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Flora of Espírito Santo, Brazil

Flora of Espírito Santo: Saccolomataceae

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Abstract

As part of the Flora of Espírito Santo project, we present the taxonomic treatment of the fern family Saccolomataceae, with a key, descriptions, illustrations, and a list of examined specimens. Two species of *Saccoloma* occur in the state of Espírito Santo: *S. elegans* and *S. nigrescens*. Both species are endemic to the Brazilian Atlantic Rainforest.

Key words: Atlantic Rainforest, early diverging leptosporangiates, endemic ferns, *Saccoloma*, Southeastern Brazil.

Resumo

Como parte do projeto Flora do Espírito Santo, aqui é apresentado o tratamento taxonômico da família de samambaias Saccolomaceae, contendo uma chave de identificação, descrições, ilustrações e lista de espécimes examinados. Neste estado, duas espécies de *Saccoloma* ocorrem, *S. elegans* e *S. nigrescens*, e ambas são endêmicas da Floresta Atlântica brasileira.

Palavras-chave: Floresta Atlântica, leptoesporangiadas cedo-divergentes, samambaias endêmicas, *Saccoloma*, sudeste do Brasil.

Introduction

Saccolomataceae is a small monophyletic family of ferns with ca. 20–25 species occurring in the Neotropics, Malesia, Australia, and Madagascar (Rojas-Alvarado 2010; Luong *et al.* 2015; PPG I 2016; Schwartsburd 2020). Some authors (Copeland 1947; Sehnem 1972; Luong *et al.* 2015) considered two genera in the family, *Orthiopteris* and *Saccoloma*, but recent phylogenetic molecular studies have shown that a one-genus classification is more natural (Lehtonen *et al.* 2012). Traditionally, *Saccoloma* was considered belonging to the Dennstaedtiaceae (*e.g.*, Tryon & Tryon 1982; Kramer 1990), but current classifications place it in its own family (Smith *et al.* 2008; PPG I 2016; Schwartsburd *et al.* 2020).

The exact number of Neotropical species is still unknown: while Tryon (1962) considered only three species, widespread in the Neotropics, other authors (Mickel 1984; Nair 1989; Moran 1992; Moran & Øllgaard 1995; Rojas-Alvarado 1996, 2010; Schwartsburd 2010, 2015, 2020) have gradually presented new species and rescues from synonymy since the work of Tryon (1962). The most comprehensive and updated works are those of Rojas-Alvarado (2010) and Schwartsburd (2020), presenting 13 Neotropical species with keys, type information, synonymies, descriptions, illustrations, and geographical distributions.

Saccoloma is mostly characterized by the erect to ascending rhizomes clothed with peltate scales, 1 to 4-pinnate leaves drying blackish in some species, marginal or sub-marginal sori which open extrorsely and are seated on single veins, with a modified abaxial indusium and an unmodified adaxial indusium, and rounded, trilete spores.

The updated taxonomic treatment of this family is presented herein for the Flora of Espírito Santo project.

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Material and Methods

We personally analyzed specimens from the herbaria MBM, MBML, RB, UPCB, VIC, and VIES (Thiers, continuously updated), plus online images from other herbaria (B, CVRD, K, L, NY, P, UCS, US, and W) available at SpeciesLink (<http://www.splink.org.br/>), Reflora (<http://floradobrasil.jbrj.gov.br/reflora/herbarioVirtual/>), and the Pteridophyte Collections Consortium (<http://www.pteridoportal.org/portal/collections/>). We personally collected field specimens of *Saccoloma brasiliense* (Presl 1836: 125) Mettenius (1861: 80) and *S. elegans* Kaulfuss (1820: 51) in other Brazilian states (Rio de Janeiro, Minas Gerais, São Paulo, and Santa Catarina), but unfortunately none from Espírito Santo. Regarding specimens from Espírito Santo, we analyzed 28 collections, totaling 47 specimens. The map was made using QGIS v. 3.16 (available at <https://qgis.org/pt_BR/site/index.html>). For specimens lacking information on geographical coordinates, this data were estimated using Google Earth (available at <https://earth.google.com/web/>).

Morphological terms follow Lellinger (2002) for leaf parts in general, Schwartsburd & Prado (2015) for petiole colors, and Schwartsburd (2020) for sorus morphology.

Results and Discussion

Two species of *Saccoloma* occur in the state of Espírito Santo: *S. elegans* and *S. nigrescens* (Kunze 1850: 132) Rojas (2010: 7). Both are endemic to the Brazilian Atlantic Rainforest. *Saccoloma elegans* occurs from Pernambuco to Santa Catarina, and *S. nigrescens* occurs from Pernambuco to São Paulo (Schwartsburd 2020).

In Espírito Santo, *Saccoloma elegans* occurs as terrestrial inside wet forests of low to mid elevation (from sea level to ca. 900 m a.s.l.), in the southern and central parts of the state (Fig. 1). *Saccoloma nigrescens* also occurs as terrestrial inside wet forests, but in mid to high elevations (from ca. 600 to 1,100 m a.s.l.); it also occurs in the southern and central parts of the state (Fig. 1).

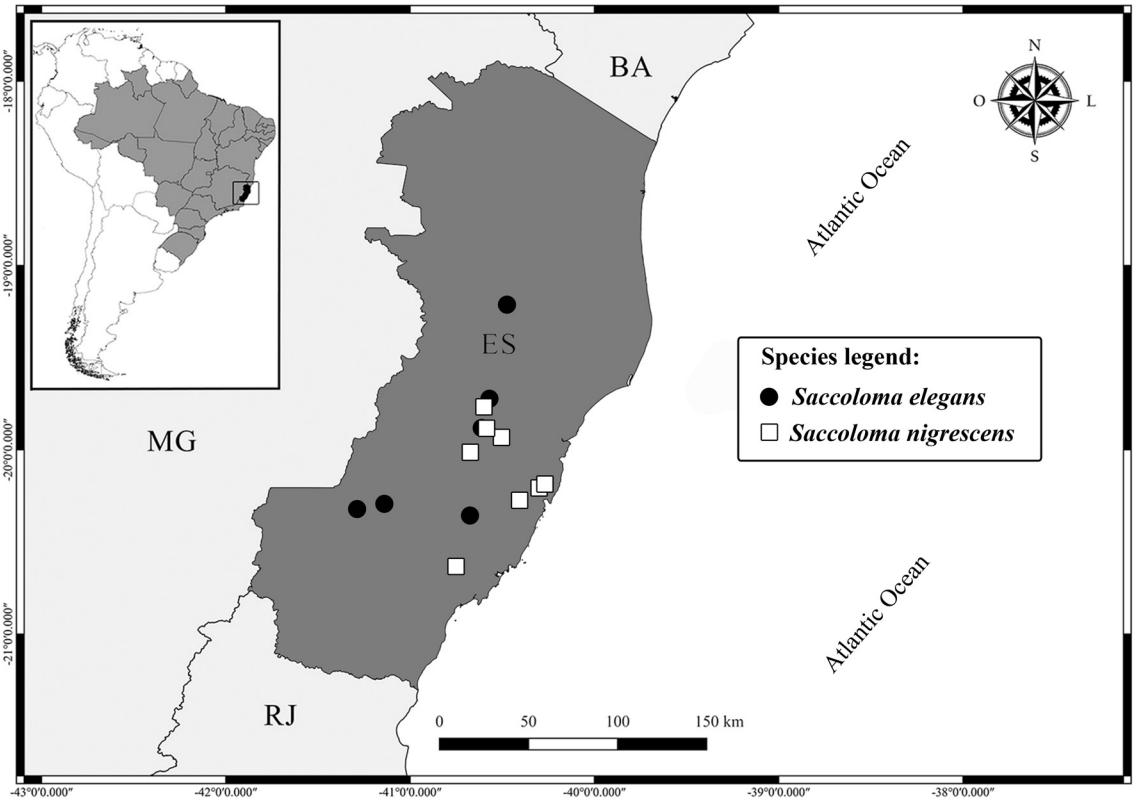

Figure 1 – Distribution of *Saccoloma elegans* (black circles) and *S. nigrescens* (white squares) in the state of Espírito Santo.

Saccolomataceae

Plants terrestrial or rarely epipetric. Rhizomes erect to decumbent, commonly forming short trunks, scaly or glabrescent; scales peltate. Leaves monomorphic, to 2 m long; petioles smooth or aculeate, scaly at the base, adaxially grooved; petiolar scales peltate, appressed or patent; laminae 1–4-pinnate or 1–3-pinnate-pinnatifid, anadromic, herbaceous to sub-coriaceous, drying green or blackish; rachises smooth or aculeate, adaxially grooved; costae generally glabrous on both sides or rarely with scattered catenate hairs; veins simple or furcate, never anastomosing; sori marginal or sub-marginal, served by single veins, sunk or not sunk, opening extrorsely, adaxially slightly or strongly impressed; abaxial indusia tubular, bell-like, or bowl-like; adaxial indusia nor modified; spores tetrahedral-globose, trilete.

Saccoloma Kaulf., Berlin. Jahrb. Pharm. Verbundenen Wiss. 21: 51. 1820.

A genus of ca. 20–25 species (and four varieties) occurring in the Neotropics, Malesia, Australia, and Madagascar (Rojas-Alvarado 2010; Luong *et al.* 2015; PPG I 2016; Schwartsburd 2020). In the state of Espírito Santo, two species occur.

Key to species of *Saccoloma* from the state of Espírito Santo

1. Laminae 1-pinnate, drying olive green ..... 1. *Saccoloma elegans*
1'. Laminae 3–4-pinnate or 3-pinnate-pinnatifid, drying blackish.....2. *Saccoloma nigrescens*

1. *Saccoloma elegans* Kaulf., Berlin. Jahrb. Pharm. Verbundenen Wiss. 21: 51. 1820. *Neuropteris elegans* (Kaulf.) Desv., Mém. Soc. Linn. Paris 6(3): 293. 1827. *Davallia saccoloma* Spreng., Syst. Veg., ed. 16 [Sprengel], 4(1): 119. 1827. *Microlepia elegans* (Kaulf.) Mett., Fil. Hort. Bot. Lips. 103. 1856. Figs. 1; 2a-d

Plants terrestrial. Rhizomes erect to decumbent, stout, glabrescent. Leaves 1.2–1.8 m long; petioles proximally burgundy, stramineous above, 40–60 cm × 4–6 mm, proximally wrinkled to minutely aculeate, smooth above, proximally scaly, glabrescent above; petiolar scales of two kinds: 1. deloid, peltate, appressed, blackish, ca. 1–1.5 mm long, 2. lanceate, peltate, patent, brown, 5–6 mm long, with dentate margins; laminae 1-pinnnate, the apices pinna-like, herbaceous, 80–120 × 40–70 cm, drying olive-green; rachises stramineous, glabrous; basal pinnae 15–25 × 2.5–3.5 cm, proximally inaequilateral; costae glabrous on both sides; veins commonly 1-furcate, rarely simple or 2 or 3-furcate (at the base of pinnae), glabrous on both sides; sori marginal, placed side by side, not sunk, adaxially slightly impressed; abaxial indusia bowl-like, widest in the mouth, much wider than longer, commonly forming wings connecting adjacent sori.

Specimens examined: Conceição do Castelo, Alto Bananal, 18.X.1985, *G. Hatschbach & F.J. Zelma 49928* (MBM, MO-*n.v.,* UCS, image!, US, image!). Governador Lindemberg, Pedra de Santa Luzia, 19°17'17"S, 40°27'56"W, 420–590 m, 7.XI.2007, *V. Demuner et al. 4508* (MBML-on 2 sheets, VIC). Linhares, Reserva Florestal de Linhares, Aceiro Ceolin, km 1,1, 20.III.1999, *A. Salino & P.O. Morais 4529* (BHCB-*n.v.,* CVRD, image!). Marechal Floriano, Sítio Almir Bressan, 21.VIII.1988, *O.J. Pereira 1671* (HUFU-*n.v.,* VIES). San Antonio, inter Campos et Vittoria, 14.XI.1815, *F. Sellow [B. 249. C. 89]* (B-20 0084489, image!, B-20 0084490, image!, K-000644022, image!, L-3610597, image!, MO-*n.v.*, P-00536371, image!, US-00066442, image!, US-01456563, image!, W-0056340, image! - type material). Santa Maria de Jetibá, Belém, 700 m, 3.XII.2002, *L. Kollmann et al. 5801* (MBML-on 2 sheets). Santa Teresa, Julião, 10.VII.2007, *P.H. Labiak 3998* (MBML, NY, image!, UPCB); Nova Lombardia, 25.II.1986, *W. Boone 1127* (MBML-on 2 sheets, RBR-*n.v.,* VIC-on 2 sheets); 11.V.2006, *L. Kollmann & S. Krauser 9078* (BHCB-*n.v.,* MBML); Reserva Biológica Augusto Ruschi, 16.VII.2002, *R.R. Vervloet et al. 470* (MBML-on 2 sheets, VIC); 8.VIII.2002, *R.R. Vervloet et al. 673* (MBML-on 2 sheets); 27.VIII.2002, *R.R. Vervloet et al. 721* (MBML); 18.XII.2002, *R.A. Krause 1* (MBML); 21.I.2003, *R.A. Krause & M. Pereira 82* (BHCB-*n.v.,* MBML). Santo Henrique, 15.IV.2005, *L. Kollmann 7652* (MBML). Venda Nova do Imigrante, Varzeão, 900 m, 17.V.1999, *G. Hatschbach et al. 69118* (CEPEC-*n.v.,* MBM, MBML, NY, image!).

Additional specimens examined: BRAZIL. MINAS GERAIS: Viçosa, Mata do Seu Nico, 20°47'S, 42°51W, 800 m, 6.XI.2012, *P.B. Schwartsburd & E. Guatimosin 2618* (NY, RB, UPCB, VIC-on 4 sheets).

Saccoloma elegans is endemic to the Brazilian Atlantic Rainforest, occurring from Pernambuco to Santa Catarina terrestrial inside wet forests. Plants from the Amazon and from

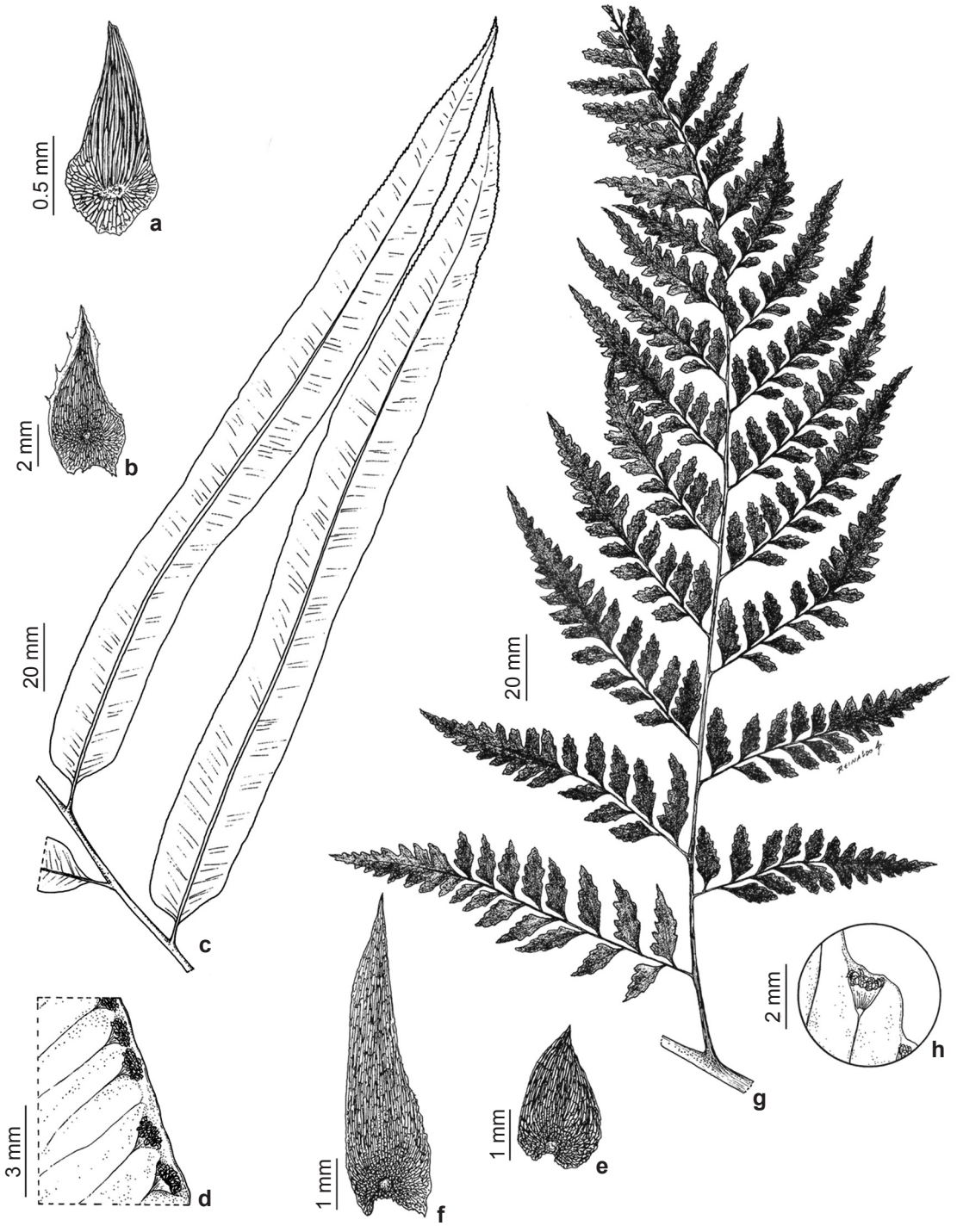

Figure 2 – a-d. *Saccoloma elegans* – a. petiolar scale; b. petiolar scale (second type); c. basal pinnae; d. detail of the sori and abaxial indusia. e-h. *Saccoloma nigrescens* – e. petiolar scale; f. petiolar scale (second type); g. basal pinna, showing blackish color; h. detail of sorus and abaxial indusium. (a-c. *Schwartsburd 2618*; d. *Demuner 4508*; e, f. *Kollmann 4910*; g. *Matos 997*; h. *Kollmann 4910*).

Central America, previously identified as "*S. elegans*", are better re-identified as *S. chartaceum* Nair (1989: 415) (Nair 1989; Schwartsburd 2020). *Saccoloma elegans* differs from *S. chartaceum* by the stramineous petioles and rachises, burgundy only at the petiolar bases (*vs.* burgundy throughout), herbaceous laminae (*vs.* chartaceous), and inaequilateral pinnae at the base, which are basiscopically cuneate and acroscopically truncate (*vs.* equilateral at the bases, basiscopically and acroscopically cuneate) (Fig. 2c).

2. *Saccoloma nigrescens* (Kunze) A. Rojas, Mét. Ecol. Sist. 5(1): 7. 2010 [as "(Mett.) A. Rojas"]. *Davallia nigrescens* Kunze, Bot. Zeitung (Berlin) 8: 132. 1850. *Microlepia inaequalis* var. *nigrescens* (Kunze) Mett. in Hohenackeri, Fil. Lechler. 1: 22. 1856. *Davallia inaequalis* var. *nigrescens* (Kunze) Hooker & Baker, Syn. Fil.: 99. 1868. *Saccoloma brasiliense* var. *nigrescens* (Kunze) Hieron., Hedwigia 47: 207. 1908.

Figs. 1; 2e-h

Plants terrestrial. Rhizomes erect to decumbent, stout, glabrescent. Leaves 1.4–2 m long; petioles proximally burgundy, grayish-brown to grayish-stramineous above, 50–100 cm × 7–12 mm, proximally rugose or minutely aculeate, smooth above, proximally scaly, glabrescent above; petiolar scales of two kinds: 1. deltoid, peltate, appressed, blackish, ca. 1.5–2 mm long, 2. ovate, peltate, patent, tortuous, orange-brown, 4–7 mm long; laminae proximally 3–4-pinnate or 3-pinnate-pinnatifid, medially 2-pinnate-pinnatifid, distally pinnatifid, anadromic, chartaceous, 80–110 × 40–90 cm, drying dark gray or blackish; rachises grayish-brown to grayish-stramineous, glabrous; basal pinnae 20–45 × 10–30 cm, proximally inaequilateral; costae glabrous on both sides; veins 1 to 4-furcate, abaxially virtually glabrous, but with scattered 1–2-celled hairs, adaxially glabrous; sori submarginal, at sinuses next to laminar teeth, not sunk, adaxially slightly impressed; abaxial indusia bell-like, widest in the mouth, equaling length and width.

Specimens examined: Alfredo Chaves, 20°29'34"S, 40°57'16"W, 1,010 m, 1.X.2016, *L.S. Sylvestre et al. 2284* (RB, VIC). Cariacica, Reserva Biológica Duas Bocas, 20°17'29"S, 40°31'10"W, 600 m, 15.II.2008, *P.H. Labiak et al. 4637* (CEPEC-*n.v.,* MBML, RB, UPCB). Limoeiro, 20.V.1946, *A.C. Brade 18322* (RB). Marechal Floriano, Sítio Almir Bressan, 12.VII.1988, *O.J. Pereira & L. Behar 1606* (VIES). Santa Maria de Jetibá, Belém, 18.VIII.2003, *L. Kollmann & M.V.S. Berger 6258* (BHCB-*n.v.,* MBML). Santa Teresa, Nova Lombardia, Reserva Biológica Augusto Ruschi, 30.VII.2002, *R.R. Vervloet et al. 581* (BHCB-*n.v.,* MBML); 27.VIII.2002, *R.R. Vervloet et al. 720* (MBML-on 2 sheets); 9.X.2002, *R.R. Vervloet 1191* (MBML); 25.II.2003, *R.R. Vervloet et al. 1915* (BHCB-*n.v.,* MBML); 800 m, 24.X.2001, *L. Kollmann et al. 4910* (MBML-on 2 sheets); São Lourenço, Reserva Biológica de São Lourenço, 700 m, 22.IX.1998, *L. Kollmann et al. 599* (MBML-on 2 sheets); Valsugana Velha, 22.V.1985, *H.Q.B. Fernandes 1162* (MBML).

Additional specimens examined: BRAZIL. BAHIA: Arataca, Serra do Peito de Moça, RPPN Caminho das Pedras, 15°10'25"S, 39°20'30"W, 1,000 m, 16.II.2006, *F.B. Matos et al. 997* (RB, UPCB).

Saccoloma nigrescens is endemic to the Brazilian Atlantic Rainforest, occurring from Pernambuco to São Paulo as terrestrial inside wet forests. Herbarium specimens now ascribed to this species had been lately identified as either "*Saccoloma inaequale*" or "*S. brasiliense*". *Saccoloma inaequale* (Kunze 1834: 87) Mettenius (1861: 80) does not occur in the Brazilian Atlantic Rainforest (Rojas-Alvarado 2010; Schwartsburd 2020); *Saccoloma brasiliense* does, but has not been recorded in Espírito Santo.

Saccoloma nigrescens differs from *S. inaequale* by the longer leaves, 1.4–2 m long (*vs.* 0.8–1.4 m), laminae drying blackish (*vs.* glossy green), presence of two types of petiolar scales (*vs.* one type), and non-sunk sori, which are only slightly impressed adaxially (*vs.* sunk, strongly impressed adaxially) (Figs. 2e-g). *Saccoloma nigrescens* differs from *S. brasiliense* by the laminae drying blackish (*vs.* olive green), and by the abaxial indusia equaling length and width (*vs.* abaxial indusia wider than longer) (Figs. 2g,h).

When Rojas-Alvarado (2010) brought the epithet "*nigrescens*" back from synonymy, he made a few nomenclatural mistakes: he cited a wrong basinonym, wrong authorship, and wrong types. Nevertheless, his new combination is not invalid (Turland *et al.* 2018: Arts. 41.6, 41.8a, examples 17 and 24). Thus, we here adopt his combination. On the other hand, the circumscription of *S. nigrescens* adopted by Schwartsburd (2020) and here is different from that of Rojas-Alvarado (2010), especially in regards to the morphological descriptions and geographical distributions. In other words, the *true Saccoloma nigrescens* (Kunze) A. Rojas is endemic to the Brazilian Atlantic Rainforest, whereas Rojas-Alvarado's (2010) "*Saccoloma nigrescens* (Mett.) A. Rojas", occurring from Costa Rica to Peru, needs a new name.

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