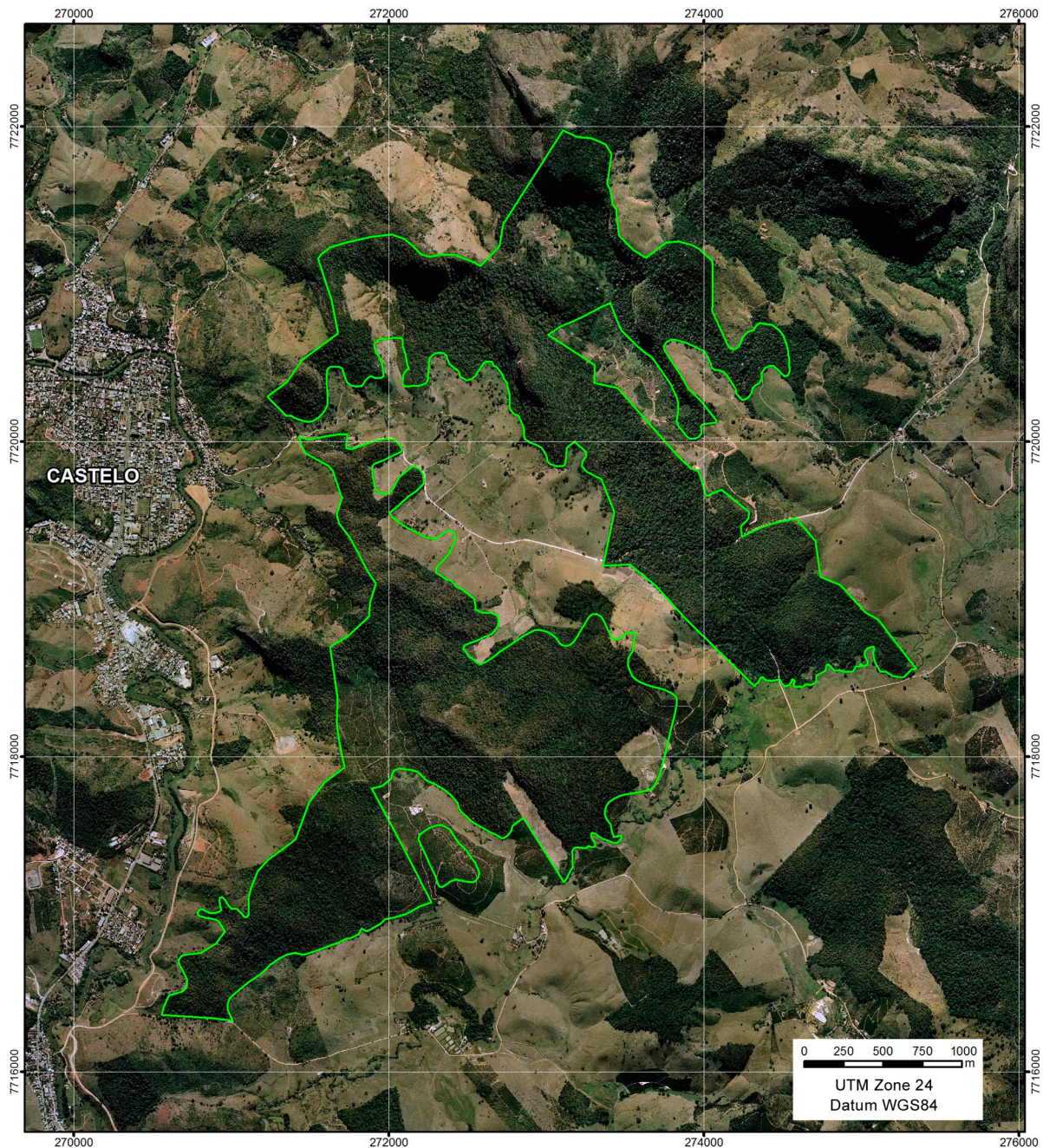


Figure 2. Map of Parque Estadual Mata das Flores. Limits of the park in bright green. (Reproduced with permission by IEMA.)

(VIC), *Schw.* 3764 (RB, VIC, VIES), *Schw.* 3765 (SP, VIC, VIES).

Ferns (Polypodiopsida)
Anemiaceae

***Anemia blechnoides* J. Sm.**

General distribution. Atlantic Forest (Minas Gerais, Espírito Santo, Rio de Janeiro).

Material examined. *Schw.* 3647 (VIC), 3667 (VIC, VIES).

Conservation status. Vulnerable (MMA 2014).

Diagnosis. *Rhizomes* ascendant, with pale orange hairs; *fronds* hemi-dimorphic; *fertile pinnae* not exceeding sterile laminae in length; *sterile laminae* 1-pinnate, with 30–45 pairs of pinnae, with radicant apex; *basal*

sterile pinnae simple, trapeziform, strongly inequilateral at base; *spores* well formed.

***Anemia collina* Raddi**

General distribution. Atlantic Forest (Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro).

Material examined. *Schw.* 3674 (RB, VIC), 3753 (VIC, VIES), 3754 (VIC).

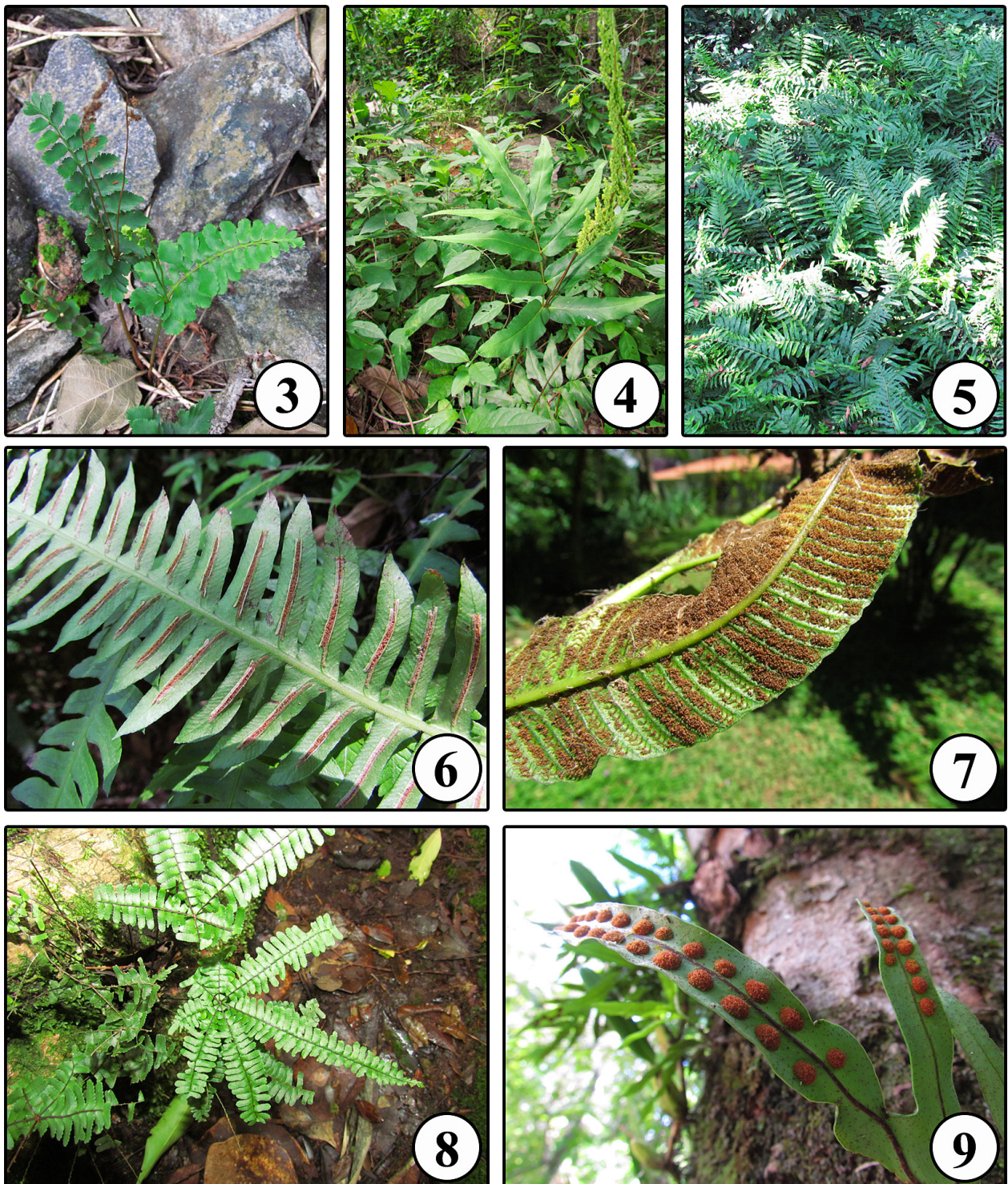
***Anemia hirsuta* (L.) Sw. (Fig. 3)**

General distribution. Neotropical.

Material examined. *Schw.* 3672 (VIC, VIES), 3676 (VIC, VIES), 3746 (VIC), 3747 (VIC), 3749 (VIC).

***Anemia hispida* Kunze**

General distribution. Neotropical.



Figures 3–9. Habits or sori of some ferns in Parque Estadual Mata das Flores. **3.** *Anemia hirsuta*. **4.** *Anemia phyllitidis*. **5.** *Meniscium serratum*. **6.** *Blechnum polypodioides*. **7.** *Meniscium serratum*. **8.** *Adiantopsis radiata*. **9.** *Pleopeltis pleopeltifolia*. (Photographs by PBS.)

Material examined. Schw. 3742 (VIC), 3743 (VIC), 3744 (VIC), 3745 (VIC).

Diagnosis. *Rhizomes* ascendant, with orange hairs; *fronds* hemi-dimorphic; *fertile pinnae* generally exceeding sterile laminae in length; *sterile laminae* 1-pinnate, with 5–10 pairs of pinnae, with sub-conform apex; *basal sterile pinnae* simple, inequilateral at base, sometimes with an acroscopical auricle; *spores* well formed.

Anemia luetzelburgii Rosenst.

General distribution. Atlantic Forest (Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro).

Material examined. Schw. 3675 (VIC, VIES)

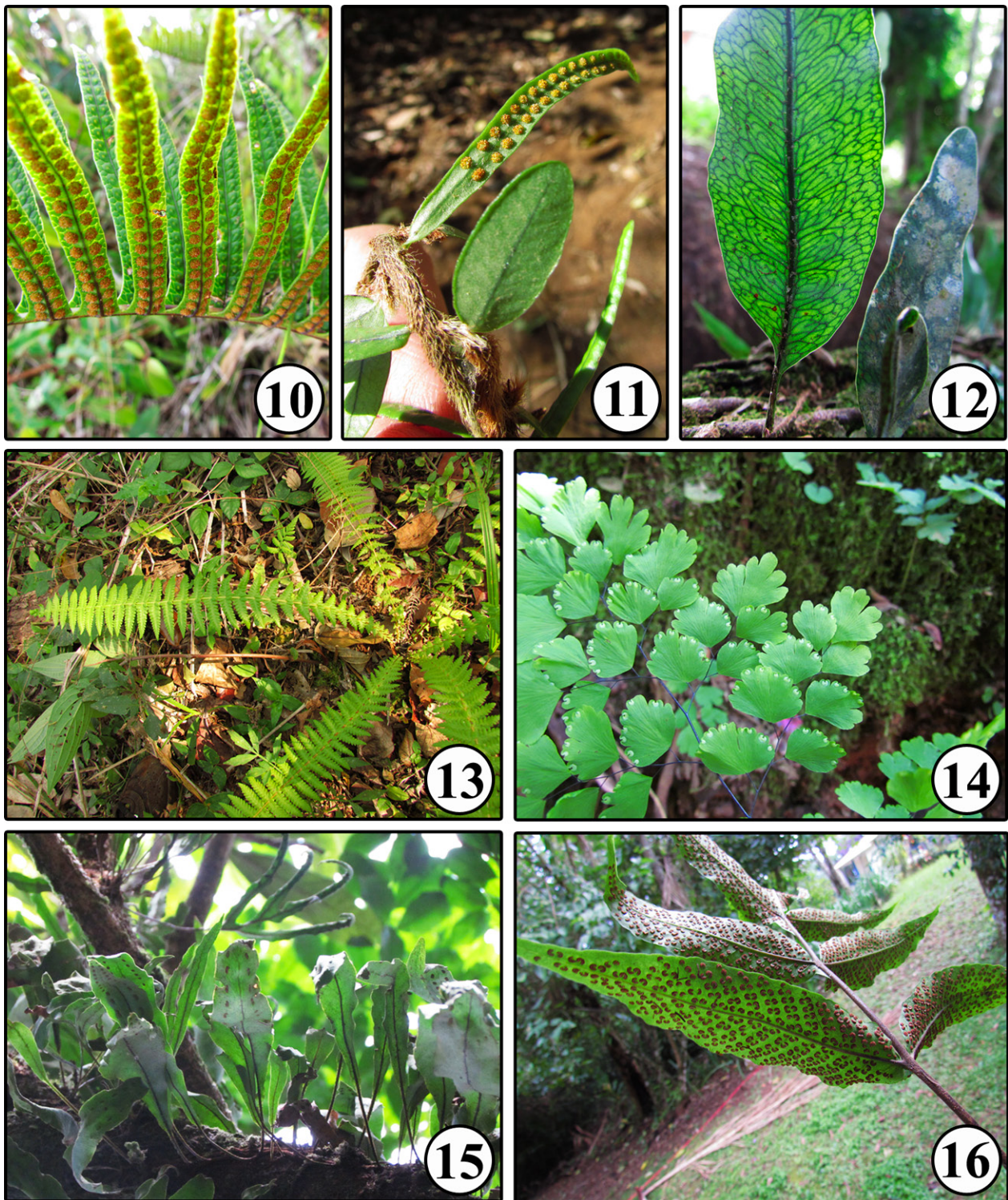
Anemia nervosa Pohl ex Sturm

General distribution. Atlantic Forest (and Cerrado).

Material examined. Schw. 3615 (VIC), 3664 (VIC), 3673 (VIC).

Anemia phyllitidis (L.) Sw. (Fig. 4)

General distribution. Neotropical.



Figures 10–19. Habits, sori, or venation patterns of some ferns in Parque Estadual Mata das Flores. **10.** *Serpocaulon latipes*. **11.** *Microgramma vacciniifolia*. **12.** *Microgramma squamulosa*. **13.** *Amauropelta opposita*. **14.** *Adiantum raddianum*. **15.** *Pleopeltis astrolepis*. **16.** *Tectaria incisa* f. *incisa*. (Photographs by PBS.)

Material examined. Schw. 3663 (VIC), 3671 (VIC).

Anemia rotundifolia Schrad.

General distribution. Atlantic Forest (Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro).

Material examined. Schw. 3632 (RB, VIC, VIES), 3724 (SP, VIC, VIES).

Anemia tomentosa (Sav.) Sw. var. *tomentosa*

General distribution. Atlantic Forest.

Material examined. Schw. 3712 (VIC, VIES), 3748 (VIC), 3768 (VIC, VIES).

Diagnosis. *Rhizomes* creeping with beige hairs; *fronds* hemi-dimorphic; *fertile pinnae* slightly exceeding sterile laminae in length; *sterile laminae* 2-pinnate-pinnatifid, with 10–15 pairs of pinnae, with pinnatifid apex; *basal sterile pinnae* inequilateral, basiscopically 1-pinnate-pin-

natifid, acroscopically 1-pinnate to 1-pinnate-pinnatifid; spores aborted.

***Anemia tomentosa* var. *anthriscifolia* (Schrader) Mickel**

General distribution. South American.

Material examined. Schw. 3751 (VIC, VIES), 3752 (VIC), 3767 (VIC, VIES).

***Anemia villosa* Humb. & Bonpl. ex Willd.**

General distribution. South American.

Material examined. Schw. 3766 (VIC, VIES).

Aspleniaceae

***Asplenium auritum* Sw.**

General distribution. Pantropical.

Material examined. Schw. 3741 (VIC).

***Asplenium balansae* (Baker) Sylvestre**

General distribution. Atlantic Forest.

Material examined. Schw. 3582 (RB, VIC), Schw. 3626 (VIC, VIES).

***Asplenium bradei* Rosenst.**

General distribution. Atlantic Forest.

Material examined. Schw. 3578 (RB, VIC, VIES), 3586 (RB, VIC, VIES), 3703 (VIC).

***Asplenium douglasii* Hook. & Grev.**

General distribution. Atlantic Forest (Espírito Santo, Rio de Janeiro).

Material examined. Schw. 3679 (VIC), 3690 (SP, VIC), 3713 (RB, VIC, VIES).

***Asplenium laetum* Sw.**

General distribution. Neotropical.

Material examined. Schw. 3589 (RB, VIC, VIES), 3641 (VIC, SP), 3701 (VIC, VIES).

Diagnosis. Rhizomes short-creeping, with clathrate scales; fronds monomorphic; petioles non alate; laminae 1-pinnate, truncate or slightly reduced at base, with pinnatifid apex; pinnae subfalcate, inequilateral at base, with a pronounced acroscopical auricle; sori abaxial, linear; indusia linear, laterally attached.

***Asplenium serratum* L.**

General distribution. Neotropical.

Material examined. Schw. 3638 (RB, VIC, VIES), 3698 (RB, VIC, VIES).

Athyriaceae

***Diplazium asplenioides* (Kunze) C. Presl**

General distribution. Neotropical.

Material examined. Schw. 3649 (VIC, VIES), 3719 (RB, VIC), 3722 (RB, VIC, VIES).

***Diplazium cristatum* (Desr.) Alston**

General distribution. Neotropical.

Material examined. Schw. 3583 (VIC, VIES), 3659 (SP, VIC, VIES), 3661 (VIC), 3717 (RB, VIC), 3718 (VIC).

Blechnaceae

***Blechnum asplenioides* Sw. (Fig. 17)**

General distribution. South American.

Material examined. Schw. 3739 (SP, VIC, VIES).

Diagnosis. Rhizomes erect, stoloniferous, with scales; fronds monomorphic; petioles short, < 1/5 of lamina length; laminae 1-pinnate, gradually tapering at base, with caudate apex; rachises glabrous; sori linear, along the costae; sporangia and spores well formed.

***Blechnum glandulosum* Kaulf. (Figs 19, 20)**

General distribution. Neotropical.

Material examined. Schw. 3595 (VIC, VIES), 3601 (VIC), 3666 (VIC, VIES).

Diagnosis. Rhizomes erect, stoloniferous, with scales; fronds monomorphic; petioles long, > 1/2 of lamina length; laminae 1-pinnate, truncate at base, with caudate apex; rachises with glandular hairs; sori linear, along the costae; sporangia and spores well formed.

***Blechnum polypodioides* Raddi (Figs 6, 22)**

General distribution. Neotropical.

Material examined. Schw. 3665 (VIC, VIES).

Diagnosis. Rhizomes erect, stoloniferous, with scales; fronds monomorphic; petioles long, > 1/2 of lamina length; laminae 1-pinnate, gradually tapering at base, with caudate apex; rachises with glandular hairs; sori linear, along the costae; sporangia and spores well formed.

***Blechnum asplenioides* × *B. glandulosum* (Fig. 18)**

General distribution. Uncertain (possibly South American).

Material examined. Schw. 3757 (SP, VIC, VIES).

Diagnosis. Rhizomes erect, stoloniferous, with scales; fronds monomorphic; petioles medium sized, ca 1/3–1/2 of lamina length; laminae 1-pinnate, slightly reduced at base, with caudate apex; rachises glabrous; sori linear, along the costae; sporangia and spores well formed.

The slightly reduced base of laminae is an intermediate morphological condition between the 2 putative parents, and so is the length of the petioles (Figs 17–19). The glabrous rachises are inheritances of *B. asplenioides*.

***Blechnum glandulosum* × *B. polypodioides* (Fig. 21)**

General distribution. Uncertain (possibly Neotropical).

Material examined. Schw. 3670 (VIC, VIES).

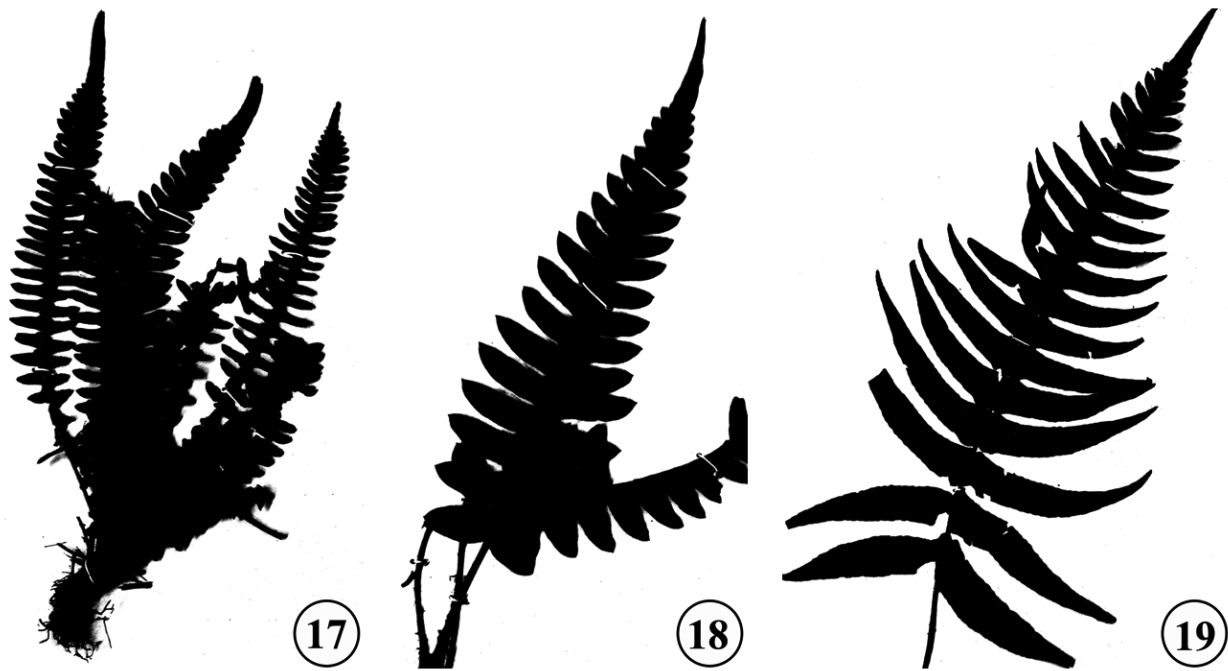
Diagnosis. Rhizomes erect, stoloniferous, with scales; fronds monomorphic; petioles medium sized, ca 1/2 of lamina length; laminae 1-pinnate, slightly reduced at base, with caudate apex; rachises with glandular hairs; sori linear, along the costae; sporangia and spores well formed.

The slightly reduced base of laminae is an intermediate morphological condition between the 2 putative parents (Figs 20–22).

Dennstaedtiaceae

***Dennstaedtia globulifera* (Poir.) Hieron.**

General distribution. Neotropical.



Figures 17–19. Silhouette of hybrid and parents from Parque Estadual Mata das Flores. **17.** *Blechnum asplenioides*. **18.** *Blechnum asplenioides* × *B. glandulosum*. **19.** *Blechnum glandulosum*.



Figures 20–22. Silhouette of hybrid and parents from Parque Estadual Mata das Flores. **20.** *Blechnum glandulosum*. **21.** *Blechnum glandulosum* × *B. polypodioides*. **22.** *Blechnum polypodioides*.

Material examined. Schw. 3702 (VIC), 3715 (VIC, VIES).

Didymochlaenaceae

Didymochlaena truncatula (Sw.) J. Sm.

General distribution. Sub-cosmopolitan.

Material examined. Schw. 3653 (SP, VIC, VIES).

Dryopteridaceae

Bolbitis serratifolia (Mertens ex Kaulf.) Schott

General distribution. Neotropical.

Material examined. Schw. 3587 (VIC, VIES), 3637 (VIC), 3650 (VIC), 3658 (VIC).

Ctenitis christensenii R.S. Viveros & Salino

General distribution. Atlantic Forest (Minas Gerais, Espírito Santo, Rio de Janeiro).

Material examined. Schw. 3573 (SP, VIC), 3579 (VIC), 3580 (SP, VIC), 3599 (SP, VIC, VIES), 3605 (VIC, VIES), 3606 (VIC, VIES).

Ctenitis deflexa (Kaulf.) Copel.

General distribution. Atlantic Forest.

Material examined. Schw. 3704 (SP, VIC, VIES).

Mickelia scandens (Raddi) R.C. Moran et al.

General distribution. Atlantic Forest.

Material examined. Schw. 3643 (VIC).

Diagnosis. Rhizomes long-scandent, with denticu-



Figures 23–25. Silhouette of hybrid and parents from Parque Estadual Mata das Flores. 23. *Campyloneurum decurrens*. 24. *Campyloneurum decurrens* × *C. repens*. 25. *Campyloneurum repens*.

late scales; *fronds* dimorphic; *sterile* laminae 1-pinnate, slightly reduced at base, with subconform apex; *veins* anastomosed, the areoles without included veinlets; *fertile* laminae 1-pinnate; *sori* acrostichoid.

***Parapolystichum effusum* (Sw.) Ching**

General distribution. Neotropical.

Material examined. Schw. 3593 (SP, VIC, VIES).

Gleicheniaceae

***Sticherus penniger* (Mart.) Ching**

General distribution. South American.

Material examined. Schw. 3729 (VIC, VIES).

Hymenophyllaceae

***Vandenboschia radicans* (Sw.) Copel.**

General distribution. Pantropical.

Material examined. Schw. 3654 (SP, VIC, VIES).

Lomariopsidaceae

***Lomariopsis japurensis* (Mart.) J. Sm.**

General distribution. Neotropical.

Material examined. Schw. 3581 (VIC, VIES).

Lygodiaceae

***Lygodium venustum* Sw.**

General distribution. Neotropical.

Material examined. Schw. 3662 (VIC).

Marattiaceae

***Danaea geniculata* Raddi**

General distribution. Atlantic Forest.

Material examined. Schw. 3644 (VIC, VIES), Schw. 3695 (SP, VIC).

Nephrolepidaceae

***Nephrolepis cordifolia* (L.) C. Presl**

General distribution. Pantropical.

Material examined. Schw. 3737 (SP, VIC, VIES).

Polypodiaceae

***Campyloneurum decurrens* (Raddi) C. Presl (Fig. 23)**

General distribution. Atlantic Forest.

Material examined. Schw. 3642 (VIC, VIES), 3657 (VIC), 3714 (RB, VIC).

Diagnosis. *Rhizomes* long-creeping, with non-clathrate, opaque scales; *fronds* monomorphic; *laminae* 1-pinnate, ovate, truncate at base, conform at apex, membranaceous; *veins* cyrtophleboid; *sori* round, 2 or 3 per aureole, exindusiate; *sporangia* and *spores* well formed.

***Campyloneurum phyllitidis* (L.) C. Presl**

General distribution. Neotropical.

Material examined. Schw. 3727 (SP, VIC, VIES).

***Campyloneurum repens* (Aublet) C. Presl (Fig. 25)**

General distribution. Neotropical.

Material examined. Schw. 3645 (SP, VIC, VIES), 3696 (VIC, VIES), 3716 (VIC, VIES).

Diagnosis. *Rhizomes* long-creeping, with clathrate, iridescent scales; *fronds* monomorphic; *laminae* simple, linear-elliptical, attenuate at base, acuminate at apex, membranaceous; *veins* cyrtophleboid; *sori* round, 2 per aureole, exindusiate; *sporangia* and *spores* well formed.

***Campyloneurum decurrens* × *C. repens* (Fig. 24)**

General distribution. Uncertain (possibly Atlantic Forest).

Material examined. Schw. 3660 (VIC).

Diagnosis. *Rhizomes* long-creeping, with clathrate,

iridescent scales; *fronds* monomorphic; *laminae* ternate, attenuate at base, acuminate at apex, membranaceous; *veins* cyrtophleboid; sori round, 2 per aureole, exindusiate; *sporangia* and *spores* aborted.

The ternate laminae is an intermediate morphological condition between the 2 putative parents (Figs 23–25). The bases of the laminae and the rhizome scales are inherited from *Campyloneurum repens*.

***Microgramma crispata* (Fée) R.M. Tryon & A.F. Tryon**

General distribution. Atlantic Forest.

Material examined. Schw. 3612 (VIC), 3613 (VIC), 3725 (VIC, VIES).

***Microgramma squamulosa* (Kaulf.) de la Sota (Fig. 12)**

General distribution. South American.

Material examined. Schw. 3731 (VIC, VIES).

***Microgramma vacciniifolia* (Langsd. & Fisch.) Copel. (Fig. 11)**

General distribution. Neotropical.

Material examined. Schw. 3689 (VIC, VIES), 3738 (VIC).

***Pecluma filicula* (Kaulf.) M.G. Price**

General distribution. South American.

Material examined. Schw. 3700 (VIC), 3735 (SP, VIC, VIES).

***Pecluma pectinatifomis* (Lindm.) M.G. Price**

General distribution. Atlantic Forest.

Material examined. Schw. 3740 (VIC), 3756 (VIC), 3771 (VIC).

***Pecluma plumula* (Humb. & Bonpl. ex Willd.) M.G. Price**

General distribution. Neotropical.

Material examined. Schw. 3571 (VIC, VIES), 3708 (VIC).

***Pleopeltis astrolepis* (Liebm.) E. Fourn. (Fig. 15)**

General distribution. Neotropical.

Material examined. Schw. 3733 (VIC, VIES).

***Pleopeltis minima* (Bory) J. Prado & R.Y. Hirai**

General distribution. South American.

Material examined. Schw. 3623 (RB, VIC, VIES), 3681 (VIC), 3688 (SP, VIC, VIES), 3732 (RB, SP, VIC).

***Pleopeltis pleopeltifolia* (Raddi) Alston (Fig. 9)**

General distribution. Atlantic Forest.

Material examined. Schw. 3611 (VIC), 3734 (RB, VIC, VIES).

***Serpocaulon latipes* (Langsd. & Fisch.) A.R. Sm. (Fig. 10)**

General distribution. Atlantic Forest.

Material examined. Schw. 3770 (VIC, VIES).

Pteridaceae

***Adiantopsis radiata* (L.) Fée (Fig. 8)**

General distribution. Neotropical.

Material examined. Schw. 3755 (VIC, VIES).

***Adiantum caudatum* L.**

General distribution. Alien invasive, from the Paleotropics.

Material examined. Schw. 3622 (VIC, VIES, SP).

Diagnosis. *Rhizomes* erect, with scales; *fronds* monomorphic; *laminae* 1-pinnate; *pinnae* non-articulate; *rachises* proliferous, with a terminal bud; *sori* marginal, elongate, at a commissural vein; *pseudo-indusia* elongate.

***Adiantum curvatum* Kaulf.**

General distribution. Atlantic Forest.

Material examined. Schw. 3634 (VIC, VIES, SP), Schw. 3687 (VIC, SP).

***Adiantum* aff. *deflectens* Mart.**

General distribution. Uncertain.

Material examined. Schw. 3723 (VIC, VIES, SP).

Diagnosis. Similar to *Adiantum deflectens* (1-pinnate lamina, orbicular and reflexed pinnae), but differs by not having a terminal bud on rachises.

***Adiantum latifolium* Lam.**

General distribution. Neotropical.

Material examined. Schw. 3575 (VIC, VIES), Schw. 3619 (VIC, VIES, SP).

***Adiantum pentadactylon* Langsd. & Fisch.**

General distribution. Atlantic Forest.

Material examined. Schw. 3655 (VIC), Schw. 3706 (VIC, VIES, SP).

Diagnosis. *Rhizomes* short-creeping, with scales; *fronds* monomorphic; *laminae* 3-pinnate; *pinnae* non-articulate, trapezoidal; *rachises* non proliferous, without buds; *sori* marginal, elongate, at a commissural vein; *pseudo-indusia* elongate.

***Adiantum pulverulentum* L.**

General distribution. Neotropical

Material examined. Schw. 3603 (SP, VIC), Schw. 3607 (VIC), Schw. 3629 (SP, VIC, VIES), Schw. 3682 (VIC, VIES, SP).

***Adiantum raddianum* C. Presl (Fig. 14)**

General distribution. Neotropical (cultivated nearly worldwide).

Material examined. Schw. 3635 (VIC).

***Adiantum* sp.**

General distribution. Uncertain.

Material examined. Schw. 3596 (VIC, SP), Schw. 3707 (VIC, VIES, SP).

***Doryopteris collina* (Raddi) J. Sm. (Fig. 26)**

General distribution. South America.

Material examined. Schw. 3736 (BM, VIC, VIES), 3758 (VIC), 3759 (VIC).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* dimorphic; *petioles* brown, adaxially flattened; *fertile laminae* pedate; *basal segments* with 1 or 2 basicopical lobes and no acroscopical lobes; *veins* anastomosed; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear; *sporangia* and *spores* well formed.



Figures 26–28. Silhouette of hybrid and parents from Parque Estadual Mata das Flores. **26.** *Doryopteris collina*. **27.** *Doryopteris collina* × *D. lorentzii*. **28.** *Doryopteris lorentzii*.

***Doryopteris concolor* var. *interrupta* Rosenst.**

General distribution. Uncertain (possibly sub-cosmopolitan).

Material examined. Schw. 3588 (VIC), 3624 (SP, VIC), 3680 (BM, VIC, VIES).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* monomorphic; *petioles* brown, adaxially sulcate; *fertile laminae* pedate, with laminar contractions at the rachises; *basal segments* with 5–10 basicopic lobes 5–7 acroscopical lobes; *veins* anastomosed; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear; *sporangia* and *spores* well formed.

***Doryopteris lorentzii* (Hieron.) Diels (Fig. 28)**

General distribution. South America.

Material examined. Schw. 3762 (BM, VIC, VIES).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* dimorphic; *petioles* black, terete; *fertile laminae* pedate; *basal segments* with 3–5 basicopical lobes and 3–5 acroscopical lobes; *veins* anastomosed; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear; *sporangia* and *spores* well formed.

***Doryopteris nobilis* (T. Moore) C. Chr.**

General distribution. Atlantic Forest.

Material examined. Schw. 3577 (BM, VIC, VIES).

***Doryopteris varians* (Raddi) J. Sm.**

General distribution. South America.

Material examined. Schw. 3761 (BM, VIC, VIES).

***Doryopteris collina* × *D. lorentzii* (Fig. 27)**

General distribution. Uncertain (possibly South America).

Material examined. Schw. 3760 (VIC), 3763 (BM, VIC).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* dimorphic(?); *petioles* dark brown, terete; *fertile laminae* pedate; *basal segments* with 3 basicopical lobes and 1 acroscopical lobe; *veins* anastomosed; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear; *sporangia* and *spores* blackish and aborted.

The dark brown color of the petioles is an intermediate morphological condition between the 2 putative parents, and so is the laminar architecture (basal segments with 3

basicopical lobes and 1 acroscopical lobe) (Figs 26–28). The terete petioles are inherited from *Doryopteris lorentzii*.

***Hemionitis tomentosa* (Lam.) Raddi**

General distribution. South America.

Material examined. Schw. 3594 (SP, VIC, VIES), 3677 (VIC), 3683 (VIC), 3709 (VIC), 3769 (VIC, VIES).

Pityrogramma calomelanos* (L.) Link var. *calomelanos

General distribution. Pantropical.

Material examined. Schw. 3726 (VIC, VIES).

***Pteris altissima* Poir. in Lam.**

General distribution. Neotropical.

Material examined. Schw. 3636 (VIC), 3656 (VIC).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* subdimorphic; *petioles* adaxially sulcate; *fertile laminae* 2-pinnate-pinnatifid; *veins* anastomosed, the aureoles without included veinlets, 2–3 elongate aureoles between costules; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear.

Pteris denticulata* Sw. var. *denticulata

General distribution. Neotropical.

Material examined. Schw. 3572 (SP, VIC, VIES), 3591 (SP, VIC, VIES), 3692 (VIC), 3711 (SP, VIC), 3684 (VIC).

***Pteris denticulata* var. *tristicula* (Raddi) J. Prado**

General distribution. South America.

Material examined. Schw. 3617 (SP, VIC), 3630 (VIC), 3631 (SP, VIC, VIES), 3685 (VIC), 3691 (SP, VIC).

Diagnosis. *Rhizomes* erect to decumbent, with scales; *fronds* subdimorphic; *petioles* adaxially sulcate; *fertile laminae* 1-pinnate-pinnatifid, with 2 or 3 pairs of basicopically pinnatifid pinnae; *veins* anastomosed, the aureoles without included veinlets; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear.

***Pteris ensiformis* Burm. f. cv. ‘victoriae’**

General distribution. Alien invasive.

Material examined. Schw. 3627 (VIC), 3669 (SP, VIC, VIES).

Diagnosis. *Rhizomes* creeping, with scales; *fronds* dimorphic; *petioles* adaxially sulcate; *fertile laminae*

2-pinnate to 2-pinnate-pinnatifid, adaxially with cream-white tonality enclosed by green; *veins* free; *sori* linear, marginal, at a commissural vein; *pseudo-indusia* linear.

***Pteris leptophylla* Sw.**

General distribution. Atlantic Forest.

Material examined. Schw. 3646 (VIC), 3668 (SP, VIC, VIES).

***Pteris propinqua* J. Agardh**

General distribution. Neotropical.

Material examined. Schw. 3576 (VIC), 3592 (VIC).

***Pteris splendens* Kaulf.**

General distribution. Atlantic Forest.

Material examined. Schw. 3625 (SP, VIC, VIES), 3693 (VIC).

Tectariaceae

***Tectaria incisa* Cav. f. *incisa* (Fig. 16)**

General distribution. Neotropical.

Material examined. Schw. 3597 (VIC), 3620 (VIC).

Thelypteridaceae

***Amauropelta opposita* (Vahl) Pic-Serm. (Fig. 13)**

General distribution. Neotropical.

Material examined. Schw. 3728 (VIC, VIES).

***Christella conspersa* (Schr.) Á. Löve & D. Löve**

General distribution. Neotropical.

Material examined. Schw. 3720 (VIC, VIES).

***Christella dentata* (Forssk.) Brownsey & Jermy**

General distribution. Alien invasive (naturalized nearly world-wide).

Material examined. Schw. 3584 (VIC, VIES), 3604 (VIC, VIES).

***Goniopteris seidlerii* Salino**

General distribution. Atlantic Forest (Espírito Santo, Rio de Janeiro)

Material examined. Schw. 3574 (SP, VIC), 3590 (VIC), 3600 (VIC, VIES), 3602 (VIC), 3608 (VIC), 3609 (VIC), 3610 (VIC), 3614 (SP, VIC), 3639 (RB, VIC), 3640 (VIC, VIES), 3686 (VIC), 3705 (VIC), 3710 (VIC).

***Macrothelypteris torresiana* (Gaudich.) Ching**

General distribution. Alien invasive (naturalized nearly worldwide).

Material examined. Schw. 3598 (VIC), 3772 (VIC).

***Meniscium serratum* Cav. (Figs 5, 7)**

General distribution. Neotropical.

Material examined. Schw. 3621 (VIC, VIES).

Discussion

In the park occur 83 taxa of ferns and lycophytes. Among these are 75 species, 3 varieties, 4 putative hybrids, and 1 cultivar. We were unable to identify 1 taxon to species (*Adiantum* sp.), and another remained an *affinis* (*Adiantum* aff. *deflectens*). *Adiantum* aff. *deflectens* is

morphologically very similar to *A. deflectens*, differing only by the non-radical laminar apices.

Twenty-five taxa (ca 31%) are endemic to the Atlantic Forest biome. Among them, 5 are endemic to southeastern Brazil, and 2 are narrow endemics to the states of Rio de Janeiro and Espírito Santo (*Asplenium douglasii* and *Goniopteris seidlerii*). The remaining taxa are either South American (15 taxa; ca 19%), Neotropical (31 taxa; ca 38%), pantropical (4 taxa; ca. 5%), sub-cosmopolitan (1 taxon; ca 1%), or naturalized (4 taxa; ca 5%). Only *Anemia blechnoides* is a species of conservation priority, considered Vulnerable by the national red list (MMA 2014). No other species are listed by MMA (2014), nor by the state of Espírito Santo red list (Sylvestre 2007).

Based on available information (Prado et al. 2015, Flora do Brasil 2017) but also the taxonomic literature cited in Methods, and the state checklists cited in Introduction, 17 taxa are newly recorded from Espírito Santo. These are: *Adiantum caudatum*, *Ad. pentadactylon*, *Anemia hispida*, *An. tomentosa* var. *tomentosa*, *Asplenium laetum*, *Blechnum asplenioides*, *Bl. glandulosum*, *Bl. asplenioides* × *Bl. glandulosum*, *Bl. glandulosum* × *Bl. polypodioides*, *C. decurrens* × *C. repens*, *Doryopteris concolor* var. *interrupta*, *Dor. lorentzii*, *Dor. collina* × *Dor. lorentzii*, *Mickelia scandens*, *Pteris altissima*, *P. denticulata* var. *tristricula*, and *P. ensiformis* cv. ‘*victoriae*’. Among these 17 novelties, only the records of *Ad. pentadactylon* and *M. scandens* expand their species’ ranges. Three hybrids are new to science (see below), and 1 is newly recorded for Brazil. The remaining 13 novelties are widespread taxa, and their discovery in Espírito Santo only indicates a lack of collections or a lack of study by specialists of the local herbaria.

We found 4 alien invasive species naturalized in the park: *Adiantum caudatum*, *Christella dentata*, *Macrothelypteris torresiana*, and *Pteris ensiformis* cv. ‘*victoriae*’. While *C. dentata* and *M. torresiana* are well-known common invaders in Brazil (e.g., Salino and Semir 2002, Schwartzburd and Labiak 2007, Prado et al. 2015), *A. caudatum* and *P. ensiformis* are rare invaders in Brazil (Prado and Windisch 2000, Winter et al. 2007, Prado et al. 2015). Our work confirms the ability of *P. ensiformis* to naturalize after escaping from cultivation. We found 4 well-developed and stable populations of *P. ensiformis* in the park.

While fern hybrids are well documented from other countries, they have been mostly neglected in Brazil (e.g., Rabelo and Schwartzburd 2016). Within the park, we found 4 putative hybrids, based on morphology, field observations, and aborted sporangia/spores. Among them, 3 are reported in the literature for the first time (*Blechnum asplenioides* × *B. glandulosum*, *Campyloneurum decurrens* × *C. repens*, and *Doryopteris collina* × *D. lorentzii*), and 1 is a new record in Brazil (*B. glandulosum* × *B. polypodioides*). Hybrids in the *B. occidentale*-complex are very common and have been extensively mentioned in literature (e.g., Mickel and Beitel 1988, Moran 1995a, Mickel and Smith 2004). Unfortunately, Dittrich et al.

(2015) overlooked most hybrid events, and included only a few hybrids from southeastern Brazil. Thus, the 2 hybrids among *Blechnum* species are not a surprise. As already noted by Mickel and Beitel (1988), among other literature, we found that the hybrids of *Blechnum* spp. may have well-formed sporangia and spores.

In the genus *Doryopteris*, a few hybrids are also known (e.g., *D. ×hybrida* Brade & Rosenst.), but they are far less common. The hybrid we found presents a typical intermediate morphology (laminar shape: Figs 26–28) and with its sporangia and spores blackish and aborted. Finally, a putative hybrid between a pinnate species of *Campyloneurum*, *C. decurrens*, and the simple leafed *C. repens* is a new and important discovery. There is no such hybrid reported in the literature. *Campyloneurum decurrens* × *C. repens* has ternate lamina (intermediate condition between simple and pinnate laminae: Figs 23–25); its sporangia and spores are aborted.

The number of species of ferns from the park greatly increased when we explored the highland area (collection numbers Schw. 3726 and above). Although the highland area is much smaller than the lowland areas, 20 taxa were found exclusively there. Certainly this can be attributed to the wetter, more favorable conditions of the highland forest. There are many mountain tops surrounding the park, and we strongly suggest a policy to include these montane areas within the park's limits, to better protect the diversity of fern species.

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Authors' Contributions

All authors collected the data, half of the taxa were identified by all authors and the other half by PBS and CVM; PBS reviewed all identifications, made the analysis and wrote the text; NTPL prepared the figures.

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